

Effects of Head Movement on Perceptions of Humanoid Robot Behavior

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Motivation

- How much does interacting with a humanoid robot enhance anthropomorphic perceptions of it?
- How do different types of head movement affect user's ratings of a robot?

Platform

- Nico is an upper-torso humanoid robot
- Body dimensions match a 50th percentile, 1 year old male child



Identifying Anthropomorphic Form

- Give survey to two groups
 - Control: No interaction with Nico
 - Experimental: Short interaction

- Anthropomorphic forms in a cluttered scene
 - *"Anthropomorphic form" is any imitation of the human form in non-human objects. It is often used in product design to make objects familiar, and to project human values.*
 - *Please specify the anthropomorphic forms you see by naming the objects*

- Nico's body parts- "Try to identify Nico's body parts in the picture below"
 - Arm
 - Hand
 - Eyes
 - Mouth
 - Neck
 - Chest

Anthropomorphic Identification

- Successful ID of Nico as anthropomorphic form
 - 30% of control
 - 77% of experimental



Body Part Identification

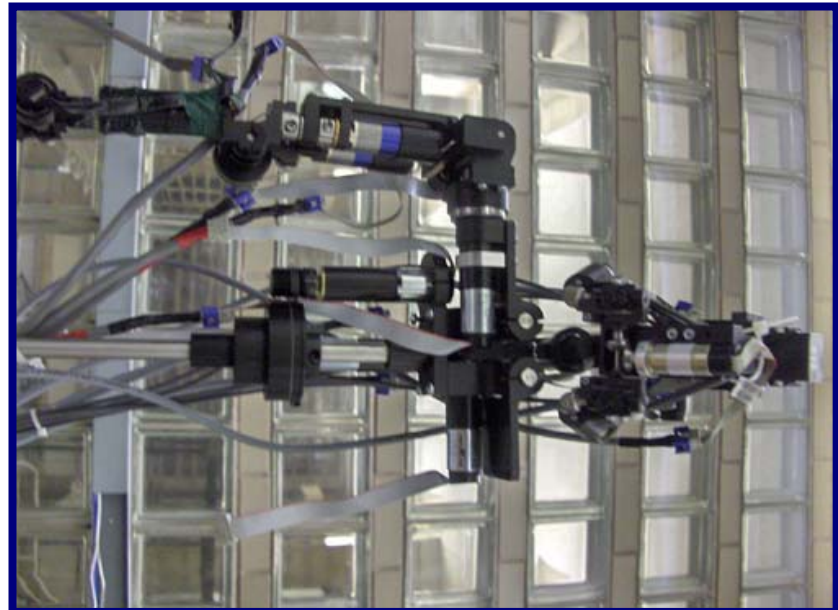
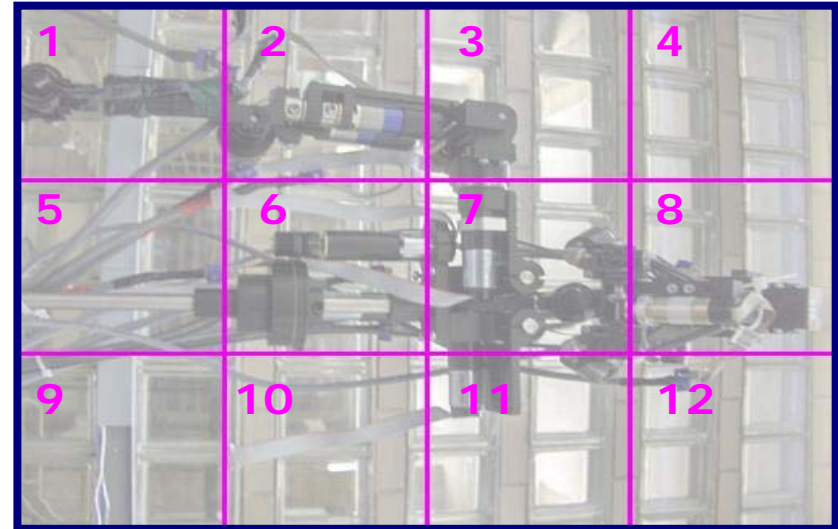
■ Success rates:

□ Rotated

- 41% control
- 58% experimental

□ Upright

- 63% control
- 60% experimental



Experimental Design

How do different types of head movement effect user's perceptions of a robot?

