6-18-2022

Chatblood - Towards designing chatbots for blood donors

Helena Monika Müller
Technical University of Darmstadt, mueller@is.tu-darmstadt.de

Melanie Reuter-Oppermann
Technical University of Darmstadt, oppermann@is.tu-darmstadt.de

CHATBLOOD - TOWARDS DESIGNING CHATBOTS FOR BLOOD DONORS

Research in Progress

Helena M. Müller, TU Darmstadt, Darmstadt, Germany, mueller@is.tu-darmstadt.de
Melanie Reuter-Oppermann, TU Darmstadt, Darmstadt, Germany, oppermann@is.tu-darmstadt.de

Abstract

Healthcare systems worldwide depend on volunteer blood donations to secure surgeries and treatments for patients. Stochastic demands and donations as well as a short shelf-life of blood products impose additional challenges. In order to adequately match demand and supply, it is crucial for blood donation centres to call in donors at the right time, reach non-donors, and motivate first-time and lapsed donors to donate regularly (again). While often websites offer information to new donors and sometimes apps provide access to appointment systems for regular donors, for example, we argue that chatbots offer an easy and anonymous access to information for all. As an addition to apps and websites they could help to reach more people to become blood donors. Applying the design science research methodology, we present design principles for blood donation chatbots. In an online survey with 213 participants, we analysed the applicability of chatbots for different use cases.

Keywords: Blood donation, Chatbot, Design science research

1 Introduction

Blood is a very important resource in all healthcare systems worldwide, often essential to save the lives of patients during surgery or treatment. Unfortunately, blood products cannot be produced artificially, but blood donations are necessary. In addition, most blood products have a relatively short shelf-life, so they cannot be easily stored. Therefore, it is crucial to receive sufficient donations to meet the demand. Donations that exceed this demand will be wasted, though, and should therefore be avoided. Additionally, due to various influencing factors, there is a high fluctuation of blood donors (Pirabán, Guerrero, and Labadie, 2019). Young adults (between 18 and 25 years old) in Germany often do not donate blood again after they have donated once (Bundeszentrale für gesundheitliche Aufklaerung, 2018). In Germany, women are allowed to donate four times a year and men six times, provided that they are between 18 and 68 years old and weigh at least 50 kilograms and a minimum of eight weeks lies between donations (Bundeszentrale für gesundheitliche Aufklaerung, 2022). During the COVID-19 pandemic, even countries like Germany experienced a shortage in blood products, especially during the summer months, as many delayed surgeries were performed leading to a higher as usual demand. On the contrary, donations declined as people went on holiday and might not have been aware of the demand increase. While the problem of better matching demand and supply can and should be addressed from both sides, the demand side will stay very stochastic (e.g., emergencies are difficult to forecast) and external events like the pandemic can additionally increase the complexity. Therefore, we argue the importance of donor mobilisation and management to enable sufficient supply and prevent "over-donation". Donor mobilisation and management includes providing access and information to all groups of donors. We can distinguish four types of donor

groups, regular (rd), lapsed (ld), first-time (fd) and non-donors (nd) (Ferguson, 1996). Each group is characterised by different needs and preferences that have to be addressed to reach all types of donors.
A chatbot offers easy access to any kind of information, for example about the donation process, requirements and potential risks, but also about locations and opening times of donation centres or current demand. Therefore, it can be a good addition to websites and blood donation apps.
Hence, in this work, we address the following research question: *How to design chatbots for potential blood donors to increase donors' willingness to give blood?* In order to do so, we present design principles for chatbots to support blood donors as well as blood donation management and to elicit changes in donor behaviour through conversational instead of static interactions. Based on a survey with 213 participants, we analyse different use cases in which a chatbot could support a (potential) blood donor.
The remainder of this paper is organised as follows. Section 2 summarises the relevant literature on chatbots as well as existing donor mobilisation and management solutions. In Section 3, the design science research (DSR) project is outlined. Section 4 presents the design requirements and design principles. The results of a first evaluation are summarised in Section 5. The paper closes with a summary and an outlook on future research in Section 6.

