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When chatbots talk about risks – artificial intelligence in risk communication in radiation protection

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1 Summary

1.1 Background

Artificial intelligence is considered promising in almost all areas, including citizen communication by public authorities. Chatbots in particular can support the workflows of press and public relations work carried out by public authorities. Chatbots can also meet the information needs of the public by providing individually tailored information. However, the use of chatbots in citizen communication is not without concerns, especially with regard to the communication of risk information, such as in a radiological emergency. This is because, in a radiological emergency in particular, there is a high demand for information among the population, and crisis communication is an essential part of emergency management. Citizens seek information about the current situation and primarily turn to the relevant authorities, such as the Federal Office for Radiation Protection (BfS), with their questions. The transmission of information and exchange with the population serve to protect the physical and mental health of the affected population (Pölzl-Viol 2018). Emergency management organisations have to cope with many different tasks, but the necessary resources are usually scarce. In a crisis, the number of enquiries would pose considerable challenges for the BfS. The use of a chatbot supports the BfS's risk and crisis communication.

There are various types of chatbots, which vary in terms of function and technology (Adamopoulou/ Moussiades 2020; Kusal et al. 2022). For the BfS chatbot, a rule-based system is planned, which will primarily map the existing BfS emergency FAQs. A rule-based chatbot works with fixed rules and scripts. It responds to predefined inputs using keyword searches and then provides answers based on the FAQs (Gruß 2024; Hussain et al. 2019; Maniou/ Veglis 2020).

The BfS plans to design and implement such a chatbot specifically for risk and crisis communication in the event of a radiological emergency. To ensure that the population is informed in the context of crisis communication, it is essential that the chatbot is perceived and accepted by the public. It can be assumed that the greater the trust placed in the chatbot, the more likely the information it provides will guide people's actions and be perceived as appropriate to the situation. In order for the chatbot to be considered helpful by citizens and used as such, thereby supporting the BfS in risk and crisis communication, its design must meet the requirements and expectations of those seeking information. **This research project aims to answer the question of how the chatbot should be designed so that it can support the BfS in risk and crisis communication in case of an emergency.**

1.2 Objective

The objective of this research project is to determine how the BfS (emergency) chatbot must be designed so that users trust it, consider it helpful and use it accordingly, thereby supporting the BfS in risk and crisis communication.

1.3 Summary of the core results

The results of this research project, including both the review of the relevant state of science and technology and the quantitative online survey, clearly show that the design of a trustworthy chatbot that is accepted by users must address several interrelated levels. It has been shown that ease of use and technical functionality form the basis of any successful chatbot use. The quantitative survey also shows that older and less tech-savvy people benefit particularly from chatbots that are structured in an easy-to-understand way and provide step-by-step instructions. The quality and timeliness of the content provided by the chatbot also play a decisive role, especially in emergency situations. Regular maintenance and technical reliability of responses increase user satisfaction and trust in the chatbot. The visual design also has a clear function. An appealing and professional design and the targeted use of visual elements such as emojis increase the perceived humanity and likeability of the chatbot when used in a targeted manner. These design elements have a particularly positive effect in risk communication when the chatbot is perceived as "human" and accessible overall. The communication style of the chatbot is also important. Here, the findings of the quantitative study show that an empathetic, personal and informal approach comes across as more human and empathetic and increases the perceived impartiality. At the same time,

the analysed specialist literature emphasises that the language used by the chatbot must always be appropriate to the situation and reliable to convey competence, especially in crisis situations where the target groups may have very different needs. A simple, clear and factual-rational communication style is just as important as an empathetic and target group-oriented style in order to build trust, increase credibility and facilitate the transfer of information. Furthermore, the quantitative survey highlights the importance of transparency, security and data protection. The results show that trust is particularly likely to develop when the chatbot is clearly identified as a non-human actor and the operating organisation (e.g. the Federal Office for Radiation Protection) communicates transparently. Providing reliable sources can also help to increase trust. The literature analysis confirms these findings and emphasises that, particularly when it comes to sensitive topics, transparent data protection information and a clear reference to institutional responsibility significantly increase credibility and willingness to use the service. Overall, the results show that the successful design of an emergency chatbot requires a balanced combination of good usability, appealing visual design, empathetic, clear, but also factual and targeted communication, as well as understandable and transparent security and data protection information.

Accordingly, we specifically recommend that in emergency situations, i.e. threatening scenarios, the chatbot should be given a female first name and use informal language and appropriate emojis. In addition, the information should be clear and easy to understand, yet still detailed, presented in a factual and rational style, and backed up with appropriate, transparent references (see section 5.2).

2 Research design

For the purpose of answering the overarching research questions of the project, namely how the chatbot must be designed so that it is accepted and used in the context of risk and crisis communication, and what influence artificial intelligence-based communication of risk information via a chatbot has on the perception of radiation risks, the research project was divided into three work packages.

- Work package 1: Literature review of the relevant state of science and technology

  The quantitative survey was preceded by research and analysis of the state of research and use of chatbots, particularly with regard to crisis communication and their effect on risk perception. To this end, relevant sources were systematically researched and the core results from the literature (e.g. method, questions, conclusions) were compiled.

- Work package 2: Quantitative survey and analysis

  The quantitative survey was conducted online in April 2025 with 3,000 people. The questionnaire designed for this purpose was developed on the basis of research and analysis of the relevant state of science and technology.

- Work package 3: Recommendations, workshop and results report

  The findings from the literature review and analysis as well as the quantitative survey are summarised in this final report. It also includes the results developed in a workshop with the BfS.

3 Literature review of the relevant state of science and technology (WP 1)

3.1 Objective and key questions for the literature review

In preparation for the quantitative data collection, Work Package 1 involved researching relevant national and international (English-language) sources on the topics relevant to the study. Based on the overarching research question for this work package: "What is the relationship between the perception and benefits of artificial intelligence and the perception of risks addressed in communication with a chatbot?", the literature review focused on the following key questions:

- What insights are there regarding the configuration and design of chatbots?
- What influences their acceptance?
- What experience has been gained with existing chatbots (e.g. "Bundesbots") and what can be learned from this regarding their design?
- What special features need to be considered in an "emergency scenario"?
- What is generally relevant in crisis communication?
- What needs to be considered when addressing (target) persons?
- Are there different criteria depending on different individuals or personas?

The research for work package 1 yielded two key results:

- Documentation: List of sources relevant to the current study (see appendix: Analysed literature)
- Evaluation: Content analysis of the sources regarding the following aspects:
    - Questions: Which topics were researched?
    - Method: Which research design was used?
    - How were the questions operationalised?
    - Results: What findings do the studies show and what conclusions can be drawn from them?
    - Limitations: Where were methodological or content-related limitations?
    - Conclusions: What methods and data collection instruments are available for evaluating chatbots? How can the insights from the processed sources be transferred to the guiding questions of the present research project? What insights can be gained for designing a chatbot, especially if it is intended to be suitable for a (radiological) emergency situation?

3.2 Procedure

The literature review was conducted in three steps: 1. Searching, 2. Collecting, and 3. Evaluate.

1. Searching: The relevant sources to be reviewed were searched for using scientifically proven research logic:
    - Definition of subject areas
    - Conversion into keywords:
        - German: Chatbot, Chatbot Gesundheit, Chatbot Corona Pandemie, Chatbot Krisensituation, Chatbot Akzeptanz, Chatbot Design, Bundesbot, Chatbot Risikowahrnehmung, KI Einsatz Behörde, Bevölkerungsschutz, Bevölkerungsschutz KI, Strahlenschutz Chatbot, Chatbot radiologischer Notfall, Chatbot Krise, Chatbot Notfall, Persona Chatbot, Gesundheit Chatbot, Vertrauen Chatbot, Risikowahrnehmung, Krisenkommunikation, Risikokommunikation, Strahlenschutz Chatbot, Bevölkerungsschutz, Notfallkommunikation, Katastrophenhilfe Chatbot, Katastrophe

Chatbot, Katastrophenunterstützung Chatbot, radiologischer Notfall Management, computerbasierte Dialogsysteme, Katastrophen Risikominimierung

- English: chatbot, chatbot health, chatbot covid-19, chatbot crisis, chatbot acceptance, chatbot design, chatbot risk perception, AI use public authority, civil protection, civil protection AI, radiation protection chatbot, chatbot radiological emergency, human-computer trust scale, chatbot crisis, chatbot emergency, persona chatbot, chatbot acceptance, health chatbots, trust chatbot, risk perception, crisis communication, risk communication, radiological emergency chatbot, civil protection, emergency communication, disaster management chatbot, disaster chatbot, disaster-support chatbot, radiation emergency management, conversational agent, disaster risk reduction

- Identification of relevant approaches, institutions, publication locations and media
- Search using keywords in relevant directories, author- and institution-based search in relevant directories and specialist portals, e.g. Google Scholar, DORIS, Uni-OPAC, websites of universities, non-university research institutions, ministries and scientific sources, such as publications by the IAEA, BfS, BMUKN and EPA. In addition, further relevant literature was researched based on the bibliographies of relevant publications. Keywords were modified or supplemented after the initial research to refine the search.
- The selection of German and English-language sources was deliberately made without any time restrictions: Since artificial intelligence and related applications, such as chatbots, are a relatively new and emerging field of research, most of the relevant literature dates from 2010 onwards. However, selected sources devoted to risk and emergency communication in general are to be distinguished from this and are not limited to a specific period. For practical research reasons, only German and English-language literature was considered, so most studies refer to Europe and North America. Some sources from Asia are also included in the literature selection.
- In terms of content, the literature selection focused on two main areas: On the one hand, the selection focused on sources on risk and emergency communication in general and the associated situation-specific needs of the population. On the other hand, the focus was on (empirical) studies that deal with the use of chatbots and artificial intelligence applications and examine their suitability and acceptance by the population. In addition to literature devoted to the use of (artificial intelligence-based) chatbots in risk communication in general, the research was further narrowed down to the use of these applications in the context of health and environmental risks. The focus was to be on social factors such as the acceptance of artificial intelligence and ethical aspects. The challenges and risks associated with the use of chatbots should also be identified with the help of the selected literature.
- Selection was based on the principle of methodological and theoretical breadth (i.e. taking into account as many different approaches as possible) on the one hand, and on the other hand, the identification of recurring approaches, constructs and operationalisations as well as content saturation, i.e. until no really new findings for the focus of the present study emerged from further publications on the topic.

2. Collecting: The systematic recording of relevant literature focused on empirical primary studies on theoretical and methodological approaches and their operationalisation, which were published in scientifically recognised journals. The focus was on the empirical implementation and testing of question formats, constructs, study designs, theories and approaches used, as well as empirical findings on the use of (artificial intelligence-based) chatbots in general and in (radiological) risk and emergency communication in particular. Empirical studies were also intended to identify possible explanatory factors for the perception and acceptance of chatbots as well as potential third factors (e.g., sociodemographic). The selected literature was first compiled in a table. In order to systematically

review the state of empirical research, the sources were divided according to their main focus or research question.

3. Evaluate: The aim of examining the selected research literature was to gain inspiration and draw concrete conclusions on the following aspects:
    - Scientifically sound findings on the design of an (artificial intelligence-based) chatbot and its evaluation by users, effects of the application of specific style and design options, and different communication styles
    - Communication and information needs of the population in crisis or emergency situations
    - Potential factors for risk perception that influence communication with a chatbot

3.3 Results from the literature review and analysis

Overall, the research yielded a wealth of scientific publications. Based on the criteria of thematic consistency and relevance of the findings for the research project, a shortlist of 53 sources was selected for closer examination. As a result, 45 relevant sources were identified, the findings of which are summarised below and listed according to the structure of the four key questions.

3.3.1 Structure and design of chatbots

Key question: What findings are there regarding the configuration and design of chatbots?
What influences their acceptance?

With regard to the key question of what insights there are into the design of chatbots and what influences their acceptance, the analysed literature (see Appendix: Analysed literature – Chatbot design) shows that the design of chatbots has a significant influence on user perception. Various design elements have a significant influence on how a chatbot is perceived.

We can start with the (technical) functionality of a chatbot, which depends heavily on its intended use. Task-oriented chatbots that work on a rule-based system are particularly suitable for specific tasks and a limited area, as is the case with Q&A chatbots, for example (Hussain et al. 2019). In order for this to work and be helpful to users, the chatbot must be able to understand user input and recognise keywords to provide the appropriate response (Hofeditz et al. 2019). Consequently, it is very important that the technical matching of keywords to generate appropriate responses works flawlessly, especially in a Q&A chatbot (Hussain et al. 2019). An appropriate response time for the chatbot also helps to improve user-friendliness (Feine et al. 2019), which has a positive effect on its acceptance. The same applies to the ease of starting and continuing a conversation (Borsci et al. 2022).

When designing chatbots, it is not only their functionality that needs to be considered. Their presentation, visual design, communication style, conversational skills, implementation of non-verbal communication tools and handling of security and data protection also influence how they are perceived and accepted. For example, the perceived humanity of chatbots increases the likelihood that users will rate them as trustworthy and credible (Borau et al. 2021; ibid.). Chatbots are perceived as more human when they use human-like language or have a human name (Araujo, 2018). This is especially true when the chatbot has a female name instead of a male name (Borau et al. 2021). Nevertheless, the chatbot should be transparent about its chatbot character and recognisable as a non-human actor (Stieglitz et al., 2022). This allows users to formulate their personal expectations of the chatbot, which are then ideally fulfilled by it. If the chatbot meets the expectations of the users, it is perceived as high quality, which has a positive effect on trust in it (Zamora, 2017).

Furthermore, the external design of a chatbot, in terms of colour and user interface presentation, should also be chosen carefully, as this can have a significant influence on how chatbots are evaluated (Maniou/Veglis 2020). An appealing, consistent design contributes to user-friendliness and supports the social presence of the chatbot (Maniou/Veglis 2020; Feine et al. 2019).

Not only the appearance of the chatbot is relevant for its acceptance, but also the communication style is essential. Differences in the technical level of the language style can influence communication with users (Linder 2020). Chatbots are particularly well received when they can communicate in a targeted manner (Stieglitz et al. 2022). It contributes to the perception of competence and social presence, if the chatbot has conversational skills in the form of tailored responses and a variety of answers. Repetitive or generic responses, on the other hand, lead to less engaging interactions and do not create a sense of connection between the chatbot and the user in the interaction (Schuetzler et al. 2020). A chatbot should therefore be socially oriented in that it responds in a personal and emotional manner (Xu et al. 2022). Accordingly, the chatbot's communication style should include elements such as greetings, small talk and emotional engagement (Feine et al. 2019; Xu et al. 2022). At the same time, the chatbot should always communicate in a targeted, precise and clear manner without using too many responses and social cues (Stieglitz et al. 2022, Borsci et al. 2022).

Similarly, the implementation of emojis as a non-verbal means of communication can increase the perceived warmth and emotionality of the chatbot (Yu/Zhao 2022), which is crucial for the positive evaluation of chatbots (Olk et al. 2020). The use of emojis can also help to fulfil non-verbal functions that a text-based chatbot lacks, making it appear more socially present. The use of emojis can improve the perceived quality of the chatbot in terms of social attractiveness and credibility (Beatie et al. 2020). However, emojis do not lead to a higher perceived competence of the chatbot (Yu/Zhao 2024). The credibility of the chatbot is increased above all when the combination of verbal and non-verbal behaviour appears natural and fits together (Feine et al. 2019).

It is also important for the acceptance of a chatbot, especially in the context of crisis communication, that it is designed to be transparent. The chatbot should not only provide information in a targeted manner and, as far as possible, in the language of the user, but also comply with clear data protection requirements and not disclose any sensitive information (Hofeditz et al. 2019). It can also be particularly helpful to increase the acceptance of chatbots in crisis communication by providing the information with a source reference and indicating that it is up to date (Stieglitz et al. 2022; Radziwill/Beton 2017). Similarly, in emergency situations, location-based adaptation of information can be crucial to maximise relevance for users (Hofeditz et al. 2019), but only to the extent that the privacy of users remains protected (Borsci et al. 2022).

In conclusion, it can be said that for a chatbot to be accepted, functionality and performance must be considered, as well as the aspects of humanity and personal communication, transparency, general user-friendliness and visual presentation (Radziwill/Beton 2017).

3.3.2 Evaluation of existing chatbots

Key question: What experience has been gained with existing (federal) chatbots and what can be learned from this regarding their design?

In recent years, research in the field of artificial intelligence and, as a result, in artificial intelligence applications such as chatbots has increased significantly. Chatbots based on artificial intelligence are now used in various sectors, from support on service portals to booking assistants. Chatbots have established themselves as effective tools for providing users with quick and customised responses. The emergence of ChatGPT in particular has given artificial intelligence chatbots another significant boost, further increasing general interest in such technologies.

Regardless of the sometimes differing assessments and varying degrees of acceptance of artificial intelligence chatbots, it can be said with certainty that the use of such technologies is growing. Chatbots have proven to be particularly useful in the healthcare sector, where they have led to a reduction in the workload of medical staff in particular (Reis et al. 2020). Chatbots have been tested in this area for several years to answer patient queries or provide information services. They are most commonly used in preventive care and risk communication, followed by public health monitoring by health authorities, telemedicine, health and safety monitoring in the workplace, and elderly care (Almaki/Azeez 2020). In the wake of the coronavirus pandemic (2020), the use of chatbots has increased worldwide (Battineni et al. 2020; Hao 2020). Chatbots have been used in particular to process the demand for information in crisis

situations and to meet the urgent need of the population for clear and consistent facts. Given the constantly evolving situation and the multitude of different sources, it was crucial to provide a reliable platform that offered people quick and direct access to accurate information on health, protective measures and the latest developments (Hao 2020). Chatbots made it possible to convey this information in an accessible and user-friendly way, thereby reducing uncertainty and misinformation (Almalki/Azeez 2020; Miner et al. 2020; Walwema 2021). The establishment of chatbots in the wake of the coronavirus pandemic has served as a valuable precedent that can be used for the implementation of chatbots in other crisis situations.

An evaluation of existing chatbots shows that their source or provider is decisive for their trustworthiness (Almaki/Azeez 2020). Chatbots provided by public authorities and central institutions are considered trustworthy. In Germany, there are already so-called "Bundesbots", which are developed and provided by the federal government and associated ministries. These include, for example, the chatbot TinA, which acts as a customs federal bot, and the chatbot ViOlA, which is provided by the Federal Central Tax Office. So far, there are no empirical studies evaluating and assessing the acceptance of these "Bundesbots". However, looking at their design, some common features can be identified: The "Bundesbots" have female names and a thematically appropriate icon. They provide information on data protection and require users to accept it. In each case, it is the chatbot that starts the conversation and begins with a greeting. However, there are differences in the specific greeting used, which ranges from a simple "Hello" to "Good day" and "Greetings" to "Welcome". The navigation through the topic structure of the federal bots is also individually designed, as is the colour scheme of the user interface. Another similarity is that both bots say goodbye at the end of the conversation, with the ViOlA bot additionally incorporating emojis into its dialogue.

The current state of research on existing chatbots provides indications of where the use of chatbots is less accepted and where challenges lie. When using chatbots in real-life contexts, several challenges can be identified. On the one hand, continuous review and updating of the information stored in the chat is a basic prerequisite for the successful use of chatbots (Peña-Cáceres 2024; Tsai et al. 2019). Depending on the subject area, new data is constantly being added and the accuracy of the information provided must be guaranteed. If these requirements are not met, there is a risk that incorrect instructions will be disseminated, which can have serious consequences, especially in sensitive areas such as the healthcare sector (Dennis et al. 2020; Miner et al. 2020).

Furthermore, it can be said that both rule-based and generative chatbots are used in practice, with both types of systems having strengths and weaknesses (Xiao/Yu 2025). Rule-based chatbots, which are based on predefined response sets, are particularly suitable for use in specific or sensitive areas (see Chapter 3.3.1 "Structure and design of chatbots"). Since they only use predefined responses (Gruß 2024; Hussain et al. 2019; Maniou/ Veglis 2020), there is no risk of conveying unvalidated or potentially incorrect information (Chandra/ Chakraborty 2024). This reduces the risk of the chatbot providing incorrect information or unwanted instructions.

The evaluation of existing chatbots shows that it is also crucial when using chatbots that they are designed in such a way that users receive clear and step-by-step instructions through the interaction. The chatbot for the presidential elections in Kenya, for example, shows that a balanced combination of text-based and visual elements is beneficial in ensuring a user-friendly and efficient experience (Piccolo et al. 2018). In addition, based on the WHO Corona chatbot on WhatsApp, it is recommended to convey information in an informal manner, as this facilitates the absorption of the information and helps users to remember the content for longer (Walwema 2021). Platforms that are already familiar or used daily, such as WhatsApp (Peña-Cáceres 2024; Walwema 2021) or Facebook (Piccolo et al. 2018), are therefore particularly suitable for implementing chatbots.

3.3.3 Risk and crisis communication

Key question: What special features need to be considered in an "emergency scenario"? What is generally relevant in crisis communication?

Risk and crisis communication are essential components of general crisis management. Unlike crisis communication, which comes into play during an emergency and is part of the protection concept in an acute threat situation, risk communication aims to prevent and prepare for a possible crisis (Pölzl-Viol 2022). The aim here is to provide the population with relevant knowledge that may be important in the event of a crisis, as well as to raise awareness of the risks and build trust (ibid.; IRPA 2023). Targeted information and communication measures can prepare the population for potential crises and ensure that tasks and responsibilities are assigned in the event of an emergency. In the course of this, communication channels, that can be used in the event of a crisis, can also be established (Pölzl-Viol 2022).

A crisis can generally be divided into different phases, each of which is associated with different communication needs among the population. The content and forms of communication should be adapted to the phase. In principle, crisis communication faces the challenge that those affected are under high stress, which impairs their ability to absorb and process complex information. Clear and precise messages that are always up to date, empathy, active listening, conveying empathy and an empathetic communication style play a decisive role in conveying trust and a feeling of security (Gruß 2024; IRPA 2023). It is equally important to be transparent and not to spread false assumptions or make promises that cannot be kept. Inconsistent and contradictory information must also be avoided at all costs (IRPA 2023).

In addition to these factors to be considered in crisis communication, it should be noted that in an emergency situation, there is a fundamentally increased need for information on the part of the population, which in turn can only be met to a limited extent by the responsible authorities (Gruß 2024). However, in order to meet this need for information, literature and practice are investigating the extent to which artificial intelligence, specifically artificial intelligence chatbots, can support the management of emergency situations and what special requirements are associated with communication in such situations. Overall, the analysis of (empirical) findings suggests that chatbots are a valuable, complementary tool in crisis situations and can improve crisis communication efficiently and effectively, as they can answer crisis-related questions for a broad section of the population in real time, thereby significantly reducing the amount of work and time required, for example by authorities (Chandra/Chakraborty 2024; Rodsawang et al. 2020; Tsai et al. 2021). They are particularly suitable for communicating with concerned citizens and those affected in radiological emergencies (Chandra/Chakraborty 2024). Empirical findings suggest that such communication with chatbots can be expected to result in a higher success rate in the search for information as well as greater trust on the part of users compared to independent information searches on the internet (Xiao et al. 2023). To ensure that the chatbot is accessible to as many people as possible and offers help, it should provide users with a simple user interface, for example by allowing them to enter their queries independently via text or predefined buttons (Tsai et al. 2021).

However, the acceptance and effectiveness of chatbots in crisis communication may depend not only on user-friendliness but also on the type of information provided: while they are effective for clear and quick instructional information, the lack of emotional support through interaction and empathy is often seen as a shortcoming of chatbots (Xiao/Yu 2025). In emergency situations in particular, chatbots are expected to do more than simply convey information in a technical manner; they must also address the emotional and social needs of the population and communicate in a friendly and context-sensitive manner (Urbanelli et al. 2024). This requires a high degree of empathy, which chatbots can only achieve "artificially" (Gruß 2024).

Furthermore, there are fundamental risks associated with artificial intelligence chatbots that must be carefully considered when using them in emergency situations. In such situations, it is even more important to guarantee unambiguous and correct answers. To prevent chatbots from providing incorrect information or instructions, it is necessary to "train" chatbots for use in radiological emergencies and subject them to continuous monitoring (Chandra/Chakraborty 2024). Based on the current state of research, the recurring checking of linked databases can be identified as a decisive factor (Chandra/Chakraborty 2024; Peña-Cáceres 2024). Rule-based systems are therefore generally more suitable than generative, autonomous systems (Gruß 2024). The literature also suggests that filling the rule-based chatbot in collaboration with (local) civil protection experts can help prepare a chatbot for real emergency scenarios (Boné et al. 2020). It can generally be assumed that information from trustworthy sources and experts will resonate more

strongly with the population and can have a decisive influence on people's behaviour in emergencies (Gruß 2024). A local connection to the source of information also helps to better assess personal impact and possible consequences, whereby the content should be specifically tailored to the respective target group (Gauntlett et al. 2019). If chatbots are equipped with implicit social or ethical cues, this has an additional positive influence on perceived trustworthiness (Hofeditz et al. 2022).

A specific branch of the literature is devoted to so-called crisis apps, some of which also use artificial intelligence technologies. They can also provide support in emergencies, for example by performing warning and alert functions. They offer advantages over traditional communication channels by providing location-based information and easy access (Karl et al. 2015). Mobile-friendly use is another important aspect in this context (Rodsawang et al. 2020).

The analysed literature suggests that, in the context of an emergency or crisis situation, special requirements must be placed on communication as a whole and on chatbots in particular. In addition to the increased communication coverage provided by their technical capabilities, chatbots can also serve as a central source of information in emergency situations, providing scientifically validated information with a wide reach (Gruß 2024). The change in the population's communication needs caused by the emergency situation is less about conveying technical, complex information and more about providing empathetic, guided crisis support. From a practical perspective, a strategic combination of chatbots and human agents adapted to the type of crisis, and the specific situation is therefore recommended (Xiao/ Yu 2025).

3.3.4 Personas (target groups)

Key question: What needs to be considered when addressing (target) individuals? Are there different criteria depending on different individuals or personas?

Effectively addressing (target) individuals is a key challenge in crisis communication in general, as well as in the context of the use of artificial intelligence and related chatbots. There are several aspects to consider here.

A target group-specific approach can be taken, for example, using so-called "personas". Personas are fictional individuals who are intended to represent a specific type of person (Salminen et al. 2020). They are based on user research and are designed to reflect the goals, needs and characteristics of real people. For this, personas are typically presented in the form of profiles (ibid.). At the same time, however, Salminen et al. (2020) suggest that people, depending on their age or cultural background, for example, have different perceptions of personas in terms of characteristics such as sympathy, empathy, similarity, credibility and relevance. The different perceptions of personas are therefore important when addressing specific target groups (Salminen et al. 2020). It is also essential to design personas in such a way that they correspond to the interests and needs of the target groups: The better the personas fit, the more positively the persona-target group-specific approach will be perceived (Salminen et al. 2020). Dametto et al. (2021) also point out that a target group-specific approach can be particularly useful in crisis communication. This is especially successful if the target groups have been analytically defined in advance. Relevant dimensions in target group-oriented communication include the level of concern, motivation and anxiety, as well as the personality of the individuals (Dametto et al. 2021).

Furthermore, a review of the literature reveals that, in the context of the use of artificial intelligence, various criteria must be considered when addressing different individuals. This is because the acceptance and evaluation of artificial intelligence in general is influenced by socio-demographic characteristics such as age, education and (technical) knowledge (Araujo 2020). Increasing age is often associated with a higher perception of risk regarding artificial intelligence. Empirical findings can only provide limited evidence of gender-related differences in this regard (Araujo 2020). When the education of individuals is considered, the existing literature suggests that education, or general knowledge, can have a positive effect on the perception of artificial intelligence, as can domain-specific knowledge of artificial intelligence, programming or technology. The IT skills of users of artificial intelligence and chatbots, their access to and aversion to using computer technologies, and their general experience with chatbots influence their acceptance and use (Nadarzynski et al. 2019).

The perceived benefits of artificial intelligence applications such as chatbots also increase with higher education and knowledge (Araujo 2020). Similarly, different levels of concern about data protection on the internet lead to differences in people's acceptance of artificial intelligence and, consequently, in the successful use of chatbots. Attitudes and trust towards chatbots, as well as curiosity about technology, are influencing factors in the acceptance of chatbots (Nadarzynski et al. 2019).

Furthermore, current research shows that the acceptance and use of artificial intelligence and chatbots is positive when the chatbot reflects the personality of the user (Shumanov/Johnson 2021). However, the acceptance of chatbots and artificial intelligence in general depends not only on the personality and socio-demographic factors of the users, but also on the context of a person. This includes, among other things, the contextual content: the general use of artificial intelligence in the healthcare sector or in media contexts, for example, is often perceived more positively than in other areas (Araujo 2020; Schwesig et al. 2023). When considering decisions made by artificial intelligence, the scope of the decisions is a criterion that people use to assess their acceptance of artificial intelligence (Araujo 2020). In general, it can be said that the lower the perceived risks or the higher the opportunities of artificial intelligence applications are assessed, the more likely a positive attitude towards them is (Schwesig et al. 2023). On the other hand, a person's emotional context must not be ignored when it comes to the acceptance of artificial intelligence and its various applications. If a person's initial situation is emotionally charged, as can be the case in an emergency or crisis communication situation, this can give rise to different communication needs. Emotions shape users' behaviour and needs, which is why they should be taken into account as individual factors in understanding personas. When it comes to sensitive or shameful topics, artificial intelligence can play a helpful role, for example in the form of chatbots, as users can obtain information without judgement. On the other hand, chatbots are less suitable in situations where emotions such as anger prevail, as these are often accompanied by the need to express them in the presence of another person (Tsai et al. 2021).

In summary, it can be emphasised that communication in crisis situations and communication via artificial intelligence should be as personal and context specific as possible. It is helpful to consider individual and situational factors, for example to promote equal acceptance of artificial intelligence among all target groups and to dispel any concerns. If so-called "personas" are identified and systematically reviewed, associated needs can be identified and an effective approach can then be ensured (Salminen et al. 2020), although it must be noted that target group-specific information does not always cause significant differences in information intake or behaviour (Dametto et al. 2021).

4 Quantitative survey and analysis (AP 2)

An online survey was chosen to answer the research questions. Before conducting the main survey, a pretest with n = 53 interviews was carried out in accordance with the field of the main survey.

4.1 Pretest

The pretest for the study took place from 5 March 2025 to 7 March 2025.

In the pretest, which preceded the main survey, the questionnaire was specifically checked to ensure that it reliably reflected the desired content and could therefore be used as a suitable survey instrument. A central focus was on the comprehensibility of the questions and the types of questions used. In addition, the extent to which the "don't know" option could potentially impair the quality of the data collected for the respondents was to be examined. From a technical perspective, the pretest was also used to test the functionality and comprehensibility of the embedded videos with the chatbot dialogue. In addition, the pretest served to check the average duration of the survey, which should not exceed a maximum of 20 minutes.

The fieldwork for the pretest was carried out as an online survey in line with the main survey. Unlike the main survey, which was conducted with two panels, the pretest was implemented with one panel due to the number of cases (n = 53) and to ensure the best possible control of the sample. Special care was taken to ensure that the pretest already had as wide a socio-demographic spread as possible to test the survey instrument across different population groups.

Table 1 Distribution of pretest interviews according to socio-demographic characteristics, presentation of case numbers

Characteristic	**Number of interviews in the pretest**
Gender	
Female	27
Male	26
Age	
16-19 years	3
20-29 years	10
30-39 years	4
40-49 years	8
50-59 years	13
60-69 years	5
70-79 years	7
80 years and older	3
School education	

Characteristic	Number of interviews in the pretest
Primary / lower secondary school leaving certificate	16
Intermediate school leaving certificate	16
Adv. technical college cert. / A-levels / university entrance qualification	20
Federal state	
Baden-Württemberg	8
Bavaria	5
Berlin	2
Brandenburg	2
Bremen	0
Hamburg	2
Hesse	4
Mecklenburg-Western Pomerania	1
Lower Saxony	4
North Rhine-Westphalia	1
Rhineland-Palatinate	3
Saarland	2
Saxony	4
Saxony-Anhalt	2
Schleswig-Holstein	1
Thuringia	1

Table 2 Overview of interview length in minutes for the pretest

Minimum	Median	Mean	Max
10 min	17 min	20 min	49 min

The findings from the pretest were incorporated into the final questionnaire (see appendix: Main survey questionnaire). Regarding reviewing the "don't know"-option, the pretest revealed that this option was only used for a few questions. In most cases, it was only used by a small number of respondents (in the low single digits) to a maximum of around five percent. A few questions for which a higher proportion of "don't

know" responses was found in the pretest were subsequently revised for the main survey. For example, in the questions on radiation and radioactivity, the high non-response rate was reduced by adding a definition of the term "radioactivity". Overall, no significant impact of the "don't know" response option was expected.

In addition, the pretest revealed a low dropout rate across all respondents and a good level of understanding of the questions, so that only a few details in the questionnaire had to be adjusted to optimise the content and the dialogue videos had to be fine-tuned. The average interview duration of 20 minutes was also already achieved in the pretest (see Table 2).

4.2 Main survey

4.2.1 Study overview

Table 3 Study overview online main survey

Characteristic	**Key data**
Survey method	CAWI survey (computer-assisted web interview)
Survey period	Main survey: 7 April to 25 April 2025
Number of interviews	Main survey n = 3,000 people aged 16 and over
Average interview length	Median: 15 minutes Mean: 17 minutes
Population	German-speaking resident population aged 16 and over who use the internet (online population)
Quota	Based on the Media Analysis Audio (2024 II) baseline study, which is weighted according to the microcensus, for the German-speaking online population aged 16 and over
Selection	2 offline recruited online access panels
Data preparation	Final plausibility check, representativeness check, weighting by age, gender, education and federal state
Evaluation	Tabulation, descriptive and statistical analyses Significance level: 5%

4.2.2 Survey instrument

The questionnaire for the study was finalised jointly by BfS and GIM. In particular, the plausibility of the order of the questions, the structure and the filter guides in the questionnaire template were checked, unclear or difficult terms were revised or explained, and based on the pretest, it was decided which questions with which variables and response options would be included in the main survey.