Head Tracking Behavior

Measure

Alive

Happy

Natural

Appropriate

Attention

Friendly

Enjoyment

Intention

Motionless

Smooth

Unsmooth

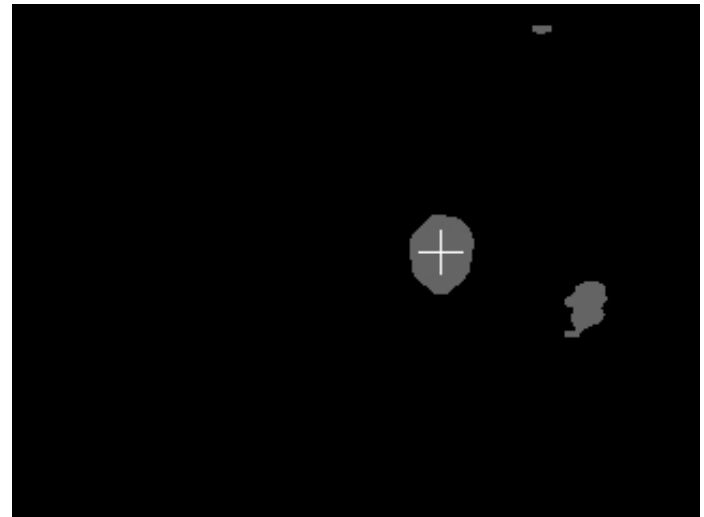
Avoiding

	Motionless	Smooth	Unsmooth	Avoiding
Alive				
Happy				
Natural				
Appropriate				
Attention				
Friendly				
Enjoyment				
Intention				

System Behavior:

- Interaction script:
 - Head rises and enters tracking mode
 - Arm waves
 - Hand beckons
- Gestures were pre-programmed and not contingent upon the position of the participant
- Tracking program relied on skin detection to locate a person's head.

[Photo from Nico cam]





Tracking Modes

- No Tracking
 - Head lifted, but remained facing straight ahead
- Smooth Tracking
 - Tracking with oscillation suppression
- Unsmooth Tracking
 - Tracking without suppression
- Avoiding
 - Negative tracking without suppression

Avoiding Mode



Experience Measures

- 7 measures rated on a 5-point scale:

- Alive
- Happiness
- Naturalness
- Appropriateness
- Attention
- Friendliness
- Enjoyment

