Engaging with Cognition and Psychology

Lecture 07 (Synthesis I)

Alessandro Vinciarelli

University of Glasgow
Social AI
UKRI Engineering and Physical Sciences Research Council

Outline

- Measuring Human-Robot Interaction
- Robot Gestures and Godspeed
- Robot Gestures and Personality
- Robot Gestures and Attraction Paradigm
- Robot Gestures and Understandability
- Conclusions

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Measuring Human-Robot Interaction

"[…] standardised measurement tools for human robot interaction (HRI) […] to compare the results from different studies […] measurements of five key concepts in HRI."

Bartneck et al., "Measurement Instruments for the Anthropomorphism, Animacy, Likeability, Perceived Intelligence, and Perceived Safety of Robots", International Journal of Social Robotics, 1(1):71-81, 2009

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Animacy

"The classic perception of life, which is often referred to as animacy, is based on [...] moving of one's own accord."

Bartneck et al., "Measurement Instruments for the Anthropomorphism, Animacy, Likeability, Perceived Intelligence, and Perceived Safety of Robots", International Journal of Social Robotics, 1(1):71-81, 2009

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Anthropomorphism

"Anthropomorphism refers to the attribution of a human form, human characteristics, or human behaviour to nonhuman things such as robots, computers, and animals."

Bartneck et al., "Measurement Instruments for the Anthropomorphism, Animacy, Likeability, Perceived Intelligence, and Perceived Safety of Robots", International Journal of Social Robotics, 1(1):71-81, 2009

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Likability

"[…] positive impressions [are] to some degree dependent on the visual and vocal behavior […] and that positive first impressions (e.g., likability) […] often lead to more positive evaluations […]"

Bartneck et al., "Measurement Instruments for the Anthropomorphism, Animacy, Likeability, Perceived Intelligence, and Perceived Safety of Robots", International Journal of Social Robotics, 1(1):71-81, 2009

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Perceived Intelligence

"[…] perceived intelligence of a robot will depend on its competence. To monitor the progress being made in robotic intelligence it is important to have a good measurement tool."

Bartneck et al., "Measurement Instruments for the Anthropomorphism, Animacy, Likeability, Perceived Intelligence, and Perceived Safety of Robots", International Journal of Social Robotics, 1(1):71-81, 2009

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Perceived Safety

"Perceived safety describes the user's perception of the level of danger when interacting with a robot, and the user's level of comfort during the interaction."

Bartneck et al., "Measurement Instruments for the Anthropomorphism, Animacy, Likeability, Perceived Intelligence, and Perceived Safety of Robots", International Journal of Social Robotics, 1(1):71-81, 2009

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Gestures

"[Gestures] often are used to communicate when distance or noise renders vocal communication impossible [...] expressing concepts that also are expressed verbally."

Krauss et al., "Lexical Gestures and Lexical Access: a process model",
in "Language and Gesture", McNeill (ed.), Cambridge University Press, 2000

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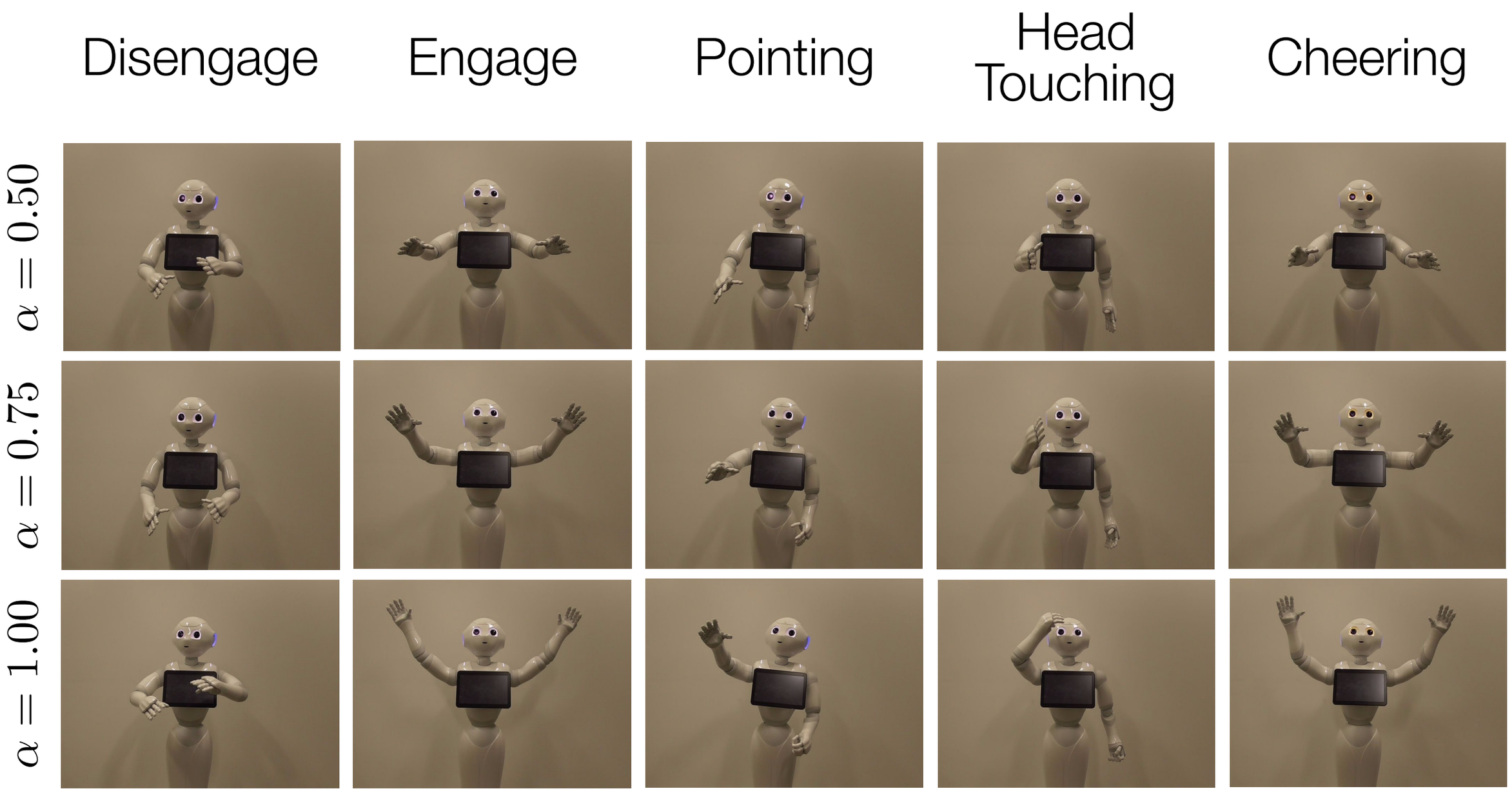
Synthetic Gestures



Deshmukh, Craenen, Vinciarelli and Foster, “Shaping Robot Gestures to Shape Users’ Perception: The Effect of Amplitude and Speed on Godspeed Ratings”, Proc. of the International Conference on Human-Agent Interaction, 2018

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Annotation

- 30 observers have filled Godspeed questionnaire and Big-Five Inventory 10 (self and attributed) while rating different interpretations for all 45 stimuli.

