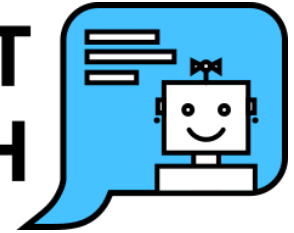




Karlsruhe Institute of Technology

**CHATBOT  
RESEARCH**



# Workshop: Designing the Human-Chatbot Interaction

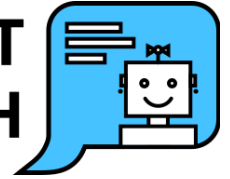
**Stefan Morana – 20.11.2019**

tekem Deutschland e.V., Regionalgruppe Baden, Walldorf



**IISM**

INSTITUTE OF INFORMATION SYSTEMS AND MARKETING



Ulrich  
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Stefan  
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Jasper  
Feine

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Benke

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Alexander  
Maedche

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

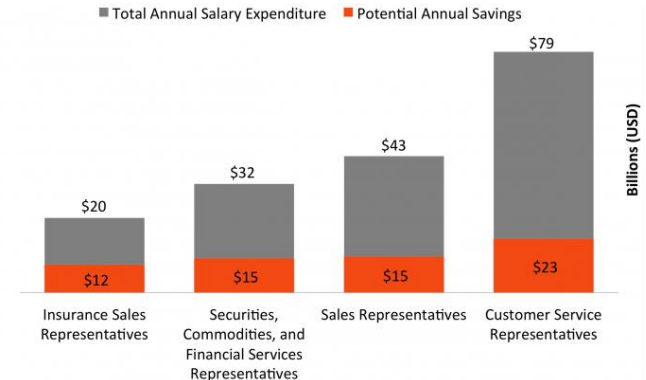
Social Cues in the  
Human-Chatbot  
Interaction

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

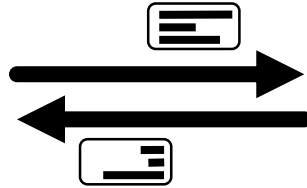
[4] Business Insider (2016), <https://www.businessinsider.de/80-of-businesses-want-chatbots-by-2020-2016-12>

[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?



*Human*

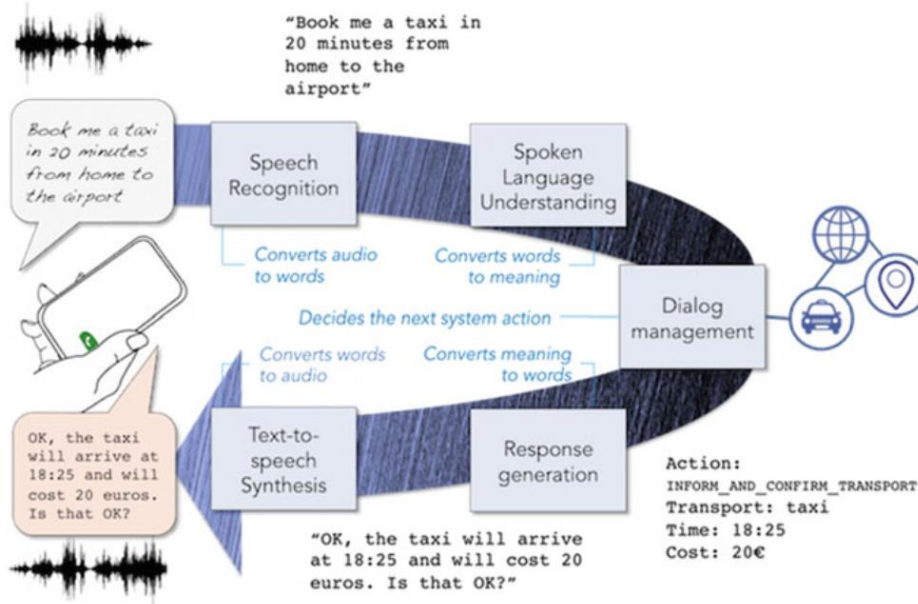


*Chatbot*

- “... 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

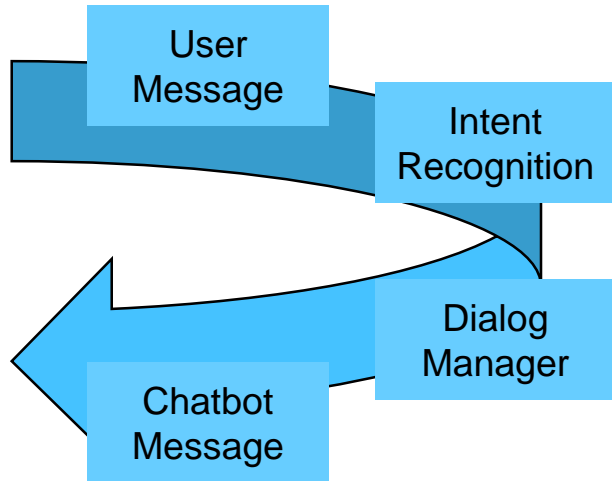
[1] McTear, M., 2002. Spoken Dialogue Technology: Enabling the Conversational User Interface. ACM Computing Surveys, 34(1), pp.90–169.

[2] McTear, M., Callejas, Z. and Griol, D. (2016), The Conversational Interface: Talking to Smart Devices, Springer.



# Chatbot

= Text-based Conversational Agent

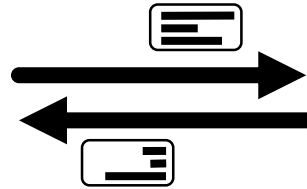


- **User Message:** “I need a hotel room”
- **Intent Recognition:** Identify intent  
<<require room>>
- **Dialog Manager:** Based on intent, select proper dialog, and send response
- **Chatbot Message:** “To book a room, please proceed the following ...”

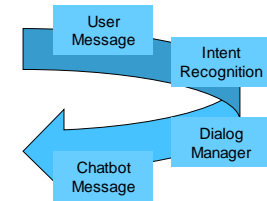
# What is a Chatbot?



Human



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.

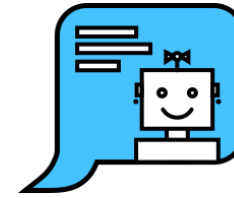
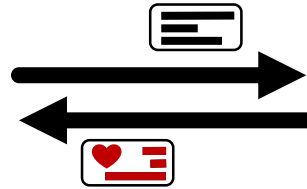
[2] Brandtzaeg, P. B., & Følstad, A. (2017). Why people use chatbots. In *Proceedings of the 4th International Conference on Internet Science* (pp. 377–392).

[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.

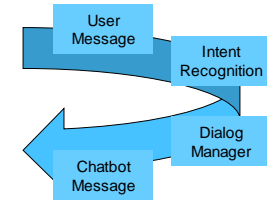
# What is a Chatbot?



