

Chatbots for Robotic Process Automation: Investigating Perceived Trust and User Satisfaction

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Abstract—Driven by ongoing improvements in machine learning, chatbots have increasingly grown from experimental interface prototypes to reliable and robust tools for process automation. Building on these advances, companies have identified various application scenarios, where the automated processing of human language can help foster task efficiency. To this end, the use of chatbots may not only decrease costs, but it is also said to boost user satisfaction. People’s intention to use and/or reuse said technology, however, is often dependent on less utilitarian factors. Particularly trust and respective task satisfaction count as relevant usage predictors. In this paper, we thus present work that aims to shed some light on these two variable constructs. We report on an experimental study ($n = 277$), investigating four different human-chatbot interaction tasks. After each task, participants were asked to complete survey items on perceived trust, perceived task complexity and perceived task satisfaction. Results show that task complexity impacts negatively on both trust and satisfaction. To this end, higher complexity was associated particularly with those conversations that relied on broad, descriptive chatbot answers, while conversations that span over several short steps were perceived less complex, even when the overall conversation was eventually longer.

Index Terms—Human-Chatbot Interaction, Robotic Process Automation, Technology Trust, Task Complexity

I. INTRODUCTION

Today’s customer service is increasingly dependent on automation. To this end, chatbots (and other natural language user interfaces) have become a popular way to deal with customers. Respective solutions not only automate current activities but may also help foster customer experiences in that chatbots are available 24/7 and thus significantly reduce waiting times. With information retrieval tasks, they may even outperform search engines [1] and with problem inquiries it has been shown that people are occasionally more open with chatbots than they are with humans, as they do not feel judged when asking trivial questions [2].

One way of expanding the capabilities of chatbots beyond their ability to offer a human-like machine interfaces is seen in their potential connection to Robotic Process Automation (RPA). RPA aims to automate highly repetitive business processes. Traditionally, it operates with deterministic inputs and thus, it is only suitable for standardized processes with rule-based decision-making, such as back-office activities. In connection with a chatbot, however, these activities could

be triggered more or less directly by a customer. That is, the chatbot’s Natural Language Processing (NLP) unit can translate natural language into standardized data, which the RPA engine then uses to (efficiently) complete back-office-related processes.

The work presented in this article aims to provide relevant insights into the potential success factors of this connection between chatbot interaction and RPA. In this, our focus lies on investigating the relationship between people’s trust towards chatbots, perceived task complexity as well as people’s satisfaction felt when using a chatbot to solve such tasks.

Our report starts with a discussion of related work in Section II. Next, we describe the methodological approach of our investigation in Section III. Respective results are then presented in Section IV and further discussed in Section V. Finally, Section VI concludes the paper and proposes directions for future work.

II. RELATED WORK

Previous work has shown that when using chatbots, people seem to care more about task completion efficiency than they care about the interaction experience they are exposed to [3]. However, negative properties of an interaction, such as conversational errors, incomprehension or task complexity, can negatively impact on users’ perceived trust in the capabilities of a chatbot and consequently hamper its adoption [4].

A. Chatbot Trust Perception

It has been shown that, next to perceived ease of use and perceived usefulness, it is particularly trust which acts as an important predictor for the adoption of chatbot technology [5]. As with other products, people’s trust perception towards chatbots is often influenced by how reliable and sophisticated an interaction is. Interpretational problems, such as incomprehension leading to long-lasting error recovery routines, significantly lower people’s trust perception [6]. So that in some cases, they refrain from asking complex questions, as they expect the chatbot to not understand and consequently to not be able to correctly answer their demand. Hence, concreteness and answering speed are generally considered to positively influence chatbot trust [7].

Another issue concerns the use and processing of (often sensitive) data [8]. That is, technology users today increasingly claim their right to privacy preserving data processing which, with respect to chatbots and other AI-driven technologies, can be challenging [9].

Finally, the risk of potentially undesired outcomes hampers chatbot interactions and may thus be considered a reason for lacking trust [10].

