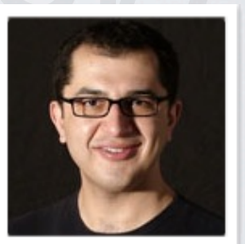
DESIGNING PERSUASIVE ROBOTS:

HOW ROBOTS MIGHT PERSUADE PEOPLE USING VOCAL AND NONVERBAL CUES

CHIDAMBARAM

CHIANG



MUTLU

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Persuasion

Part of **everyday life** — both professional and personal

Crucial in several spheres

Sports

Education

Health and Well-being

What makes a person persuasive?

What makes a person persuasive?

“Immediacy”

Immediacy

"The degree of perceived **bodily** and **psychological closeness** between people**"**

[Mehrabian 1971]

Immediacy shaped by

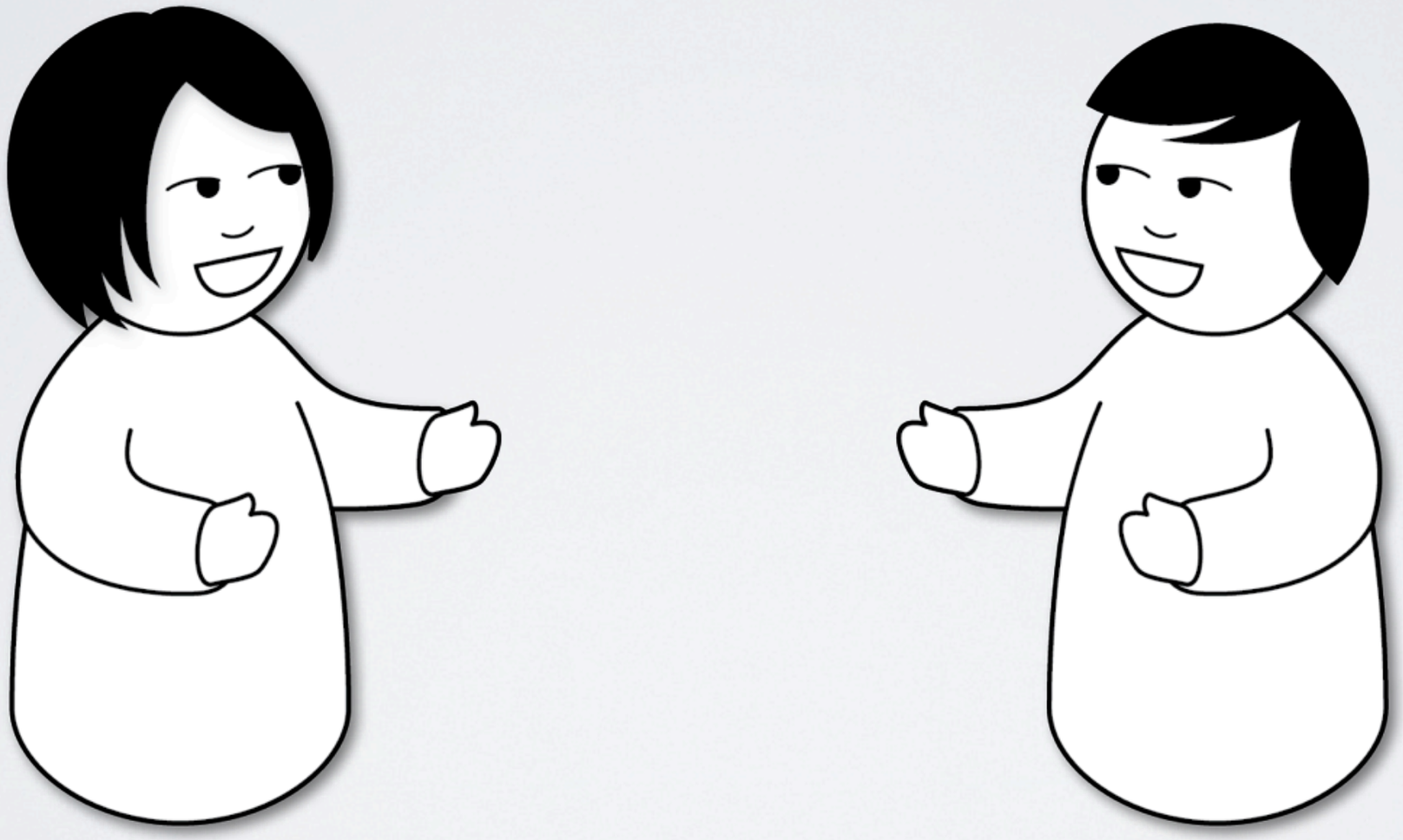
Bodily, vocal, verbal cues

Cues Shaping Nonverbal Immediacy

Behavioral cues	Cue Affordances
Moves around class room when teaching.	Proximity
Gestures when talking to the class.	Gestures
Looks at the class when talking.	Gaze
Uses a variety of vocal expressions.	Vocal Expressions

[Richmond et.al 1987]

Persuasive Behavior



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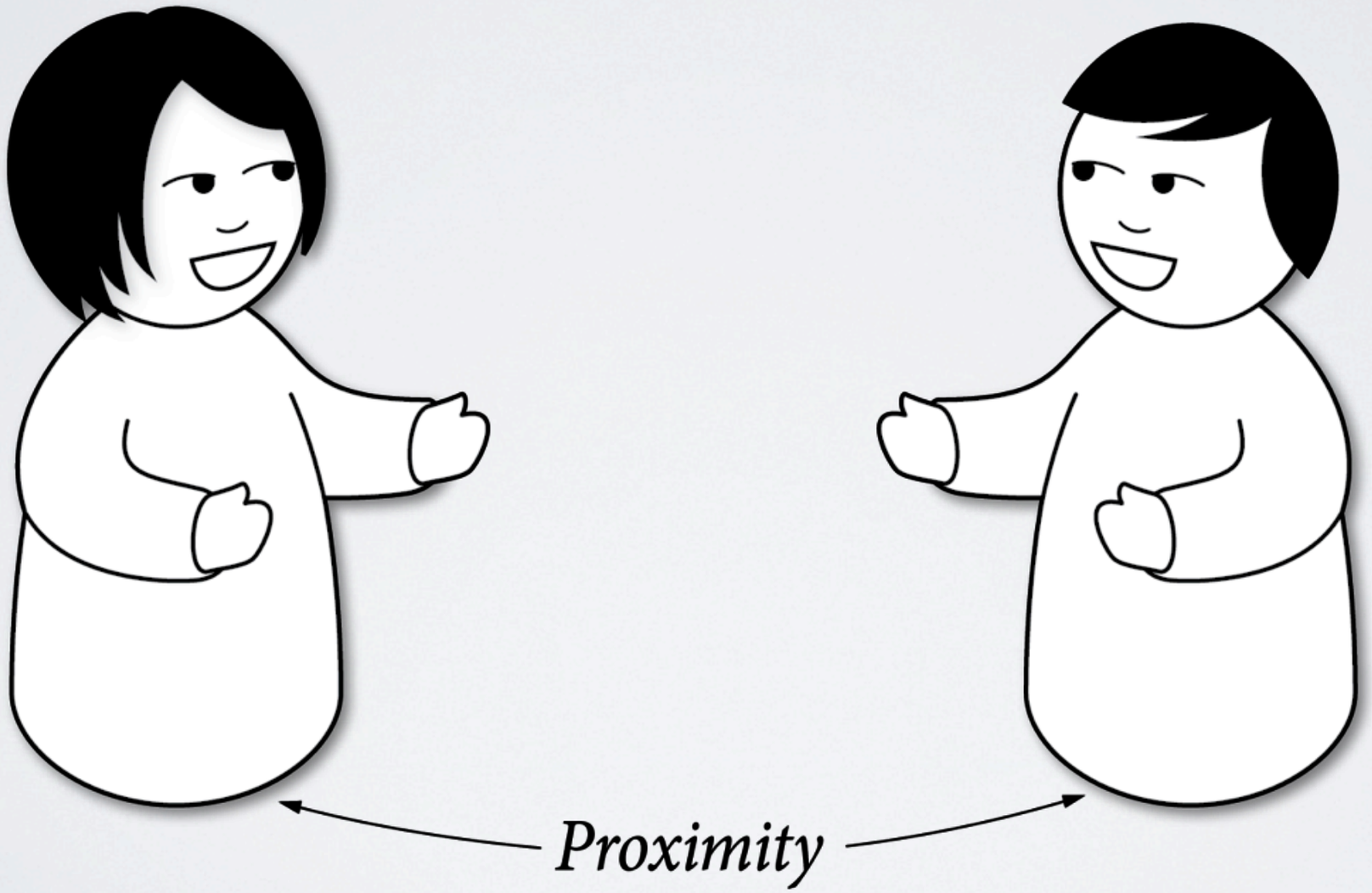

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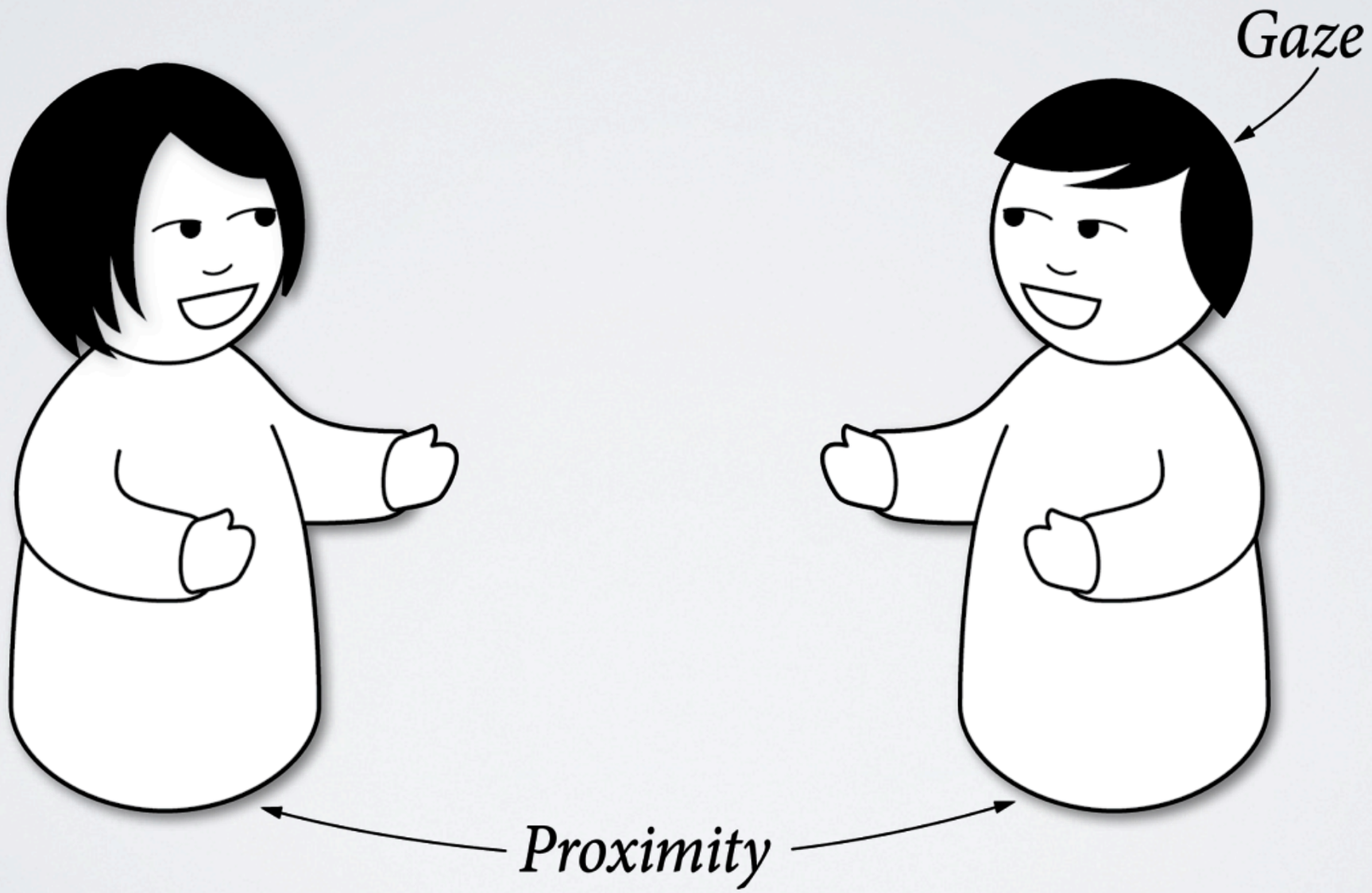

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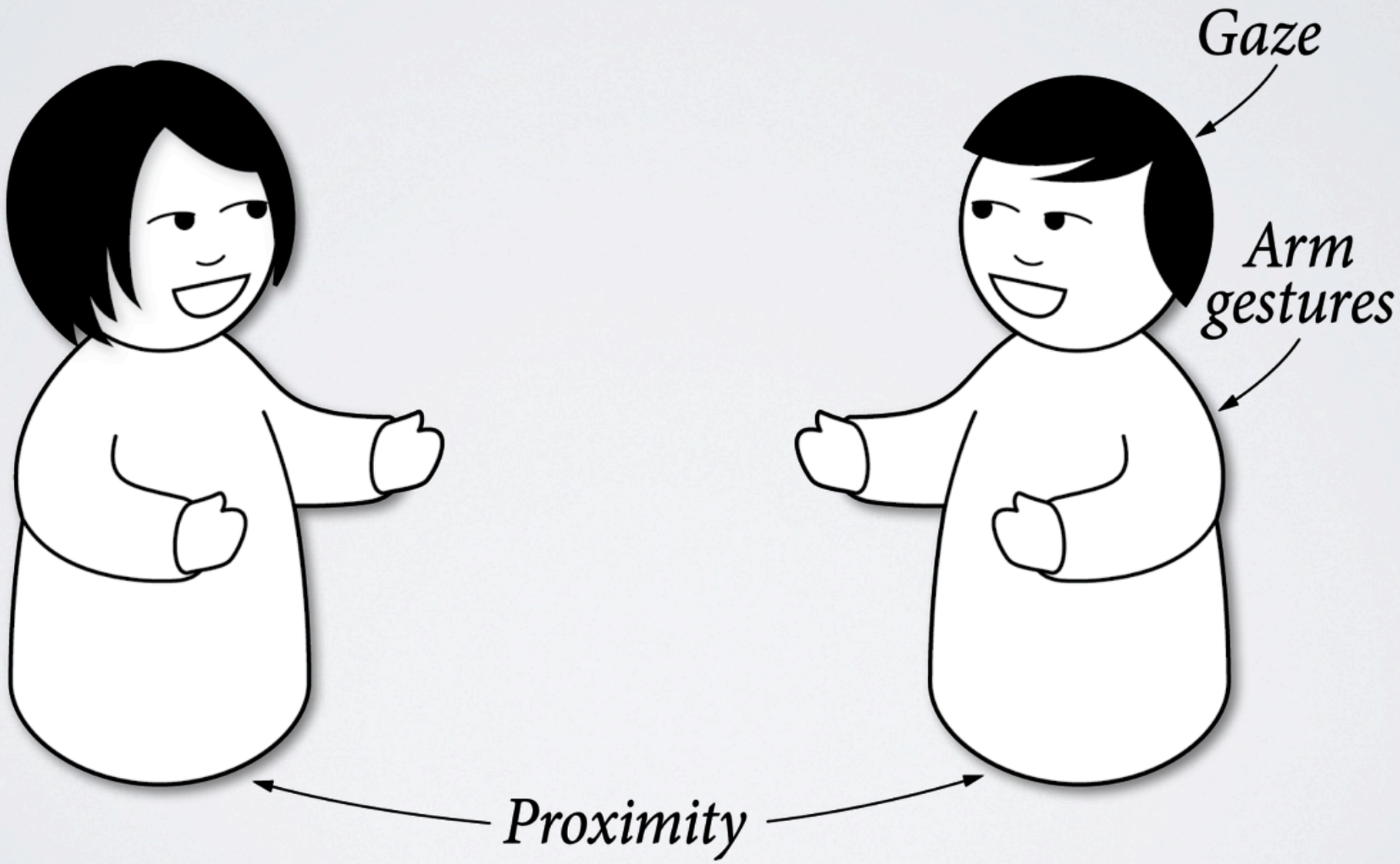