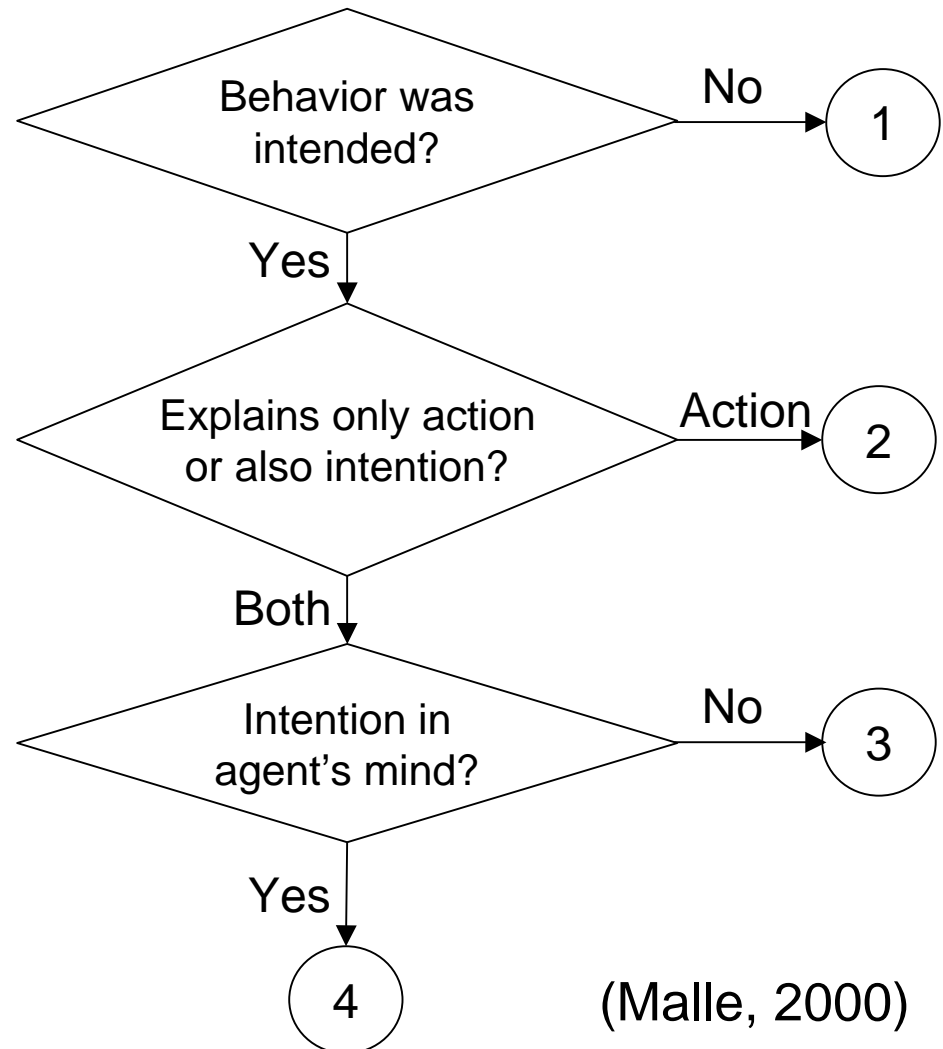
5 = Very much
4 = Somewhat
3 = Average
2 = A little
1 = Not at all

- 1 measure coded from written, free responses

- Intentionality

Coding Intentionality

- “Please describe Nico’s attitude, and ****why**** you think Nico acted that way.”
- Subjects make statements about their experience with Nico
- Experimenters code the written descriptions
 - 4 categories of intent normalized to a 5-point scale



Experimental Protocol

Perception	Motionless	Smooth	Unsmooth	Avoiding
Alive	1.00	2.77	2.36	1.90
Happy	1.33	2.73	2.25	2.57
Natural	2.00	3.00	2.64	2.90
Appropriate	1.83	2.31	3.40	2.50
Attention	1.83	2.69	3.27	2.50
Friendly	1.80	2.85	3.20	3.25
Enjoyment	1.80	2.75	3.18	3.20
Intention	1.66	2.60	3.30	3.00

