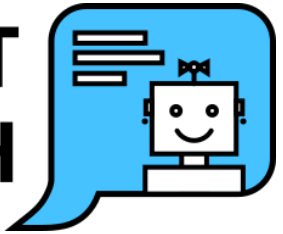
Karlsruhe Institute of Technology

CHATBOT RESEARCH



Workshop: Designing the Human-Chatbot Interaction

Stefan Morana – 20.11.2019
tekom Deutschland e.V., Regionalgruppe Baden, Walldorf

IISM
INSTITUTE OF INFORMATION SYSTEMS AND MARKETING

CHATBOT RESEARCH

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Professor and Head of Research Group

Introduction

Dr. Stefan Morana

Karlsruhe Institute of Technology (KIT)

Postdoctoral Researcher, Institute of Information Systems and Marketing (IISM)

Short Vita

- since 2016: Postdoctoral Researcher, Karlsruhe Institute of Technology
- 2015: Dr. rer. pol., University of Mannheim
- 2012-2015: Researcher and Doctoral student, University of Mannheim
- 2012-2015: Technical Consultant, Freudenberg Sealing Technologies
- 2010-2012: Researcher, University of Applied Sciences Darmstadt
- 2004-2010: Bachelor / Master of Science in Computer Science, University of Applied Sciences Darmstadt

Workshop Outline

Chatbot Fundamentals

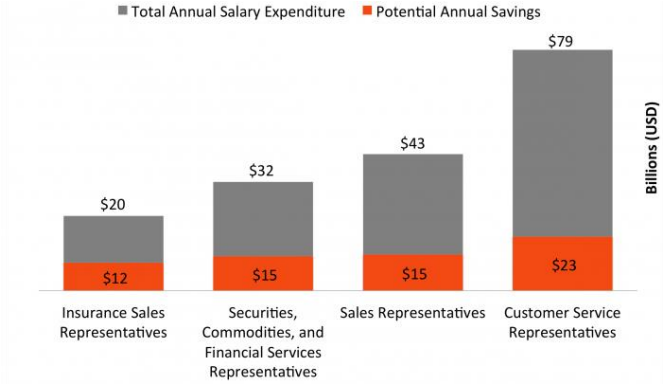
Social Cues in the Human-Chatbot Interaction

Dialog Improvement Platform

Chatbot Fundamentals

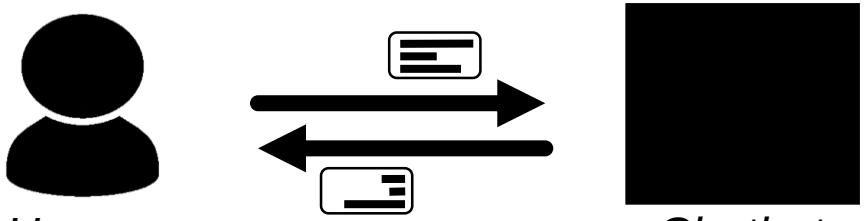
Chatbots …

- … are getting hyped as the ‘next big thing’ *[1, 2]*
  - 40% of consumers do not care whether a chatbot or a real human helps them, as long as they are getting the help they need *[3]*
  - 55% of consumers are interested in interacting with a business using messaging apps to solve a problem *[3]*
  - Chatbots can save up to $23 billions in customer service *[4]*
  - By 2020, over 80% of businesses are expected to have some sort of chatbot automation implemented *[4]*
  - By 2020, 25% of customer service operations will use chatbots to automate and provide 24/7 support *[5]*



[1] Hopkins and Silverman (2016). “The Top Emerging Technologies To Watch: 2017 To 2021,” Forrester Research
[2] Oracle (2016) Can Virtual Experiences Replace Reality?, Report
[3] HubSpot (2017), Artificial Intelligence Is Here, Report
[4] Business Insider (2016), https://www.businessinsider.de/80-of-businesses-want-chatbots-by-2020-2016-12
[5] Gartner. (2018). Gartner says 25 percent of customer service operations will use virtual customer assistants by 2020. https://www.gartner.com/newsroom/id/3858564

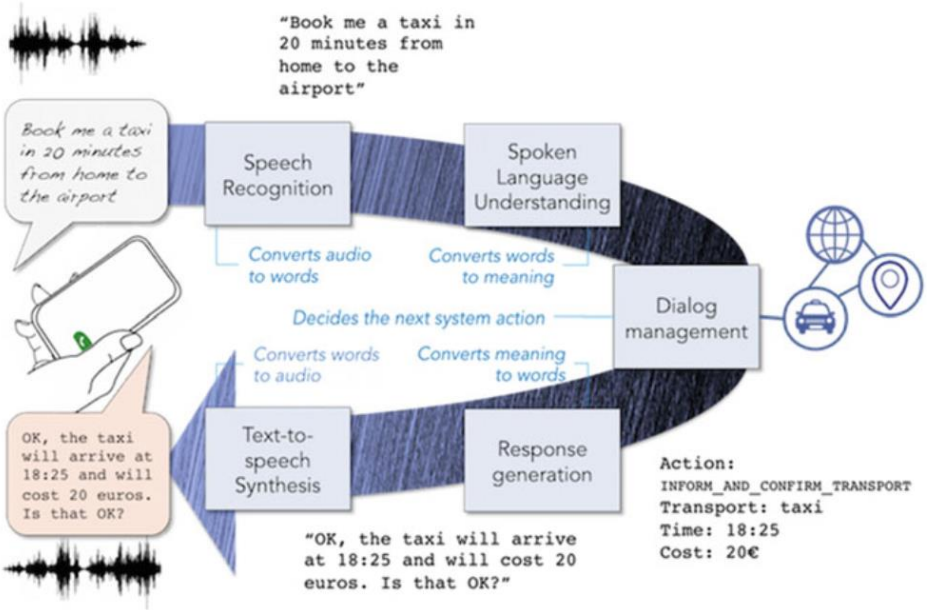
What is a Chatbot?



- *"… achieve some result by conversing with a machine in a dialogic fashion, using natural language!"*[1]

[1] Dale, R. 2016. "The return of the chatbots," Natural Language Engineering (22:5), pp. 811–817.

Conversational Agent [1,2]

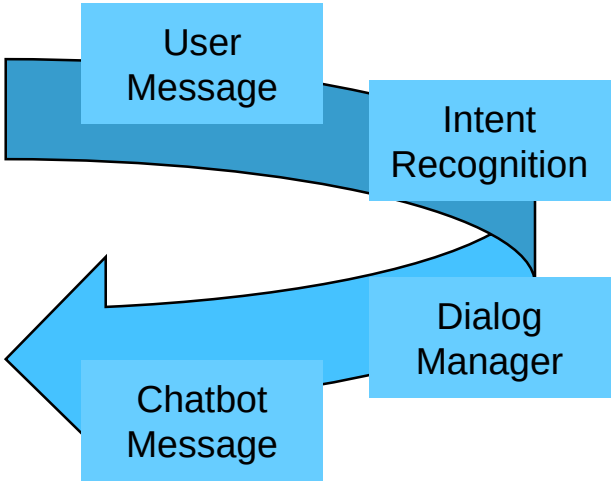


- **Speech recognition**: converts the speech input into a string of words
- **Spoken language understanding**: interpret the user's input and to extract a representation of its meaning
- **Dialog management**: tracks the state and flow of the conversation and controls how the system responds to the user's input
- **Response generation**: Formulate a response in natural language
- **Text-to-speech synthesis**: converts the response string into speech output

[1] McTear, M., 2002. Spoken Dialogue Technology: Enabling the Conversational User Interface. ACM Computing Surveys, 34(1), pp.90–169.
[2] McTear, M., Callejas, Z. and Griol, D. (2016), The Conversational Interface: Talking to Smart Devices, Springer.

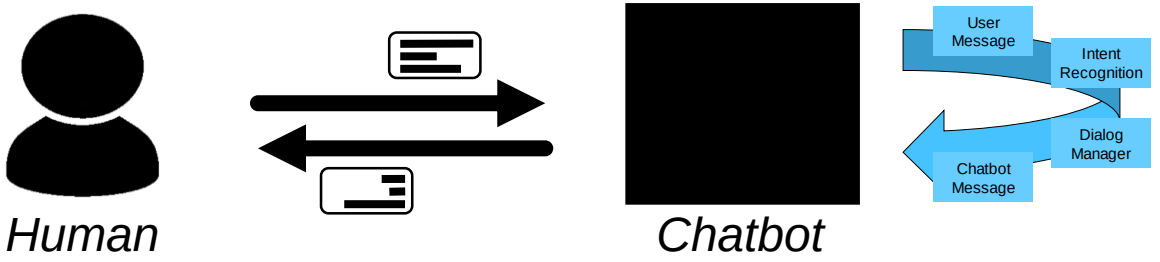
Chatbot

= Text-based Conversational Agent



- **User Message**: “I need a hotel room”
- **Intent Recognition**: Identify intent *<<require room>>*
- **Dialog Manager**: Based on intent, select proper dialog, and send response
- **Chatbot Message**: “To book a room, please proceed the following …”

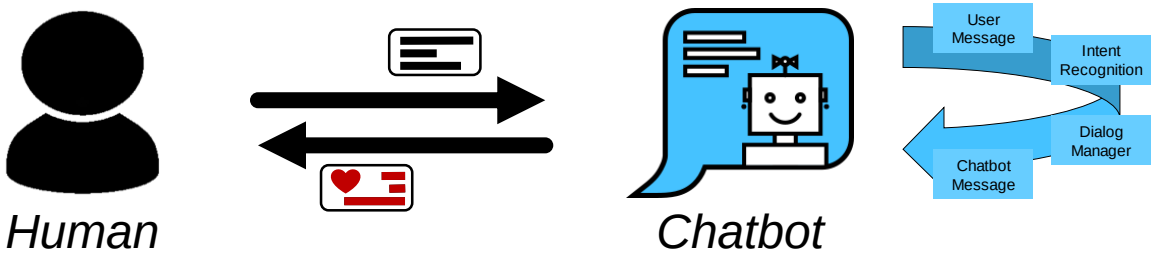
What is a Chatbot?



