Affordances in human-chatbot interaction: a review of the literature

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Abstract. The present study advances our understanding of human-AI interactions, by identifying and analyzing chatbot affordances in prior research. The results of this review consolidate research findings on chatbots' affordances, which must be taken into consideration when chatbot-based services are designed and deployed. Specifically, the review of state-of-the-art literature led to the identification of nine high level affordances: Human Like Conversing, Assistance Provision, Facilitation, Distilling Information, Enriching Information, Context Identification, Personalization, Fostering Familiarity and Ensuring Privacy. Our contribution is twofold. First, we map the chatbot affordances identified in prior research and group them in higher-level, overarching affordances through a thematic analysis. Furthermore, we identify areas for future research providing a foundation for researchers aiming to engage with the research area.

Keywords: Chatbots, human-chatbot interaction, human-AI interaction, affordances, review

1 Introduction

Chatbots, or conversational agents, are increasingly being used in various contexts to handle large volumes of inquiries from customers [1], to automate mundane tasks internally in organizations [2], or for the delivery of public services, with a focus on citizen inquiries and information [3]. They use natural language to interact and communicate with different users, allowing 'rich' and expressive digital interactions convincingly simulating how a human would behave in a conversation [4]. Chatbots not only automate communication tasks replacing humans but also, provide opportunities for developing new types of services through synergies between humans and digital agents [5]. Since the early chatbot developments back in the 1960s, chatbots have significantly

improved leveraging advancements in machine learning (ML), natural language processing (NLP) [6], natural language understanding (NLU) [1], natural language generation (NLG) [7], and other artificial intelligence techniques. By 2024, chatbots are projected to facilitate 142 billion US dollars of retail enabled by the advances in NLU capabilities that allow to significantly increase chatbot effectiveness [8].

There is an increase in implementing chatbots in online service encounters. Many companies communicate with their end users through chatbots, on either their own website or via social media [9]. Typically, chatbots are introduced to reduce or eliminate the waiting time customers spend on phone or email-inquiries or reduce the workload of chat employees [1]. Chatbots have proven to be very useful for addressing demand surges handling inquiries that correspond to the capacity of multiple human agents. This has been especially useful during the major crisis caused by the Covid-19 pandemic [10]. Recent studies discuss the required characteristics of chatbots along with the pitfalls that must be avoided [11, 12], while offering suggestions for further advancements in chatbot technologies through innovations such as sentiment-adaptive responses for increased empathy [13]. There is extensive research on chatbot features, nevertheless, for the design and deployment of chatbot-based services it is important to leverage insights that go beyond chatbots´ capabilities. Service design relies on insights for the emergent relations between users and chatbots and especially the synergetic relationships that make possible human-AI hybridization in service offerings [14].

To better understand and explain the complex relations between humans and AI, we take an affordance theory perspective [15], as it can help conceptualize what action possibilities chatbots afford to their users. Affordances are "possibilities for goal-oriented action afforded to specified user groups by technical objects" [16]. Taking into account the vast increase of chatbot implementations across industries, it is critical to explore the action possibilities offered by chatbots helping to advance research and practice from the traditional uses of chatbots for task substitution (AI substitutes humans by chatbots responding to user inquiries) towards the combination of chatbots with human agents in new types of task assemblages.

The present study identifies, analyses, and integrates empirical research on chatbot affordances across different contexts. We performed a systematic literature review covering empirical studies done in the last five years in this research area. The research question is as follows: What affordances of chatbots are identified in prior literature? Our contribution is twofold. First, we map the chatbot affordances identified in prior research and group them in higher-level, overarching affordances through a thematic analysis. The results of this review offer important information on chatbots' affordances, which can inform the design of chatbot-based services. Furthermore, we identify areas for future research providing a foundation for researchers aiming to engage with this research area.

The remainder of the paper is organized as follows. First, we present the method used for selecting and analyzing the articles for this review. Then, we present the findings and the groupings of affordances. We continue by discussing the implication these findings have for further research, before we end with overall concluding remarks.

2 Research method

In this systematic literature review we followed the process as described by Kitchenham [17] who presents a structured approach comprising three main steps: a) planning the review, where a detailed protocol containing specific search terms and inclusion/exclusion criteria is developed, b) conducting the review, where the selection, appraisal and synthesis of prior published research is performed and c) reporting the review, where the write-up is prepared. We used these steps as our methodological framework. Further, we implemented key principles offered by Webster and Watson [18] for the article analysis. Following these principles, we identified key concepts and created a concept-centric matrix that provides an overview of the literature reviewed.

