Online appendix to chapter 6

of Robots in Care and Everyday Life – Future, Ethics, Social Acceptance. Springer

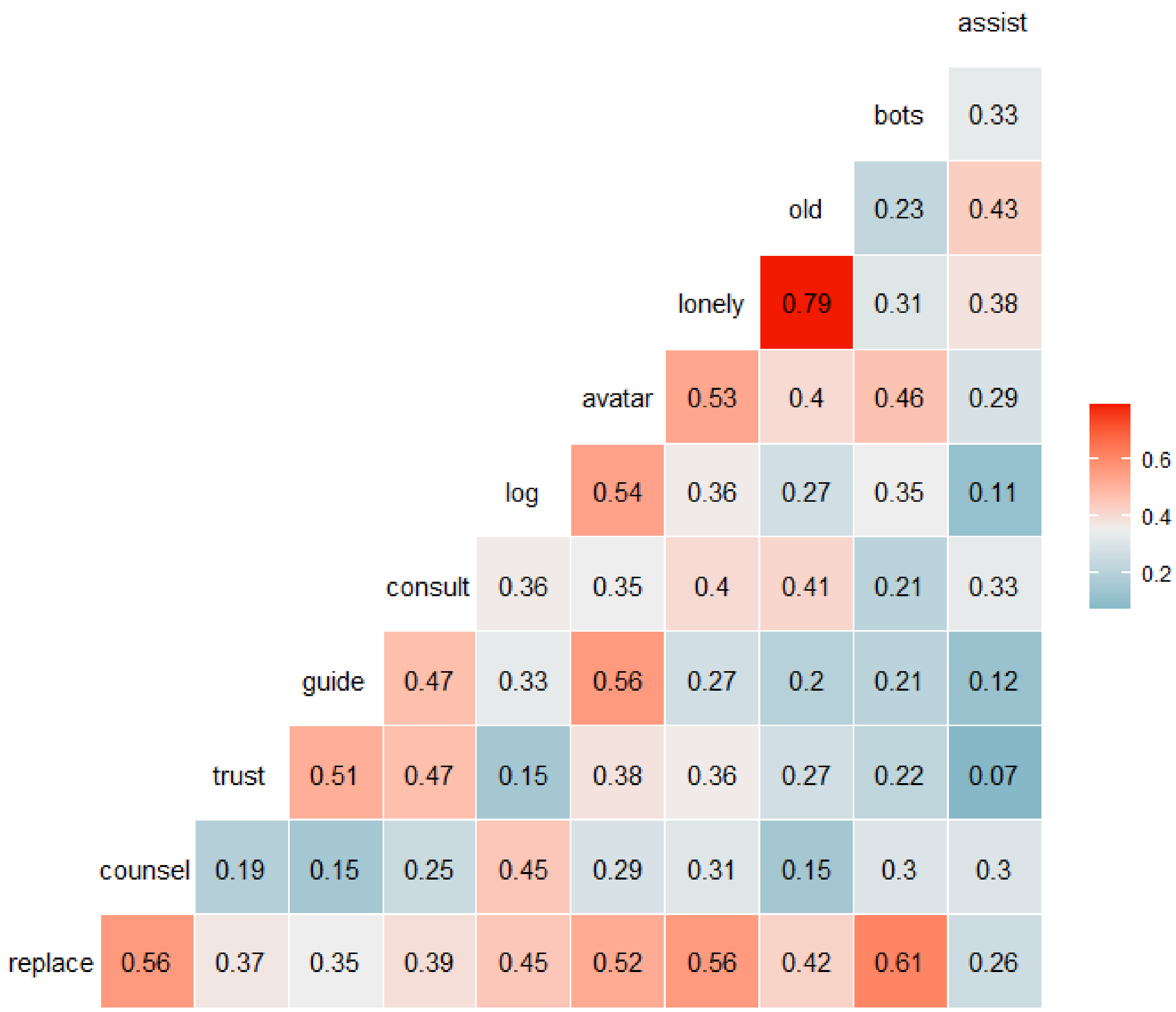

Fig. A1 Polychoric correlations of eleven ratings

Table A1 Indicator variables

Label	Factor*	Degree of belief that …
assist	2: 0.42	AI and robots take on more and more assistant functions in the life of humans and contribute much to their quality of life
bots	1: 0.64	Bots communicate as perfectly as humans
old	2: 0.83	Robots keep old people company at home
lonely	2: 0.96	Robots keep lonely people of different age company at home
avatar	3: 0.74	Digital assistants have become personal avatars as steady advisory life companions at home and en route.
log	1: 0.54	Lifelogging is followed by communication of humans with personal avatars about their continuously recorded life data and behavioral data
consult	3: 0.62	Consultation – seek a first doctor's advice from a robot in telemedicine
guide	3: 0.70	Guidance – Cognitive AI-assistance in rational choice
trust	3: 0.63	Humans trust AI more than the human himself
counsel	1: 0.59	Counseling – Specialized robots provide psychological advice
replace	1: 0.92	Robots tend to replace humans situationally in interpersonal communication