2 Foundations and Related Work

2.1 Health Chatbots

Since progress in artificial intelligence enables chatbots to be much more intelligent than in the past, starting in the 1960s with their rule-based version of the chatbot ELIZA (Weizenbaum, 1966), the interest in chatbots has permanently increased. Another reason in addition to technological advances, is the proliferation of text messaging as a standard form of communication. Text messages in natural language form the basis for interaction with a chatbot. However, instead of talking to a human being, interaction with a chatbot means communicating with a software program that emulates human conversation (Dale, 2016). With their roots in healthcare via the psychotherapeutic chatbot ELIZA, one of the opportunities of chatbots is being perceived as anthropomorphic to give the feeling of a human contact (Verhagen et al., 2014). Due to the intuitive interaction with a conversational interface via input in natural language instead of manually activating existing elements on a graphical interface, chatbots also purpose easy access to available systems (McTear, Callejas, and Griol, 2016). One current example is the Ada Health app that supports its users in self-diagnoses. By using a natural language interface for users typing in responses to several questions, Ada collects relevant information to assess symptoms for diagnostic suggestions, even with the consultation of the related specialist (Ada Health GmbH, 2022). This is possible with the help of algorithms searching for patterns of symptoms by applying a medical knowledge base.
Besides medical-advisory in healthcare, chatbots are used in various domains such as customer service and enterprise applications in many industries like banking, air travel and entertainment to support users in searching for relevant information and to automate easy tasks like checking the calendar for booking an appointment (Morana et al., 2017). By running cost effectively and providing availability 24 hours a day on seven days a week with short resolution times, chatbots offer benefits for both, companies and customers (Gnewuch, Morana, and Maedche, 2017). Apart from domain-specific use, they can also be applied as general-purpose technology depending on their scope of application (Gnewuch, Morana, and Maedche, 2017). Along with their versatility, chatbots are spreading rapidly because of their easy implementation on websites and messenger platforms, often used as massaging apps on smartphones. Putting this all together, we argue that chatbots designed for potential blood donors might serve as a persuasive and natural way to increase donors' willingness to give blood.

2.2 Blood Donation Apps and Chatbots

The American National Red Cross (2022a), for example, provides an app, which can be used to make and manage appointments, find nearby blood donation centres, transfer necessary data before an appointment, overview the donor history and track the path of the own blood donation all the way to the transfusion. For each blood donation, the donor receives achievement badges via the app, which can be shared with friends. Some similar functions are provided by the app of the German Red Cross (DRK) (DRK-Blutspendedienste, 2022). The app does not transfer data or allows the tracking of donations. Instead, it offers real-time insights when the next donation is allowed again and enables appointment reminder services via email. Furthermore, in the integrated chat forum, users are free to exchange information with other blood donors within Germany. The app "Statusplus Blutspende" combines all the functions of the two apps mentioned before and even connects hospitals to inform the users about their blood values as well as the current blood stock and, if needed, to send them push messages to appeal for blood donations (Schäfer, 2020). So far, the app is used in Lübeck and Kiel. In the future, "Statusplus Blutspende" will also be used to fill out the donor questionnaires digitally in order to reduce the administrative workload at the blood donation centres, where it will only take half the average process lead time then. This feature, besides other mentioned functions, is already available in the app "Mein Blut" of the Austrian Red Cross (Oesterreichisches Rotes Kreuz, 2022). For a detailed overview of different blood donation apps used worldwide, we recommend the publication of Ouhbi et al. (2015).

To the best of our knowledge, only few publications have studied chatbots for blood donors and so far, no chatbot was developed for the use in Germany. Roman et al. (2020) propose a chatbot initiated by a Brazilian blood donation centre, which is accessible via Google Assistant to educate and mobilise blood donors, motivated by a large number of redundant enquiries about the blood donation process. The chatbot offers a simpler and faster access to information and provides an easy communication exchange in an entertaining way compared to websites, using multimedia content (i.e., images, links to videos). The user receives answers in informal language and if necessary, the chatbot suggests topics to continue the conversation and provides the user with a help option to select a topic. The start-up BloodLink provided a chatbot prototype that was available in India via Facebook Messenger (Mayroth, 2017). Applying the chatbot, users were able to get specific questions about blood or the blood donation process answered, as well as schedule blood donation appointments in their immediate vicinity. In addition, the chatbot uncovered myths about blood donation and made it possible to forward the conversation to an experienced blood donor or doctor. Similarly, the chatbot of the Canadian Blood Services that is also accessible via Facebook Messenger, informs potential donors about blood donation and its benefits, and motivates them to make blood donation appointments (Canadian Blood Services, 2017). The American National Red Cross has integrated its chatbot "Clara", which appears in the form of a female doctor, directly into their website (The American National Red Cross, 2022b). In addition to answering questions about the blood donation process and its benefits, as well as making appointments, the chatbot removes doubts about donor suitability, e.g., due to recent long-distance travel or the intake of medication, and can connect the user with a blood service employee if necessary.

However, all of the described chatbots interact only rarely with the user, just reactively for a quick exchange of information or making appointments and therefore do not ensure a sustainable positive influence on the user's behaviour (i.e., transition to and retention of regular blood donors), which would require a long-term relationship with the user. Therefore, to address this lack of design knowledge on chatbots, we argue that it is suitable to apply the DSR methodology.

3 Design Science Research Project

Our research project follows the DSR approach (Hevner et al., 2004) as it addresses a real-word problem (i.e., matching supply and demand of blood donations) by designing a software artefact in a specific context (i.e., chatbots for potential blood donors in Germany) through deriving design principles (DPs) to

increase donors' willingness to give blood. We argue that this approach helps us to answer our research question, because it allows an iterative process of designing and evaluating our IT artefact in a rigorous way and at the same time incrementally improves its functionality and relevance through the involvement of experts and end users (Hevner et al., 2004; Kuechler and Vaishnavi, 2008).