- "*… achieve some result by conversing with a machine in a dialogic fashion, using natural language!*"*[1]*
- Technology is mature (MS Bot Framework, IBM Watson, DialogFlow, Rasa, etc.)
- Adoption and use of chatbots is growing slower than expected *[2]* and interacting with most chatbots does not feel natural and human-like *[3]*

[1] Dale, R. 2016. "The return of the chatbots," Natural Language Engineering (22:5), pp. 811–817.
[2] Brandtzaeg, P. B., & Følstad, A. (2017). Why people use chatbots. In Proceedings of the 4th International Conference on Internet Science (pp. 377–392).
[3] Go, E., & Sundar, S. S. (2019). Humanizing chatbots: The effects of visual, identity and conversational cues on humanness perceptions. Computers in Human Behavior, 97, 304–316.

What is a Chatbot?



- *"… achieve some result by conversing with a machine in a dialogic fashion, using natural language!"* [1]
- Technology is mature (MS Bot Framework, IBM Watson, DialogFlow, Rasa, etc.)
- Adoption and use of chatbots is growing slower than expected [2] and interacting with most chatbots does not feel natural and human-like [3]
- Design of the conversation between human and chatbot is key

HOW *the chatbot is communicating*

WHAT *the chatbot is communicating*

[1] Dale, R. 2016. "The return of the chatbots," Natural Language Engineering (22:5), pp. 811–817.
[2] Brandtzaeg, P. B., & Følstad, A. (2017). Why people use chatbots. In Proceedings of the 4th International Conference on Internet Science (pp. 377–392).
[3] Go, E., & Sundar, S. S. (2019). Humanizing chatbots: The effects of visual, identity and conversational cues on humanness perceptions. Computers in Human Behavior, 97, 304–316.

Who is using Chatbots?

Lufthansa

Mildred (retired)

unitymedia

Ubo

klarmobil.de
Echt einfach. Echt günstig.

Elvis

H&M

H&M Bot

IKEA

Anna (retired)

2DF ARD

Novi

W&W wüstenrot
Partner der Württembergischen

KFZ-Berater

yello

Eve (retired)

WIEN ENERGIE

BotTina

LIDL

Wine Bot

sky SPORT

Fredl

eprimo

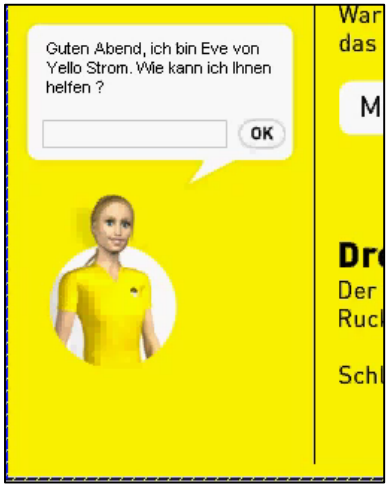
Sophie

Why do Chatbots fail?

2005-2016

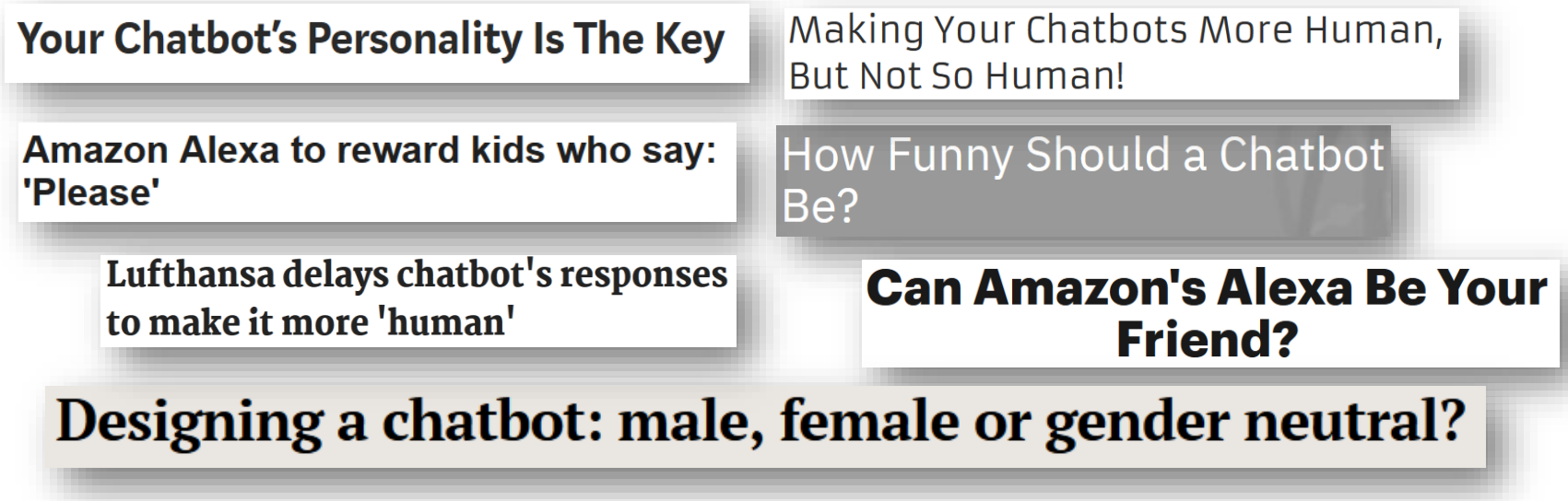
Anna

2003-2015



Eve

But … How to Design a Chatbot?!



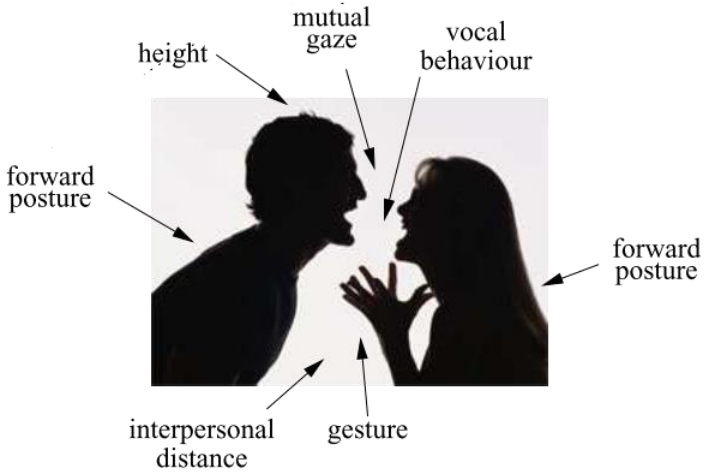
- Many chatbots fail because designing natural language UI is different from designing graphical UI *[1, 2]*

[1] Følstad, A. and Brandtzæg, P.B. (2017), "Chatbots and the new world of HCI", Interactions, Vol. 24 No. 4, pp. 38–42.
[2] Moore, R. K. 2013. "Spoken Language Processing: Where Do We Go from Here ?," in Your Virtual Butler, LNAI 7407, R. Trappl (ed.), Springer, pp. 119–133.

Social Cues in the Human-Chatbot Interaction

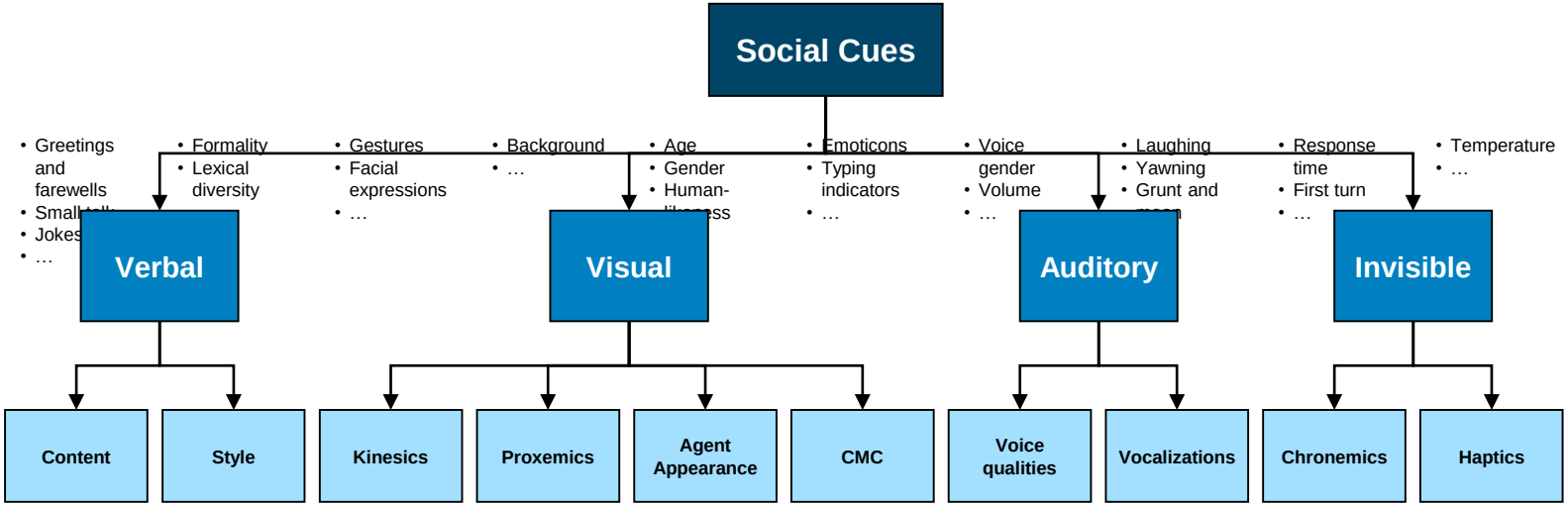
Computers Are Social Actors (CASA)