*Factor and standardized factor loadings (N=155, SRMR=0.082)

Figure A1 displays the matrix of polychoric correlations among the eleven scales employed in the present thematic context. An attempt at revealing the inherent structure of these responses uncovered the three latent factors outlined in Figure A2 and Table A1. Based on a moderate goodness of fit, the CFA solution offers only a tentative orientation. For the reference year of 2030, Factor 1 represents the belief that specialized robots will be able to communicate with humans as humans communicate among each other. Accordingly, bots communicate as perfectly as humans, humans communicate with personal avatars, and specialized robots provide psychological advice, so that robots replace humans situationally in interpersonal communication. The observation that these ratings form one factor, simply means: the more one believes in one aspect, the more one also believes in the other, and vice versa. Factor 2 refers to assistant robots keeping people company at home, that way improving their quality of life, and factor 3 aims at robots and AI as steady advisory life companions, advisors, and guides in decisions. The factor correlations of r_{12}=0.61, r_{13}=0.67, and r_{23}=0.60 indicate the expectable positive correlations among the three factors, their sizes suggest plausible discriminant validity.

Factor 1		Factor 2		Factor 3	
Bots communicate as perfectly as humans	L	AI and robots take on more and more assistant functions in the life of humans and contribute much to their quality of life	L		
		Robots keep old people company at home	L		
Lifelogging is followed by communication of humans with personal avatars about their continuously recorded life data and behavioral data	P	Robots keep lonely people of different age company at home	P	Digital assistants have become personal avatars as steady advisory life companions at home and en route	P
Counseling – Specialized robots provide psychological advice	U			Consultation – seek a first doctor's advice from a robot in telemedicine	U
Robots tend to replace humans situationally in interpersonal communication	U			Guidance – Cognitive AI-assistance in rational choice	U
				Humans trust AI more than the human himself	U
L=likely, P=possibly, U=unlikely					

Fig. A2 Structure of expert opinion

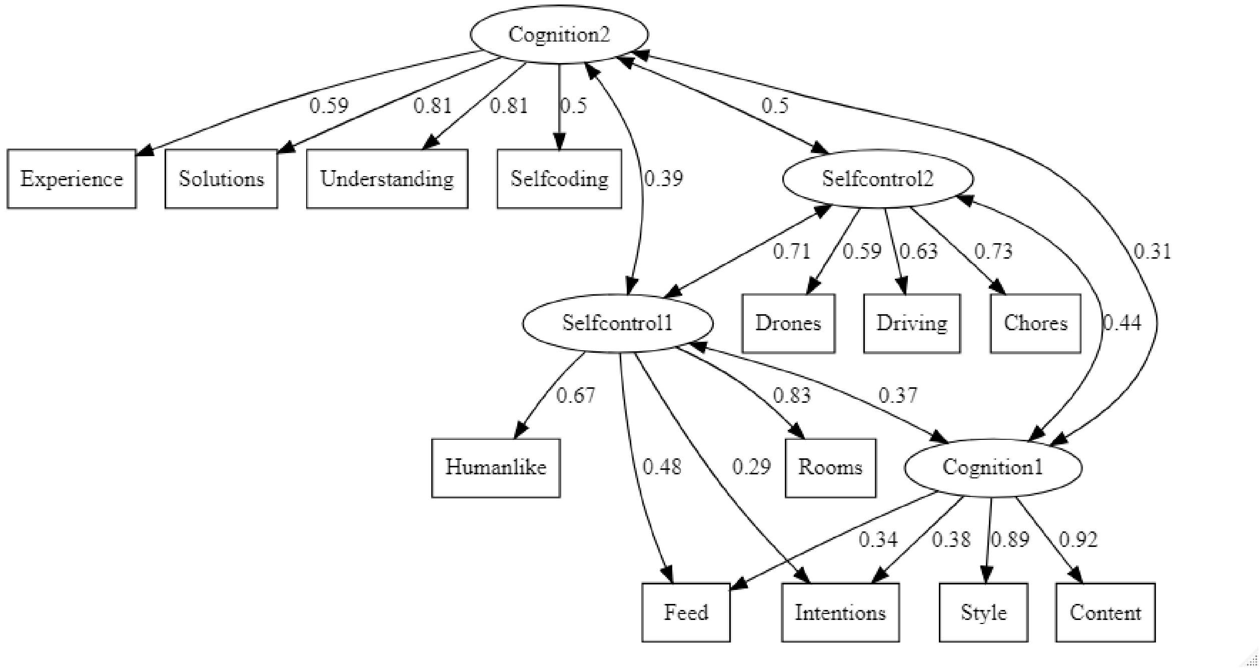

Fig. A3 Temporal structure of four robotic skill areas

Table A2 Structure of robotic skills

Item		F1	F2	F3	F4	R^2
A	Drones			0.59		0.345
B	Feed	0.34	0.48			0.467
C	Rooms		0.84			0.697
D	Humanlike		0.67			0.453
E	Style	0.89				0.787
F	Content	0.92				0.846
G	Intentions	0.38	0.29			0.309
H	Experience				0.59	0.351
I	Selfcoding				0.50	0.246
J	Driving			0.63		0.393
K	Chores			0.73		0.527
L	Solutions				0.81	0.663
M	Understanding				0.82	0.664

Confirmatory factor analysis (CFA). Displayed are standardized factor loadings.
N=113; CFI/TLI=0.89/0.86; RMSEA=0.096; SRMR=0.075 (at best a moderate fit).

