

How should my chatbot interact? A survey on social characteristics in human-chatbot interaction design

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1. Supplemental Material

This supplementary material include a list of tables that summarize the outcomes presented in the paper. Additionally, we include insights on five constructs that can be used to assess whether social characteristics are reaching the intended design goals and leading to the expected benefits.

2. Overview of the surveyed literature

Table 1 shows the which interaction type is evaluated in each paper while Table 2 describe the list of topics the chatbots could handle along with the number of papers. Tables 3 and 4 reports whether the studies investigates real or simulated chatbots and, in case of real chatbots, the platforms used to develop them.

Table 1. Interaction type

Interaction type	Counting (%)	Surveyed studies
Task-oriented	32 (57%)	Araujo (2018) Avula, Chadwick, Arguello, and Capra (2018) Ayedoun, Hayashi, and Seta (2017) Brandtzaeg and Følstad (2018) Candello, Pinhanez, and Figueiredo (2017) Chaves and Gerosa (2018) Ciechanowski, Przegalinska, Magnuski, and Gloor (2018) Coniam (2008) Dohsaka, Asai, Higashinaka, Minami, and Maeda (2014) Duijst (2017) Duijvelshoff (2017) Dyke, Howley, Adamson, Kumar, and Rosé (2013) Fitzpatrick, Darcy, and Vierhile (2017) Gnewuch, Morana, and Maedche (2017) Hayashi (2015) Jain, Kota, Kumar, and Patel (2018) Jenkins, Churchill, Cox, and Smith (2007) Kumar, Ai, Beuth, and Rosé (2010) Lasek and Jessa (2013) Lee and Choi (2017) V. Q. Liao, Davis, Geyer, Muller, and Shami (2016) Mäurer and Weihe (2015) Morris (2002) Schuetzler, Grimes, and Giboney (2018) Silvervarg and Jönsson (2013) Sjödnén, Silvervarg, Haake, and Gulz (2011) Tallyn, Fried, Gianni, Isard, and Speed (2018) Tegos, Demetriadis, and Tsiatsos (2016) Toxtli, Cranshaw, et al. (2018) Valério, Guimarães, Prates, and Candello (2017) Wallis and Norling (2005) Zamora (2017)
General purpose chat	19 (34%)	Brahnam and De Angeli (2012) Corti and Gillespie (2016) Curry and Rieser (2018) De Angeli (2005) De Angeli and Brahnam (2006) De Angeli, Johnson, and Coventry (2001) Hill, Ford, and Farreras (2015) Ho, Hancock, and Miner (2018) Kirakowski, Yiu, et al. (2009) Q. V. Liao et al. (2018) Mairesse and Walker (2009) Marino (2014) Miner et al. (2016) Morrissey and Kirakowski (2013) Portela and Granell-Canut (2017) Ptaszynski et al. (2010) Schlesinger, O'Hara, and Taylor (2018) Shum, He, and Li (2018) Thies, Menon, Magapu, Subramony, and O'Neill (2017)
Both or not defined	5 (9%)	Banks (2018) Brandtzaeg and Følstad (2017) Jain, Kumar, Kota, and Patel (2018) Meany and Clark (2010) Neururer, Schlögl, Brinkschulte, and Groth (2018)

Table 2. Conversational topics for chatbots in the surveyed studies

# of papers	Topics handled by the chatbots
16	Open domain (unrestricted topics)
9	Education
5	Customer services
2	Financial services, game, health, information search, race, task management, virtual assistants
1	Business, credibility assessment interviews, e-commerce, decision-making coach, ethnography, human resources, humor, movie recommendation, news, tourism

Table 3. Chatbots introduced in the reviewed literature

Chatbot investigated	#papers	Surveyed studies
None	8	Brandtzaeg and Følstad (2017) Brandtzaeg and Følstad (2018) Gnewuch et al. (2017) Mairesse and Walker (2009) Meany and Clark (2010) Morris (2002) Neururer et al. (2018) Schlesinger et al. (2018)
Real chatbot	35	Araujo (2018) Ayedoun et al. (2017) Brahnam and De Angeli (2012) Ciechanowski et al. (2018) Coniam (2008) Corti and Gillespie (2016) Curry and Rieser (2018) De Angeli (2005) De Angeli and Brahnam (2006) De Angeli et al. (2001) Dohsaka et al. (2014) Duijst (2017) Fitzpatrick et al. (2017) Hayashi (2015) Hill et al. (2015) Jain, Kota, et al. (2018) Jain, Kumar, et al. (2018) Kirakowski et al. (2009) Kumar et al. (2010) Lasek and Jessa (2013) V. Q. Liao et al. (2016) Q. V. Liao et al. (2018) Marino (2014) Mäurer and Weihe (2015) Miner et al. (2016) Morrissey and Kirakowski (2013) Ptaszynski et al. (2010) Schuetzler et al. (2018) Shum et al. (2018) Silvervarg and Jönsson (2013) Tallyn et al. (2018) Tegos et al. (2016) Toxtli et al. (2018) Valério et al. (2017) Zamora (2017)
Simulated chatbot	11	Wizard of Oz (Avula et al. (2018) Chaves and Gerosa (2018) Duijvelshoff (2017) Dyke et al. (2013) Ho et al. (2018) Lee and Choi (2017) Sjöden et al. (2011) Thies et al. (2017) Wallis and Norling (2005)), Video chatbot Banks (2018), Pre-recorded conversations Candello et al. (2017)
Real chatbot and WoZ	2	Jenkins et al. (2007) Portela and Granell-Canut (2017)