To identify and select research articles to be reviewed, we used the terms "Chatbot AND affordance", "Conversational-agent AND affordance", "Chat-agent AND affordance". We searched for these combinations in the abstract, title and keywords of published articles. Moreover, we performed backward and forward searches to review relevant citations. While the main search was performed in Scopus, we used Google Scholar for our backward and forward searches.

Inclusion and exclusion criteria were established to reduce selection bias, guarantee the quality of the papers selected and increase the validity of our review. Peer-reviewed, empirical papers, written in English, published in the last five years were included. Conceptual papers that lacked empirical evidence, reviews, papers that did not have an author, all duplicate, and papers not in English were excluded. The initial search yielded 67 articles in total. The next step was to read the titles and abstracts of the articles identified checking their relevance to the research question. For this step the exclusion criteria were used. After this step, 48 papers were shortlisted. Finally, the full text of the shortlisted papers was assessed for relevance leading to 9 papers being included in the review. Figure 1 provides an overview of the selection process and Table 1 presents the list of articles included in the final review corpus.

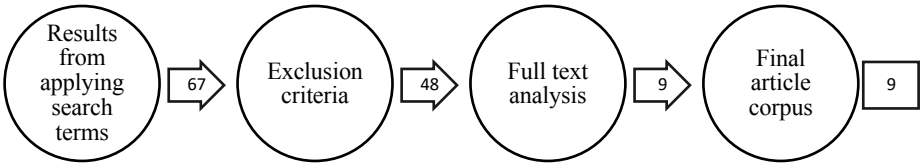

Figure 1 The literature selection process.

Table 1. Final article corpus

#	References
1	Barnett, A., Savic, M., Pienaar, K., Carter, A., Warren, N., Sandral, E., & Lubman, D. I. (2020). Enacting 'more-than-human'care: Clients' and counsellors' views on the multiple affordances of chatbots in alcohol and other drug counselling. International Journal of Drug Policy, 102910.
2	Knote, R., Janson, A., Söllner, M., & Leimeister, J. M. (2020). Value Co-Creation in Smart Services: A Functional Affordances Perspective on Smart Personal Assistants. Journal of the Association for Information Systems, 78

3	Lippert, A., Gatewood, J., Cai, Z., & Graesser, A. C. (2019). Using an Adaptive Intelligent Tutoring System to Promote Learning Affordances for Adults with Low Literacy Skills. Adaptive Instructional Systems. HCII 2019. Lecture Notes in Computer Science, 11597, 327-339.
4	Lunberry, D., & Liebenau, J. (2020). Human or Machine? A Study of Anthropomorphism Through an Affordance Lens. Digital Transformation and Human Behavior. Lecture Notes in Information Systems and Organisation, 37, 201-215.
5	Meske, C., Amojo, I., & Thapa, D. (2020). Understanding the Affordances of Conversational Agents in Mental Mobile Health Services. ICIS 2020 Proceedings.
6	Moussawi, S. (2018). User Experiences with Personal Intelligent Agents: A Sensory, Physical, Functional and Cognitive Affordances View. SIGMIS-CPR'18: Proceedings of the 2018 ACM SIGMIS Conference on Computers and People Research, 86–92.
7	Stoeckli, E., Dremel, C., Uebernickel, F., & Brenner, W. (2020, 06). How affordances of chatbots cross the chasm between social and traditional enterprise systems. Electron Markets, 30, 369–403.
8	Stoeckli, E., Uebernickel, F., & Brenner, W. (2018). Exploring Affordances of Slack Integrations and Their Actualization Within Enterprises –Towards an Understanding of How Chatbots Create Value. Hawaii International Conference on System Sciences (HICSS)
9	Waizenegger, L., Seeber, I., Dawson, G., & Desouza, K. (2020). Conversational agents-exploring generative mechanisms and second-hand effects of actualized technology affordances. In Proceedings of the 53rd Hawaii international conference on system sciences.

The full texts of the papers identified were analyzed. All the different chatbot affordances identified in the papers were listed. We then performed a thematic analysis grouping together affordances in higher level affordances. The outcome of this analysis is presented in the next section.

3 Results

This section presents the literature review results. Prior research has investigated the action possibilities provided by chatbots in different contexts. Across these different contexts, 91 different affordances have been identified and grouped in nine categories.