Human



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*



*Elvis*



*H&M Bot*



*Anna (retired)*



*Novi*



**wüstenrot**

Partner der Württembergischen

*KFZ-Berater*



*Eve (retired)*



*Wine Bot*



*BotTina*



*Fredl*



*Sophie*

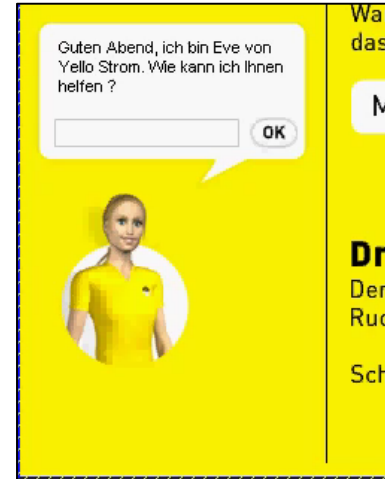
# Why do Chatbots fail?

2005-2016



Anna

2003-2015



Eve

# But ... How to Design a Chatbot?!

**Your Chatbot's Personality Is The Key**

Making Your Chatbots More Human,  
But Not So Human!

**Amazon Alexa to reward kids who say:  
'Please'**

How Funny Should a Chatbot  
Be?

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

**Can Amazon's Alexa Be Your  
Friend?**

**Designing a chatbot: male, female or gender neutral?**

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

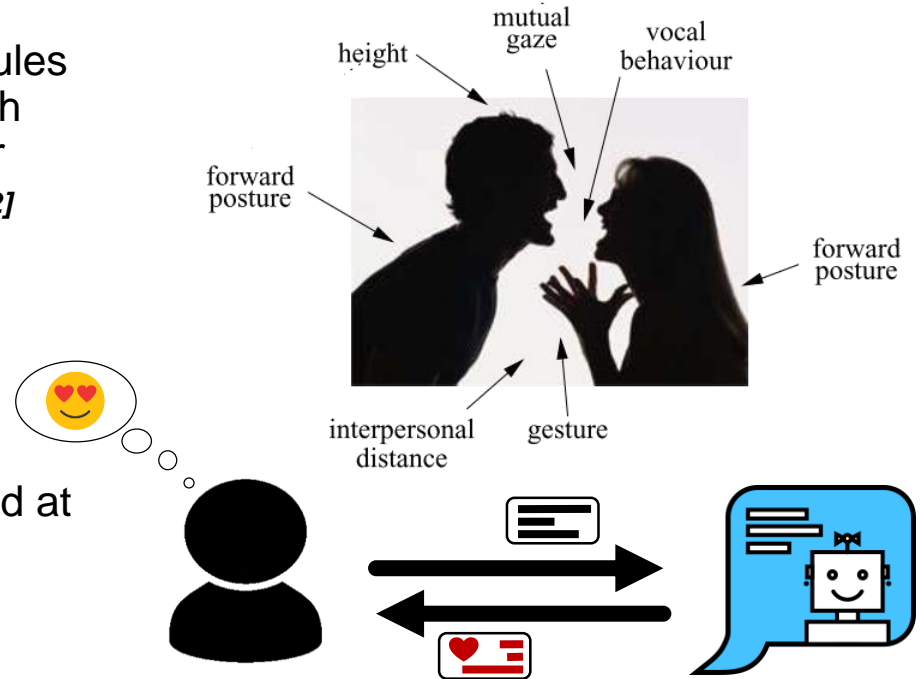
[1] Følstad, A. and Brandtzaeg, P.B. (2017), "Chatbots and the new world of HCI", Interactions, Vol. 24 No. 4, pp. 38–42.

[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]



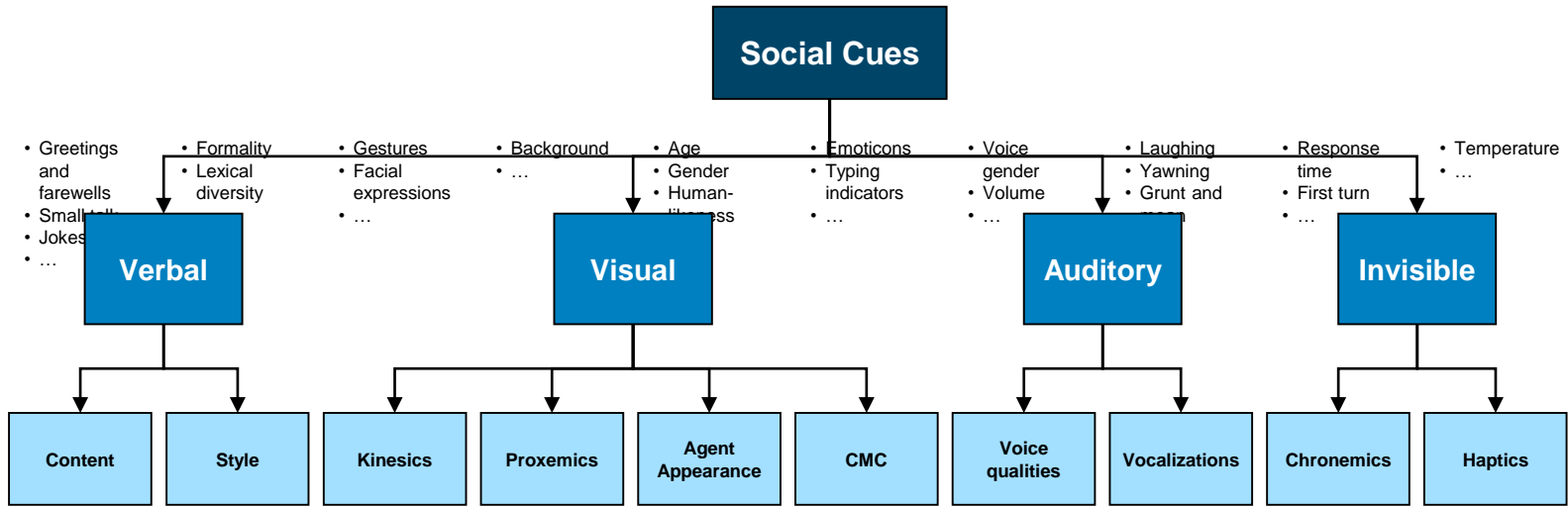
[1] Nass, C., Steuer, J. and Tauber, E.R. (1994), "Computers are social actors", Proceedings of the SIGCHI Conference on Human Factors in Computing Systems, Boston, MA, USA, pp. 72–78.