Table 4. Real chatbots' technologies

Not available	Ciechanowski et al. (2018) Schuetzler et al. (2018)
Third-party/commercial chatbot	Brahnam and De Angeli (2012) Coniam (2008) Corti and Gillespie (2016) Curry and Rieser (2018) De Angeli (2005) De Angeli and Brahnam (2006) De Angeli et al. (2001) Fitzpatrick et al. (2017) Hill et al. (2015) Jain, Kumar, et al. (2018) Lasek and Jessa (2013) Marino (2014) Miner et al. (2016) Shum et al. (2018) Valério et al. (2017) Zamora (2017)
Self-developed architecture/ dialogue management	Ayedoun et al. (2017) Dohsaka et al. (2014) Hayashi (2015) Kumar et al. (2010) Mäurer and Weihe (2015) Ptaszynski et al. (2010) Shum et al. (2018) Tallyn et al. (2018) Tegos et al. (2016)
Pattern-matching	AIML Silvervarg and Jönsson (2013), adapted ELIZA (Kirakowski et al. (2009), Morrissey and Kirakowski (2013))
Third-party platforms	Facebook Messenger Araujo (2018), Chatfuel platform Duijst (2017), IBM/Watson Jain, Kota, et al. (2018); Q. V. Liao et al. (2018); V. Q. Liao et al. (2016), Microsoft Bot Framework Toxtli et al. (2018)

3. Chatbots Social Characteristics

In this section, we present some tables to summarize the outcomes of the conceptual model of social characteristics. For the categories, Tables 5, 10, and 18 depicts an overview of the included studies.

3.1. Conversational Intelligence

Table 5. Description of the studies that report conversational intelligence

Study	Main investigation	Domain	Interaction	Analyzed data	Methods	Reported social characteristics
V. Q. Liao et al. (2016)	Social-agent orientation; Proactivity	Task management	Real chatbot	Log of conversations; Questionnaires; Interviews	Quantitative; Qualitative	Proactivity
Avula et al. (2018)	Intervention mode	Information search	WoZ	Log of conversations; Questionnaires	Quantitative; Qualitative	Proactivity
Schuetzler et al. (2018)	Intervention mode; Users deceptive behavior	Credibility assessment interviews	Real chatbot	Questionnaires	Quantitative	Proactivity; Conscientiousness
Chaves and Gerosa (2018)	Sequential coherence	Tourism	WoZ	Log of conversations; Think aloud; Interviews	Quantitative; Qualitative	Proactivity
Portela and Granell-Canut (2017)	Emotional engagement	Open domain	Real chatbot; WoZ	Log of conversations; Questionnaires; Interviews	Quantitative; Qualitative	Proactivity
Shum et al. (2018)	Emotional engagement	Open domain	Real chatbot	Log of conversations	Qualitative	Proactivity
Jain, Kumar, et al. (2018)	First-time users experience	Not defined	Real chatbot	Log of conversations; Questionnaires; Interviews	Quantitative; Qualitative	Proactivity; Conscientiousness; Communicability
Duijvelshoff (2017)	Privacy and ethics	Business	WoZ	Workshop outcomes; Interviews	Qualitative	Proactivity
Thies et al. (2017)	Personality traits	Open domain	WoZ	Log of conversations; Focus group discussion; Interviews;	Qualitative	Proactivity
Morrissey and Kirakowski (2013)	Naturalness	Open domain	Real chatbot	Log of conversations; Interviews; Questionnaires	Quantitative; Qualitative	Proactivity; Conscientiousness
Silverbarg and Jönsson (2013)	Iterative prototyping	Education	Real chatbot	Log of conversations	Quantitative; Qualitative	Proactivity
Mäurer and Weihe (2015)	Conversational decision-making	Decision-making coach	Real chatbot	Log of conversations; Questionnaires	Quantitative; Qualitative	Proactivity
Dyke et al. (2013)	Intervention mode (APT moves)	Education	WoZ	Log of conversations	Quantitative	Proactivity; Conscientiousness
Tallyn et al. (2018)	Ethnographic data collection	Ethnography	Real chatbot	Log of conversations; Interviews	Qualitative	Proactivity; Conscientiousness
Toxtli et al. (2018)	Task management chatbot design	Task management	Real chatbot	Log of conversations; Questionnaires	Quantitative; Qualitative	Proactivity
Fitzpatrick et al. (2017)	Conversational mental health care	Health-care	Real chatbot	Questionnaires	Quantitative	Proactivity
Hayashi (2015)	Intervention mode (APT moves)	Education	Real chatbot	Log of conversations	Quantitative	Proactivity
Tegos et al. (2016)	Intervention mode (APT moves)	Education	Real chatbot	Log of conversations; Questionnaires	Quantitative; Qualitative	Proactivity
Jain, Kota, et al. (2018)	Context management	E-commerce	Real chatbot	Log of conversations; Questionnaires; Subjective feedback	Quantitative; Qualitative	Conscientiousness
Coniam (2008)	Language capabilities	Education	Real chatbot	Log of conversations	Qualitative	Conscientiousness
Ayedoun et al. (2017)	Communication strategies and affective backchannels	Education	Real chatbot	Questionnaires	Quantitative	Conscientiousness
Gnewuch et al. (2017)	Chatbots design principles	Customer services	None	Literature review	Qualitative	Conscientiousness; Communicability
Brandtzaeg and Følstad (2017)	Users' motivations	Not defined	None	Questionnaires; Subjective feedback	Quantitative; Qualitative	Conscientiousness
Duijst (2017)	Personalization	Financial services	Real chatbot	Questionnaires; Think aloud; Interviews	Quantitative; Qualitative	Conscientiousness; Communicability
Valério et al. (2017)	Communicability	News reading	Real chatbot	Semiotic Inspection	Qualitative	Communicability
Q. V. Liao et al. (2018)	Playfulness	Human resources	Real chatbot	Log of conversations; Questionnaires	Quantitative; Qualitative	Communicability
Lasek and Jessa (2013)	Patterns of use of hotel chatbots	Customer services	Real chatbot	Log of conversations	Quantitative; Qualitative	Communicability

Table 6. Domains in which **Conversational Intelligence** is investigated per social characteristic

