

# Deep Dive to an AR Psychology Paper

Thr, July 23 (Week 5.5)

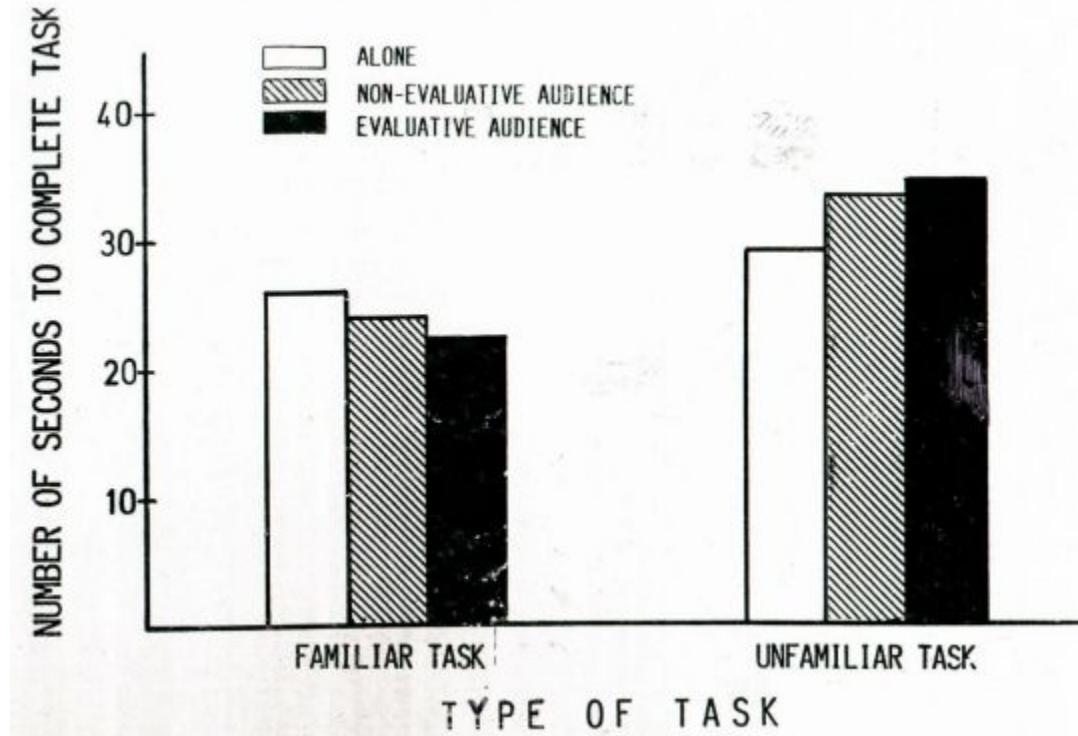
# Application of Psychology Theory to AR/VR

(Social) psychology theories are based on experiments with real people.

Replication of the real people experiments, confirming the psychology theories with virtual humans provides evidence that virtual humans are similar to real people.

A short-cut for AR/VR research that does not have much history.

# Example: Social Facilitation and Inhibition



# Example: Social Facilitation and Inhibition

Triplet's (1898) Experiment:

People bike faster when there are other people biking next to them.

Many Study Afterwards:

That is not always the case. When people met difficult or unfamiliar tasks, having an observer did decrease their task performance.

# Social Interaction in AR, Study 1 (Miller et al., 2019)

Task: Anagram (find the original word from its letters in random order)

Conditions: With/without a virtual human observer & easy/difficult problems



# Social Interaction in AR, Study 1 (Miller et al., 2019)

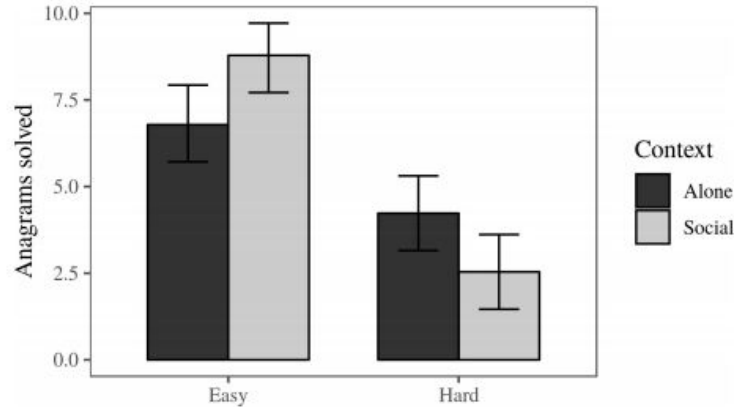
Four tasks per a participant: {(with, easy), (without, easy), (with, difficult), (without, difficult)} in a randomized order.

When the virtual human was there, it had a verbal introduction of itself before the task.

(This type of detail is very important since it determines the level of presence that decides the position of this study as a pursuit toward the grand question for virtual humans.)



