

What the Factor(s)!?: Perceptions Social Intelligence in Robots

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INTRO

- Robots are increasingly interacting with humans in social roles such as assistants, companions, and teachers.
- The Perceived Social Intelligence (PSI) of robots may influence the effectiveness of human robot interactions.
- The purpose of this study was to determine the number and nature of the factors that underlie the PSI Scales, a measure of perceived social intelligence.
- We hypothesized four factors would be found.

METHOD

- Adult MTurk workers aged 19 to 72 (M = 37.39, SD = 11.50) viewed five videos of human robot interactions and rated the robots on the PSI Scales. See Table 1.
- PSI Scales (Barchard, Lapping-Carr, Westfall, Banisetty, & Feil-Seifer, 2018) measure overall social intelligence; the abilities to (1) recognize, (2) adapt to, and (3) predict human (a) emotions, (b) behaviors, and (c) cognitions; to identify humans, individuals, and social groups; and to present oneself as a desirable social partner: someone who is friendly, helpful, caring, and trustworthy, and who is not rude, conceited, or hostile.
- Participants rated their impressions of the robots on each item (4 items per scale, 80 questions total) using a 5-point agreement scale. See Table 2.
- Five criteria were examined to determine the number of factors to extract. See Table 4. Three factors were extracted.
- Different rotations were examined. See Table 5.
- Direct oblimin with delta -1 was selected as the best rotation because it had the fewest complex scales, the second highest hyperplanar count, and moderate correlations among the factors.

RESULTS

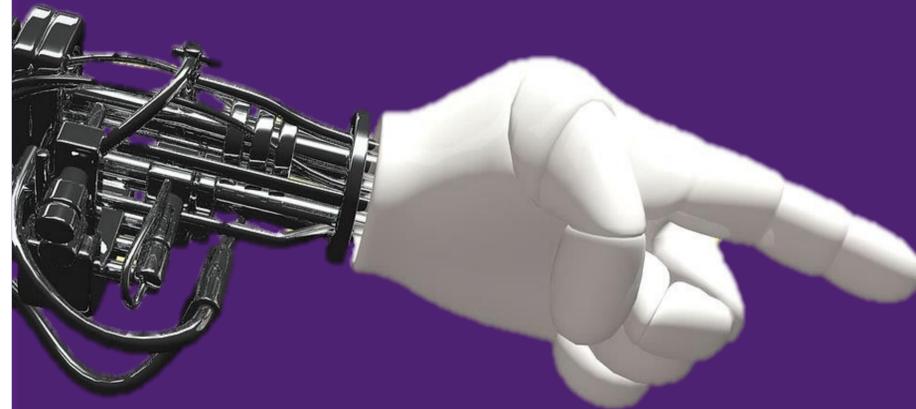
- The three extracted factors were interpreted as and labeled:
 - Theory of Mind: This factor reflects the perception of a mind (see Table 3).
 - Approachable Disposition: This factor reflects a quality of approachability.
 - Reasoning about Behavior: This factor reflects recognizing, predicting, and adapting to human behaviors.

DISCUSSION

- The abilities of the robots used in the study may have influenced the number of factors found.
- Future research exploring the effects of gender, culture, and age may influence the nature and number of factors.
- Knowing the factors that underlie PSI is important because it can help designers create more effective robots.

Three Factors Underlie the Perception of Social Intelligence in Robots.

- Theory of Mind
- Approachable Disposition
- Reasoning about Behavior



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Table 1

Participant Demographics		
Characteristic	n	Percentage
Ethnicity		
White	238	80.41%
African-American	21	7.09%
Asian	15	5.07%
Hispanic	12	4.05%
Native American	1	0.34%
Other	9	3.04%
Gender		
Male	150	50.68%
Female	145	48.99%
Unidentified	1	0.34%
Total	296	100%