Conversational Intelligence		
Proactivity	Open domain	Thies et al. (2017) Portela and Granell-Canut (2017) Shum et al. (2018) Morrissey and Kirakowski (2013)
	Education	Dyke et al. (2013) Tegos et al. (2016) Hayashi (2015) Silvervarg and Jönsson (2013)
	Ethnography	Tallyn et al. (2018)
	Task management	V. Q. Liao et al. (2016) Toxtli et al. (2018)
	Tourism	Chaves and Gerosa (2018)
	Business	Duijvelshoff (2017)
	Information search	Avula et al. (2018)
	Decision-making coach	Mäurer and Weihe (2015)
	Health-care	Fitzpatrick et al. (2017)
	Credibility assessment interviews	Schuetzler et al. (2018)
Not defined	Jain, Kumar, et al. (2018)	
Conscientiousness	Open domain	Morrissey and Kirakowski (2013)
	Not defined	Brandtzaeg and Følstad (2017) Jain, Kumar, et al. (2018)
	Ethnography	Tallyn et al. (2018)
	Credibility assessment interviews	Schuetzler et al. (2018)
	Education	Dyke et al. (2013) Ayedoun et al. (2017) Coniam (2008)
	Financial services	Duijst (2017)
	Customer services	Gnewuch et al. (2017)
	E-commerce	Jain, Kota, et al. (2018)
	News	Valério et al. (2017)
	Customer services	Lasek and Jessa (2013) Gnewuch et al. (2017)
Communicability	Financial services	Duijst (2017)
	Human resources	Q. V. Liao et al. (2018)
	Not defined	Jain, Kumar, et al. (2018)

Table 7. *Proactivity* social characteristic

Proactivity	Benefits	[B1] to provide additional information	Morrissey and Kirakowski (2013) Thies et al. (2017) Avula et al. (2018)
		[B2] to inspire users and to keep the conversation alive	Avula et al. (2018) Chaves and Gerosa (2018) Silvervarg and Jönsson (2013) Tallyn et al. (2018) Schuetzler et al. (2018)
		[B3] to recover from a failure	Portela and Granell-Canut (2017) Silvervarg and Jönsson (2013)
		[B4] to improve conversation productivity	Avula et al. (2018) Jain, Kumar, et al. (2018)
		[B5] to guide and engage users	Mäurer and Weihe (2015) Tallyn et al. (2018) Dyke et al. (2013) Hayashi (2015) Fitzpatrick et al. (2017) Toxtli et al. (2018) Tegos et al. (2016)
	Challenges	[C1] timing and relevance	Portela and Granell-Canut (2017) Chaves and Gerosa (2018) V. Q. Liao et al. (2016) Silvervarg and Jönsson (2013)
		[C2] privacy	Duijvelshoff (2017)
		[C3] users' perception of being controlled	Tallyn et al. (2018) Toxtli et al. (2018)
	Strategies	[S1] leveraging conversational context	Avula et al. (2018) Chaves and Gerosa (2018) Shum et al. (2018) Duijvelshoff (2017)
		[S2] select a topic randomly	Portela and Granell-Canut (2017)

Table 8. *Conscientiousness* social characteristic

Conscientiousness	Benefits	[B1] to keep the conversation on track	Brandtzaeg and Følstad (2017) Duijst (2017) Jain, Kumar, et al. (2018) Ayedoun et al. (2017)
		[B2] to demonstrate understanding	Dyke et al. (2013) Duijst (2017) Jain, Kumar, et al. (2018) Ayedoun et al. (2017) Gnewuch et al. (2017) Schuetzler et al. (2018)
		[B3] to hold a continuous conversation	Jain, Kumar, et al. (2018) Gnewuch et al. (2017) Coniam (2008) Morrissey and Kirakowski (2013)
	Challenges	[C1] to handle task complexity	Duijst (2017) Dyke et al. (2013) Gnewuch et al. (2017)
		[C2] to harden the conversation	Duijst (2017) Jain, Kumar, et al. (2018) Tallyn et al. (2018)
		[C3] to keep the user aware of the chatbot's context	Jain, Kota, et al. (2018) Jain, Kumar, et al. (2018) Gnewuch et al. (2017)
	Strategies	[S1] conversational flow	Duijst (2017) Ayedoun et al. (2017) Gnewuch et al. (2017)
		[S2] visual elements	Duijst (2017) Jain, Kumar, et al. (2018) Tallyn et al. (2018)
		[S3] confirmation messages	Jain, Kota, et al. (2018) Ayedoun et al. (2017) Gnewuch et al. (2017) Duijst (2017)

Table 9. *Communicability* social characteristic

Communicability	Benefits	[B1] to unveil functionalities	Valério et al. (2017) Jain, Kumar, et al. (2018) Q. V. Liao et al. (2018) Lasek and Jessa (2013)
		[B2] to manage the users' expectations	Valério et al. (2017) Duijst (2017) Jain, Kumar, et al. (2018) Q. V. Liao et al. (2018)
	Challenges	[C1] to provide business integration	Jain, Kumar, et al. (2018) Gnewuch et al. (2017)
		[C2] to keep visual elements consistent with textual inputs	Valério et al. (2017)
		[C3] to clarify the purpose of the chatbot	Valério et al. (2017) Jain, Kumar, et al. (2018) Gnewuch et al. (2017)
	Strategies	[S1] to advertise the functionality and suggest the next step	Valério et al. (2017) Jain, Kumar, et al. (2018)
		[S2] to provide a help functionality	Jain, Kumar, et al. (2018) Q. V. Liao et al. (2018) Valério et al. (2017)
		[S3] to provide a help functionality	Jain, Kumar, et al. (2018) Q. V. Liao et al. (2018) Valério et al. (2017)