[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

[submit cue](#) [about](#) [impressum](#) [login](#)


**KIT** Chatbot Design KIT  
Karlsruhe Institute of Technology


Search all cues

## Social Cue Taxonomy

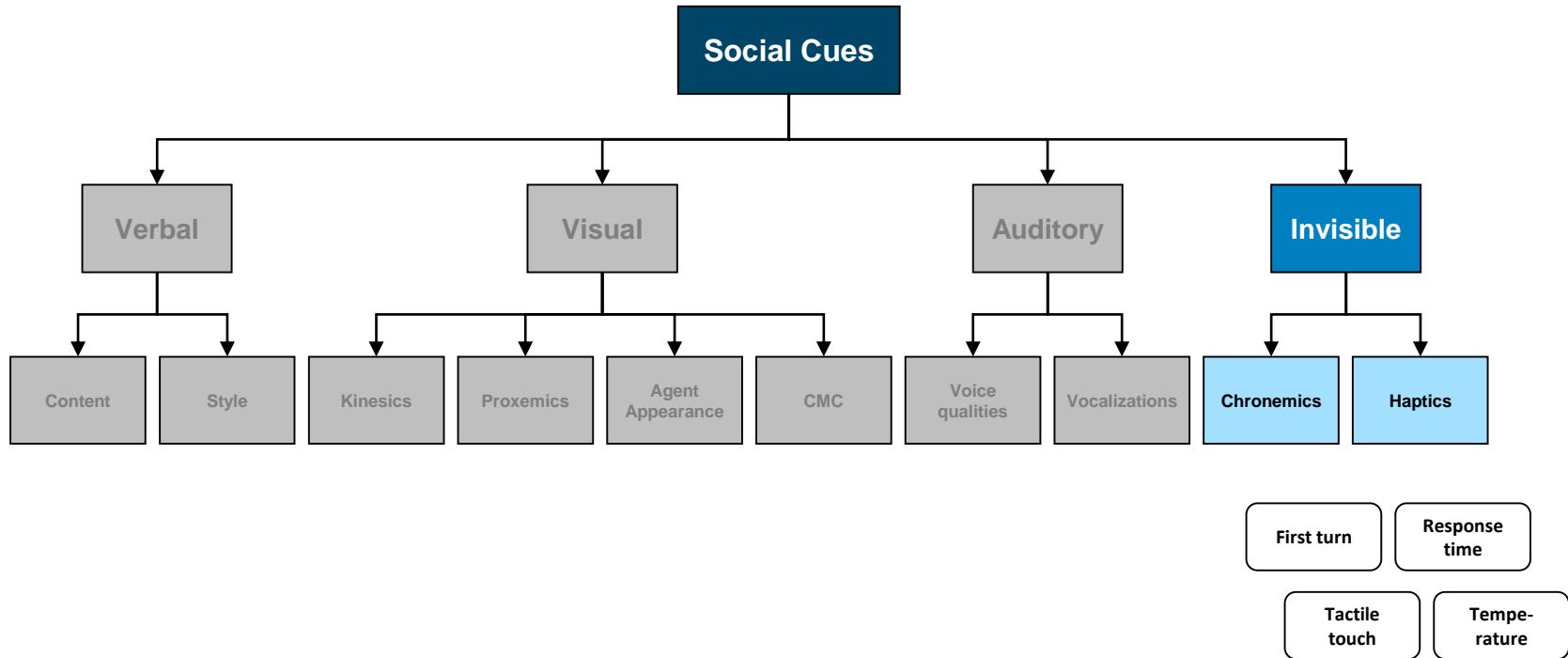
Verbal		Visual				Auditory		Invisible	
Content	Style	Kinesics	Proxemics	Appearance	CMC	Voice Qualities	Vocalizations	Chronemics	Haptics
Ask to start/ pursue dialog	Abbreviation	Arm and hand gesture	Background	2D-/3D-agent visualisation	Emoticons	Pitch range	Grunt and moan	First turn	Tactile touch
Excuse / Apologize	Formality	Eye movement	Conversational distance	Age	Typeface	Voice gender	Laugh	Response time	Temperature
Express content from past	Lexical diversity	Facial expression		Attractiveness		Voice tempo	Vocal segregate		
Greeting and Farewell	Sentence complexity	Head movement		Clothing		Volume	Yawn		
Joke	Strength of language	Posture shift		Color of agent					
Opinion conformity				Degree of human-likeness					
Praise				Facial feature					
Self-disclosure				Gender					
Self-focused question				Name tag					
Small talk				Photorealism					
Thanking									
Tips and advice									