The framework of Kuechler and Vaishnavi (2008) builds the basis of our DSR project. In the problem awareness phase, we reviewed extant literature and conducted an expert interview in order to analyse the needs and issues of our relevant stakeholders (i.e., potential blood donors). We selected appropriate databases regarding important components of our topic: (1) chatbots, (2) donor mobilisation and management solutions and (3) donor behaviour. These included ACM DL (Association for Computing Machinery Digital Library), AISeL (Association for Information Systems Electronic Library), EBSCOhost, ScienceDirect, Web of Science and PubMed. For practical relevance, we also searched the internet for existing solutions that have not yet been described in the literature. The practical examples used for comparison helped us to find out which challenges of potential blood donors are currently addressed by modern information systems. Factors influencing blood donor behaviour were also reviewed to better understand our user group for derivation of its possible requirements regarding the design of chatbots. These findings were used as a first set of design requirements (DRs) to prepare a semi-structured interview with a blood donation expert, who extensively considered the factors influencing donor behaviour within a specific context (in this case African minorities in Western Europe) (Klinkenberg et al., 2019). The guided interview divided into three sections ((1) general opinion on chatbots, (2) challenges regarding communication and information exchange between blood services and blood donors, (3) application scenarios and usefulness of chatbots) was conducted to refine as well as identify DRs and lasted one hour. Based on these results, we proposed three DPs for chatbots for potential blood donors. Subsequently, we instantiated our DPs in a chatbot prototype developed with Botframe, a platform for building previews of interactions with a chatbot (Botframe, 2022). Parts of this prototype were then evaluated in an end user online survey with construct questionnaire items and identified requirements queried in fictional blood donation scenarios. For the evaluation, we used the questionnaire of Batis and Albarrak (2021) inspired by Yuan et al. (2016) for structure orientation. With this, they also wanted to evaluate the requirements of blood donors, but instead of regarding chatbots, they were interested in the design and development of a blood donation app for a specific city in Saudi Arabia. Based on our survey participants' feedback, we will refine our DPs in a second design cycle and instantiate them in a fully-functional prototype then.

4 Designing Chatbots for Potential Blood Donors

In order to increase donors' willingness to donate blood, it is important to minimise potential barriers (e.g., inconvenience, lack of knowledge) and to foster motivators (Klinkenberg et al., 2019). Therefore, we derived three design requirements for blood donation chatbots:

DR1: The chatbot should provide organisational and planning support to the potential blood donor.

DR2: The chatbot should shape knowledge and awareness to the potential blood donor.

DR3: The chatbot should motivate the potential blood donor and gather as well as give feedback.

The DPs focus specifically on the chatbot and the way it should increase donors' willingness to give blood, primarily derived from pragmatic and service-oriented requirements. In this paper, we do not further consider the underlying algorithms or technical infrastructure that is necessary for the integration of data sources. Regarding our main goal of designing chatbots, we focus our DPs on how this technology can be used to increase donors' willingness to give blood. Next, we derive and formulate three DPs for chatbots for potential blood donors based on the structure proposed by Chandra, Seidel, and Gregor (2015).

According to behavioural researchers, when blood donation appointments are made, they are often not kept due to forgetfulness, convenience or other scheduling issues (Bosnes, Aldrin, and Heier, 2005; Van Dongen, Ruiter, et al., 2014) or because donors are overwhelmed with their everyday appointments and therefore do not prioritise blood donation (Van Dongen, Abraham, et al., 2012). Thus, the chatbot

should be able to assist the user to register and make an appointment (**DR1.1**). Due to the fact that a chatbot can also act proactively, a chatbot is able to send notifications to the user (Følstad, Skjuve, and Brandtzaeg, 2019; Sarikaya, 2017). Consequently, the chatbot should be able to remind the user of his/her upcoming blood donation appointment (**DR1.2**). Furthermore, to help blood donors who doubt whether they are eligible to give blood again after their last donation, according to the interviewed blood service employees in the study of Batis and Albarrak (2021), reminders to donate again are useful. Therefore, the chatbot should be able to remind the user of his/her eligibility to give blood again (**DR1.3**). In addition, the chatbot should be able to notify the user about opening hours, place, free parking and estimated time required of his/her booked blood service in preparation for his/her appointment (**DR1.4**) (Batis and Albarrak, 2021). Some behavioural researchers found out that mobile donation centres are often preferably visited by new donors a few times at the beginning of their donor career (Schreiber, Sharma, et al., 2005) and that due to their easy accessibility they can help to facilitate donors' transition towards regularly donating blood (Godin, Sheeran, et al., 2005; Schreiber, Sharma, et al., 2005). Therefore, the chatbot should be able to notify the user of nearby mobile blood drives taking place (**DR1.5**). In the event of a crisis when there is an acute shortage of supply, the labour-intensive and time-consuming conventional donation requests by post or telephone may take too long to ensure a timely and appropriate blood supply. Batis and Albarrak (2021) showed that almost half of the 383 surveyed blood donors are interested in alerts about critical blood stock levels and more than half of them about shortages of blood donations. Consequently, the chatbot should be able to notify the user about current blood stock levels and especially about urgently needed blood donations due to shortage (**DR1.6**). As known from the example of the app "Statusplus Blutspende", the donor questionnaires are accompanied by a high administrative effort for the employees of the blood donation centres, which is also responsible for long waiting times of blood donors. According to behavioural researchers, a long length of stay provides demotivation with regard to future blood donations (Bosnes, Aldrin, and Heier, 2005; Godin, Sheeran, et al., 2005). Hence, the chatbot should be able to assist the user in filling out the donor questionnaire in advance (**DR1.7**). In conclusion, we propose:

> **DP1:** *Provide the chatbot with proactive organisational and planning interventions comprising reminders, push notifications and assistance to enable users to integrate and prioritise blood donations in their busy lifestyles.*

Foth et al. (2013) identified different user archetypes (i.e., Technologists, Biologists, Escapists) with different interests regarding the blood donation process (i.e., the system behind, the role of blood, the methods for distraction during blood donation) and pointed out the huge variety of possible questions of potential blood donors. Therefore, the chatbot should be able to answer a lot of varying user questions concerning the blood donation process (**DR2.1**). In opinion of the interviewed blood service employees in the study of Batis and Albarrak (2021), the possibility for potential blood donors to educate themselves about what they need to know before and after donating blood (e.g., via access to tutorials) helps potential donors to get to know the benefits of donating blood. Consequently, the chatbot should be able to make the user aware of the blood donation process and its benefits (**DR2.2**). The interviewees in the study of Batis and Albarrak (2021) also indicated that blood donation centres often have to temporarily defer potential donors who could save time if they knew the general donation criteria they have to fulfil (e.g., weight or age) and the necessary documents they have to bring (e.g., identity card) beforehand. According to behavioural researchers, it is important to make potential blood donors aware of these requirements, because uninformed donors may perceive this deferral as a permanent rejection and often do not return due to frustration (Bednall et al., 2013; J. A. Piliavin, 1987). Hence, the chatbot should be able to inform the user about blood donation requirements in preparation for his/her appointment (**DR2.3**). In conclusion, we propose:

> **DP2:** *Provide the chatbot with reactive statements comprising informational and awareness-raising input to enable users to draw their own conclusions from the responses and to help them better understand their impact of donating blood.*

Godin, Conner, et al. (2007) and Van Dongen, Ruiter, et al. (2014) pointed out that, especially for new donors, motivation is one of the most decisive motives for future blood donations and therefore motivational approaches are appropriate for their recruitment. Thus, the chatbot should be able to motivate the user depending on the number of past blood donations (**DR3.1**). To the best of our knowledge, Sardi et al. (2019) were the first to apply gamification techniques guided by the principles of behaviour change theory to target all donor groups and showed that an appropriate mix and balance of various elements is necessary to trigger the change process of the potential donor towards engagement and loyalty. Other incentives besides points and badges, which are assumed to support in transition, could be quizzes, levels, trophies, progress bars and leaderboards (Sardi et al., 2019). Consequently, the chatbot should be able to motivate the user by applying appropriate elements of gamification (**DR3.2**). In our interview, the blood donation expert stated that it is also particularly motivating for donors to be informed when the own blood donation has been transfused to a patient. Hence, the chatbot should be able to notify the user as soon as his/her blood donation has been transfused (**DR3.3**). There should also be the possibility for potential donors to give feedback by expressing their expectations and experiences related to the blood donation process, because this kind of feedback is essential to make donating blood a habit (J. A. Piliavin, Callero, and Evans, 1982; Schreiber, Schlumpf, et al., 2006). Gathering this feedback could help to better address barriers such as initial anxiety, doubts about donor eligibility, inappropriate donor locations and opening hours, or incompetent blood service employees and unsatisfying service quality. Targeting these issues makes it possible to respond more effectively to donors' needs and to build a closer relationship with them. Therefore, the chatbot should be able to share expectations and experiences with the user by asking specific questions (**DR3.4**). Applying informal language may attract younger adults who, according to Godin, Conner, et al. (2007), donate blood less frequently than older people. Roman et al. (2020) stated that the appearance of the mascot of the blood donation centre in Brazil mentioned in Section 2.2 helped users to overcome their inhibitions when interacting with the chatbot, to trust the bot more easily and to experience a more satisfying use. Thus, a chatbot should not appear as an image of a real person, but as an avatar. Consequently, the chatbot should be able to display social cues embodying a mix of characteristics including friendliness, expertise, trust and support (**DR3.5**). In conclusion, we propose:

> **DP3:** *Provide the chatbot with motivational and encouraging methods comprising dosed approaches as well as gamification, bidirectional feedback and appropriate social cues in order to help users either start donating (again) or keep on track in donating blood (more) regularly.*

5 Evaluation

We designed an online survey as a structured, self-administered questionnaire that was available online for participation within one week, after we had conducted pretests with our research colleagues to test the framing and timing for data collection. German participants who were at least 18 years old were recruited randomly between 2 November 2021 and 9 November 2021 via different social media channels. Our questionnaire consisted of three higher-level sections: Respondent's demographics and characteristics (eight closed-ended questions), respondent's familiarity with chatbots (five closed-ended questions) and ten fictional blood donation scenarios as well as three mock-ups of our chatbot that represented our identified requirements. The last section was partly embedded by questions adapted to the particular type of donor (i.e., nd, fd, ld, rd) that emerged from answers to the first section. For each represented requirement either via scenario or mock-up, we wanted to determine the usefulness of a chatbot. For the scenarios, the participants could choose from three alternatives, i.e., chatbot, website and app. If the participants had decided on a chatbot to meet the presented requirement, in some scenarios a further distinction had to be made regarding its integration (i.e., calling the chatbot via website, WhatsApp, blood donation app). The survey ended with an open-ended question about further comments and feedback.
In total, we received 213 complete responses. Table 1 displays their statistics. Table 2 summarises the results of the survey. It shows the number of respondents who preferred the chatbot in each of the ten

Variable	N = 213	%	Variable	N = 213	%	Variable	N = 213	%
Gender			**Age (y)**			**Chatbot Used**		
Female	118	55.40	18 to 25	69	32.39	yes	128	60.09
Male	95	44.60	26 to 35	93	43,66	no	85	39.91
Pref. Tool			36 to 55	31	14.55	**Donor Group**		
Website	89	41.78	56 to 68	20	9.39	non-donor (nd_{tot})	93	43.66
Chatbot	21	9.86	> 69	0	0.00	first-time donor (fd_{tot})	22	10.33
App	103	48.36				lapsed donor (ld_{tot})	34	15.96
						regular donor (rd_{tot})	64	30.05

Table 1. Characteristics of the respondents.

scenarios and the respective proportion of the donor groups they belong to. Note that for the scenarios S2, S6, S7, S8, S10 the respondents could only choose from two instead of three alternatives, i.e., chatbot and app, because via website it is not possible to engage proactively with the user. Regarding the donor types, the only time that the chatbot was chosen as the preferred tool was for S1 among the fd (eight out of 22 (36.36 %)). Overall, the majority of votes often correspond to non-donors, as they also form the biggest group of respondents. What is important is to put the number of votes per group in relation to the overall number of respondents of the group. This shows that especially first-time donors would potentially benefit the most from an additional source of information. Surprisingly, for S2, more than a quarter of the nd and fd were chatbot voters. Potentially, they need more planning support than those who are used to regularly donating blood. For S3, almost 20 % of the rd voted for the chatbot, presumably because due to their regular visits of donor sites they benefit most from enabling the chatbot to answer their questions about donating blood in times of the COVID-19 pandemic. For S4, only few respondents from all groups have opted for a chatbot. For S5, over 20 % of the fd chose the chatbot to receive notifications about place, times and conditions of the booked blood service in preparation for the appointment. For S7, S8 and S9, the relations to overall respondents show that ld would benefit most from enabling the chatbot offering planning support. Six out of the 21 chatbot voters of our total sample (almost 30 %) were ld who chose the chatbot as their preferred tool for matters related to blood donation after considering all the scenarios. The proportion of the other donor groups was much lower, especially for nd and rd, compared to the total sample (i.e., nd: 38.10 % vs. 43.66 % and rd: 23.81 % vs. 30.05 %). The most preferred tool was the app, with the 18 to 25 year olds being most open-minded towards app usage compared to the other age groups. Almost 75 % of them stated that after considering all the scenarios, they would be somewhat likely or very likely to use the app in the future for matters related to blood donation. However, in eight out of ten scenarios, a higher percentage of the 36 to 55 years old would choose the chatbot compared to the total sample. We see that the choice of chatbot integration depended on the scenario (i.e., S1: Website, S2: WhatsApp, S4: blood donation app, S9: WhatsApp). The mock-ups were used to find out if the chatbot would be able to motivate respondents through motivational approaches (M1), through gamification (M2) and if it could be helpful by sharing (bad) experiences about blood donations (M3). For M1, M2 and M3, the respondents could choose between three options, i.e., "yes", "no" and "I do not know". In order to allow our survey participants to identify themselves with the situation of being a potential blood donor interacting with a chatbot, for each of the three use cases, we provided screenshots of our prototypical chatbot user interfaces developed with Botframe. Looking at the total sample, M2 and M3 are clearly not useful to the participants because for both use cases almost twice as many chose "no" instead of "yes". Not so for M1, here the proportion was fairly even. Looking more closely at the different groups of donors, for M1 and M2, the results were clearly influenced by the preponderance of non-donors. For M1, in all of the donor groups other than nd, more respondents voted "yes" than "no". For M2, more fd respondents voted "yes" than "no", while for the other two donor groups (i.e., ld and rd) it was fairly even. Even though the results show that for all groups of donors the chatbot is rather not helpful by sharing experiences, the result of M3 was strongly influenced by the regular donors, who made donating blood a