3.2. Social Intelligence

Table 10. Description of the studies that report social intelligence

Study	Main investigation	Domain	Interaction	Analyzed data	Methods	Reported social characteristics
Jain, Kumar, et al. (2018)	First-time users experience	Not defined	Real chatbot	Log of conversations; Questionnaires; Interviews	Quantitative; Qualitative	Damage control; Manners; Personalization
De Angeli et al. (2001)	Anthropomorphism	Open domain	Real chatbot	Log of conversations	Qualitative	Damage control
Silvervag and Jönsson (2013)	Iterative prototyping	Education	Real chatbot	Log of conversations	Quantitative; Qualitative	Damage control
Maurer and Weihe (2015)	Conversational decision-making	Decision-making coach	Real chatbot	Log of conversations; Questionnaires	Quantitative; Qualitative	Damage control; Manners
Toxtli et al. (2018)	Task management chatbot design	Task management	Real chatbot	Log of conversations; Questionnaires	Quantitative; Qualitative	Damage control; Manners; Personalization
Gnewuch et al. (2017)	Chatbots design principles	Customer services	None	Literature review	Qualitative	Damage control; Thoroughness
Duijst (2017)	Personalization	Financial services	Real chatbot	Questionnaires; Think aloud; Interviews	Quantitative; Qualitative	Damage control; Thoroughness; Personalization
Q. V. Liao et al. (2018)	Playfulness	Human resources	Real chatbot	Log of conversations; Questionnaires	Quantitative; Qualitative	Damage control; Manners
Lasek and Jessa (2013)	Patterns of use of hotel chatbots	Customer services	Real chatbot	Log of conversations	Quantitative; Qualitative	Damage control; Personalization
Wallis and Norling (2005)	Social intelligence	Information search	WoZ	Log of conversations	Qualitative	Damage control; Manners; Emotional intelligence
Jenkins et al. (2007)	Users' expectations and experience	Customer services	Real chatbot; WoZ	Log of conversations; Questionnaires; Subjective feedback	Quantitative; Qualitative	Damage control; Thoroughness; Manners; Emotional intelligence
Curry and Rieser (2018)	Sexual verbal abuse	Open domain	Real chatbot	Log of conversations;	Quantitative	Damage Control
Morrissey and Kirakowski (2013)	Naturalness	Open domain	Real chatbot	Log of conversations; Interviews; Questionnaires	Quantitative; Qualitative	Thoroughness; Manners
Hill et al. (2015)	Communication changes with human or chatbot partners	Open domain	Real chatbot	Log of conversations;	Quantitative	Thoroughness
Coniam (2008)	Language capabilities	Education	Real chatbot	Log of conversations	Qualitative	Thoroughness
Kirakowski et al. (2009)	Naturalness	Open domain	Real chatbot	Log of conversations; Interviews; Questionnaires	Quantitative; Qualitative	Thoroughness; Manners
Lee and Choi (2017)	Self-disclosure and reciprocity	Movie recommendation	WoZ	Questionnaires	Quantitative	Emotional intelligence
Thies et al. (2017)	Personality traits	Open domain	WoZ	Log of conversations; Focus group discussion; Interviews;	Qualitative	Thoroughness; Emotional intelligence; Personalization
Mairesse and Walker (2009)	Expressing personality through language	Open domain	None	Automatically generated utterances; Questionnaires	Quantitative	Thoroughness
Chaves and Gerosa (2018)	Sequential coherence	Tourism	WoZ	Log of conversations; Think aloud; Interviews	Quantitative; Qualitative	Thoroughness; Manners
Morris (2002)	Believability	Gaming	None	Not evaluated	Not evaluated	Thoroughness; Emotional intelligence
Shum et al. (2018)	Emotional engagement	Open domain	Real chatbot	Log of conversations	Qualitative	Moral agency; Emotional intelligence; Personalization
Marino (2014)	Racial stereotypes	Race-talk	Real chatbot	Log of conversations	Qualitative	Moral agency
De Angeli and Brahnam (2006)	Gender affordances	Open domain	Real chatbot	Log of conversations	Qualitative	Moral agency
Banks (2018)	Perceived moral agency	Open domain	Video chatbot	Questionnaires	Quantitative	Moral agency
Brahnam and De Angeli (2012)	Gender affordances	Open domain	Real chatbot	Log of conversations; Questionnaires	Quantitative; Qualitative	Moral agency
Schlesinger et al. (2018)	Race-talk	Race-talk	None	Literature	Qualitative	Moral agency
Kumar et al. (2010)	Socially capable chatbot	Education	Real chatbot	Log of conversations; Questionnaires	Quantitative	Emotional intelligence; Manners
Dohsaka et al. (2014)	Thought-evoking dialogues	Education	Real chatbot	Log of conversations; Questionnaires	Quantitative	Emotional intelligence
Fitzpatrick et al. (2017)	Conversational mental health care	Health-care	Real chatbot	Questionnaires	Quantitative	Emotional intelligence
Ayedoun et al. (2017)	Communication strategies and affective backchannels	Education	Real chatbot	Questionnaires	Quantitative	Emotional intelligence
Miner et al. (2016)	Mental health care	Health-care	Real chatbot	Log of conversations	Quantitative	Emotional intelligence
Ho et al. (2018)	Self-disclosure	Open domain	WoZ	Log of conversations; Questionnaires	Quantitative; Qualitative	Emotional intelligence
Portela and Granell-Canut (2017)	Emotional engagement	Open domain	Real chatbot; WoZ	Log of conversations; Questionnaires; Interviews	Quantitative; Qualitative	Emotional intelligence; Personalization
Tallyn et al. (2018)	Ethnographic data collection	Ethnography	Real chatbot	Log of conversations; Interviews	Qualitative	Thoroughness; Personalization
V. Q. Liao et al. (2016)	Social-agent orientation; Proactivity	Task management	Real chatbot	Log of conversations; Questionnaires; Interviews	Quantitative; Qualitative	Personalization
Duijvelshoff (2017)	Privacy and ethics	Business	WoZ	Workshop outcomes; Interviews	Qualitative	Personalization
Neururer et al. (2018)	Authenticity	Not defined	None	Interviews	Quantitative; Qualitative	Personalization
Zamora (2017)	Users' expectations and experiences	Virtual assistant	Real chatbot	Subjective feedback	Qualitative	Thoroughness; Emotional intelligence; Personalization

Table 11. Domains in which **Social Intelligence** is investigated per social characteristic