Affordances related to Human-like Conversing

Chatbots provide to users action possibilities for engaging in conversations. They represent a shift in how people interact with software applications. They can produce human-like message content allowing users to communicate with computers using natural language. Due to advancements in natural language processing and interpretation and progress in conversational modelling the flow of conversation with chatbots is becoming smoother than ever. Chatbots can infer users' intent, synthesize answers responding to users in natural language and retain the conversation context to answer follow-up questions. Table 2 provides an overview of the affordances related to human-like conversing in the literature reviewed.

Table 2. Affordances related to Human-like Conversing

Related Affordances Identified in the Literature	
Capture, Storage and Renderings of Voice Recordings	Lunberry and Liebenau [19]
Mimicry of Human-like Conversation Methods	
Mimicry of Human-like Conversational Elements	
Presentation of Human-like Message Content	
Fostering team cohesion	Stoeckli, Dremel [2]
Enforcing discipline and compliance	
Socializing	Waizenegger, Seeber [20]
Mitigating boredom	
Simulating a human-like interaction	
Depending on the degree of anthropomorphism of virtual anthropomorphic advisors, they afford users to establish positive emotions (such as empathy) to increase users' satisfaction during and after value co-creation in a U-shaped manner	
Through their anthropomorphic design, virtual anthropomorphic advisors help users overcome information disclosure barriers in value co-creation	
Hands-free and eyes-free use	Moussawi [21]
Communication	Lippert, Gatewood [22]

Affordances related to Assistance Provision

Chatbots are commonly used to assist employees of organizations or external audiences (customers, patients, or citizens in general in the context of public services) in their everyday transactions. They can carry out a range of assistive tasks such as setting and getting reminders and notifications, invoking software functionality, or accessing relevant information. The chatbot assistance capabilities provide to users interesting novel action possibilities, they can offload some of their everyday tasks to these smart agents and they can get smart support for their exchanges with service providers. Table 3 provides an overview of the affordances related to assistance provision in the literature reviewed.

Table 3. Affordances related to Assistance Provision

Related Affordances Identified in the Literature	
Receiving status notifications and updates	Stoeckli, Dremel [2]
Receiving real-time information	
Receiving metrics and key performance indicators	
Setting and getting reminders	
Setting and getting nudges/triggers to action	
Having messages processed and replaced	
Increasing visibility and ambient awareness	
Relieving employees from application switching	
Relieving employees from repetitive work	

Receiving status notifications and updates	Stoeckli, Uebernickel [23]
Receiving real-time information	
Receiving metrics and key performance indicators	
Getting reminded	
Getting nudges	
Getting a nudge to action and resolve it	
Invoking functionality	
Invoking functionality and making invocation visible	
Instantaneous solving of fact-based questions	Waizenegger, Seeber [20]
Executing tasks	
Help-seeking for personal issues	
Relief from mundane tasks	
Self-servicing	
Different affordances according to their unique combinations of material properties that influence value co-creation in smart services.	Knote, Janson [24]
Afford users to spend more cognitive load on the actual value-creating task rather than on interacting with the system.	
Afford users to identify the technical object as an expert in a certain domain.	
Speedy assistance	Moussawi [21]
Usefulness	
Access relevant information	Meske, Amojo [25]
Engage with application	
Minimising human error and maximising expertise	Barnett, Savic [26]

Affordances related to Facilitation

Chatbots can offer facilitation in the relationship between users and organizations. They provide users action possibilities for querying information or invoking functionalities from third party systems without engaging directly with the third parties. They can unify access across multiple systems offering external integration. Overall, chatbots can reduce the effort required for different tasks through their facilitation. Table 4 provides an overview of the affordances related to facilitation in the literature reviewed.

Table 4. Affordances related to Facilitation

Related Affordances Identified in the Literature	
Capturing data in third party systems	Stoeckli, Dremel [2]
Querying information from third-party systems	
Invoking functions from third-party systems and make this invocation visible	
Unifying access to third-party systems	
Building rapid prototypes (F)	

General activity assistants afford smart service stakeholders to co-create value through external integration, and, thus, shape affordances accordingly in a reciprocal and dynamic manner.	Knote, Janson [24]
Contact relevant institutions	Meske, Amojo [25]

Affordances related to Distilling Information

Chatbots provide users with action possibilities related to distilling information. For instance, they aggregate information, they facilitate users´ understanding of large information amounts and they can even help users reflect on the information they provide for their own mood or mental state. Table 5 provides an overview of the affordances related to distilling information in the literature reviewed.