Survey Results

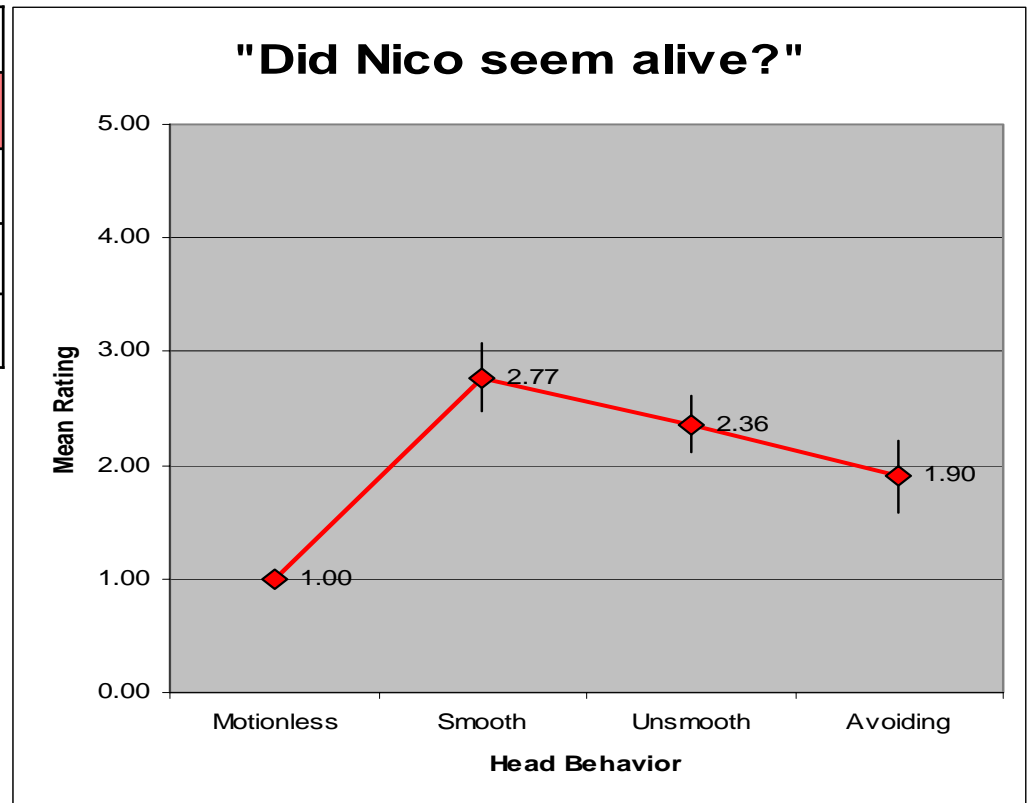
- Clustered according to high correlation
($R \geq .94$, Mean .98)

Measure	Motionless	Smooth	Unsmooth	Avoiding
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Natural	2.00	3.00	2.64	2.90
Appropriate	1.83	2.31	3.40	2.50
Attention	1.83	2.69	3.27	2.50
Friendly	1.80	2.85	3.20	3.25
Enjoyment	1.80	2.75	3.18	3.20
Intention	1.66	2.60	3.30	3.00

Motionless	Smooth	Unsmooth	Avoiding
1.00	2.77	2.36	1.90
1.67	2.87	2.45	2.74
1.83	2.50	3.34	2.50
1.75	2.73	3.23	3.15