Social Intelligence		
Damage control	Information search	Wallis and Norling (2005)
	Task management	Toxtli et al. (2018)
	Customer services	Lasek and Jessa (2013) Jenkins et al. (2007) Gnewuch et al. (2017)
	Open domain	Curry and Rieser (2018) De Angeli et al. (2001)
	Financial services	Duijst (2017)
	Not defined	Jain, Kumar, et al. (2018)
	Human resources	Q. V. Liao et al. (2018)
	Decision-making coach	Mäurer and Weihe (2015)
	Education	Silvervarg and Jönsson (2013)
Thoroughness	Open domain	Morrissey and Kirakowski (2013) Hill et al. (2015) Kirakowski et al. (2009) Thies et al. (2017) Mairesse and Walker (2009)
	Customer services	Gnewuch et al. (2017) Jenkins et al. (2007)
	Education	Coniam (2008)
	Virtual assistant	Zamora (2017)
	Ethnography	Tallyn et al. (2018)
	Tourism	Chaves and Gerosa (2018)
	Financial services	Duijst (2017)
	Game	Morris (2002)
	Open domain	Morrissey and Kirakowski (2013) Kirakowski et al. (2009)
Manners	Tourism	Chaves and Gerosa (2018)
	Human resources	Q. V. Liao et al. (2018)
	Customer services	Jenkins et al. (2007)
	Education	Kumar et al. (2010)
	Decision-making coach	Mäurer and Weihe (2015)
	Task management	Toxtli et al. (2018)
	E-commerce	Jain, Kota, et al. (2018)
	Information search	Wallis and Norling (2005)
	Race-talk	Marino (2014) Schlesinger et al. (2018)
Moral agency	Open domain	De Angeli and Brahnam (2006) Banks (2018) Shum et al. (2018) Brahnam and De Angeli (2012)
	Open domain	Shum et al. (2018) Thies et al. (2017) Ho et al. (2018)
Emotional intelligence	Open domain	Portela and Granell-Canut (2017)
	Game	Morris (2002) Dohsaka et al. (2014)
	Education	Kumar et al. (2010) Ayedoun et al. (2017)
	Health	Fitzpatrick et al. (2017) Miner et al. (2016)
	Information search	Wallis and Norling (2005)
	Virtual assistant	Zamora (2017)
	Customer services	Jenkins et al. (2007)
	Movie recommendation	Lee and Choi (2017)
	Ethnography	Tallyn et al. (2018)
Personalization	Financial services	Duijst (2017)
	Task management	V. Q. Liao et al. (2016) Toxtli et al. (2018)
	Customer services	Lasek and Jessa (2013)
	Not defined	Jain, Kumar, et al. (2018) Neururer et al. (2018)
	Business	Duijvelshoff (2017)
	Virtual assistant	Zamora (2017)
	Open domain	Thies et al. (2017) Shum et al. (2018)

Table 12. Damage control social characteristic

Damage control	Benefits	[B1] to appropriately respond to harassment	Lasek and Jessa (2013) Curry and Rieser (2018)
		[B2] to deal with testing	Wallis and Norling (2005) Silvervarg and Jönsson (2013) Q. V. Liao et al. (2018) Jain, Kumar, et al. (2018)
		[B3] to deal with lack of knowledge	Wallis and Norling (2005) Jain, Kumar, et al. (2018) Toxtli et al. (2018) Silvervarg and Jönsson (2013) Gnewuch et al. (2017) Mäurer and Weihe (2015)
	Challenges	[C1] to deal with unfriendly users	Silvervarg and Jönsson (2013) Mäurer and Weihe (2015) De Angeli et al. (2001)
		[C2] to identify abusive utterances	Curry and Rieser (2018)
		[C3] to balance emotional reactions	Wallis and Norling (2005) Curry and Rieser (2018)
	Strategies	[S1] emotional reactions	Wallis and Norling (2005) Curry and Rieser (2018) Silvervarg and Jönsson (2013) De Angeli et al. (2001)
		[S2] authoritative reactions	Wallis and Norling (2005) Jenkins et al. (2007) Toxtli et al. (2018) Silvervarg and Jönsson (2013)
		[S3] to ignore the user's utterance and change the topic	Wallis and Norling (2005) Silvervarg and Jönsson (2013)
		[S4] <i>conscientiousness</i> and <i>communicability</i>	Silvervarg and Jönsson (2013) Wallis and Norling (2005) Duijst (2017) Jain, Kumar, et al. (2018) Gnewuch et al. (2017)
		[S5] to predict users' satisfaction	Q. V. Liao et al. (2018)

Table 13. Thoroughness social characteristic

Thoroughness	Benefits	[B1] to increase human-likeness	Mairesse and Walker (2009) Duijst (2017) Thies et al. (2017) Jenkins et al. (2007) Gnewuch et al. (2017) Hill et al. (2015) Morrissey and Kirakowski (2013)
		[B2] to increase believability	Jenkins et al. (2007) Mairesse and Walker (2009) Morrissey and Kirakowski (2013) Coniam (2008) Morris (2002) Tallyn et al. (2018)
	Challenges	[C1] to decide on how much to talk	Jenkins et al. (2007) Zamora (2017) Gnewuch et al. (2017) Chaves and Gerosa (2018) Duijst (2017)
		[C2] to be consistent	Duijst (2017) Kirakowski et al. (2009)

Table 14. Manners social characteristic

Manners	Benefits	[B1] to increase human-likeness	Jenkins et al. (2007) Morrissey and Kirakowski (2013) Kirakowski et al. (2009) Toxtli et al. (2018)
	Challenges	[C1] to deal with face-threatening acts	Wallis and Norling (2005) Mäurer and Weihe (2015)
		[C2] to end a conversation gracefully	Jain, Kumar, et al. (2018) Chaves and Gerosa (2018)
	Strategies	[S1] to engage in small talk	Q. V. Liao et al. (2018) Jain, Kumar, et al. (2018) Kumar et al. (2010)
[S2] to adhere turn-taking protocols		Toxtli et al. (2018)	

Table 15. Moral agency social characteristic

Moral agency	Benefits	[B1] to avoid stereotyping	Marino (2014) Schlesinger et al. (2018) Brahnam and De Angeli (2012) De Angeli and Brahnam (2006)
		[B2] to enrich interpersonal relationships	Banks (2018) Shum et al. (2018)
	Challenges	[C1] to avoid alienation	De Angeli and Brahnam (2006) Schlesinger et al. (2018)
		[C2] to build unbiased training data and algorithms	Schlesinger et al. (2018) Shum et al. (2018)