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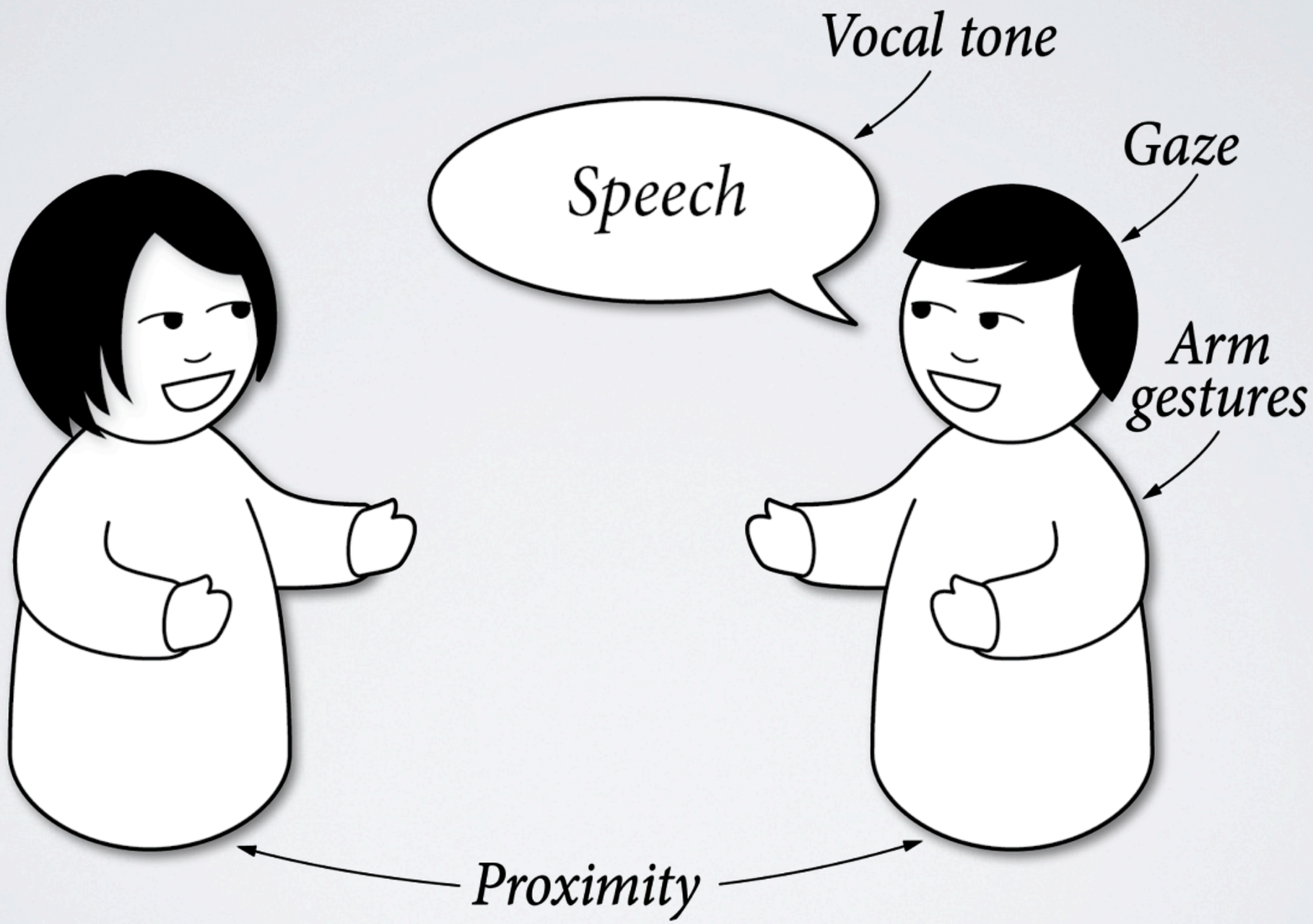


Robots In Persuasive Roles

Education

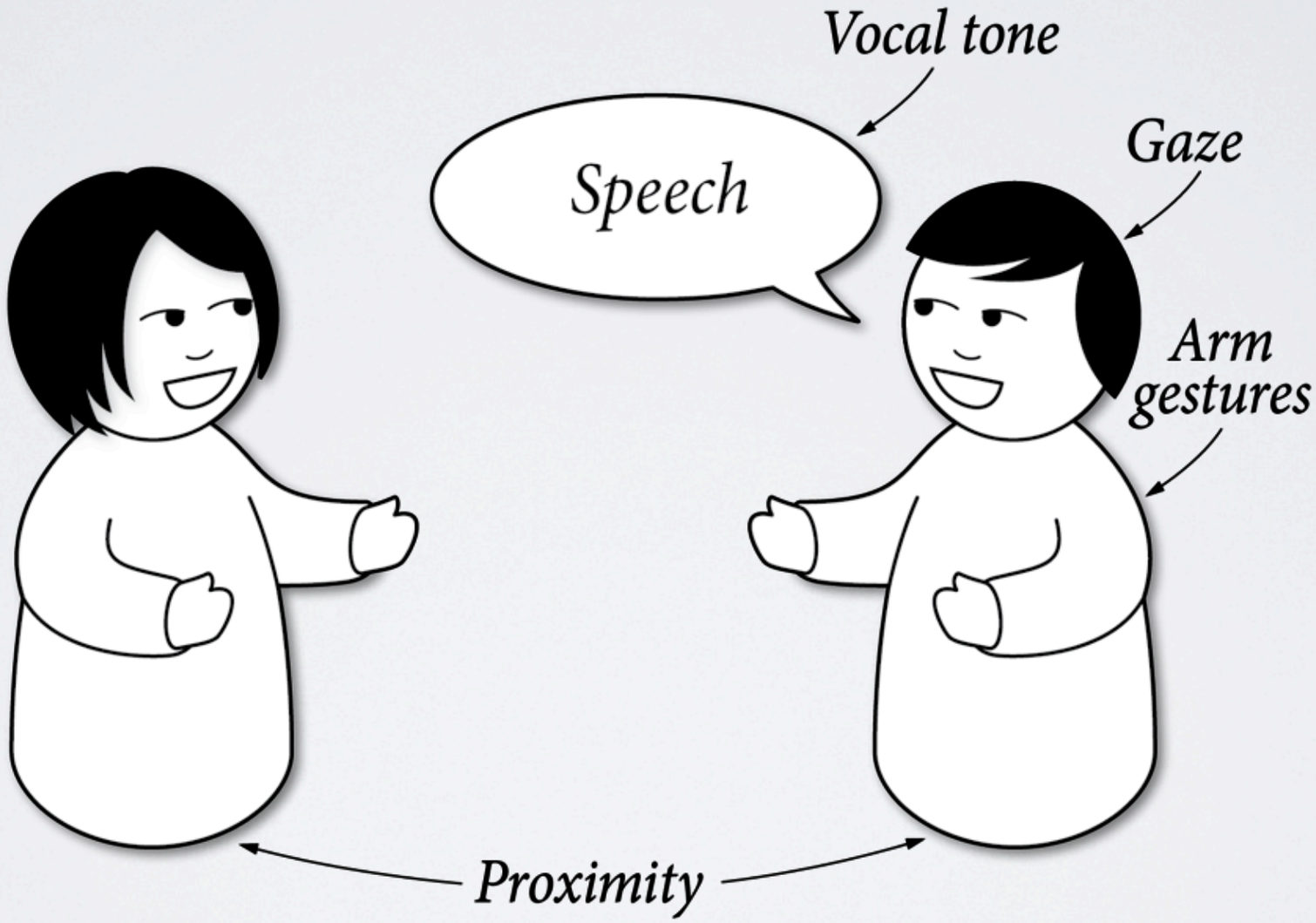
Healthcare

Sports

Well-being

How do we design **persuasive** robots?

Design Space



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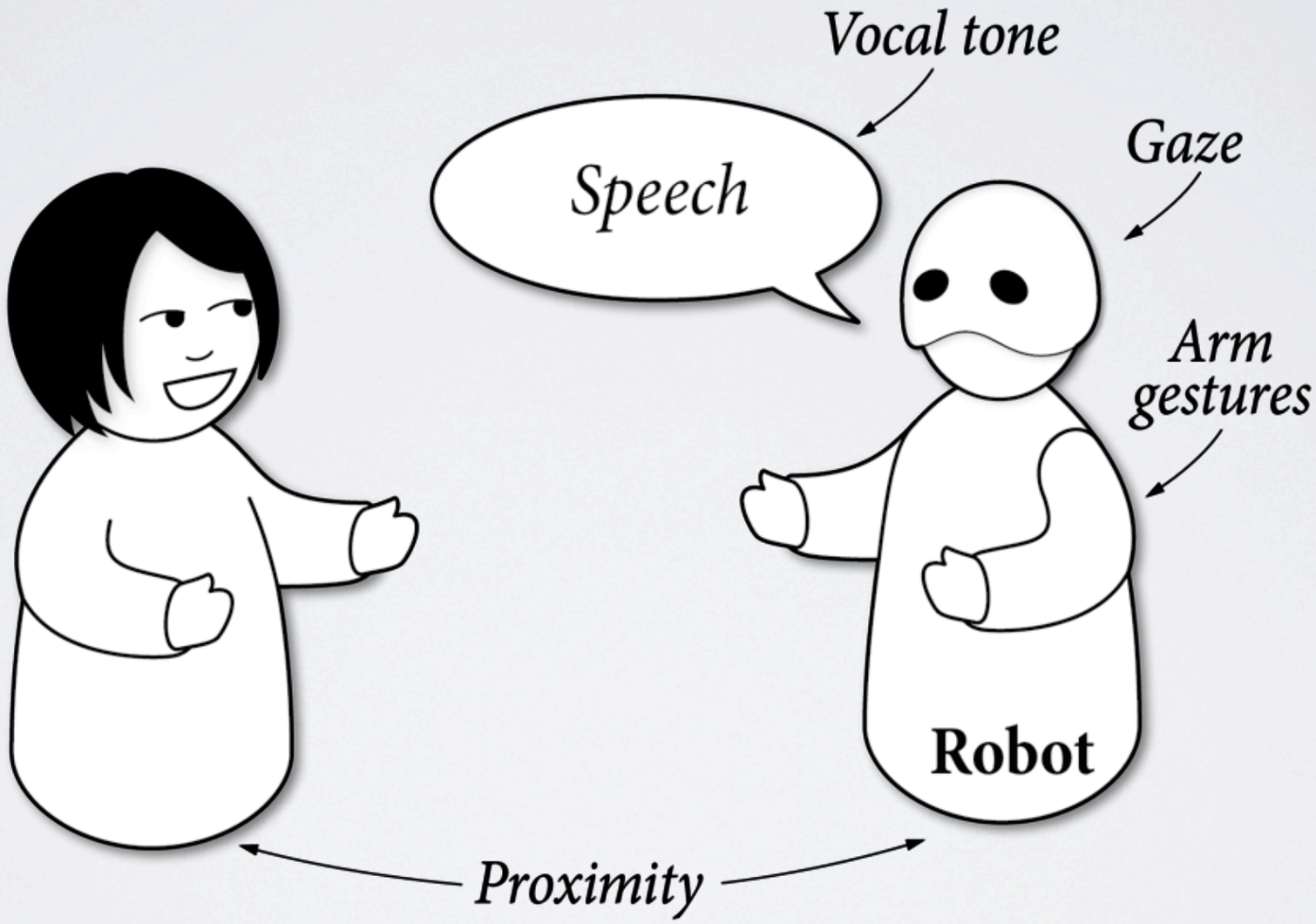

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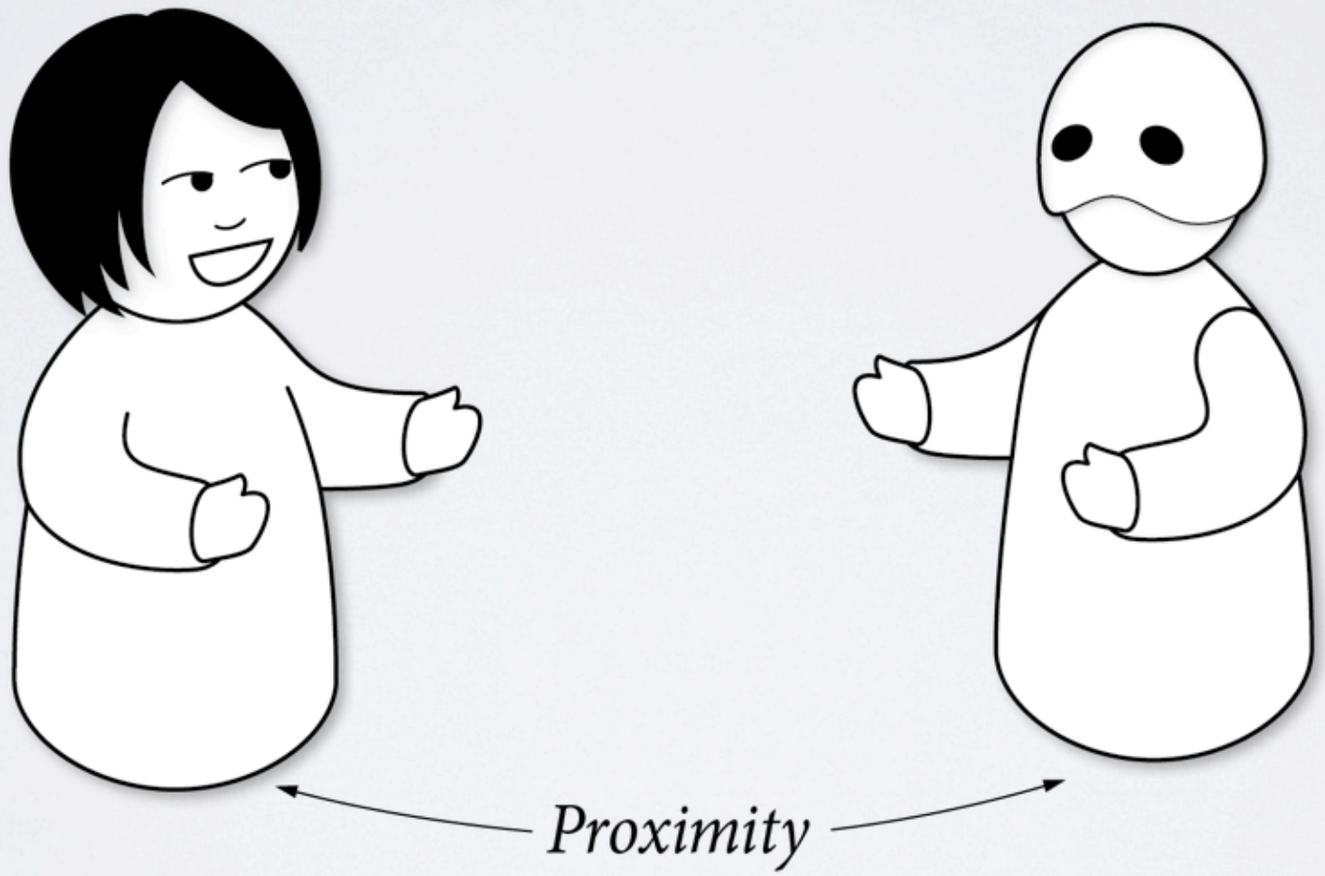
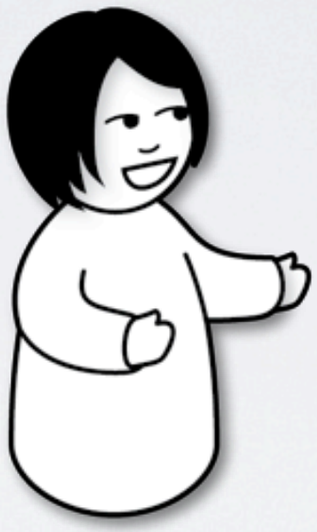