### Available on

## chatbotresearch.com

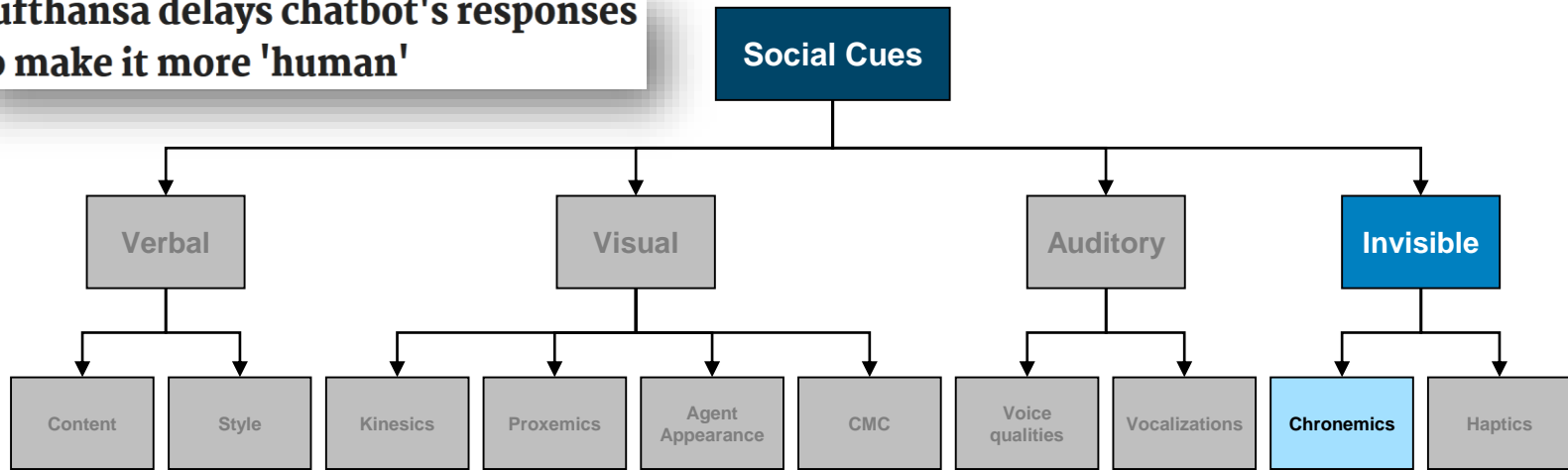


# Invisible Cues

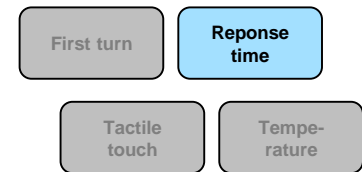


# Lab Experiment – Response Time

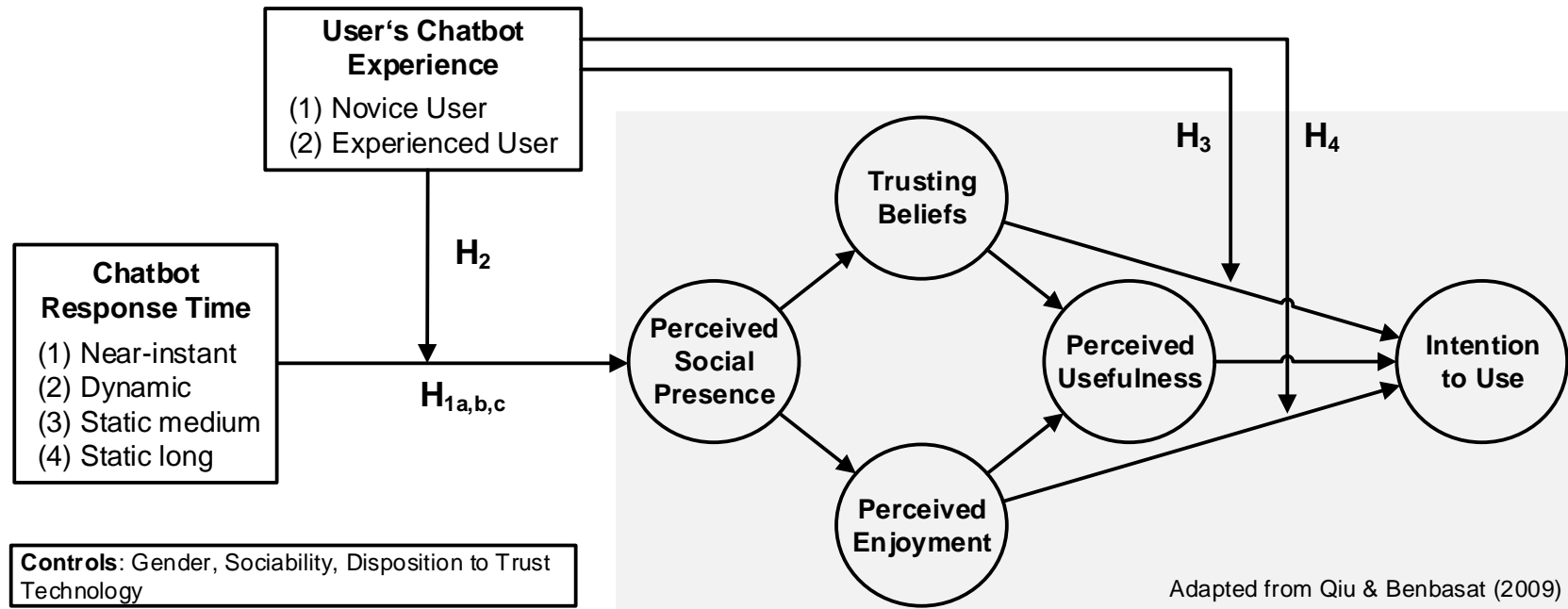
Lufthansa delays chatbot's responses to make it more 'human'



- 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)

Control Group	Treatment Group: Dynamic Response Delays
<p>Hey there!</p> <p>I'm a chatbot trained to help you find the best mobile phone plan for you. How may I help you?</p>	<p>Hello!</p> <p>I'm a chatbot trained to help you find the best mobile phone plan for you. What can I do for you?</p>
Type a message...	Type a message...



## 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 €
<b>Total charges:</b>	<b>32.29 €</b>

**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



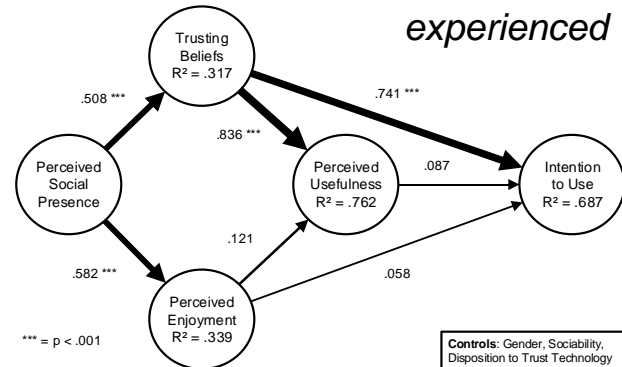
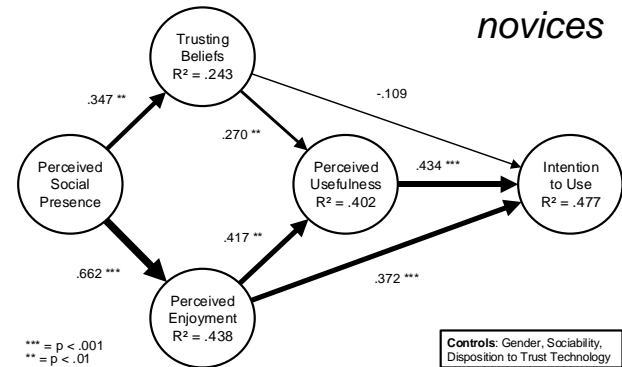
Microsoft Bot  
Builder SDK