Table 16. Emotional intelligence social characteristic

Emotional Intelligence	Benefits	[B1] to enrich interpersonal relationships	Kumar et al. (2010) Wallis and Norling (2005) Dohsaka et al. (2014) Lee and Choi (2017) Ho et al. (2018) Ayedoun et al. (2017) Fitzpatrick et al. (2017) Zamora (2017) Miner et al. (2016)
		[B2] to increase engagement	Dohsaka et al. (2014) Shum et al. (2018) Portela and Granell-Canut (2017)
		[B3] to increase believability	Morris (2002)
	Challenges	[C1] to regulate affective reactions	Kumar et al. (2010) Jenkins et al. (2007) Thies et al. (2017) Ho et al. (2018)
	Strategies	[S1] to use social-emotional utterances	Kumar et al. (2010) Ayedoun et al. (2017)
		[S2] to manifest <i>conscientiousness</i>	Shum et al. (2018) Portela and Granell-Canut (2017)
[S3] reciprocity and self-disclosure		Dohsaka et al. (2014) Lee and Choi (2017)	

Table 17. Personalization social characteristic

Personalization	Benefits	[B1] to enrich interpersonal relationships	Duijvelshoff (2017) Duijst (2017) Neururer et al. (2018) Shum et al. (2018) Portela and Granell-Canut (2017)
		[B2] to provide unique services	Duijst (2017) Tallyn et al. (2018) Toxtli et al. (2018) V. Q. Liao et al. (2016) Thies et al. (2017) Jain, Kumar, et al. (2018)
		[B3] to reduce interactional breakdowns	Lasek and Jessa (2013) Duijst (2017) Jenkins et al. (2007)
	Challenges	[C1] privacy	Duijvelshoff (2017) Zamora (2017) Neururer et al. (2018) Thies et al. (2017)
	Strategies	[S1] to learn from and about the user	Neururer et al. (2018) Thies et al. (2017) Shum et al. (2018) Zamora (2017)
		[S2] to provide customizable agents	V. Q. Liao et al. (2016) Duijvelshoff (2017) Thies et al. (2017)
[S3] visual elements		Tallyn et al. (2018)	

3.3. Personification

Table 18. Description of the studies that report personification

Study	Main investigation	Domain	Interaction	Analyzed data	Methods	Reported social characteristics
Jain, Kumar, et al. (2018)	First-time users experience	Not defined	Real chatbot	Log of conversations; Questionnaires; Interviews	Quantitative; Qualitative	Personality
Silvervarg and Jönsson (2013)	Iterative prototyping	Education	Real chatbot	Log of conversations	Quantitative; Qualitative	Identity
Toxtli et al. (2018)	Task management chatbot design	Task management	Real chatbot	Log of conversations; Questionnaires	Quantitative; Qualitative	Identity
Gnewuch et al. (2017)	Chatbots design principles	Customer services	None	Literature review	Qualitative	Identity
Q. V. Liao et al. (2018)	Playfulness	Human resources	Real chatbot	Log of conversations; Questionnaires	Quantitative; Qualitative	Identity
Jenkins et al. (2007)	Users' expectations and experience	Customer services	Real chatbot; WoZ	Log of conversations; Questionnaires; Subjective feedback	Quantitative; Qualitative	Identity
Thies et al. (2017)	Personality traits	Open domain	WoZ	Log of conversations; Focus group discussion; Interviews;	Qualitative	Personality
Mairesse and Walker (2009)	Expressing personality thorough language	Open domain	None	Automatically generated utterances; Questionnaires	Quantitative	Personality
Morris (2002)	Believability	Gaming	None	Not evaluated	Not evaluated	Personality
Shum et al. (2018)	Emotional engagement	Open domain	Real chatbot	Log of conversations	Qualitative	Personality
Marino (2014)	Racial stereotypes	Race-talk	Real chatbot	Log of conversations	Qualitative	Identity
De Angeli and Brahnam (2006)	Gender affordances	Open domain	Real chatbot	Log of conversations	Qualitative	Identity
Schlesinger et al. (2018)	Race-talk	Race-talk	None	Literature	Qualitative	Identity
Kumar et al. (2010)	Socially capable chatbot	Education	Real chatbot	Log of conversations; Questionnaires	Quantitative	Personality
Ayedoun et al. (2017)	Communication strategies and affective backchannels	Education	Real chatbot	Questionnaires	Quantitative	Personality
Portela and Granell-Canut (2017)	Emotional engagement	Open domain	Real chatbot; WoZ	Log of conversations; Questionnaires; Interviews	Quantitative; Qualitative	Personality
Ciechanowski et al. (2018)	Uncanny valley	Virtual assistant	Real chatbot	Psychophysiological measures; Questionnaires	Quantitative	Identity
Araujo (2018)	Anthropomorphic clues and agency framing	Customer services	Real chatbot	Questionnaires	Quantitative	Identity
De Angeli (2005)	Social perception	Open domain	Real chatbot	Log of conversations	Qualitative	Identity
De Angeli et al. (2001)	Anthropomorphism	Open domain	Real chatbot	Log of conversations	Qualitative	Identity
Corti and Gillespie (2016)	Anthropomorphism and Initiation repairs	Open domain	Real chatbot	Log of conversations	Quantitative; Qualitative	Identity
Brandtzaeg and Følstad (2018)	User needs and motivations	Customer services	None	None	Qualitative	Identity
Candello et al. (2017)	Humanness and typefaces	Financial services	None	Questionnaires; Think aloud	Quantitative; Qualitative	Identity
Neururer et al. (2018)	Authenticity	Not defined	None	Interviews	Quantitative; Qualitative	Identity
Ptaszynski et al. (2010)	Sense of humor	Open domain	Real chatbot	Questionnaires	Quantitative	Personality
Meany and Clark (2010)	Sense of humor	Humorous talk	None	Literature	Qualitative	Personality
Brandtzaeg and Følstad (2017)	Users' motivations	Not defined	None	Questionnaires; Subjective feedback	Quantitative; Qualitative	Personality
Sjödén et al. (2011)	Personality preferences	Education	WoZ	Log of conversations; Focus group discussion; Questionnaires	Quantitative; Qualitative	Personality