The questionnaire was divided into several thematic sections and was designed to systematically collect sociodemographic information as well as the attitudes, experiences and expectations of the respondents on the topic of chatbots and artificial intelligence. At the beginning, information about the respondents was

collected, including socio-demographic data and health-related aspects such as chronic illnesses, pregnancy or whether the respondent was currently breastfeeding. Individual risk tolerance was also recorded. Another section of the questionnaire was devoted to the topic of artificial intelligence. Here, several questions were used to assess the respondents' knowledge of artificial intelligence. In addition, the survey asked whether and in which areas of life they already use chatbots and what their general expectations of chatbots are.

The second section of the questionnaire focused on the topic of radioactivity. Respondents were asked whether they had already heard or read about radioactivity and were then asked to assess their own knowledge of the topic. Additionally, their trust in different sources of information, including television and social media, regarding radiation was also assessed.

The experimental part of the survey was preceded by a brief description of a scenario which, depending on the experimental group, either involved an accident at a nuclear power plant near the border or the discovery of a lost capsule containing radioactive material. After the respondents had read the respective scenario, they were shown a video presenting a fictional dialogue between a person affected by the scenario and the BfS chatbot.

The video was followed by an open question about how the dialogue and chatbot were perceived. Specific aspects of the chatbot shown were then evaluated. Respondents were also asked to assess how likely they would be to actually use such a chatbot in the event of a radiological emergency. This assessment was supplemented by another open question asking about the reasons for potential (non-)use.

The final survey instrument can be found in the appendix to this report (Appendix: Main survey questionnaire).

4.2.3 Fieldwork

Two offline-recruited online-panels were used for the main survey of the study. These included the offline-recruited panel GIMpulse, which was set up specifically by GIM to improve the sample quality. The panels used are characterised above all by the fact that they actively recruit their panellists and self-registration is not possible. This compensates for possible selection effects that are present in conventional, online recruited panels and ensures a better distribution of interviews across different types of Internet users. The use of two panels, GIMpulse and another offline-recruited panel, enables a more comprehensive sample. GIMpulse recruits through random selection and ADM (Arbeitskreis Deutscher Markt- und Sozialforschungsinstitute e.V.) in order to obtain a broad and representative sample, including people with less internet usage behaviour. The other panel actively recruits via its "loyalty system" to also reach internet users. The combination of both panels ensures a representative sample.

The panellists were remunerated for their participation in accordance with the recommendation of the BVM (Berufsverband Deutscher Markt- und Sozialforscher e.V.) at a rate of 1 euro per 10 minutes of survey length.

The two online panels used have a large number of variables that can be used for stratification and sampling. The selection of target persons for a study is generally controlled in the two panels used according to various criteria. These include sociodemographic, region and level of activity, among other things, to represent all groups as proportionally as possible so that a representative sample population is available.

In the present case, the sample was selected by first pre-stratifying the sample according to the agreed characteristics of gender and age (gender x age), education (formal education in three levels: low, medium, high) and federal state. The addresses were then drawn from the available addresses for each cell to achieve a spread across different participant types, ensure representativeness and avoid systematic errors. The selected respondents were then invited to participate in the online survey via email with a personalised link. By sending unique invitation links directly to the panellists via email, multiple participation was ruled out.

Overall, the following participation rates were achieved across the entire sample:

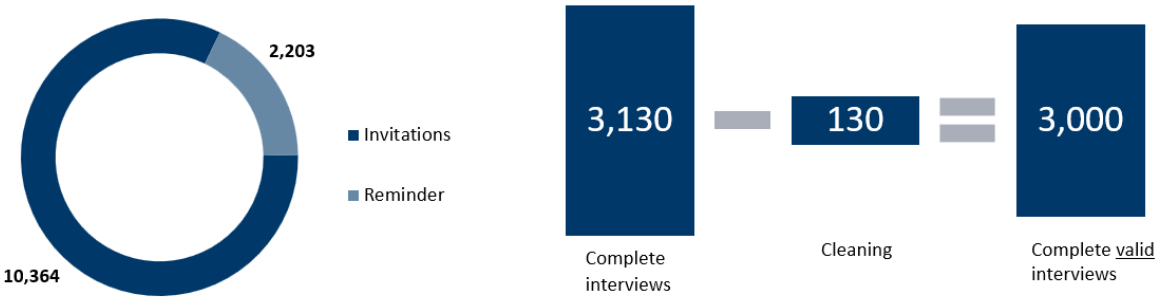

Fig.1: Number of invitations/ reminders, response rate

Of the 10,364 people invited, 2,203 were sent reminders. This resulted in 3,130 complete interviews. Not all the complete interviews met the quality criteria, which is why 130 of the cases had to be removed, leaving a total of 3,000 completely valid interviews from the main survey available for analysis.

In addition to the cases removed due to poor quality (cleaning, n = 130), there were a further 948 cases that did not result in a fully valid interview. These included 450 cases that were unable to participate in the survey due to quota fulfilment. This means that sufficient interviews had already been conducted for certain quota cells, so that no further persons with these characteristics were required. In addition, there were 498 people invited to participate in the survey who independently discontinued the interview during the survey and did not resume it.

4.2.4 Quality control, data preparation and weighting

4.2.4.1 Quality control

To achieve high data quality, proven data verification procedures were used when programming the questionnaire. Statistical checks were implemented in the questionnaire to determine whether the value entered corresponded to the permitted number range. Furthermore, plausibility checks were implemented which, for example, displayed a message to respondents in the event of unacceptable values and required correction. As a further quality assurance measure, the correct storage of variables was checked again after the first 60 cases in the main survey.

The data sets of all online interviews were also continuously checked against selected criteria during the survey. All cases identified as having quality defects according to the criteria were blocked during data collection (cleaning) and removed from the cleaned and transmitted SPSS data set during data cleansing. Due to quality defects, n = 130 cases were removed. This corresponds to a share of around 4 percent of the completely valid interviews.

During cleaning, a distinction was made between hard and soft criteria. The distinction aims to ensure well-founded decisions during data cleaning and helps to ensure data quality without prematurely discarding relevant information. So-called soft criteria are indications of possible inconsistencies, but do not necessarily lead to the exclusion of an interview. They are always considered in combination with other characteristics. Hard criteria, on the other hand, define clear exclusion conditions. Failure to comply with these criteria leads to the direct exclusion of the interview in question, regardless of the evaluation of other interview characteristics. The following cleaning criteria were used for data cleaning in the present study:

- Total duration of the interview (speeder) as a hard criterion: If the interview duration was 60% or more below the median, it was cleaned. Cases with an interview duration of 5.6 minutes or less were therefore excluded from the final data regardless of the other criteria.
- Variance in scale questions (straightliners): For longer item batteries, attention was paid to the variance in responses in order to identify so-called straightliners. If no variance was found within the items of a question, specifically in questions A6, C1, E2 and E3, this was considered a soft

criterion. Affected cases were examined in detail in combination with other criteria. A hard criterion was applied if there was no variance in all four item batteries. This then led to the immediate exclusion of the interview in question.

- Open responses (implausible answers): Open responses were checked to see whether their content was appropriate for the respective question. Any anomalies in the open response criterion were assessed in combination with other criteria and were therefore considered a soft cleaning criterion.
- Attention check: An incorrect answer in the attention check in question E0b, i.e. answers that did not match the video shown, was considered an indication of low attention and was used as a soft criterion. A single incorrect answer in the attention check did not lead to the exclusion of the case on its own.

4.2.4.2 Data preparation

After completing the data collection, GIM provided a complete data set from the main survey in a transferable format (SPSS) with the code names (labels) specified in the questionnaire. This data set was transmitted as a cleaned data set containing only valid cases (n = 3,000).

During the fieldwork and after completion of the survey, data checks and adjustments were carried out for the adjusted data set as described in the previous chapter. Further processing steps were also carried out. Since labels and code names from a predefined questionnaire can only be set in advance to a limited extent in the software used for programming, subsequent data processing was required regarding the code names and labels. Furthermore, the open-ended responses were reviewed and coded by GIM. To this end, the responses per question were first reviewed and a coding scheme (see Appendix: Codeplan) was designed based on this. After the coding scheme was agreed upon with the BfS, the individual responses were manually categorised according to this scheme. As in the previous procedure, appropriate labels and codes were also added to these new items. The coded responses were included in the data set alongside the original open-ended responses provided by the respondents.

During data preparation, it was also taken into account that in chatbot variant 2.B.1, one item, namely E2_2 "I think the use of emojis is good", was accidentally not addressed. However, as the evaluation of this item, i.e. emojis, is available from three other experimental groups (1.A.1, 1.B.1, 2.A.1), a solid data basis is still available. In effort to ensure a fully complete data set, the distribution of the data for item E2_2, which was not presented in scenario 2.B.1, was estimated and the missing values were imputed using a suitable method. The so-called expectation maximisation (EM) imputation was used. This method is based on regression calculations and does not estimate missing values using simple averages but uses an iterative procedure assuming probability distributions. The EM algorithm uses maximum likelihood estimation to determine the most probable values for the missing data.

The procedure is divided into two central steps: First, a distribution for the missing values is estimated based on the available data and an assumed probability distribution of the affected variables. The missing values are not replaced directly, but their most likely expected values are calculated under the estimated distribution. These estimates are then optimised by iteratively checking whether they fit the structure of the existing data and reflect its relationships as accurately as possible. These loops are repeated until convergence is achieved, i.e. until the estimates change only minimally. The advantage of this method is that it considers dependencies between variables as well as variances and correlations within the data, thus delivering more accurate results than simpler methods such as mean or median imputation. Data from scenarios in which an emoji was actually displayed was used for the imputation, as well as the correct context variables from scenario 2.B.1 (1.A.1, 1.B.1, 2.A.1 and 2.B.1). The following variables from the questionnaire (see Appendix: Main Survey Questionnaire) were used to determine the data structure: Gender (S2), age (S1), education (S3), subjective knowledge of artificial intelligence (A2), knowledge of radioactivity (B1b) and assessments of empathy ("E2_5 The chatbot is empathetic") and sympathy ("E2_7 The chatbot is likeable") of the chatbot.

4.2.4.3 Weighting

In order to obtain a sample of the German-speaking population aged 16 and over in private households in the Federal Republic of Germany who use the internet (online study) that is as representative as possible in terms of socio-demographic and regional indicators, panellists were selected according to the characteristics of gender and age (gender x age), education (formal education in three levels: low, medium, high) and federal state from the available addresses per cell.

For the purpose of compensate for slight deviations in the realisation of the sample, the valid cases in the sample were weighted according to the characteristics of gender and age (gender x age), education and federal state so that their distribution corresponded to the target population (see Appendix: Overview of sample quality). No distribution of the target population was specified for the characteristics "diverse" for gender and "other qualification" for education. These characteristics were therefore given a weighting factor of 0 and were not included in the weighting, which slightly increased the weighting of the remaining characteristics of the variables gender and education.

The weighting of the variables age and gender, as well as education and federal state, was carried out in consultation with the BfS based on the MA-Audio (2024 II) baseline study. This was recommended because the microcensus changed the question on internet usage and now only reports this for people aged 16 to 74. The Media Analysis Audio (MA-Audio) is a basic study conducted annually on a representative basis of the population with around 66,500 interviews. The MA-Audio data itself is weighted using the latest microcensus. To obtain a highly granular distribution of Internet users for weighting in relation to all age groups aged 16 and above, the sample from the Media Analysis weighted on the basis of the microcensus was used and filtered to the subgroup of Internet users.

The smallest weight used was 0.92 (minimum), the largest 1.13 (maximum). The standard deviation was 0.29.

4.3 Results of the quantitative survey

The key survey results are presented below, based on the final, processed data set with n = 3,000 completely valid interviews.

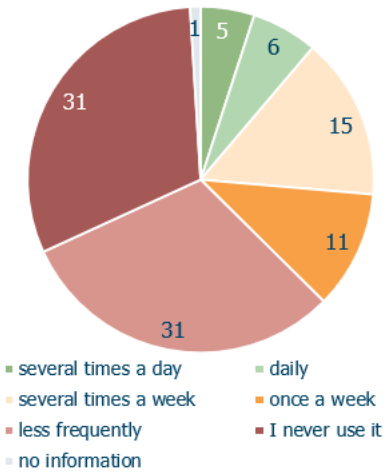

Fig.2: Frequency of chatbot use

When looking at the **previous use of chatbots**, whether in a private or professional context, the quantitative survey showed that 26 percent of respondents said they use a chatbot at least several times a week. Since it was assumed that the term chatbot is not understood equally across all population groups and age groups, it should be noted that the term was introduced as follows in order to classify the results: "A chatbot is a system that enables communication in natural language between a human and a computer. Chatbots exist, for example, in the form of booking and service assistants or as voice assistants such as Siri

or Alexa, as dialogue systems such as ChatGPT, or in various consulting situations where you can ask a chatbot questions and it answers them."

According to the study results, around 11 percent of respondents use a chatbot daily or even several times a day. Men report regular use slightly more often (Top-2-Box, 12%) than women (Top-2-Box, 11%). In addition, there are clear differences in usage behaviour between age groups. The use of chatbots is most widespread among 16- to 29-year-olds (Top-2-Box, 23%) and 30- to 39-year-olds (Top-2-Box, 16%). Usage declines significantly with increasing age. Over half of respondents aged 65 and over also stated that they had never used a chatbot.

A similar pattern can be seen with regard to **knowledge of artificial intelligence**. Overall, around 20 percent of respondents rate their knowledge of artificial intelligence as (very) good. This knowledge is more pronounced in the younger age groups. For example, 38 percent of 16- to 29-year-olds and 27 percent of 30- to 39-year-olds said they had (very) good knowledge. The older the respondents, the lower this assessment. These results thus reflect the findings of other studies, which showed a clear age effect in the use of modern technology, with older adults reporting lower levels of comfort and efficiency in using computers, for example (Lee et al. 2019). Lee et al. (2019), among others, also found that younger cohorts have a more positive attitude towards modern technology. It can be assumed that an interest in technology is a significant predictor of the use and acceptance of digital technologies and also supports higher technological self-efficacy, greater willingness to engage with new digital tools and a more positive attitude towards technical innovation. The results of the present quantitative survey can be classified against this background. Existing research on artificial intelligence also shows that older people tend to perceive decisions made by artificial intelligence as less useful and at the same time perceive them as posing a higher risk (Araujo et al. 2020). The quantitative survey conducted as part of this research project also revealed gender-specific differences, with men significantly more likely than women to rate their knowledge of artificial intelligence as (very) good. This pattern also continues in the assessment of their own level of knowledge about how artificial intelligence works and their ability to recognise artificial intelligence applications. This finding from the present survey is also in line with the research results of other empirical studies that show gender-specific differences in the acceptance of artificial intelligence. For example, men are more willing to use artificial intelligence systems than women (Schwesig et al. 2023).

Around one-fifth of respondents to the online study expressed a (very) strong **interest in chatbots in general**. Here as well, men show a significantly greater interest, with 24 percent (Top-2-Box), compared to women (Top-2-Box, 17%). Interest is also particularly pronounced among 16- to 29-year-olds and 30- to 39-year-olds, at 40 percent and 29 percent (Top-2-Box) respectively. According to the study results, the level of education also appears to have an impact on interest in chatbots, as around one third of respondents with a high level of education expressed (very) strong interest (Top-2-Box, 32%), while interest was significantly lower among respondents with a medium or low level of education (Top-2-Box, 16% and 9% respectively). This is consistent with existing research, which suggests that the perceived benefits of artificial intelligence applications, such as chatbots, increase with higher education and knowledge (Araujo 2020). Overall, chatbots were most frequently used by respondents for product and purchase advice (Top-2-Box, 19%), followed by health and nutrition (Top-2-Box, 16%) and communication with public authorities (Top-2-Box, 13%).

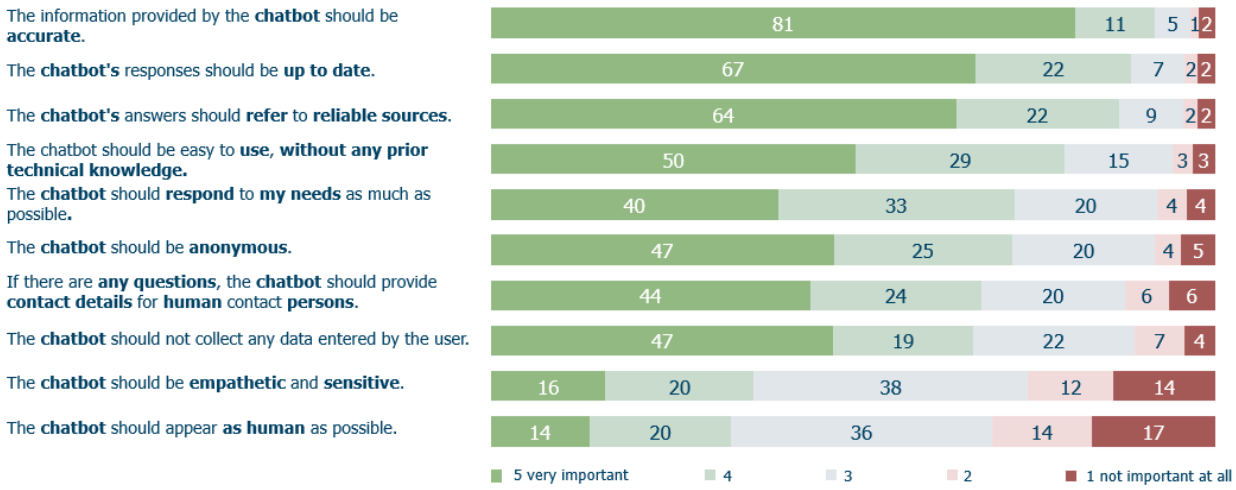

Fig.3: Expectations of chatbots

In the further course of the online survey, respondents were asked to express their **expectations of chatbots** in general. The demand for truthful information is the top priority for respondents (Top-2-Box, 92%). Equally important is the timeliness of the information (Top-2-Box, 89%) and the trustworthiness of the sources (Top-2-Box, 87%). Technical handling also plays a significant role: it is important to respondents that a chatbot can be used without specific technical knowledge. This requirement was particularly evident in the older age groups. For example, 82 percent of 50- to 64-year-olds (Top-2-Box) and 81 percent of respondents aged 65 and over (Top-2-Box) consider technical ease of use to be (very) important. By contrast, the requirement that a chatbot be empathetic (Top-2-Box, 36%) and human (Top-2-Box, 33%) is less pronounced in the results.

When it comes to digital tools (e.g. search engines, chatbots, knowledge databases), instrumental trust is therefore at the forefront. Users primarily expect accurate, relevant and verifiable information. Social research distinguishes between cognitive and affective evaluation dimensions. Cognitive criteria dominate the evaluation of information sources, such as: Is the information reliable? Is it up to date? Is it consistent with other sources? However, friendliness, sympathy or humanity becomes relevant when the systems are used in social roles (e.g. as a coach, assistant or in health contexts), so that a lower rating for "sympathetic" or "empathetic" is not because these attributes are unimportant, but because their relevance context is highly dependent on the purpose of the tool's use. It can therefore be assumed that if digital systems, especially in the healthcare sector, are not perceived as empathetic, sympathetic or friendly, dissatisfaction with this tool will increase when emotional characteristics are expected in context. At the same time, empathy and sympathy are assumed to be basic requirements in the context of digital systems and are rarely formulated as explicit expectations. Dissatisfaction arises when basic requirements are not met or are perceived negatively.

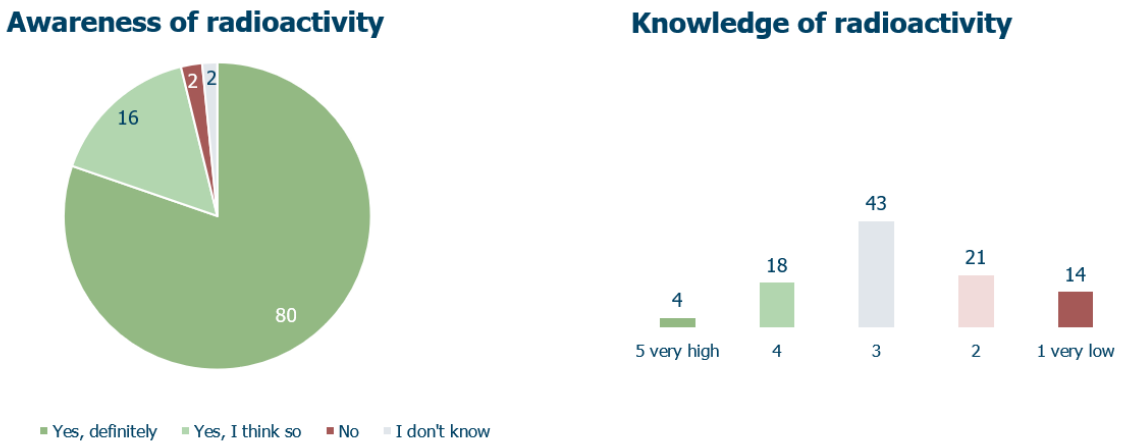

Fig.4: Awareness and knowledge of radioactivity

To the aim of drawing conclusions for a chatbot in a radiological emergency situation, the quantitative survey of this research project also recorded the **respondents' knowledge of radioactivity and radiation**. While almost all respondents are familiar with the term radioactivity ("Yes, definitely" and "Yes, I think so", 96%), their specific knowledge of radioactivity is rather limited. One-fifth of respondents stated that they had (very) extensive knowledge of radioactivity. Differences can be observed here depending on educational attainment, with people with a high level of education (Top-2-Box, 31%) reporting significantly higher levels of knowledge than people with a low level of education (Top-2-Box, 13%). Male respondents (Top-2-Box, 29%) also stated significantly more often that they had (very) extensive knowledge of radioactivity than women (Top-2-Box, 15%).

In addition, trust in all sources of information on the subject of radiation was examined. This revealed a **high level of trust in information** from experts in science and universities (Top-2-Box, 72%) and government institutions (Top-2-Box, 53%), such as ministries or federal and state agencies. On the other hand, social media (Top-2-Box, 6%), such as Instagram and Facebook, are hardly trusted when it comes to radiation. It should be noted that the survey focused on general trustworthiness and did not examine the level of trust placed in different sources of information on social media. It can be assumed that the sender also contributes significantly to the credibility of the information in this context. Given the high level of trust in experts from science and government institutions identified in the study, it can be assumed that referring to these sources in the chatbot dialogue can positively influence the perceived trustworthiness of the information. In particular, a reference to the Federal Office for Radiation Protection (BfS) can therefore be expected to result in higher perceived trustworthiness, which may be further enhanced by the BfS's high level of awareness. 67 percent of those surveyed in the study stated that they were at least familiar with the name BfS. 8 percent of those surveyed had already visited the BfS website.

Accident at a nuclear power plant (scenario 1)

Variant	Description
1.A.1	Karla, Empathetic, more personal tone, informal address, emojis
1.A.2	Karl Empathetic, more personal tone, formal address, **no** emojis
1.B.1	Karla Factual and rational, detailed information, informal address, emojis
1.B.2	Karl Factual and rational, detailed information, formal address, **no** emojis

Lost radioactive capsule (scenario 2)

Variation	Description
2.A.1	Karla, Empathetic, more personal tone, informal address, emojis
2.A.2	Karl Empathetic, more personal tone, formal address, **no** emojis
2.B.1	Karla Factual and rational, detailed information, informal address, emojis
2.B.2	Karl Factual and rational, detailed information, formal address, **no** emojis

Fig.5: Brief description of chatbot variants

In the experimental part of the survey, respondents were randomly assigned to an experimental group. Randomisation ensured that the respondents were evenly distributed across the experimental groups in terms of socio-demographic characteristics.

The content of the experimental groups with the attributes used was based on the previous literature review and the research hypotheses derived from it regarding possible factors influencing the evaluation of the chatbot. As explained in the results of the literature review and analysis (Chapter 3.3), it can be assumed that trust in and acceptance of a chatbot depend on its functionality and transparency, as well as its character, communication style and quality of information, and on the initial situation or context of the users. Although it would have been interesting to investigate other potentially relevant characteristics within the scope of the experiment, it was necessary to focus on a few factors for methodological reasons, in particular to ensure the statistical reliability of the results with a minimum number of cases per experimental group. The factors examined in the experimental groups and their specific implementation were therefore selected in close consultation with the BfS. Against the background of the existing findings from the literature analysis and the available design scope for the future BfS chatbot, the variation of the experimental groups was limited on the one hand to the character of the chatbot, in combination with the naming and use of emojis, and on the other hand to the fictional initial scenario, whereby a conscious distinction was made between scenarios of varying degrees of threat, namely a slightly more threatening scenario (scenario 1, accident in a nuclear power plant) and a slightly less threatening scenario (scenario 2, lost radioactive capsule).

Depending on the experimental group, the respondents were given either a scenario describing an **accident in a nuclear power plant near the border** (scenario 1) or the **loss of a radioactive capsule** (scenario 2) during transport. A video then simulated the communication between the fictional BfS chatbot and a user affected by the scenario. Depending on the experimental group, the chatbot had a female or male name, addressed users informally or formally, had an empathetic-personal or factual-rational character, and used emojis or not. This resulted in a total of eight different variants. Figure 5 provides an overview of the chatbot variants.

The respondents evaluated the chatbot presented to them (one of the eight variants per respondent) based on various criteria.

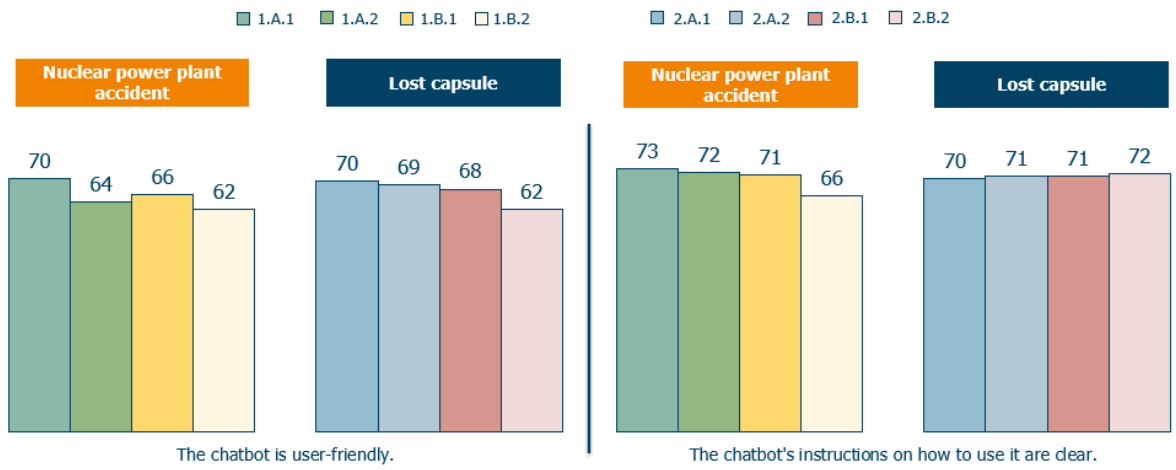

Fig.6: Evaluated user-friendliness and usability of the different chatbot variants

The **perceived functionality** of the chatbot was measured using four items: user-friendliness, usability, speed of responses and competence of the chatbot. User-friendliness was rated as equivalent for all chatbot variants. However, variant 1.A.1 scored slightly better than the other variants in terms of user-friendliness. Variant 1.A.1 also achieved the highest score in terms of overall usability. One possible explanation for this is the empathetic and personal tone of the chatbot "Karla" in variant 1.A.1, which

helped to reduce the perceived distance to the user and thus had a positive influence on the user experience. However, the differences between the variants were also minor in terms of overall usability, with variant 1.B.2 receiving a slightly lower rating for usability. In general, however, the usability of all variants was presented equally in the respective videos. In relation to the perceived response speed, there were no significant differences between the individual variants. All chatbots were rated similarly in this respect. Since the response time of the chatbots did not differ in the video variants shown, this result was to be expected.

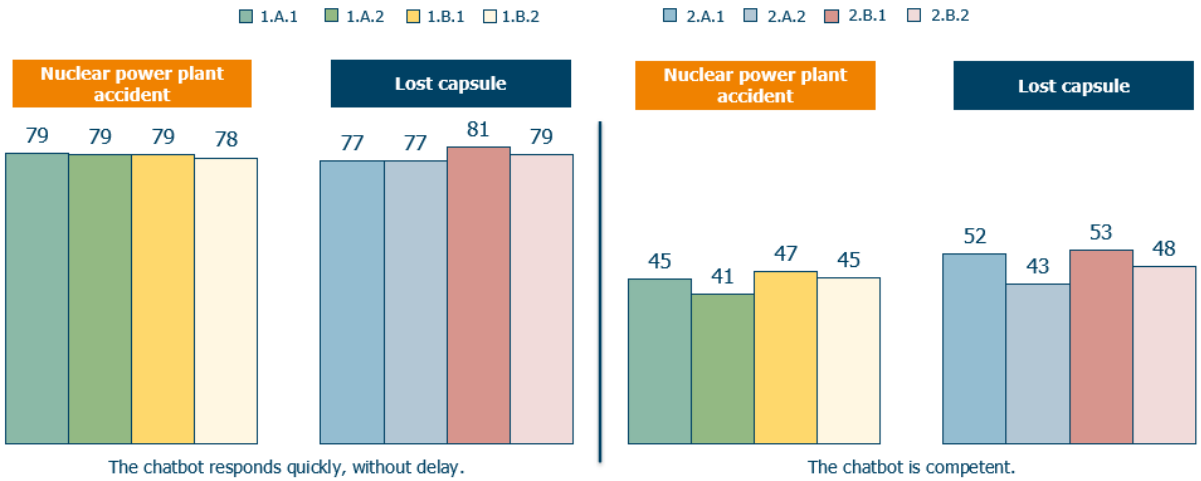

Fig.7: Evaluated response time and competence of the different chatbot variants

The perception of the chatbot's competence was, however, somewhat more differentiated. Variants 2.A.1 and 2.B.1 were rated as slightly more competent than all other variants. The lowest level of competence was attributed to variant 1.A.2. The higher perceived competence in variants 2.A.1 and 2.B.1 can be interpreted as an indication that the female chatbot variant in combination with the informal "you" form of address conveys information in a way that the respondents found understandable and appropriate. Other empirical studies also confirm that informal, easily understandable language is particularly effective (Walwema 2021).

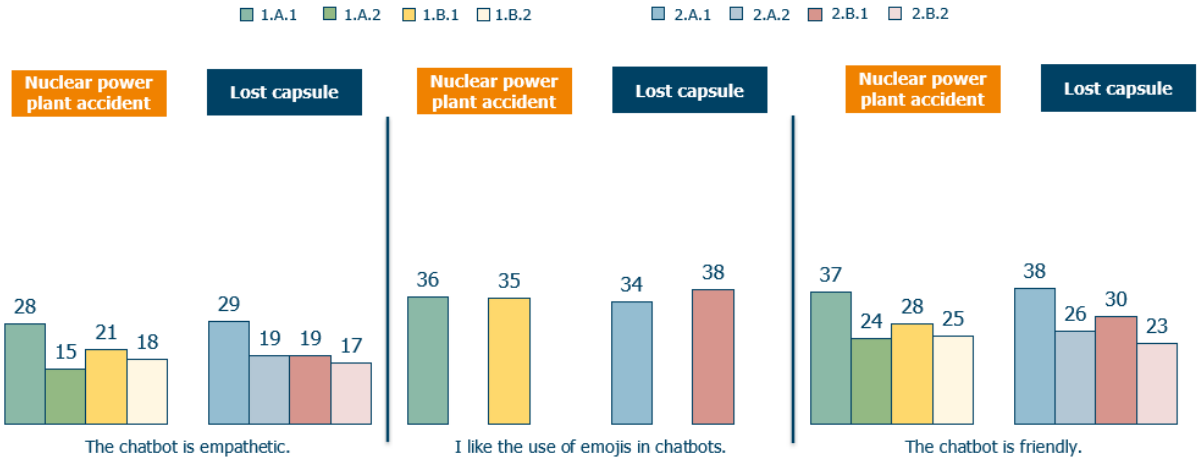

Fig.8: Evaluated empathy, emoji use and sympathy of the different chatbot variants

With regard to the **character of the chatbot**, the evaluation of empathy and sympathy, as well as the included emojis (in experimental groups 1.A.1, 1.B.1, 2.A.1, 2.B.1), was used. In addition, the extent to

which the chatbot was perceived as a human conversation partner and how unbiased the chatbot was, was also included in the evaluation. Differences between the variants can be seen in the visual design of the chatbot. It appears that those chatbot variants that were given an empathetic character in their expression were also perceived as more empathetic on average by the respondents than those that expressed themselves in a factual and rational manner. In particular, variants 1.A.1 and 2.A.1 (Top-2-Box empathetic 28% and 29%, likeable 37% and 38%), which use emojis in addition to the empathetic expression of the chatbot and address users with "you", are rated significantly more empathetic and likeable than the other variants.