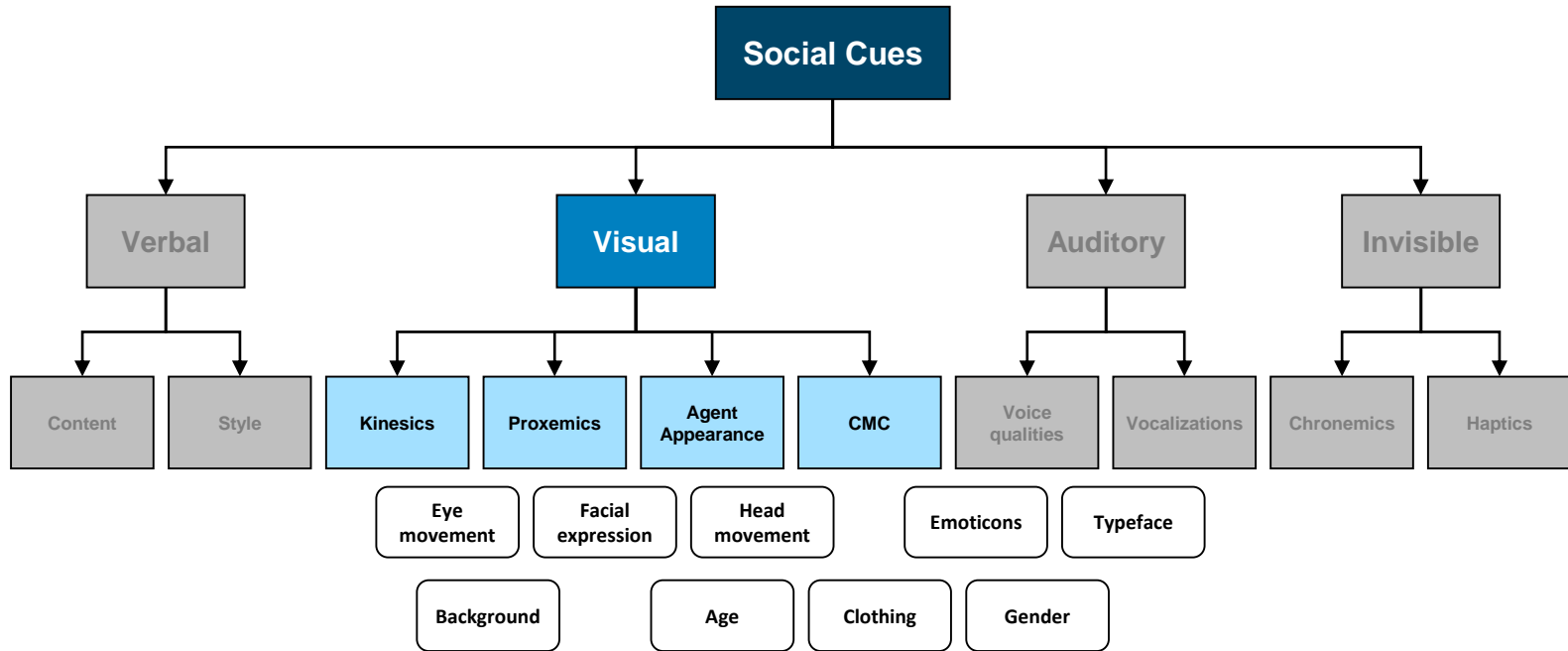
Microsoft  
LUIS

# 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

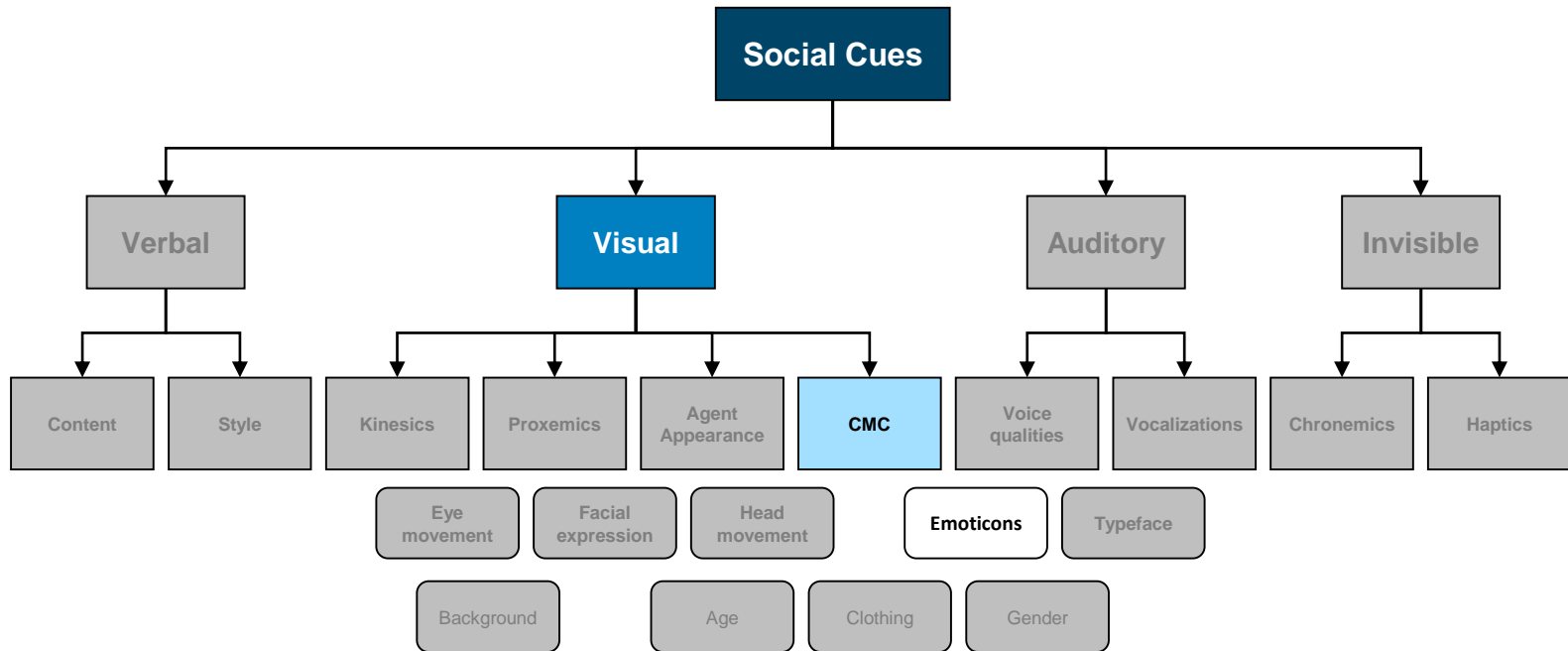


# Visual Cues





# 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

Chat	Chat	Chat
<p>Hey!</p> <p>Chatbot</p> <p>Ich bin ein Chatbot und kann dir bei der Suche nach einem neuen Handytarif helfen. Momentan vergleiche ich die Tarife fast aller Anbieter. Wie kann ich dir helfen?</p> <p>Chatbot um 11:28:46</p> <p>Verfasse eine Nachricht... &gt;</p>	<p>Hey!</p> <p>Chatbot</p> <p>Ich bin ein Chatbot und kann dich bei der Suche nach einem passenden Handytarif unterstützen. Momentan vergleiche ich die Tarife fast aller Anbieter. Wie kann ich dir heute weiterhelfen?</p> <p>Chatbot um 11:28:47</p> <p>Verfasse eine Nachricht... &gt;</p>	<p>Hey!</p> <p>Chatbot</p> <p>Ich bin ein Chatbot und kann dir bei der Suche nach einem neuen Handytarif helfen. Momentan vergleiche ich die Tarife fast aller Anbieter. Wie kann ich dir behilflich sein?</p> <p>Chatbot um 11:28:48</p> <p>Verfasse eine Nachricht... &gt;</p>



Microsoft Bot Builder SDK



Microsoft LUIS

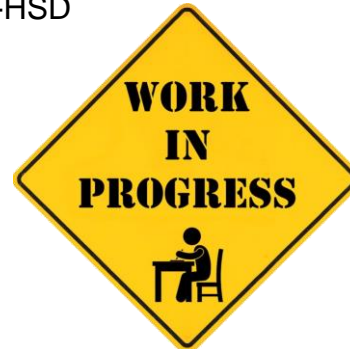
# Online Experiment – Preliminary Findings