Nonverbal cue #1: **Proximity**

Proximity known to affect **compliance**

[Hall 1966, Glick et.al 1988]



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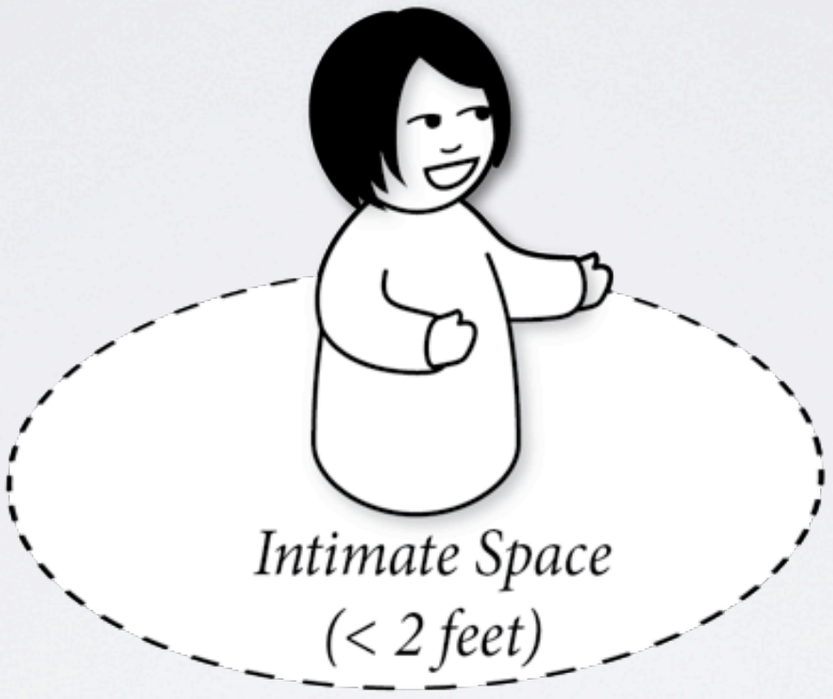

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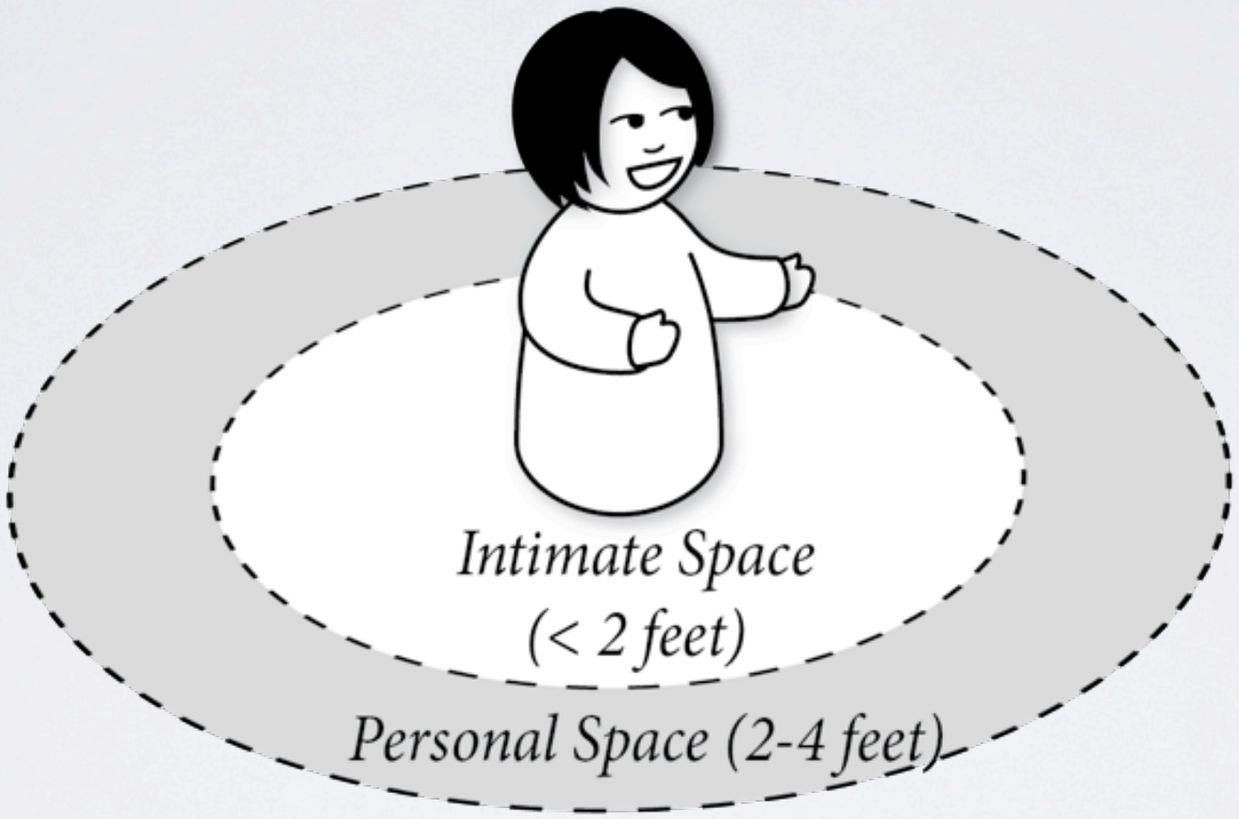

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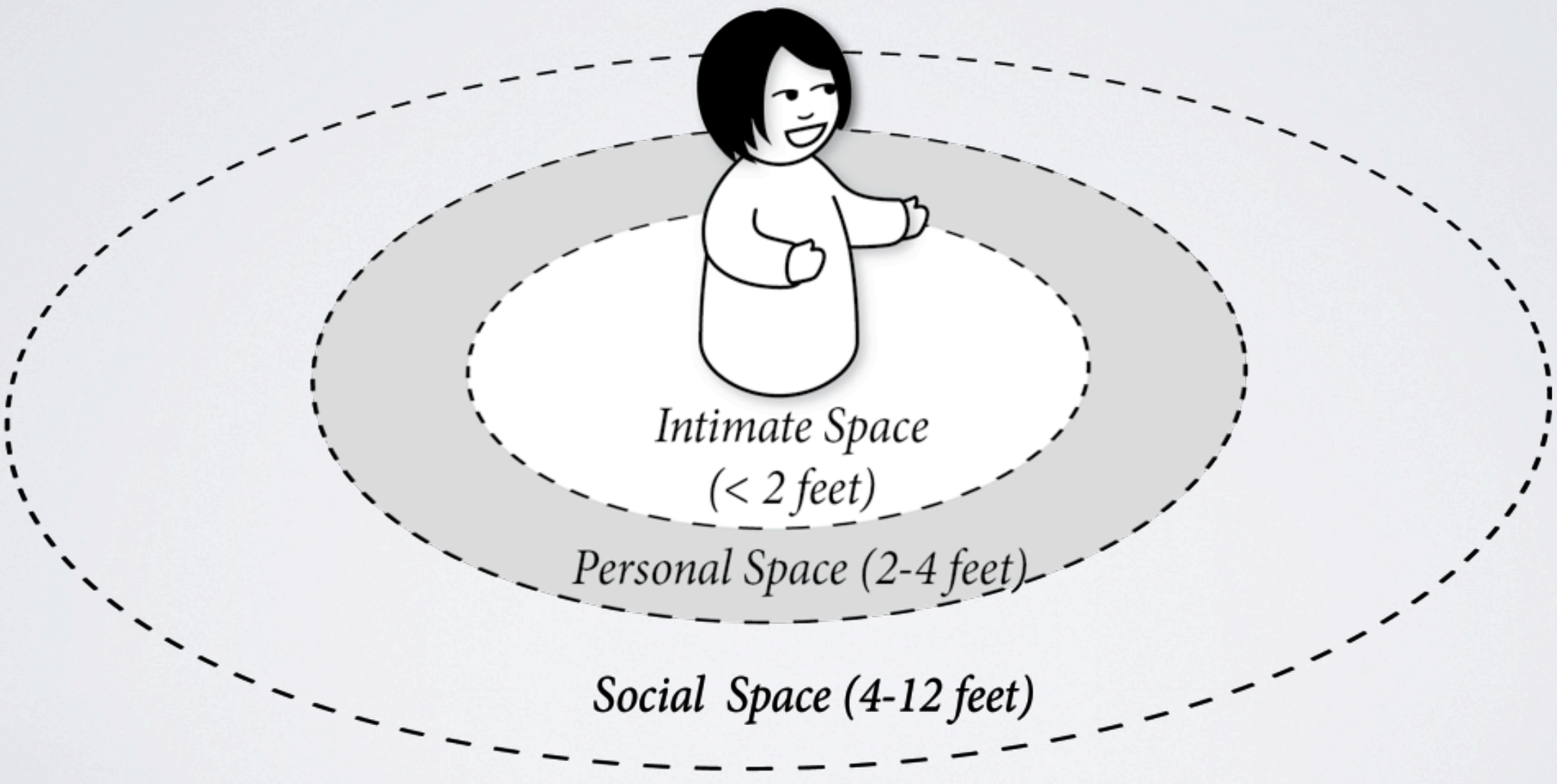

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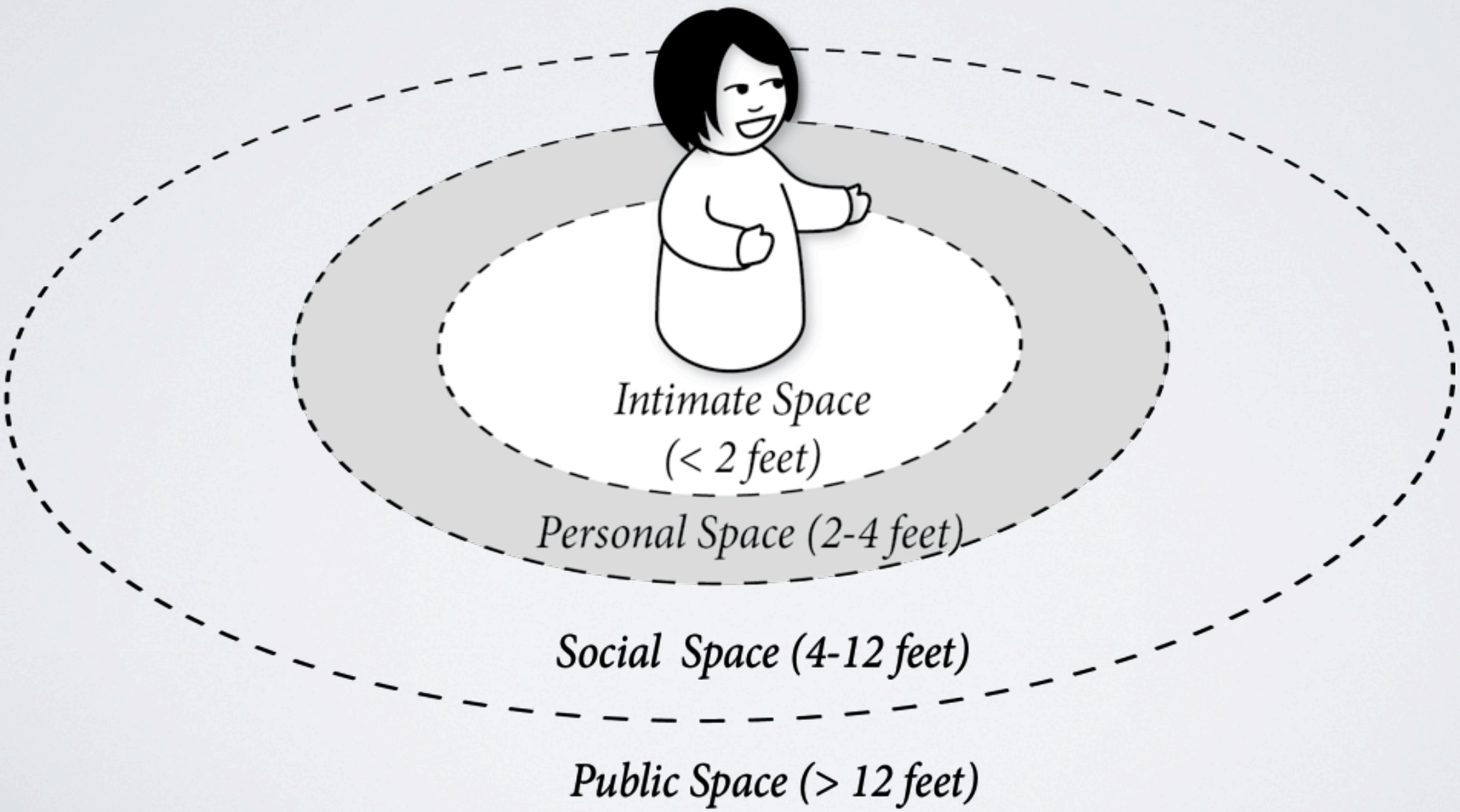