Deshmukh, Craenen, Vinciarelli and Foster, “Shaping Robot Gestures to Shape Users’ Perception: The Effect of Amplitude and Speed on Godspeed Ratings”, Proc. of the International Conference on Human-Agent Interaction, 2018.

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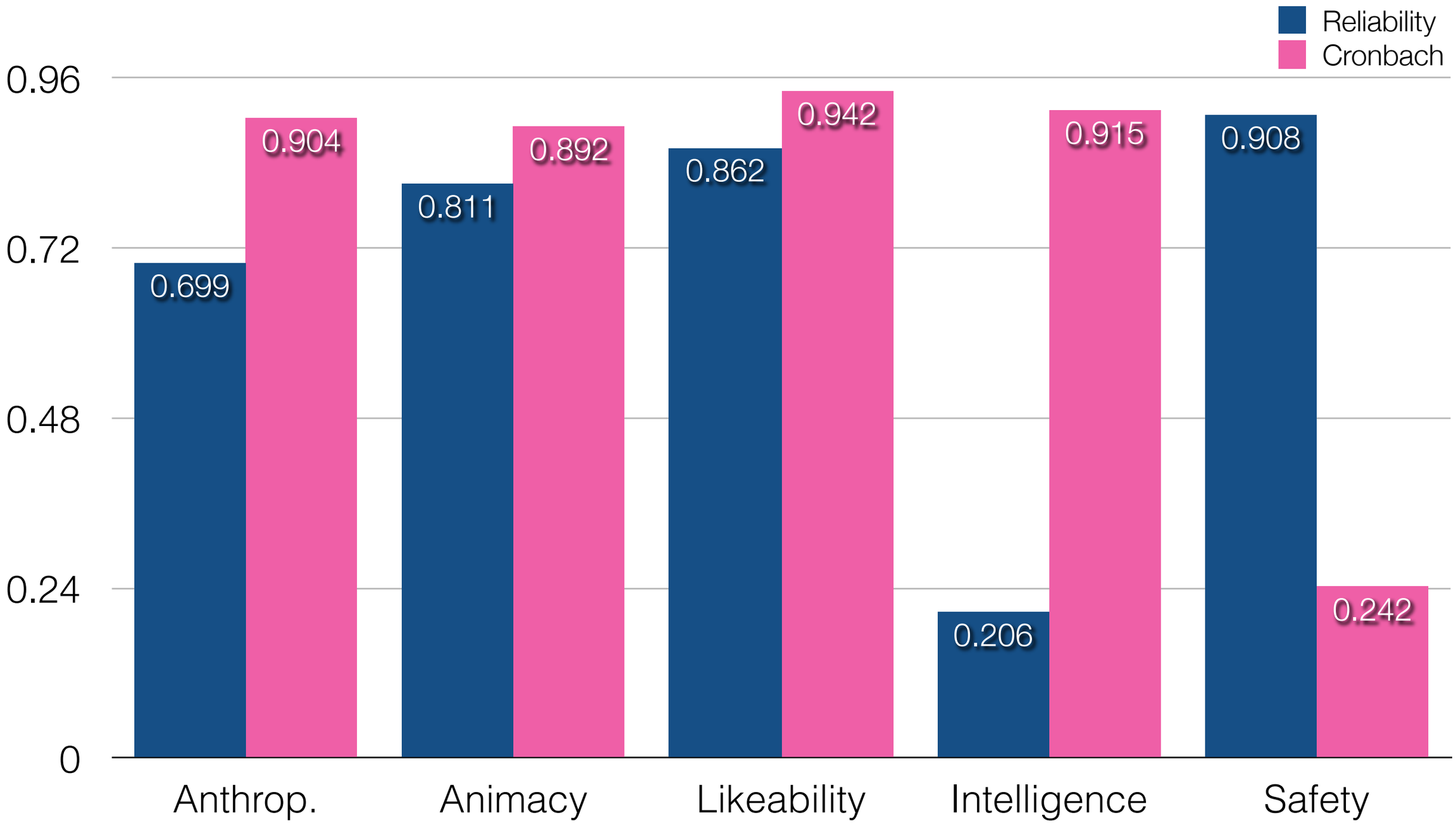
Reliability



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A matrix for a specific stimulus (speed and amplitude)

An element is the score of observer “i” for GS dimension “k”

$$S^{(\alpha,\lambda)} = \{ s_{ik}^{(\alpha,\lambda)} \}$$

$$c_j^{(\alpha,\lambda)} = \sum_{i=1}^{N} s_{ij}^{(\alpha,\lambda)}$$

Total number of points along GS dimension “j” for one stimulus

Sum over the elements of column “j” of the matrix

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Total number of points
along GS dimension “j”

$$T_j = \sum\sum c_j^{(\alpha,\lambda)}$$

$\alpha \quad \lambda$

Sum over all values of
amplitude and speed

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$$\chi^2 = \sum_{\alpha} \sum_{\lambda} \frac{(c_j^{(\alpha,\lambda)} - E)^2}{E}$$

$$E = \frac{1}{9} T_j$$

Chi Square variable for testing whether the distribution of the points across the 9 variants of the same core gesture is uniform

Average over all variants of the same core gesture

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	Anthrop.	Animacy	Likability	Perceived Intelligence	Perceived Safety
Engaging	α λ	α λ	α λ		
Disengaging			α λ		α λ
Pointing					
Head Touching		α λ			
Cheering		α λ			

Deshmukh, Craenen, Vinciarelli and Foster, “Shaping Robot Gestures to Shape Users’ Perception: The Effect of Amplitude and Speed on Godspeed Ratings”, Proc. of the International Conference on Human-Agent Interaction, 2018

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Key-Findings

- There is a relationship between “shape” of a gesture (amplitude and speed) and perception of users (Godspeed scores);
- Animacy and Likability are the dimensions along which there is more interaction;
- The core gesture “Pointing” does not show any interaction between shape and perception.
- All observed effects appear to be reasonable, that is, to replicate the type of effects we observe in human-human interactions.

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Personality

"The Big Five Personality Factors appear to provide a set of highly replicable dimensions that parsimoniously and comprehensively describe most phenotypic individual differences."

Saucier, Goldberg, "The Language of Personality: Lexical Perspectives on the Five-Factor Model", in "The Five-Factor Model of Personality", Wiggins (ed.), 21-50,1996

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The Big-Five

- Extraversion: tendency to be active, assertive, energetic, outgoing, etc.;
- Agreeableness: tendency to be appreciative, forgiving, generous, kind, sympathetic, trusting, etc.;
- Conscientiousness: tendency to be efficient, organised, planful, reliable, responsible, thorough, etc.;
- Neuroticism: tendency to be anxious, self-pitying, tense, touchy, unstable, worrying, etc.;
- Openness: tendency to be artistic, curious, imaginative, insightful, etc.