B. Chatbot Task Complexity

The perception as to how complex it is to interact with a chatbot in order to accomplish a given task impacts on the technology's initial use and consequent reuse intention. Previous work furthermore shows that with respect to chatbots, task complexity takes on a moderating role between the perceived chatbot friendliness and people's trust in the technology [11]. In other words, the potentially beneficial effects of chatbot friendliness on customer trust will be less pronounced when a task is perceived to be more complex. Thus, when it comes to seemingly complex activities, customers prefer human over chatbot assistance. On the other hand, it has been shown, that customers are likely to use chatbots for low-complexity activities, since they believe that chatbots may be able to accomplish these tasks better and/or quicker than human operators [12].

C. Chatbot User Satisfaction

Radziwill & Benton [13] propose to measure chatbot quality along three characteristics, i.e. effectiveness, efficiency and satisfaction. Similarly, Brandtzaeg & Folstad [14] found that the primary reason for people to use chatbots lies in expected productivity gains. Unmet expectations, however, negatively impact on people's service satisfaction, for which chatbot capabilities should be transparently outlined at the beginning of an interaction [15]. Furthermore it has been found that information and service quality are major drivers for user satisfaction [16], while enjoyment, usefulness and ease of use are predictors for continuance of use [17]. To this end, Rossmann et al. [18] identified various relevant service dimensions, among which *task effort* and *procedural justice* have been found to be the ones that affect user satisfaction the most.

III. METHODOLOGY

Building upon the above presented previous work, the primary goal of our study was to investigate the connection between perceived chatbot task complexity, chatbot trust and chatbot user satisfaction and consequent reuse intention. To do this, we designed an online experiment comprising four different tasks with varying complexity levels (cf. Figs. 1–4). Then we asked study participants to solve these tasks through a chatbot interface we developed using Microsoft's Power Virtual Agent platform¹. The chatbot appeared as a web page whose link was included in the experiment introduction. Participants were introduced to each task separately,

provided by a short textual description. After reading the task description, they were instructed to request assistance from the chatbot, prompting the right task-related conversational flow. The objective was to complete an end-to-end conversation by providing the right data or choosing the correct options to complete the task. After each task, participants were sent a link to a survey asking them to rate their interaction experience via five point Likert-scale based survey items focusing on chatbot trust and chatbot user satisfaction.

A. Task Design

The goal was to design four realistic tasks whose complexity could be controlled, allowing for a broad exploration of user perceptions. Consequently, the following task classes were defined: (1) Obtain an answer to a simple question; (2) obtain a detailed answer/explanation; (3) solve a simple problem; and (4) solve a problem which requires human assistance.

Next, we decided to give these generic tasks a general theme so that study participants would experience an integrated and authentic problem space. We opted for the tourism domain, in which study participants should put themselves in the role of tourists visiting Vienna, and consequently use a chatbot as a first level customer assistance tool to tackle respective tasks regarding their hotel stay. Thus, the following four tasks were presented to them (note: the task complexity was meant to be ascending for which the task order was the same for all participants):

Task 1: The first task focused on obtaining an answer to a simple question.

Task description: You are on your train headed for Vienna. You have booked the hotel in advance and you are arriving at 11 AM at the main station. You can't wait to go to your room and leave the luggage there to explore the city. However, you can't find the email with the check-in time. You think that the conversational agent on the hotel website could help you find this information ...

Task success: The respective check-in time is provided.

Intended complexity: Low

Fig. 1. Task 1: Obtaining an answer to a simple question

¹Online: <https://powerplatform.microsoft.com/en-us/power-virtual-agents/>
accessed: August 30th 2022

Task 2: The second task aimed at obtaining a detailed answer and respective description.

Task description: You checked in and the room is very hot. The air conditioning is new and futuristic. You lower the temperature setting but it's still very hot. You want to adjust the fan speed to cool the room quicker but you don't know if there is such an option on the thermostat. So you try once more with the hotel's conversational agent ...
Task success: A description on how to change the fan speed is provided.
Intended complexity: Low/Middle

Fig. 2. Task 2: Obtaining a detailed answer/explanation

Task 3: For the third task participants had to solve a concrete but rather simple problem.