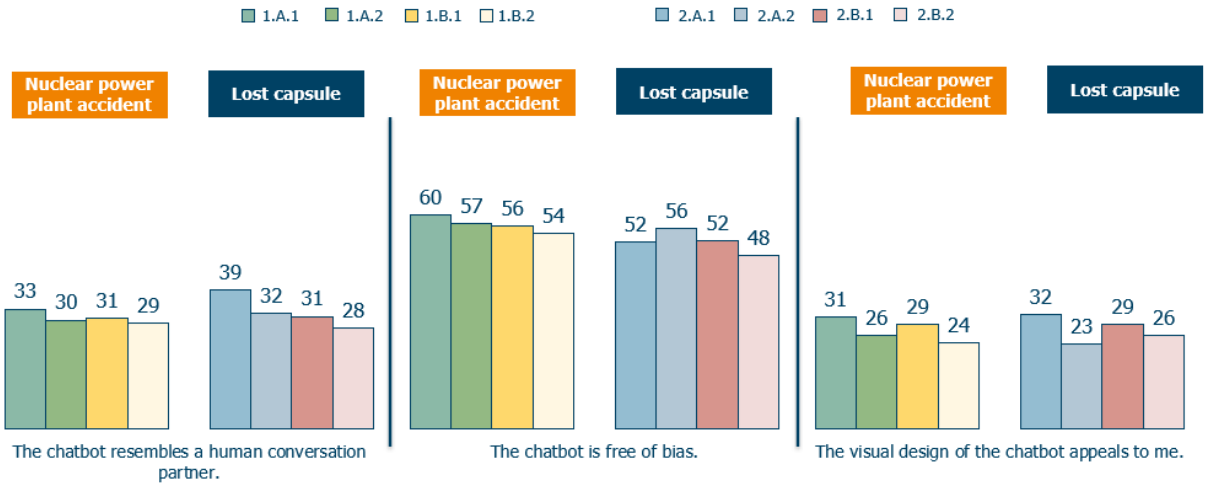

Fig.9: Rated humanity, impartiality and visual design of the different chatbot variants

A similar picture emerges when chatbots are perceived as human conversation partners. Chatbots in variants 1.A.1 (Top-2-Box, 33%) and 2.A.1 (Top-2-Box, 39%) were perceived as more human than the other variants, with significant differences in variant 2.A.1. These findings are consistent with existing research on the impact of artificial intelligence chatbots: the perceived interaction with a chatbot is positively influenced when it treats users with warmth and empathy, thereby imitating characteristics of human communication (Gruß 2024). The emojis used in variants 1.A.1, 1.B.1, 2.A.1 and 2.B.1 were rated similarly positively in all four variants. Study results show that the use of emojis can help fulfil non-verbal functions that are lacking in a text-based chatbot, making it appear more socially present (Beattie et al. 2020). This is also evident in the evaluation of the chatbot's visual design in the present online study. Variants 1.A.1, 1.B.1, 2.A.1 and 2.B.1, in which the chatbot used emojis, are perceived as more appealing on average than the variants that did not use emojis. The chatbot's impartiality is at a similar level, with variant 1.A.1 having the Top-2-Box value at 60 percent and variant 2.B.2 having the lowest top 2 value at 48 percent. It seems to be emerging that the perceived impartiality is positively influenced by the empathetic nature of the chatbot in the "Karla" variants.

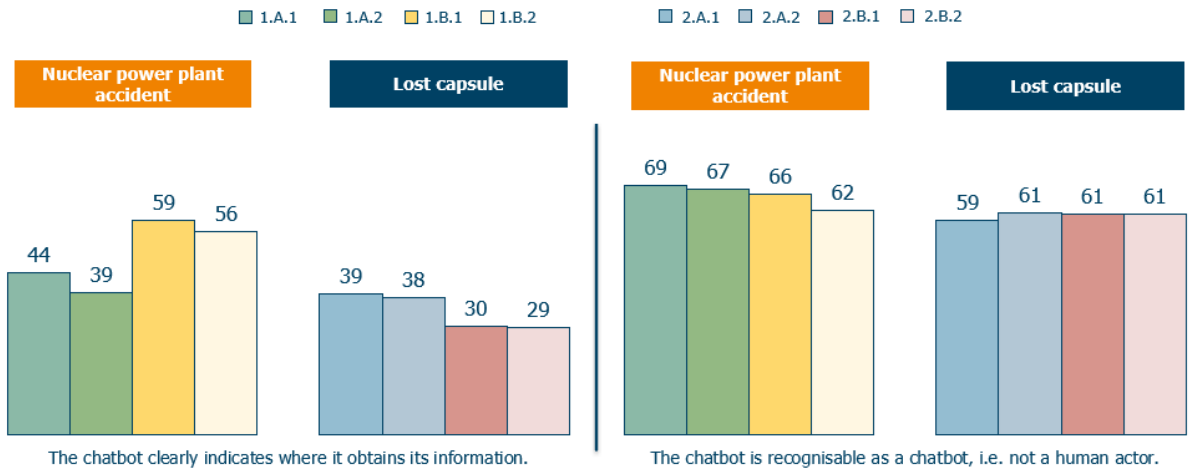

Fig.10: Evaluated transparency of information sources and use of artificial intelligence in the different chatbot variants

Other items in the questionnaire assessed **the transparency and trustworthiness** of the chatbot. Respondents were asked to indicate the extent to which the chatbot presented the sources of its information in a comprehensible manner and how credible the information was. In addition, the perception of privacy was to be evaluated.

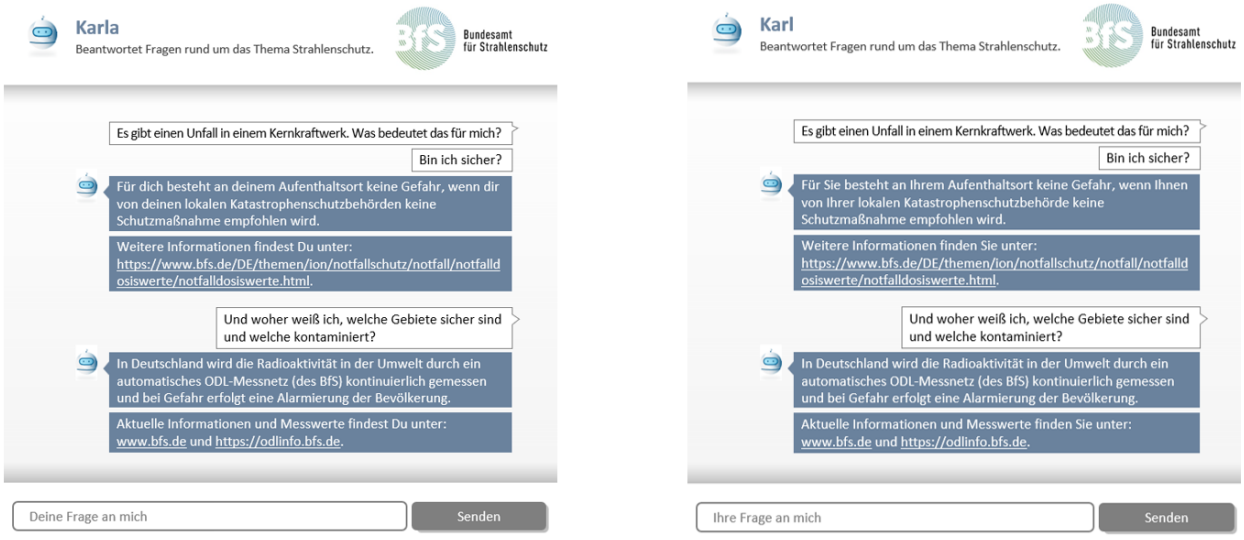

Fig.11: Excerpt from dialogue with the chatbot (german) in scenario 1 (left: variant 1.B.1 "Karla", factual-rational character, informal address/ right: variant 1.B.2 "Karl", factual-rational character, formal address)

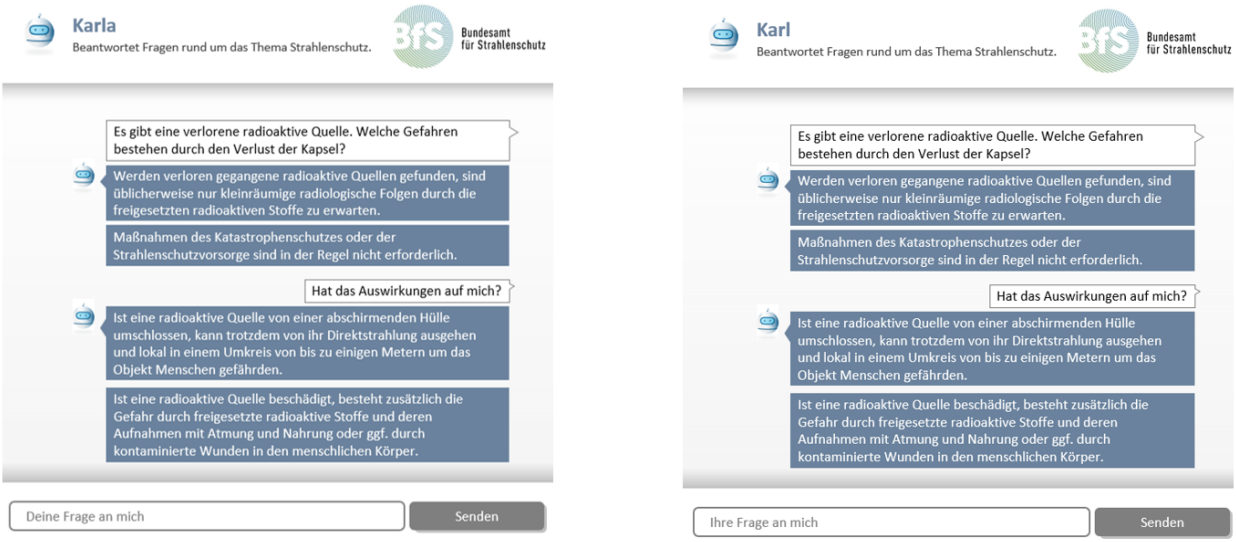

Fig.12: Excerpt from dialogue with the chatbot (german) in scenario 2 (left: variant 2.B.1 "Karla", factual and rational character, informal address; right: variant 2.B.2 "Karl", factual and rational character, formal address)

When assessing whether the chatbot clearly indicates where its information comes from, particularly high scores were achieved for variants 1.B.1 and 1.B.2. These chatbot variants were both factual and rational in nature and were tested in the more threatening scenario (scenario 1), which describes a nuclear accident. The respondents rated these chatbot variants (1.B.1, 1.B.2) as particularly transparent regarding their sources of information. An examination of the simulated dialogues can help explain these differences: Although the equivalent chatbot variants (e.g. 1.A.1 and 2.A.1, 1.B.1 and 2.B.1, etc.) were basically designed in the same way across the scenarios (see Fig. 5) and, accordingly, more detailed information was provided in variants 1.B.1 and 1.B.2 and 2.B.1 and 2.B.2, variants 1.B.1 and 1.B.2 were unique in that they referred to further sources of information from the BfS in several places. The references to the BfS information sources were only included in variants 1.B.1 and 1.B.2, as sufficient source references were available for scenario 1 (accident in a nuclear power plant) (e.g. BfS FAQ on radiological emergency response). For scenario 2 (lost radioactive capsule), however, there were not enough such source references from the BfS to include them in chatbot variants 2.B.1 and 2.B.2. When looking at the results, it becomes clear that the references in scenarios 1.B.1 and 1.B.2 contribute to increasing the perceived transparency and quality of information. When assessing whether the chatbot was recognisable as a non-human actor, there were only minor differences between the variants, as was the case with the protection of user privacy.

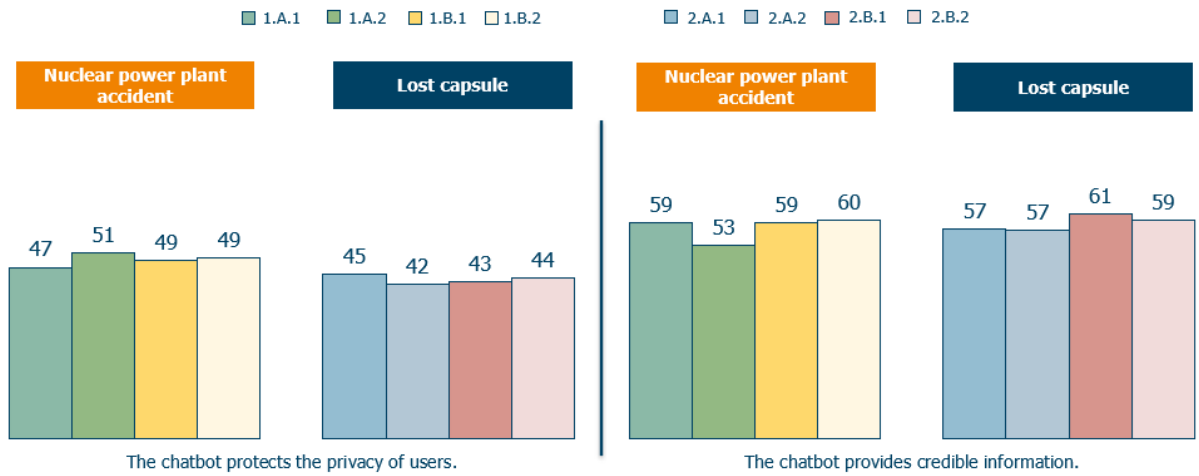

Fig.13: Evaluated privacy protection and credibility of information provided by the different chatbot variants

On the other hand, the chatbot variants with a factual and rational character (1.B.1, 1.B.2, 2.B.1, 2.B.2) received slightly higher scores than the other variants when it came to assessing whether credible information was provided. However, the differences are not considered significant. Here, too, the source references implemented in the dialogue and the factual and rational transmission of information may be decisive for the differences.

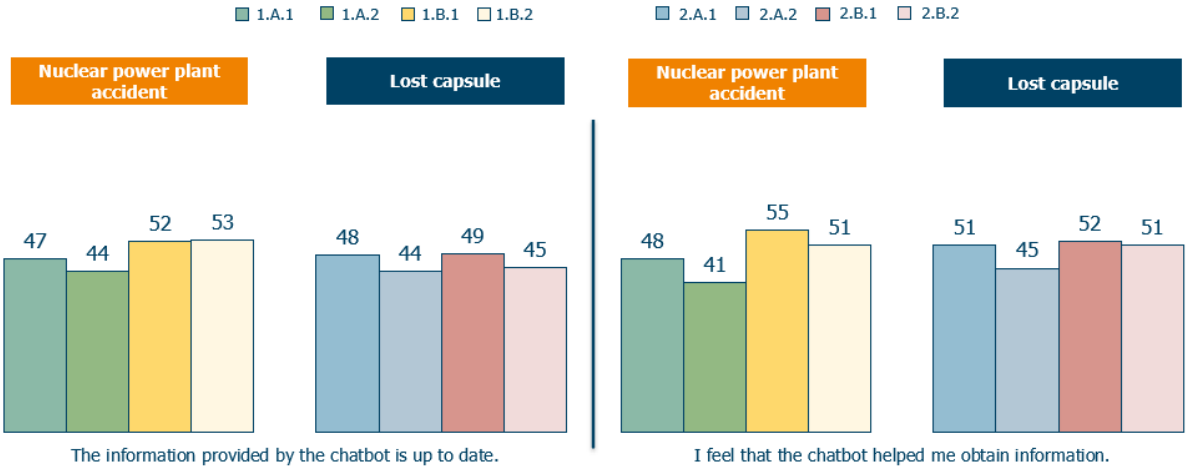

Fig.14: Evaluated topicality and usefulness of the information provided by the different chatbot variants

More focused on the information were the questions about the topicality and usefulness of the information as well as the questions about trustworthiness and comprehensibility. There were only minor differences between the chatbot variants in terms of the topicality of the information. The respondents perceived the topicality to be slightly higher in the variants with a rational and factual character (1.B.1, 1.B.2, 2.B.1, 2.B.2). A similar picture emerges when assessing the usefulness of the information provided.

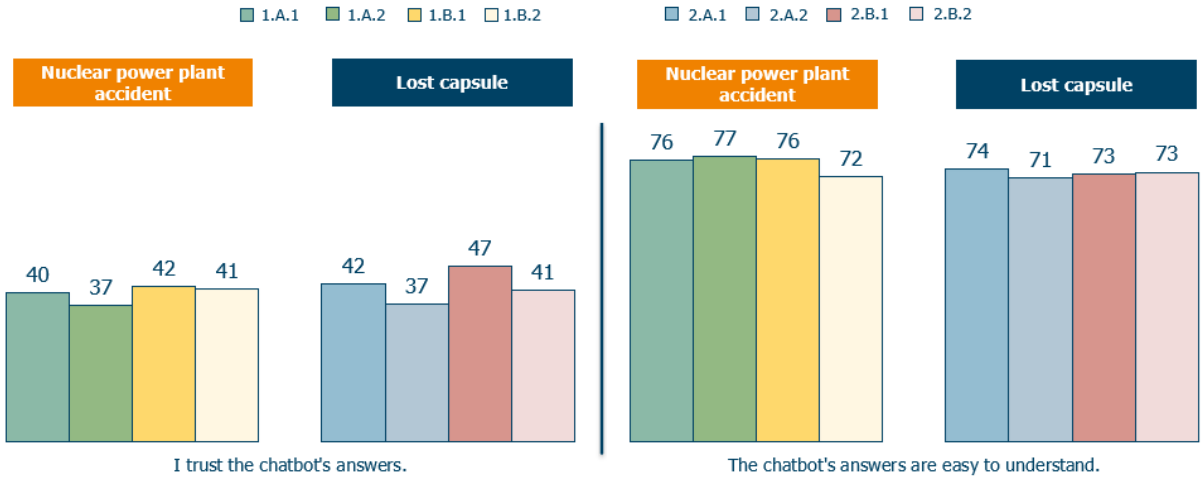

Fig.15: Evaluated trustworthiness and comprehensibility of the responses provided by the different chatbot variants

In terms of **trust in the answers**, the variants were rated quite similarly overall, although variant 2.B.1 stands out positively with a Top-2-Box value of 47 percent. Although the difference is not significant, trust in the chatbot responses is lowest on average for variants 1.A.2 and 2.A.2, which were characterised by an empathetic tone using "you" and without the use of emojis. This may be related to the combination of elements within the chatbot variants, whereby the chatbot has an empathetic, personal style of language on the one hand, but conveys a certain distance from the user by using formal address on the other. The fact that the female variants 1.A.1, 1.B.1, 2.A.1 and 2.B.1 are slightly more trusted overall can be attributed to the fact that female chatbots are generally perceived as more human and therefore more trustworthy than male chatbots. According to empirical findings, the perceived humanity of chatbots increases the

likelihood that users will rate these chatbots as trustworthy and credible (Borau et al. 2021). In terms of the comprehensibility of the responses, however, no significant differences can be observed depending on the chatbot variant. However, the variants from scenario 1 achieve slightly higher values overall than those from scenario 2, which may be related to the lower acute threat level of scenario 2.

Looking at the ratings for the chatbot variants as a whole, a variance in the rating levels becomes apparent. While the Top-2-Values for some items, regardless of the chatbot variant, are at a comparatively high level with an average of around 70% and more agreement (e.g. user-friendliness, usability, response time), other items have low Top-2-Values of, for example, 40% and less (e.g. empathy, competence, trustworthiness of responses). However, a look at the results of the entire five-point scale (1 = strongly disagree to 5 = strongly agree) shows that a lower level of Top-2-Values does not necessarily mean a higher level of Low-2-Values. Instead, there is usually a greater tendency to choose the middle category of the scale (value 3 on the 5-point scale). People who do not wish to express either (strong) agreement or (strong) disagreement with a statement show recognisable similarities in the present survey. A higher selection of the middle categories is primarily associated with several forms of knowledge at the same time. Respondents with a lower formal level of education and those with little prior knowledge of artificial intelligence, but also those with little knowledge of radioactivity, were particularly likely to choose the "middle" category. This correlation can be explained by the fact that, in general, any form of knowledge strengthens a directional decision. For example, the less knowledge a person has about artificial intelligence, the more difficult it is for them to agree or disagree with a statement in the context of artificial intelligence, such as whether the chatbot is competent or the answers are trustworthy. This lack of "knowledge advantage" among some individuals must be taken into account when considering the results as a whole, especially when interpreting (lower) Top-2-Values. It also appears that respondents who tend to have moderate trust in information from authorities and institutions are more likely to choose the "middle" category of the 5-point agreement scale.

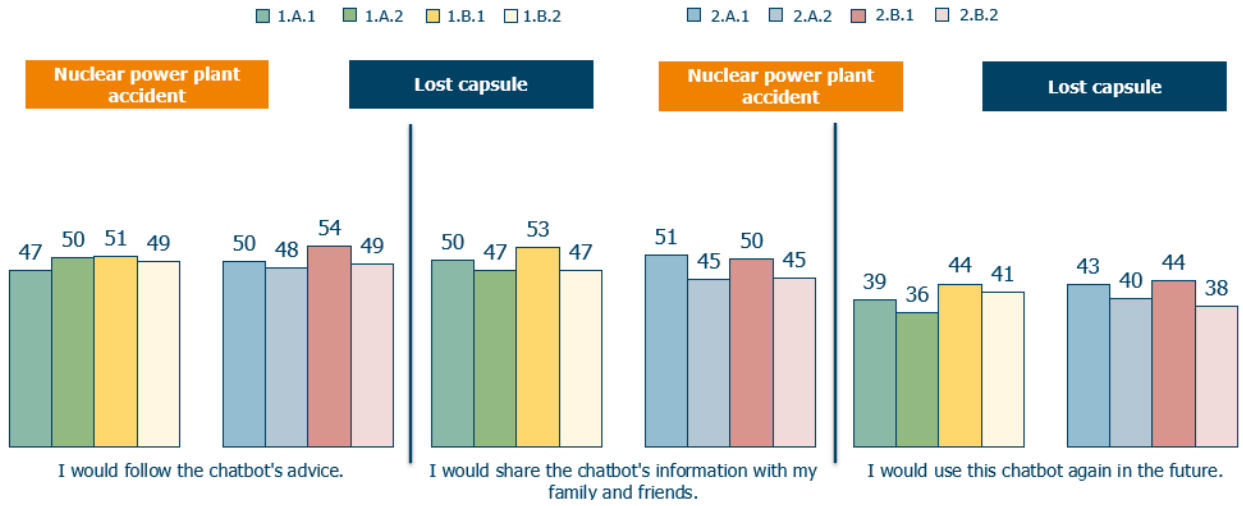

Fig.16: Agreement to follow the advice, recommend to friends and future usage of the various chatbot variants

A final evaluation of the chatbot should be based on whether respondents would follow the chatbot's advice, whether they would pass on the information they received to family and friends, and whether they would contact the chatbot again themselves. The values for the different variants are similar for all three items. Respondents who saw variants 1.B.1 and 2.B.1 in the experiment stated slightly more often that they would follow the chatbot's advice than those who saw other variants. This could highlight the persuasive effect of a factual-rational style combined with a female chatbot name. A slightly higher willingness to recommend to family and friends can be observed across all chatbot variants in variants 1.A.1, 1.B.1, 2.A.1 and 2.B.1. Regarding the future use of the chatbot, there is a tendency towards lower ratings across all variants, with variants 1.B.1, 2.A.1 and 2.B.1 receiving slightly higher approval ratings. The relatively low

average future use of a chatbot in a radiological emergency situation could be due to the fact that chatbots are currently used to a limited extent and are not part of everyday life for all respondents, which is also confirmed by the data from the quantitative survey and that the topic of artificial intelligence and related tools have so far played a rather minor role in the everyday lives of the respondents as a whole.

In the final general assessment of the different scenarios and chatbot variants, it can be concluded that the experiment did not reveal a single chatbot variant that was consistently rated best, but rather that the rating of the variants depended on the context and the of the "evaluation dimension". As detailed above, the study examined the dimensions of functionality, character, transparency and information quality.

Particularly with regard to the perceived **functionality** of the chatbot, which was primarily measured using the four items user-friendliness, usability, speed and competence, it is not clear which chatbot variant is most popular with the respondents. About **user-friendliness** in the "functionality" dimension, it is clear that, regardless of the scenario, variants 1.A.1 and 2.A.1, i.e. the chatbot variants with the female first name, emojis and the empathetic, more personal, informal address, are rated best. In terms of **competence**, however, variants 1.B.1 and 2.B.1, i.e. the comparable variant (female first name, informal address, emojis), are preferred, as the information is conveyed in more detail and in a factual and rational communication style. It can therefore be concluded that addressing users personally, conveying information in an empathetic style and using emojis and a female first name generally contribute to a positive assessment of user-friendliness. If the chatbot is to be perceived as particularly competent, it is also advisable to give it a female first name, appropriate emojis and to address users informally, but the information should be presented in a factual and rational manner and be more detailed.

Considering the chatbot's **character**, as measured by empathy, sympathy, perceived humanity and impartiality, as well as emojis, it can be seen that chatbot variants 1.A.1 and 2.A.1 are rated best across all character-related items. In terms of character, the variant with the female first name (Karla) is particularly convincing, as it uses a more personal, informal form of address, conveys information empathetically and uses emojis. Furthermore, it can be noted that when comparing the value levels between scenarios 1 and 2, the character rating is higher overall in scenario 2. This suggests that characteristics such as empathy, sympathy, humanity and the use of emojis play a central role in positive perception, especially in comparatively less threatening contexts (scenario 2).

Regarding the chatbot's **transparency**, which is evaluated based on factors such as transparent source references, artificial intelligence transparency, and data protection, the assessment varies mainly depending on the scenario, but no clear direction emerges regarding the design of the chatbot (chatbot variants). The rating level in scenario 1 is higher than in scenario 2 for all items relating to transparency. This suggests that, especially in a more threatening scenario, it is important for a positive evaluation of the chatbot that it is transparent and therefore uses and presents transparent source references, and also that it is clear that the chatbot is an artificial intelligence, and that it adequately protects the privacy of users.

In terms of the dimension of **information and information quality**, which was measured by the credibility and timeliness of the information, as well as its usefulness and trustworthiness and whether users would follow the chatbot's advice and recommend it to others, it can be said that the rating depends primarily on the scenario at hand. This is because scenario 1 consistently shows higher approval ratings for information and information quality. This means that it is essential, especially in more threatening scenarios (scenario 1), that the information is up-to-date, trustworthy and useful. Looking at the variants, it becomes apparent that variants 1.B.1 and 2.B.1, i.e. the variants with a female first name and informal address as well as emojis, but which provide more detailed information in a factual and rational manner, are rated best.

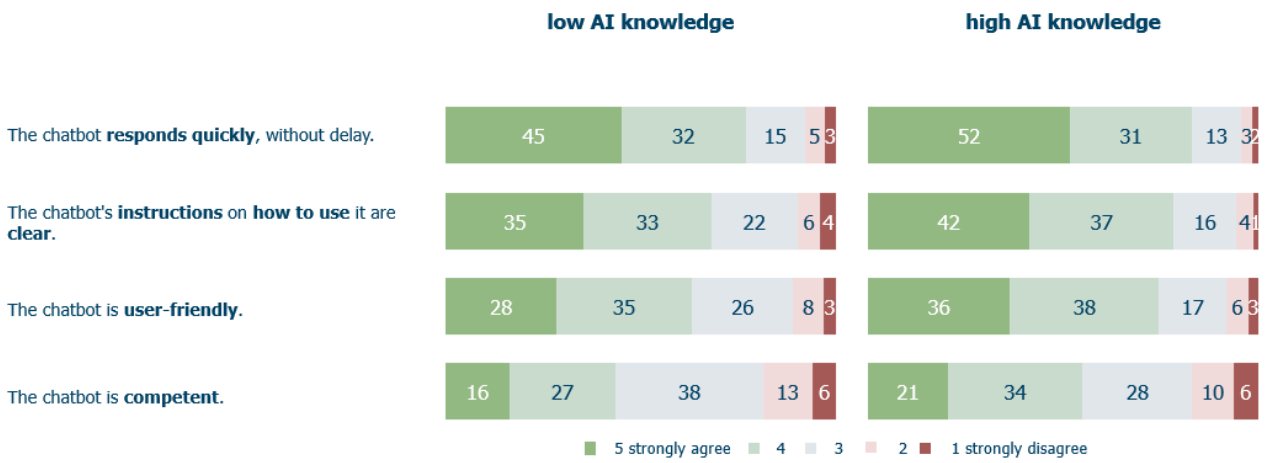

Fig.17: Evaluation of the chatbot's functionality based on low and high prior knowledge of artificial intelligence

Since it was assumed that people with more knowledge about artificial intelligence and technology in general are more open to new technologies such as chatbots, the evaluation of the different chatbot variants was additionally differentiated **according to prior knowledge about artificial intelligence**.

This revealed significant differences: people with greater prior knowledge of artificial intelligence rated the chatbot as more user-friendly, found it easier to use and rated the chatbot they were shown as competent significantly more often than people with little prior knowledge of artificial intelligence.

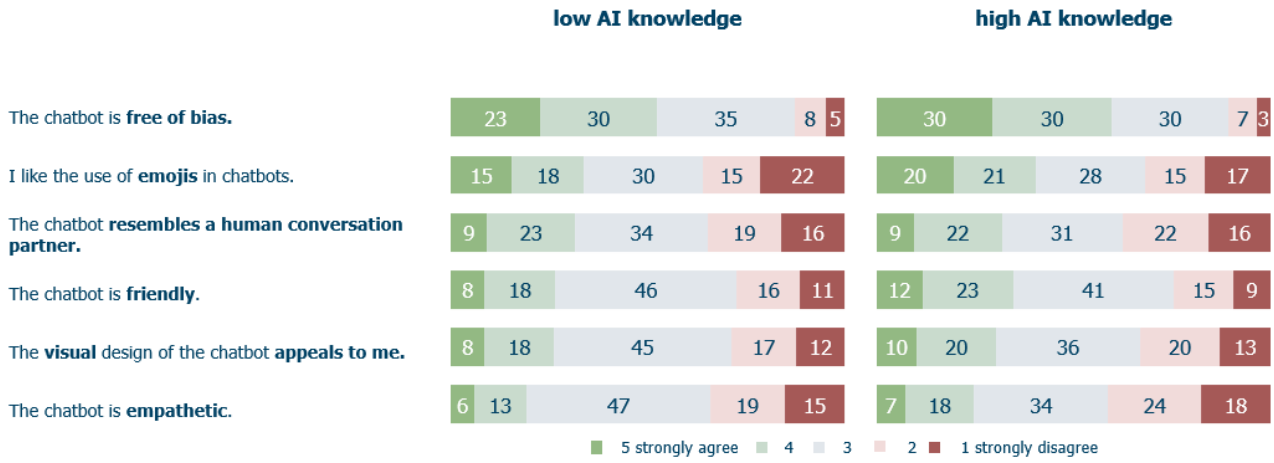

Fig.18: Evaluation of the chatbot's character according to low and high prior knowledge of artificial intelligence

Differences also emerge in the assessment of the chatbot's character. People with a high level of knowledge about artificial intelligence perceive the chatbot as empathetic and likeable significantly more often. They also agree more often with the statement that the chatbot acts impartially.

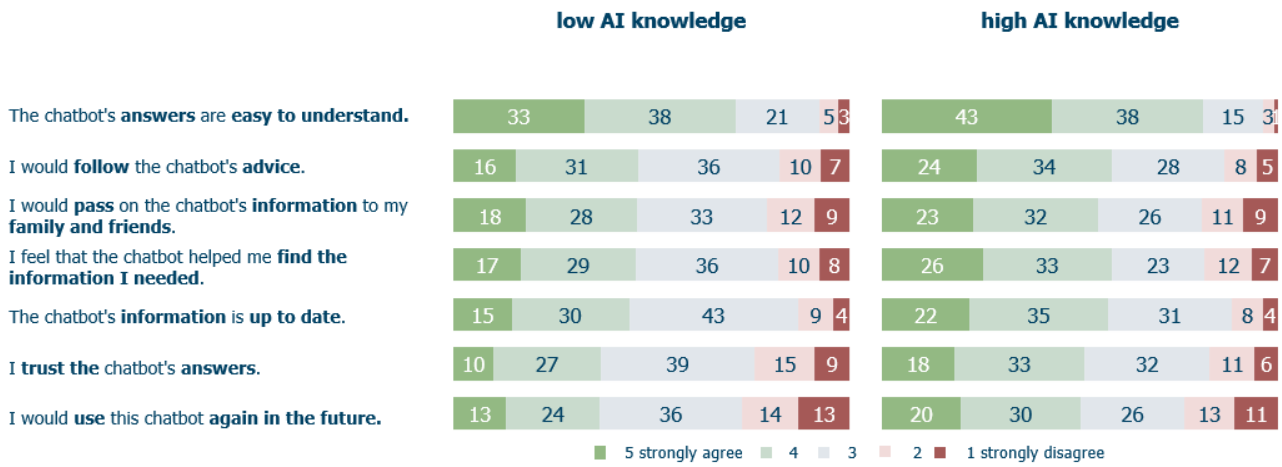

Fig.19: Evaluation of the chatbot's information quality according to low and high prior knowledge of artificial intelligence

For the group of people with a high level of prior knowledge about artificial intelligence, it was also clear where the chatbot obtained its information. They also clearly recognise it as a non-human actor. The pattern continues with reference to data protection and security concerns: people with prior knowledge of artificial intelligence agree significantly more often that the chatbot protects users' privacy and provides credible information. Differences also emerge in terms of user experience depending on prior knowledge of artificial intelligence. People with prior knowledge of artificial intelligence are significantly more likely to say that the chatbot helped them find information and that they trust the answers it provided. They also had significantly fewer difficulties understanding the chatbot's responses. The final evaluation of the chatbot paints a similar picture. People with prior knowledge of artificial intelligence are more willing to follow the chatbot's advice, share the information they receive with friends and family, and use the chatbot again in the future. These clear differences based on prior knowledge of artificial intelligence can be attributed to higher technological self-efficacy and thus to a belief in one's own abilities when dealing with technology.