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This robot is reserved	E	-
This robot is generally trusting	A	+
This robot tends to be lazy	C	-
This robot is relaxed, handles stress well	N	-
This robot has few artistic interests	O	-
This robot is outgoing, sociable	E	+
This robot tends to find faults with others	N	+
This robot does a thorough job	C	+
This robot gets nervous easily	A	-
This robot has an active imagination	O	+

Rammstedt and John, “Measuring Personality in One Minute or Less: A 10-item short version of the BFI”, Journal of Research in Personality, 41(1):203-212, 2007

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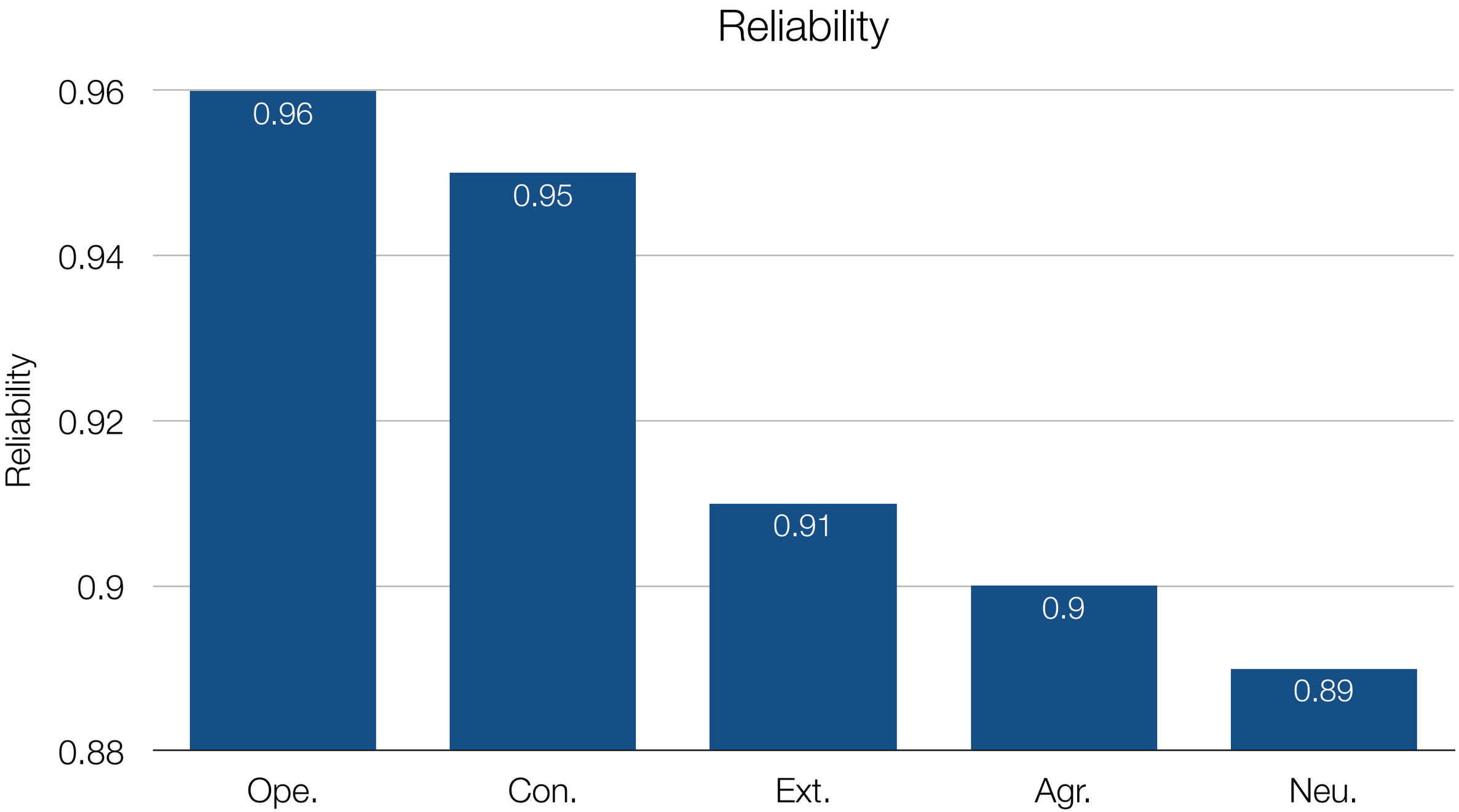

B.Craenen, A.Deshmukh, M.E.Foster & A.Vinciarelli, “Shaping Gestures to Shape Personalities: Interplay Between Gesture Parameters, Attributed Personality Traits and Godspeed Scores”, Proceedings of the IEEE International Symposium on Robot and Human Interactive Communication, 2018.

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A matrix for a specific stimulus (speed and amplitude)

An element is the score of observer “i” for B5 trait “k”

$$A^{(\alpha,\lambda)} = \{a_{ik}^{(\alpha,\lambda)}\}$$

$$t_j^{(\alpha,\lambda)} = \sum_{i=1}^{N} a_{ij}^{(\alpha,\lambda)}$$

Total number of points along B5 trait “j” for one stimulus

Sum over the elements of column “j” of the matrix

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Total number of points
along B5 trait “j”

$$T_j = \sum\sum t_j^{(\alpha,\lambda)}$$

α λ

Sum over all values of
amplitude and speed

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$$\chi^2 = \sum_{\alpha} \sum_{\lambda} \frac{(t_j^{(\alpha,\lambda)} - E)^2}{E}$$

$$E = \frac{1}{9} T_j$$

Chi Square variable for testing whether the distribution of the points across the 9 variants of the same core gesture is uniform

Average over all variants of the same core gesture

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	Openness	Conscient.	Extraversion	Agreeabl.	Neuroticism
Engaging			α λ		α λ
Disengaging				α λ	α λ
Pointing			α λ		α λ
Head Touching			α λ		
Cheering			α λ		α λ

B.Craenen, A.Deshmukh, M.E.Foster & A.Vinciarelli, “Shaping Gestures to Shape Personalities: Interplay Between Gesture Parameters, Attributed Personality Traits and Godspeed Scores”, Proceedings of the IEEE International Symposium on Robot and Human Interactive Communication, 2018.

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The Spearman Correlation Coefficient

Difference between rank of trait and rank of GS score for the same stimulus

$$r = 1 - \frac{6 \sum_{k=1}^{M} d(t_k, g_k)}{M(M^2 - 1)}$$

- The Spearman Correlation Coefficient is more robust to outliers than the most common Pearson Correlation.