- **CASA**: Users mindlessly apply social rules and expectations in their interaction with computers that use natural language or display other human characteristics *[1, 2]*
- **Social cues** as design features of a chatbot that automatically trigger emotional, cognitive, or behavioral reactions by the user that are appropriate when directed at other humans but inappropriate when directed at chatbots *[1, 3]*

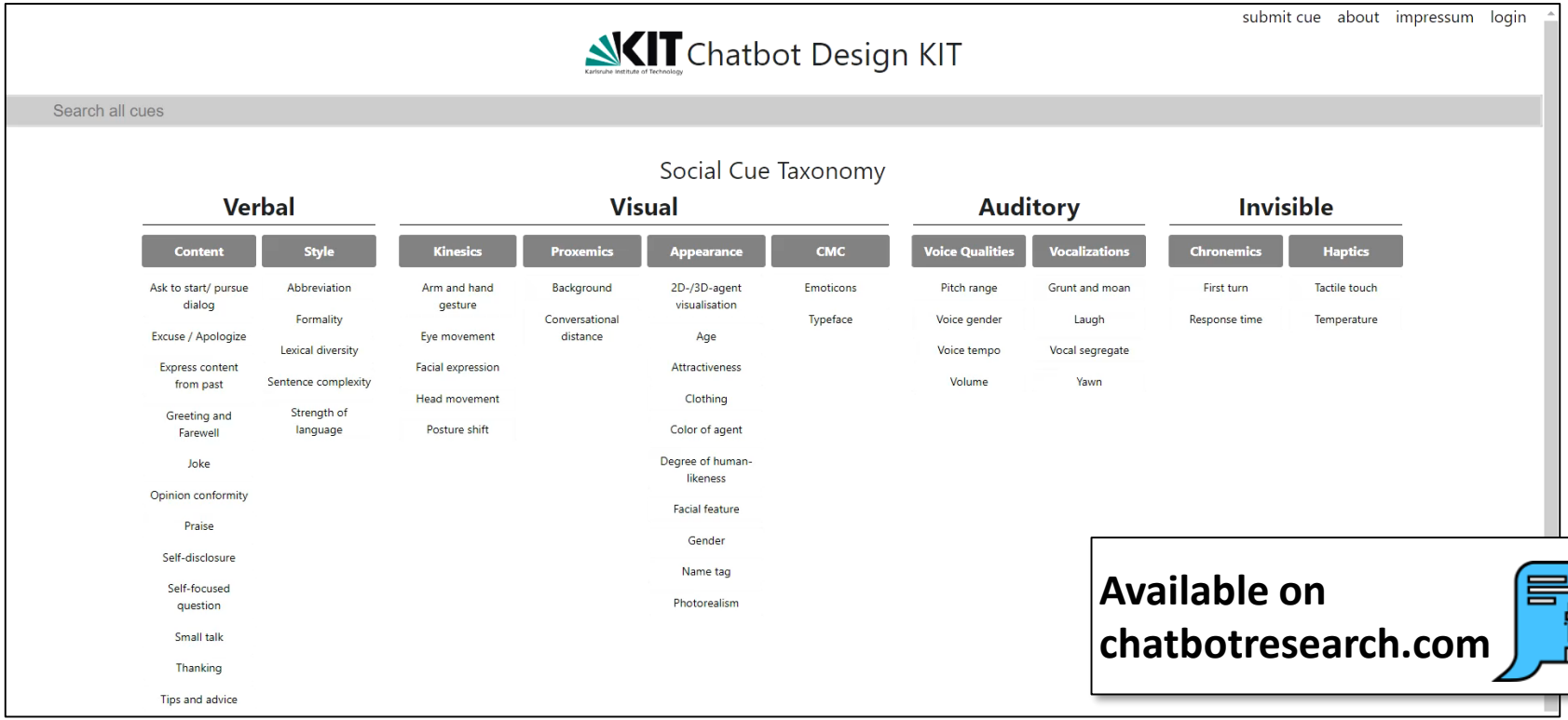


[1] Nass, C., Steuer, J. and Tauber, E.R. (1994), "Computers are social actors", Proceedings of the SIGCHI Conference on Human Factors in Computing Systems, Boston, MA, USA, pp. 72–78.
[2] Nass, C. and Moon, Y. (2000), "Machines and Mindlessness: Social Responses to Computers", Journal of Social Issues, Vol. 56 No. 1, pp. 81–103.
[3] Krämer, N. C. 2008. "Social Effects of Virtual Assistants. A Review of Empirical Results with Regard to Communication," in Intelligent Virtual Agents: 8th International Conference, IVA 2008, Tokyo, Japan, September 1-3, 2008. Proceedings, H. Prendinger, J. Lester and M. Ishizuka (eds.), Berlin, Heidelberg: Springer Berlin Heidelberg, pp. 507–508.