Table 5. Affordances related to distilling information

Related Affordances Identified in the Literature	
Receiving aggregated information	Stoeckli, Uebernickel [23]
Ensuring information flow through uncoupling	Stoeckli, Dremel [2]
Receiving aggregated information	
Afford users to effectively access and better understand large amounts of potentially consecutive information necessary for information-intensive value co-creation in a particular domain of interest.	Knote, Janson [24]
Reflect own mood/mental state	Meske, Amojo [25]

Affordances related to Enriching Information

Chatbots can enrich the information provided. For instance, they can enrich information visually or with additional text. This way, they can accelerate communication making it possible to connect more effectively. AI-enabled information enrichment makes chatbots more helpful as assistants in everyday tasks. Table 6 provides an overview of the affordances related to assistance provision in the literature reviewed.

Table 6. Affordances related to enriching information

Related Affordances Identified in the Literature	
Having messages processed and enriched with additional information	
Having messages processed and visually enriched with user interface elements	Stoeckli, Dremel [2]
Voice facilitators afford the facility to complement or replace interaction modes other than voice in value co-creation with respect to specific user needs.	
Voice facilitators afford the facility to complement other smart services through external integration that enable/shape new value co-creation possibilities.	
General activity assistants rely on continuous adaptation in affordance actualization processes through crowd data integration to improve value co-creation.	Knote, Janson [24]

Affordances related to Context Identification

Chatbots can provide context to what users are talking about or looking for. Hence, they can identify problem-specific information, provide feedback as reaction and orient ongoing conversations. Related affordances are presented in table 7.

Table 7. Affordances related to context identification

Related Affordances Identified in the Literature	
Consolidating information flow	Stoeckli, Dremel [2]
Facilitating feedback as reaction and discussions	
Separating organizational units	
Capturing data	Stoeckli, Uebernickel [23]
Querying information	
Having messages processed and replaced	
Afford users to explore a wide range of value co-creation possibilities for different purposes within their ecosystem.	Knote, Janson [24]
Identify problem specific information	Meske, Amojo [25]
Access to other affordances	
Identify relevant institutions	
Identify others with similar problems	
Identify problem specific information	

Affordances related to Personalization

Chatbots contribute to the provision of personalized experiences. They are able to adapt interactions to their users providing tailored responses, adjusting their tone and style. Personalization means that the chat becomes more appealing to the user. As chatbots learn from interactions further they continually improve personalization. Related affordances found in the papers reviewed are presented in table 8.

Table 8. Affordances related to personalization

Related Affordances Identified in the Literature	
Personal assistance	Waizenegger, Seeber [20]
SPAs provide different affordances for specified users or user groups, which in turn influences value co-creation in smart services.	Knote, Janson [24]
Personalization and learning from interactions	Moussawi [21]
Interactivity	Lippert, Gatewood [22]
Adaptivity	
Feedback	
Choice	
Nonlinear access	
Linked representations	
Open-ended learner input	

Affordances related to Fostering Familiarity

The use of chatbots requires little prior experience as practically everybody is familiar with chat applications nowadays. Users are increasingly familiar with messaging and

chatbots allow them to express their needs directly through a familiar interaction mode. The familiarity with the channel allows also tensions to emerge, user satisfaction can be followed by disappointment when expectations are not fulfilled. Related affordances found in the papers reviewed are presented in table 9.

Table 9. Affordances related to fostering familiarity

Related Affordances Identified in the Literature	
Emerging Tensions: Satisfaction and Disappointment	Moussawi [21]
Emotional connection	
Familiarity and Potential Improvement	

Affordances related to Ensuring Privacy

Chatbots employ privacy preserving approaches and may also act as gatekeepers for access to different functions. Chats may require the disclosure of key information about users so, it is important to ensure privacy in conversations. Related affordances found in the papers reviewed are presented in table 10.

Table 10. Affordances related to ensuring privacy

Related Affordances Identified in the Literature	
Adding gatekeepers that validate access to function of third-party systems	Stoeckli, Dremel [2]
Adding gatekeeper Stoeckli, Dremel [2]	Stoeckli, Uebernickel [23]
Leveraging anonymity	Waizenegger, Seeber [20]
If the user is aware that the data-driven active observer collects context and usage data, information disclosure barriers (such as privacy and trust concerns) will negatively influence value co-creation in smart services.	Knote, Janson [24]

4 Discussion and Conclusions

The present study advances our understanding of human-AI interactions, by identifying and analyzing the affordances of chatbots through a systematic review of the state-of-the-art literature in the area. By conducting a thematic analysis, we present 9 higher level affordances that capture the variety of action possibilities that chatbots afford to their users. Table 11 provides a concise overview of the papers reviewed in the form of a concept matrix.