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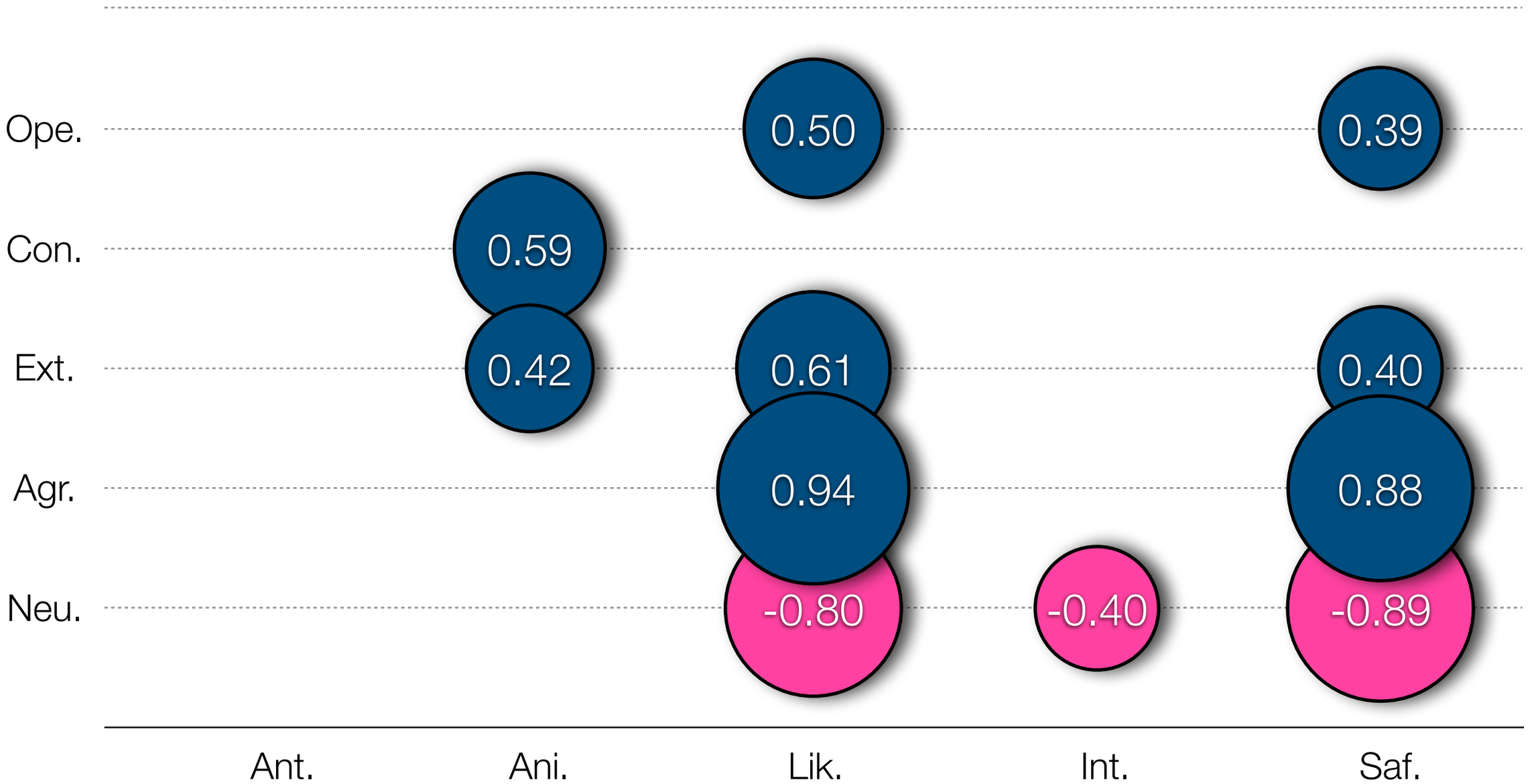
Personality and Godspeed



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Key-Findings

- There is a relationship between “shape” of a gesture (amplitude and speed) and the Big Five traits attributed by the users;
- There is a significant interplay between Godspeed Scores and Big-Five Traits;
- It is possible to change the perception of the users by changing the personality impressions that the robots convey.
- All observed effects appear to be reasonable, that is, to replicate the type of effects we observe in human-human interactions.

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Attraction Paradigm (I)

"[…] evaluations of strangers appear to be affected by degree of similarity, and statistical analysis confirms this impression."

Byrne, "An Overview (and Underview) of Research and Theory Within the Attraction Paradigm", Journal of Social and Personal Relationships, 14(3):417-431, 1997.

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Attraction Paradigm (II)

"[…] perceived similarity predicted attraction in no-interaction, short-interaction, and existing relationship studies."

Montoya, Horton & Kirchner, "Is Actual Similarity Necessary for Attraction? A Meta-Analysis of Actual and Perceived Similarity", Journal of Social and Personal Relationships, 25(6):899-922, 2008.

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Distance between self-assessed and attributed traits for stimulus “k”

“T” is the total number of traits

$$d_k = \left[\sum_{j=1}^{T} \left(t_j^{(s)} - t_{jk}^{(a)} \right)^2 \right]^{\frac{1}{2}}$$

The expression corresponds to one of the observers

Trait “j” attributed to stimulus “k”

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The Spearman Correlation Coefficient

Difference between rank of trait and rank of GS score for the same stimulus

$$r = 1 - \frac{6 \sum_{k=1}^{M} d(t_k, g_k)}{M(M^2 - 1)}$$

- The Spearman Correlation Coefficient is more robust to outliers than the most common Pearson Correlation.