habit and therefore probably do not need to exchange experiences.

Scenario (S) / Mock-up (M)	N	nd	$\frac{nd}{nd_{tot}}$	fd	$\frac{fd}{fd_{tot}}$	ld	$\frac{ld}{ld_{tot}}$	rd	$\frac{rd}{rd_{tot}}$
S1 (DR2.1 "Answering Questions")	35	12	12.90%	8	36.36%	4	11.76%	11	17.19%
S2 (DR1.2 "Appointment Reminder")	53	26	27.96%	6	27.27%	8	23.53%	13	20.31%
S3 (DR2.1 "Answ. Corona Questions")	25	6	6.45%	2	9.09%	5	14.71%	12	18.75%
S3.1 (DR2.3 "Corona Requirements")	29	13	13.98%	2	9.09%	5	14.71%	9	14.06%
S3.2 (DR2.3 "Legislation Requ.")	19	6	6.45%	0	0.00%	5	14.71%	8	12.50%
S4 (DR1.7 "Complete Questionnaire")	18	8	8.60%	2	9.09%	4	11.76%	4	6.25%
S5 (DR1.4 "Alert Logistic Problems")	29	9	9.68%	5	22.73%	5	14.71%	10	15.63%
S6 (DR3.3 "Alert Transfusion")	60	25	26.88%	7	31.82%	10	29.41%	18	28.13%
S7 (DR1.5 "Alert Blood Drives")	46	21	22.58%	3	13.64%	9	26.47%	13	20.31%
S8 (DR1.3 "Eligibility Reminder")	54	22	23.66%	3	13.64%	14	41.18%	15	23.44%
S9 (DR1.1 "Making Appointments")	18	5	5.38%	2	9.09%	4	11.76%	7	10.94%
S10 (DR1.6 "Alert Shortage")	57	23	24.73%	7	31.82%	10	29.41%	17	26.56%
M1 (DR3.1 / DR3.5 / DR2.2 / DR2.3 "Motivational Approach")	76	29	31.18%	9	40.91%	13	38.24%	25	39.06%
M2 (DR3.2 / DR3.5 "Gamification")	65	22	23.66%	9	40.91%	11	32.35%	23	35.94%
M3 (DR3.4 / DR3.5 "Exp. Exchange")	64	29	31.18%	8	36.36%	11	32.35%	16	25.00%

Table 2. Number of respondents who would prefer the chatbot (S) and who would find it useful (M) with respective proportion of donor groups.

6 Conclusion

In this ongoing DSR project, we investigated which design principles should guide the development of chatbots for potential blood donors to increase donors' willingness to give blood. More specifically, we derived three DPs from 14 identified DRs. Subsequently, we evaluated our proposed design with 213 respondents who took part in our online survey. With regard to the different donor types, our results reveal that to embrace the "one size fits all" principle all of our identified requirements have to be considered for the development phase. To specifically reach the 18 to 25 year olds, upgrading to an app could make sense to provide users with even more functionalities.

Although we followed established DSR guidelines, there are some limitations that need to be discussed. First, we only conducted one expert interview for the refinement and identification of the DRs without a specific focus on the German culture. Therefore, additional interviews with experts coming directly from Germany could provide an important complementary perspective on our DPs. Finally, we theoretically instantiated our derived DPs via fictional blood donation scenarios embedded in an online survey with unequal proportions of donor types regarding its participants. Thus, in future work, we aim to implement a prototype of the chatbot and test it with equally grouped participants from Germany by conducting several focus group workshops. We will evaluate different donor types as well as use cases and study the potential integration into apps, websites and messenger services like WhatsApp. In addition, we will develop a chatbot for blood donors in South Africa as part of a funded research project. Besides the general evaluation of the chatbot, we aim to compare the two designs and study similarities and potential differences, e.g., due to cultural differences. More specifically, in this context, we will also explore the different preferences for chatbot personalities and compare the impact of a generic with an individual version of the chatbot on the willingness to donate. As the survey has proven the importance of blood donation apps, we envision a DSR project on the design of these apps to determine how a helpful and efficient blood donation app should be designed. As part of this research, we will also investigate the best integration of a chatbot.