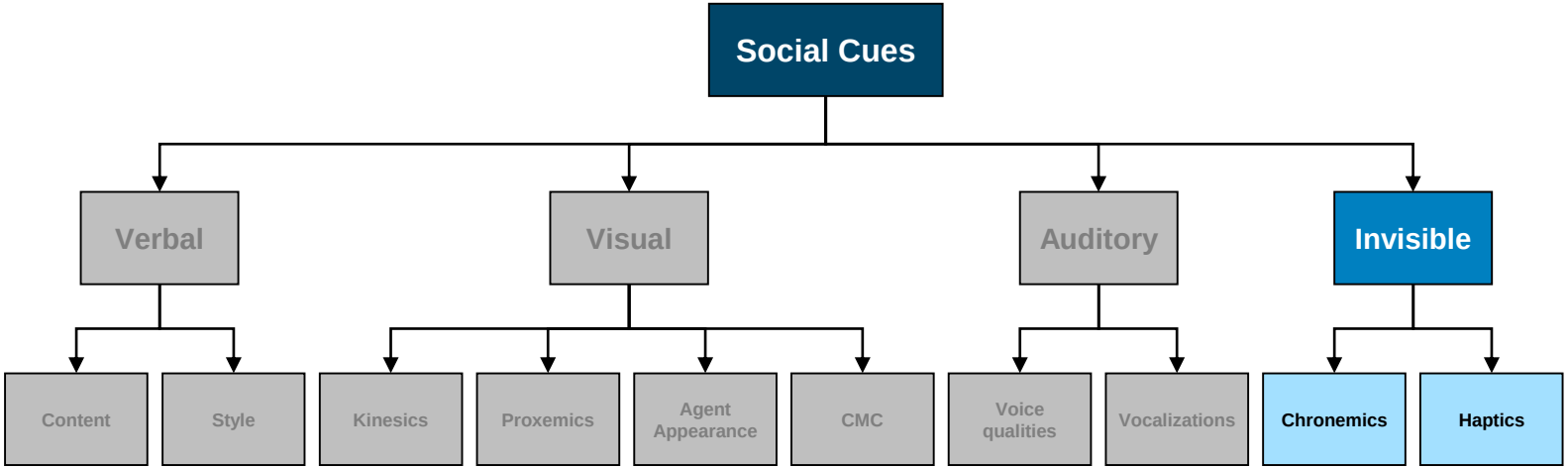
Taxonomy of Social Cues



Taxonomy of Social Cues - Web Tool



Invisible Cues



First turn

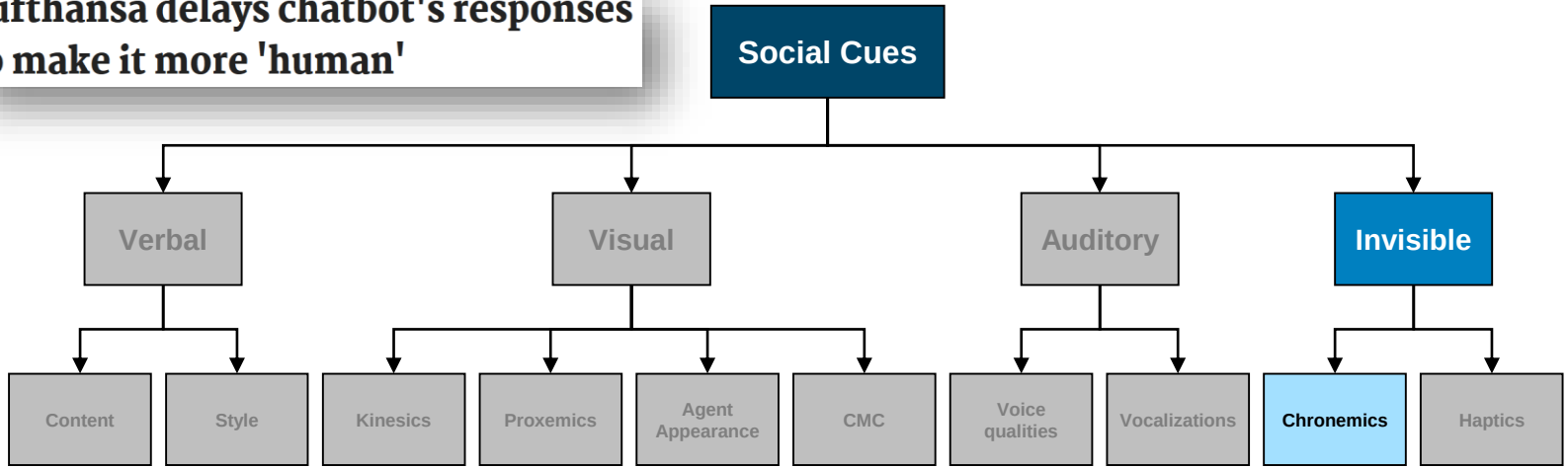
Response time

Tactile touch

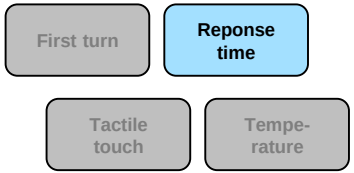
Tempe-rature

Lab Experiment – Response Time

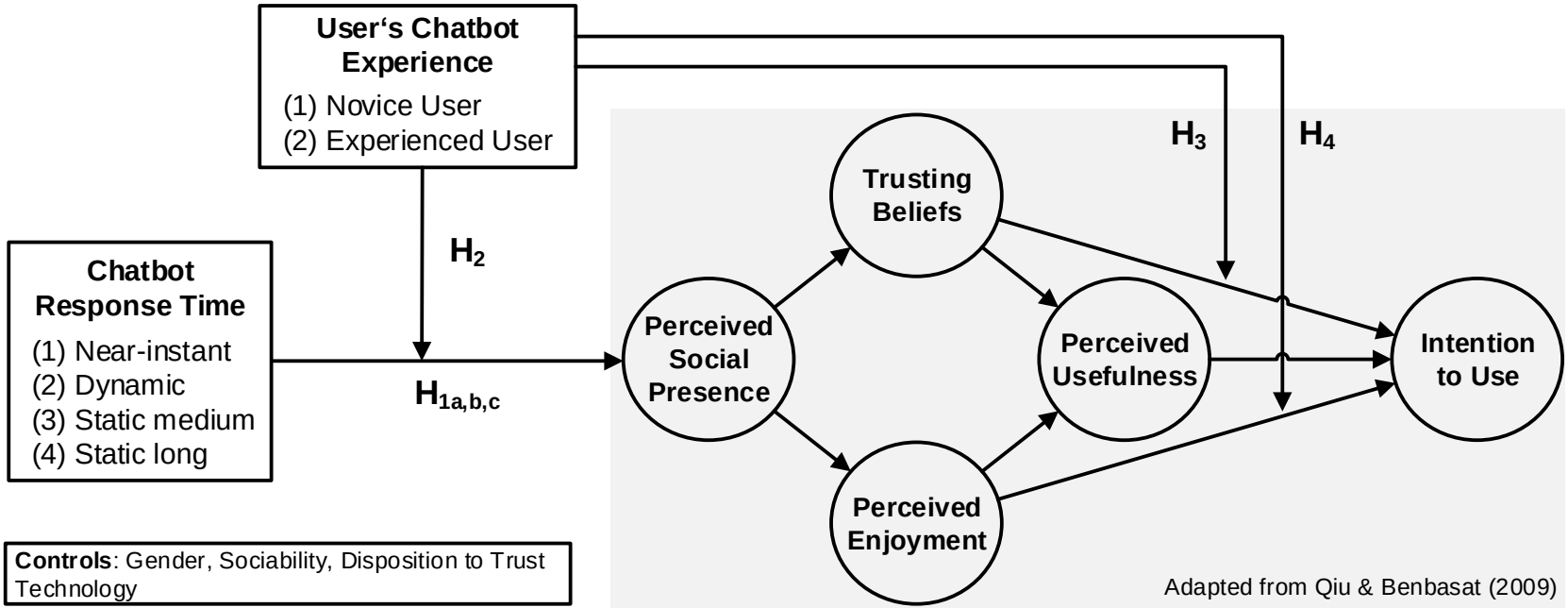
Lufthansa delays chatbot's responses to make it more 'human'



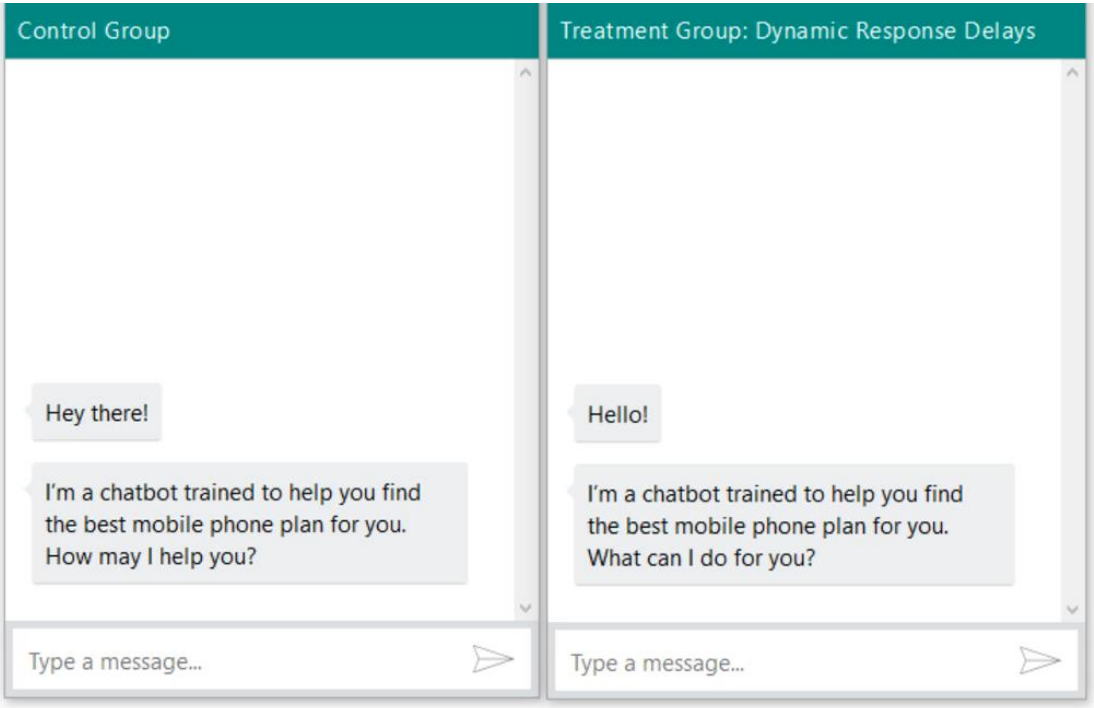
- Focus on the **response time** of a chatbot
  - *"The length of time it takes for the agent to respond to a message of the user".*

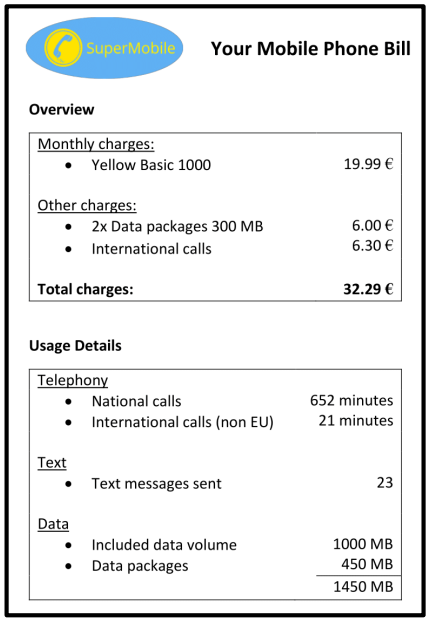


Lab Experiment – Research Model



Lab Experiment – Artifact (Pilot Test)





SuperMobile

Your Mobile Phone Bill

Overview

Monthly charges:	
• Yellow Basic 1000	19.99 €
Other charges:	
• 2x Data packages 300 MB	6.00 €
• International calls	6.30 €
Total charges:	**32.29 €**

Usage Details

Telephony	
• National calls	652 minutes
• International calls (non EU)	21 minutes
Text	
• Text messages sent	23
Data	
• Included data volume	1000 MB
• Data packages	450 MB
	1450 MB