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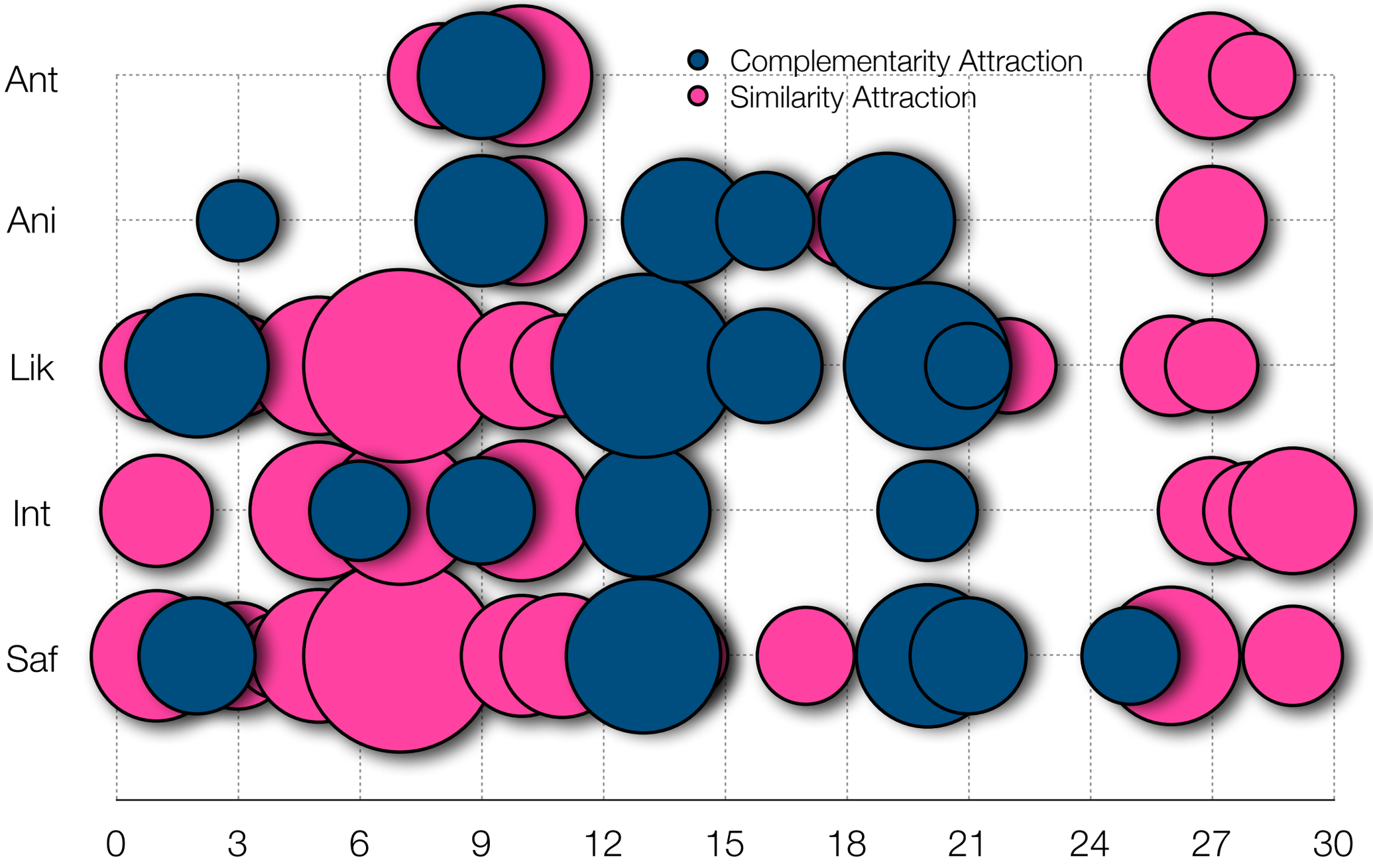
Attraction and Godspeed Scores



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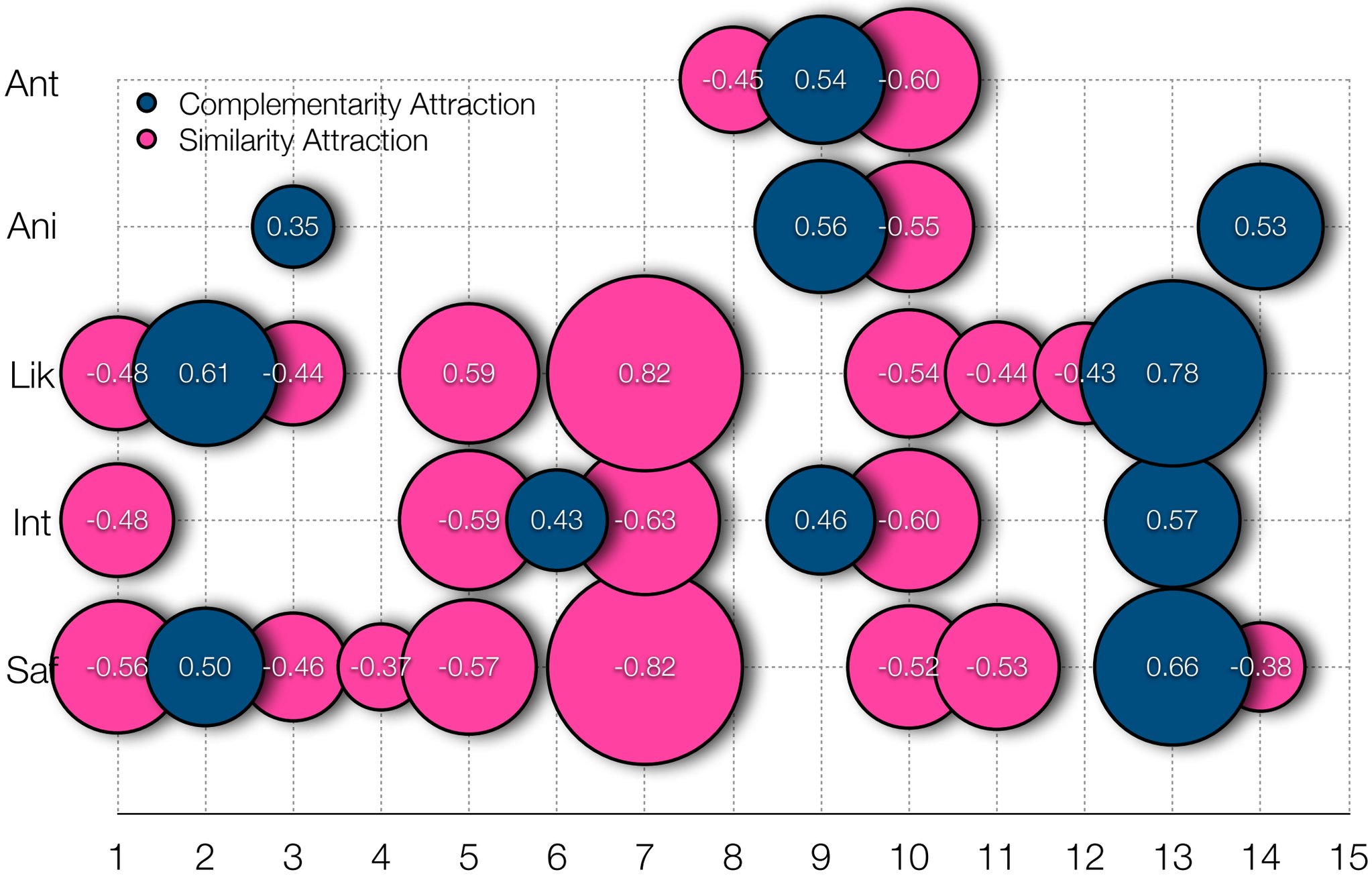
Attraction and Godspeed Scores