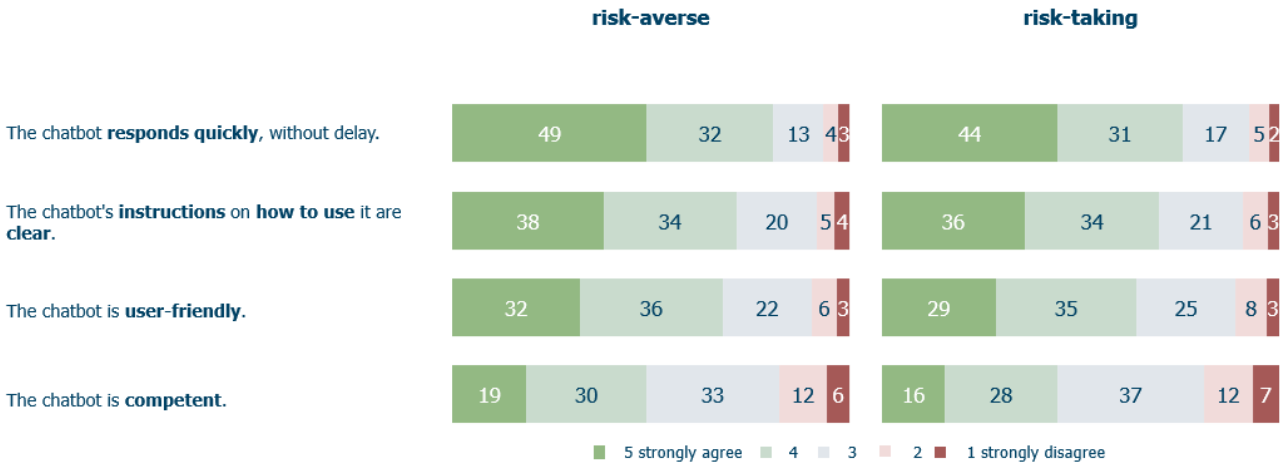

Fig.20: Evaluation of chatbot functionality according to risk-aversion and risk-seeking

Differentiating between **risk-averse and risk-seeking individuals** relating to the evaluation of chatbots in a radiological emergency situation can also prove informative. It appears that risk tolerance has an influence on certain evaluations. Risk-averse individuals rate the chatbot as more user-friendly across all variants. They also agree more often with the statement that the chatbot responds without delay and rate it significantly more often as competent. Compared to risk-seeking individuals, risk-averse individuals perceive the chatbot as more empathetic and likeable and are more likely to see it as a human conversation partner.

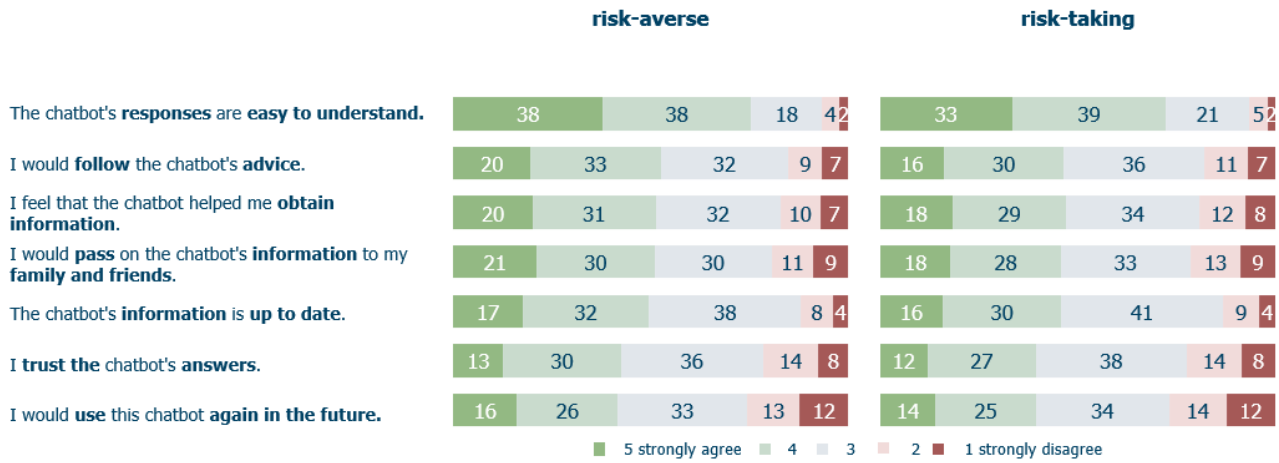

Fig.21: Rating of the chatbot's information quality according to risk-aversion and risk-seeking

The overall user experience also varies depending on risk tolerance: risk-averse individuals significantly more often say that the information provided by the chatbot was helpful. Consequently, they also more often say that they intend to follow the chatbot's advice and share the information they received with friends and family. How people deal with fear or risk varies from person to person. Psychological research broadly distinguishes between two opposing coping approaches: active confrontation vs. avoidance and suppression. There are many nuances in between. Based on this consideration, one possible explanation for the group-specific differences could be that risk-averse individuals have a greater need for comprehensive information in emergency situations and feel more insecure. Risk-seeking individuals may be more relaxed in such situations. It is therefore conceivable that risk-averse individuals rated the chatbot more positively in those aspects that were decisive for them in the specific situation, while these aspects played a lesser role for risk-seeking individuals.

Furthermore, it can be assumed that people belonging to a **vulnerable group** perceive the user experience with a chatbot differently. In the survey, people with chronic illnesses and pregnant or breastfeeding women were defined as vulnerable groups. Due to their situation, they are at increased risk in a radiological emergency, which could lead to a greater need for immediate help or heightened emotional reactions such as fear or panic. This, in turn, could lead to different expectations of a chatbot (Dametto et al. 2021). However, contrary to this assumption, the empirical findings show hardly any significant differences between vulnerable and non-vulnerable individuals in terms of their evaluation of the chatbot. The exception to this is that members of a vulnerable group rated the chatbot significantly more often as unbiased and expressed a better assessment of privacy protection. One possible explanation for this could be that these aspects are more important to people in a more sensitive situation, such as pregnant women, and therefore influence the evaluation positively when these criteria are met. In contrast, these criteria are less important for people who do not belong to a vulnerable group and therefore have less influence on the chatbot's rating. The above section already covers all relevant differences between the two groups, so the group of vulnerable people will not be treated separately below.

Having first considered the evaluation of the different chatbot variants and then looked at different target groups (evaluations), the focus in the following section is now on **specific predictors for the future use of the BfS chatbot**. To draw concrete conclusions, it may be useful to focus on relevant items that may determine the future acceptance and use of the chatbot. In addition to the fundamental technical requirements for an artificial intelligence tool like a chatbot, such as data protection measures, there are additional key factors that will determine the future adoption and use of a chatbot.

Firstly, it seems important to look at the **level of trust** measured, as this forms the basis for the acceptance and use of the BfS chatbot. In order to measure trust more comprehensively, an index was created in the evaluation of the quantitative survey, which summarises five items that can be considered indicators of trust and uses them to generate a total score. The items are as follows: "The chatbot provides credible

information", "I trust the chatbot's answers", "I would follow the chatbot's advice", "I would pass on the chatbot's information to my family and friends" and "I would use this chatbot again in the future". When scaling the total index, values between 1 and 2.4 are considered low, values between 2.5 and 3.5 are considered medium, and values between 3.6 and 5 are considered high. If trust is considered a predictor of future use of the BfS chatbot, the following section examines which variables increased or decreased trust in the BfS chatbot as shown in the quantitative survey. As already mentioned in the general evaluation of the chatbot, knowledge of artificial intelligence can be identified as an influencing variable. While more than half (chatbot trust "high", 57%) of those with a high level of knowledge about artificial intelligence have a high level of trust in the chatbot shown, trust is significantly lower among those with less knowledge about artificial intelligence (chatbot trust "high", 42%).

Another factor influencing trust in the BfS chatbot is greater trust in public authorities as a source of information. When trust in information from government institutions and authorities such as ministries, federal or state agencies is divided into "low", "medium" and "high", significant differences can be observed. If people trust government institutions (completely), their trust in the BfS chatbot is also significantly higher, at 59 percent "high" trust, than among people with low (chatbot trust "high", 27%) or medium (chatbot trust "high", 36%) trust in this source of information. As proven in other empirical studies, institutional trust is a prerequisite for the population to accept and use government communication channels (Jackob et al. 2023).

Last but not least, familiarity with chatbots leads to greater trust in the chatbot in question. People who stated that they use chatbots daily or several times a week (chatbot trust "high", 56%) or at least once a week (chatbot trust "high", 53%) trust the chatbot shown significantly more than people who use a chatbot less frequently or never (chatbot trust "high", 42%). Habitual use of artificial intelligence and related tools is therefore a decisive factor in trust in a future BfS chatbot. Since it can be assumed that the use of chatbots will increase not only among specific target groups but also across the entire population over the next few years, this will automatically lead to increased trust in a future BfS chatbot.

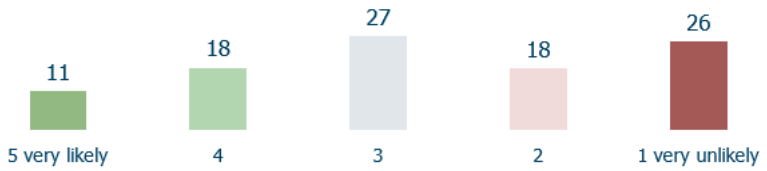

Fig.22: Probability of future use of a chatbot in a radiological emergency

The quantitative survey also specifically asked respondents how likely they thought it was that they would use such a chatbot in a radiological emergency situation in the future. It should be noted that the responses given may be somewhat cautious overall. As already mentioned, factors such as trust often play a key role in the actual willingness to use a chatbot. The results should therefore be interpreted against this background. When asked about the **future use of a chatbot** in a radiological emergency situation, around 29 percent of respondents said they were very likely or likely to use such a chatbot. 27 percent of respondents were undecided and chose the middle answer category. A quarter tended to reject such a chatbot and considered its use very unlikely.

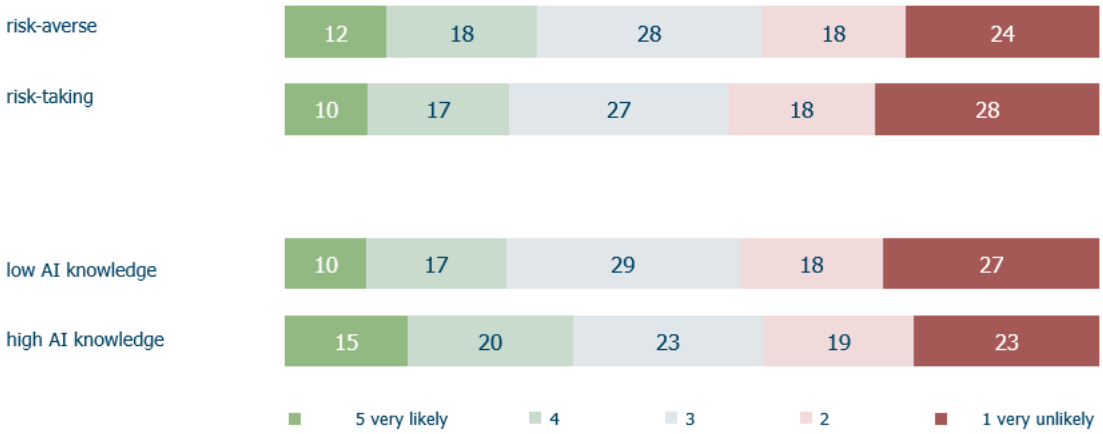

Fig.23: Probability of future use of chatbots in radiological emergency situations according to risk aversion/risk seeking and low/high prior knowledge of artificial intelligence

Two key predictors can also be identified in this context. On the one hand, significant differences can be seen depending on risk tolerance, with risk-averse individuals indicating a significantly higher probability of future use (30%) compared to risk-seekers (27%). As mentioned above, these group-specific differences are based on the fact that risk-averse individuals seek more security in emergency situations and therefore rate the chatbot more highly if they have a positive user experience, while risk-seeking individuals perceive such situations more calmly and consider the corresponding functions of the chatbot to be less important.

On the other hand, as mentioned above, a person's knowledge of artificial intelligence can also be identified as a driving variable for the stated probability of future use. Being well informed and knowledgeable about artificial intelligence in general reinforces the ability to use artificial intelligence-based chatbots and has a positive effect on willingness to use them. People with a high level of prior knowledge of artificial intelligence are significantly more likely (Top-2-Box, 35%) to say that they are (very) likely to use a chatbot in a radiological emergency situation than people with low knowledge of artificial intelligence (Top-2-Box, 27%). This finding can also be attributed to the higher technological self-efficacy and confidence in their own use of technology among people with prior knowledge of artificial intelligence.

5 Recommendations, workshop and results report (AP 3)

The findings from the literature review and analysis as well as the quantitative survey are summarised in this final report, which also includes the conclusions and recommendations for the best possible design of the planned chatbot.

5.1 Workshop

After completion of the fieldwork for the quantitative survey and the evaluation of the data, a joint workshop with the BfS and GIM took place on 12 June 2025. The workshop presented the core results of the quantitative survey and jointly explored further conclusions and recommendations for the design of the planned BfS emergency bot.

The design options for the emergency bot discussed in the workshop mainly related to the visual design of the chatbot and the communication style, also considering specific target groups such as vulnerable groups, people with different risk levels and different levels of knowledge about artificial intelligence.

5.2 Overall conclusions from the results

If we first summarise the **results of the literature review and analysis** (AP 1), we can generally conclude that the design of chatbots has a significant influence on their perception and acceptance. Key success factors include technical functionality (e.g. response quality, response time), a user-friendly and appealing design (e.g. colour choice, interface) and socially effective communication that is personalised, emotional

and targeted. Human-like characteristics, such as language, name or emojis, can promote trust and sympathy, but must be combined with transparency about the chatbot's character. Data protection, clear source references and situation-specific information further increase acceptance, especially in sensitive contexts such as crisis communication. According to the results of the analysis of the relevant state of science and technology, trust is established above all when chatbots are operated by official institutions, as is particularly evident in the evaluation of existing chatbots, which are used successfully primarily in health communication and in crisis situations. Design plays a central role here: clear, step-by-step user guidance, regular updating of content and transparent data protection information are important. The literature shows that rule-based chatbots are particularly suitable for sensitive topics because they are based on verified answers. Informal language, visual elements and integration into familiar platforms also promote user-friendliness and acceptance. The literature analysis also shows that special requirements apply to communication in emergency situations: it must be clear, empathetic, reliable and tailored to the target group. While risk communication serves as preparation, acute crisis communication focuses on protecting and maintaining public trust. Chatbots can be a useful addition in such scenarios, as they provide information in real time and relieve the burden on authorities. They demonstrate their strengths particularly when providing clear, instructive content, but are only of limited use for emotional support. Furthermore, according to the literature, it is crucial for the acceptance of a chatbot that it is user-friendly, transparent and based on trustworthy sources. Rule-based systems are particularly suitable here, as they remain controllable and do not generate incorrect information. It is important to continuously maintain the content, ideally in collaboration with subject matter experts. Based on the literature analysis, it is also important to note, especially in crisis situations and when using artificial intelligence such as chatbots, that target groups must be considered specifically. The use of so-called "personas" can help to define typical user profiles and address their needs, fears and expectations in a targeted manner. Age, education, technical knowledge and personal attitudes towards artificial intelligence have a significant influence on acceptance. The more users can identify with the chatbot, the more willing they are to use it. This is especially true when the communication style, relevance of the topics and tone of voice match the respective reality of life. Emotional states such as uncertainty or anger also affect communication behaviour. According to the existing literature, it is therefore important to design chatbots to be as empathetic and context sensitive as possible. Differentiated, personalised and situationally adapted communication is ideal, as this increases acceptance of the chatbot and enables information to be conveyed in a targeted manner.

Based on the **quantitative survey** (AP 2), it can also be concluded that chatbots are already used regularly by a significant portion of the population, especially younger and more highly educated individuals. In addition, the results show that usage declines significantly with age. Knowledge about artificial intelligence also varies according to age, gender and educational background. Younger respondents and men tend to rate their knowledge of artificial intelligence higher and show a greater willingness to engage with artificial intelligence systems. Interest in technology and technological self-efficacy are key predictors of acceptance and use. Interest in chatbots is moderate across all respondents, but is more pronounced among young adults, men and people with higher levels of education.

During the survey, participants expressed their key expectations of chatbots. Truthful, up-to-date and trustworthy information appear to be particularly important. In addition, operation should be easy to understand without prior technical knowledge, especially for older groups. In general, the instrumental benefits are more important for digital applications, while emotional characteristics become relevant primarily when the context of use requires them.

The survey also examined the respondents' knowledge of radioactivity and their trust in sources of information. Awareness of the term "radioactivity" is very high, but only about one-fifth of respondents consider their knowledge of the subject to be extensive. Men and people with higher levels of education report more extensive knowledge. Scientific and government institutions enjoy the highest level of trust on this topic, while social media is viewed with little trust.

In the experimental part of the study, participants were assigned to different chatbot scenarios that differed in terms of address (informal or formal), language style (empathic vs. factual), design (with or without emojis) and the name of the chatbot (female vs. male first name), it was found that the perceived functionality (user-friendliness, usability, speed, competence) of the different chatbot variants was similar overall. Only variant 1.A.1 scored slightly better in terms of user-friendliness and usability, which can be attributed, among other things, to the empathetic, personal form of address ("Karla"). The respondents rated the competence of the chatbot variant with the female first name, informal address and use of emojis (especially 2.A.1 and 2.B.1) as the highest and that of the variant with the male first name, formal address and no emojis (1.A.2) as the lowest. According to the study results, female chatbots that use informal address and emojis appear more understandable and competent.

In terms of the chatbot's character (empathy, sympathy, emojis, human impact), empathetically designed variants (1.A.1, 2.A.1) with emojis and informal address were rated better. They appeared more human, which, according to research, has a positive influence on users (Gruß 2024; Beattie et al. 2020). The empathetic design also increased the perceived impartiality of the chatbot.

In terms of data protection and trust perception, the factual-rational variants (1.B.1, 1.B.2), which cited sources more frequently, scored particularly well. These variants were also rated as more credible. However, the comprehensibility of the responses was largely consistent across all chatbot variants.

The willingness to follow the chatbot or share information varied slightly. The factual and rational variants with a female first name, informal address and emojis (1.B.1 and 2.B.1) were rated best in this respect. The results also showed differences based on the respondents' knowledge of artificial intelligence and their attitude towards risk: the more previous experience with artificial intelligence and the more risk-averse the respondents were, the more positive their assessment of the chatbot was in all dimensions.

The analysis showed that previous experience with chatbots and trust in authorities significantly increase acceptance of the BfS chatbot. Overall, both previous experience with artificial intelligence and chatbots as well as trust in authorities increase the likelihood of using the chatbot in an emergency situation. Among all respondents, risk-averse individuals and those with experience of artificial intelligence were most likely to consider using it.

Consequently, when designing the BfS emergency chatbot, it is particularly advisable to consider the following aspects. As shown by the results of the research project, this will increase the overall acceptance of the emergency bot, boost trust in it and generate satisfaction among users.

1. Usability and (technical) functionality:
    - **Clear, easy-to-understand and step-by-step instructions**

      Improves usability even without prior technical knowledge, thereby increasing its appeal to users, especially older people and those who are less tech-savvy.
    - **Verified and updated answers**

      Up to date (real-time) information increases the reliability of the information and thus contributes to trust.
2. Visual design:
    - **Emojis**

      They have a non-verbal function and increase the perceived humanity and likeability of the chatbot. However, when using emojis, it is particularly important to ensure that they are used appropriately in the context to avoid negatively influencing trust in the information.
    - **Appealing and consistent design**

      Helps with orientation and increases perceived professionalism.
    - **Human, female name**

Is perceived as more human and empathetic and increases the perceived competence and trust in the chatbot.

3. Communication style:
   - **Greeting**

     Serves primarily to gain the trust of users in crisis situations.
   - **Informal address**

     Increases perceived competence and creates closeness. This also contributes to user loyalty.
   - **Empathetic, informal address**

     Comes across as more human and empathetic and increases perceived impartiality.
   - **Targeted communication (related to the situation/scenario)**

     Promotes trust in the chatbot, leading to it being seen as adding value and being better accepted.
   - **Factual and rational communication style**

     Increases credibility and trust, especially in threatening emergency situations.
4. Transparency, security and data protection:
   - **Identifying the chatbot as a non-human actor**

     Helps users to better assess the information and prevents deception.
   - **Transparent data protection information**

     If not overly detailed, increases acceptance and trust, especially in sensitive crisis communication contexts.
   - **Identifying the chatbot operator**

     Naming the official institution (BfS) that operates the chatbot increases trust in it and promotes acceptance and likelihood of use.
   - **Source references**

     Increases credibility and trust in the information, especially for security-related content.

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Appendix: Analysed literature – Chatbot configuration and design

Table 4 Source: Araujo, T. (2018)

Source	
Authors	Araujo, T.
Year	2018
Title	Living up to the chatbot hype: The influence of anthropomorphic design cues and communicative agency framing on conversational agent and company perceptions
Abstract	Disembodied conversational agents in the form of chatbots are increasingly becoming a reality on social media and messaging applications, and are a particularly pressing topic for service encounters with companies. Adopting an experimental design with actual chatbots powered with current technology, this study explores the extent to which human-like cues such as language style and name, and the framing used to introduce the chatbot to the consumer can influence perceptions about social presence as well as mindful and mindless anthropomorphism. Moreover, this study investigates the relevance of anthropomorphism and social presence to important company-related outcomes, such as attitudes, satisfaction and the emotional connection that consumers feel with the company after interacting with the chatbot.
Key research question	To what extent do the communication style and name of the chatbot influence the conscious and unconscious perception of anthropomorphism and social presence?
Target group	207 participants recruited via a snowball system on Facebook, within a university and through the Amazon Mechanical Turk platform.
Method	Experiment
Key content	State of research: This study distinguishes between "embodied" (ECA) and "disembodied conversational agents" (DCA). While ECAs can also communicate non-verbally through their virtual appearance, interaction with DCAs is limited to text only. The research interest of this study is limited to DCAs. Existing research suggests that the perception of human traits in chatbots can lead to a change in user perception. Regardless of this, interaction with chatbots or so-called "conversational agents" exhibits human communication patterns. Research design: To investigate the extent to which human traits influence the perception of a chatbot, a 2x2 experiment was conducted in which a "human-like" chatbot was tested against a "computer-like" chatbot: While one chatbot has human characteristics, a name, uses informal language and greets and bids farewell in a human manner, the other chatbot has a "computer-like" appearance, is called "ChatBotX" and communicates in a formal style. In addition, two different framings of the chatbot are used: While some of the test subjects are introduced to the chatbot as a virtual

Source	
	agent with artificial intelligence ("intelligent frame"), it is referred to as a virtual agent ("neutral frame") in the other experimental group. The dependent variables measured are conscious and unconscious anthropomorphism, a kind of humanisation, social presence and problem-solving competence. The study's findings relating to the effect on company valuations are not considered below. Effect of the "human-like agent": If the chatbot exhibits human-like traits, this significantly influences unconscious and conscious anthropomorphism compared to a computer-like chatbot. No direct significant effects can be identified for the framing of the chatbot. However, when test subjects interact with the computer-like chatbot and it is described as artificial intelligence ("intelligent frame"), this has a negative influence on unconscious anthropomorphism compared to the neutral frame. The perceived social presence is not directly influenced by the type of chatbot or the framing.
Conclusions for AP 2	The study results suggest that anthropomorphic design cues influence the perception of a chatbot. The conscious and unconscious attribution of human characteristics is more likely when the chatbot uses human-like language and has a human name. The perception is less influenced by the designation of chatbots as artificial intelligence.
Limitations	The author of the study acknowledges limitations regarding the operationalised variables and the recruitment method.

Table 5 Source: Beattie, A./ Edwards, A./ Edwards, C. (2020)

Source	
Authors	Beattie, A./ Edwards, A./ Edwards, C.
Year	2020
Title	A Bot and a Smile: Interpersonal Impressions of Chatbots and Humans Using Emoji in Computer-mediated Communication
Abstract	Artificially intelligent (AI) agents increasingly occupy roles once served by humans in computer-mediated communication (CMC). Technological affordances like emoji give interactants (humans or bots) the ability to partially overcome the limited nonverbal information in CMC. However, despite the growth of chatbots as conversational partners, few CMC and human-machine communication (HMC) studies have explored how bots' use of emoji impact perceptions of communicator quality. This study examined the relationship between emoji use and observers' impressions of interpersonal attractiveness, CMC competence, and source credibility; and whether impressions formed of human versus chatbot message

Source	
	sources were different. Results demonstrated that participants rated emoji-using chatbot message sources similarly to human message sources, and both humans and bots are significantly more socially attractive, CMC competent, and credible when compared to verbal-only message senders. Results are discussed with respect to the CASA paradigm and the human-to-human interaction script framework.
Key research question	To what extent do emojis change the perception of (chatbot) dialogues?
Target group	96 students enrolled in introductory courses at a research university (USA).
Method	Experiment
Key content	Research design: To investigate the extent to which emojis change the perception of chatbots outside specific contextual boundaries in terms of communication quality, 96 students were randomly assigned to a human or a chatbot as part of an experiment. Those assigned to the chatbot received either verbal messages only or messages that also included emojis. The content of the messages is otherwise always the same and relates to the topic of "restaurant recommendations". Participants are instructed to carefully read the dialogue, which was displayed as a screenshot in the experiment. After reading the dialogues, respondents are asked to complete a survey containing questions to evaluate the chatbot and measure the quality of the conversation. Quality refers specifically to the following aspects: social appeal, competence, appropriateness, goodwill and trustworthiness. Results: Both the chatbot source and the human source are rated as comparable in terms of social attractiveness, competence and credibility when they convey the same message content. However, the study also shows that messages, regardless of whether they come from a human or a chatbot, are rated more positively in terms of social attractiveness, competence and credibility when they contain emojis than when they are only verbal. People process non-verbal messages faster than verbal messages. The target persons rate messages that use emojis as more socially attractive than message sources that use only verbal messages. The use of emojis increases attention and emotional expression, which contributes to the perception of competence. Chatbot users also rate message sources that use emojis as more competent than message sources that use only verbal messages. In terms of credibility, the experiment also shows that the use of emojis conveys an impression of goodwill and care, thereby contributing to credibility. A chatbot is rated as more credible when emojis are used. Credibility is described in the study as the extent to which a person considers a message source to be credible.
Conclusions for AP 2	The use of emojis can help fulfil non-verbal functions that a text-based chatbot lacks, making it appear more socially present. The use of emojis can improve the perceived quality of the chatbot in terms of social attractiveness, competence and credibility.

Source	
	A query after an experiment can capture how the chatbot is rated in terms of quality in the form of social attractiveness, competence and credibility.
Limitations	The present study surveys students aged 18 to 37, i.e. predominantly younger individuals. Furthermore, no real chatbots are used; instead, a fictional dialogue is displayed as a screenshot; it is not a live experiment. In addition, the topic of the dialogue is a "neutral" one, namely restaurant recommendations; the evaluation could be different in a different context.

Table 6 Source: Borau, S./ Otterbring, T./ Laporte, S./ Fosso Wamba, S. (2021)

Source	
Authors	Borau, S./ Otterbring, T./ Laporte, S./ Fosso Wamba, S.
Year	2021
Title	The most human bot: Female gendering increases perceptions of bots as human and acceptance of AI
Abstract	Companies have repeatedly launched Artificial Intelligence (AI) products such as intelligent chatbots and robots with female names, voices, and bodies. Previous research posits that people intuitively favor female over male bots, mainly because female bots are judged as warmer and more likely to experience emotions. We present five online studies, including four preregistered, with a total sample of over 3,000 participants that go beyond this longstanding perception of femininity. Because warmth and experience (but not competence) are seen as fundamental qualities to be a full human but are lacking in machines, we argue that people prefer female bots because they are perceived as more human than male bots. Using implicit, subtle, and blatant scales of humanness, our results consistently show that women (Studies 1A and 1B), female bots (Studies 2 and 3), and female chatbots (Study 4) are perceived as more human than their male counterparts when compared with non-human entities (animals and machines). Study 4 investigates explicitly the acceptance of gendered algorithms operated by AI chatbots in a health context. We found that the female chatbot is preferred over the male chatbot because it is perceived as more human and more likely to consider our unique needs. These results highlight the ethical quandary faced by AI designers and policymakers: Women are said to be transformed into objects in AI, but injecting women's humanity into AI objects makes these objects seem more human and acceptable.
Key research question	How does female gender assignment influence human perception of chatbots and the acceptance of artificial intelligence?

Source	
Target group	Participants were recruited via an online panel (Prolific). Those in studies 1 and 2 are resident in the UK or the US, while those in studies 3 and 4 are all from the US.
Method	Four studies were conducted, three of which were experiments and one was a so-called "Implicit Association Test" (IAT).
Key content	State of research: The state of research suggests that female chatbots are preferred over male chatbots because they are perceived as more human and more responsive to individual needs. Results: The results of the study confirm that female chatbots are preferred over male chatbots because they are perceived as warmer and more emotional, which makes them appear more human. Female bots are perceived as more human and are therefore more readily accepted. This is particularly true in contexts where emotional intelligence is important, such as healthcare. Female bots are also associated with positive human characteristics such as warmth and morality, while male bots are more likely to be associated with supposedly negative human characteristics. The perceived humanity of female bots leads them to be considered more capable of taking individual needs into account, which increases the acceptance of artificial intelligence solutions. While the feminisation of artificial intelligence can increase acceptance, it also carries the risk of reinforcing gender stereotypes and objectifying women.
Conclusions for AP 2	Female chatbots are perceived as more human than male chatbots. The perceived humanity of chatbots increases the likelihood that users will rate these chatbots as trustworthy and credible. According to the source, there are no significant differences between male and female chatbots in terms of perceived competence. This needs to be verified for the present research project in the setting of radiological emergencies.
Limitations	The study is subject to limitations due to its lack of generalisability, as no real human-robot interactions are examined. Participants may also have expressed more positive views towards female chatbots due to social desirability. The type of tasks performed by the bots could influence the perception of humanity and acceptance, as people may prefer male bots for tasks that require rational intelligence and female bots for tasks that require emotional intelligence.

Table 7 Source: Borsci, S./ Malizia, A./ Schmettow, M./ Van Der Velde, F./ Tariverdiyeva, G./ Balaji, D./ Chamberlain, A. (2022)

Source	
Authors	Borsci, S./ Malizia, A./ Schmettow, M./ Van Der Velde, F./ Tariverdiyeva, G./ Balaji, D./ Chamberlain, A.

Source	
Year	2022
Title	The chatbot usability scale: the design and pilot of a usability scale for interaction with AI-based conversational agents
Abstract	Standardised tools to assess a user's satisfaction with the experience of using chatbots and conversational agents are currently unavailable. This work describes four studies, including a systematic literature review, with an overall sample of 141 participants in the survey (experts and novices), focus group sessions and testing of chatbots to (i) define attributes to assess the quality of interaction with chatbots and (ii) the designing and piloting a new scale to measure satisfaction after the experience with chatbots. Two instruments were developed: (i) A diagnostic tool in the form of a checklist (BOT-Check). This tool is a development of previous works which can be used reliably to check the quality of a chatbots experience in line with commonplace principles. (ii) A 15-item questionnaire (BOT Usability Scale, BUS-15) with estimated reliability between .76 and .87 distributed in five factors. BUS-15 strongly correlates with UMUX-LITE by enabling designers to consider a broader range of aspects usually not considered in satisfaction tools for non-conversational agents, e.g. conversational efficiency and accessibility, quality of the chatbot's functionality and so on. Despite the convincing psychometric properties, BUS-15 requires further testing and validation. Designers can use it as a tool to assess products, thus building independent databases for future evaluation of its reliability, validity and sensitivity.
Key research question	Which attributes can be defined to measure the quality of interactions with chatbots and satisfaction after the chatbot experience?
Target group	A total of 141 designers and end users of chatbots.
Method	Systematic literature review and studies
Key content	Research design: The source describes having first compiled a literature review, based on which attributes are identified and systematically reviewed. A study is then used to reach a consensus on the list of attributes, which is subsequently expanded to develop a list of items for the questionnaire. The resulting list was tested to create a final scale for future studies that can be used to measure satisfaction with a chatbot in a differentiated manner. Results: The result is a diagnostic tool in the form of a checklist for measuring satisfaction with a chatbot using this tool. The final scale contains 15 elements (bot usability scale), with the assessment dimensions including the visual appearance, behaviour and capabilities of the chatbot. It is clear that the assessment of attributes varies depending on previous experience with chatbots. However, it is clear that chatbots must meet the needs of users, which must first be identified. The 15 elements of the chatbot usability scale are:

Source	
	1. Easy conversation start: The chatbot is able to initiate and continue the conversation (e.g. make suggestions, give hints); it is easy to start a conversation with the chatbot. 2. Access to the chatbot/environment: The chatbot is designed to guide users to their destination and has options, buttons on the screen and information to do so. 3. Expectations/transparency: The chatbot clearly communicates its capabilities and therefore does not raise false expectations among users. 4. Flexibility: The chatbot can adapt to different conversation styles of end users. 5. Conversation topic and context: The chatbot maintains a conversation topic once it has been introduced and keeps track of the context in order to understand the user's statements. 6. Support: The chatbot supports users and the interaction is perceived as pleasant. 7. Privacy and security: The chatbot protects the privacy and security of users. 8. Recognising user goals and intentions: The chatbot is able to recognise the user's intention and guide them to their goal. 9. Relevance of information: The chatbot provides people with relevant and appropriate information/answers at every stage. 10. Quantity: The chatbot responds in an informative manner without adding too many answers. 11. Resilience/robustness: The chatbot finds appropriate ways to respond even when confronted with situations for which it is not prepared. 12. Comprehensibility and politeness: The chatbot is able to understand user input and make correct, linguistically pleasant statements without causing misunderstandings. 13. Credibility: The chatbot responds in a credible and informative manner. 14. Speed: The chatbot is perceived as capable of responding to queries and solving problems in a timely manner. 15. Needs: The chatbot can meet the needs of users regardless of their specific characteristics such as age, health status, etc.
Conclusions for AP 2	Various characteristics in the design of a chatbot influence its perception and evaluation. The bot usability scale provides a good overview of these characteristics. The following seem to be particularly important for the research project in this report: fast response time, informative answers without giving too many answers, language style appropriate to the context, recognising the user's intention, initiating conversation, protecting user privacy, easy start to conversation and easy continuation of conversation.