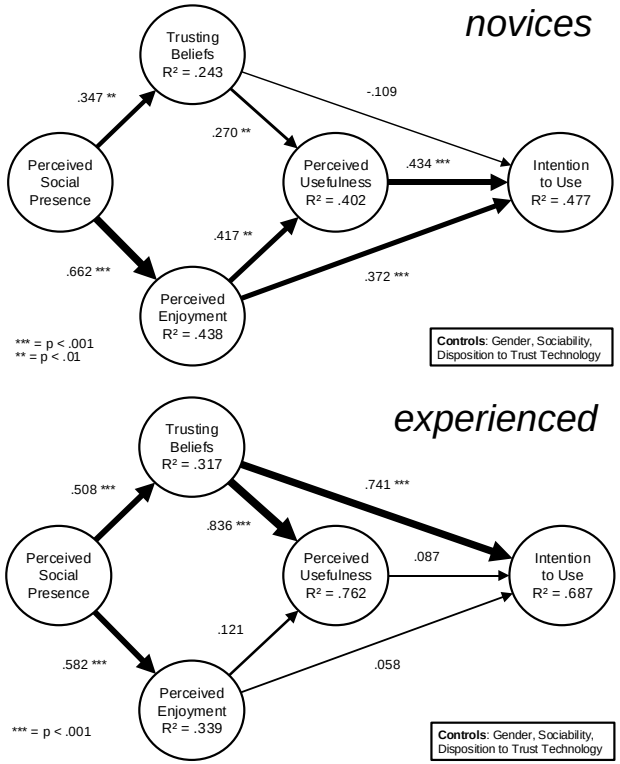
Microsoft Bot Builder SDK

Microsoft LUIS

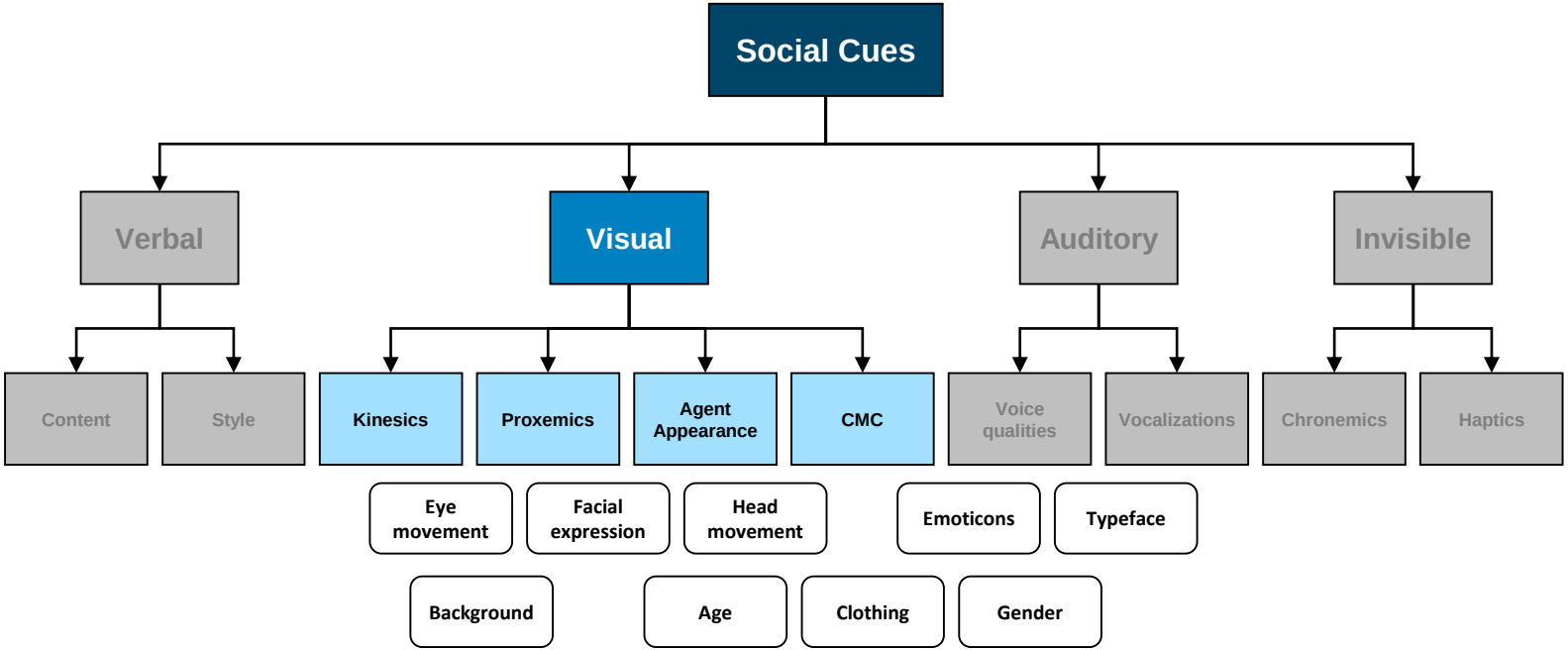
Lab Experiment – Results (Excerpt)

- Response time effect on social presence
  - Novice users exhibit the highest level of social presence for medium response time, closely followed by dynamic and long response times
  - Experienced users do not exhibit a significant difference in social presence across the four treatment conditions

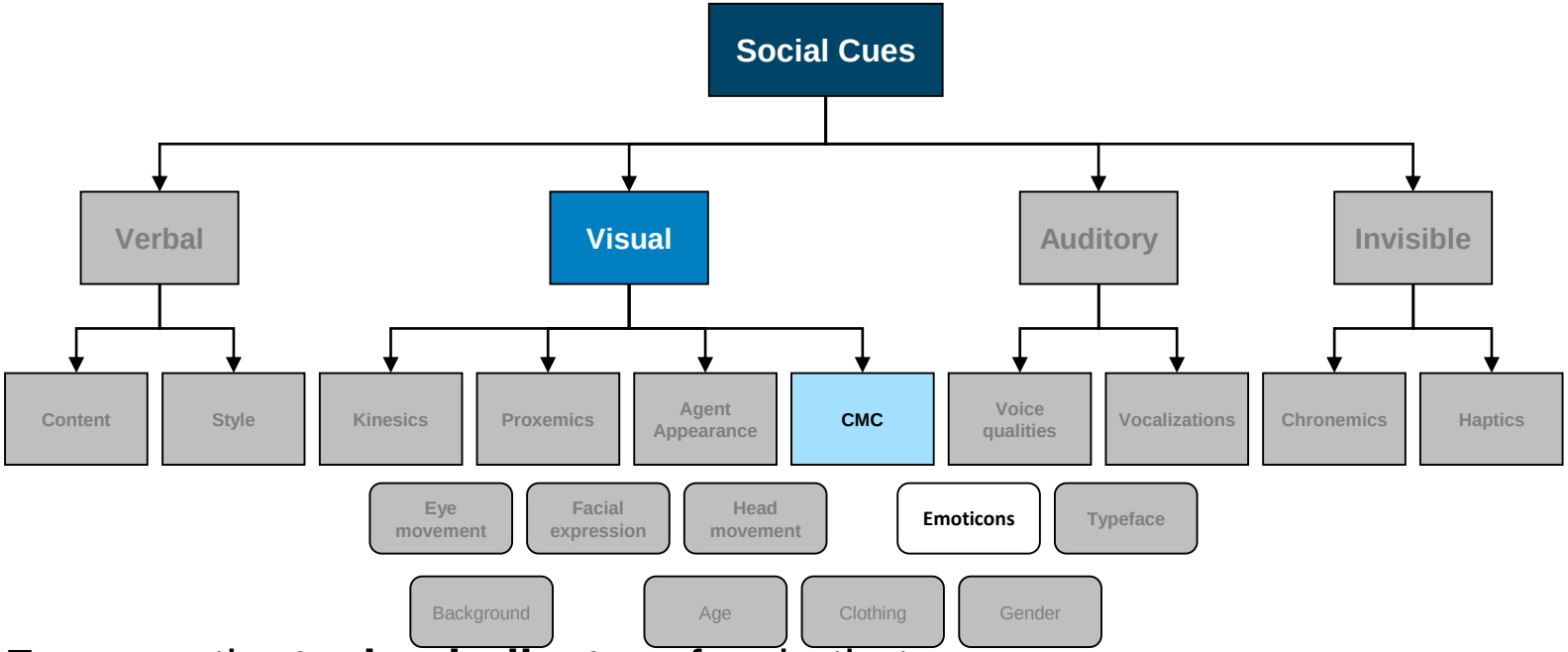
- Formation of usage intentions differs between novice and experienced users
  - Novice users via perceived enjoyment and usefulness
  - Experienced users via trusting beliefs