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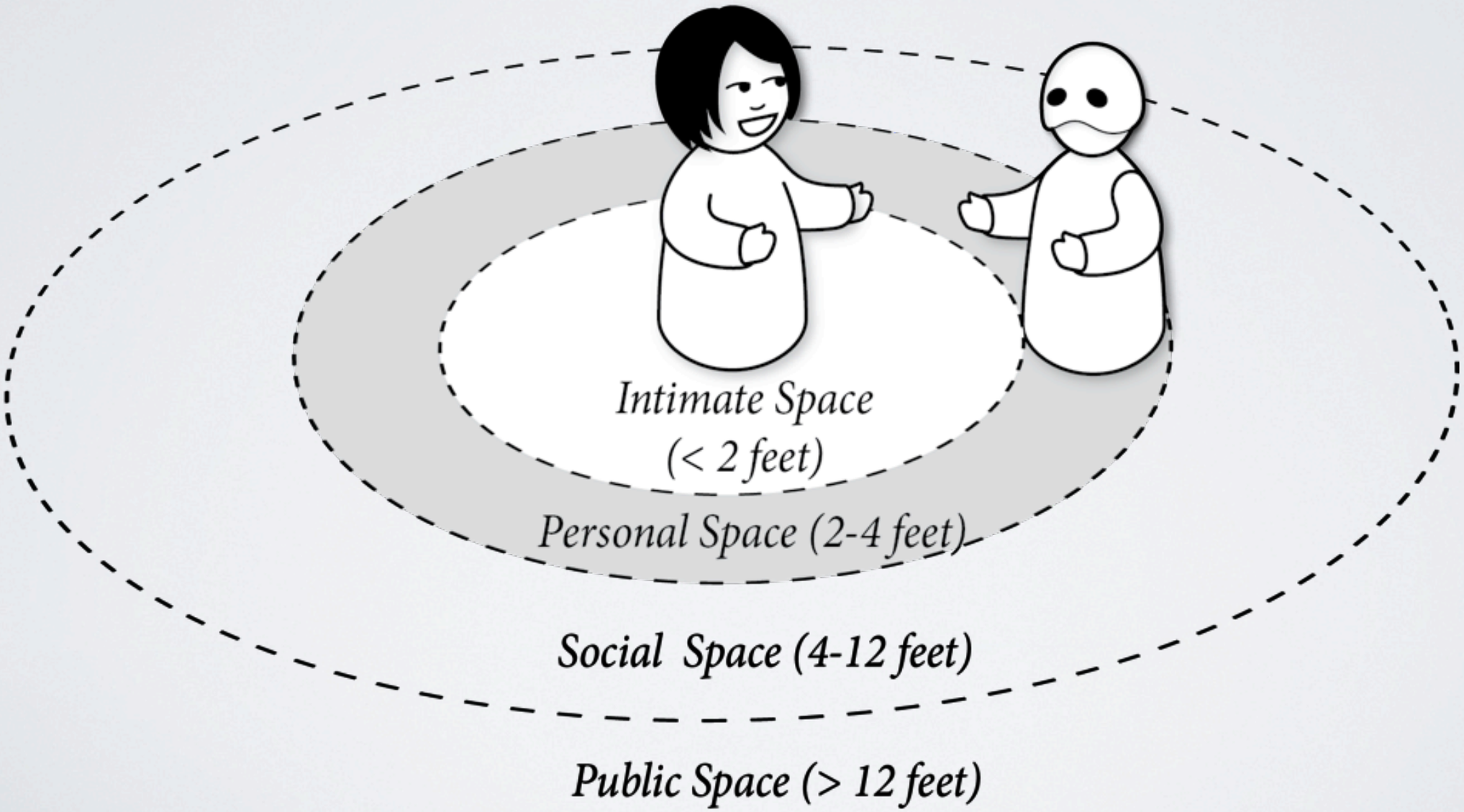
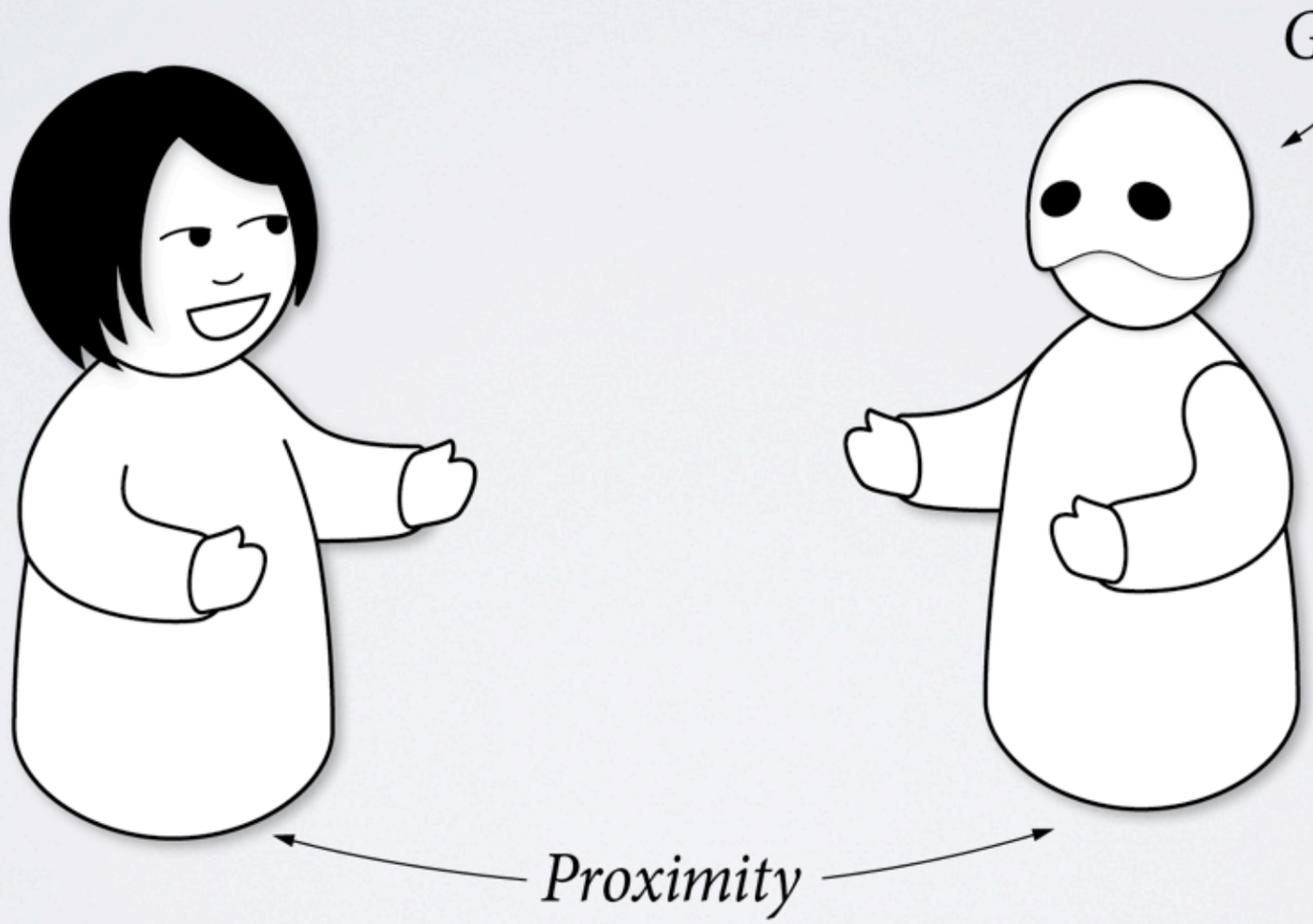


Design Space



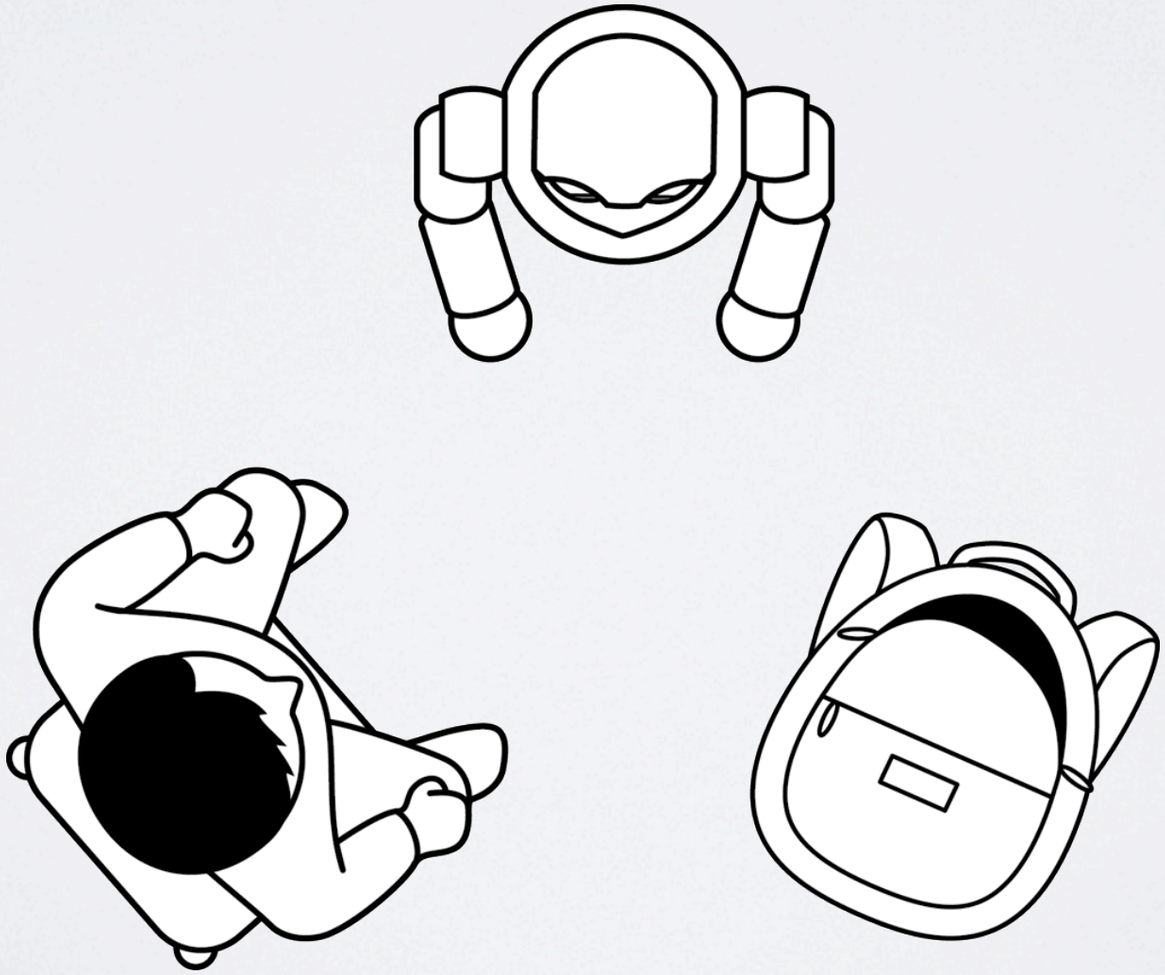
Nonverbal cue #2: **Gaze**

Gaze cues communicate **social accessibility**

[Goffman 1969]

Robot **looks at human** when **talking**

[Kendon 1967]



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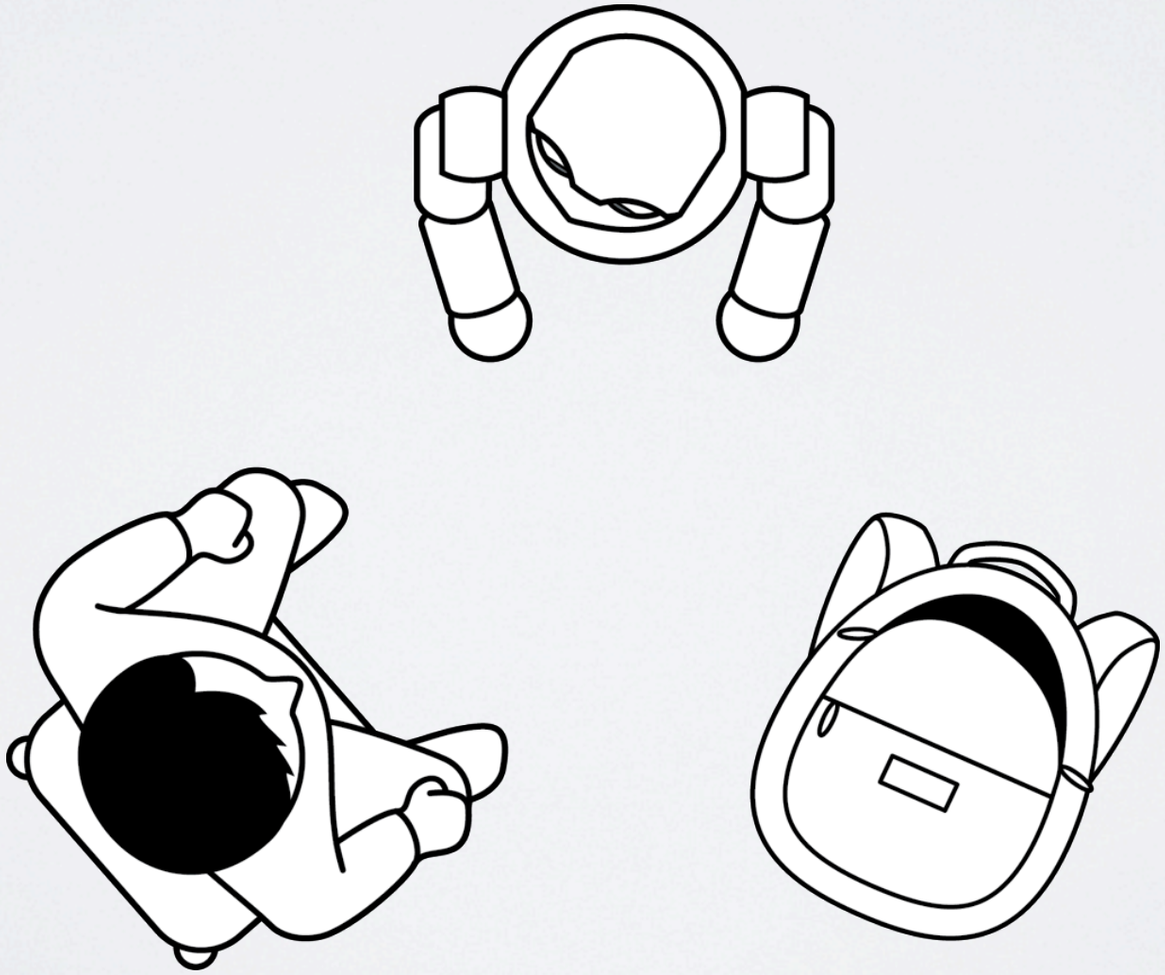

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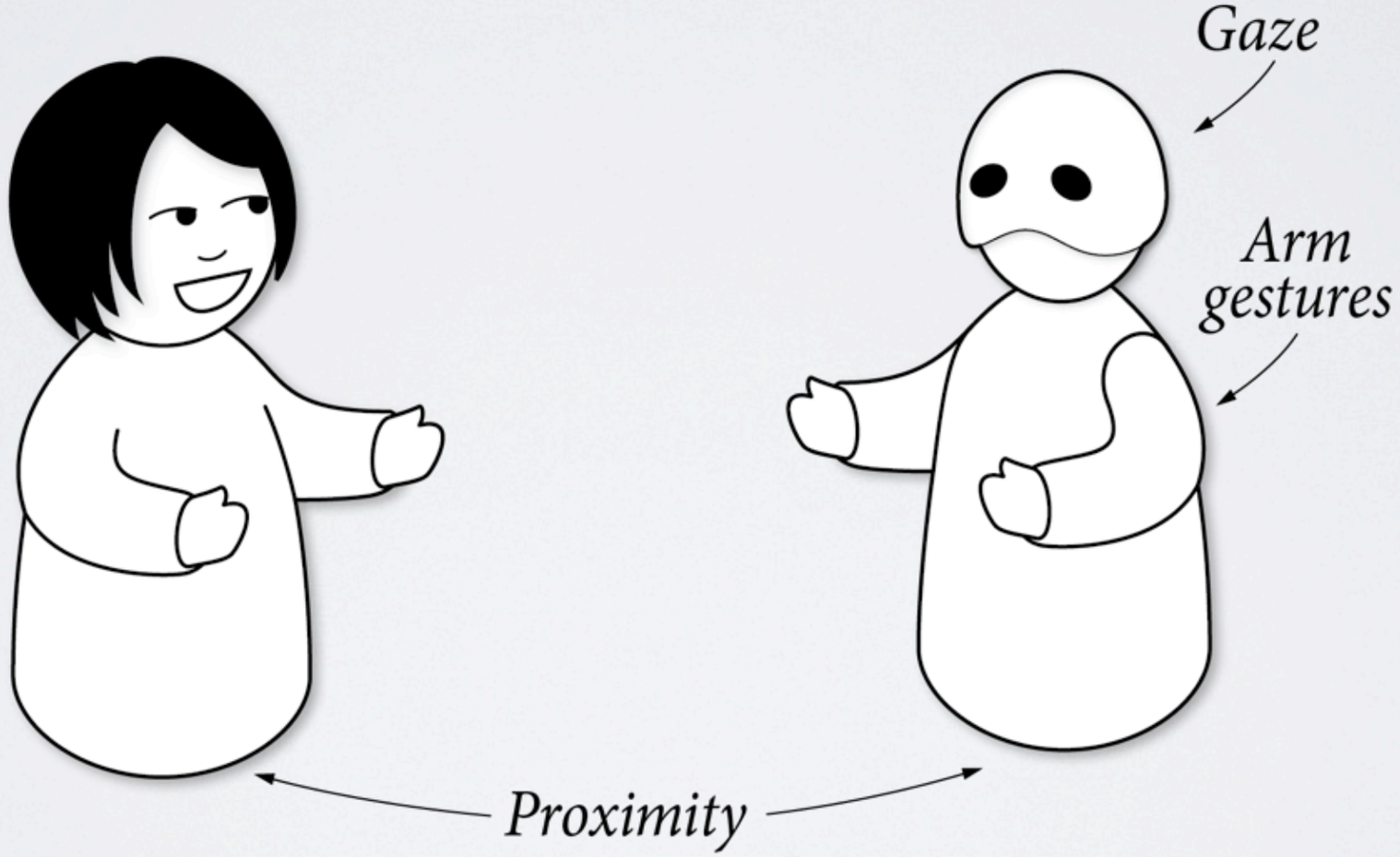