References

Ada Health GmbH (2022). *Gesundheit. Powered by Ada. Bessere Gesundheitsversorgung durch intelligente Technologie*. URL: https://ada.com/de/ (visited on 24 March 2022).

Batis, A. A. and A. Albarrak (2021). "Preferences and features of a blood donation smartphone app: A multicenter mixed-methods study in Riyadh, Saudi Arabia." *Computer Methods and Programs in Biomedicine Update* 1, 100005.

Bednall, T. C., L. L. Bove, A. Cheetham, and A. L. Murray (2013). "A systematic review and meta-analysis of antecedents of blood donation behavior and intentions." *Social Science & Medicine* 96, 86–94.

Bosnes, V., M. Aldrin, and H. E. Heier (2005). "Predicting blood donor arrival." *Transfusion* 45 (2), 162–170.

Botframe (2022). *Botframe*. URL: https://botframe.com/editor/new (visited on 24 March 2022).

Bundeszentrale für gesundheitliche Aufklaerung (2018). *Praevalenz der Blutspende*. `https://www.blutspenden.de/fileadmin/Blutspende/05_Infothek/03_Studien/11321_9_FINAL_Infoblatt_20Blutspende_180608_Final.pdf` (visited on 24 March 2022).

— (2022). *Voraussetzungen für eine Blut- oder Plasmaspende*. URL: https://www.blutspenden.de/blut-und-plasmaspende/voraussetzungen-fuer-eine-blut-oder-plasmaspende/ (visited on 24 March 2022).

Canadian Blood Services (2017). *Canadian Blood Services launches new tool to engage young donors. New chat bot a world's first among national blood operators.* URL: https://www.blood.ca/en/about-us/media/newsroom/canadian-blood-services-launches-new-tool-engage-young-donors (visited on 24 March 2022).

Chandra, L., S. Seidel, and S. Gregor (2015). "Prescriptive Knowledge in IS Research: Conceptualizing Design Principles in Terms of Materiality, Action, and Boundary Conditions." In: *Proceedings of the 48th Hawaii International Conference on System Sciences*. Hawaii, USA, pp. 4039–4048.

Dale, R. (2016). "The return of the chatbots." *Natural Language Engineering* 22 (5), 811–817.

DRK-Blutspendedienste (2022). *HERZLICH WILLKOMMEN BEIM DIGITALEN SPENDERSERVICE*. URL: https://www.spenderservice.net/ (visited on 24 March 2022).

Ferguson, E. (1996). "Predictors of future behaviour: A review of the psychological literature on blood donation." *British Journal of Health Psychology* 1, 287–308.

Følstad, A., M. Skjuve, and P. B. Brandtzaeg (2019). "Different Chatbots for Different Purposes: Towards a Typology of Chatbots to Understand Interaction Design." In: *International Conference on Internet Science 2018 International Workshops*. St. Petersburg, Russland, pp. 145–156.

Foth, M., C. Satchell, J. Seeburger, and R. Russell-Bennett (2013). "Social and Mobile Interaction Design to Increase the Loyalty Rates of Young Blood Donors." In: *Proceedings of the 6th International Conference on Communities and Technologies*. Munich, Germany, pp. 64–73.

Gnewuch, U., S. Morana, and A. Maedche (2017). "Towards Designing Cooperative and Social Conversational Agents for Customer Service." In: *Proceedings of the 38th International Conference on Information Systems*. Seoul, South Korea.

Godin, G., P. Sheeran, M. Conner, M. Germain, D. Blondeau, C. Gagné, D. Beaulieu, and H. Naccache (2005). "Factors explaining the intention to give blood among the general population." *Vox Sanguinis* 89 (3), 140–149.

Godin, G., M. Conner, P. Sheeran, A. Bélanger-Gravel, and M. Germain (2007). "Determinants of repeated blood donation among new and experienced blood donors." *Transfusion* 47 (9), 1607–1615.

Hevner, A. R., S. T. March, J. Park, and S. Ram (2004). "Design Science in Information Systems Research." *Management Information Systems Quarterly* 28 (1), 75–105.

Klinkenberg, E., E. Huis In't Veld, P. De Wit, A. Van Dongen, J. Daams, W. De Kort, and M. Fransen (2019). "Blood donation barriers and facilitators of Sub-Saharan African migrants and minorities in Western high-income countries: a systematic review of the literature." *Transfusion Medicine* 29, 28–41.

Kuechler, W. L. and V. Vaishnavi (2008). "Theory Development in Design Science Research: Anatomy of a Research Project." *European Journal of Information Systems* 17 (5), 489–504.

Mayroth, N. (2017). *Meet the chatbot that helps you donate blood.* https://www.thehindu.com/news/cities/mumbai/meet-the-chatbot-that-helps-you-donate-blood/article20735945.ece (visited on 24 March 2022).

McTear, M., Z. Callejas, and D. Griol (2016). *The Conversational Interface: Talking to Smart Devices*. Springer International Publishing.