Visual Cues

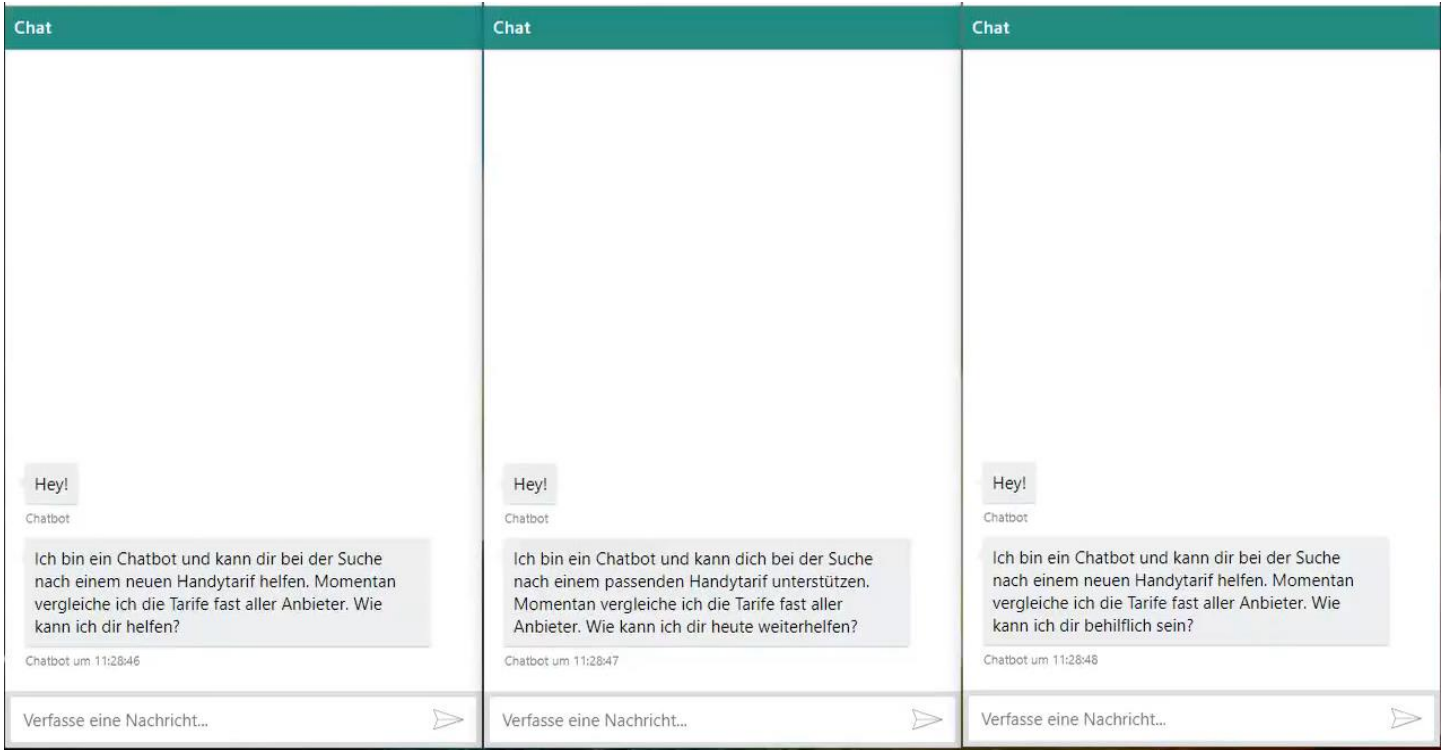

Social Cues
Verbal
Visual
Auditory
Invisible
Content
Style
Kinesics
Proxemics
Agent Appearance
CMC
Voice qualities
Vocalizations
Chronemics
Haptics
Eye movement
Facial expression
Head movement
Emoticons
Typeface
Background
Age
Clothing
Gender

Online Experiment – Typing Indicator



- Focus on the **typing indicator** of a chatbot
  - *"A visual feedback by the chatbot indicating that a response is being prepared".*

Online Experiment – Treatment



Microsoft Bot Builder SDK

Microsoft LUIS

Online Experiment – Preliminary Findings

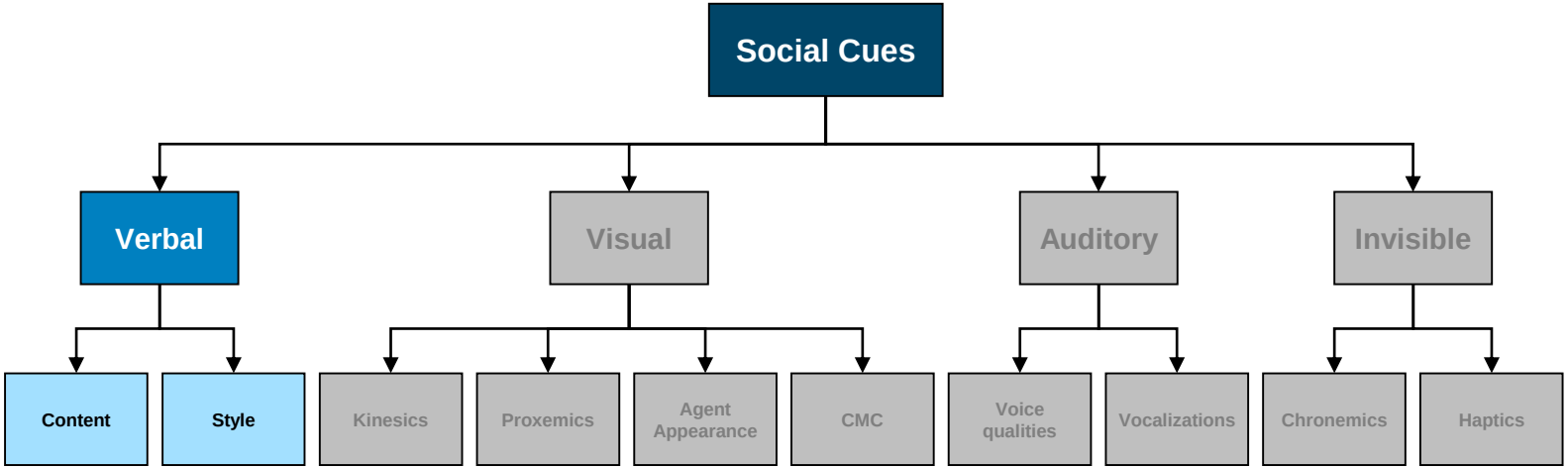
Condition	Social Presence		
	Mean	SD	SE
CTRL (n=63)	3.448	1.442	0.182
3DOTS (n=63)	3.902	1.451	0.183
TYPING (n=63)	3.663	1.408	0.177
SD = standard deviation | SE = standard error			

Manipulation check

- Chatbot indicated message preparation (1 = “strongly disagree”; 7 = “strongly agree”)
  - $F(2, 186)=439.3$, $p<.001$ with Tukey-HSD
  - M_{CTRL} = 2.587, SD = 1.328
  - M_{3DOTS} = 6.778, SD = 0.851
  - M_{TYPING} = 6.889, SD = 0.317

Independent Variables	Dependent variables	
	(I) Perceived Social presence	(II) Perceived Social presence
Dummy: 3DOTS	1.147 ** (0.369)	
Dummy: TYPING	0.376 (0.362)	- 0.771 * (0.387)
Dummy: CTRL		- 1.147 ** (0.369)
Dummy: EXP	0.751 * (0.359)	- 0.588 (0.364)
Dummy: Male	- 0.234 (0.211)	- 0.234 (0.211)
Trust in Technology	0.042 (0.072)	0.042 (0.072)
CTRL x EXP		1.339 ** (0.510)
3DOTS x EXP	- 1.334 ** (.510)	
TYPING x EXP	- 0.447 (0.507)	0.891 + (0.511)
Constant	3.057 *** (0.458)	4.204 *** (0.426)
	N = 189 R^2 = 0.068	N = 189 R^2 = 0.068
EXP = Users' prior experience with chatbots *Note: + < 0.1 * < .05; ** < 0.01; *** < 0.001*		

Verbal Cues

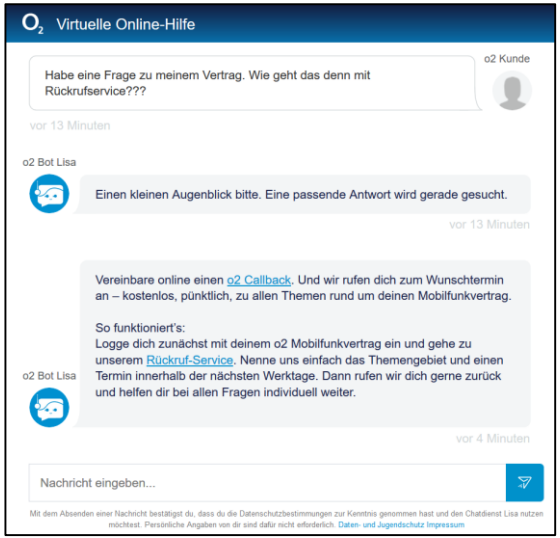


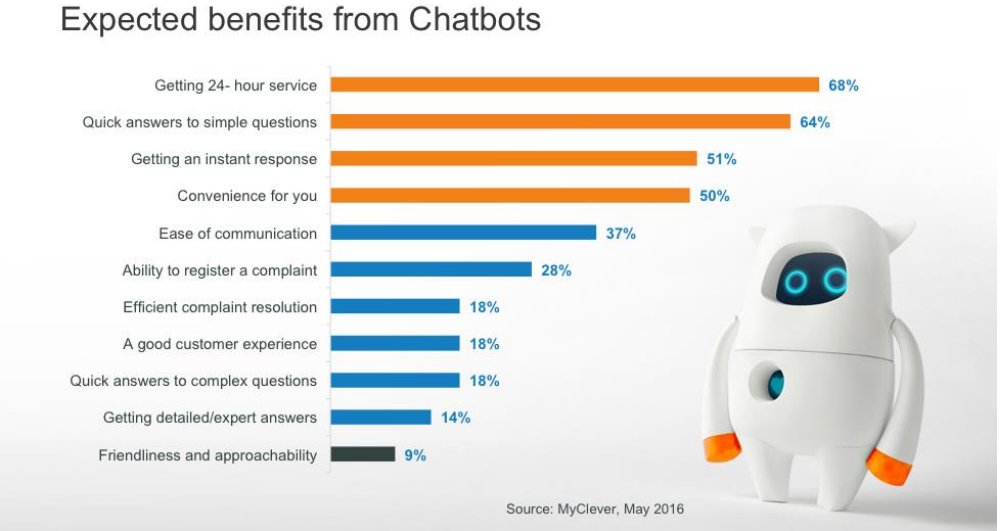
Confused expressions | Excuse / Apologize | Greeting & Farewell | Joke | Small talk | Thanking | ...