Source	
Limitations	The scale requires further testing and validation; it is very general and does not refer to crisis communication, for example.

Table 8 Source: Feine, J./ Gnewuch, U./ Morana, S./ Maedche, A. (2019)

Source	
Authors	Feine, J./ Gnewuch, U./ Morana, S./ Maedche, A.
Year	2019
Title	A Taxonomy of Social Cues for Conversational Agents
Abstract	Conversational agents (CAs) are software-based systems designed to interact with humans using natural language and have attracted considerable research interest in recent years. Following the Computers Are Social Actors paradigm, many studies have shown that humans react socially to CAs when they display social cues such as small talk, gender, age, gestures, or facial expressions. However, research on social cues for CAs is scattered across different fields, often using their specific terminology, which makes it challenging to identify, classify, and accumulate existing knowledge. To address this problem, we conducted a systematic literature review to identify an initial set of social cues of CAs from existing research. Building on classifications from interpersonal communication theory, we developed a taxonomy that classifies the identified social cues into four major categories (i.e., verbal, visual, auditory, invisible) and ten subcategories. Subsequently, we evaluated the mapping between the identified social cues and the categories using a card sorting approach in order to verify that the taxonomy is natural, simple, and parsimonious. Finally, we demonstrate the usefulness of the taxonomy by classifying a broader and more generic set of social cues of CAs from existing research and practice. Our main contribution is a comprehensive taxonomy of social cues for CAs. For researchers, the taxonomy helps to systematically classify research about social cues into one of the taxonomy‘s categories and corresponding subcategories. Therefore, it builds a bridge between different research fields and provides a starting point for interdisciplinary research and knowledge accumulation. For practitioners, the taxonomy provides a systematic overview of relevant categories of social cues in order to identify, implement, and test their effects in the design of a CA.
Key research question	What characteristics (verbal, visual, invisible) must a conversation agent have in order for people to interact with it and perceive it as positive?
Target group	Evaluation: students, doctoral candidates, practitioners
Method	Literature analysis and evaluation of theoretical findings through card sorting

Source	
Key content	Procedure: In order to provide a comprehensive taxonomy of social cues for conversation agents and to find out which characteristics a conversation agent such as chatbots should have so that people interact with it and perceive it as positive, various relevant publications are first identified in a literature review and then processed. This is followed by a standardisation of the research findings by creating a systematic classification of the characteristics. The developed taxonomy is then evaluated. Results: According to the developed taxonomy, there are four main characteristics that should be carefully considered when designing a chatbot. These are: verbal, visual, auditory and invisible. The "verbal" category can be further divided into content and style. Content refers to the chatbot's ability to start and continue a dialogue, greet and say goodbye, express gratitude, make small talk, and give tips and advice. The style in the "verbal" category refers to sentence complexity, formality, strength of language and abbreviations. With regard to the "visual" category, avatars with human features and an appealing and professional design should be taken into account when designing chatbots. It is important that all visual cues match the tone and style of the chatbot. With regard to "audibility", the taxonomy recommends, for example, that the voice quality be natural, i.e. that a pleasant and realistic voice be used that does not sound overly robotic or monotonous. In addition, the voice should be designed to appeal to the target group and can therefore be male or female. "Invisible" characteristics are understood to be cues that are not directly perceptible, such as the chatbot's response time. For example, a delay of 1 to 2 seconds can help simulate human thinking time, which can come across as authentic.
Conclusions for AP 2	By integrating the following characteristics from the authors' taxonomy, a chatbot is perceived as social, human and trustworthy, which is crucial for acceptance and long-term use. Chatbots should be equipped with: personalised address and response to individual preferences, situation-appropriate language, naturalness in the form of a combination of verbal and non-verbal behaviour that is credible; an informal and friendly communication style, taking into account the context (e.g. customer service, health advice, risk communication); an appealing and consistent design and an appropriate response time to improve user-friendliness.
Limitations	The taxonomy of the present source describes characteristics that relate to conversation agents of various types (written, verbal, implemented on social media channels, etc.). The taxonomy of the source is therefore more comprehensive than applicable to the chatbot in question. Furthermore, it is clear that users find a (written) chatbot more satisfactory and beneficial if it matches their personality. The different personalities of people are problematic in this context, as they cannot usually be fully represented in a chatbot.

Table 9 Source: Hofeditz, L./ Ehnis, C./ Bunker, D./ Brachten, F./ Stieglitz, S. (2019)

Source	
Authors	Hofeditz, L./ Ehnis, C./ Bunker, D./ Brachten, F./ Stieglitz, S.
Year	2019
Title	Meaningful use of social bots? Possible applications in crisis communication during disasters
Abstract	Social bots are gaining in popularity and complexity. These technologies could provide assistance and new approaches to handle the numerous tasks on social media that occur in crisis communication. Social bots are applications that automatically produce content and interact with humans on social media, trying to emulate and possibly influence human behaviour. They often have a negative association, but there are many bots which perform benign tasks. Currently, there is no overview of tasks that social bots could support in emergency management. This project is intended to contribute to close this gap by examining possible applications of such bots in crisis communication during natural disasters. The research problem is investigated from two perspectives. First, we explore whether there is already existing bot activities in crisis communication through analysing the Twitter communication of the Eastern Australian bushfires in March 2018. Second, to identify possible bot application in the context of crisis and emergency management experts were interviewed. The results indicate current crisis communication bot activities are mostly limited to automated alerts by emergency management organisations. The expert interviews illustrate high potential and demand for social bots in relevant emergency management organisations. The study shows application fields for social bots in all phases of the emergency management cycle and beyond.
Key research question	What needs to be considered when using bots in disaster control and what tasks can they perform to support emergency management in natural disasters?
Target group	Expert interviews: 13 experts from disaster management organisations in Australia
Method	Qualitative content analysis of expert interviews, social media network analysis of a Twitter data set
Key content	Research design Two methods are used to answer the research questions: a social network analysis of a Twitter dataset to identify existing bot applications in crisis communication surrounding the 2018 Australian bushfires, and a qualitative content analysis of expert interviews to examine the potential of social bots in the emergency sector. Results Twitter data analysis shows that the largest proportion of existing bots are news bots, which automatically tweet content from websites by creating

Source	
	text teasers from articles. The second largest group are spam bots, which spread similar messages many times in a short period of time. Only around 9% of bots are emergency bots that issue automated emergency alerts. In emergencies, information must be disseminated, rumours combated and warnings and recommendations for action issued. Further information about specific details must also be communicated. This can be done by a chatbot. There are different phases of emergency management: prevention, preparation, response and recovery (PPRR emergency management framework), with a chatbot able to perform support tasks in all phases of emergency management. For example, an emergency reporting bot can be used to receive emergency reports (on social media), an emergency warning bot can issue automated warnings and alerts about disasters, and a news bot/chatbot can record and respond to messages from users. It is important that the chatbot technically recognises keywords in order to provide the appropriate response. When using bots in disaster control, it is also important to ensure that irrelevant communication such as general messages is minimised in chatbot communication in order to avoid distraction. In addition, the bot should be reliable and transparent and should not disseminate sensitive information. The results of the source also show that the chatbot should be able to translate responses in real time into the user's preferred language, and that responses should be automatically based on the user's geographical location.
Conclusions for AP 2	Chatbots can be helpful in all phases of emergency management in the event of a disaster. It is important to note that the chatbot is able to recognise keywords and provide the appropriate response without digressing into irrelevant communication. In addition, the chatbot should be reliable and transparent and not disclose any sensitive information. The chatbot should also be able to translate the answers into the user's language and, in the event of a disaster, the answers should ideally refer to the user's location in order to provide them with the most relevant information.
Limitations	This source refers primarily to social media bots and thematically to a natural disaster (bush fires in Australia).

Table 10 Source: Hussain, S./ Ameri Sianaki, O./ Ababneh, N. (2019)

Source	
Authors	Hussain, S./ Ameri Sianaki, O./ Ababneh, N.
Year	2019
Title	A survey on conversational agents/chatbots classification and design techniques

Source	
Abstract	A chatbot can be defined as a computer program, designed to interact with users using natural language or text in a way that the user thinks he is having dialogue with a human. Most of the chatbots utilise the algorithms of artificial intelligence (AI) in order to generate required response. Earlier chatbots merely created an illusion of intelligence by employing much simpler pattern matching and string processing design techniques for their interaction with users using rule-based and generative-based models. However, with the emergence of new technologies more intelligent systems have emerged using complex knowledge-based models. This paper aims to discuss chatbots classification, their design techniques used in earlier and modern chatbots and how the two main categories of chatbots handle conversation context.
Key research question	How can chatbots be classified and designed to effectively achieve specific application goals?
Target group	-
Method	Literature analysis
Key content	Procedure: The article analyses existing sources from the literature with a view to the classification and design methods of chatbots and discusses these existing approaches. Results: Chatbots can be task-oriented or non-task-oriented, for example, with task-oriented chatbots designed for a specific task and therefore more suited to short conversations. Their main goal is to help users complete specific tasks. This type of chatbot is goal-oriented and therefore works well in limited areas. In contrast, non-task-oriented chatbots can simulate a conversation with a person and thus serve entertainment purposes. There are also different approaches to design techniques, such as the rule-based approach or the generative approach. Usually, the conversation is initiated by the chatbot user by asking the chatbot a question. The chatbot then has to examine the user input for keywords and transform them into a targeted response. This is done by technically matching the keywords entered with documents stored in the chatbot. This pattern matching technique is mainly used in Q&A chatbots. The key to effective responses is that the chatbot understands the question and recognises the keywords. It must therefore understand different user inputs that are formulated in different ways by recognising the context and formulating the appropriate response.
Conclusions for AP 2	According to the results of the source, with regard to the research project of this report, which discusses the implementation of a Q&A chatbot, it is appropriate to use a task-oriented, rule-based chatbot. In order for this to work and be helpful to users, the chatbot can only be used for a limited area. At the same time, the chatbot must be able to understand user input and present the appropriate response using keyword matching. Accordingly, the technical matching of keywords to generate the appropriate responses should work flawlessly.
Limitations	-

Table 11 Source: Linder, C. (2020)

Source	
Author	Linder, C.
Year	2020
Title	The Effects of a Healthcare Chatbots' Language and Persona on User Trust, Satisfaction, and Chatbot Effectiveness
Abstract	Healthcare technology is growing in its capabilities and capacity to impact people's daily lives. One area of interest for growth is the use of chatbots and other telehealth applications that allow people to receive ubiquitous health information. The benefit of these systems is the ability to give access to pertinent, personalized healthcare information and services that could otherwise be inaccessible for some populations. With personalized information, patients may gain the information needed to make efficacious healthcare decisions which ideally will result in quicker recovery times and lower overall healthcare system costs. Chatbots have already been studied in the healthcare domain as resources for smoking cessation, diet recommendation, and other assistive applications. Yet, few studies have examined the specific design characteristics of healthcare chatbots. My research objective was to analyze two characteristics, language and persona, and their effect on outcomes such as effectiveness, usability, and trust in a chatbot. A between-subject study was performed where participants interacted with a chatbot. Each of chatbot conditions had a language of either technical or non-technical, and persona of Doctor, Nurse, or Nursing Student Sarah. Language was found to have a significant effect on effectiveness, but not trust or usability. In particular, participants who experienced technical language improved significantly greater than those who experienced non-technical language. Persona was found to not be significant for any of the outcomes. Overall, this study demonstrated a need to further study and understand how chatbot design characteristics impact users and how they comprehend the information given to them, particularly from a healthcare perspective.
Key research question	What effect does language (technical vs. non-technical) and the mentioned function of a chatbot have on its evaluation?
Target group	People aged 18-26 were selected. The underlying criterion for selection was the ability to read, write and speak English.
Method	Experiment
Key content	The effectiveness of the chatbot is measured in this study by assessing the level of knowledge about blood pressure before and after interaction with the chatbot. In addition to effectiveness, trust in the chatbot and perceived usefulness are also measured.

Source	
	The chatbot examined works on a rule-based system and is filled with answers from a 16-question catalogue on the topic of blood pressure. Study design: The reading comprehension of the test subjects is determined using the Flesch-Kincaid readability test so that they can then be assigned to different experimental conditions. The experimental conditions vary in terms of language: the chatbot uses either technical or non-technical language in its responses. Furthermore, the chatbot is presented in different roles: The chatbot is introduced as a doctor, nurse or medical student. Results: The study results suggest that the chatbot is generally considered effective. This can be determined by comparing the test subjects' knowledge of blood pressure before and after using the chatbot. When investigating whether the type of language or the persona of the chatbot has an effect on effectiveness, perceived usefulness or trust, a significant effect of technical language style on effectiveness can be observed: the effectiveness of the chatbot's use of technical language is significantly higher compared to non-technical language. In contrast, trust and perceived usefulness of the chatbot are not influenced by language style. The study results can demonstrate an effect through the attribution of different functions to the chatbot. Despite the chatbot being introduced by name as "Sarah," there is no evidence of increased interaction by the test subjects that goes beyond the mere gathering of information.
Conclusions for AP 2	Differences in the technical level of language style can influence communication with users. A thematic knowledge query before and after an experiment can determine how effective the chatbot was at conveying information.
Limitations	The present study only considers young people (aged 18-26), which implies limitations in terms of generalisability.

Table 12 Source: Maniou, T. A./ Veglis, A. (2020)

Source	
Authors	Maniou, T. A./ Veglis, A.
Year	2020
Title	Employing a Chatbot for News Dissemination during Crisis: Design, Implementation and Evaluation
Abstract	The use of chatbots in news media platforms, although relatively recent, offers many advantages to journalists and media professionals and, at the

Source	
	same time, facilitates users' interaction with useful and timely information. This study shows the usability of a news chatbot during a crisis situation, employing the 2020 COVID-19 pandemic as a case study. The basic targets of the research are to design and implement a chatbot in a news media platform with a two-fold aim in regard to evaluation: first, the technical effort of creating a functional and robust news chatbot in a crisis situation both from the AI perspective and interoperability with other platforms, which constitutes the novelty of the approach; and second, users' perception regarding the appropriation of this news chatbot as an alternative means of accessing existing information during a crisis situation. The chatbot designed was evaluated in terms of effectively fulfilling the social responsibility function of crisis reporting, to deliver timely and accurate information on the COVID-19 pandemic to a wide audience. In this light, this study shows the advantages of implementing chatbots in news platforms during a crisis situation, when the audience's needs for timely and accurate information rapidly increase.
Key research question	What functions should chatbots be assigned in a crisis situation? How can new chatbots be designed to be perceived as trustworthy and reliable?
Target group	Journalism students from the University of Cyprus and Aristotle University in Thessaloniki were selected for this study. The students are in their second year of study and are familiar with the use of chatbots.
Method	Focus groups Focus group 1: Journalism students at the University of Cyprus Focus group 2: Journalism students at Aristotle University of Thessaloniki
Key content	Research design: This study examines the use of chatbots in crisis situations based on the COVID-19 pandemic. It assumes that chatbots are suitable for crisis communication because they can ensure access to up-to-date and validated information for all citizens. Chatbots can take on a social responsibility function in crisis situations. The "COVINFO Reporter" chatbot The chatbot examined in this study works on a rule-based system using predefined responses. After a welcome message and a brief introduction, the chatbot lists possible topic categories that users can click on. Once a category has been selected, the chatbot presents related newspaper articles from the BBC News source. Evaluation of the chatbot: Participants evaluate the chatbot within focus groups in terms of performance, reliability, functionality, personalisation, interactivity, ethical standards and accessibility. The chatbot is tested on both a laptop and a mobile phone. Results: The chatbot is perceived as efficient, with only a few technical problems identified. The simple language used by the chatbot is also rated positively. The information provided by the chatbot is considered helpful. The topic structure within the chatbot is also highlighted as a positive

Source	
	feature. The logic of the menu is therefore self-explanatory and easy to use. The perceived trustworthiness is reinforced by the reliable sources cited and the reputable information provided. Some users liked the fact that the chatbot was accompanied by an image, as this made it seem more human. In terms of interactivity, users emphasise that the interaction is pleasant and that they find it a pleasant way to obtain information. Users appreciate the fact that no personal data needs to be stored. At the same time, the focus groups also expressed some points of criticism: In view of the initial situation of the COVID-19 pandemic, it would be desirable for the chatbot to not only provide national information but also take an international perspective into account. The colour scheme of the chatbot was also evaluated: the use of red is perceived as distracting. In addition, users would prefer the chatbot's responses not to be displayed against a white background for better readability.
Conclusions for AP 2	A variety of criteria should be taken into account when designing a chatbot: in addition to accessibility and reliability, the chatbot's interface (colour, presentation) and the use of language should be chosen carefully. Details can have a significant impact on how the chatbot is evaluated.
Limitations	-

Table 13 Source: Nadarzynski, T./ Miles, O./ Cowie, A./ Ridge, D. (2019)

Source	
Authors	Nadarzynski, T./ Miles, O./ Cowie, A./ Ridge, D.
Year	2019
Title	Acceptability of artificial intelligence (AI)-led chatbot services in healthcare: A mixed-methods study
Abstract	Background: Artificial intelligence (AI) is increasingly being used in healthcare. Here, AI-based chatbot systems can act as automated conversational agents, capable of promoting health, providing education, and potentially prompting behaviour change. Exploring the motivation to use health chatbots is required to predict uptake; however, few studies to date have explored their acceptability. This research aimed to explore participants' willingness to engage with AI-led health chatbots. Methods: The study incorporated semi-structured interviews (N-29) which informed the development of an online survey (N-216) advertised via social media. Interviews were recorded, transcribed verbatim and analysed thematically. A survey of 24 items explored demographic and attitudinal variables, including acceptability and perceived utility. The quantitative data were analysed using binary regressions with a single categorical predictor.

Source	
	Results: Three broad themes: 'Understanding of chatbots', 'AI hesitancy' and 'Motivations for health chatbots' were identified, outlining concerns about accuracy, cyber-security, and the inability of AI-led services to empathise. The survey showed moderate acceptability (67%), correlated negatively with perceived poorer IT skills OR=0.32 [CI95%:0.13–0.78] and dislike for talking to computers OR=0.77 [CI95%:0.60–0.99] as well as positively correlated with perceived utility OR¼5.10 [CI95%:3.08–8.43], positive attitude OR=2.71 [CI95%:1.77–4.16] and perceived trustworthiness OR=1.92 [CI95%:1.13–3.25]. Conclusion: Most internet users would be receptive to using health chatbots, although hesitancy regarding this technology is likely to compromise engagement. Intervention designers focusing on AI-led health chatbots need to employ user-centred and theory-based approaches addressing patients' concerns and optimising user experience in order to achieve the best uptake and utilisation. Patients' perspectives, motivation and capabilities need to be taken into account when developing and assessing the effectiveness of health chatbots.
Key research question	What influences users' use of health chatbots?
Target group	Qualitative interviews: Students aged 18 and over at the University of Southampton Quantitative survey: social media users
Method	This study uses a mixed-method approach consisting of a qualitative and a quantitative part.
Key content	Research design: Students aged 18 and over at the University of Southampton were invited to take part in individual interviews on the university campus via printed and digital advertisements to determine their attitudes towards new technologies in healthcare. The 20–30-minute interview, which was conducted by qualitative researchers and included a chatbot demonstration, focused on understanding chatbots, attitudes, user-friendliness and general concerns. For the quantitative survey, in the form of an online questionnaire, advertisements were placed on social media (university accounts on Facebook, Twitter, etc.) to direct users to the questionnaire. Users were also able to share the survey link via a snowball system. The online questionnaire, which took about 10 minutes to complete, focused on awareness and experience with health chatbots and their perceived usefulness. Results: Chatbots in health communication fundamentally improve access to healthcare and help to cope with the growing demand for healthcare services, among other things by providing convenient, immediate answers to health-related queries. Awareness and experience with health chatbots are rather low across participants, and most have mixed (positive and negative) attitudes or acceptance towards the technology. Overall, however, a health chatbot is accepted for obtaining general health advice. At the same time, chatbots are considered unqualified to provide diagnoses and expert advice. The main limitation is seen in the lack of

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	human presence and the fact that chatbot responses are perceived as impersonal, cold and inhuman. Respondents (in the online survey) who have only moderate IT skills and those who dislike talking to computer technologies show a lower acceptance of health chatbots. The strongest predictors of acceptance of health chatbots are a positive attitude towards chatbots and curiosity about new technology, as well as the perceived trustworthiness of the chatbot.
Conclusions for AP 2	Chatbots in the healthcare sector are only suitable for providing general health information. The acceptance and use of health chatbots is linked to users' knowledge and experience with chatbots, their IT skills, their affinity or aversion to interacting with computer technologies, their attitude towards and trust in chatbots in general, and their curiosity about new technologies.
Limitations	This study only considers health chatbots.

Table 14 Source: Nißen, M./ Selimi, D./ Janssen, A./ Cardona, D. R./ Breitner, M. H./ Kowatsch, T./ von Wangenheim, F. (2022)

Source	
Authors	Nißen, M./ Selimi, D./ Janssen, A./ Cardona, D. R./ Breitner, M. H./ Kowatsch, T./ von Wangenheim, F.
Year	2022
Title	See you soon again, chatbot? A design taxonomy to characterise user-chatbot relationships with different time horizons
Abstract	Users interact with chatbots for various purposes and motivations – and for different periods of time. However, since chatbots are considered social actors and given that time is an essential component of social interactions, the question arises as to how chatbots need to be designed depending on whether they aim to help individuals achieve short-, medium- or long-term goals. Following a taxonomy development approach, we compile 22 empirically and conceptually grounded design dimensions contingent on chatbots' temporal profiles. Based upon the classification and analysis of 120 chatbots therein, we abstract three time-dependent chatbot design archetypes: Ad-hoc Supporters, Temporary Assistants, and Persistent Companions. While the taxonomy serves as a blueprint for chatbot researchers and designers developing and evaluating chatbots in general, our archetypes also offer practitioners and academics alike a shared understanding and naming convention to study and design chatbots with different temporal profiles.
Key research question	Do different time profiles of a chatbot influence design considerations and, if so, how?

Source	
Target group	-
Method	This study uses a mixed-method approach consisting of a qualitative and a quantitative part.
Key content	State of research: The time profile of a chatbot, i.e. how long and how often the chatbot is expected to be used, can be a factor influencing its design. Chatbots can be divided into short-term, medium-term and long-term chatbots, or even life-long chatbots. While short-term chatbots are designed for quick, spontaneous, interactions, such as in customer service, medium-term or long-term chatbots are designed for ongoing, recurring processes. The time profile of a chatbot is characterised by the period of interaction, the duration of the interaction and the frequency of the interaction. Research design and results: As part of the study, a taxonomy for the systematic classification of chatbots is being developed. Existing chatbots are used for this purpose. The design features considered in the taxonomy are examined by comparing the time profilies of all selected chatbots (n=120) using frequency counts and the calculation of indices. The analysis of the characteristics of real chatbots shows that "long-term" chatbots are more complex and pronounced in all measured dimensions than "medium" or "short-term" chatbots. Overall, three different types of chatbots can be identified: 1. "Ad hoc supporters": One type is the so-called "ad hoc supporters", which are mostly short-term chatbots designed for quick interaction and a short period of time. They have less complex technology, are task-oriented and try to solve user concerns as efficiently as possible. 2. Persistent companions: If chatbots are designed for the long term and interactions are longer and recurring, they can be classified as persistent companions. These types of chatbots are flexible, personal and socially oriented and aim to build a relationship with users. 3. Temporary Advisors: The third type, "Temporary Advisors," mostly includes chatbots designed for medium-term use. They are designed to enable recurring interactions over a longer period of time, but shorter than long-term chatbots. This type is similar to "ad hoc supporters" in that no personal relationship is established, but, like "persistent companions," it has additional functions.
Conclusions for AP 2	The time profile of a chatbot is a factor that must be taken into account when designing a chatbot. The distinction between whether a chatbot is used by users in the short, medium or long term has implications for its design and characteristics. If a chatbot is designed for long-term interaction, it will tend to be more complex, have functions that go beyond the fulfilment of tasks, and take on personal traits to shape the interaction with users. Short-term chatbots, on the other hand, are limited to performing their essential tasks and have few personal traits.
Limitations	The study focuses on domain-specific, text-based chatbots.

Table 15 Source: Olk, S./ Tscheulin, D. K./ Zogaj, A. (2020)

Source	
Authors	Olk, S./ Tscheulin, D. K./ Zogaj, A.
Year	2020
Title	Crisis communication via COVID-19 chatbots – Effects of communication style on public management objectives
Abstract	Effective communication during public health emergencies is critical to handling a crisis. In uncertain times, those in charge are faced with the challenge of providing citizens with sufficient information on the one hand and avoiding panic reactions on the other hand. Due to the high demand for information, organizations and public administrations are increasingly using chatbots in order to implement their crisis strategies. The present study investigates the effects of a chatbot's communication style on the objectives of crisis management using the example of the COVID-19 pandemic. Based on the stereotype content model, this study empirically shows that the combination of the goal frame and the use of emojis has an impact on citizens' responses to chatbot communication. The implications for effective risk communication and limitations are discussed.
Key research question	How effective are chatbots in crisis communication and how can crisis communication via chatbots be designed to achieve the objectives of crisis management?
Target group	247 Facebook users
Method	Experiment
Key content	Research design: A 2x2 between-subjects experimental design was used to test the authors' hypotheses. The hypotheses related to various goal frames, such as the gain and loss goal frames. The gain goal frame means that the chatbot messages are formulated in such a way that the gain of something is emphasised. For example, the chatbot information is noted as follows: "With the help of this measure, we can achieve the goal and protect everyone who needs our help." This contrasts with the loss goal frame, in which the chatbot information is formulated in the opposite way and focuses on the loss, emphasising how something can be prevented (rather than gained), for example with the words "without this measure, we will no longer be able to achieve the goal and protect everyone who needs our help." Hypotheses: 1a) The use of a gain-oriented goal frame (the desired state is achieved) in chatbot dialogue increases its perceived warmth compared to the use of a loss-oriented goal frame (undesirable state is avoided).

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	1b) Using a gain-oriented goal frame in chatbot dialogue reduces the perceived competence of the chatbot compared to using a loss-oriented goal frame. 2a) The use of emojis in crisis communication with a chatbot increases its perceived warmth compared to when no emojis are used. 2b) The use of emojis in crisis communication with a chatbot reduces its perceived competence compared to when no emojis are used. 3) A communication style in which both warmth and competence are perceived has a positive influence on: 3a) (...) the perceived quality of the information conveyed 3b) (...) the intention to follow the chatbot's crisis instructions 3c) (...) the perceived sense of security In a randomly distributed experiment, participants recruited via Facebook were shown one of four videos (loss vs. gain goal frame and emojis vs. no emojis) depicting a dialogue between a chatbot and users on the topic of COVID-19. Following the dialogue, participants were asked to answer questions such as whether they found the chatbot friendly, competent, whether they would follow the chatbot's instructions, etc. Results: The results show that hypothesis 1a cannot be supported, as the use of a positive goal frame has no influence on perceived warmth. However, it does have a negative effect on perceived competence, so hypothesis 1b applies. The use of emojis appears to have a positive effect on the perceived warmth of the chatbot, which supports hypothesis 2a. However, no significant effect was observed regarding perceived competence when using emojis, so hypothesis 2b is rejected. The result also shows that, in line with hypothesis 3, the combination of emojis and framing (gain vs. loss goal frame) has an effect on the quality of the information conveyed/informativeness, the intention to comply with crisis instructions and the perceived safety, insofar as the combination of the loss goal frame and the use of emojis positively influences the perceived quality of the information conveyed, thus supporting hypothesis 3a. Hypothesis 3b, on the other hand, is rejected, while hypothesis 3c is supported.
Conclusions for AP 2	Perceived warmth and competence are decisive for the positive evaluation of chatbots. Perceived warmth can be positively influenced using emojis.
Limitations	The personal attitudes of users (e.g. norm orientation) may also have an influence on the effects that could not be investigated through experimentation and chatbot design. In addition, despite efforts to ensure realistic treatment, the target group of the experiment was relatively young, with an average age of 28.

Table 16 Source: Radziwill, N./ Benton, M. (2017)

Source	
Authors	Radziwill, N./ Benton, M.
Year	2017
Title	Evaluating quality of chatbots and intelligent conversational agents
Abstract	Chatbots are one class of intelligent, conversational software agents activated by natural language input (which can be in the form of text, voice, or both). They provide conversational output in response, and if commanded, can sometimes also execute tasks. Although chatbot technologies have existed since the 1960's and have influenced user interface development in games since the early 1980's, chatbots are now easier to train and implement. This is due to plentiful open source code, widely available development platforms, and implementation options via Software as a Service (SaaS). In addition to enhancing customer experiences and supporting learning, chatbots can also be used to engineer social harm - that is, to spread rumors and misinformation, or attack people for posting their thoughts and opinions online. This paper presents a literature review of quality issues and attributes as they relate to the contemporary issue of chatbot development and implementation. Finally, quality assessment approaches are reviewed, and a quality assessment method based on these attributes and the Analytic Hierarchy Process (AHP) is proposed and examined.
Key research question	What quality characteristics must be considered when developing and implementing chatbots?
Target	-
Method	Literature analysis on quality criteria for chatbots
Key content	Approach: To get an overview of the quality features of chatbots and conversation agents, a systematic search to find different publications on the quality of chatbots and conversation agents was done and subsequently processed. Only publications were included where quality was an important part of the research. Results: The literature review in this article shows that consistent characteristics representing the key quality characteristics for chatbots are identified across various sources. Three main categories can be identified, which are divided into further sub-characteristics. One of these main categories of quality characteristics is "efficiency." In this context, efficiency means that a chatbot must be powerful, i.e., robust against manipulation and unexpected inputs. The second quality category is called "effectiveness," which can be divided into "functionality" and "humanity." The characteristic of "functionality" therefore means that the chatbot must be functional and must interpret input commands accurately and respond correctly in terms of language. It is central to functionality that the chatbot provides precise answers and is user-friendly. "Humanity" in the context of

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	the quality feature "effectiveness" means that the chatbot should demonstrate transparency with regard to its identity, making it clear that it is a chatbot and not a real person. Another key quality feature of chatbots is a certain level of "satisfaction". This is made up of greetings and the conveyance of personality, as well as emotionality in dialogue and an appropriate response to social cues. "Ethics and trust" is also mentioned as a quality feature in connection with "satisfaction" and means that trustworthiness should be ensured by citing sources in the chatbot and that the chatbot should demonstrate a certain degree of sensitivity to security and social issues. Furthermore, the characteristic of "satisfaction" includes a form of accessibility in that the chatbot responds to social cues and has a short response time.
Conclusions for AP 2	For the design and implementation, the quality characteristics of efficiency (performance, robustness), effectiveness (functionality, precise answers, user-friendliness), humanity (transparency with regard to the chatbot's character), satisfaction (greeting, emotionality) and ethics or trust in the form of source references and sensitivity to security and social issues should be taken into account.
Limitations	-

Table 17 Source: Schuetzler, R. M./ Grimes, G. M./ Scott Giboney, J. (2020)

Source	
Authors	Schuetzler, R. M./ Grimes, G. M./ Scott Giboney, J.
Year	2020
Title	The impact of chatbot conversational skill on engagement and perceived humanness
Abstract	Conversational agents (CAs)- frequently operationalized as chatbots - are computer systems that leverage natural language processing to engage in conversations with human users. CAs are often operationalized as chatbots which are used for many applications including technical support, customer service, and digital personal assistants. Despite their widespread use, little research to date has investigated how improving the conversational skill of a CA impacts user perceptions of the agent. To elucidate this relationship, this research uses Social Presence Theory to describe how conversational skill influences perceived social presence and ultimately anthropomorphism of a chatbot. We conducted a series of studies in which 450 participants interacted with CAs exhibiting varying levels of conversational skill. We show that people perceive a more skilled CA to be more socially present and anthropomorphic than a less skilled CA. This research advances the knowledge of computer-human interface in information systems, as CA research to date has largely focused on the

Source	
	technical challenges rather than the behavioral questions of how users interact with CAs.
Key research question	How does a chatbot's conversational ability influence the perception of its engagement and perceived humanity?
Target group	Study 1: 150 students at a large university in the United States Study 2: 245 students from the United States, recruited through Amazon Mechanical Turk
Method	Experiment
Key content	Procedure: In the experiment, users interact with different chatbots that have varying levels of conversational skills and then answer a series of questions about their perception of the chatbot's humanity, engagement and social presence, such as whether the chatbot was competent and polite, whether it was attentive and engaged as well as friendly, whether it was perceived as sociable or unsociable, sensitive or rather insensitive. Results: The results show that tailored responses lead to a higher perceived humanity among users. The same applies to response variety, which increases perceived humanity. Simple repetitions without variation, on the other hand, have a negative effect. Not only does perceived humanity increase, but so does perceived engagement, with improved conversational skills evident in tailored responses and response variety. Furthermore, improvements in the form of adjustments to responses to user queries have a significant impact.
Conclusions for AP 2	A chatbot is particularly well-rated when it demonstrates high conversational skills in the form of tailored responses and a variety of responses. Repetitive responses lead to less engaging interactions and do not create a sense of connection between the chatbot and the user during the interaction.
Limitations	-

Table 18 Source: Shumanov, M./ Johnson, L. (2021)

Source	
Authors	Shumanov, M./ Johnson, L.
Year	2021
Title	Making conversations with chatbots more personalised
Abstract	Many of the world’s leading brands and increasingly government agencies are using intelligent agent technologies, also known as chatbots to interact with consumers. However, consumer satisfaction with chatbots is mixed. Consumers report frustration with chatbots arising from misunderstood

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	questions, irrelevant responses, and poor integration with human service agents. This study examines whether human-computer interactions can be more personalized by matching consumer personality with congruent machine personality using language. Although the idea that personality is manifested through language, and that people are more likely to be responsive to others with the same personality is well known, there is a dearth of research that examines whether this is consistent for human-computer interactions. Based on a sample of over 57,000 chatbot interactions, this study demonstrates that consumer personality can be predicted during contextual interactions, and that chatbots can be manipulated to 'assume a personality' using response language. Matching consumer personality with congruent chatbot personality had a positive impact on consumer engagement with chatbots and purchasing outcomes for interactions involving social gain.
Key research question	Can chatbots be designed to assume a personality by changing their language? Can user engagement be increased if the personality of chatbots matches the personality of these users?
Target group	Customers of a telecommunications company
Method	Experiment
Key content	Research status: Empirical findings suggest that chatbots that reflect the personality of their users are better rated and more likely to be accepted. A person's everyday language and vocabulary provide information about their personality. This study focuses on personality in general and, more specifically, on the characteristics of introversion versus extroversion. The personality of users is classified based on their choice of words and sentences. The introverted chatbot uses language that is "purposeful" and "efficient," while the extroverted chatbot speaks in a more "commanding" and "assertive" manner. The customers surveyed who submit service requests to the chatbot are randomly assigned to a chatbot. Engagement with the chatbot is measured in terms of the average duration of the conversation. Results: In line with theoretical expectations, a significant effect was found between matching personalities and engagement with the chatbot. The study also examined the effect on purchase intent, which is not discussed here. It was also found that the effect of matching personalities between customers and chatbots is stronger for extroverts than for introverts. An unexpected finding concerns the fundamental distinction between introversion and extroversion: on average, introverted users and introverted chatbots show a longer retention time than extroverted matches. The authors therefore conclude that introverted users generally prefer interactions with artificial intelligence to human interaction. The finding of congruent personalities is validated by the fact that no significant effects on chatbot engagement can be observed when the personalities of customers and chatbots do not match.