Task description: You are really enjoying the city and yesterday you went out partying. You are waking up at 11.30 AM. The check-out is at 12.00 AM. Your head hurts and thus you want to ask the conversational agent about options for postponing your check-out ...
Task success: Option on how to remain in the room (i.e. late check-out or book another night) are provided.
Intended complexity: Middle

Fig. 3. Task 3: Solving a simple problem

Task 4: Finally, to solve the fourth task participants had to ask for human assistance.

Task description: You get up last minute and want to take a hot shower. The water is ice cold. Your train is leaving in 60 minutes. Life sucks. It must be a problem with the water heater. Nothing you can fix by yourself, thus you want to reach a person who can help you. You don't want to get dressed and walk down to the lobby, so you start the conversational agent and hope to reach a real person through it ...
Task success: The conversational agent says that you will be forwarded to a human operator.
Intended complexity: High

Fig. 4. Task 4: Solving a problem which requires human assistance

B. Sampling Frame and Procedure

We aimed for a generic, gender-balanced study sample. No age or technology experience requirements were set so as to

allow for a broad spectrum of potential participants. Language-wise, we targeted mainly native (or close to native) speakers of English.

Most study participants were recruited via Prolific², a micro-worker platform that previous work has shown to be trustworthy in terms of participants' attention, comprehension, honesty and reliability [19]. Additionally we used social networks (i.e., LinkedIn and WhatsApp) as well as direct email to attract potential study participants. A total of $n = 277$ participants (76% English native speakers of whom 69% lived in the UK at the time of the study) completed the entire study, i.e. all of the four tasks and the respective survey items. The average age of participants was 38.5 ($min = 19$; $max = 76$; $SD = 13.8$).

C. Post-Task Survey

As outlined earlier, participants had to use our Power Virtual Agent chatbot to complete the above outlined tasks, after each of which they were asked to complete survey items assessing their interaction experience. Items focused on perceived task complexity (note: we consciously designed tasks that would represent four different levels of complexity, cf. Section III-A, Figs. 1-4), trust and user satisfaction. The latter two dimensions have shown to be considerably relevant in predicting reuse intention [7], [16], [18]. To this end, trust was found to be mainly rooted in utilitarian factors, and thus to play a rather complementary role to satisfaction. Our survey aimed to measure it through participants' perceptions concerning the chatbot's *answer correctness*, *communication effectiveness* and *responsiveness* [10]. As for satisfaction, however, we focused on the already discussed insights of Rossmann et al. [18] and thus used measures of perceived *task effort* and *procedural justice* [18]. A copy of the respective survey items for both trust and satisfaction is depicted in Fig. 5.

Finally, after completing all four tasks, participants were asked to order them concerning their perceived task complexity. Furthermore, they had to answer question items asking about their general experience with technology, their previous experience with chatbots and their experience with (other) online services, before being confronted with an optional open question asking about general feedback concerning the accomplished tasks.

IV. RESULTS

Looking at the two key measures chatbot trust and user satisfaction, the collected data shows high reliability for all constructs (Cronbach's $\alpha > 0.90$).

A. Perceived Task Complexity

Results show that on a ranking scale from 1 = *easiest task* to 4 = *hardest task*, participants perceived the first task to have been the easiest (Rank: $Mean = 1.42$; $Median = 1.00$, $Mode = 1.00$, $SD = 0.83$), and the fourth task the hardest one to accomplish (Rank: $Mean = 3.82$; $Median = 4.00$; $Mode = 4.00$, $SD = 0.55$). This aligns with our intention to present to them tasks in ascending order of