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

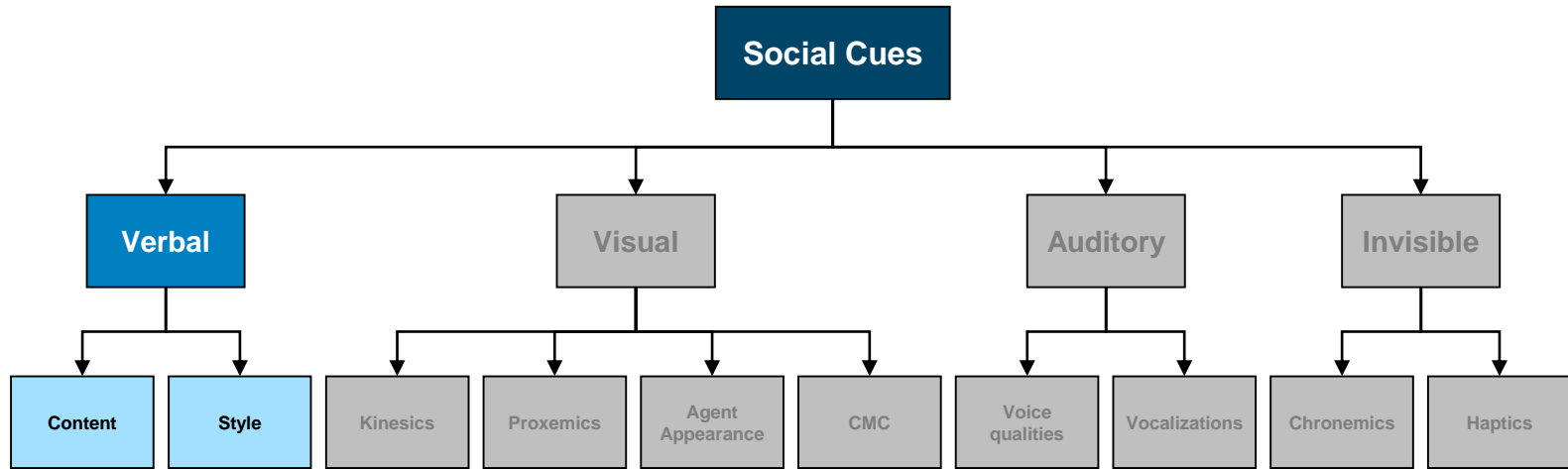
- Chatbot indicated message preparation (1 = “strongly disagree”; 7 = “strongly agree”)
  - $F(2, 186)=439.3, p<.001$  with Tukey-HSD
  - $M_{CTRL} = 2.587, SD = 1.328$
  - $M_{3DOTS} = 6.778, SD = 0.851$
  - $M_{TYPING} = 6.889, SD = 0.317$



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 <sup>2</sup> = 0.068	N = 189 R <sup>2</sup> = 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 | ... |
| Abbreviation         | Formality          | Lexical diversity   | Sentence complexity | Strength of language |          |     |

# Chatbot Development & Improvement Platform

# Chatbots are more and more used ...

O<sub>2</sub> Virtuelle Online-Hilfe

Habe eine Frage zu meinem Vertrag. Wie geht das denn mit Rückrufservice???

o2 Kunde

vor 13 Minuten

o2 Bot Lisa

Einen kleinen Augenblick bitte. Eine passende Antwort wird gerade gesucht.

vor 13 Minuten

Vereinbare online einen [o2 Callback](#). Und wir rufen dich zum Wunschtermin an – kostenlos, pünktlich, zu allen Themen rund um deinen Mobilfunkvertrag.

So funktioniert's:  
Logge dich zunächst mit deinem o2 Mobilfunkvertrag ein und gehe zu unserem [Rückruf-Service](#). Nenne uns einfach das Themengebiet und einen Termin innerhalb der nächsten Werktage. Dann rufen wir dich gerne zurück und helfen dir bei allen Fragen individuell weiter.

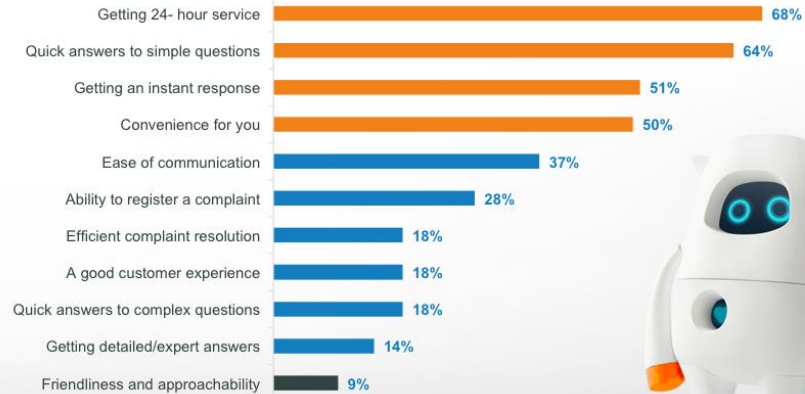
o2 Bot Lisa

vor 4 Minuten

Nachrichte eingeben...

Mit dem Absenden einer Nachricht bestätigst du, dass du die Datenschutzbestimmungen zur Kenntnis genommen hast und den Chatsdienst Lisa nutzen möchtest. Persönliche Angaben von dir sind dafür nicht erforderlich. [Daten- und Jugendschutz Impressum](#)