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Conclusions for AP 2	If the chatbot reflects the personality of the user (e.g. the introversion of a user), this can have a positive effect on the acceptance of the chatbot.
Limitations	Only one personality trait (introversion/extroversion) is considered in the study.

Table 19 Source: Stieglitz, S./ Hofeditz, L./ Brünker, F./ Ehnis, C./ Mirbabaie, M./ Ross, B. (2022)

Source	
Authors	Stieglitz, S./ Hofeditz, L./ Brünker, F./ Ehnis, C./ Mirbabaie, M./ Ross, B.
Year	2022
Title	Design principles for conversational agents to support emergency management agencies
Abstract	Widespread mis- and disinformation during the COVID-19 social media „infodemic“ challenge the effective response of Emergency Management Agencies (EMAs). Conversational Agents (CAs) have the potential to amplify and distribute trustworthy information from EMAs to the general public in times of uncertainty. However, the structure and responsibilities of such EMAs are different in comparison to traditional commercial organizations. Consequently, Information Systems (IS) design approaches for CAs are not directly transferable to this different type of organization. Based on semi-structured interviews with practitioners from EMAs in Germany and Australia, twelve meta-requirements and five design principles for CAs for EMAs were developed. In contrast to the traditional view of CA design, social cues should be minimized. The study provides a basis to design robust CAs for EMAs.
Key research question	How should chatbots be designed to improve crisis communication, and what requirements must they meet?
Target group	Experts in the fields of crisis communication, news services and operational editing at the government level.
Method	Semi-structured interviews
Key content	State of research: The state of research on the principles of chatbots discussed in the article describes that they should be sociable, communicate proactively, be transparent and flexible, user-friendly, and allow for the reporting of errors. Research design: To answer the research question and understand how chatbots need to be designed to support crisis communication, 16 semi-structured interviews will be conducted in Germany and Australia with experts in crisis management.

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	Results: In a crisis, the population's need for information depends on the crisis itself and the degree of individual involvement. However, the use of information and communication technologies such as chatbots can fundamentally improve crisis response and emergency management. Chatbots can, for example, help to answer frequently asked questions about ongoing disasters quickly and accurately. To do this, however, chatbots must provide reliable real-time information. In addition, special requirements apply to chatbots in crisis communication regarding content, technical, organisational and legal aspects, namely: Sociability/friendliness, i.e. the ability to adapt the conversational style to communicate with the user in their preferred manner, proactive communication, i.e. informing the user about relevant information instead of just receiving input from them. Chatbots must also be transparent, declare themselves as machines rather than humans, point out potential errors and lack of knowledge, and explain specific functions. Another feature that chatbots should have is flexibility, which means that they can respond to changing contexts. They should also be user-friendly and allow for error handling, e.g. in the form of error reporting, be powerful and also take ethical aspects such as security and data protection into account. Furthermore, when designing chatbots, it is important to ensure that they are efficient and effective, identify sources and indicate that the information is up to date. Especially in crisis situations, it is important that chatbot conversations are designed with simple and natural, purely functional dialogue. The information provided should be consistent, precise and not confusing. This feature in particular, along with minimal social cues so that users can focus on the essential information, distinguishes a standard chatbot from a chatbot used in crisis communication. Demographic characteristics can lead to differences in reactions and behaviour during crisis events, which should result in different communication strategies for chatbots. Furthermore, chatbots are required to be multilingual and to offer the option of forwarding users to real people or to a website with more information, as well as providing location-based information. It is also advisable to place crisis chatbots on different channels, as people use different channels.
Conclusions for AP 2	If various aspects are considered when designing the chatbot, it can provide helpful support in crisis communication. Above all, the chatbot should communicate in a targeted manner (functional, precise, clear, minimal social cues), demonstrate a high degree of transparency (source identification and up-to-date information), be clearly identified as a chatbot, and comply with data protection regulations.
Limitations	Crisis communication can vary depending on the type of crisis. Here, the focus was primarily on natural disasters (fires, floods, etc.). Another limitation is that there are general requirements for chatbots that may go beyond what current technology can offer.

Table 20 Source: Xiao, Z./ Liao, Q. V./ Zhou, M. X./ Grandison, T./ Li, Y. (2023)

Source	
Authors	Xiao, Z./ Liao, Q. V./ Zhou, M. X./ Grandison, T./ Li, Y.
Year	2023
Title	Powering an AI Chatbot with Expert Sourcing to Support Credible Health Information Access
Abstract	During a public health crisis like the COVID-19 pandemic, a credible and easy-to-access information portal is highly desirable. It helps with disease prevention, public health planning, and misinformation mitigation. However, creating such an information portal is challenging because 1) domain expertise is required to identify and curate credible and intelligible content, 2) the information needs to be updated promptly in response to the fast-changing environment, and 3) the information should be easily accessible by the general public; which is particularly difficult when most people do not have the domain expertise about the crisis. In this paper, we presented an expert-sourcing framework and created Jennifer, an AI chatbot, which serves as a credible and easy-to-access information portal for individuals during the COVID-19 pandemic. Jennifer was created by a team of over 150 scientists and health professionals around the world, deployed in the real world and answered thousands of user questions about COVID-19. We evaluated Jennifer from two key stakeholders' perspectives, expert volunteers and information seekers. We first interviewed experts who contributed to the collaborative creation of Jennifer to learn about the challenges in the process and opportunities for future improvement. We then conducted an online experiment that examined Jennifer's effectiveness in supporting information seekers in locating COVID-19 information and gaining their trust. We share the key lessons learned and discuss design implications for building expert-sourced and AI-powered information portals, along with the risks and opportunities of misinformation mitigation and beyond.
Key research question	How can expert sourcing contribute to the development of a chatbot for a crisis situation?
Target group	On the one hand, experts and volunteers who helped fill the chatbot were surveyed, and on the other hand, users of the chatbot Jennifer were interviewed.
Method	Interviews with experts followed by an online experiment.
Key content	State of research: So-called "expert sourcing" of information can help meet the information needs of the population in crisis situations. An information portal used in crisis situations must meet the following requirements: It must be accessible (via multiple platforms), provide fast and high-quality information, use understandable language to convey information that is sometimes complex, and, last but not least, enable continuous updating of information without the need for technical expertise. However, a lack of expertise (or personnel with expertise) is often a challenge that makes it

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	difficult to use chatbots in crisis situations. The aim of this study is to investigate whether expert sourcing can be a possible solution to this problem. Results: The chatbot "Jennifer" was developed in the wake of the coronavirus pandemic. It is a system with a rule-based and generative component that is based on stored question-and-answer pairs from trustworthy sources and answers additional questions with the help of available databases. Expert sourcing was used to create the chatbot: experts in scientific communities were called upon to help populate and maintain the chatbot. The team of experts comprises approximately 150 volunteers who fulfil various roles within the framework of "Jennifer". The individuals are interviewed after their work to identify potential challenges in the expert sourcing process. The work of the experts for the chatbot is evaluated in interviews: The majority of those involved in the creation and maintenance of the chatbot report challenges with the flood of information and the ongoing revision loops. Another challenge mentioned is the language style used when dealing with people who are concerned and, for the most part, have no scientific background. The chatbot created through this collaboration is evaluated by selected users (n=90). The chatbot Jennifer is compared to a standard Internet search in terms of information retrieval. The results of the quantitative survey show that users receive more correct answers to their questions when using the chatbot compared to internet searches. Users also express significantly more trust in the chatbot Jennifer and the information it provides. In addition, the speed and ease of access to information are highlighted as positive aspects, although no significant differences to internet searches can be identified.
Conclusions for AP 2	Chatbots are suitable for use in crisis situations. They have advantages in terms of the accuracy of responses and the trust they inspire compared to independent information searches on the internet.
Limitations	-

Table 21 Source: Xu, Y./ Zhang, J. Y./ Deng, G. K. (2022)

Source	
Authors	Xu, Y./ Zhang, J. Y./ Deng, G. K.
Year	2022
Title	Enhancing customer satisfaction with chatbots: The influence of communication styles and consumer attachment anxiety

Source	
Abstract	Chatbots are increasingly occupying the online retailing landscape, and the volume of consumer-chatbot service interactions is exploding. Even so, it still remains unclear how chatbots should communicate with consumers to ensure positive customer service experiences and, in particular, to improve their satisfaction. A fundamental decision in this regard is the choice of a communication style, specifically, whether a social-oriented or a task-oriented communication style should be best used for chatbots. In this paper, we investigate how using a social-oriented versus task-oriented communication style can improve customer satisfaction. Two experimental studies reveal that using a social-oriented communication style boosts customer satisfaction. Warmth perception of the chatbot mediates this effect, while consumer attachment anxiety moderates these effects. Our results indicate that social-oriented communication style can be beneficial in enhancing service satisfaction for highly anxiously attached customers, but it does not work for the lowly anxiously attached. This study provides theoretical and practical implications about how to implement chatbots in service encounters.
Key research question	How do communication styles in chatbots affect (customer) satisfaction?
Target group	Study 1: 142 students at a university in China Study 2: 185 participants from a Chinese survey platform Study 3: 147 students at a university in China
Method	Experiment
Key content	State of research: Sources cited in this article show that the current state of research suggests that chatbots should exhibit humanity and have identity features such as a name and visual characteristics (avatar/figure), as well as gender and conversational characteristics, in order to positively influence user perception. However, research into the communication style of chatbots has remained largely unexplored. Research design: In order to investigate how communication in chatbots should be designed to improve user satisfaction and what influence the communication style of the chatbot has on this, three experimental studies were conducted, each involving a chatbot dialogue (as a screenshot or live, as well as socially or task-oriented) and a questionnaire was then completed with a focus on satisfaction, perceived warmth and competence of the chatbot. Study 1: Experiment to test hypothesis 1: Customers show higher satisfaction when a socially-oriented communication style is used instead of a task-oriented communication style, and hypothesis 2: The perceived warmth of the chatbot mediates the relationship between the socially oriented communication style and customer satisfaction. In the experiment, respondents were presented with a screenshot of a conversation with a chatbot that used a socially-oriented or task-oriented communication style.

Source	
	Study 2: Experiment to test Hypothesis 3: Commitment aversion moderates the effect of the socially oriented communication style of chatbots on customer satisfaction, with the effect being stronger among consumers with high commitment aversion. Study 3: To test hypotheses 1, 2 and 3. Results There are different communication styles (socially-oriented vs. task-oriented) with which chatbots can interact. Socially-oriented means that the chatbot is more personal and emotional (satisfying emotional needs) and tries to build a relationship, for example by greeting the user and making small talk. The task-oriented chatbot, on the other hand, is goal-oriented, more formal and purely task-related in its dialogue. Firstly, it appears that users actually rate the social orientation of socially oriented chatbots as higher. No gender-related correlation in the results could be seen. Furthermore, regardless of user characteristics, socially-oriented chatbots generally lead to higher customer satisfaction across the board. Satisfaction correlates significantly and positively with the perceived warmth of the chatbot. The perceived warmth also correlates with the perceived competence of the chatbot. The socially oriented communication style makes the chatbot appear more cordial to users, thereby increasing customer satisfaction. Satisfaction with the chatbot increases with a socially-oriented communication style, especially for people with high commitment anxiety, whereas this does not apply to people with low commitment anxiety. Adding human characteristics and identity features such as a human name and visual features also leads to higher satisfaction with the chatbot. Satisfaction with the chatbot increases when the chatbot is friendly and helpful, as well as trustworthy and competent, i.e. intelligent and skilled.
Conclusions for AP 2	To increase (customer) satisfaction, the chatbot should be socially-oriented in its communication style, i.e. personal, emotional, with greetings and small talk.
Limitations	The study looks at chatbot dialogues that involve customer communication and focus on the topic of customer satisfaction in China.

Table 22 Source: Yu, S./ Zhao, L. (2022)

Source	
Authors	Yu, S./ Zhao, L.
Year	2022
Title	Designing emotions for healthcare chatbots: Text-based or icon-based approach

Source	
Abstract	Health care chatbots, which are being widely adopted by providers, offer many benefits to users. However, the limited communication capabilities of chatbots hinder their interactions with humans. Therefore, text-based (ie, verbal emotional expression, eg, saying „I am so sorry to hear that“) and icon-based (ie, nonverbal emotional expression, eg, using emojis, emoticons, or stickers) approaches are adopted to communicate emotion in chatbot messages. Previous studies have suggested that both emotion design approaches are effective in improving the evaluation of health care chatbots. However, the two approaches differ greatly from each other in their presentation, mechanism, and effectiveness. Understanding such differences could help system developers to optimize their health care chatbots. Nevertheless, research comparing these two approaches of emotion designs, to our knowledge, is nonexistent. This study aims to understand the mechanism and the interaction effect of these two approaches to see if the effect of one approach depends on the other one. In general, we proposed the following hypothesis: both text-based and icon-based emotional clues for health care chatbots can increase perceived emotional intensity (H1). To test the interaction effect of the two approaches, we hypothesized that the addition of an icon-based clue would not significantly affect emotional intensity when a text-based clue is already present (H2). Furthermore, emotional intensity will reduce psychological distance and increase behavioral intention (H3). Please refer to Multimedia Appendix 1 for the theoretical framework and hypothesis development.
Key research question	Can text-based and icon-based emotional cues for healthcare chatbots increase perceived emotional intensity?
Target group	483 online panellists in China
Method	Experiment
Key content	Research design: To investigate how chatbots should be designed in healthcare (text-based emotions vs. emojis) in order to increase perceived emotional intensity, 483 online panellists in China were randomly assigned to an experimental condition as part of a 2x2 factorial experiment (text-based emotion design: yes or no and symbol-based emotion design: yes or no). They were shown a screenshot of a conversation with a chatbot and, after viewing the screenshot, participants were asked to answer a series of questions about their perceived emotional intensity, psychological distance and behavioural intention in relation to the chatbot. Results: Since chatbots have limited communication abilities, attempts are made to incorporate emotions in text-based (e.g., "I'm so sorry") and icon-based (e.g., with emojis, stickers) forms. Symbol-based (emoji) and text-based designs significantly increase perceived emotionality. Emojis increase emotional intensity, especially when no text-based designs are used. However, if text-based designs are also used, the effect of symbol-based designs (emojis) disappears. If there are no text-based emotions, symbol-based designs significantly increase emotional intensity, thereby reducing

Source	
	psychological distance and strengthening behavioural intent. However, this effect was not significant when text-based designs were used.
Conclusions for AP 2	To increase perceived emotionality, both symbol-based and text-based emotion designs are generally suitable for chatbots. However, according to the study, the effect of the text-based approach on emotional intensity is stronger than that of the symbol-based approach (emojis), at least when both (text-based and emoji) are included. It is therefore recommended to use emojis or text-based emotions, but not in combination. A query after an experiment can capture how the chatbot is perceived in terms of its emotionality.
Limitations	This source refers to chatbots in the healthcare sector in China. Under certain circumstances, the use of emojis can also have a negative impact on the perception of chatbots, for example in terms of professionalism. However, this was not investigated in the study but included as an outlook and limitation.

Table 23 Source: Yu, S./ Zhao, L. (2024)

Source	
Authors	Yu, S./ Zhao, L.
Year	2024
Title	Emojifying chatbot interactions: An exploration of emoji utilisation in human-chatbot communications
Abstract	The prevalence of chatbots in human–computer communication has significantly increased. Emojis, as a form of emotional disclosure, have gained significant attention for their potential to boost chatbot service satisfaction. However, how and when emoji usage can increase satisfaction toward chatbots is not fully examined. This paper aims to fill this gap and contribute to the rapidly evolving field of human-chatbot communication research. Through three experiments, this paper investigates and explores the role of emojis in enhancing chatbot interactions. The results reveal that emojis heighten chatbot's perceived warmth but do not necessarily augment their competence. This warmth promoting effect leads to boosted service satisfaction and is more apparent when chatbots serve hedonic purposes and are pre-programmed rather than highly autonomous. However, the warmth upshot of emojis is not as potent for chatbots as it is for humans. While this study unravels the intricate pathway of how emojis augment service satisfaction, it also extends the dialogue of the Stereotype Content Model (SCM) and propels the new wave of the Computers Are Social Actors (CASA) paradigm. Thus, this research lays down pathways for

Source	
	further studies in understanding the role of emotionally simulated interactions in automated technologies.
Key research question	To what extent does the use of emojis influence the perceived warmth and competence of chatbots in interactions with humans? Under what conditions are the effects of emojis most visible?
Target group	Test subjects from consumer panel (China)
Method	Experiment
Key content	State of research: The state of research suggests that chatbots are often denied emotionality and empathy, which is why interaction with them may be perceived as less satisfying. To counteract this, human traits such as facial expressions can be used in "embodied chatbots" to make the chatbot appear more "human" and "warmer". In chatbots that rely purely on textual interaction, emojis may make the conversation feel more emotional. Empirical studies confirm that emojis in communication with chatbots lead users to build more rapport and trust the chatbot more. However, study results leave open the question of under what conditions emojis have a positive effect on perceived warmth and competence. Research design: The research question will be investigated on the basis of three online experiments. The dependent variables measured are the perceived warmth and competence of the chatbots. Three hypotheses are put forward during the investigation. It is generally assumed that emojis lead to a stronger perception of warmth, but not to a higher perceived competence of the chatbot. The effect of perceived warmth on satisfaction also depends on the type of chatbot: the effect is stronger for a chatbot that is used for emotional/hedonic motives. Given that chatbots can be differentiated in terms of their degree of autonomy, it can be assumed that the effect of perceived warmth through emojis is stronger in rule-based or predefined systems. Results: Study 1: The findings of this study confirm a significant positive effect of emojis on the perceived warmth of a chatbot. The effect is independent of whether the chatbot is a "human agent" or a chatbot. Perceived warmth, but not competence, has a mediating effect on satisfaction with the chatbot. Study 2: When distinguishing between the motive for use (utility-oriented or hedonic), there is also a direct, significant effect of emoji use on perceived warmth. The motive for use also has a moderating effect in that it amplifies the effect of perceived warmth on satisfaction when used for hedonic motives. Study 3: The distinction between whether a chatbot is rule-based/predefined or acts autonomously has a moderating effect: the positive effect of perceived warmth on satisfaction using emojis is stronger for predefined/rule-based chatbots than for autonomous chatbots.

Source	
Conclusions for AP 2	The use of emojis by a chatbot can positively influence its perceived warmth. However, emojis do not lead to a higher perceived competence. The effect of emojis is most pronounced when the motive for use is hedonic and not utility-oriented. In addition, a stronger effect of emojis can be expected when the chatbot is predefined.
Limitations	The authors acknowledge limitations regarding the transferability of the Chinese context to Western cultures, as there are differences in facial expressions and gestures. Only one evaluation is measured as a dependent variable, but not future (usage) behaviour. Furthermore, this study does not distinguish between the emojis used.

Table 24 Source: Zamora, J. (2017)

Source	
Authors	Zamora, J.
Year	2017
Title	I'm sorry, Dave, I'm afraid I can't do that: Chatbot perception and expectations
Abstract	Artificial intelligence continues to grow in popularity on mobile platforms, increasing exposure to chatbot apps. Chatbot technology has evolved over time, yet the purpose and added value that chatbots offer has not been clearly defined. In order to design a chatbot that provides a meaningful experience, we must first understand what expectations people have for this technology, and what opportunities are there for chatbots based on user needs. This study includes qualitative data from 54 participants in the US and India, sharing their expectations and experiences with a chatbot. The research objectives include: 1) understand user perception and expectations of chatbots 2) surface preferences for input modality and 3) identify domains where chatbots can add meaningful purpose.
Key research question	What expectations do users have of a chatbot?
Target group	People aged 24 to 40 from India and the US who are in a recruitment database.
Method	Quantitative study
Key content	Study design: In the study, 26 participants from the USA and 28 participants from India were asked to use various chatbots and search applications for everyday tasks such as finding an activity nearby, preparing a meal, researching a topic, etc. Data was collected through daily surveys. Users were asked to rate their experiences, such as starting a conversation with

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	the chatbot and the quality of the results, and to describe in three words what they thought made a good virtual assistant. Results: The chatbot essentially acts as an electronic butler, with its human-like behaviour eliciting social behaviour from users, which in turn helps to build trust between the chatbot and users. Interaction and visual design can influence the perception of a chatbot's trustworthiness. If a chatbot is perceived as a high-quality artefact, users are more likely to trust it. However, in order to assess quality, expectations must first be defined. According to the study, users expect a good chatbot to be powerful (technical performance), intelligent (forward-thinking, knowledgeable, accurate) and friendly. Just over half of users say they do not want to continue using the chatbot because it does not meet their expectations. For example, it is slower or less efficient than expected. Users who want to continue using the chatbot cite perceived user-friendliness as the main reason.
Conclusions for AP 2	A chatbot is trusted when it is perceived as high quality and meets user expectations. Quality can be measured by the fulfilment of expectations, which can include performance, intelligence and likeability.
Limitations	The target group for the survey was relatively young, aged between 24 and 40. The chatbot was used for everyday tasks such as finding an activity nearby, preparing a meal, researching a topic, etc., and not in connection with an emergency scenario.

Appendix: Analysed literature – Evaluation of existing chatbots

Table 25 Source: Almalki, M./ Azeez, F. (2020)

Source	
Authors	Almalki, M./ Azeez, F.
Year	2020
Title	Health Chatbots for fighting COVID-19: a scoping review
Abstract	Background: Health chatbots are rising in popularity and capability for fighting the novel SARS-CoV-2 coronavirus (COVID-19). Objectives: This study aims to review the current literature on COVID-19 related chatbots in healthcare, identify and characterize these emerging technologies and their applications for combating COVID-19, and describe related challenges. Methods: The authors conducted a scoping review of peer-reviewed literature on COVID-19, guided by the Arksey and O'Malley framework. PubMed/MEDLINE and Google Scholar were searched over a period between January and September 2020 by using the keywords „COVID* chatbot", „virtual assistant", „AI enabled platform COVID" and associated synonyms. Relevant studies' references were checked for further articles. The content of these studies was screened and thematically analyzed by the two authors. Results: Out of 543 articles initially identified, 9 were eligible for inclusion. Studies describing chatbots' development and architecture (n=6) were the most common, and only 3 empirical studies on the user experience were identified. Our scoping review identified five key applications of the current health chatbots, which were: disseminating health information and knowledge; self-triage and personal risk assessment; monitoring exposure and notifications; tracking COVID-19 symptoms and health aspects; and combating misinformation and fake news. Furthermore, these technologies can accomplish the following tasks: ask and answer questions; create health records and history of use; complete forms and generate reports; and take simple actions. Nonetheless, the use of health chatbots poses many challenges both at the level of the social system (i.e., consumers' acceptability) as well as the technical system (i.e., design and usability). Conclusion: Using health chatbots to combat COVID-19 is a practice still in its infancy. We believe that our work will help researchers in this domain gain better understanding of this novel technology's design and applications, which are needed for continuous improvement in the health chatbots' functionalities and their usefulness to fight COVID-19.
Key research question	1. How were health chatbots described in the reviewed literature on COVID-19? 2. How were these new technologies used to combat COVID-19?

Source	
	3. What challenges has the use of health chatbots raised?
Target group	-
Method	Systematic literature review on the topic of health chatbots in the fight against COVID-19
Key content	Health chatbots are used in various areas and play an important role in the fight against COVID-19. They are most commonly used in preventive care and risk communication, followed by public health monitoring by health authorities, telemedicine, occupational health and safety, and elderly care. In the literature, chatbots are described as virtual agents that enable users to interact via a computer programme based on artificial intelligence. These agents respond to user queries and provide answers based on them. Health chatbots offer a wide range of functions: they answer questions, ask specific follow-up questions (e.g. about socio-demographic or health characteristics), create and store usage histories, fill out forms, generate reports and perform simple actions by responding to user responses. In the context of COVID-19, they are primarily used in five areas of application: They disseminate health information and knowledge, serve as tools for self-triage and personal risk assessment, monitor potential exposure to the virus and issue notifications, assist in monitoring health symptoms and mental well-being related to the pandemic, and combat misinformation and fake news about COVID-19.
Conclusions for AP 2	Negative perceptions regarding the integrity, accuracy, data protection and benevolence of chatbots further impair their acceptance. On a technical level, the continuous review and updating of information poses a challenge as new data is added daily. Usage and acceptance vary greatly between target groups and are influenced by the popularity of the hosting apps that promote long-term adoption of chatbots.
Limitations	To date, there are only a few studies that deal with the user experience of health chatbots (only three so far). Particularly vulnerable population groups, such as older people, should be given greater consideration in this context. Another obstacle is the lack of interest among many consumers in using such technologies.

Table 26 Source: Dennis, A. R./ Kim, A./ Rahimi, M./ Ayabaka, S. (2020)

Source	
Authors	Dennis, A. R./ Kim, A./ Rahimi, M./ Ayabaka, S.

Source	
Year	2020
Title	User reactions to COVID-19 screening chatbots from reputable providers
Abstract	-
Key research question	Do people use high-quality chatbots if they are created by reputable organisations? How important is trust in this context?
Target group	371 participants were recruited via the Amazon Mechanical Turk platform.
Method	Experimental design
Key content	From a theoretical perspective, it can be assumed that trust in artificial intelligence chatbots is composed of the factors ability, integrity and benevolence. Trust influences the willingness to use and accept advice from chatbots. Research design: An online experiment was conducted to investigate the research question. During the experiment, participants watched a video of a text chat between an agent from the "COVID-19 Screening Hotline," who was either a human or a chatbot depending on the experimental group, and a user with mild or severe (COVID) symptoms. The dependent variables measured are the chatbot's ability, integrity, benevolence and trustworthiness. In addition, the effect of control variables is recorded. Results: The severity of symptoms influences the assessment of ability and integrity but has no effect on the perception of goodwill. The perception of the chatbot's ability is less influenced by the type of agent and more by the trust in the chatbot provider. Integrity, on the other hand, is influenced by both the type of chatbot and the trust in the provider. When evaluating goodwill, the strongest factor for the test subjects is whether the chatbot is a human or artificial intelligence. In a second step, the dependent variables persuasiveness, satisfaction, the likelihood of following the chatbot's advice, trust and future usage probability are measured. The previously dependent variables, ability, integrity and goodwill, are integrated as independent variables. The type of chatbot then has a moderate but significant effect on persuasiveness, satisfaction, the likelihood of following the advice and the likelihood of use. In contrast, these dependent variables are not influenced by the severity of the symptoms. Looking at the proxy variables for trust (ability, integrity and benevolence), the results show a strong effect of ability: how capable the chatbot is perceived to be has a significant positive effect on persuasiveness and satisfaction with the chatbot. This also significantly increases the likelihood of following the advice and the basic likelihood of use. Finally, trust in the chatbot is also significantly positively influenced by the perception of its capabilities.
Conclusions for AP 2	The perception of the chatbot's capabilities is a decisive factor in the acceptance of artificial intelligence chatbots.

Source	
Limitations	-

Table 27 Source: Miner, A. S./ Laranjo, L./ Kocaballi, A. B. (2020)

Source	
Authors	Miner, A. S./ Laranjo, L./ Kocaballi, A. B.
Year	2020
Title	Chatbots in the fight against the COVID-19 pandemic
Abstract	We are all together in a fight against the COVID-19 pandemic. Chatbots, if effectively designed and deployed, could help us by sharing up-to-date information quickly, encouraging desired health impacting behaviors, and lessening the psychological damage caused by fear and isolation. Despite this potential, the risk of amplifying misinformation and the lack of prior effectiveness research is cause for concern. Immediate collaborations between healthcare workers, companies, academics and governments are merited and may aid future pandemic preparedness efforts.
Key research question	How can a chatbot help in the fight against the coronavirus pandemic?
Target group	-
Method	Literature review
Key content	This study evaluates the use of artificial intelligence chatbots during the coronavirus pandemic – a situation that is accompanied by a particular need for information on the part of the population. The situation is exacerbated by the ongoing spread of infection and the varying progression of the disease in individual cases. Due to the risk of infection, information cannot be exchanged as usual through social networks, but is limited to individual information gathering. At the same time, healthcare facilities and medical staff are unable to provide individual advice. Against this background, the use of chatbots is a possible solution. Chatbots serve to exchange information and can make behavioural recommendations for dealing with COVID-19. Chatbots can be used to convey up-to-date information quickly. They are available at any time of day and can communicate with millions of people simultaneously in their local language. Chatbots are particularly well accepted when it comes to sensitive health issues. If chatbots are to be used to support crisis communication, certain requirements must be met: Accurate, reliable information provided by the chatbot is crucial. Information should come from credible sources.

Source	
	There is a risk that the information provided by the chatbot will not be regularly checked and updated. This could lead to risks associated with obtaining information, for example through incorrect instructions.
Conclusions for AP 2	This study assesses the use of artificial intelligence chatbots as suitable. Especially under pandemic conditions, which are accompanied by contact restrictions and changed communication behaviour, chatbots can help meet the information needs of the population and relieve the burden on medical staff. Given that health issues are a sensitive matter, there is also a preference in some cases for artificial intelligence, which allows information to be obtained in a neutral manner. If chatbots are used, the information provided must be up to date and trustworthy. Otherwise, there is a risk of spreading incorrect instructions, which could have consequences for public health.
Limitations	-

Table 28 Source: Piccolo, L. S. G./ Roberts, S./ Iosif, A./ Alani, H. (2018)

Source	
Authors	Piccolo, L. S. G./ Roberts, S./ Iosif, A./ Alani, H.
Year	2018
Title	Designing Chatbots for Crises: A Case Study Contrasting Potential and Reality
Abstract	Chatbots are becoming ubiquitous technologies, and their popularity and adoption are rapidly spreading. The potential of chatbots in engaging people with digital services is fully recognised. However, the reputation of this technology with regards to usefulness and real impact remains rather questionable. Studies that evaluate how people perceive and utilise chatbots are generally lacking. During the last Kenyan elections, we deployed a chatbot on Facebook Messenger to help people submit reports of violence and misconduct experienced in the polling stations. Even though the chatbot was visited by more than 3,000 times, there was a clear mismatch between the users' perception of the technology and its design. In this paper, we analyse the user interactions and content generated through this application, and discuss the challenges and directions for designing more effective chatbots.
Key research question	How can chatbots be effectively designed and implemented to achieve social benefits in crisis situations, and what challenges arise in the process?
Target group	Facebook users in Kenya (especially those who were potentially affected by violations at polling stations or violence during the 2017 Kenyan elections or who wanted to report relevant incidents).