The results show that the literature covers the two key perspectives regarding the users of chatbots. These are: 1) the customers' perspective, including a large variety of audiences, such as consumers, patients, and service seeking citizens, and 2) the employee's perspective, including employees that seek interorganizational collaboration but also employees that simply aim to improve their efficiency in day-to-day tasks. Furthermore, prior research covers both text and voice based chatbots. The mapping of

these affordances enables the better understanding of the complex interrelations between humans and AI enabled services, towards the creation of human-AI hybrids [14]. This is particularly interesting for the design and deployment of novel types of services.

The most commonly researched affordances for chatbots are *human-like conversing* and *assistance provision*. These two, form the basis of conventional human-chatbot interactions. Our study shifts attention beyond the conventional human chatbot interaction by pointing to 7 additional affordances. Specifically, the *facilitation* affordance indicates that there are significant opportunities for digital intermediation by chatbots in service provision. Such intermediation can pave the way towards the creation of one stop services, where the chatbots provide a gateway to multiple systems in an easy and seamless manner. Furthermore, the *distilling* and *enriching information* affordances create prospects for more synergies between chatbots and human service agents. For instance, chatbots can enrich the content of short messages drafted quickly by agents, increasing their efficiency allowing them to serve a greater number of customers. Furthermore, the *personalization* affordance is especially interesting as it can enable private and public organizations to revolutionize customer experience. Personalization may be achieved through implementation of authentication functionalities, that are widely used in other contexts. User authentication allows chatbots to access customers' personal and case-related data.

The findings reveal 3 affordances that need to be further researched aiming to more mature and reliable chatbot implementations through the use of emerging technologies. These are the *context identification*, *familiarity* and *privacy* affordances. Identifying context is critical in any service provision. For example, if the chatbot is aware that an inquiry relates to private or business purposes, it may provide the appropriate type of information in a faster way requiring less iterations. However, identifying the context in a human-chatbot interaction requires access to information that is not always available (e.g., due to privacy issues) or because the chatbot is not advanced enough to ask the right questions, as a human agent would do when interacting with a customer. Regarding familiarity, although the findings show that only one paper has explicitly examined related affordances, the general chatbot literature suggests that creating chatbots with high empathy that are able to mimic emotional responses remains a challenge [13]. Privacy is by itself a very complex and sensitive issue, thus creating challenges for chatbot development, as for example in cases where access to personal data is required for service provision.

Table 11. Concept Matrix

					Affordance								
Article	User		Means of communication		**Human Like Conversing**	**Assistance Provision**	**Facilitation**	**Distilling Information**	**Enriching Information**	**Context Identification**	**Personalisation**	**Fostering familiarity**	**Ensuring privacy**
	Customer	Employee	Text	Voice									
Stoeckli, Dremel [2]		X	X		X	X	X	X	X	X			X
Stoeckli, Uebernickel [23]		X	X			X		X		X			X
Waizenegger, Seeber [20]	X	X	X	X	X	X					X		X
Knote, Janson [24]	X		X	X	X	X	X	X	X	X	X		X
Moussawi [21]	X			X	X	X					X	X	
Meske, Amojo [25]	X		X			X	X	X		X			
Lunberry and Liebenau [19]	X			X	X								
Lippert, Gatewood [22]	X		X		X						X		
Barnett, Savic [26]	X		X			X							

The current work can contribute to research on AI and autonomous agents in the context of citizen and worker behavior towards successful digital transformation [27, 28]. Overall, we find that the studies reviewed, explored different chatbot characteristics and related action possibilities afforded to users. Nevertheless, we find little engagement with aspects that are critical for the actualization of affordances such as digital literacy and the elimination of digital inequalities [29] and the responsiveness of structures and processes at the organizational level. A clearer focus on relevant users´ and organizational aspects could be helpful for service designers and those who define digital channel strategies in organizations. Affordances create potential, it is important to have in place the necessary conditions for goal-oriented actions [16]. In conclusion, we call for further research on affordances related to context identification, familiarity and privacy and on the different facilitating conditions for the actualization of chatbot affordances in different contexts.

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