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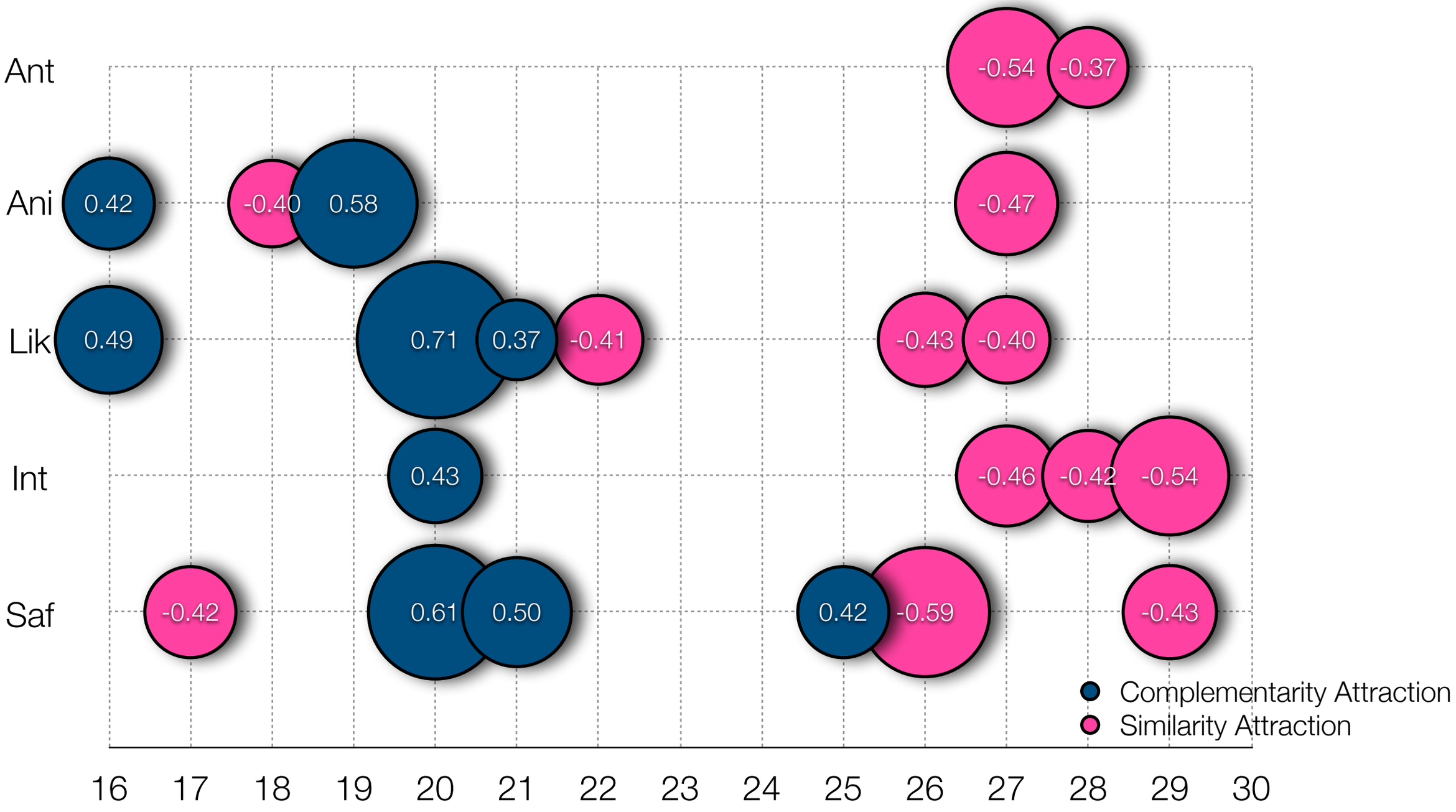
Attraction and Godspeed Scores



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Key-Findings

- The attraction paradigm appears to apply, to a large extent, to Human-Robot Interaction;
- Out of 30 observers, 16 show similarity-attraction, 9 show complementarity-attraction, and 2 show mixed effects;
- The attraction paradigm can be exploited only if it is possible to understand which of the effects is taking place.

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Emblems

"[emblems are] steadily linked to a meaning, so that the two make a signal-meaning pair [...] like it happens, for instance, with the lexical items of a verbal lexicon."

Poggi, "Mind, hands, face and body. A goal and belief view of multimodal communication", Weidler 2007

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Annotation

- The observers have rated 10 interpretations of every gesture: Getting Distracted, Aggressing, Flirting, Pointing, Complaining, Cheering, Reflecting, Teasing, Rejecting, and Welcoming.

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A matrix for a specific stimulus (speed and amplitude)

An element is the score of observer “i” for interpretation “k”

$$M^{(\alpha,\lambda)} = \{m_{ik}^{(\alpha,\lambda)}\}_{N}$$

$$u_j^{(\alpha,\lambda)} = \sum_{i=1} m_{ij}^{(\alpha,\lambda)}$$

Total number of points for interpretation “j” for one stimulus

Sum over the elements of column “j” of the matrix

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Probability of one interpretation being voted

Sum over all elements of matrix “M”

$$p_k = \frac{u_k}{\sum_{i=1}^{N}\sum_{j=1}^{T} m_{ij}}$$

$$U = 1 - \frac{-\sum_{j=1}^{T} p_j \log p_j}{\log T}$$

Understandability (high when interpretation only attracts many votes)

Entropy (measuring how uniform the distribution is)

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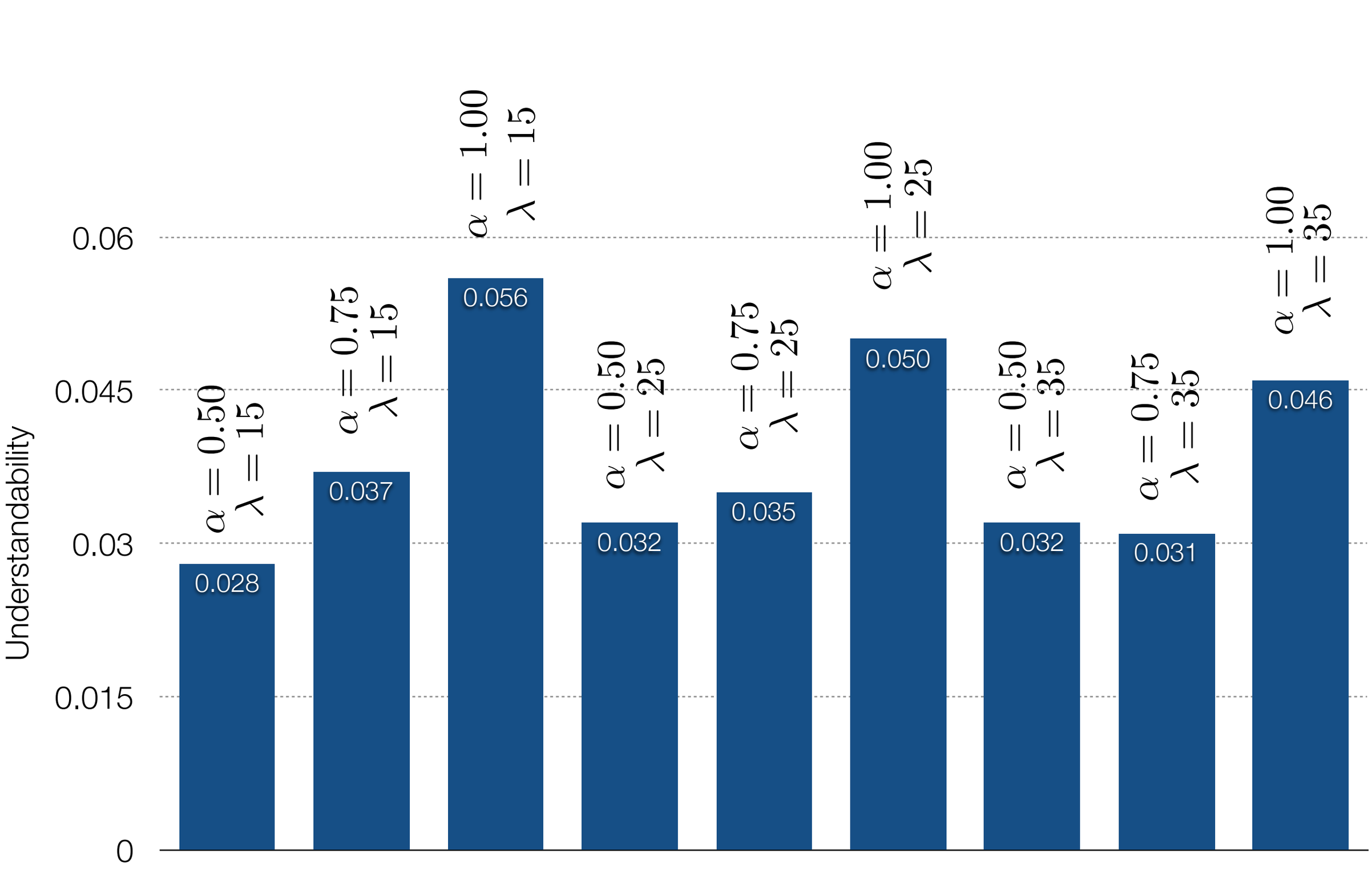