Source	
Method	Experiment
Key content	An effective chatbot for crisis situations should take several aspects into account to ensure high performance and user acceptance. First, the chatbot must guide inexperienced users through the navigation and motivate them to complete all necessary steps to complete a task. In terms of functionality, care must be taken to avoid mixing languages, as this can lead to misunderstandings. Humanity and emotion also play an important role: politeness, informal language and a friendly response to the user's mood contribute to a positive experience. In a crisis context, ethics are of central importance. The chatbot should clearly disclose its identity and not attempt to pretend to be human. Users must also be informed about the protection of their privacy and how their data will be handled. Accessibility should go beyond traditional aspects and also take into account technical factors such as bandwidth, network availability, device compatibility and features such as voice control. Challenges Less than 2% of users were able to successfully complete a report, indicating design problems and a discrepancy between user expectations and actual functionality. It is recommended that interaction processes be made clearer and that graphical and text-based elements be combined in a targeted manner. Especially in crisis situations, chatbots must be robust, reliable and context-sensitive in order to effectively engage both first-time and regular users.
Conclusions for AP 2	The chatbot should be designed to guide users, especially first-time users, clearly and step by step through the interaction, maintaining a balance between conversational and graphical elements. Instructions should be simplified, unnecessary typing feedback removed (visual indication that the chatbot is preparing information when it is actually just waiting for user input) and every action checked for efficiency and user-friendliness to ensure a fast, reliable and pleasant experience for users.
Limitations	The study only examined one situation as part of a short pilot project in a crisis context.

Table 29 Source: Tsai, M.-H./ Chen, J.Y./ Kang, S.-C. (2019)

Source	
Authors	Tsai, M.-H./ Chen, J.Y./ Kang, S.-C.
Year	2019

Source	
Title	Ask Diana: A Keyword-Based Chatbot System for Water-Related Disaster Management
Abstract	This research developed a keyword-based chatbot system, Ask Diana, for water-related disaster management. Disaster management has been considered difficult and tedious due to the complex characteristics of disaster-related data. To deal with this problem, this research developed a chatbot system with a water-related disaster database, a user intent mechanism, and an intuitive mobile-device-based user interface. With such a system, users are able to access important data or information they need for decision making by directly asking the proposed chatbot or operating the image-based menus. The system was validated through a usability test and a six-month field test. The results demonstrated that Ask Diana can help related personnel access disaster data intuitively and develop corresponding response strategies efficiently.
Key research question	How can a chatbot system effectively help with data management and decision-making in disaster situations?
Target group	People in relevant authorities during (flood) disasters in Taiwan
Method	Testing of five tasks via the chatbot, followed by an evaluation of how well this worked
Key content	As part of this study, the chatbot system "Ask Diana" is being developed to provide decision-makers with a simple and efficient way to access relevant disaster data. The keyword-based chatbot can provide support in all phases of water-related disaster management and efficiently relieve staff. When developing Ask Diana, care was taken to ensure that the chatbot contains sufficient data to provide answers to questions in the event of a disaster. The system must have a mechanism that recognises and analyses the user's intention in order to understand what information they want. This is done by assigning keywords. The user interface must also be user-friendly and intuitive, and no separate introduction is required. Questions can be asked via an input field or by clicking on suggested topics. The name "Ask Diana" should sound elegant and have a calm and positive vibe. The word "Ask" is meant to show users that they can ask anything they want to know about the disaster. With the help of "Ask Diana", users can access the information they need by entering keywords without having to search through different sources. This automated provision of information in real time can reduce response times in disaster management. In this study, "Ask Diana" is undergoing a usability test and a six-month field test to check the chatbot's suitability for five tasks, with the time required and the success rate being the decisive criteria. The usability test shows that most tasks are completed successfully and that the test subjects rate the system as user-friendly. In the field trial, the high usage rate of the

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	system by decision-makers is documented, especially in critical disaster phases. However, the chatbot "Ask Diana" has a few limitations: First, time-consuming system maintenance needs to be considered. The keyword table should be constantly reviewed and checked. Second, entering long texts or natural language is a challenge for the system. This is where the keyword-based chatbot has some shortcomings.
Conclusions for AP 2	With the help of chatbots that work, for example, with a keyword system, information can be provided automatically in real time in emergency situations without having to search through different sources. This can significantly reduce response times in disaster management.
Limitations	-

Table 30 Source: Walwema, J. (2021)

Source	
Author	Walwema, J.
Year	2021
Title	The WHO Health Alert: Communicating a Global Pandemic with WhatsApp
Abstract	Upon declaring COVID-19 a global pandemic, the World Health Organization (WHO) orchestrated a global risk-communication outreach. The WHO's objective was to persuade the public to upend and alter their lives so as to contain the disease and minimize its spread and infection. The WHO found a simple and efficient medium to communicate glocally through the social media application WhatsApp, through which individuals could access information without gatekeeping by governments and local agencies.
Key research question	To what extent can a chatbot implemented on WhatsApp support crisis communication during the coronavirus pandemic?
Target group	-
Method	Analysis of a WhatsApp chatbot
Key content	In the event of a risk, effective communication plays a key role, especially in informing the population about potential risks. For communication to be successful, it is essential that experts and the population exchange information, as this is the only way to create a common basis for understanding risks. The chatbot examined in this study was implemented on WhatsApp by the World Health Organisation (WHO) in response to the coronavirus

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	pandemic. It uses emojis to illustrate its content and make it easy to understand. The chatbot also generates content and visual cues related to COVID-19 to provide users with accurate and relevant information. A significant advantage of this chatbot is that, unlike human communication channels, it is able to inform millions of users simultaneously in their own language, thus achieving an enormous reach. In crisis situations, people tend to avoid platforms created by authorities at short notice and prefer to use familiar platforms. Implementing a chatbot like this on WhatsApp therefore seems appropriate. Availability in multiple languages is important to reach a wider target group and ensure access to important information for the entire population. The chatbot uses a predefined menu designed with emojis and topic categories. Users can access linked information by selecting a topic or emoji. For each topic, the chatbot provides clear instructions, supplemented by emojis or illustrated with videos. The aim of the platform is to make content informal and dialogue-oriented. This can have a positive impact on the population's absorption and understanding of information. Emojis play a crucial role in this: they improve the readability of messages and help the message stick in people's minds for longer. They also help to avoid ambiguity and provide unambiguous information. In addition, emojis can help build trust, especially when there is no direct personal interaction.
Conclusions for AP 2	The WhatsApp chatbot is proving to be particularly suitable for use in a pandemic because it uses a familiar and widely used platform that many people already use in their everyday lives. This lowers the barrier to use, as the public is more willing to access information via a platform they are already familiar with. The chatbot enables important information to be disseminated quickly and easily, as it is directly accessible on users' mobile devices. In addition, the chatbot can be offered in several languages, which increases its accessibility for diverse population groups. Thanks to the integration of emojis and visual media such as videos, information is conveyed in an easily understandable and appealing way, which is particularly important in times of crisis.
Limitations	-

Appendix: Analysed literature – Risk and crisis communication

Table 31 Source: Boné, J./ Ferreira, J.C./ Ribeiro, R./ Cadete, G. (2020)

Source	
Authors	Boné, J./ Ferreira, J.C./ Ribeiro, R./ Cadete, G.
Year	2020
Title	DisBot: A Portuguese Disaster Support Dynamic Knowledge Chatbot
Abstract	This paper presents DisBot, the first Portuguese speaking chatbot that uses social media retrieved knowledge to support citizens and first-responders in disaster scenarios, in order to improve community resilience and decision-making. It was developed and tested using Design Science Research Methodology (DSRM), being progressively matured with field specialists through several design and development iterations. DisBot uses a state-of-the-art Dual Intent Entity Transformer (DIET) architecture to classify user intents, and makes use of several dialogue policies for managing user conversations, as well as storing relevant information to be used in further dialogue turns. To generate responses, it uses real-world safety knowledge, and infers a dynamic knowledge graph that is dynamically updated in real-time by a disaster-related knowledge extraction tool, presented in previous works. Through its development iterations, DisBot has been validated by field specialists, who have considered it to be a valuable asset in disaster management.
Key research question	To what extent can the chatbot DisBot, developed in Portugal, provide support in the event of a disaster?
Target group	-
Method	Systematic literature review, Design Science Research Methodology (DSRM) for the development of the chatbot
Key content	The literature on chatbots in emergency situations is still limited, even though chatbots have great potential for providing support in time-critical situations. This study conducts a systematic literature review on the topic of chatbots in disaster control. Only three papers are considered relevant by the authors, which illustrates that research on chatbots in disaster control is limited and there is a need for further investigation. The selected papers and associated chatbots are systematically classified according to the type of disaster, the type of knowledge, language comprehension, navigation and the chatbot's responses, as is the DisBot developed in connection with this study. The findings from the existing scientific publications will be used to (further) develop the Portuguese DisBot. The three comparative studies focus on the scenario of a flood or drought. In contrast, the DisBot will take other types of disasters into account. The DisBot is being developed according to the Design Science Research Methodology (DSRM) and is subject to an iterative process. An important

Source	
	step in this process is to record the expectations of target persons or potential users. In the course of this, input from three civil protection experts will be considered in the development of the chatbot. The following criteria, among others, will be used to evaluate the chatbot: efficiency, usefulness, comprehensibility, level of detail and learning ability. After the chatbot has been developed, it will be presented to civil protection experts and a scenario will be developed in which an earthquake occurs in Lisbon, causing explosions and fires. Following the iterative process, which aims to optimise the DisBot, implementation options will be discussed. The preferred proposal is to integrate the chatbot into an existing local app (in Portugal). Implementation in less developed regions should be supported. The chatbot is ultimately deemed suitable by the experts and can also be considered for various types of disasters.
Conclusions for AP 2	The application of DSRM and, in particular, the exchange with (local) civil protection experts can help prepare a chatbot for real-life scenarios. The input of experts regarding the expectations of an emergency chatbot and the design of content for different scenarios is essential in this regard.
Limitations	The study is limited by the small number of participants in the evaluation, a simulated test scenario and the lack of long-term studies, which could affect its generalisability and practical applicability. In addition, comprehensive quantitative validation and greater involvement of potential users are lacking.

Table 32 Source: Chandra, A./ Chakraborty, A. (2024)

Source	
Authors	Chandra, A./ Chakraborty, A.
Year	2024
Title	Exploring the role of large language models in radiation emergency response
Abstract	In recent times, the field of artificial intelligence (AI) has been transformed by the introduction of large language models (LLMs). These models, popularized by OpenAI's GPT-3, have demonstrated the emergent capabilities of AI in comprehending and producing text resembling human language, which has helped them transform several industries. But its role has yet to be explored in the nuclear industry, specifically in managing radiation emergencies. The present work explores LLMs' contextual awareness, natural language interaction, and their capacity to comprehend diverse queries in a radiation emergency response setting. In this study we identify different user types and their specific LLM use-cases in radiation emergencies. Their possible interactions with ChatGPT, a popular LLM, has

Source	
	also been simulated and preliminary results are presented. Drawing on the insights gained from this exercise and to address concerns of reliability and misinformation, this study advocates for expert guided and domain-specific LLMs trained on radiation safety protocols and historical data. This study aims to guide radiation emergency management practitioners and decision-makers in effectively incorporating LLMs into their decision support framework.
Key research question	Who are the potential users of large language models (LLMs) in radiological emergencies and how would they be used? What are the risks and challenges for the use of LLMs in radiological emergencies?
Target group	-
Method	-
Key content	Large language models (LLMs) could be of great importance in radiological emergencies in the future, as the population has an increased need for information in these situations, which cannot be fully met by the responsible authorities. There are several fundamental challenges in the context of radiological emergency management. On the one hand, there is a high number of enquiries in a very short time, combined with a feeling of fear and uncertainty among users. On the other hand, there are a multitude of possible nuclear scenarios and potentially affected persons with different needs. Some tools are already being used in emergency management. However, there is an unmet need for a tool for "non-experts" and citizens. This study analyses a solution to these challenges using an LLM tool, for which an analysis of traditional and existing tools is carried out. Large language models (LLM) can take the form of chatbots or so-called "smart assistants". For the development of an LLM tool for use in radiological emergencies, potential users are first identified: these could be first responders and incident commanders, for example. Use by doctors is also conceivable. The analysis for these groups of people is not carried out below. Based on the research interests of the literature review in AP1, the focus will be on "concerned citizens" and "crisis victims." People affected by crises usually have questions about symptoms or treatment options. Concerned citizens have an increased need for information about the radiological emergency in general, as well as possible recommendations for behaviour and dangers. After identifying potential users and their needs, this study examines suitability in different phases of the emergency. The possible uses by the selected target persons are examined. Due to the research interest in AP1, only the urgency phase will be considered in the following. The so-called urgency phase begins with the accident and ends when the radioactive substances no longer pose a danger. It can last from a few hours to several

Source	
	days. This phase is characterised by a high degree of uncertainty among the population. An LLM can help in this phase by providing the population with answers to their fears and concerns. An LLM, for example in the form of a chatbot, can communicate protective measures to citizens and provide information about the radiological accident. This potential application is examined in a second step of this study using a simulation of a radiological emergency scenario. The underlying scenario is used by the International Atomic Energy Agency (IAEA). In the course of this, ChatGPT is to act as a chatbot in the emergency scenario, once without "priming" and once with "priming" for a radiological emergency. In the variant in which ChatGPT is provided with priming, the model is equipped with content on radiological emergencies. Use with affected persons The differences between the model with priming and without priming relate to the identification of symptoms: when symptoms are described by users, the primed chatbot can classify the symptoms against the background of the radiological emergency. The chatbot without priming, on the other hand, cannot specify the symptoms. The comparative test of the chatbots shows that the model without priming is unable to classify the symptoms, concerns and questions of the users sufficiently, as it lacks background information on radiological emergencies. The symptoms described are not associated with radiation exposure, whereas the primed model can identify them as such, provide information and give individual recommendations for action. Use with "concerned" citizens To compare the chatbots in use for citizens, a scenario is presented in which a woman observes the radiological accident from her home, describes the situation to the chatbot and has questions about safety and protective measures. Both chatbots then provide correct instructions on how to behave and refer to possible sources of information. At the request of the system administrator, both create a press release on the situation that is equally informative.
Conclusions for AP 2	Large language models, in the form of chatbots or voice assistants, are suitable as decision support tools in radiological emergencies. Chatbots are particularly suitable for communicating with concerned citizens and people affected by radiological accidents. However, it should be noted that non-predefined systems or chatbots can produce untrained responses that have consequences and, in some cases, endanger the health of citizens. It can therefore be concluded that it is generally helpful to train an LLM for use in radiological emergencies with answers and to incorporate continuous checks.
Limitations	-

Table 33 Source: Gauntlett, L./ Amlôt, R./ Rubin, G.J. (2019)

Source	
Authors	Gauntlett, L./ Amlôt, R./ Rubin, G.J.
Year	2019
Title	How to inform the public about protective actions in a nuclear or radiological incident: a systematic review
Abstract	Studying how the public behaves after a nuclear emergency will help to assess overall morbidity and mortality. Pre-event education might help to shape behaviour, but how best to engage people with emergency communications for low likelihood, high-impact events is unknown. We did a systematic review to identify factors that predict behaviour in preparation for a nuclear incident, factors that predict behaviour in the immediate aftermath of a nuclear incident, and preferences among members of the public for information designed to educate them about which actions to take in the event of a nuclear incident. In general preparedness, behaviour was predicted by factors including perceived coping effectiveness and having children, among others, but absence of preparedness was attributed to fatalistic attitudes. Importantly, for pre-incident communications to be accepted and recommendations adhered to, the source had to be trusted and perceived to be credible. However, it is notable that family needs, such as picking up children from school, were a stronger predictor of behaviour in a nuclear emergency than communicated directives from authorities. If pre-incident education about nuclear incidents is to be used, several factors—including the source and method of communication, the content, and format of messaging—might increase public engagement with messages and promote the uptake of protective behaviours in a radiation event.
Key research question	What factors influence the behaviour of the population in preparing for a possible radiological emergency? What factors influence behaviour immediately after a radiological accident? What communication would be accepted by the population in a radiological emergency?
Target group	-
Method	Systematic literature review of 31 studies on the topic of radiological emergencies
Key content	Emergency communication and the reactions of the population are crucial for the course of a disaster and the potential number of people affected. These scenarios are often characterised by panic and a lack of knowledge. There is little literature available on public communication in radiological emergencies. In order to conclude how good emergency communication can work, it is important to consider the phase before and after the accident.

Source	
	This study uses a literature review to examine factors that influence behaviour before and after a radiological emergency, as well as preferred sources of information during an emergency. The majority of the selected studies use a quantitative approach, with qualitative or mixed-mode approaches being less common. More than half of the studies were conducted with the US or Canadian population. About half of the studies focus on real emergency scenarios, while the other half work with hypothetical emergency scenarios. Predictors of behaviour before a radiological emergency: Behaviour before a radiological emergency depends on how a person assesses the likelihood of being affected by such an event. In addition, the perceived ability to cope with such a situation and the level of concern can influence information behaviour before a radiological emergency. With regard to sociodemographic factors, the current state of research shows that older age, living in rural areas and higher education are predictors of behaviour before a radiological emergency. Predictors of behaviour after a radiological emergency: Behaviour after a radiological emergency is measured by whether people evacuate or follow protective measures. The fear of being contaminated leads to an increased need for information. The decision to evacuate, on the other hand, is influenced by communicated instructions and fear of consequential damage. Factors such as age, household size and the presence of children also influence the decision to evacuate. Families with small children tend to evacuate more readily. Non-compliance with protective measures can mostly be explained by concern for relatives or a lack of trust in the authorities, as well as a lack of information. Preferences for information: During a radiological emergency, information via local and national media, such as television or radio, as well as via the internet, is preferred. Study results also indicate that information communicated by experts and local authorities, and ultimately also by emergency broadcast systems, is accepted. Other studies show that friends and family are the preferred source of information, as are first responders. Social media is less popular as a source in emergency situations. Influence of trust on behaviour: Trustworthy sources can influence behaviour during a radiological emergency: scientists and recognised experts are considered credible. In addition, local authorities and institutions enjoy more trust than the nuclear industry. Consistency of information between different sources strengthens credibility, whereas conflicting information can increase uncertainty. Information that is perceived as too technical or alarming tends to be less accepted.
Conclusions for AP 2	If information during a radiological emergency comes from trustworthy sources or experts, this can significantly influence the behaviour of the population. A local connection to the source of information also makes it possible to assess the impact and personal consequences for the recipients

Source	
	of the information. Information should be tailored specifically to the target group concerned.
Limitations	A limitation of this study is the lack of information on actual observed behaviour, as it mainly covers studies on hypothetical scenarios. Some selected sources have methodological shortcomings.

Table 34 Source: Gruß, M. (2024)

Source	
Authors	Gruß, M.
Year	2024
Title	Wir müssen reden! – Hilft ein Chatbot im radiologischen Notfall?
Abstract	In a radiological emergency, the public's need for information is particularly high. Citizens seek information about the current situation and direct their questions to relevant authorities, such as the Federal Office for Radiation Protection (BfS). The volume of inquiries would pose challenges for the BfS in a crisis scenario. Automated responses through a chatbot can support crisis communication and meet the public's information needs. The development and use of a chatbot for crisis communication present both opportunities and challenges, as outlined in this article.
Key research question	Can a chatbot be a support in radiological emergency communication?
Target group	-
Method	-
Key content	This source evaluates whether and to what extent an artificial intelligence-based chatbot can provide support in a radiological emergency situation. Given that existing channels for obtaining information would reach their limits in a radiological emergency, an automated response system in the form of a chatbot could be a possible tool for emergency communication. An artificial intelligence-based chatbot would therefore have the advantage that information would be available at any time and could be communicated across the board. The increased and successful use of chatbots is already evident in health communication and has also been tested during the COVID-19 pandemic. This study assumes that a chatbot must meet certain requirements in order to be accepted and used by the population: Firstly, it should be trustworthy, which may be related to its (communication) skills or its handling of data protection. Furthermore, it should communicate without prejudice and act as a neutral conversation partner. The perceived interaction with a chatbot is also positively influenced if it treats users with

Source	
	warmth and empathy, thereby imitating characteristics of human communication. As a dialogue format, a chatbot should be able to successfully handle user requests. However, if it gives incorrect answers or misunderstands the user, this can have a negative impact on the perceived competence of the chatbot. Finally, the chatbot should be self-explanatory for all user groups. The chatbot should be sensitive to emergency situations and the associated needs of users. If the chatbot is to be used to convey information on complex issues such as radiation protection, the information entered into the chatbot is extremely important in order to prevent potential misunderstandings or ambiguities. In the event of a constantly evolving emergency situation, the information must be continuously checked to ensure that it is up to date and correct. The use of a rule-based system, as opposed to a generative system, can further prevent the transmission of incorrect information by limiting the chatbot to a predefined set of validated question-answer pairs. To strengthen user confidence in the chatbot and the information communicated, a (trustworthy) source should also be provided. The protection of sensitive or personal data must always be ensured.
Conclusions for AP 2	If a chatbot can be developed that meets the above requirements, overcomes the challenges and, in addition to providing information, acts as an empathetic dialogue partner, it can certainly be an asset to citizen communication in a (radiological) emergency situation.
Limitations	-

Table 35 Source: Hofeditz, L./ Mirbabaie, M./ Erle, L./ Knoßalla, E./ Timm, L. (2022)

Source	
Authors	Hofeditz, L./ Mirbabaie, M./ Erle, L./ Knoßalla, E./ Timm, L.
Year	2022
Title	Automating Crisis Communication in Public Institutions – Towards Ethical Conversational Agents That Support Trust Management
Abstract	To improve disaster relief and crisis communication, public institutions (PIs) such as administrations rely on automation and technology. As one example, the use of conversational agents (CAs) has increased. To ensure that information and advisories are taken up seriously, it is important for PIs to be perceived as a trusted source and a trustworthy point of contact. In this study, we therefore examine how CAs can be applied by PIs to, on the one hand, automate their crisis communication and, on the other hand, maintain or even increase their perceived trustworthiness. We developed two CAs – one equipped with ethical cues in order to be perceived more trustworthy and one without such cues – and started to conduct an online experiment to evaluate the effects. Our first results indicate that applying

Source	
	ethical principles such as fairness, transparency, security and accountability have a positive effect on the perceived trustworthiness of the CA.
Key research question	Which characteristics of a conversation agent (chatbot) contribute to perceived trustworthiness in crisis situations? How can ethical principles be applied to conversation agents to increase the trustworthiness of public institutions in times of crisis?
Target group	Online population in Germany, online communities via email and social media, recruited at random.
Method	Experimental design
Key content	Study design: This study uses a 2x1 online experiment to investigate the influence of ethical principles on trustworthiness. The experimental groups differ in that two prototypes of chatbots are developed: one is a neutral chatbot that is not equipped with ethical guidelines; the other is a chatbot that is equipped with ethical guidelines on fairness, transparency, security and accountability. Study results: The results suggest that taking into account the ethical principles of fairness, transparency, security and accountability has a significant positive influence on the perceived trustworthiness of chatbots. The strongest effect comes from the factor of security and data protection, followed by transparency and fairness. In contrast, no significant effect can be confirmed for respect for human autonomy, suggesting that a dominant language appears more trustworthy in chatbots. It remains unclear to what extent the design of the references to ethical principles can have different effects.
Conclusions for AP 2	When chatbots are used in crisis situations, equipping them with social or ethical information can lead to them being perceived as more trustworthy.
Limitations	-

Table 36 Source: International Radiation Protection Association (IRPA) (2023)

Source	
Authors	International Radiation Protection Association (IRPA)
Year	2023
Title	Practical guidance for engagement with the public on radiation and risk
Abstract	Public understanding, trust and consent are absolutely central to implementing effective and proportionate radiation protection. Without this we, as radiation protection professionals, will not fully achieve our aim of adequately protecting the public without unduly limiting the safe use of medical, scientific and industrial radiological practices for the benefit of

Source	
	mankind. IRPA strongly believes that all radiation protection professionals and radiation protection societies ('Associate Societies') have a duty to engage with the public, to play our part in helping to address and alleviate concerns, and to ensure that solutions put forward really do take account of the issues, perceptions and concerns of all interested parties. This can only be achieved by approaches based on active listening and engagement, developing empathy, transparency and building trust. The objective of this guidance document is two-fold. Firstly, it is to enthuse all radiation protection professionals to become more active public advocates for radiation protection. Secondly, it is to provide information, experiences and techniques to help all of us in our profession to become more effective and comfortable in this challenging task.
Key research question	How can information, experience and techniques help to make risk communication more effective and safer, and how should interaction be structured and communication conveyed?
Target group	Population/public
Method	Guidelines
Key content	This source is a guide designed to encourage radiation protection professionals to become more involved in public outreach on radiation protection and to provide information, techniques and experience to help them accomplish this task. The handbook emphasises that public understanding and trust are central to the implementation of effective and appropriate radiation protection. To achieve this, communication preparation, clear and precise messages, empathy and active listening are essential. The communication and engagement strategy should therefore take into account the objectives, messages and target groups. Strategies must be defined and implementation plans developed to protect the population adequately, with the practices implemented having a strong influence on the effectiveness of communication strategies. Emergency situations in particular require crisis communication, which focuses on explanations and persuasion with a view to taking the necessary swift action. It should not be forgotten that extreme situations can cause great fear and concern among the population, and stress levels will be high. This makes it even more important to recognise emotions and acknowledge feelings, to convey empathy, which can be achieved through an approach based on mutual dialogue, active listening, transparency, empathy and, ultimately, the development of trust and respect between the parties. Solutions are therefore not necessarily based exclusively on scientific findings; understanding emotions is just as important. This is because the perception of risk also influences how information is perceived, and risk perception varies from person to person. In general, however, clear and precise messages should always be used in risk communication, whereby the 27-9-3 rule can also be used as a guideline, which states that information should comprise a maximum of 27 words, take no longer than 9 seconds to read and discuss no more than 3 points. It is also important in risk

Source	
	communication to avoid technical terminology, acronyms and alarming phrases, even if different target groups require different approaches depending on their social context. It is also important in risk communication to make it clear what is to be achieved. No assumptions or promises should be made that cannot be kept. This makes it all the more important that communication is transparent and fast and that information is always kept up to date. Ultimately, crisis communication should help to encourage people to behave in a certain way. Inconsistent and contradictory information must therefore be avoided at all costs.
Conclusions for AP 2	Effective crisis communication requires trust between the sender and recipient of information. To gain and maintain this trust, clear and precise messages that are always up to date, empathy, and active listening are essential. It is important to be transparent and not to spread false assumptions or make promises. Inconsistent and contradictory information must therefore be avoided at all costs.
Limitations	-

Table 37 Source: Karl, I./ Rother, K./ Nestler, S. (2015)

Source	
Authors	Karl, I./ Rother, K./ Nestler, S.
Year	2015
Title	Crisis-Related Apps: Assistance for Critical and Emergency Situations
Abstract	In this paper the authors developed applications for apps in times of crises and critical situations. They analyzed how people act in these situations and how to mitigate their uncertainty and fears through situation-specific communication. Including these aspects as well as the general challenges of crisis communication, pros and cons of apps based on existing examples were discussed. The resulting requirements for an app for crises and dangerous situations should assist in designing a communication solution that strengthens the feeling of security of citizens in critical times, such as life-threatening situations. This solution is intended as an additional means of communication for emergency services to modernize crisis communication with affected people.
Key research question	What factors are crucial for designing an effective communication app for citizens in crisis situations?
Target group	-
Method	A literature review and analysis of existing crisis apps was conducted and, based on this, a concept for crisis apps was developed.

Source	
Key content	State of research Emergency situations are characterised by feelings of fear and uncertainty, which can affect human behaviour. As a result, the demands placed on communication also change. Distinguishing between the different phases of a crisis allows for a more nuanced view of human behaviour. In the period before a crisis, the population has little need for specific information. In this phase, it is important to build trust in information sources. When a crisis occurs, those affected find it difficult to control their emotions and their ability to take in information decreases, as does their attention span. During this phase, information must be fast, transparent and targeted. Once the crisis is over, there is an increased need for communication. People want to reflect on what they have experienced. Looking at the various communication channels, there are advantages and disadvantages. Communication via traditional media such as television or radio is less able to meet personal needs in a crisis situation. Social media offer those affected opportunities for exchange. However, information available on these channels is not verified by the relevant authorities. Emerging research on crisis communication is focusing on the use of crisis apps as an additional communication channel. Analysis of existing crisis apps to assess their potential Existing apps for use in a crisis have a wide range of functions. Some apps fulfil a warning function by alerting those affected in real time. Push notifications can be sent based on location. Filter functions can be integrated so that users can prioritise information according to location, relevance or hazard category. Other apps, on the other hand, can be used for alarms and calls for help when users find themselves in an emergency situation or have had an accident. The app makes it possible to locate people. First aid apps are one example of existing apps that provide behavioural instructions. Developed apps offer step-by-step instructions on first aid measures in emergencies and support users in acting autonomously in stressful situations. Suitability of crisis apps for emergency communication This study highlights the strengths of the crisis apps mentioned. On the one hand, apps enable information to be transmitted quickly and without delay, which distinguishes them from traditional communication channels. Crisis apps also provide easy access to information. Another advantage of crisis-apps is the possibility of location-based information: information is personalised for the user's location. They also empower users by providing them with instructions and stored emergency information. However, crisis apps also have disadvantages compared to traditional communication channels. On the one hand, these include technical limitations due to dependence on GPS accuracy or lack of an internet connection. On the other hand, there are limitations due to insufficient access for people who do not use the internet or a smartphone. A large

Source	
	number of specialised apps can also lead to uncertainty when choosing the right app for a specific situation.
Conclusions for AP 2	Crisis apps can provide support in emergencies as they have several advantages over traditional communication channels. If they are to be used in the future, it should be noted that it makes sense to pre-install such apps so that users can access them immediately in a crisis situation. Crisis apps should also have intuitive navigation. Feedback from users can strengthen trust in the apps.
Limitations	The results are based purely on a theoretical analysis of existing apps, without evaluation by users or testing in real crisis situations.

Table 38 Source: Peña-Cáceres, O./ Tavara-Ramos, A./ Correa-Calle, T./ More-More, M. (2024)

Source	
Authors	Peña-Cáceres, O./ Tavara-Ramos, A./ Correa-Calle, T./ More-More, M.
Year	2024
Title	WhatsApp-based cloud service chatbot application for emergencies or disasters
Abstract	Climate change and its effects have led to the presence of disruptive and dynamic climate events. Piura is geographically the most affected region of Peru by the El Niño phenomenon. The limited technological means of communication between the local authority and the community have generated decisions that are not very acceptable to the population. The purpose of the study was to develop a Chatbot focused on WhatsApp, ManyChat, and Google Sheets services to facilitate the referral and consultation of relevant information in emergency or disaster situations considering the particularities and limitations of the population of Piura, Peru. To achieve this objective, the following phrases were proposed: (1) defining and establishing the types of conversations using a logical, intuitive, and friendly approach; (2) designing and implementing the specific functionalities required by users to send and consult information through the WhatsApp platform service; and 3) evaluating and refining the Chatbot in terms of its effectiveness and acceptance during emergency or disaster situations. The results highlight the solution as a digital alternative that improves communication and coordination during emergency or disaster in Piura. The Chatbot optimizes incident management and provides efficient responses to users with acceptable levels of satisfaction.
Key research question	How can a chatbot provide support in communication during (natural) disasters? And how should it be designed?
Target group	People living in Piura or Castilla (Peru)

Source	
Method	Quantitative survey of two groups
Key content	State of research Chatbots in disaster situations must meet certain requirements. For one thing, they must consider the individual needs of those affected. A friendly appearance can also have a positive effect on the user experience. The chatbot should also ensure easy access and communicate in an understandable way. The chatbot examined in this study links the ManyChat system with Google Sheets as a database and uses WhatsApp as a platform for interaction. The chatbot is evaluated by two groups. One group is not affected by a disaster, while the other group is presented with a simulated disaster scenario. The test subjects are asked about the chatbot's responses and language in a quantitative survey. In addition, the clarity and accessibility as well as the overall satisfaction with the use of the chatbot are recorded. Results In the group of respondents who are not affected by a disaster scenario, approximately 29% express satisfaction with the chatbot. Around 28% also appreciate the user-friendliness of the chatbot and 22% appreciate the accuracy of the information. In the second group, which is confronted with a simulated emergency, satisfaction with the chatbot is 27%. The accuracy of the information is rated lowest (21%), which may be due to the fact that the chatbot can only provide information on local emergencies with a delay. Overall, there are no significant differences between people in a peaceful situation and those in a (simulated) emergency situation.
Conclusions for AP 2	The WhatsApp chatbot can be an effective tool for supporting communication and coordination in emergencies. It offers the population a way to quickly obtain information and report emergencies. Accessibility is an advantage here, as WhatsApp has a large number of users who use the messenger on a daily basis. Communication on an everyday platform can create normality and maintain structures in emergency situations. It is possible to link the platform to other services or websites. However, successful use of the chatbot depends on the linked database being continuously updated.
Limitations	-

Table 39 Source: Pölzl-Viol, C. (2022)

Source	
Authors	Pölzl-Viol, C.
Year	2022
Title	Besonderheiten der Risiko- und Krisenkommunikation im Strahlenschutz und radiologischen Notfallschutz
Abstract	-
Key research question	To what extent can risk and crisis communication be considered separately in terms of time and subject matter? To what extent is successful risk communication in advance important for good crisis communication?
Target group	-
Method	-
Key content	Crisis communication in the field of radiology is a complex matter. The aim of crisis communication is to ensure the physical safety of the population by communicating clear behavioural and protective measures. At the same time, psychosocial effects should be minimised and people's mental health should be taken into account. To achieve these goals, it is crucial to acknowledge the fears and concerns of the population, provide easily understandable and accessible information, alleviate fears and prevent the spread of misinformation. Effective crisis communication is characterised by up-to-date and clear information communicated in understandable language. It must be tailored to the needs of the population and offer an empathetic approach. A fundamental prerequisite for this is that citizens trust the responsible authorities and communication channels. Radiological emergencies go through different phases, each of which requires specific communication approaches. In the emergency phase, feelings of fear and stress predominate, which is why complex information is less in demand at this stage. Instead, there is a need for a general assessment of the crisis. People are concerned about their own safety and that of their loved ones and want clarity on how they can be protected. In this phase, the responsible authorities should assign clear responsibilities and provide the population with action-oriented instructions. In the post-accident phase, however, the public is more receptive to detailed information and figures. In this phase, dialogue-oriented communication approaches are particularly effective in meeting the need for information and further strengthening trust. In contrast to crisis communication, which takes place during an emergency, risk communication deals with preparing for a potential crisis and takes place during calmer times. It serves to promote transparency, build trust and impart knowledge that can be used in the event of a crisis.