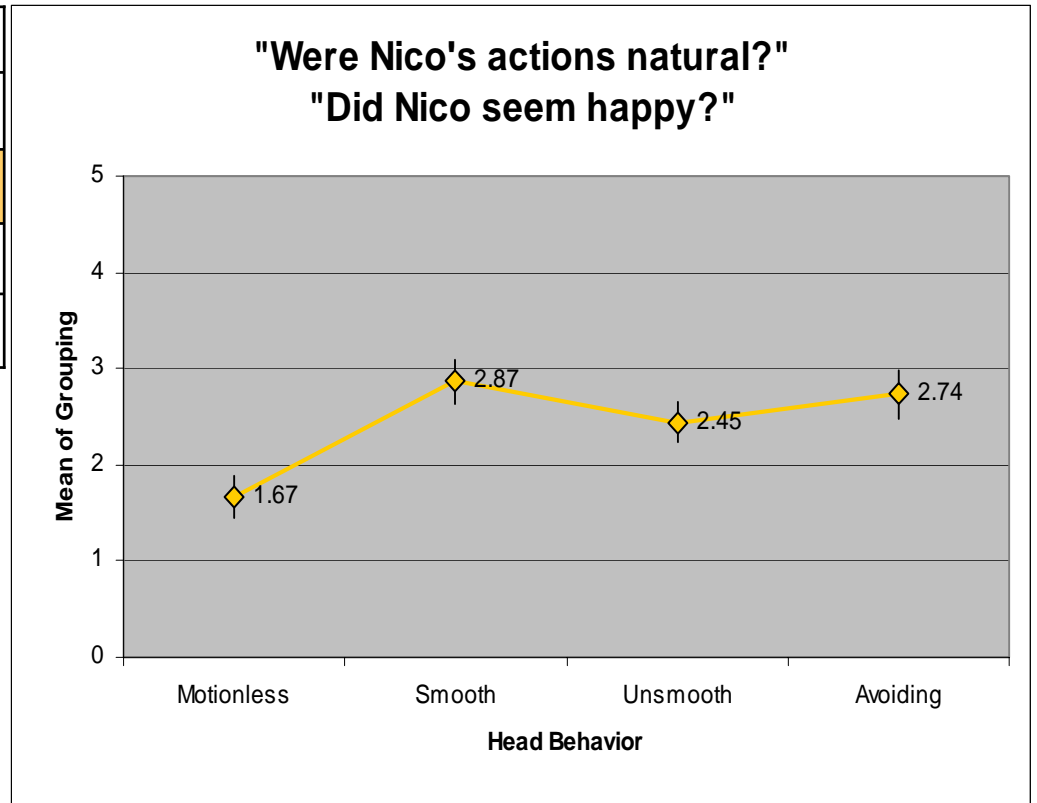
Category 1: Alive

Motionless	Smooth	Unsmooth	Avoiding
1.00	2.77	2.36	1.90
1.67	2.87	2.45	2.74
1.83	2.50	3.34	2.50
1.75	2.73	3.23	3.15



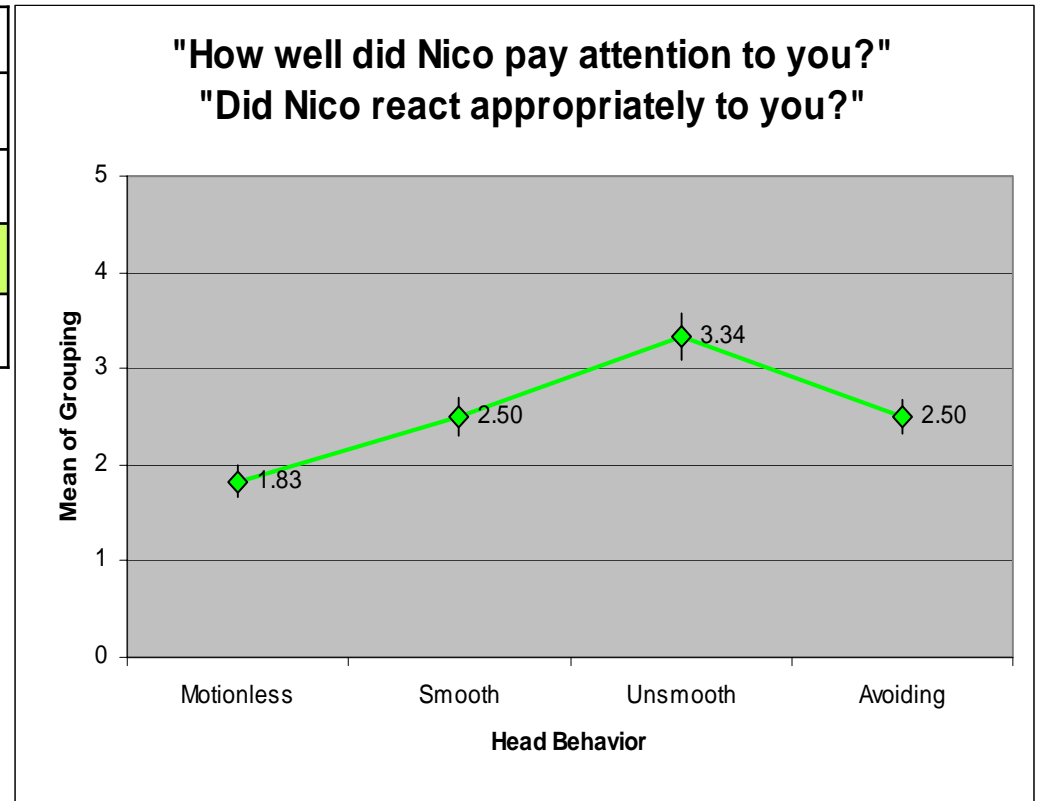
Category 2: Natural, Happy

Motionless	Smooth	Unsmooth	Avoiding
1.00	2.77	2.36	1.90
1.67	2.87	2.45	2.74
1.83	2.50	3.34	2.50
1.75	2.73	3.23	3.15