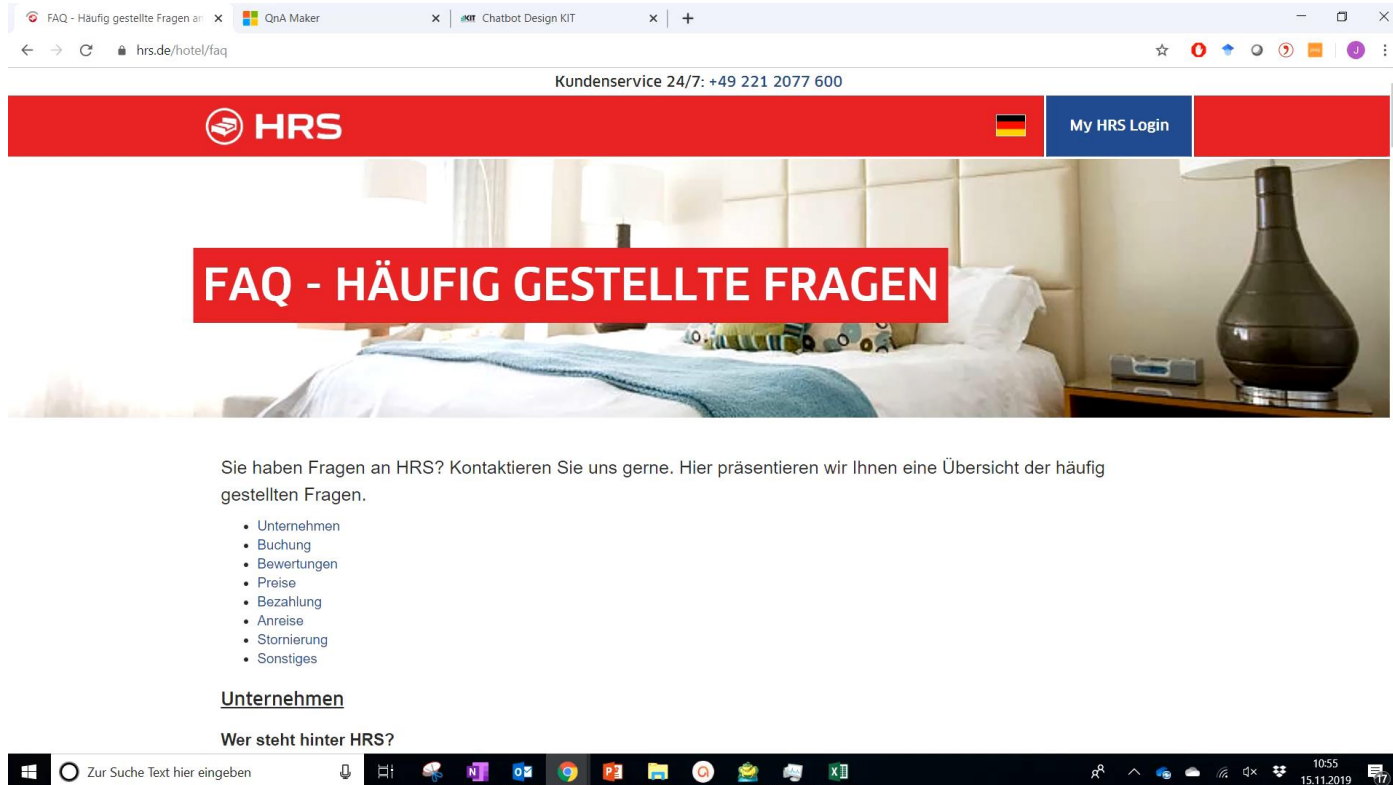
## Expected benefits from Chatbots



Source: MyClever, May 2016



# ..because they are simple to create ...



The screenshot shows a web browser window with the URL `hrs.de/hotel/faq`. The browser tabs include "FAQ - Häufig gestellte Fragen an...", "QnA Maker", and "Chatbot Design KIT". The page header features the HRS logo, a German flag, and a "My HRS Login" button. The main content area has a red banner with the text "FAQ - HÄUFIG GESTELLTE FRAGEN" over a background image of a hotel room. Below the banner, the text reads: "Sie haben Fragen an HRS? Kontaktieren Sie uns gerne. Hier präsentieren wir Ihnen eine Übersicht der häufig gestellten Fragen." This is followed by a bulleted list of categories: "Unternehmen", "Buchung", "Bewertungen", "Preise", "Bezahlung", "Anreise", "Stornierung", and "Sonstiges". A link for "Unternehmen" is underlined. At the bottom, there is a section titled "Wer steht hinter HRS?". The Windows taskbar at the bottom shows the search bar, task view, and various application icons, with the system tray displaying the time as 10:55 on 15.11.2019.

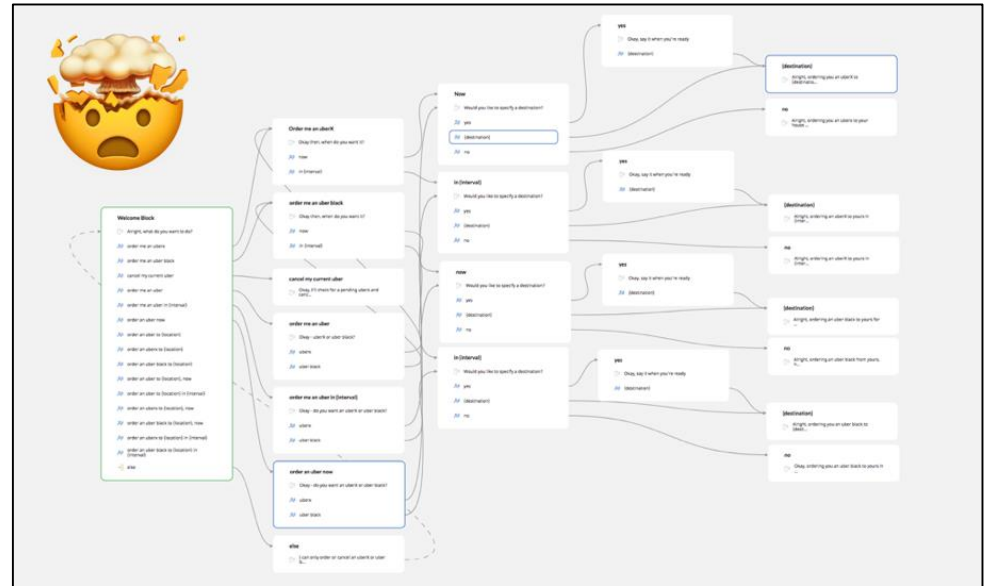
# ... even without coding! [1]

The screenshot displays the Microsoft Power Virtual Agents interface. On the left, a sidebar contains navigation options: Home, Topics, Analytics, and Deploy. The main area is split into two panes. The left pane, titled 'Test Virtual Agent', shows a chat window with a user 'luca@email.com'. The chat history includes a user message about a SmartPrinterX purchase, a bot response identifying the printer and offering assistance, and a user response 'Yes, please look up the issue for me'. The right pane, titled 'SmartPrinter X troubleshooter', shows a visual flowchart. The flowchart starts with an 'Expression' node (Yes) leading to a 'Bot Says' node with a message and a question. Below this is a 'User Responses' section with options like 'Yes, please look up the issue for me' and 'No, I'll describe the issue myself'. The flowchart branches based on these responses to different 'Expression' nodes, which then lead to 'Bot Says' or 'Redirect' nodes. A vertical toolbar with search, refresh, and other icons is visible on the left side of the flowchart area.

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



# Challenging Design of Chatbot Dialogs

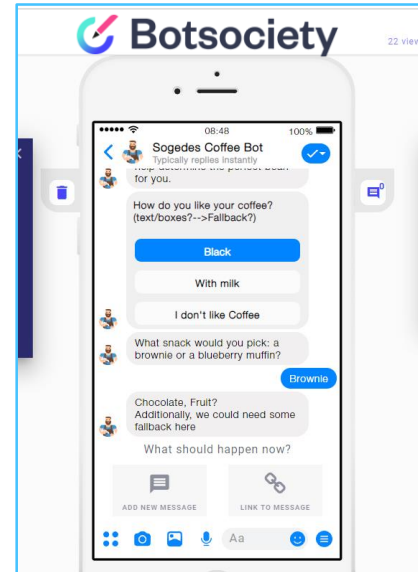


WHO is writing chatbot dialogs?