Nonverbal cues #3: **Gestures**

Gestures shape the persuasiveness of speech

[Maricchiolo et al. 2009]

We used four kinds of gestures in designing the behavior of the robot

[McNeil 1996, Kendon 1996, Goldin-Meadow 2005]

1. Iconic gestures
2. Metaphoric gestures
3. Deictic gestures
4. Beat gestures

Nonverbal cues #3: **Gestures**

Iconic gestures: depict a **concrete** event or object

Nonverbal cues #3: **Gestures**

Iconic gestures: depict a **concrete** event or object

Nonverbal cues #3: **Gestures**

Metaphoric gestures: depict **abstract** events

Nonverbal cues #3: **Gestures**

Metaphoric gestures: depict **abstract** events

Nonverbal cues #3: **Gestures**

Deictic gestures: **points** at objects in the environment

Nonverbal cues #3: **Gestures**

Deictic gestures: **points** at objects in the environment

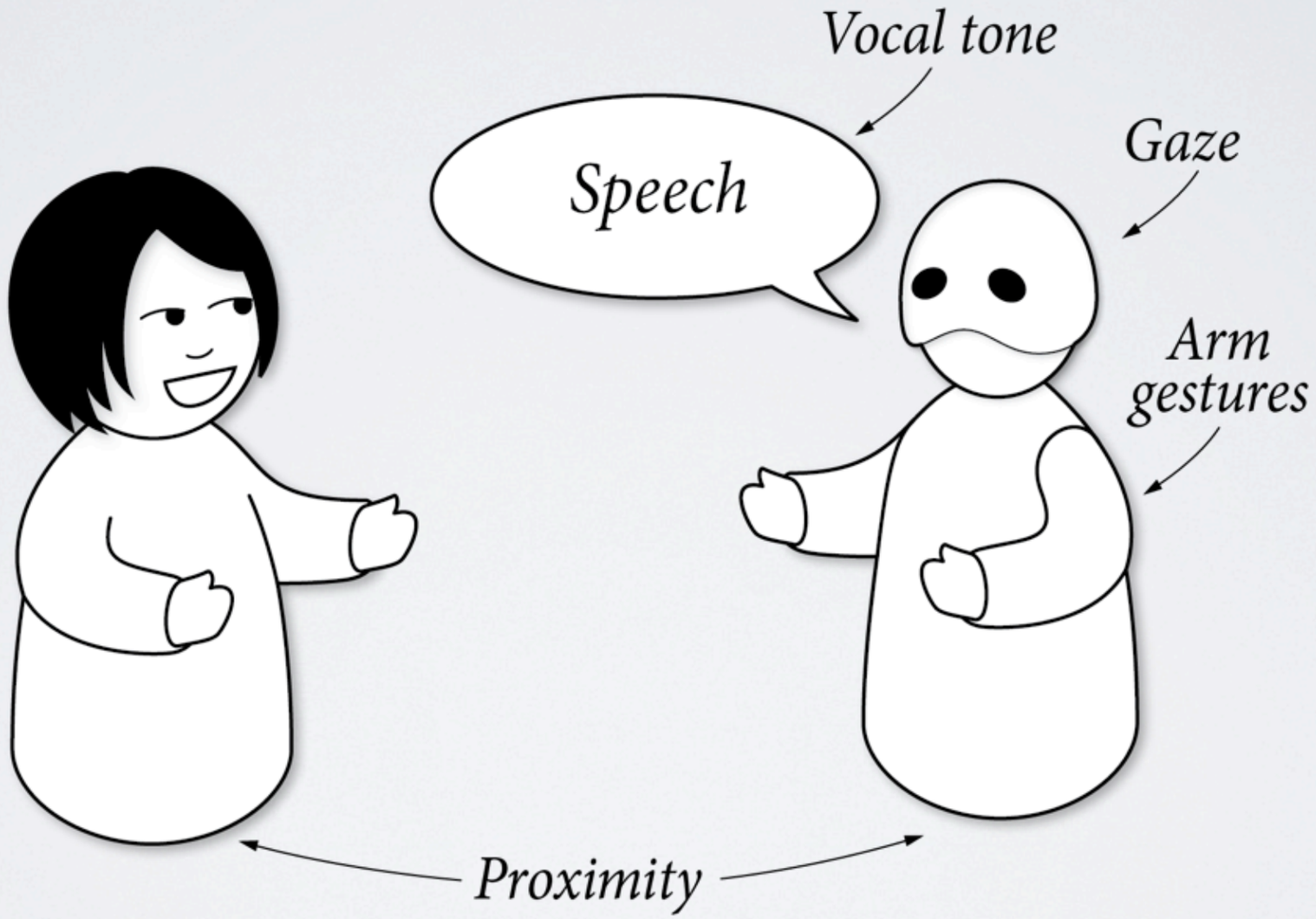
Nonverbal cues #3: **Gestures**

Beat gestures: used to **maintain rhythm**

Nonverbal cues #3: **Gestures**

Beat gestures: used to **maintain rhythm**

Design Space



Nonverbal Cues #4: **Vocal tone**

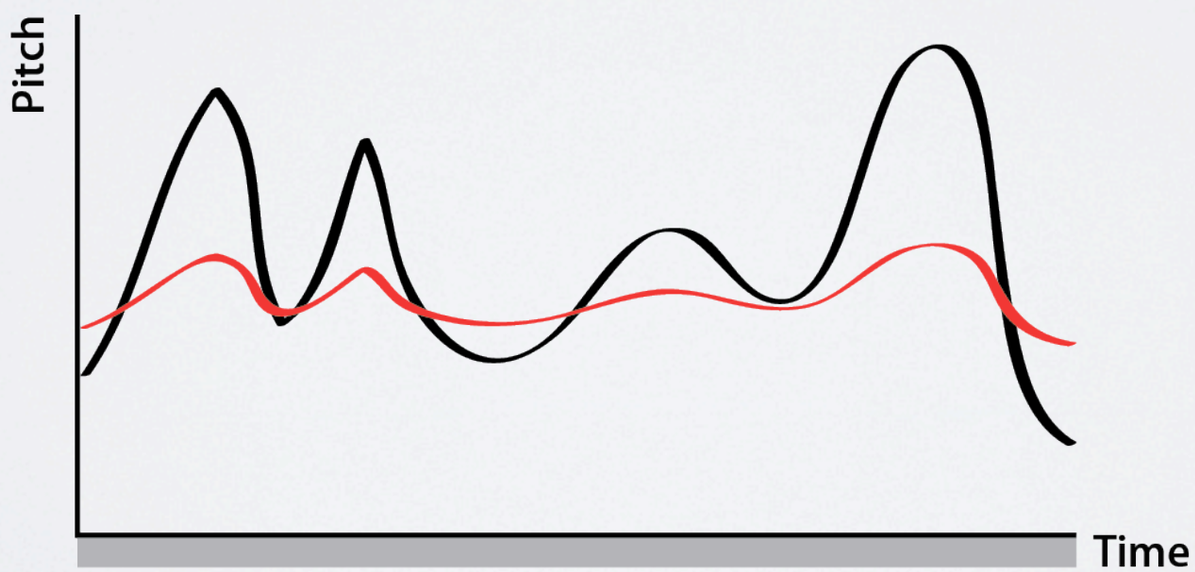
Vocal parameters known to affect **compliance**

[Buller et al. 1986]

Used **Festival** text-to-speech system

[Taylor et al. 1998]

Manipulated vocal tone by **varying the pitch**



"The trench coat should be ranked higher."

Experimental Design

Experimental Design

Study

Two-by-two

Between-participants

Dependent variables

Compliance

Perception of persuasiveness

Independent variables

Use of vocal cues

Use of bodily cues

Gender

Condition	Vocal	Bodily
#1		
#2		✓
#3	✓	
#4	✓	✓

Experimental Task

Scenario

Airplane crash in the middle of the desert

Task

Rank 12 items in the order of importance for survival

[Lafferty et al. 1974]

Experimental Task

Participant is shown the list

↓

Participants ranks all the items

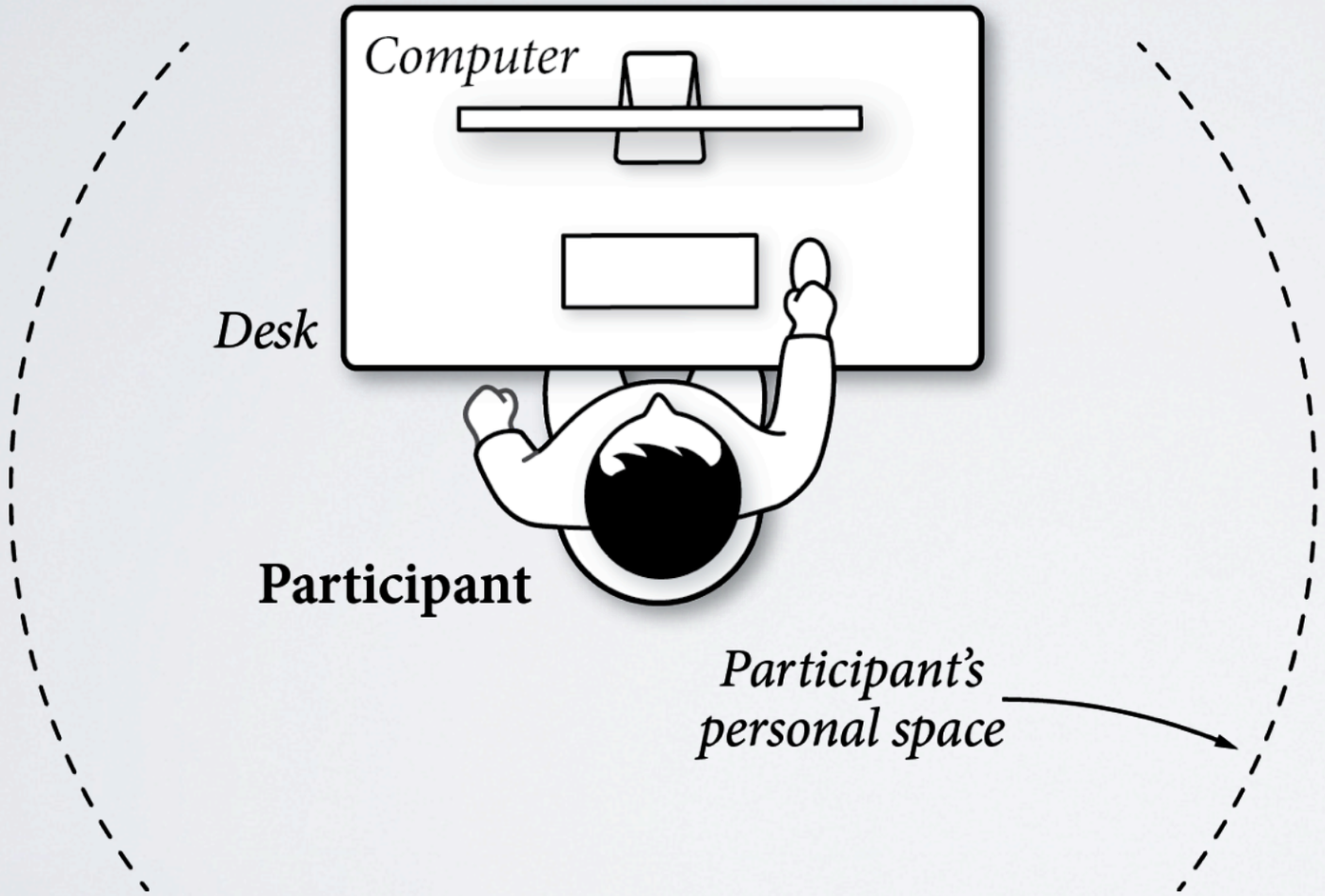
↓

Robot makes a suggestion about a specific item

↓

Participant listens to suggestion, and changes ranking

Experimental Setup



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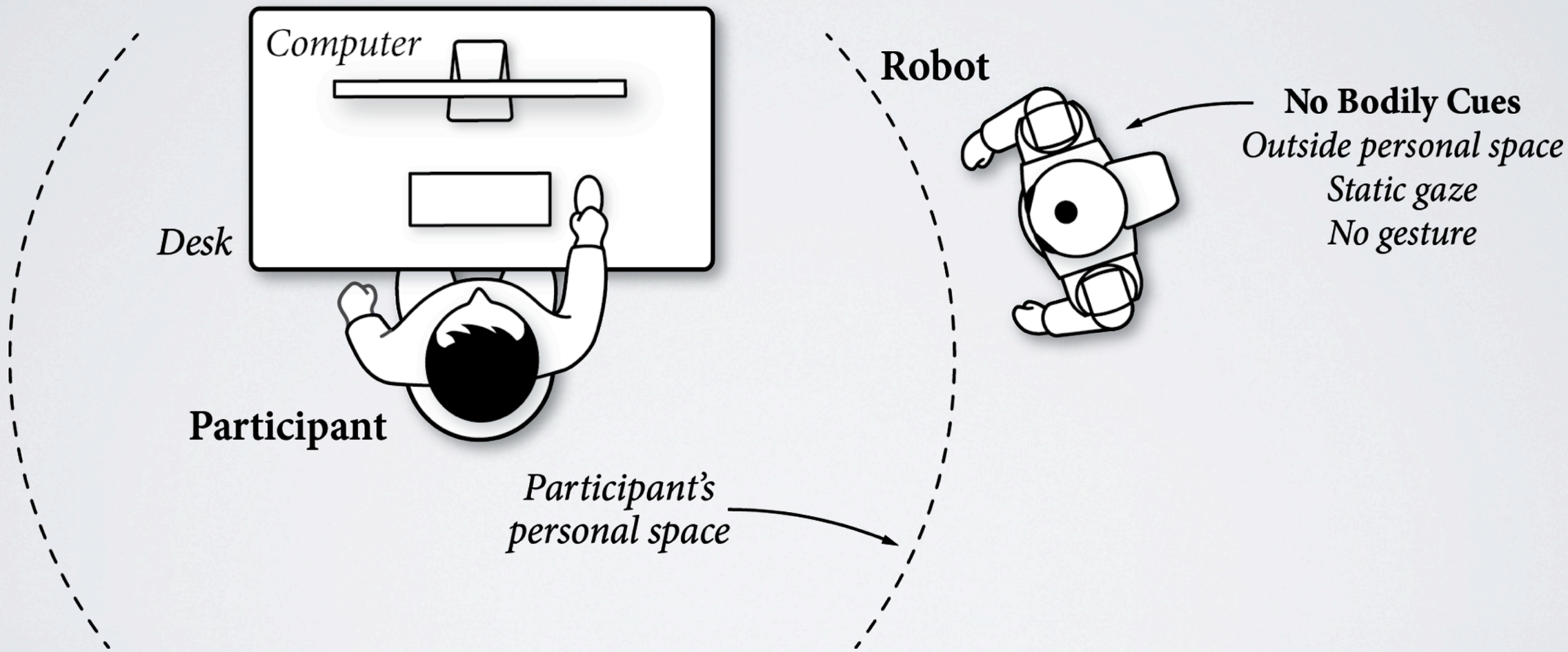