Items treated as metric scales. R package used: Lavaan

Table A3 Factor correlations

	Cognition1	Selfcontrol1	Selfcontrol2
Selfcontrol1	0.37		
Selfcontrol2	0.44	0.71	
Cognition2	0.31	0.39	0.50

Table A4 How expected skills of a care robot relate to the target scales *talk* and *care*.

	Talk			Care		
	b_{yes}	b_{others}	R	b_{yes}	b_{others}	R
everyday conversation	1.11 (8.7)	0.46 (3.7)	0.56	1.10 (7.9)	0.43 (3.2)	0.52
personal conversion	0.90 (4.3)	0.51 (3.2)	0.35	1.35 (6.1)	0.62 (3.8)	0.46
play card/ board games	1.18 (7.0)	0.62 (3.2)	0.50	1.26 (6.8)	0.64 (3.0)	0.50
pick up/take away items	0.89 (2.6)	-0.31 (-0.4)	0.21	1.44 (3.8)	0.06 (0.1)	0.29
emergency contacts	0.42 (2.5)	0.44 (1.7)	0.16	0.65 (3.5)	0.63 (2.1)	0.25
dress up & off	0.64 (4.8)	0.52 (2.7)	0.34	1.14 (9.1)	0.48 (2.6)	0.58
help with pers. hygiene	0.48 (3.7)	0.19 (1.1)	0.26	1.22 (10.0)	0.60 (3.8)	0.61
feed, give to drink	0.94 (7.8)	0.42 (2.8)	0.52	1.27 (10.2)	0.53 (3.4)	0.62
monitor: medication	0.55 (3.7)	0.23 (1.2)	0.27	1.15 (7.8)	0.54 (2.7)	0.52

Estimates of b and b divided by its standard error in (), of linear regression equations for the survey-weighted frequency distributions. Two regression equations are estimated for each capability (table row): one for target "talk" and one for target "care" (scales of factor scores introduced in chapter 1). Dummy coding used: b_{yes} An assistant robot should be specially trained for this; b_{others} An assistant robot should rather be trained for other tasks. Reference category, respectively: An assistant robot should not be able to do this. "R" stands for "multiple R", this is here the square root of the adjusted R-Square of a regression.

Each b_{yes} yields the expected mean difference on the target scale, between the subgroup of advocates of the view that an assistant robot should be specifically trained for a task (coded 1), and the reference group of advocates of the opposite view that a robot should not be able to do the task in question (coded 0). Since all such b's are positive and statistically significant, both subgroups differ every time in their positions on the two target scales *talk* and *care*. That means: the group that advocates a training element is always the one with the higher values on both target scales. However, the correlations vary considerably in strength. Regarding *talk*, for example, they are between 0.16 and 0.56, regarding *care* between 0.25 and 0.62.

Pictures of robots

We presented twelve pictures showing different types of robots and asked about: "When the language comes up with 'robots': What do you spontaneously associate with this term? We have put together a small selection of images of robots that already exist or that will be available soon - and we would like to ask you: Which of these images comes closest to your spontaneous idea of a robot? (...) Which robot image would you select at second glance, which would you place in third place?" (Sequence of pictures is re-randomized for each individual interview). The probability that a shown robot is part of a respondent's TOP 3 preference set produced this sequence: Pepper (0.55), Robots in car factory (0.42), PR2 from Collaborative Research Center EASE – Everyday Activity Science and Engineering of Bremen University (0.38), Care-O-bot 4 from Fraunhofer IPA Institute for Manufacturing Engineering and Automation (0.26), Space robot Coyote III from Robotics Innovation Center Bremen, German Research Center for Artificial Intelligence GmbH (0.17), Service Assistant 4 from Fraunhofer IPA Institute for Manufacturing Engineering and Automation (0.13), Underwater robot Dagon from Robotics Innovation Center Bremen, German Research Center for Artificial Intelligence GmbH (0.08), CIMON, the intelligent astronaut assistant from the DLR German Aerospace Center (0.08), delivery robot at George Mason University (0.07), the DHL package drone Paketcopter 4.0 (0.05), Chatbot (Photo of a cell phone with the text "Live Chat" and "Hi. How can I help you?" on the screen (0.05), self-driving test vehicle in Gothenburg (Sweden) (0.03). The twelve robot pictures are shown in Engel (2020, p. 10f.).