Abbrev-iation | Formality | Lexical diversity | Sentence complexity | Strength of language

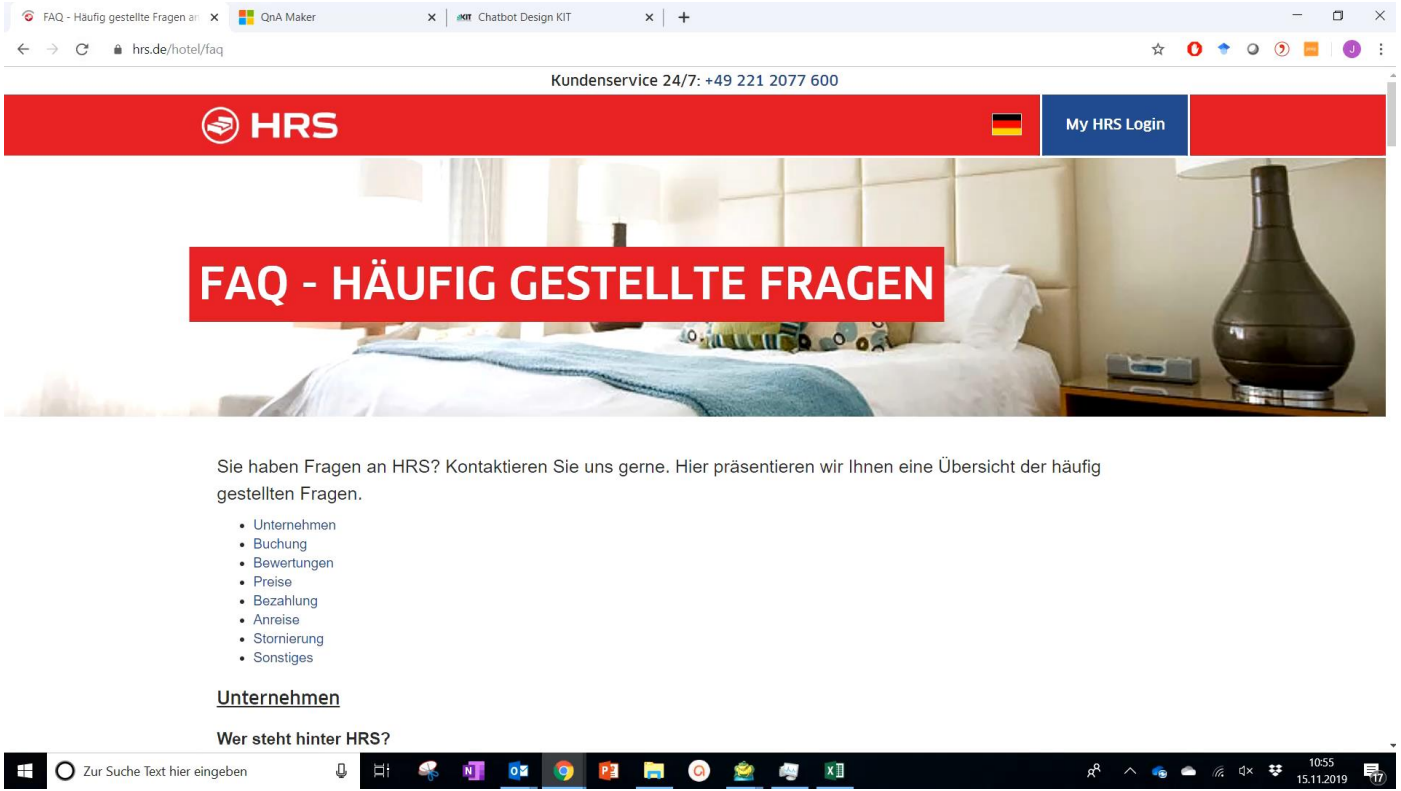
Chatbot Development & Improvement Platform

Chatbots are more and more used …

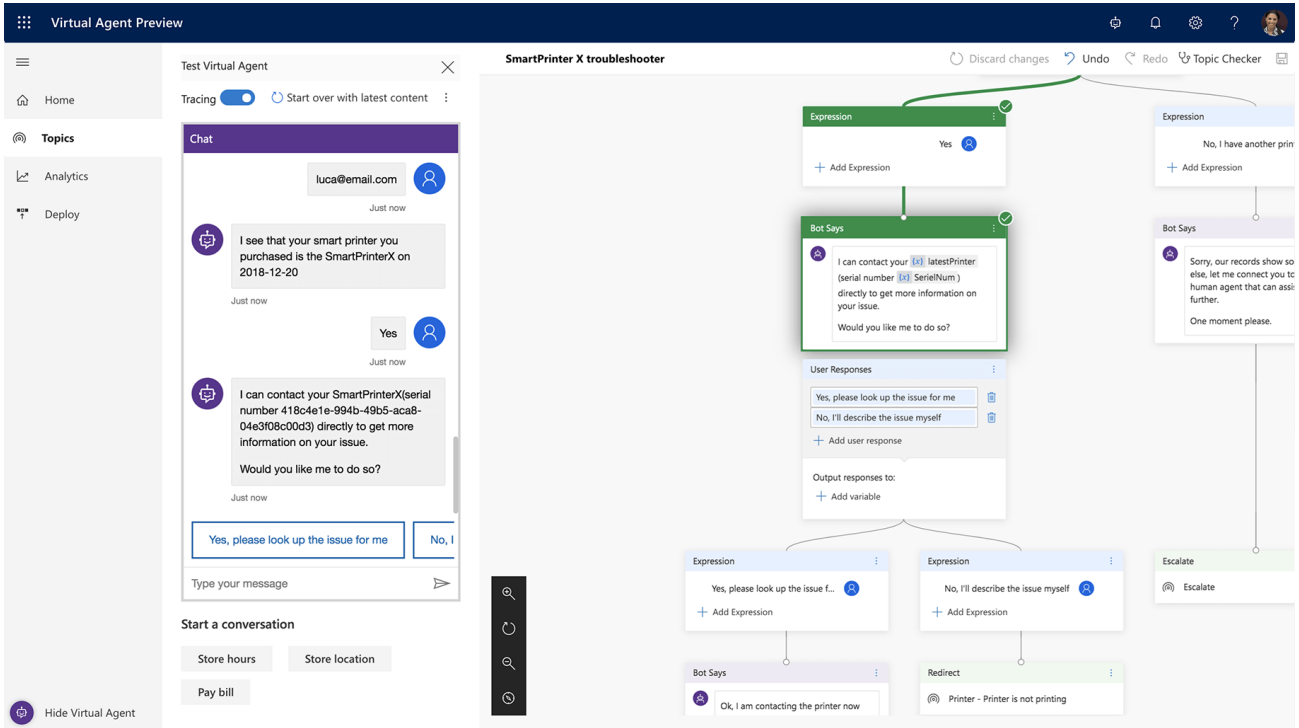




..because they are simple to create …

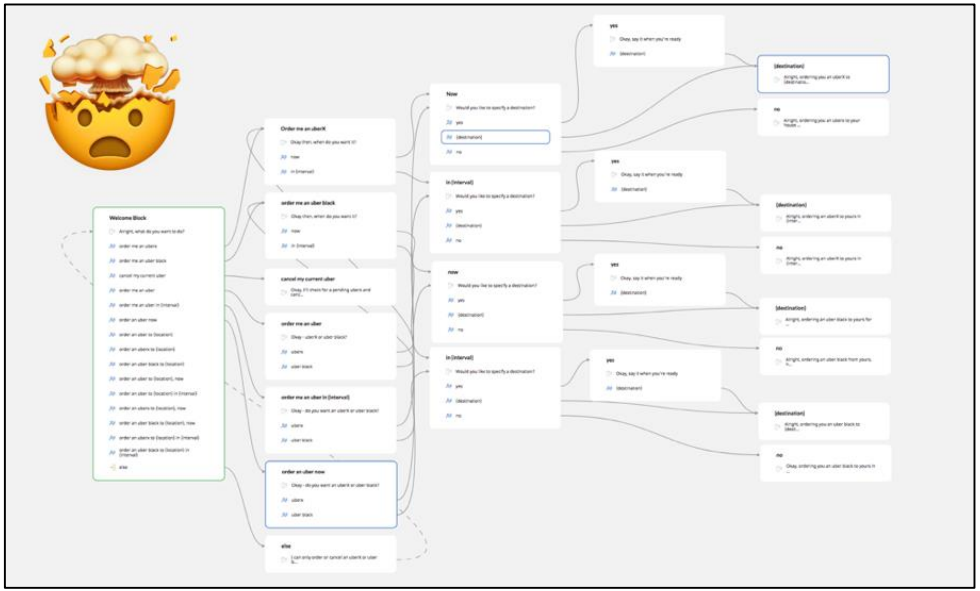


… even without coding! [1]



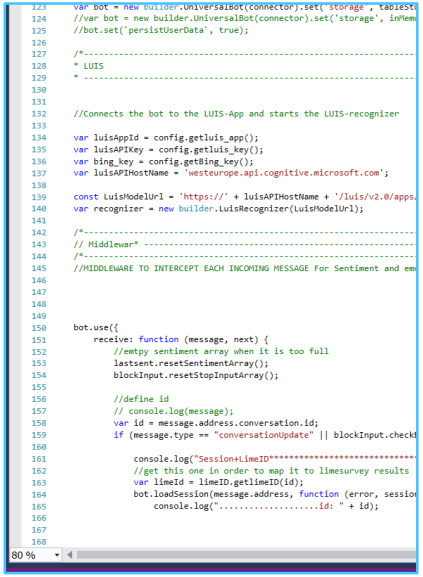
[1] https://techcrunch.com/2019/11/04/microsoft-launches-power-virtual-agents-its-no-code-bot-builder/

Challenging Design of Chatbot Dialogs



WHO is writing chatbot dialogs?