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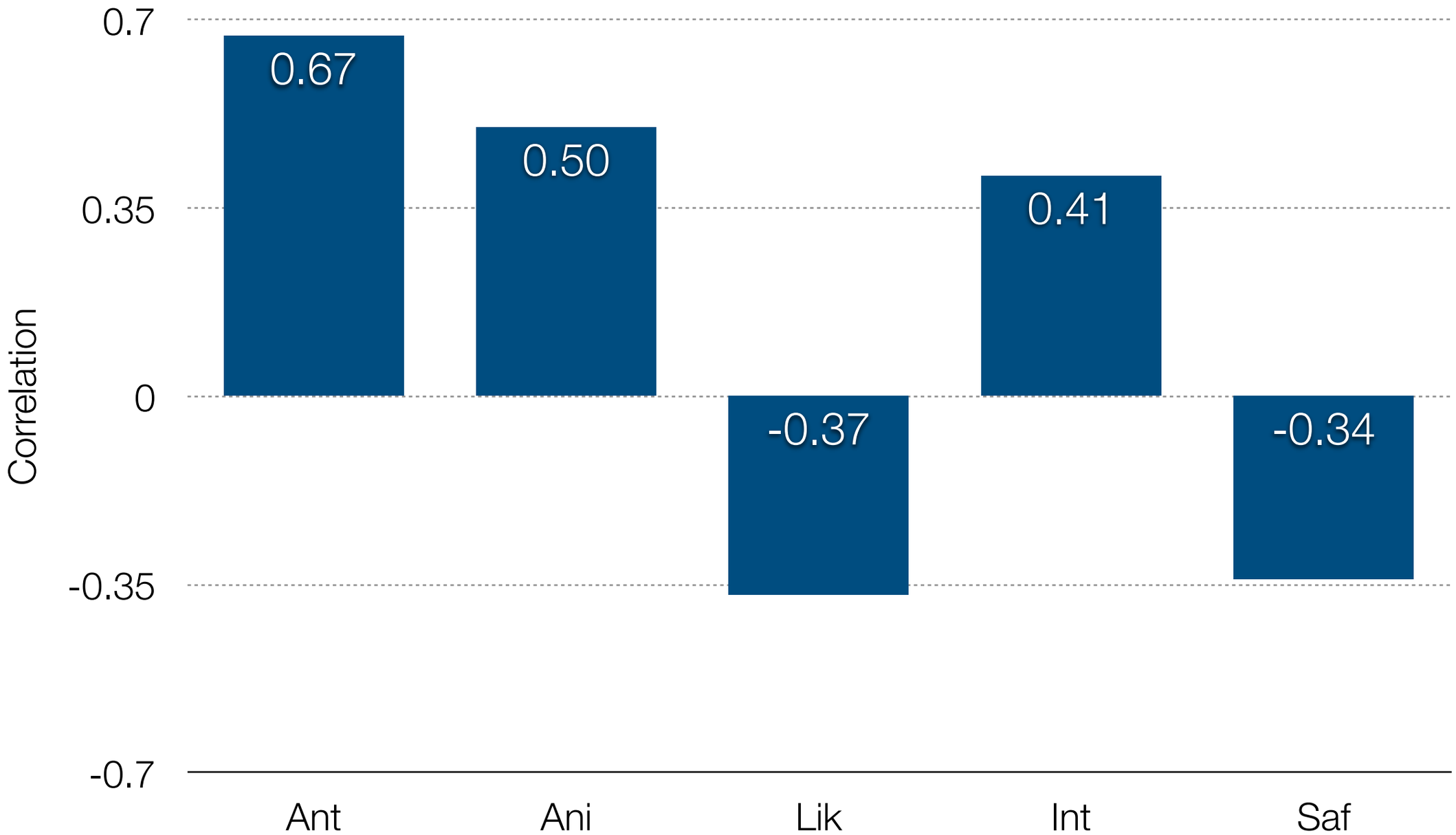
Correlation Understandability - Godspeed Scores



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Key-Findings

- There is an association between changes in amplitude and changes in understandability;
- There is limited association between changes in speed and changes in understandability;
- There is a statistically significant correlation between understandability and Godspeed scores;
- The interplay appears to reproduce the incompatibility between social and task skills;
- However simple, the synthetic gestures lead to effects like those observed in human-human interactions.