Table 2

PSI Scales, Descriptions, and Best Items

Scales	Description	Single best item for each scale
Recognizes Human Emotions (RE)	detect human emotions	recognizes human emotions.
Recognizes Human Behaviors (RB)	detect human behaviors	notices when people do things.
Recognizes Human Cognitions (RC)	detect human thoughts ^b	can figure out what people think.
Adapts to Human Emotions (AE)	adapt to human emotions	responds appropriately to human emotion.
Adapts to Human Behaviors (AB)	adapt to human behaviors	adapts effectively to different things people do.
Adapts to Human Cognitions (AC)	adapt to human thoughts ^b	adapts its behavior based upon what people around it knows.
Predicts Human Emotions (PE)	predicts human emotions	anticipates others' emotions.
Predicts Human Behaviors (PB)	predicts human behaviors	anticipates people's behavior.
Predicts Human Cognitions (PC)	predicts human thoughts ^b	anticipates others' beliefs.
Identifies Humans (IH)	detect human presence	notices human presence.
Identifies Individuals (II)	identify individual humans	recognizes individual people.
Identifies Social Groups (IG)	identify groups of humans	knows if someone is part of a social group.
Social Competence (SOC)	displays social skills	is socially competent.
Friendly (FRD)	be friendly and sociable	enjoys meeting people.
Helpful (HLP)	be helpful or considerate	tries to be helpful.
Caring (CAR)	care about others	cares about others.
Trustworthy (TRU)	be trustworthy	is trustworthy.
Rude (RUD) ^a	be rude or disrespectful	is impolite.
Conceited (CON) ^a	be conceited or prideful	thinks it is better than everyone else.
Hostile (HST) ^a	be hostile or violent	tries to hurt people.

^aScales score needs to be reversed before computing the total scores. ^bThoughts in this context refer to both thoughts and beliefs held by humans.

Table 3

Factor Analysis Results for Rotated Factors

Variables	Factor			h ²
	1	2	3	
Recognizes Human Emotions	.94	.03	.01	.90
Adapts to Human Emotions	.93	.08	-.05	.88
Predicts Human Emotions	.91	-.05	.08	.85
Predicts Human Cognitions	.91	-.09	.01	.87
Identifies Social Groups	.88	-.19	.07	.79
Socially Competent	.83	.14	.06	.82
Identifies Individuals	.82	-.08	.09	.87
Recognizes Human Behaviors	.81	-.06	.23	.76
Cognitions		.77	.13	.20
Adapts to Human Cognitions		.74	.47	-.13
Caring		.62	-.02	.44
Predicts Human Behaviors		.62	-.02	.44
Friendly		.60	.47	.01
Conceited		.04	-.88	-.07
Hostile		.14	-.86	-.16
Rude		-.09	-.86	-.13
Trustworthy		.21	.76	.02
Helpful		.16	.64	.35
Recognizes Human Behaviors		.08	.62	.90
Behaviors		.20	.10	.76
Adapts to Human Behaviors		.14	.16	.68
Identifies Humans		1	2	.80
Factor Intercorrelations				
Factor 1	1.00	.22	-.37	
Factor 2		1.00	.29	
Factor 3			1.00	

Note. Salient factor pattern matrix coefficients > |0.3| are in bold face. h² = communality. No variables were reverse-scored for this analysis. Factor 1 = Theory of Mind. Factor 2 = Approachable Disposition. Factor 3 = Reasoning about Behavior.

Table 4

Number of Factors Indicated

Criteria	Factors Indicated	
	Theory	Factors Indicated
Theory		4
Kaiser-Guttman rule		3
Scree Test		3
Parallel Analysis		3
MAP Test		4

Table 5

Rotation Selection Summary

Rotation	Rotation Type	Max Correlation	Average Correlation	Complex Variables	Hyperplanar
Equimax	orthogonal	NA	NA	10	5
Varimax	orthogonal	NA	NA	8	6
Quartimax	orthogonal	NA	NA	9	16
Direct Oblimin	delta 0.25	0.59	0.49	4	20
Direct Oblimin	delta 0	0.47	0.38	4	22
Direct Oblimin	delta -1	0.37	0.29	4	21
Direct Oblimin	delta -1.5	0.23	0.12	10	7
Direct Oblimin	delta -30	0.02	0.02	14	8
Promax	kappa 2	0.36	0.31	4	20
Promax	kappa 3	0.48	0.42	4	21
Promax	kappa 4	0.53	0.47	4	21

Note. Best rotation in boldface.

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