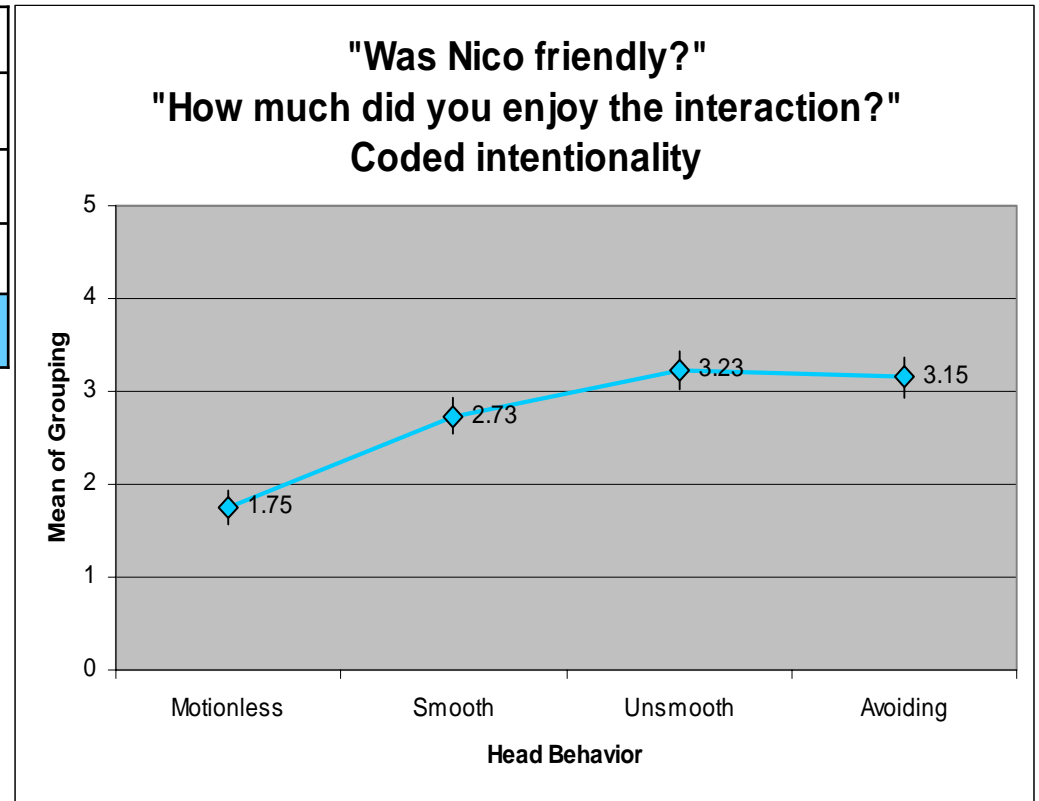
Category 3: Attention, Appropriateness

Motionless	Smooth	Unsmooth	Avoiding
1.00	2.77	2.36	1.90
1.67	2.87	2.45	2.74
1.83	2.50	3.34	2.50
1.75	2.73	3.23	3.15



Category 4: Friendliness, Enjoyableness, Intentionality

Motionless	Smooth	Unsmooth	Avoiding
1.00	2.77	2.36	1.90
1.67	2.87	2.45	2.74
1.83	2.50	3.34	2.50
1.75	2.73	3.23	3.15



Summary of Results

Category		None	Smooth	Unsmooth	Avoiding
1	Alive				
2	Happy~Natural				
3	Appropriate~Attention				
4	Intention~Friendly~Enjoyment				

Conclusions

- Users who have not interacted with a robot are willing to ascribe structural anthropomorphism to the robot when it is presented in a favorable context
 - Users do this much more readily, even in distracting contexts, after a social interaction with the robot
- Users form clear perceptions based on robot head behavior, which vary along several independent dimensions