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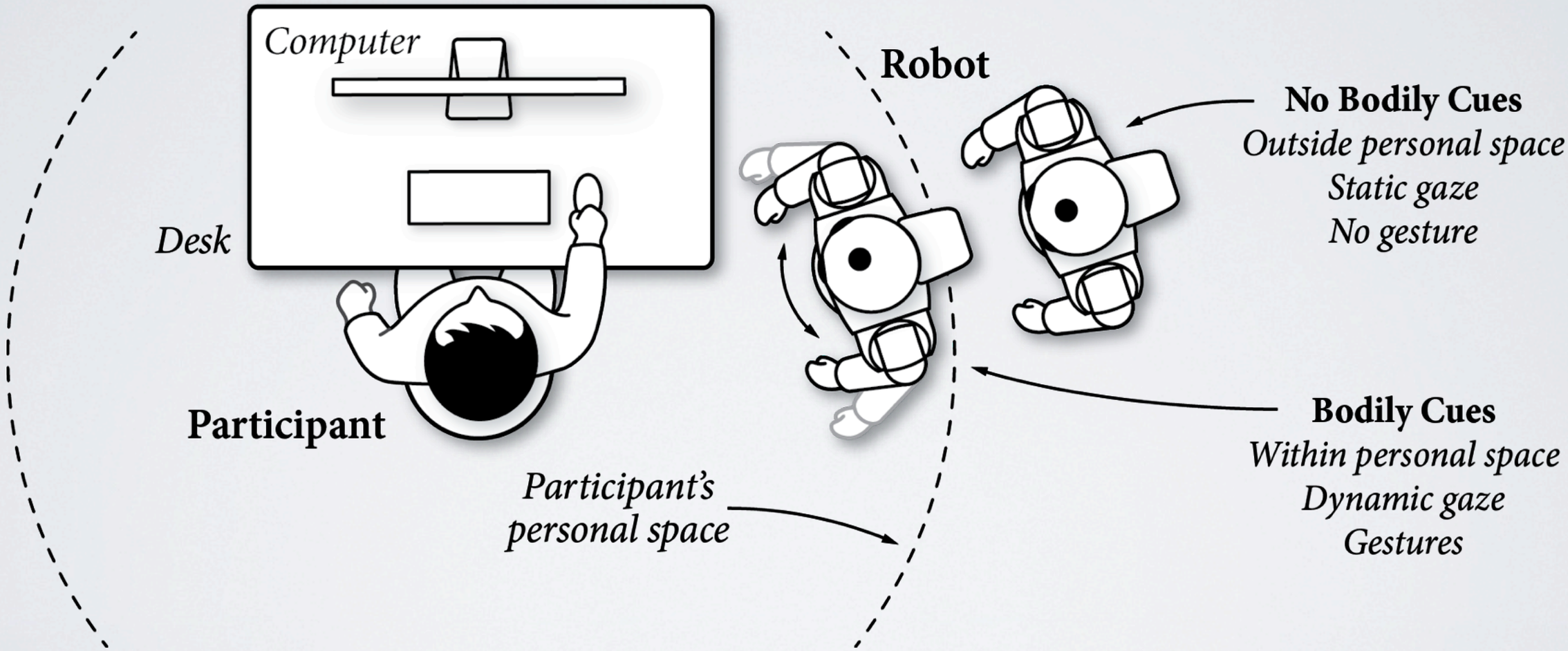


Measurements

Objective

Measured participant's **compliance** through **change in item ranking** done **after** listening to **robot's suggestions**

Subjective

Measured participant's **perception of robot** and **task experience**

Used **post-experiment** questionnaire

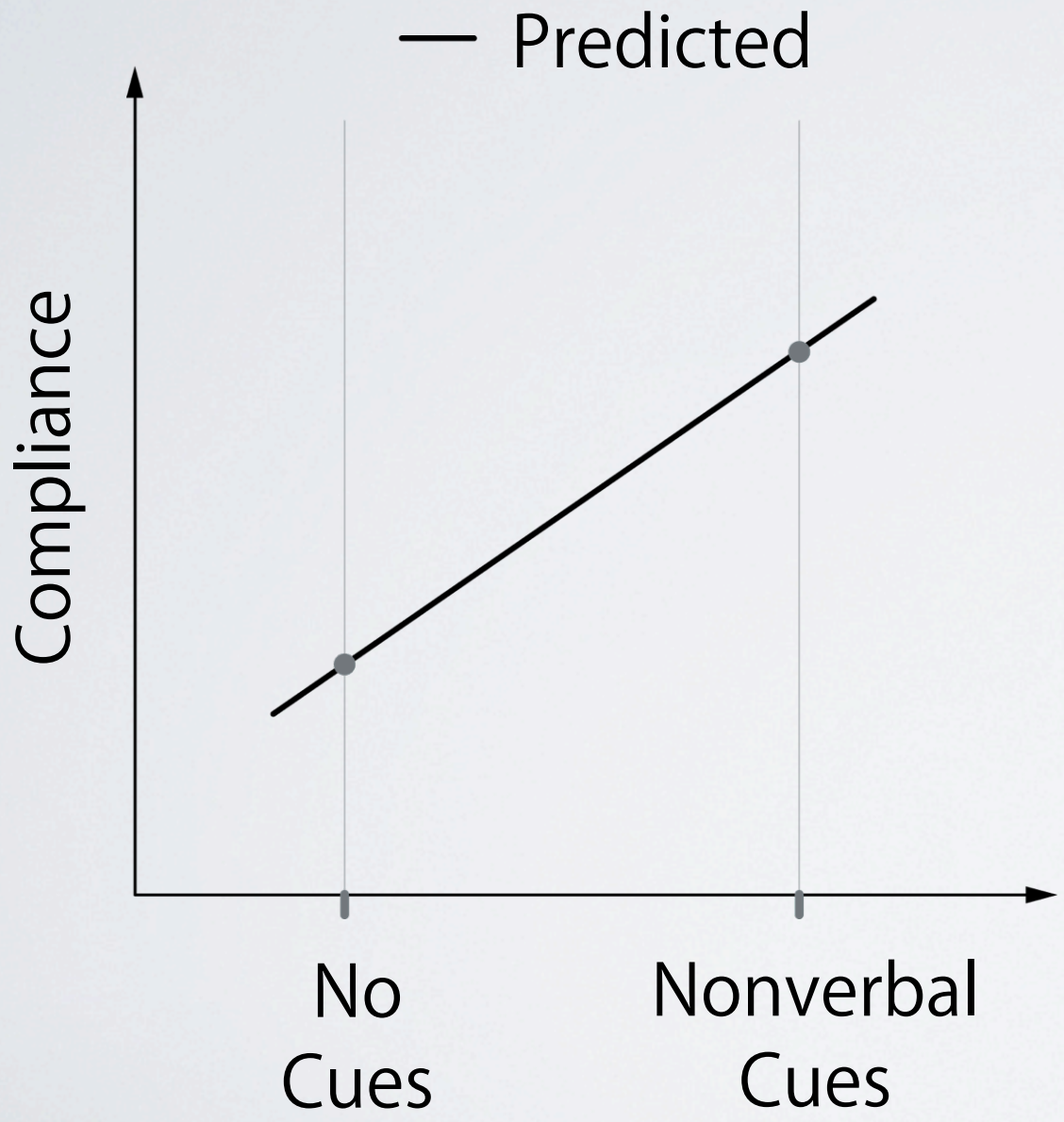
Three scales

Persuasiveness (Cronbach's $\alpha = 0.78$)

Intelligence (Cronbach's $\alpha = 0.83$)

Satisfaction (Cronbach's $\alpha = 0.79$)

Hypothesis #1



Basis

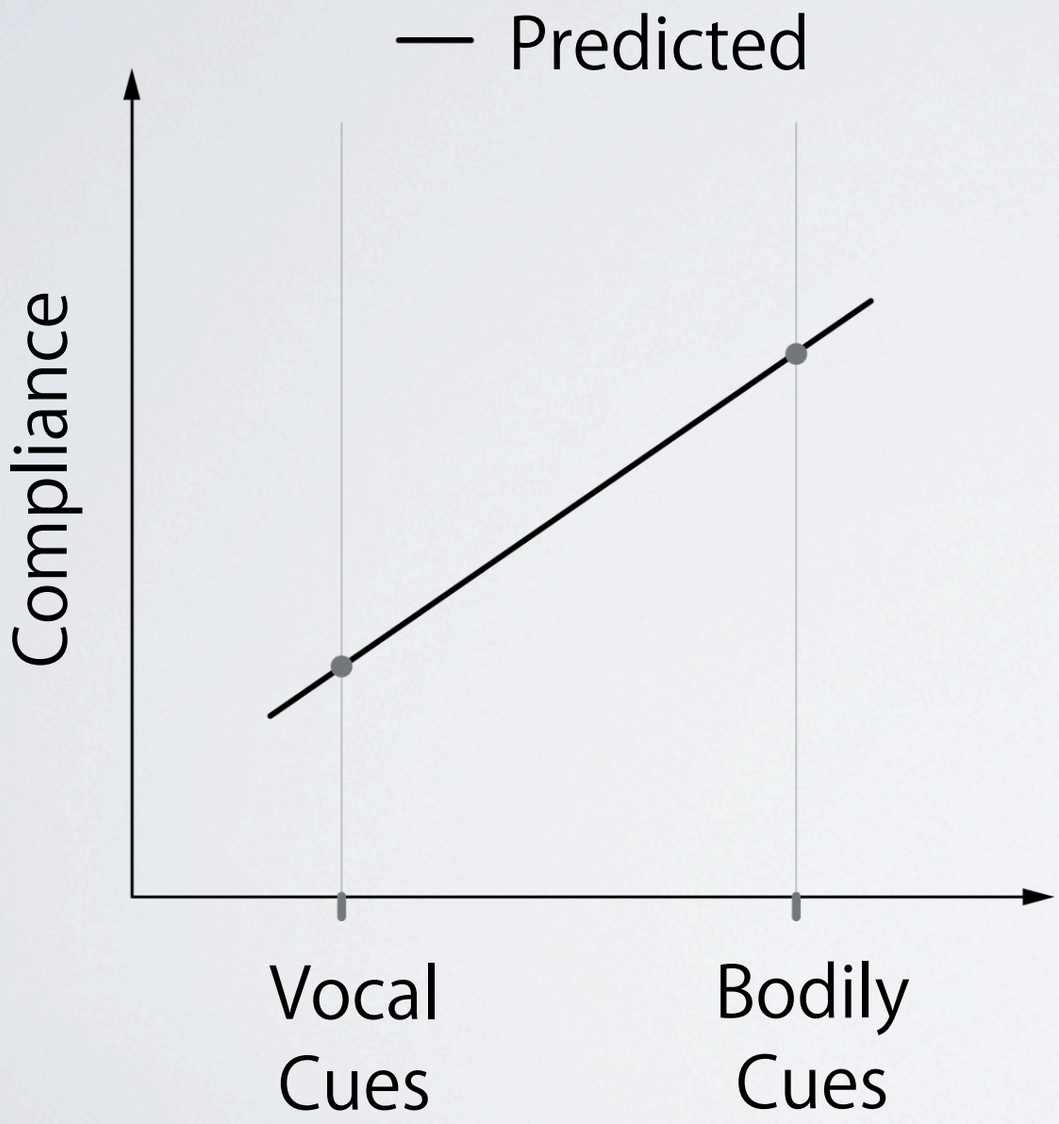
Nonverbal behavior **facilitates persuasion**

[Sergin 1993, Peters 2007]

Hypothesis

Compliance with the robot's suggestions will be **higher** when the robot **displays nonverbal cues** (verbal and/or bodily cues) than when it does not display nonverbal cues

Hypothesis #2



Basis

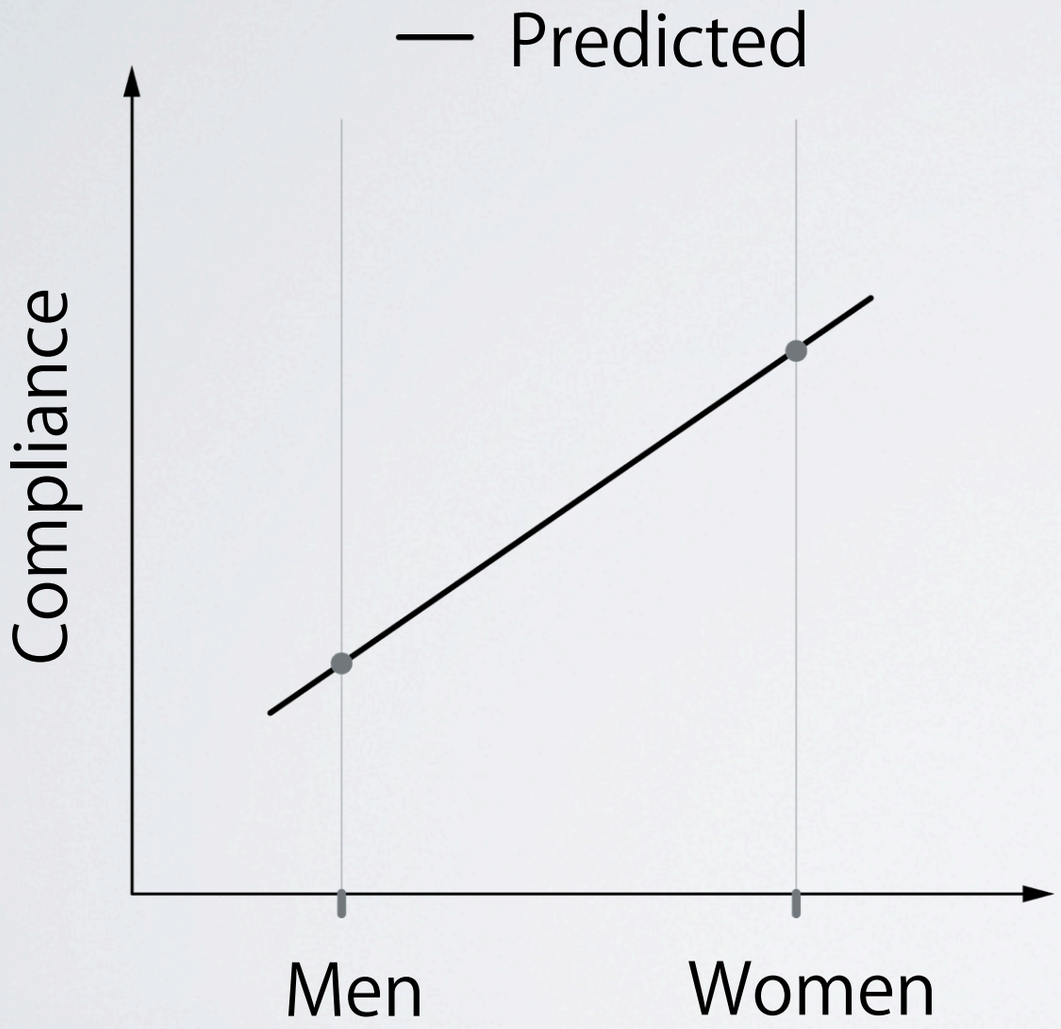
Bodily cues might play a **stronger role** than vocal cues do in **people's impressions** of others