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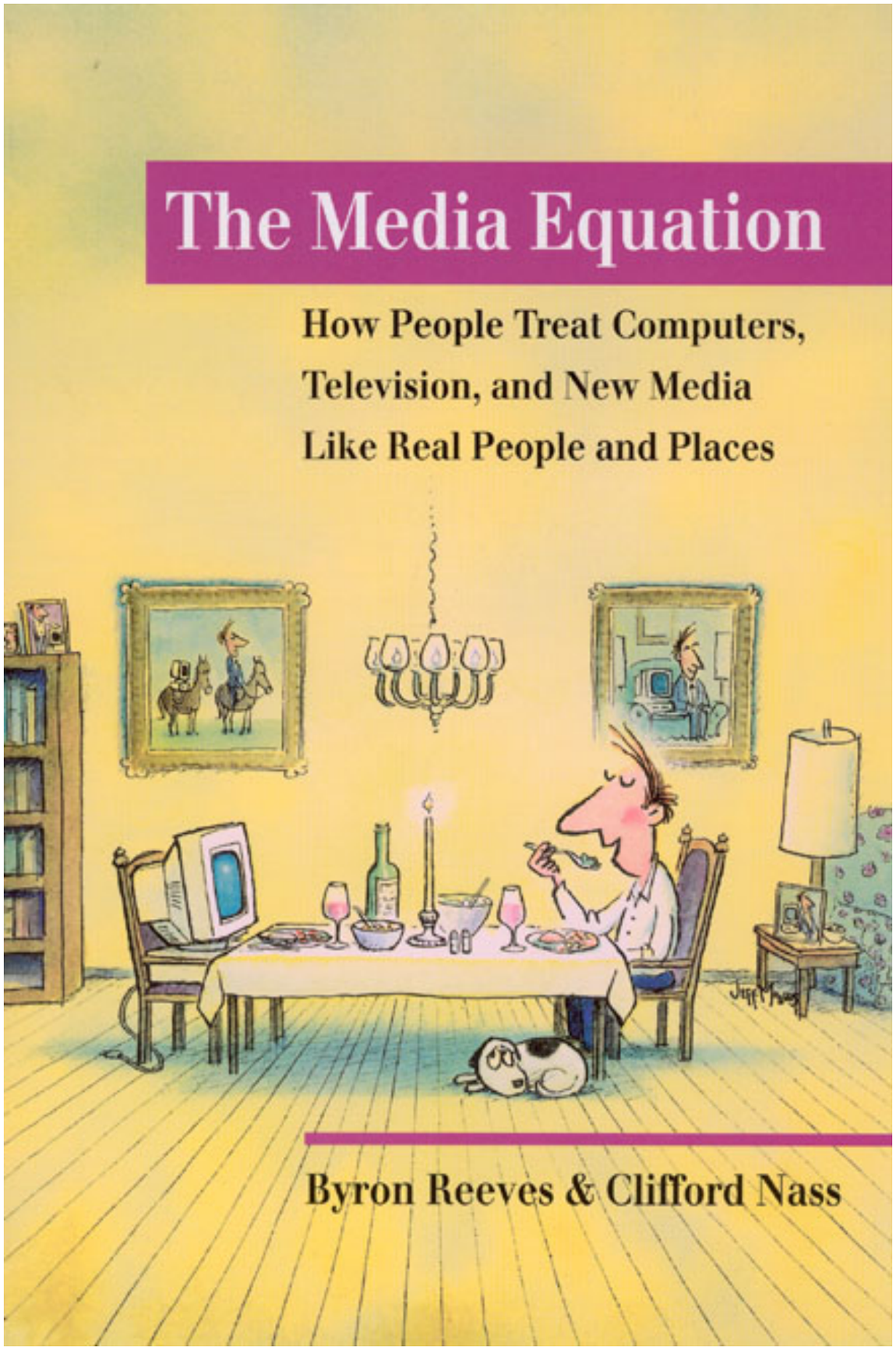

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Media Effect (I)

"The human brain evolved in a world in which only humans exhibited rich social behaviours, and a world in which all perceived objects were real physical objects. Anything that seemed to be a real person or place was real."

Reeves & Nass, "The Media Equation", CSLI, 1996

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Media Effect (II)

"Can human beings relate to computer or television programs in the same way they relate to other human beings? […] this book concludes that people not only can but do treat computers, televisions, and new media as real people and places."

Reeves & Nass, "The Media Equation", CSLI, 1996

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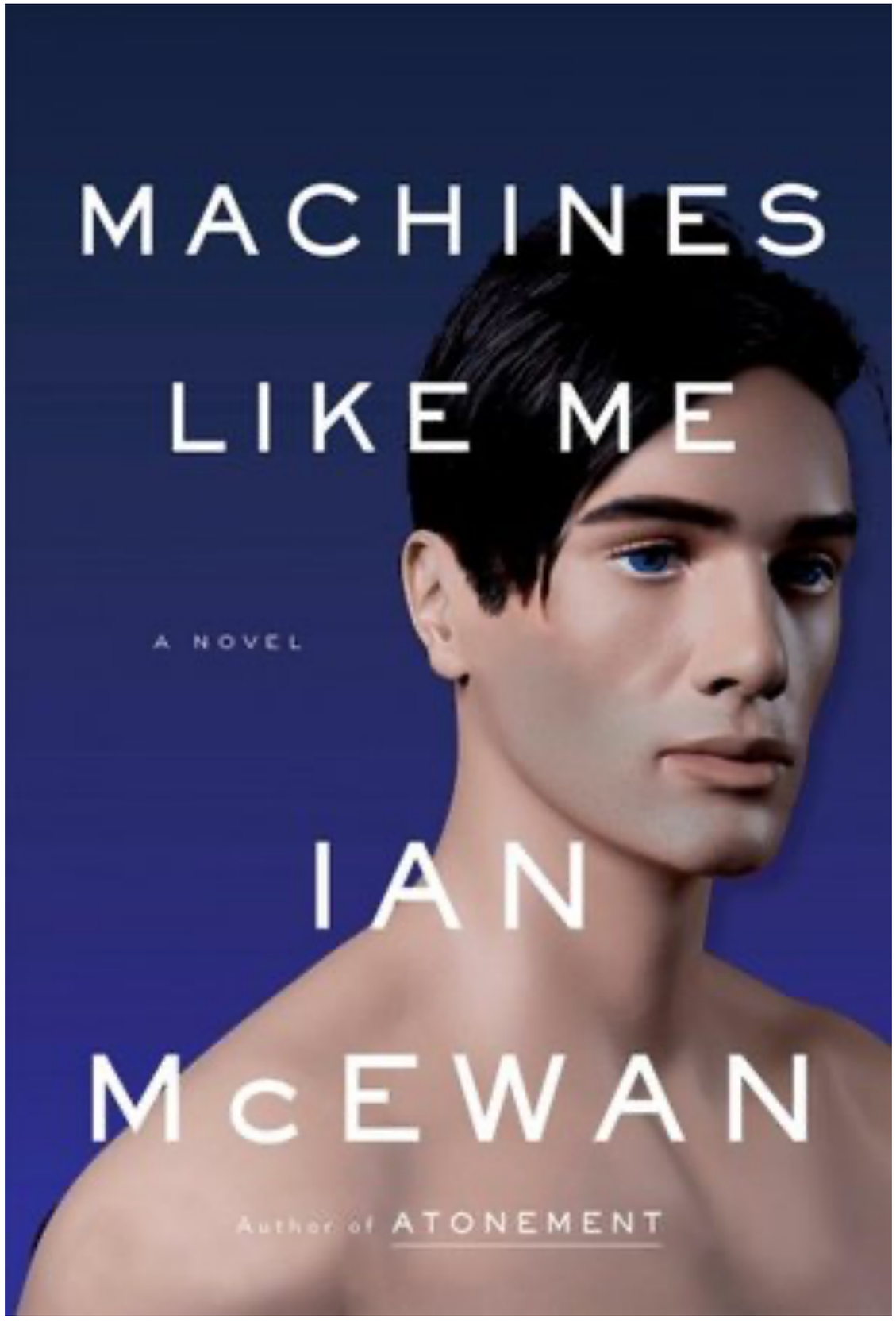
MACHINES
LIKE ME
A NOVEL
IAN
McEWAN
Author of ATONEMENT

Media Effect (III)

"It was eerie to be standing by this naked man, struggling between what I knew and what I felt."

McEwan, "Machines Like Me", Vintage, 2019.

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Thank You!

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