Table 19. Domains in which **Personification** is investigated per social characteristic

Personification		
Identity	Task management	Toxtli et al. (2018)
	Virtual assistant	Ciechanowski et al. (2018)
	Customer services	Jenkins et al. (2007) Gnewuch et al. (2017) Araujo (2018) Brandtzaeg and Følstad (2018)
	Open domain	De Angeli (2005) De Angeli et al. (2001) Corti and Gillespie (2016) De Angeli and Brahnam (2006)
	Not defined	Neururer et al. (2018)
	Human resources	Q. V. Liao et al. (2018)
	Education	Silverbarg and Jönsson (2013)
	Race	Marino (2014) Schlesinger et al. (2018)
	Financial services	Canello et al. (2017)
Personality	Open domain	Thies et al. (2017) Portela and Granell-Canut (2017) Ptaszynski et al. (2010) Shum et al. (2018) Mairesse and Walker (2009)
	Education	Ayedoun et al. (2017) Kumar et al. (2010) Sjöden et al. (2011)
	Not defined	Brandtzaeg and Følstad (2017) Jain, Kumar, et al. (2018)
	Game	Morris (2002)
	Humor	Meany and Clark (2010)

Table 20. *Identity* social characteristic

Identity	Benefits	[B1] to increase engagement	Araujo (2018) Silverbarg and Jönsson (2013) Q. V. Liao et al. (2018)
		[B2] to increase human-likeness	Canello et al. (2017) Araujo (2018)
	Challenges	[C1] to avoid negative stereotypes	De Angeli (2005) Schlesinger et al. (2018) Brahnam and De Angeli (2012) Marino (2014) De Angeli and Brahnam (2006) Brahnam and De Angeli (2012) De Angeli et al. (2001) Jenkins et al. (2007)
		[C2] to balance the <i>identity</i> and the technical capabilities	Corti and Gillespie (2016) Ciechanowski et al. (2018) Gnewuch et al. (2017) Brandtzaeg and Følstad (2018) De Angeli (2005)
Strategies	[S1] to design and elaborate on a persona	Q. V. Liao et al. (2018) Neururer et al. (2018) Toxtli et al. (2018) Thies et al. (2017) Silverbarg and Jönsson (2013) De Angeli (2005) De Angeli et al. (2001)	

Table 21. *Personality* social characteristic

Personality	Benefits	[B1] to increase believability	Morris (2002) Mairesse and Walker (2009) Ptaszynski et al. (2010) Portela and Granell-Canut (2017)
		[B2] to enrich interpersonal relationships	Brandtzaeg and Følstad (2017) Jain, Kumar, et al. (2018) Thies et al. (2017) Sjöden et al. (2011) Shum et al. (2018) Kumar et al. (2010) Ayedoun et al. (2017)
	Challenges	[C1] to adapt humor to the users' culture	Ptaszynski et al. (2010)
		[C2] to balance the <i>personality</i> traits	Thies et al. (2017) Mairesse and Walker (2009) Sjöden et al. (2011)
	Strategies	[S1] to use appropriate language	Shum et al. (2018) Morris (2002) Mairesse and Walker (2009) Jain, Kumar, et al. (2018)
		[S2] to have sense of humor	Meany and Clark (2010) Ptaszynski et al. (2010) Thies et al. (2017) Brandtzaeg and Følstad (2017) Jain, Kumar, et al. (2018)

4. Measurements of social characteristics

The surveyed literature revealed a number of constructs that are used to measure whether the interaction with the chatbot reaches the intended social goals. In general terms, task-oriented interactions focus on completing the task, while the general purpose chatbots aim to engage users in general conversations. In both cases, engagement performs an important role, and therefore is a commonly used metric. However, we also found that social characteristics can be measured looking at additional constructs, which include interpersonal relationship, social presence, social influence, and anthropomorphism. In this section, we discuss each of these constructs and the characteristics that can influence the measurements.

Engagement relates to attracting and holding the user’s attention and interest (O’Brien & Toms, 2008). In the chatbot domain, engagement can be measured by the number of exchanges per session (Dohsaka et al., 2014; Shum et al., 2018), although other attributes can manifest users’ engagement, such as emotional connection, attention, the perception of time, and self- and external awareness (O’Brien & Toms, 2008). In this survey, we found social characteristics in all the three categories measured in terms of their impact on engagement. **Conversational intelligence** teaches users how to interact (*communicability*), demonstrate attention to the users’ intentions and needs (*conscientiousness*) (Schuetzler et al., 2018), and encourage users to continue the conversation (Tegos et al., 2016), even after periods of inactivity (*proactivity*) (Fitzpatrick et al., 2017). **Personification** makes the interaction more fun and enjoyable (*personality*) (Jain, Kumar, et al., 2018; Ptaszynski et al., 2010; Sjødén et al., 2011), while **social intelligence** provides emotional connection and support (*emotional intelligence*) (Ayedoun et al., 2017; Portela & Granell-Canut, 2017; Shum et al., 2018). In line with the engagement with technology framework (O’Brien & Toms, 2008), usability also came up as influencing engagement, particularly the ease of use (Jain, Kota, et al., 2018; Jain, Kumar, et al., 2018; Jenkins et al., 2007; Tallyn et al., 2018; Toxtli et al., 2018) and accessibility (Duijst, 2017; Tamayo-Moreno & Pérez-Marín, 2016), which can be improved with *personalization* (Jain, Kumar, et al., 2018). For example, Tamayo-Moreno and Pérez-Marín (2016) show how adapting the visual interface (color scheme, input mode, background images, and amount of textual information) changes the user’s experience when the interlocutors are children in early childhood education.