# Solution?

```
123 var bot = new builder.UniversalBot(connector).set('storage', 'local');
124 //var bot = new builder.UniversalBot(connector).set('storage', 'memory');
125 //bot.set('persistUserData', true);
126
127 /*-----
128 * LUIS
129 * -----
130
131
132 //Connects the bot to the LUIS-App and starts the LUIS-recognizer
133
134 var luisAppId = config.getLuis_app();
135 var luisAPIKey = config.getLuis_key();
136 var bing_key = config.getBing_key();
137 var luisAPIHostName = "westeurope.api.cognitive.microsoft.com";
138
139 const luisModelUrl = "https://" + luisAPIHostName + "/luis/v2.0/apps/";
140 var recognizer = new builder.LuisRecognizer(luisModelUrl);
141
142 /*-----
143 // Middleware
144 *-----
145 //MIDDLEWARE TO INTERCEPT EACH INCOMING MESSAGE For Sentiment and em
146
147
148
149
150 bot.use({
151   receive: function (message, next) {
152     //empty sentiment array when it is too full
153     lastSent.resetSentimentArray();
154     blockInput.resetStopInputArray();
155
156     //define id
157     console.log(message);
158     var id = message.address.conversation.id;
159     if (message.type == "conversationUpdate" || blockInput.check
160
161     console.log("Session+LineID*****");
162     //get this one in order to map it to limesurvey results
163     var lineId = lineID.getLineID(id);
164     bot.loadSession(message.address, function (error, session) {
165       console.log(".....id: " + id);
166
167
168
```

Chatbot development

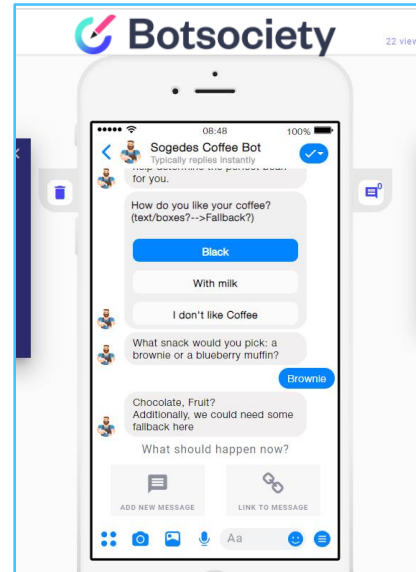
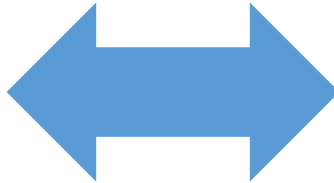


Chatbot prototyping

# Solution?

```
123 var bot = new builder.UniversalBot(connector).set('storage', 'local');
124 //var bot = new builder.UniversalBot(connector).set('storage', 'lmem');
125 //bot.set('persistUserData', true);
126
127 /*-----
128 * LUIS
129 * -----
130
131
132 //Connects the bot to the LUIS-App and starts the LUIS-recognizer
133
134 var luisAppId = config.getLuis_app();
135 var luisAppKey = config.getLuis_key();
136 var bing_key = config.getBing_key();
137 var luisAPIHostName = "westeurope.api.cognitive.microsoft.com";
138
139 const luisModelUrl = "https://" + luisAPIHostName + "/luis/v2.0/apps/";
140 var recognizer = new builder.LuisRecognizer(luisModelUrl);
141
142 /*-----
143 // Middleware
144 *-----
145 //MIDDLEWARE TO INTERCEPT EACH INCOMING MESSAGE For Sentiment and em
146
147
148
149
150 bot.use({
151   receive: function (message, next) {
152     //entropy sentiment array when it is too full
153     lastSent.resetSentimentArray();
154     blockInput.resetStopInputArray();
155
156     //define id
157     console.log(message);
158     var id = message.address.conversation.id;
159     if (message.type == "conversationUpdate" || blockInput.check
160
161     console.log("Session+LineID*****");
162     //get this one in order to map it to limesurvey results
163     var lineId = lineID.getLineID(id);
164     bot.loadSession(message.address, function (error, session) {
165       console.log(".....id: " + id);
166
167
168
169
170
```

Chatbot development



Chatbot prototyping

# Solution!

The image is a composite of three panels illustrating a chatbot solution:

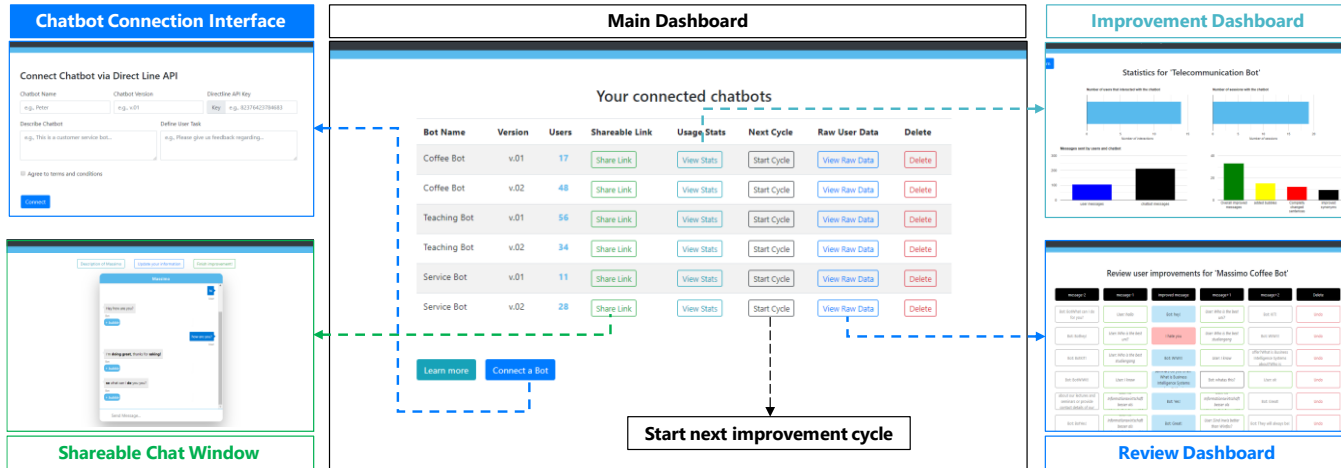
- Left Panel:** A code editor showing JavaScript code for a bot using the Microsoft Bot Framework. The code includes LUIS integration and message handling logic.
- Middle Panel:** A web-based interface for a chatbot named "Massimo". It shows a conversation where the user asks "Hello!" and the bot responds with "Hello! I can help you find great... always ask for help! What are you looking for?". A dropdown menu lists suggestions: "outstanding", "smashing", "corking", "cracking", "dandy", "groovy", "keen", "neat", "nifty", and "not bad". A text box contains "so what can I do you you?". A button labeled "Improve Answer" is at the bottom.
- Right Panel:** A mobile app prototype for "Sogedes Coffee Bot". The interface shows a chat conversation with options like "Black", "With milk", "I don't like Coffee", and "Brownie".

Chatbot  
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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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