[Mehrabian 1971]

Hypothesis

Compliance with the robot's suggestions will be **higher** when the robot employs **only bodily cues** than when it employs **only vocal cues**

Hypothesis #3



Basis

Women are **more adept** than **men** at **reading** nonverbal cues

[Hoffmann 1977, Rosip et.al 2004]

Hypothesis

Women's compliance with the robot's suggestions will be **higher** than that of **men** in the presence of **nonverbal cues**

Participants

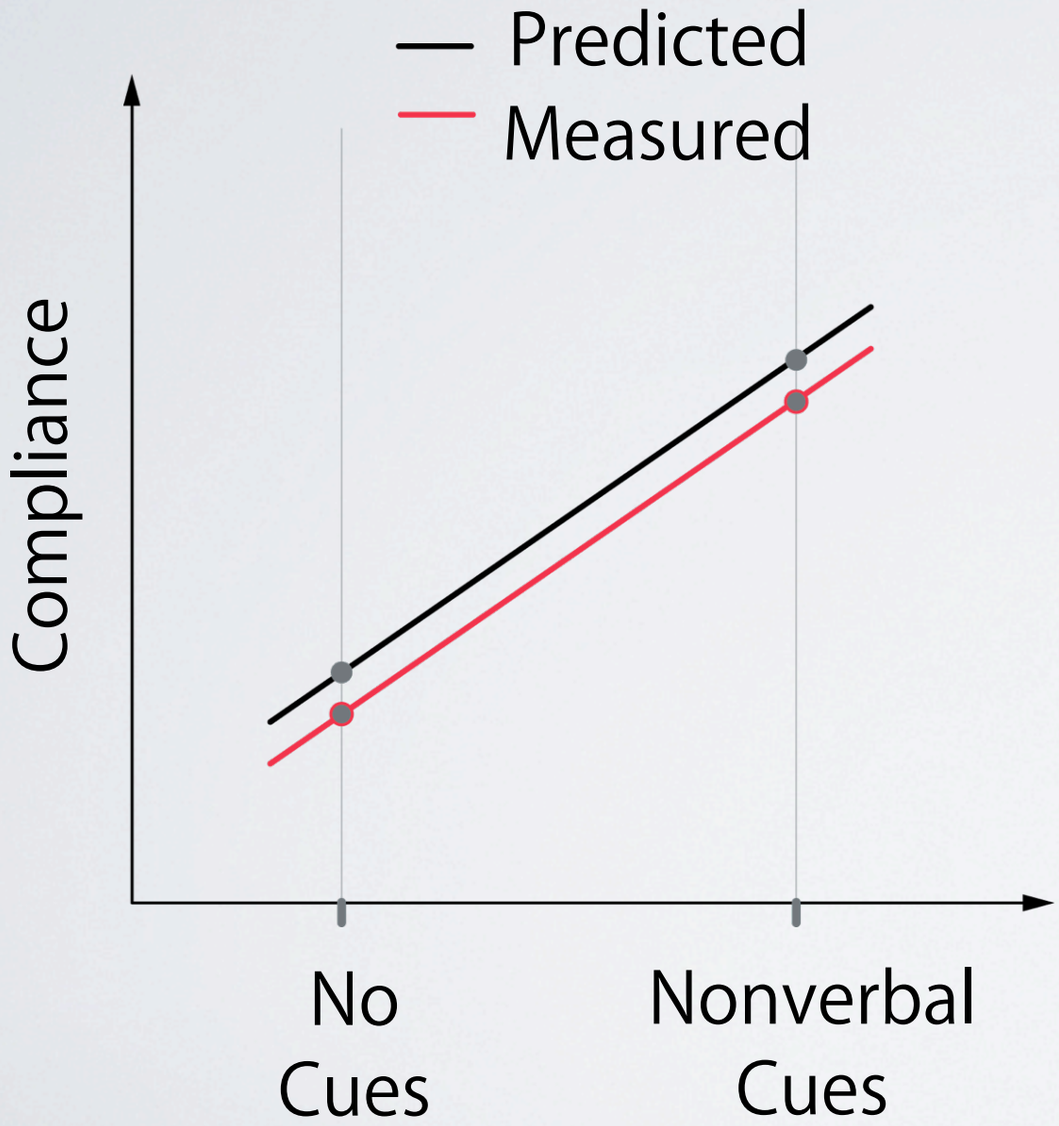
32 participants were recruited (M age = 25.39)

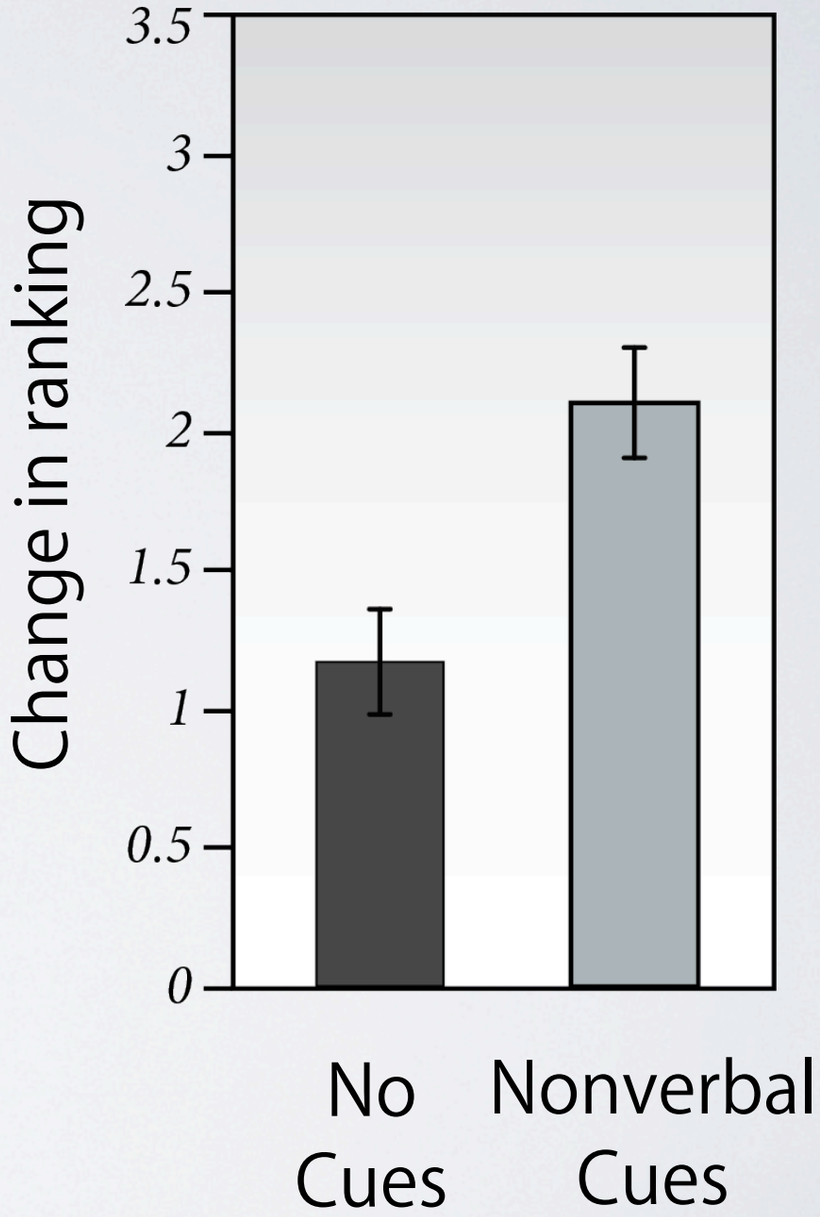
Gender balanced within each condition

Familiarity with computers (**M = 7**, SD = 0)

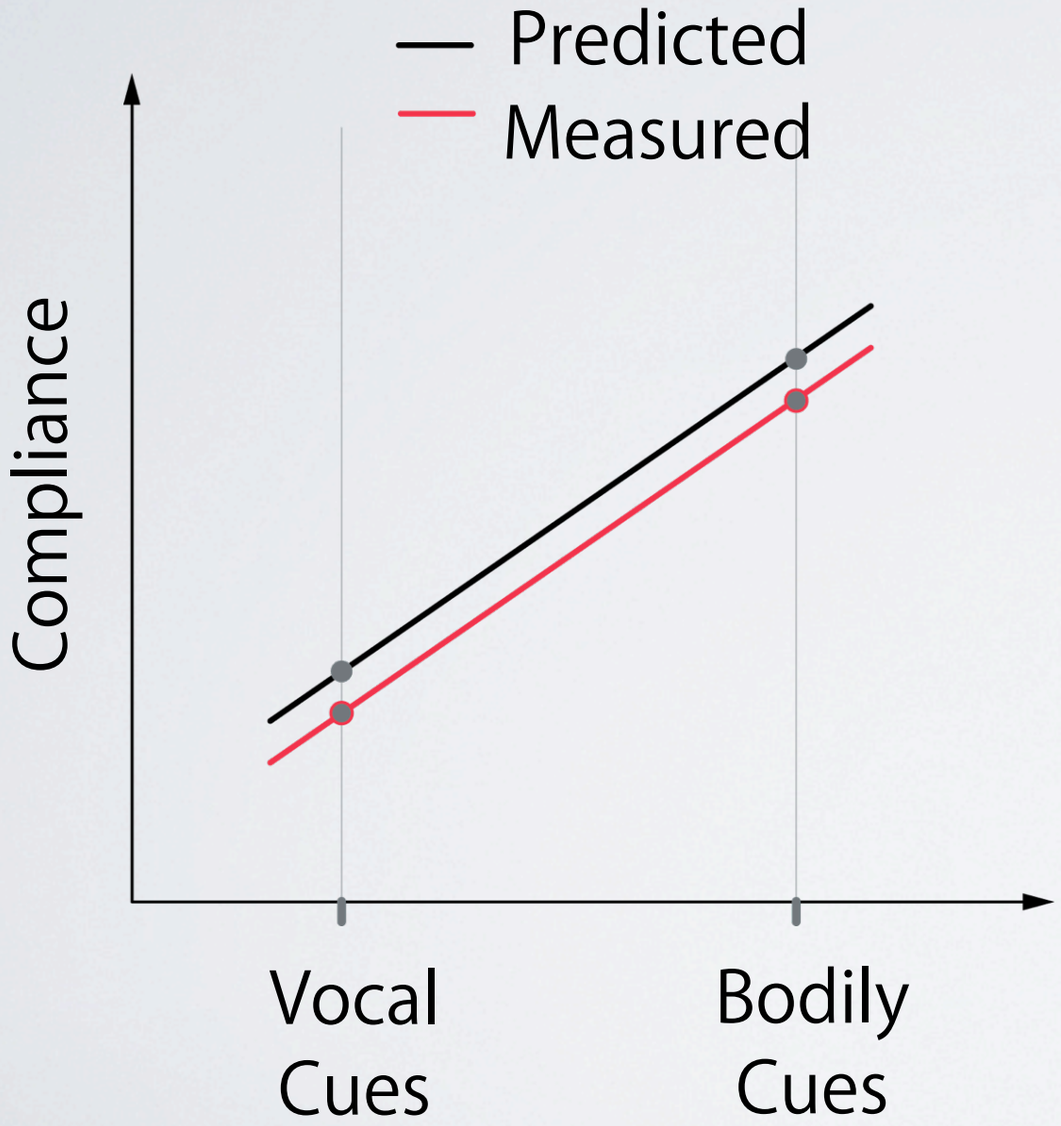
Familiarity with robots (**M=3.67**, SD = 1.71)