Interpersonal relationship relates to building a social connection with the chatbot that relies on trust, intimacy, common ground, and reciprocal enjoyment (Lee & Choi, 2017). We found that **social intelligent** and appropriately **personified** chatbots are more likely to build an interpersonal relationship to the user. In Lee and Choi (2017), Ho et al. (2018), and Dohsaka et al. (2014), the authors showed that *emotional intelligence* potentially helps with building trust, intimacy, and enjoyment, which influences the willingness to engage. Duijvelshoff (2017) and Duijst (2017) argue that reducing privacy and security concerns also increases trust. Hence, personalizing the information stored by the chatbot and transparency result in higher interpersonal relationship and consequently willingness to engage. In addition, Banks (2018) showed that perceived *moral agency* also correlates with higher trustworthiness and goodwill. Regarding **personification**, De Angeli et al. (2001) argue that improper *personality* and *identity* representations may lead to confusing, disempowering, and distracting the users, ultimately raising interpersonal conflicts.

Interpersonal relationship is a consequence of social presence (Gunawardena & Zittle, 1997; Short, Williams, & Christie, 1976). In CMC fields, social presence describes

the degree of salience of an interlocutor (Short et al., 1976), in this case, the chatbot, and how it can project itself as an individual. As a determinant of interpersonal relationship, social presence is also influenced by intimacy and trust; however, social presence is also assessed as how much the chatbot was considered to be a “real” person (Ciechanowski et al., 2018), where humanness and believability are influencing factors. In this sense, **personification** may drive the creation of social presence, since it increases the perception of anthropomorphic clues (Ciechanowski et al., 2018; De Angeli, 2005). However, anthropomorphic clues by themselves do not imply social presence. For example, Araujo (2018) did not find a main effect on social presence of anthropomorphic clues, such as having a human name (*identity*) and language style (*thoroughness*). On the other hand, they found that framing the chatbot as “intelligent” slightly increased social presence, and higher social presence resulted in higher emotional connection with the company represented by the chatbot. Hence, **social** and **conversational intelligence** are also required to increase social presence, most likely due to the potential elevation of the chatbot’s social positioning (Wallis & Norling, 2005). For example, Laban and Araujo (2020) showed that perceiving a chatbot as cooperative increases the perceptions of social presence attributed to the agent. In Tallyn et al. (2018), participants who complained about the chatbot’s handcrafted responses expressed the desire for spontaneous (*thoroughness*) and somewhat emotional reactions (*emotional intelligence*) to their inputs, so the chatbot would be “*more like a person.*” Participants in both Jain, Kumar, et al. (2018) and Portela and Granell-Canut (2017) related human-likeness to the ability to hold meaningful conversations, which include context preservation (*conscientiousness*) and timing (*proactivity*). In addition, Schuetzler et al. (2018) showed that increasing the relevance of the chatbot’s utterance (*conscientiousness*) increases social presence and perceived humanness. Morrissey and Kirakowski (2013) list a number of characteristics that increases chatbot’s believability, including *manners*, *proactivity*, *damage control*, *conscientiousness*, and *personality*. These align with the dimensions of social presence theory in CMC (Tu & McIsaac, 2002).

Anthropomorphism, in its turn, is a process of attributing of human traits to a non-human entity, even when this attribution is known to be inappropriate (Nass, Steuer, Tauber, & Reeder, 1993); for example, referring a chatbot with a personal pronoun (he/she) rather than “*it.*” Anthropomorphism can be induced by **personification** (Araujo, 2018; De Angeli, 2005; Nass et al., 1993) since the human traits are explicitly attributed by the designer. Laban and Araujo (2020) showed that perceiving the conversational agent as cooperative positively influence the perceptions of the chatbot as anthropomorphic, which leads to increased positive perceptions of service performance. Characteristics as *manners* (Tallyn et al., 2018) and *emotional intelligence* (Portela & Granell-Canut, 2017) were also shown to trigger anthropomorphism (Q. V. Liao et al., 2018), although it may depend on the user’s tendency to anthropomorphize (V. Q. Liao et al., 2016).

Finally, a chatbot’s social influence refers to its capacity to promote changes in the user’s cognition, attitude, or behavior (Raven, 1964), which is sometimes called persuasiveness (Narita & Kitamura, 2010). Although we did not find studies that focus on formally measuring the social influence of chatbots, the surveyed literature revealed a few instances of chatbots changing users’ behaviors in particular domains. For example, in health, Fitzpatrick et al. (2017) showed that a chatbot with *proactivity* and *emotional intelligence* can motivate users to engage in a self-help program for students who self-identify as experiencing symptoms of anxiety and depression. In education, tutor chatbots proactive interventions (APT moves) that helped students to increase

participation in group discussions (Dyke et al., 2013; Hayashi, 2015; Tegos et al., 2016). In the customer services field, Araujo (2018) evaluated whether anthropomorphic clues and framing changes the users’ attitude toward the company being represented by the chatbot; however, they did not find a significant effect. Although social influence has shown to increase with higher social presence levels in CMC fields (e.g., see Postmes, Spears, Sakhel, and De Groot (2001)), the impact of enriching chatbots with social characteristics is still under-investigated.

5. Related Surveys

Table 22 shows the social characteristics covered by each related survey, where the content in each cell represents how the paper refers to the social characteristic.

Table 22. Social characteristics from related surveys

This survey	Pereira, Coheur, Fialho, and Ribeiro (2016)	Ferman (2018)	Radziwill and Benton (2017)
<i>Proactivity</i>	-	social intelligence, users’ control	-
<i>Conscientiousness</i>	guiding the users through the topics	chatbot’s conversational flows, chatbot’s memory, making changes on the fly, conversational and situational knowledge	maintain the theme and respond specific questions
<i>Communicability</i>	-	chatbot’s help, documentation	-
<i>Damage control</i>	-	-	damage control
<i>Thoroughness</i>		chatbot’s language; user’s recognition and recall	appropriate linguistic register/accuracy
<i>Manners</i>	handling small talk	-	-
<i>Moral agency</i>	-	-	respect, inclusion, and preservation of dignity, ethics and cultural knowledge of users
<i>Emotional intelligence</i>	-	social intelligence	provide emotional information, be warm, adapt to the human’s mood
<i>Personalization</i>	-	social intelligence; ethics regarding privacy (data retention and transparency)	meets neurodiverse needs
<i>Identity</i>	-	-	transparent to inspection and discloses its <i>identity</i>
<i>Personality</i>	personality	personality	personality, fun, humor

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