²Online: <https://www.prolific.co/> accessed: August 25th 2022

Dimension and Reference	Attribute	Attribute Description	Statements
TRUST (Nordheim et al., 2019 and Davis, 1989)	Effectiveness - Correct answer	Perceived accuracy and relevance of the results	1) The task was solved successfully 2) The service agent had the knowledge to answer my questions 3) I'm happy with the outcome provided 4) The obtained outcome makes me willing to use the service agent for similar tasks in the future
	Effectiveness - Concrete communication	Perceived concreteness of the communication	1) The communication with the service agent is adequate 2) The communication with the service agent is concrete 3) The communication with the service agent is clear 4) The service agent's quality of communication makes me willing to use it for similar tasks in the future
	Efficiency - Responsiveness	Perceived response time and overall efficiency of the chatbot	1) The service agent's answers were timely 2) The service agent proved to be an efficient way to solve the task 3) I think the service agent proved to be the most efficient way to solve the task 4) The service agent's efficiency makes me willing to use it for similar tasks in the future
SATISFACTION (Rossmann et al., 2020 and Davis, 1989)	Reduction of customer efforts	Perceived efforts required to complete the task	1) Interacting with the service agent was easy and intuitive 2) The task was completed faster than if it had been taken over by an employee (considering queue and response time) 3) It wasn't required much effort to get the job done 4) The ease of use of the service agent makes me willing to use it for similar tasks in the future
	Procedural justice	Perceived appropriateness of the communication and perceived degree of fairness	1) The service agent displayed individual attention 2) The service agent cared about my task 3) The service agent understood my messages 4) The service agent's consideration towards me makes me willing to use it for similar tasks in the future

Fig. 5. Survey items focusing on chatbot trust and user satisfaction

complexity. As for tasks two and three, however, participants had a different impression. That is, the second task was felt to be more complex (Rank: *Mean* = 2.47; *Median* = 3.00; *Mode* = 3.00; *SD* = 0.76) than the third task (Rank: *Mean* = 2.13; *Median* = 2.00; *Mode* = 2.00; *SD* = 0.74). A reason for this reversed complexity perception may be found in the rather long chatbot answer, which was provided as a solution to the second task. Here, participants were asked to use the chatbot to investigate on how to lower the room's temperature. Once the chatbot had recognized this intention, the following instruction was presented:

"To make quick temperature adjustments, press the Tem-

perature Up or Temperature Down arrows on the thermostat display. If the mode Heat or Cool is on, you can press the Fan indicator to switch between the different fan modes. Tip: If you have set a schedule for your thermostat, manual changes temporarily override the schedule. The temperature you requested holds until the next scheduled change time, such as from Home to Sleep."

The third task, on the other hand, consisted of several steps in order to confirm a late check-out or to book the room for an extra day. Here a participant was required to follow the following three steps so as to complete the task:

- 1) State your room number;
- 2) Inquire whether a late check-out or a booking extension

- is available;*
- 3) *Confirm the late check-out or complete the reservation for an extra day;*

The higher number of steps and respective decisions that had to be made were supposed to lead to a higher level of perceived complexity. Participants, however, seem to have felt that reading and interpreting a long message, as it was provided in Task 2, is cognitively more demanding and consequently more complex than following a (small) number of relatively simple steps, as was required for Task 3.

B. The Impact of Task Complexity

A Pearson correlation was used to assess the impact of task design on human-chatbot interaction. The survey data confirms previous work [11] in that it points to a significant negative relationship between perceived task complexity and all the measured trust constructs ($p < 0.001$): i.e. *answer correctness*: -0.622 ; *communication effectiveness*: -0.528 ; *responsiveness*: -0.406 .

Similarly, the data suggests a significant negative connection between *perceived task complexity* and participants' satisfaction with the chatbot ($p < 0.001$): *task effort*: -0.500 ; *procedural justice*: -0.445 . Here, the correlation with *procedural justice* particularly supports Cheng et al.'s claim that the perceived friendliness of a chatbot may significantly decrease with increasing task complexity [11].

C. Qualitative Findings

After participants had completed all tasks, they were given the opportunity to comment on whether they would use the chatbot again in a similar future task setting. An inductive approach was then used to classify the comments in three categories: preference for chatbots, preference for human assistance and preference depending on the task complexity. A total of 37 responses were collected. Of these 37 responses, 10 respondents clearly underlined their preference for being helped by a human operator. They did not raise any concerns regarding the chatbot's ability to help or communicate. Rather, they expressed their desire for a more human touch, generally disliking the idea of chatting to or with an artificial entity. To this end, the simple awareness that one is interacting with a chatbot seems to be enough to make users feel uncomfortable. As one of the respondents exemplifies: “[...] I understand that chatbots save time (and money!) to their company but I still prefer a proper person to have a conversation with.”