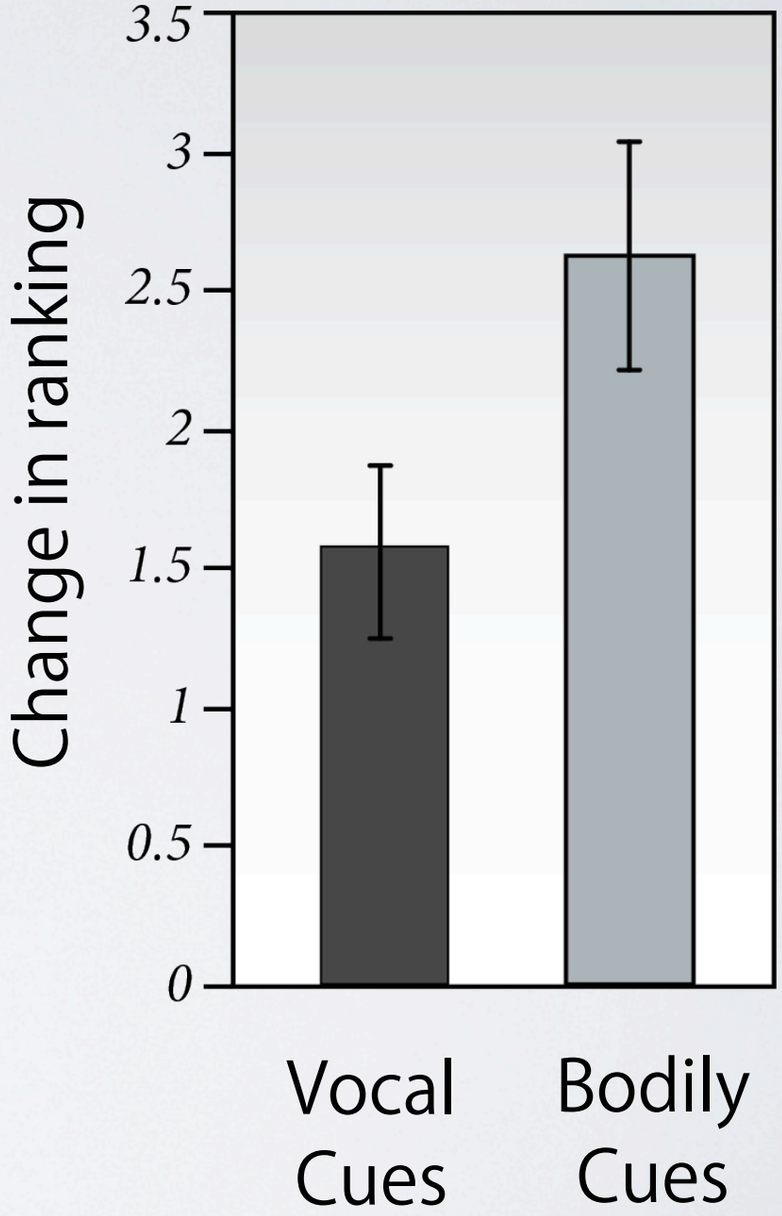
Results: Hypothesis #1





Results: Hypothesis #2





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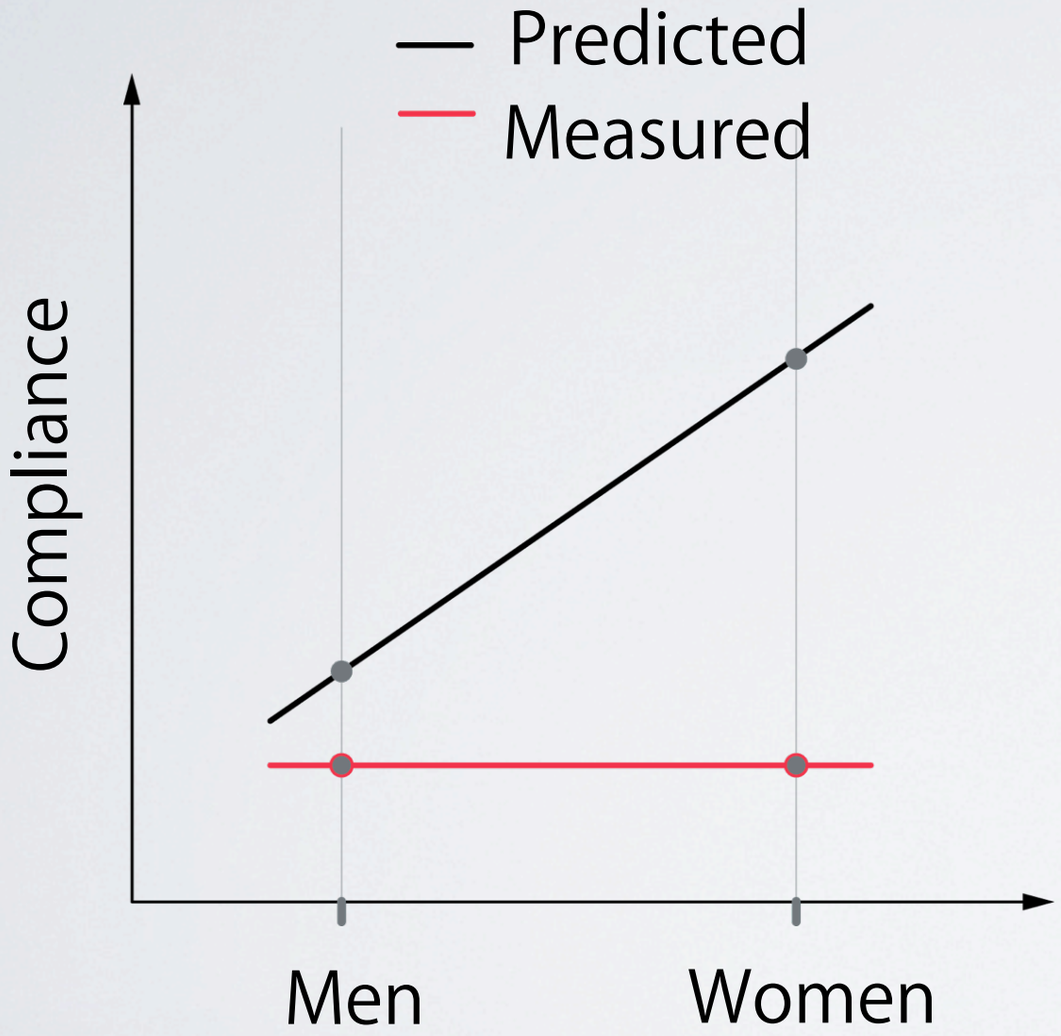
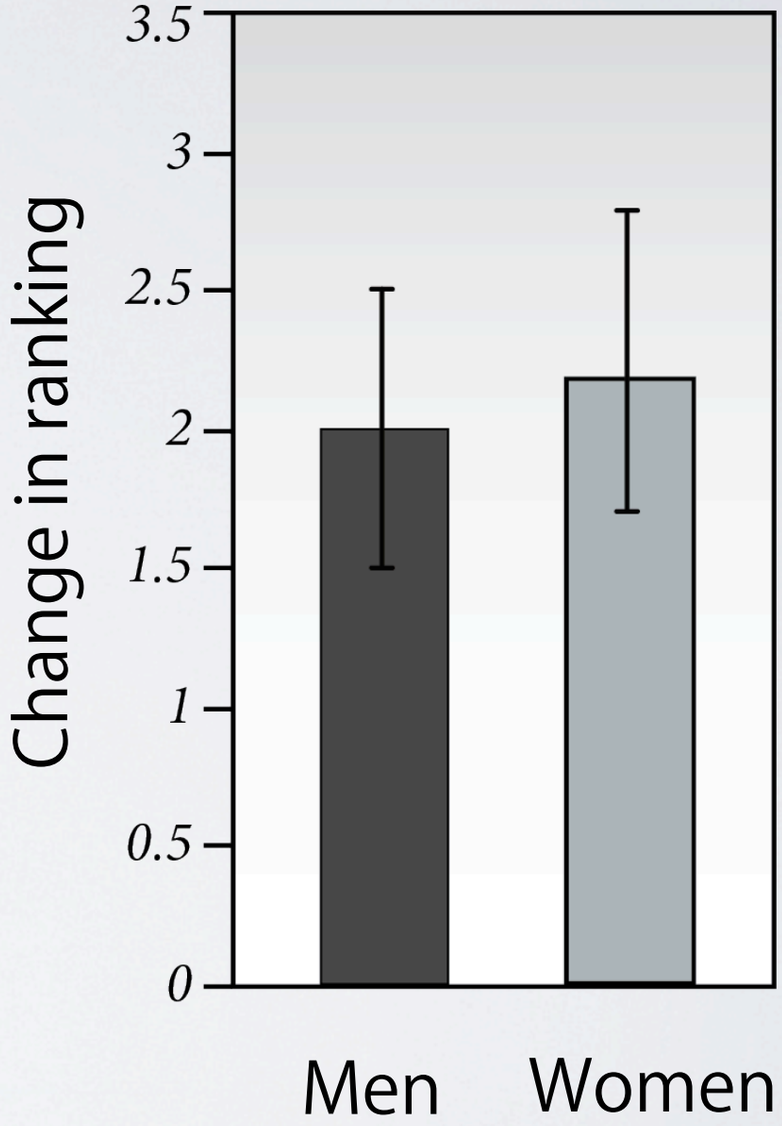
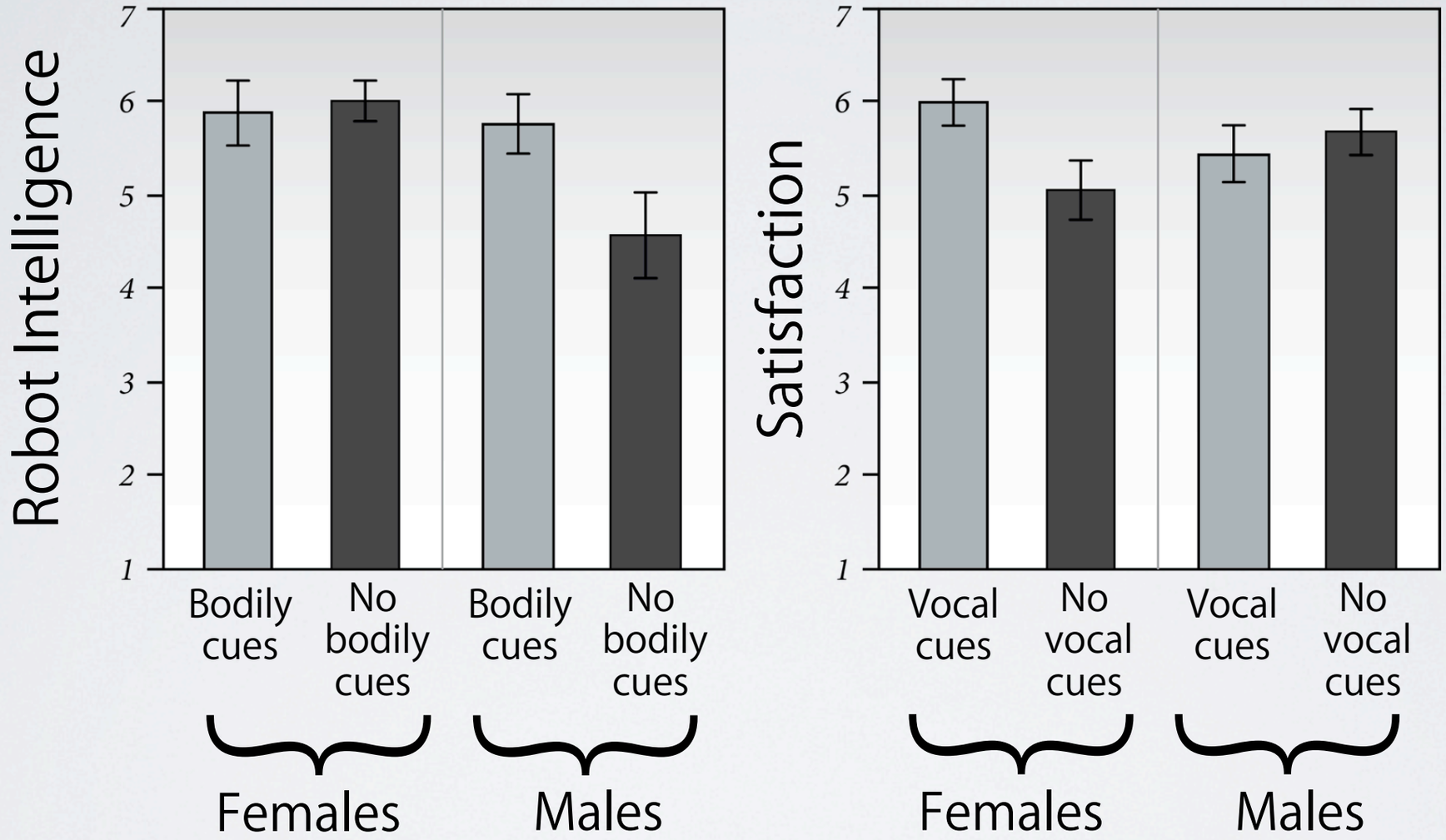




Results: Subjective measurements



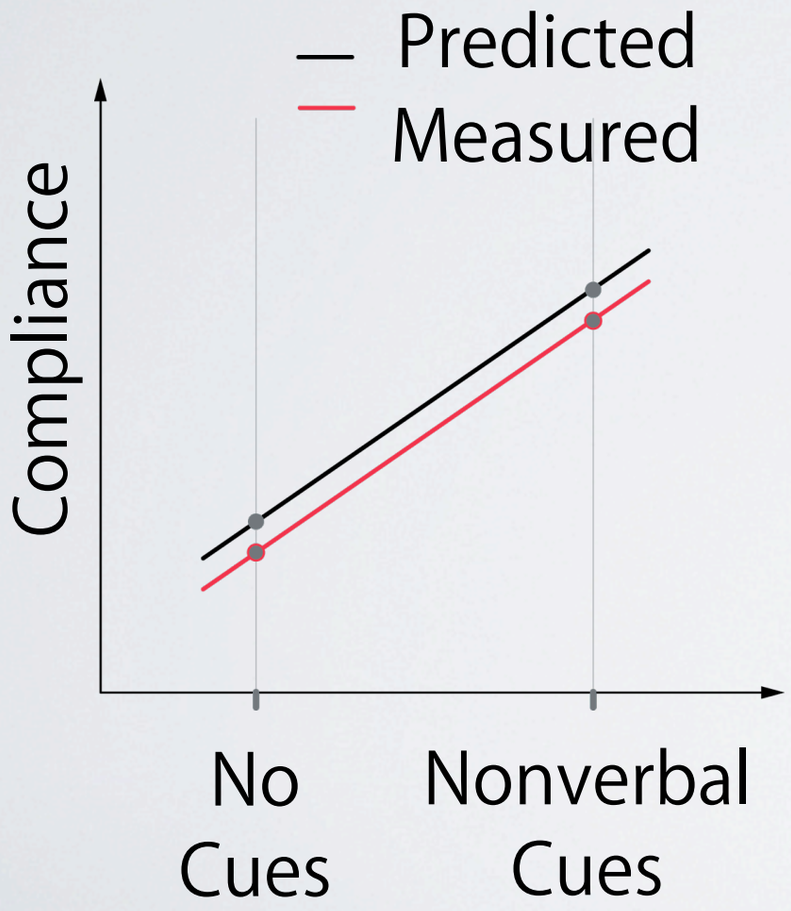
Men found the robot **more intelligent** when it employed **bodily cues**.

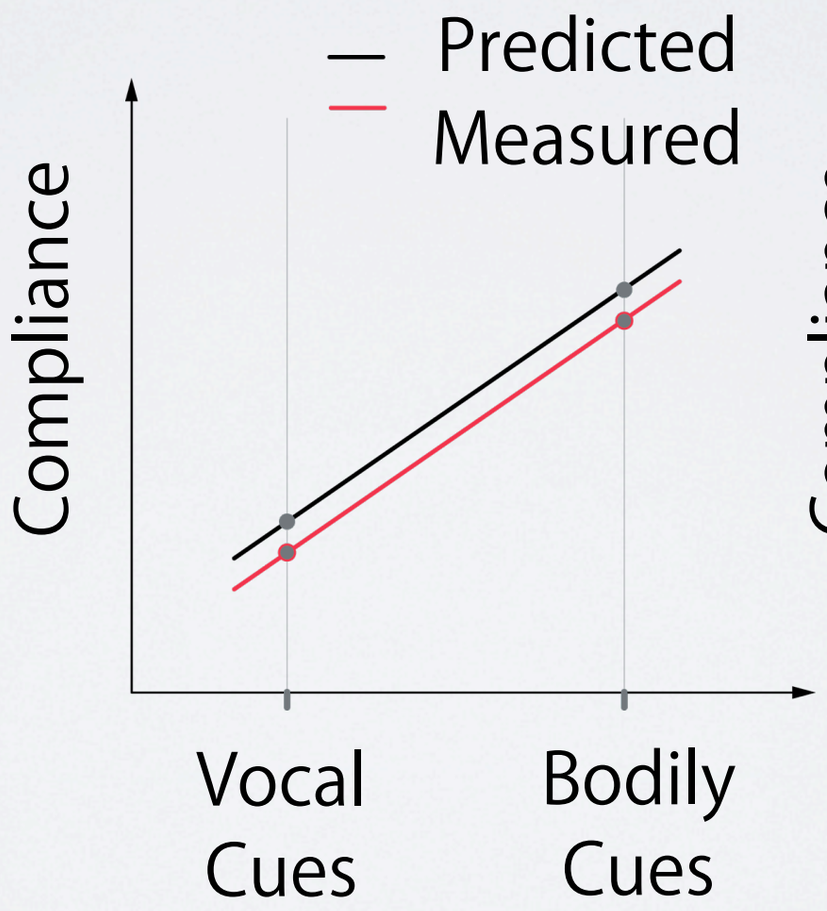
Women obtained **more task satisfaction** when the robot employed **vocal cues**.

Results

Hypothesis #1 and #2 **were supported**

Hypothesis #3 was **not** supported





Design Implications

Nonverbal immediacy plays a **key role** in determining persuasiveness of the robot

Bodily cues are **crucial** for a persuasive robot

Limitations

Compound conditions

- **Tease apart** components in future work

Design of the robot

- Investigate the effect of cues across **platforms**

Generalizability of experimental task

- Explore a **variety** of tasks

Conclusion

Designed immediacy cues for a humanoid robot

Evaluated their effectiveness in persuasion

Found that **nonverbal immediacy** plays a key role in the **persuasiveness** of the robot

THANK YOU!

QUESTIONS?

Acknowledgements

Mitsubishi Heavy Industries, Ltd.

Members of the HCI laboratory

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