# Social Interaction in AR, Study 1 (Miller et al., 2019)



**Fig 3. Anagrams solved per condition.** This chart displays means and 95% CI's for the number of anagrams solved in each condition.

With an analysis only with the first trials, the social psychology theory was replicated!

# Social Interaction in AR, Study 1 (Miller et al., 2019)

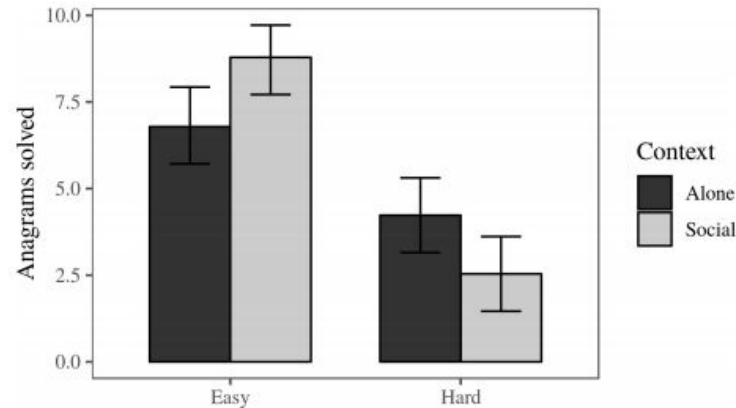


Table 2. Means and standard deviations of anagrams solved per condition and order.

The gap disappeared over the trials...

Trial	Conditions (Difficulty / Social Context)			
	Easy / Alone	Easy / Social	Hard / Alone	Hard / Social
	<i>M (SD), n</i>	<i>M (SD), n</i>	<i>M (SD), n</i>	<i>M (SD), n</i>
1st	6.79 (2.19), 14	8.79 (1.97), 14	4.23 (2.13), 13	2.54 (2.07), 13
2nd	7.50 (2.75), 12	7.38 (2.50), 13	4.00 (2.67), 15	4.07 (2.20), 14
3rd	8.36 (1.69), 14	7.21 (2.89), 14	4.58 (2.57), 14	4.93 (3.17), 13
4th	8.14 (2.85), 14	7.15 (2.94), 13	4.36 (3.05), 14	4.54 (2.11), 13



# Social Interaction in AR, Study 1 (Miller et al., 2019)

## The Most Likely Interpretation of the Study:

When the participants first met the virtual human, they felt the virtual human as if another person and that presence caused arousal for social facilitation and inhibition. But the presence disappeared afterwards.

## Alternative Interpretations:

- Once after a trial with a virtual human, people kept feeling presence even in the trials without a virtual human.
- People got used to the lab setting and no longer cared about the virtual human.
- People started too much concentrating to the task.
- People started recognizing the low level of realism of the virtual humans.

# Social Interaction in AR, Study 2 (Miller et al., 2019)

There are two chairs and one virtual human appears in front of you. It sits on one of the chairs and then verbal introduces itself (for about 40 seconds).

Now, the experimenter asks you to sit on a chair--one of the two chairs.

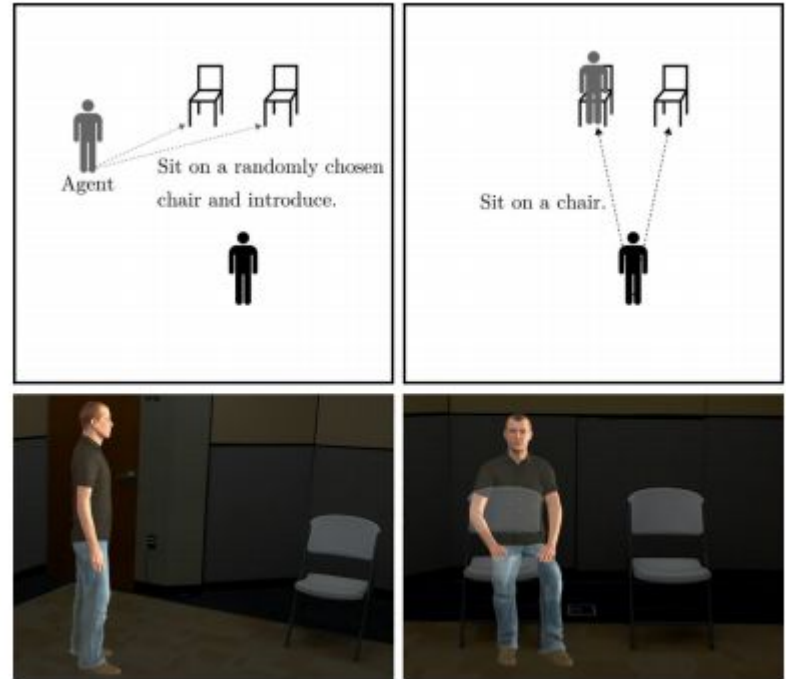


Fig 4. The participant's interaction with the virtual human. The virtual objects are colored gray.