Contrary to this antipathy for language-based human-technology interaction, 9 respondents expressed their clear preference for using a chatbot over talking to a human operator. Here, the most common reason was given in the desire to avoid human conversation altogether. As stated by one respondent: “chatbots are a great solution especially for the younger generation with anxieties for making a phone call”. Previous work supports this statement, in that it has shown that people with a certain level of social phobia are more prone to engaging with (anthropomorphic) chatbots than with human beings [20].

The remaining 18 responses did neither show a clear preference for nor against chatbot interaction. It was rather pointed out that the choice would depend on the type of task to be accomplished. As one respondent puts it: “I think I would be ready to reuse the chatbot for simpler and more straightforward tasks. However, I feel in more complex or less common scenarios, like the fourth task, I would probably prefer speaking to a member of staff instead.” In other words, the decision to choose one over the other seems to be grounded in the expected effectiveness and efficiency with which the operator of choice (i.e., chatbot or human) may solve a given problem. Looking at the statistical data, it can further be seen that respective respondents were mostly satisfied with the way the chatbot helped them solve the first three tasks, while for the fourth task, satisfaction was consistently lower. This also confirms previous work in that users' preferences for chatbot use is higher for low-complexity tasks [12].

Lastly, our data shows that existing technology experience is positively connected to chatbot trust and user satisfaction, supporting the assumption that also natural language based human-computer interaction may need to be learned.

V. DISCUSSION

Literature states that missing user focus is one of the main reasons for chatbot applications to fail [2]. A comprehensive understanding of potential chatbot users, their perceptions, attitudes as well as preferences thus counts as a necessary prerequisite for the respective technology to be adopted [5]. Still, today we see a prevailing preference for human-human over human-chatbot interaction [21]. While our results confirm this merit for human operators, they also point to a specific group of users who see chatbot interaction as a welcoming possibility to avoid human contact. In this, our findings support the work of Müller et al. [22], who found that specific personality traits and psychological characteristics act as significant predictors for chatbot acceptance.

With respect to our research agenda, results show that perceived task complexity influences people's preferences for or against chatbot use. Contrary to our expectations, however, complexity was not dependent on the number of steps needed to achieve a task. Rather, it was shown that a multi-step task, requiring several small steps, is often perceived to be less complicated than a single-step task, which may in turn require greater text understanding. Such also aligns with previous work, suggesting that if a chatbot offers a simple step at the beginning of an interaction, users are more likely to trust the chatbot's ability to also solve the subsequent steps [23].

Finally, our findings confirm the work of Cheng et al. [11] in that they generally point to a significant negative correlation between perceived task complexity and people's trust in a chatbot's ability. To this end, it is assumed that more complicated tasks require more user effort, for which also the perceived usefulness of such a system decreases with increasing task complexity. In accordance with Davis et al. [24] this may further hamper the overall acceptance and consequent adoption of the chatbot.

VI. CONCLUSION AND FUTURE WORK

Our study explored the use of a chatbot interface in combination with RPA. Data shows that perceived task complexity impacts on people's trust in and preference for using such an interface in a given problem setting. Consequently, tasks which require a seemingly higher cognitive understanding (particularly on the technology side) are less likely to be chosen for a chatbot-driven solution approach. Results, however, also show that users' personality and psychological traits influence the preference for or against chatbot engagement.

As for future research directions, we propose to focus on three aspects. First, since our findings suggest a clear relationship between task complexity and potential chatbot use, it seems relevant to better understand the characteristics which make a task seem difficult. Second, building upon the assumption that for seemingly difficult tasks the use of a chatbot may not even be considered, it seems relevant to investigate ways to lower this entry barrier. And finally, we suggest for future work to also focus on improving the ways chatbot engagement may be adapted to individual user preferences, particularly with respect to personality traits and characteristics.

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