Morana, S., C. Friemel, U. Gnewuch, A. Maedche, and J. Pfeiffer (2017). "Interaktion mit smarten Systemen — Aktueller Stand und zukünftige Entwicklungen im Bereich der Nutzerassistenz." *Wirtschaftsinformatik & Management* 9 (5), 42–51.

Oesterreichisches Rotes Kreuz (2022). *MEIN BLUT DIE APP - JETZT WIRD BLUTSPENDEN NOCH EINFACHER!* URL: https://www.roteskreuz.at/blutspenden/app-mein-blut (visited on 24 March 2022).

Ouhbi, S., J. L. Fernández-Alemán, A. Toval, A. Idri, and J. R. Pozo (2015). "Free Blood Donation Mobile Applications." *Journal of Medical Systems* 39 (5), 1–20.

Piliavin, J. A., P. L. Callero, and D. E. Evans (1982). "Addiction to altruism? Opponent-process theory and habitual blood donation." *Journal of Personality and Social Psychology* 43 (6), 1200–1213.

Piliavin, J. A. (1987). "Temporary deferral and donor return." *Transfusion* 27 (2), 199–200.

Pirabán, A., W. J. Guerrero, and N. Labadie (2019). "Survey on blood supply chain management: Models and methods." *Computers & Operations Research* 112, 104756.

Roman, M. K., E. A. Bellei, D. Biduski, A. Pasqualotti, C. D. S. R. De Araujo, and A. C. B. De Marchi (2020). ""Hey assistant, how can I become a donor?" The case of a conversational agent designed to engage people in blood donation." *Journal of Biomedical Informatics* 107, 103461.

Sardi, L., M. Kharbouch, T. Rachad, A. Idri, J. M. C. de Gea, and J. L. Fernández-Alemán (2019). "Blood4Life: A Mobile Solution to Recruit and Retain Blood Donors Through Gamification and Trans-Theoretical Model." In: *New Knowledge in Information Systems and Technologies*. Ed. by Á. Rocha, H. Adeli, L. Reis, and S. Costanzo. Vol. 932. Advances in Intelligent Systems and Computing. Cham: Springer, pp. 3–12.

Sarikaya, R. (2017). "The Technology Behind Personal Digital Assistants: An overview of the system architecture and key components." *IEEE Signal Processing Magazine* 34 (1), 67–81.

Schäfer, F. (2020). *Studenten der FH Kiel und UKSH veröffentlichen Blutspende-App.* https://nachrichten.idw-online.de/2020/06/10/studenten-der-fh-kiel-und-uksh-veroeffentlichen-blutspende-app/ (visited on 24 March 2022).

Schreiber, G. B., K. S. Schlumpf, S. A. Glynn, D. J. Wright, Y. Tu, M. R. King, M. J. Higgins, D. Kessler, R. Gilcher, C. C. Nass, et al. (2006). "Convenience, the bane of our existence, and other barriers to donating." *Transfusion* 46 (4), 545–553.

Schreiber, G. B., U. Sharma, D. Wright, S. Glynn, H. Ownby, Y. Tu, G. Garratty, J. Piliavin, T. Zuck, R. Gilcher, et al. (2005). "First year donation patterns predict long-term commitment for first-time donors." *Vox Sanguinis* 88 (2), 114–121.

The American National Red Cross (2022a). *Download the Blood Donor App Today*. https://www.redcrossblood.org/blood-donor-app.html (visited on 24 March 2022).

— (2022b). *Meet Clara, the Blood Donation Chatbot.* https://www.redcrossblood.org/donate-blood/dlp/meet-clara--the-blood-donation-chatbot-.html (visited on 24 March 2022).

Van Dongen, A., C. Abraham, R. A. C. Ruiter, H. P. Schaalma, W. L. A. M. de Kort, J. A. Dijkstra, and I. J. T. Veldhuizen (2012). "Are lapsed donors willing to resume blood donation, and what determines their motivation to do so?" *Transfusion* 52 (6), 1296–1302.

Van Dongen, A., R. Ruiter, C. Abraham, and I. Veldhuizen (2014). "Predicting blood donation maintenance: the importance of planning future donations." *Transfusion* 54 (3pt2), 821–827.

Verhagen, T., J. Van Nes, F. Feldberg, and W. Van Dolen (2014). "Virtual Customer Service Agents: Using Social Presence and Personalization to Shape Online Service Encounters." *Journal of Computer-Mediated Communication* 19 (3), 529–545.

Weizenbaum, J. (1966). "ELIZA—A Computer Program For the Study of Natural Language Communication Between Man And Machine." *Communications of the ACM* 9 (1), 36–45.

Yuan, S., S. Chang, K. Uyeno, G. Almquist, and S. Wang (2016). "Blood donation mobile applications: are donors ready?" *Transfusion* 56 (3), 614–621.