# Social Interaction in AR, Study 2 (Miller et al., 2019)

Condition: after the verbal introduction, the experimenter while asking to sit on a chair may

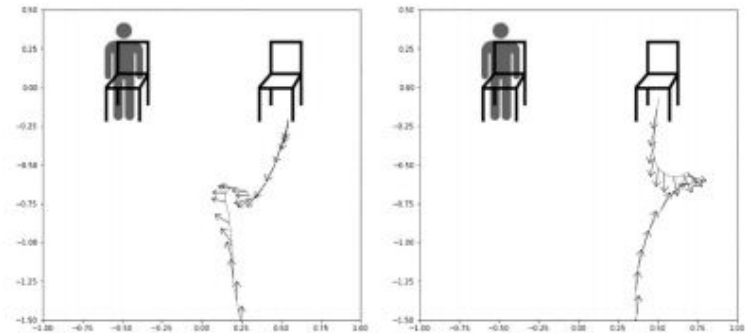
*take off the headset or not.*

Measured Behavior:

- Do people sit on the empty chair?
- Do people rotate toward the virtual human?



Fig 5. Examples of sitting next to and on the virtual agent.



# Social Interaction in AR, Study 2 (Miller et al., 2019)

**Table 3. Number of participants who either sat on or next to the agent in each condition.**

<b>Wearing headset when sitting?</b>	<b>Seat Choice</b>	
	<b>On Agent</b>	<b>Next to Agent</b>
Headset	0	27
Without Headset	8	21

If you flip a coin 29 times and there were 21 heads, there must have been a trick behind.

21 out of 29 people sitting on the empty chair means, the invisible virtual human did the trick. In others words, there was a statistically significant effect from the virtual human to participants' behavior.

# Social Interaction in AR, Study 2 (Miller et al., 2019)

Table 3. Number of participants who either sat on or next to the agent in each condition.

Wearing headset when sitting?	Seat Choice	
	On Agent	Next to Agent
Headset	0	27
Without Headset	8	21

And with the virtual human, all participants sat on the empty chair and 25 out of those 27 participants rotated toward the virtual human.

Interpretation:

A piece of evidence of people perceiving virtual humans as if they are real people.

# Social Interaction in AR, Study 3 (Miller et al., 2019)

Two people talking to each other.

Would one of them wearing an AR headset degrade the quality of the face-to-face communication?



Fig 7. Video shot of a pair of actors simulating the experiment.

# Social Interaction in AR, Study 3 (Miller et al., 2019)

Two conditions: with or without a virtual object on other's face.

Task: talking to each other for 5 minutes.

Measures: through questionnaires

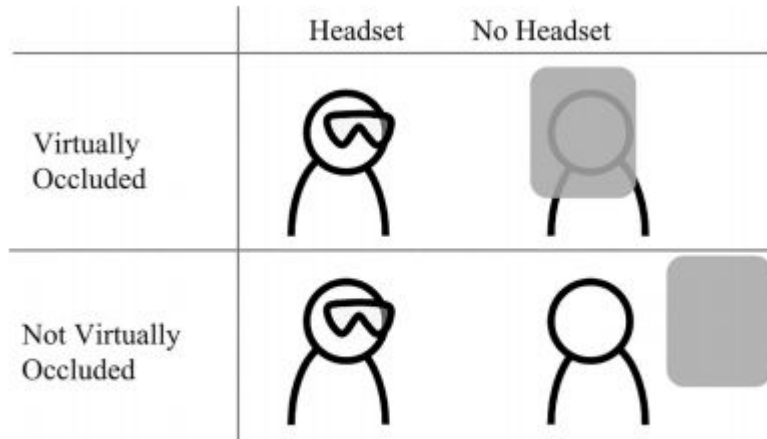


Fig 9. Diagram of conditions for Study 3.



Fig 8. View of the other participant from the AR user's point of view in the Virtually Occluded condition (left) and Not Virtually Occluded condition (right).

# Social Interaction in AR, Study 3 (Miller et al., 2019)

Person wearing the headset had more problem than the other person.

The effect was larger when there was a virtual object in front of.

Table 4. Means and standard deviations for all outcome variables by condition and users and non-users.

	Conditions			
	Virtually Occluded		Not Virtually Occluded	
	Headset (n = 25)	No Headset (n = 25)	Headset (n = 26)	No Headset (n = 26)
Measures	<i>M (SD)</i>	<i>M (SD)</i>	<i>M (SD)</i>	<i>M (SD)</i>
Social Presence	4.22 (.57)	4.52 (.55)	4.49 (.45)	4.45 (.44)
IOS	2.88 (1.5)	3.72 (1.7)	3.73 (1.3)	3.5 (1.4)
Interpersonal Attraction	4.19 (.61)	4.4 (.47)	4.24 (.65)	4.2 (.72)

*M* = Mean, *SD* = Standard deviation