Solution?



```
var bot = new builder.UniversalBot(connector).set('storage', tableSto
//var bot = new builder.UniversalBot(connector).set('storage', inMem
//bot.set(`persistUserData`, true);

/*-----------------------------------------------------------------
* LUIS
* ----------------------------------------------------------------


//Connects the bot to the LUIS-App and starts the LUIS-recognizer

var luisAppId = config.getluis_app();
var luisAPIKey = config.getluis_key();
var bing_key = config.getBing_key();
var luisAPIHostName = 'westeurope.api.cognitive.microsoft.com';

const LuisModelUrl = 'https://' + luisAPIHostName + '/luis/v2.0/apps/
var recognizer = new builder.LuisRecognizer(LuisModelUrl);

/*-----------------------------------------------------------------
// Middlewar*
/*-----------------------------------------------------------------
//MIDDLEWARE TO INTERCEPT EACH INCOMING MESSAGE For Sentiment and em



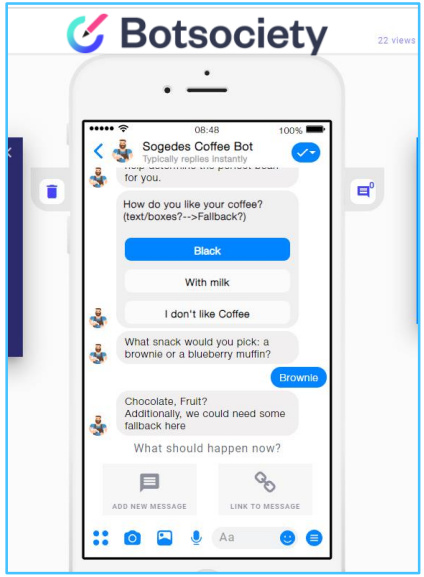
bot.use({
    receive: function (message, next) {
        //emtpy sentiment array when it is too full
        lastsent.resetSentimentArray();
        blockInput.resetStopInputArray();

        //define id
        // console.log(message);
        var id = message.address.conversation.id;
        if (message.type == "conversationUpdate" || blockInput.checkI

            console.log("Session+LimeID**************************
            //get this one in order to map it to limesurvey results
            var limeId = limeID.getlimeID(id);
            bot.loadSession(message.address, function (error, session
                console.log(".....................id: " + id);
```

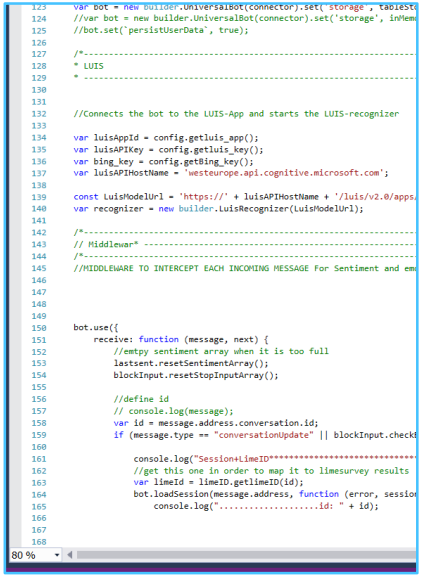
80 %

Chatbot development



Chatbot prototyping

Solution?



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const LuisModelUrl = 'https://' + luisAPIHostName + '/luis/v2.0/apps/
var recognizer = new builder.LuisRecognizer(LuisModelUrl);

/*-----------------------------------------------------------------
// Middlewar*
/*-----------------------------------------------------------------
//MIDDLEWARE TO INTERCEPT EACH INCOMING MESSAGE For Sentiment and em



bot.use({
    receive: function (message, next) {
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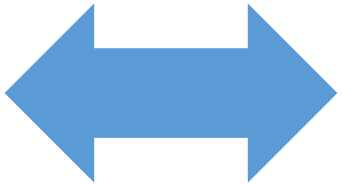
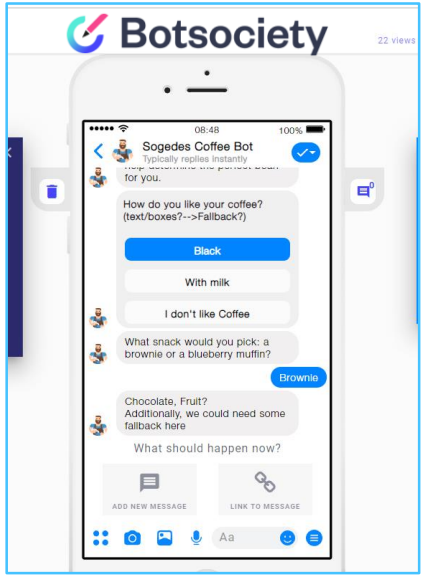
        blockInput.resetStopInputArray();

        //define id
        // console.log(message);
        var id = message.address.conversation.id;
        if (message.type == "conversationUpdate" || blockInput.checkI

            console.log("Session+LimeID**************************
            //get this one in order to map it to limesurvey results
            var limeId = limeID.getlimeID(id);
            bot.loadSession(message.address, function (error, sessio
                console.log(".....................id: " + id);

80 %
```

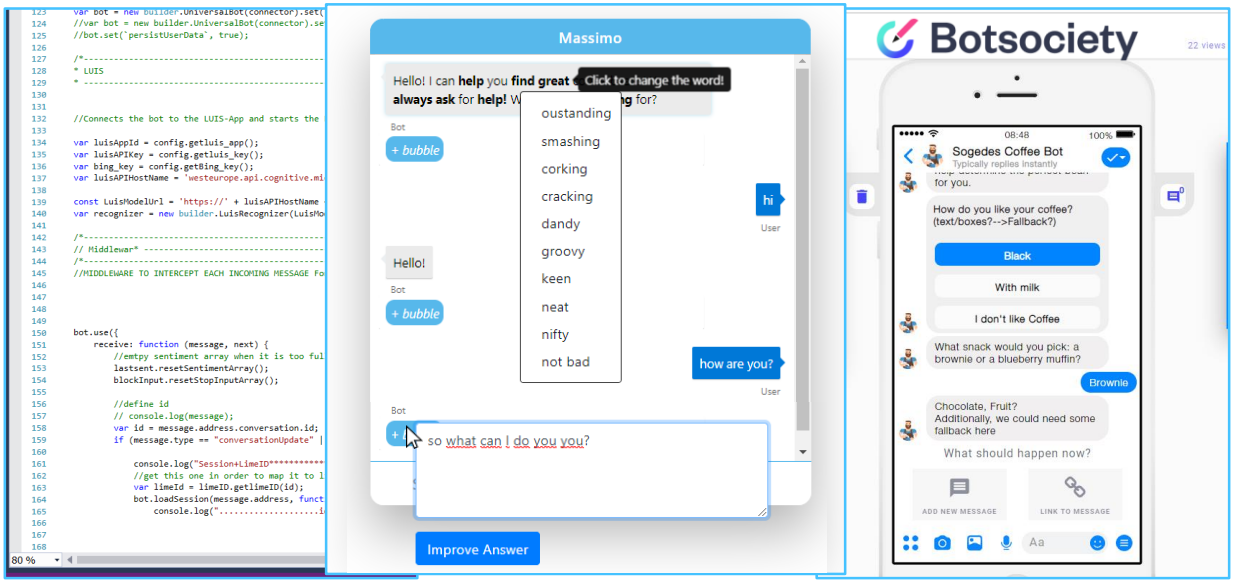




Chatbot development

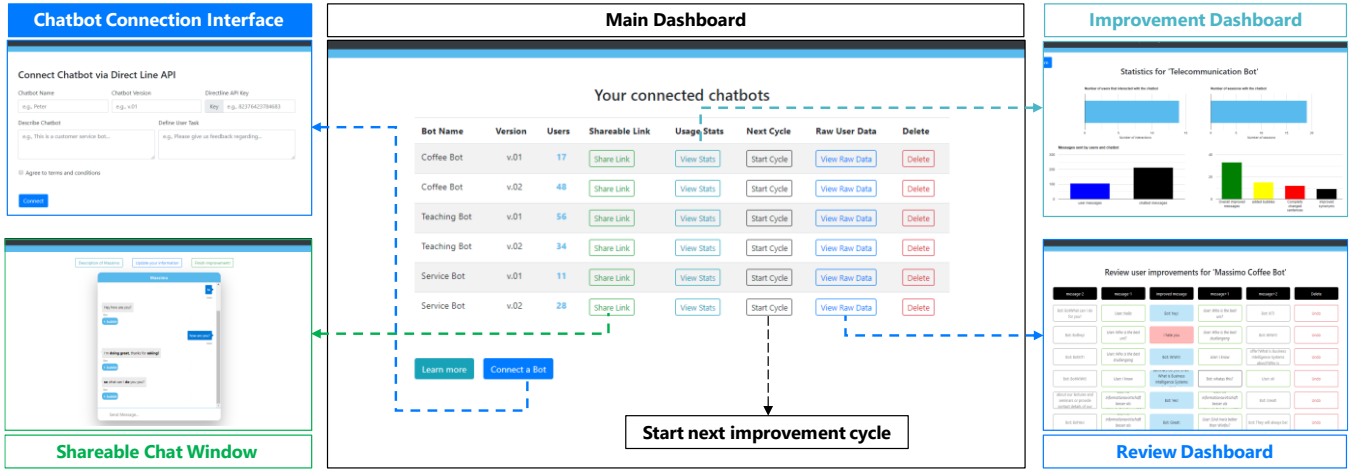
Chatbot prototyping

Solution!



Chatbot developmer | **Chatbot Response Improvement** | **Chatbot prototyping**

Requirements



- **Req 1**: The portal should be compatible with existing chatbots independent of their technology and goal.
- **Req 2**: The portal should engage chatbot users to increase language variation of chatbot responses using both restricted and unrestricted improvement mechanisms.
- **Req 3**: The portal should automatically update chatbot responses based on user improvements from previous cycles without causing additional development effort.

Contact

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