Source	
	In addition, risk communication helps to clarify responsibilities and establish communication channels that can be used in an emergency.
Conclusions for AP 2	The design of a chatbot for use in emergency situations should be based on the findings of emergency communication, which distinguishes between the urgency phase and the post-accident phase. Each phase brings with it specific needs of the population that must be taken into account in the design. If the chatbot is used in the urgency phase, it is important to bear in mind that the population is in a state of stress. In this situation, there is little interest in complex information, figures and facts. Instead, the focus is on protecting one's own health and the safety of loved ones. There is also a need for the crisis to be handled professionally and effectively. In this phase, personal relationships and empathetic communication are particularly important. The chatbot should provide information in simple and understandable language while conveying the feeling that users' concerns are being taken seriously.
Limitations	-

Table 40 Source: Rodsawang, C./ Thongkliang, P./ Intawong, T./ Sonong, A./ Thitiwatthana, Y./ Chottanapund, S. (2020)

Source	
Authors	Rodsawang, C./ Thongkliang, P./ Intawong, T./ Sonong, A./ Thitiwatthana, Y./ Chottanapund, S.
Year	2020
Title	Designing a competent chatbot to counter the COVID-19 pandemic and empower risk communication in an emergency response system
Abstract	Risk communication is incorporated into an emergency response system. In Thailand, the Department of Disease Control (DDC) manages emergencies through the Emergency Operation Center (EOC). As a part of the EOC, the risk communication unit provides a hotline service that delivers information to and receives complaints and concerns from the general public. During the Coronavirus Disease 2019 (COVID-19) pandemic, a chatbot, which is a type of artificial intelligence (AI) was used to support the hotline service. This paper focuses on how to design an informative chatbot for the COVID-19 pandemic period that disseminates information to the general public. The chatbot, named „COVID-19 Preventable“, was created based on the Design Science Research Methodology (DSRM) under two cycles of design and development. At the early stage of development, information from reliable sources was transformed into a question and answer system and imported to natural language processing in the Dialogflow on Google Cloud. The chatbot was the first official chatbot to

Source	
	communicate on COVID-19 on behalf of public health authorities. It consists of seven prompt features, namely, a situation report, how to protect yourself from COVID-19, fake news, self-screening for COVID-19, a list of nearest hospitals, the hotline number to call, and report notification. The uniquely informative and dynamic chatbot is likely to be an alternative channel for disseminating timely information on COVID-19.
Key research question	To what extent does an FAQ chatbot support the hotline service of a health authority?
Target group	Testing: Employees of the Thai health authority
Method	Development of a chatbot and testing of the chatbot
Key content	In this study, a chatbot called "COVID-19 Preventable" is being developed using the Design Science Research Methodology. It is intended for use during the coronavirus pandemic. A total of 262 pre-programmed questions relating to general knowledge and protective measures against COVID-19 are being added to the chatbot's database. The subsequent survey on the use of the chatbot shows positive feedback: 64% of respondents find the chatbot's answers appropriate and 98% say they would continue to use the chatbot. In addition, 96% of respondents say they would recommend the chatbot to others. The rapid availability of information and navigation were also highlighted as positive features. Data security and data protection were guaranteed, as no personal data was collected from users. The chatbot developed therefore proves to be a suitable support for the hotline service and can thus make a decisive contribution to relieving the burden on the healthcare sector.
Conclusions for AP 2	A chatbot should be informative, dynamic and user-friendly in order to provide effective support in crisis situations. Continuous, even daily, updates of the content ensure that information is up to date and trustworthy. The user interface should also be mobile and desktop friendly. To ensure data protection and security, no personal data should be requested. Regular updates ensure the long-term functionality and relevance of the chatbot.
Limitations	-

Table 41 Source: Tsai, M.-H./ Chan, H.-Y./ Chan, L.-Y./ Shen, H.-K./ Lin, P.-Y./ Hsu, C.-W. (2021)

Source	
Authors	Tsai, M.-H./ Chan, H.-Y./ Chan, L.-Y./ Shen, H.-K./ Lin, P.-Y./ Hsu, C.-W.
Year	2021

Source	
Title	A Chatbot System to Support Mine Safety Procedures during Natural Disasters
Abstract	This study developed a chatbot to improve the efficiency of government activation of mine safety procedures during natural disasters. Taiwan has a comprehensive governmental system dedicated to responding to frequent natural disasters, and the Bureau of Mines has instituted clear procedures to ensure the delivery of disaster alarms and damage reports. However, the labor- and time-consumption procedures are inefficient. In this study, we propose a system framework for disaster-related information retrieval and immediate notifications to support the execution of mine safety procedures. The framework utilizes instant messaging (IM) applications as the user interface to look up information and send messages to announce the occurrence of disaster events. We evaluated the efficiency of the procedures before and after adopting the system and achieved a time-cost reduction of 55.8 min among three types of disaster events. The study has proven the feasibility of adopting novel techniques for decision-making and assures the improvement of the efficiency and effectiveness of the procedure activation.
Key research question	How can a chatbot improve the efficiency and effectiveness of safety measures in natural disasters?
Target group	Taiwanese population
Method	Description of a chatbot
Key content	Government agencies in Taiwan have developed chatbots for public services, which are primarily used for crisis communication in the event of natural disasters. The core system of the chatbot consists of three modules: a search module, a user module and a notification module. In line with the research project of this report, the search module is of particular interest. It provides disaster-related information via a series of assignment keywords as entries to the information. The chatbot user asks the chatbot a question by entering a text message. The system processes this message and compares the text with the stored keyword assignment list. In this list, the requested information whose keyword matches the user's text is matched and the user receives a response. Chatbot users can enter their input via text or by clicking (clickable images or buttons), with both modes technically accessing the keyword information mapping. A key aspect of keyword-based FAQ chatbots is therefore that the keyword mapping list is always up to date, enabling the chatbot to generate the appropriate response. Tsai et al. show that a chatbot is efficient in supporting the state in crisis communication because it reduces the amount of work and, above all, the time required, with the chatbot helping to answer questions about real-time information and statistical documentation. The chatbot system thus improves the efficiency and effectiveness of crisis communication.

Source	
Conclusions for AP 2	A chatbot can improve the efficiency and effectiveness of crisis communication primarily by reducing the amount of work and time required, for example by authorities, as the chatbot can answer frequently asked questions. This is particularly successful if the chatbot is equipped with a well-maintained and continuously updated list of keywords. At the same time, the chatbot must be able to provide the correct information in response to user input. For successful use of the chatbot, users should be provided with a simple user interface, for example by allowing them to enter their input independently via text or predefined buttons.
Limitations	-

Table 42 Source: Urbanelli, A./ Frisiello, A./ Bruno, L./ Rossi, C. (2024)

Source	
Authors	Urbanelli, A./ Frisiello, A./ Bruno, L./ Rossi, C.
Year	2024
Title	The ERMES chatbot: A conversational communication tool for improved emergency management and disaster risk reduction
Abstract	The increased occurrence and severity of worldwide disasters, exacerbated by the impact of climate change, pose significant challenges to emergency management, calling for novel and more effective Disaster Risk Reduction (DRR) approaches. Despite the phenomenological differences of diverse hazards and the heterogeneity of local policies and governance structures, effective communication systems are needed to better manage the available resources in all phases of the emergency management cycle, especially in the case of cross-border events. In this work, we present the design, implementation, and validation of a novel tool for emergency management, i.e., the ERMES Chatbot: a mobile-based conversational communication system developed to facilitate real-time bidirectional communication between control centres, in-field forces, and citizens. The methodology used to create the ERMES Chatbot is grounded on the user-centred design approach, which entails end-user involvement in all key phases of the development, including the definition of the end-user requirements, the technical design, and the final validation of the proposed solution. The co-design approach involved several organisations belonging to the DRR domain, which includes a gamified experience for citizens and is iteratively validated through four in-field demonstration events based on realistic emergency scenarios with the involvement of emergency practitioners, volunteering organisations, and citizens.
Key research question	(How) can a chatbot implemented on Telegram improve emergency management and reduce disaster risk?

Source	
Target group	Volunteer experts and citizens from four European countries (France, Greece, Italy, Spain)
Method	Online survey, workshop
Key content	Research design: The study examines a chatbot that was implemented on Telegram for emergency management and developed using a user-centred design approach. Its primary aim is to improve communication between citizens, emergency services and control centres in risk situations. Accordingly, the chatbot not only answers questions, but also issues warnings and records reports. Prior registration was required to use the chatbot. This gave the chatbot access to location data, enabling it to respond more accurately to user input. The chatbot also allows audio messages, text messages and photos to be recorded and shared. To better classify the results of the chatbot evaluation by users, these were already differentiated in the chatbot into experts and normal users, each of whom had a different set of functions, with the latter being addressed through gamification, for example. Results: Chatbots are effective communication systems that are advantageous for reaching as many people as possible. The chatbot examined begins the conversation with a welcome message and explains the purpose of the chatbot at the same time. Users can then decide how they want to continue the conversation. This user-centred design approach increases the effectiveness of the chatbot, as demonstrated by simple and personalised interactions. For chatbot users to rate the user-friendliness positively, it is important that the interface and navigation scheme are intuitive so that it is easy to understand and interact with the various buttons and menus. To serve this purpose as well as possible, the chatbot allows interaction in natural language, either typed or spoken, and is relatively easy to use even for less tech-savvy people. In addition to user-friendliness in user interaction, the conversation interaction should also be friendly and context-sensitive. It is well known that text is less efficient than images, especially when people are in a critical emotional state. It has also been found that chatbots should have linguistic skills to convey empathy and trustworthiness. This is particularly successful in emergency situations through simple and direct conversation. It is also advantageous if the chatbot can provide appropriate responses to keyword-based inputs, i.e. without whole sentences. In order to appeal to as many people as possible, the chatbot should be able to speak different languages. Gamification also helps to promote engagement, which is important for a chatbot such as this one so that users will use it.
Conclusions for AP 2	In emergency situations, it is particularly important that the chatbot follows a user-centred design approach and is easy to use. A friendly and context-sensitive conversation also contributes to perceived user-friendliness. Gamification can be useful if the chatbot is used not only to answer questions but also to issue warnings, collect information and record messages from users.

Source	
Limitations	Different areas have different socio-economic and cultural characteristics and government structures and guidelines, so a chatbot will not work equally well everywhere. In addition, the chatbot was implemented on a platform (Telegram) that required users to register for the chatbot, making it relatively easy to personalise the responses.

Table 43 Source: Xiao, Y./ Yu, S. (2025)

Source	
Authors	Xiao, Y./ Yu, S.
Year	2025
Title	Can ChatGPT replace humans in crisis communication? The effects of AI-mediated crisis communication on stakeholder satisfaction and responsibility attribution
Abstract	Imagine a world where chatbots are the first responders to crises, efficiently addressing concerns and providing crucial information. ChatGPT has demonstrated the capability of GenAI (Generative Artificial Intelligence)- powered chatbots when deployed to answer crisis-related questions in a timely and cost-efficient manner, thus replacing humans in crisis communication. However, public reactions to such messages remain unknown. To address this problem, this study recruited participants (N1 = 399, N2 = 189, and N3 = 121) and conducted two online vignette experiments and a qualitative survey. The results suggest that, when organizations fail to handle crisis-related requests, stakeholders exhibit higher satisfaction and lower responsibility attribution to chatbots providing instructing (vs. adjusting) information, as they are perceived to be more competent. However, when organizations satisfy requests, chatbots that provide adjusting (vs. instructing information) lead to higher satisfaction and lower responsibility attribution due to higher perceived competence. The second experiment involving a public emergency crisis scenario reveals that, regardless of the information provided (instructing or adjusting), stakeholders exhibit greater satisfaction and positive attitudes toward high-competence (vs. low competence) chatbots. The qualitative study further confirms the experimental findings and offers insights to improve crisis chatbots. These findings contribute to the literature by extending situational crisis communication theory to nonhuman touchpoints and providing a deeper understanding of using chatbots in crisis communication through the lens of machine heuristics. The study also offers practical guidance for organizations to strategically integrate chatbots and human agents in crisis management based on context.

Source	
Key research question	Are ChatGPT or comparable artificial intelligence technologies suitable for use in crisis communication?
Target group	Study 1: Recruitment via the Credamo platform, participants from China Study 2: Recruitment via the "Mturk" platform; participants from the USA
Method	Experiments and qualitative survey
Key content	State of research: The functions of ChatGPT and other artificial intelligence applications suggest that they could support responsible authorities in a crisis situation. By accessing large databases, they offer answers to a wide range of questions and can answer them in a very short time. Information in crisis situations can be divided into three categories: 1. Instructional information that conveys facts or clear instructions for action 2. Adjustive information that provides emotional support or psychological coping aids 3. Reputation-restoring information, which is communicated on behalf of the organisation and is intended to restore its reputation. A large number of studies indicate that people unconsciously display the same social characteristics when interacting with chatbots as they do when interacting with other people. In contrast, other studies emphasise the difference between human-chatbot interaction by taking into account the expectations placed on the "agent": the perceived responsibility of a chatbot in a crisis situation is significantly lower, which is why users also have lower expectations of it. A relevant difference between humans and chatbots is the lack of emotion and empathy in artificial intelligence. Research design: This study examines the suitability of artificial intelligence-based chatbots such as ChatGPT in crisis communication and conducts two online experiments and a qualitative survey. Results: If the crisis concerns of the population or so-called stakeholders are not met, chatbots will be perceived as more competent if they provide precise, instructive information. However, this effect does not apply to adjustive information. This is because chatbots are perceived as more objective and less flexible than humans, which reduces expectations of their performance. In addition, tolerance for errors is higher with chatbots. If, on the other hand, crisis concerns are successfully addressed, chatbots with adjustive information have a stronger effect, as users expect such services less from a chatbot and therefore rate them more positively. There is then no effect for instructive information. The study distinguishes between two types of chatbots: the "high-competence chatbot," which is characterised by flexible responses and a generative system such as ChatGPT, and the "low-competence chatbot," which works on a rule-based system with predefined responses. The "high-competence chatbot" is rated significantly more competent by the test subjects than the "low-competence chatbot". No significant effects on the evaluation of the chatbots can be determined through so-called "message

Source	
	framing" – i.e. the way in which the information was conveyed in an instructive or adaptive manner. Study 3 uses a qualitative survey with open-ended questions to examine the perception and evaluation of chatbots in crisis situations. Respondents were asked to imagine themselves in a described scenario and evaluate the use of a chatbot in a crisis situation from the perspective of a user. The results showed a mixed picture. On the one hand, the chatbot's quick response and practical assistance were highlighted as positive, as this was perceived as efficient and helpful. On the other hand, the chatbot's lack of emotional competence was criticised, in particular its lack of empathy, which is often considered necessary in crisis situations. In addition, respondents expressed concerns about technical errors that could lead to miscommunication, as well as concerns about data protection, particularly with regard to the processing of personal data by chatbots.
Conclusions for AP 2	Overall, the study shows that chatbots can be a valuable addition to crisis communication, although their effectiveness depends heavily on the type of information provided and the specific crisis situation. The results of the study suggest that chatbots should be used specifically for providing instructive information, especially in crises that require a high level of clear and rapid information. Adjustive information that includes emotional support, on the other hand, is better provided by human agents in complex crisis situations. A strategic combination of chatbots and human agents, tailored to the type of crisis response and the specific situation, is recommended to maximise the effectiveness of crisis communication.
Limitations	-

Appendix: Analysed literature – Personas (target groups)

Table 44 Source: Araujo, T./ Helberger, N./ Kruikemeier, S./ de Vreese, C. H. (2020)

Source	
Authors	Araujo, T./ Helberger, N./ Kruikemeier, S./ de Vreese, C. H.
Year	2020
Title	In AI we trust? Perceptions about automated decision-making by artificial intelligence
Abstract	Fueled by ever-growing amounts of (digital) data and advances in artificial intelligence, decision-making in contemporary societies is increasingly delegated to auto-mated processes. Drawing from social science theories and from the emerging body of research about algorithmic appreciation and algorithmic perceptions, the current study explores the extent to which personal characteristics can be linked to perceptions of automated decision-making by AI, and the boundary conditions of these perceptions, namely the extent to which such perceptions differ across media, (public) health, and judicial contexts. Data from a scenario-based survey experiment with a national sample (n = 958) show that people are by and large concerned about risks and have mixed opinions about fairness and usefulness of automated decision-making at a societal level, with general attitudes influenced by individual characteristics. Interestingly, decisions taken automatically by AI were often evaluated on par or even better than human experts for specific decisions. Theoretical and societal implications about these findings are discussed.
Key research question	Which personal characteristics can be linked to perceptions of fairness, usefulness and risk in automated decision-making? What are the boundary conditions for these perceptions? Do perceptions differ depending on the (subject) area?
Target group	Population of the Netherlands, random sample from the Kantar Public database
Method	Experimental design
Key content	State of research: A variety of factors influence the perception of artificial intelligence. Existing research suggests that trust in artificial intelligence is influenced by, among other things, the presentation of artificial intelligence and the context. Research design: Building on this, the present study investigates whether the perception of artificial intelligence is influenced by contextual factors as well as personal factors of the users. To answer the research question, an online experiment is conducted. Participants are randomly assigned to an experimental condition that varies in terms of the decision-maker (human or artificial intelligence), the subject area (media, health, justice) and the

Source	
	impact ("low impact" or "high impact"). The participants then evaluate how useful, fair and risky automated decisions made by artificial intelligence are. Results: Linear regression analysis confirms a significant positive effect of general knowledge or education on the perception of the usefulness of artificial intelligence. In addition, a positive effect of domain-specific knowledge of programming, technology or artificial intelligence on the perception of the usefulness and fairness of decisions based on artificial intelligence can be observed. It cannot be confirmed that the perception of the risk of artificial intelligence decisions is influenced by general or specific knowledge. The more pronounced individual concerns about data protection on the internet are, the more negative the usefulness and fairness of artificial intelligence decisions are perceived, while at the same time the perceived risk increases. In contrast, higher "online self-efficacy" has a positive effect on the perception of the usefulness and fairness of artificial intelligence, in line with expectations, and reduces risk perception. With increasing age, artificial intelligence decisions are associated with lower usefulness and higher risk perception. Gender differences emerge in the assessment of usefulness, with men perceiving it as significantly higher. The stronger the belief in economic equality, the stronger the perception of the usefulness and fairness of artificial intelligence decisions. In order to examine contextual factors for the evaluation of artificial intelligence decisions in addition to personal factors, context effects are examined using a multi-level model. The effects are compared for humans and artificial intelligence, as well as for "high" and "low impact" decisions, for the decision-maker and the topic context. The results show that there are no significant differences in the perception of fairness between the different subject areas. Artificial intelligence decisions are rated slightly fairer in topics from the legal context and are considered less risky than human decisions in the media context. Significant differences between humans and artificial intelligence can be observed across all subject areas in risk perception when it comes to high-impact decisions. Artificial intelligence decisions are considered more useful than human decisions in the healthcare sector. Artificial intelligence decisions are also rated as more useful than human decisions in high-impact decisions in the justice and healthcare sectors.
Conclusions for AP 2	Both personal and contextual factors are important for the acceptance and evaluation of artificial intelligence and related decisions. Sociodemographic characteristics such as age, education and technical knowledge can be predictors. In some subject areas, there is greater acceptance of artificial intelligence than in others. When it comes to artificial intelligence as a social development, many respondents are sceptical, especially with regard to its fairness and usefulness. However, when considering the targeted use of artificial intelligence in specific areas such as health or media, it is perceived much

Source	
	more positively and in some cases even seen as a possible alternative to human decisions.
Limitations	Within the scope of the experiment, this study only measures the isolated assessment of decision-makers; it does not include a decision between artificial intelligence and humans. Decision scenarios are evaluated, not real decisions.

Table 45 Source: Dametto, D./ Oertel, B./ Maier, J. (2021)

Source	
Authors	Dametto, D./ Oertel, B./ Maier, J.
Year	2021
Title	Möglichkeiten des Zuschnitts von Risikoinformationen im Strahlenschutz auf unterschiedliche Zielgruppen im Internet
Abstract	Mit dem Projekt „Möglichkeiten des Zuschnitts von Risikoinformationen im Strahlenschutz auf unterschiedliche Zielgruppen im Internet“ sollten auf verschiedene Rezipient*innen „zugeschnittene“ Formen der Risikokommunikation empirisch erprobt werden, um so zu prüfen, ob die Effektivität der Risikokommunikation verbessert werden kann. Thematisch befasste sich das Projekt mit dem Risikothema Radon. Vorbereitend zur empirischen Untersuchung wurden eine Literatur- sowie eine Praxisbeispielrecherche durchgeführt. Daraus wurde ein 2x2-Between-Subjects-Experiment abgeleitet. Die zwei Untersuchungsfaktoren – die Betroffenheit und das Eigentums- bzw. Mietverhältnis – gliedern sich jeweils in zwei Stufen und identifizieren dadurch vier Zielgruppen, die von „zugeschnittenen“ Informationsseiten adressiert wurden. Die Ergebnisse wurden mit den Angaben einer Kontrollgruppe verglichen, die keine „zugeschnittene“ Informationsseite betrachtete. Die statistische Auswertung der Ergebnisse zeigte, dass der Effekt der „zugeschnittenen“ Informationsseiten auf die entsprechenden Zielgruppen sich nicht vom Effekt der zielgruppenunspezifischen Informationsseiten unterscheidet. Der einzig statistisch relevante Effekt bestand darin, dass Eigentümer*innen im Vergleich zu Mieter*innen handlungsbereiter sind. Eine explorative Analyse der Faktoren, die die Rezeption der Inhalte beeinflussen, zeigte, dass Vorkenntnisse zum Thema sowie die Wohnperspektive einen Effekt auf die Rezeption der Inhalte haben.
Key research question	To what extent can the effectiveness of risk communication be improved if it is specifically tailored to the target group(s)?
Target group	Experiment: A total of 293 tenants and owners of residential property from an online access panel.

Source	
Method	Literature review, experiment
Key content	State The literature review in this article finds that different people have different information needs, which must not only be taken into account but also addressed in detail. Furthermore, based on the literature review, it is shown that the effectiveness of risk communication and thus also the implementation of the messages (willingness to act) is increased when tailor-made information is provided. Research design To answer the research question, a two-factor experimental design (2x2 between-subjects experiment) is used. The independent variables to be investigated are geographical exposure (place of residence in a radon area or adjacent to a radon area) and the characteristic of tenant or owner. The target groups are selected via an online access panel. Before the experiment, in which participants are shown target group-specific content or target group-unspecific information, a pre-measurement is conducted to analyse existing biases prior to the experiment and identify factors influencing the dependent variable. The pre-measurement is then used to assign participants to one of the four target groups, after which they are randomly assigned to the experimental groups. This is followed by a post-measurement using a questionnaire and the topic blocks information comprehension, risk perception, willingness to act, coping strategy and uncertainty, which measure the influence of the risk information on the relevant dependent variable. Results The experiment did not yield any significant results with regard to the question of whether target group-specific risk information is perceived as "better" by the relevant target groups than target group-unspecific risk information, and how it affects the recipients. The hypothesis that target group-specific information performs better therefore had to be rejected. However, the target groups differ in terms of the uncertainty and willingness to act based on the different risk information they have considered, but again not significantly. No general difference can be identified with regard to risk perception and understanding of information. Consequently, the hypothesis that target groups differ from one another in terms of their understanding of information, willingness to take action, coping behaviour and risk perception due to the different information they have considered must also be rejected. There are also no significant differences in coping behaviour, understanding of information, risk perception, willingness to take action and uncertainty between respondents in radon areas and respondents adjacent to radon areas. However, a significant difference is apparent with regard to willingness to take action, showing that owners are more willing to take action than tenants, regardless of whether target group-specific or non-target group-

Source	
	specific information was viewed. However, this significant difference does not exist between owners and tenants with regard to information comprehension, coping behaviour, risk perception and uncertainty. The survey's hypothesis that target group-specific information performs better, i.e. leads to a better understanding of the information and is associated with increased risk perception and willingness to take action, as well as strengthening coping skills and reducing uncertainty, must therefore be rejected on the basis of the study. However, it has been shown that having already heard something about the topic has a positive influence on information comprehension and willingness to take action. There is also a negative relationship between the emergence of uncertainty and the level of education: participants with a higher level of education tend to agree less often with statements that indicate uncertainty.
Conclusions for AP 2	A target group-specific approach can be useful if the target groups are defined analytically. The level of concern, motivation and anxiety as well as the personality of individuals are particularly relevant dimensions for creating target group-oriented risk information. A target group-specific approach, in which the target groups are derived on the basis of scientifically documented risk characteristics (e.g. in vs. near radon areas), shows no significant differences in terms of information comprehension, willingness to take action, coping behaviour and risk perception.
Limitations	-

Table 46 Source: Salminen, J./ Santos, J./ Kwak, H./ An, J./ Jung, S./ Jansen, B. J. (2020)

Source	
Authors	Salminen, J./ Santos, J./ Kwak, H./ An, J./ Jung, S./ Jansen, B. J.
Year	2020
Title	Persona Perception Scale: Development and Exploratory Validation of an Instrument for Evaluating Individuals' Perceptions of Personas
Abstract	Although used in many domains, the evaluation of personas is difficult due to the lack of validated measurement instruments. To tackle this challenge, we propose the Persona Perception Scale (PPS), a survey instrument for evaluating how individuals perceive personas. We develop the scale by reviewing relevant literature from social psychology, persona studies, and Human-Computer Interaction to find relevant constructs and items for measuring persona perceptions. Following initial pilot testing, we conduct an exploratory validation of the scale with 412 respondents and find that the constructs and items of the scale perform satisfactorily for deployment. The research has implications for both academic researchers and persona

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	developers. Using the PPS, researchers and designers can evaluate how different persona designs affect individual perceptions of personas, for example persona users' (e.g., designers, marketers, software developers) perceived credibility of the persona and their willingness to use it. Because persona perceptions are associated with persona acceptance and adoption, using a perceptual measurement instrument can improve the chances of persona adoption and use in real organizations.
Key research question	How can individuals' perceptions of personas be systematically and quantitatively evaluated?
Target group	-
Method	First, a literature review was conducted, which forms the basis for construct selection and item development. Expert feedback supplements the findings. A study with 412 participants was then conducted and the results were verified using factor analyses (exploratory and confirmatory). Finally, a validity and reliability analysis as well as a measurement invariance analysis were performed.
Key content	Previous studies have shown that evaluating personas is difficult, with one frequently overlooked aspect being the influence of individual perceptions of personas. Since the same persona can be perceived differently by different people, the acceptance and use of personas by these individuals is influenced by their perceptions, which means that evaluation methods should also be individualised. The Persona Perception Scale (PPS) measures the perception of personas based on dimensions such as similarity, likability, empathy, coherence, completeness, usefulness, credibility, and clarity. With regard to the immersion construct, the authors recommend that PPS users select the dimensions that are relevant to their specific problem and measure immersion either by combining the dimensions similarity, sympathy and empathy or by considering these constructs separately. Practitioners can use surveys to examine the perception of personas among the group of end users, such as marketers, product managers and software developers, and also use the PPS tool to measure changes in the perception of personas over a longer period of time.
Conclusions for AP 2	The Persona Perception Scale (PPS) can be used to analyse the perception of personas in order to identify possible prejudices or stereotypes. The authors refer to the dimensions of similarity, sympathy, empathy, coherence, completeness, usefulness, credibility and clarity.
Limitations	One of the main limitations of the study is that although the participants had a basic understanding of personas, they did not necessarily have experience in the practical application of personas, which could affect the transferability of the results to actual end users. In addition, the participants' experience with the specific task (e.g., social media content creation) was not controlled, which could also influence the interpretation of the results.

Table 47 Source: Schwesig, R./ Brich, I./ Buder, J./ Huff, M./ Said, N. (2023)

Source	
Authors	Schwesig, R./ Brich, I./ Buder, J./ Huff, M./ Said, N.
Year	2023
Title	Using Artificial Intelligence (AI)? Risk and Opportunity Perception of AI Predict People's Willingness to use AI
Abstract	Surveys around the world show that the public perceives artificial intelligence (AI) as a double-edged sword: As a risk but also as an opportunity. However, if and how this ambiguous perception of AI relates to people's willingness to use it has yet to be investigated. Thus, the present research investigated how people's risk and opportunity perception influences their willingness to use AI. Additionally, we examined people's confidence in their risk and opportunity perception as a possible moderator. To this end, we conducted two online experiments with N = 246 and N = 495 (representative) participants to assess (i) risk and opportunity perception of AI, (ii) confidence in risk and opportunity perception of AI, and (iii) willingness to use AI. As hypothesized, risk-opportunity perception (opportunity minus risk perception) of AI correlated positively with the probability to use AI. Contrary to our hypothesis, the strength of this association was not significantly moderated by people's confidence in their risk and opportunity perception. Exploratory analyses indicated that the probability to use AI also depended on the context of the AI use (medicine, transport, media, psychology). This research expands existing behavioral research by including opportunity and not solely risk perception as a predictor variable for behavior and by investigating the relationship of risk and opportunity perception to ambiguous and not solely risk-taking behavior. Additionally, the experimental results motivate the investigation of causal-effect relations as well as further moderating cognitive variables (e.g., AI knowledge) and underline the need to gain a deeper understanding of the stability of risk and opportunity perception across different contexts of AI use.
Key research question	a) Is the perception of artificial intelligence associated with the willingness to use artificial intelligence? b) Is this connection moderated by people's trust in the accuracy of their perception of artificial intelligence?
Target group	German population
Method	Experiment
Key content	Participants perceived both the risks and opportunities of artificial intelligence equally in all scenarios, but there were differences in perception depending on the context. In the scenarios for media and psychology, the risks were perceived more strongly than the opportunities, while in the scenarios for transport and medicine, the opportunities were perceived more strongly.

Source	
	A positive association was found between the perception of risks and opportunities (ROP) and the willingness to use artificial intelligence: the higher the perception of opportunities compared to risks, the more likely people are to be willing to use artificial intelligence. In the studies, the likelihood of using artificial intelligence did not depend significantly on the variables age, gender and education. An exception was gender in the second study, in which male participants were more willing to use artificial intelligence than female participants. The willingness to use artificial intelligence depends more on the context of use than on a stable attitude towards artificial intelligence. This shows that the use of artificial intelligence is situation-dependent, rather than there being a general attitude for or against artificial intelligence.
Conclusions for AP 2	People's willingness to use artificial intelligence depends heavily on the context in which artificial intelligence is used, especially in areas such as medicine and psychology, where acceptance tends to be higher. There is consistent evidence that the use of artificial intelligence cannot be considered a stable, person-specific attitude, but rather depends on the specific area of application. The lower the perceived risks or the higher the perceived opportunities of artificial intelligence, the more willing people are to use these technologies.
Limitations	The study measures the perception of risks and opportunities associated with artificial intelligence specifically in relation to certain applications and scenarios, leaving it unclear how this perception can be transferred to other contexts of artificial intelligence. Furthermore, no specific questions are asked to capture the actual reasons for the use or rejection of artificial intelligence and thus identify both fears and perceived prejudices and opportunities.

Table 48 Table Source: Tsai, W.-H. S./ Lun, D. /Nicholas Carcioppolo, N./ Chuan, C.H. (2021)

Source	
Authors	Tsai, W.-H. S./ Lun, D. /Nicholas Carcioppolo, N./ Chuan, C.H.
Year	2021
Title	Human versus chatbot: Understanding the role of emotion in health marketing communication for vaccines
Abstract	Based on the theoretical framework of agency effect, this study examined the role of affect in influencing the effects of chatbot versus human brand representatives in the context of health marketing communication about HPV vaccines. We conducted a 2 (perceived agency: chatbot vs. human) × 3 (affect elicitation: embarrassment, anger, neutral) between-subject lab experiment with 142 participants, who were randomly assigned to interact

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	with either a perceived chatbot or a human representative. Key findings from self-reported and behavioral data highlight the complexity of consumer–chatbot communication. Specifically, participants reported lower interaction satisfaction with the chatbot than with the human representative when anger was evoked. However, participants were more likely to disclose concerns of HPV risks and provide more elaborate answers to the perceived human representative when embarrassment was elicited. Overall, the chatbot performed comparably to the human representative in terms of perceived usefulness and influence over participants' compliance intention in all emotional contexts. The findings complement the Computers as Social Actors paradigm and offer strategic guidelines to capitalize on the relative advantages of chatbot versus human representatives.
Key research question	How do different emotions affect the assessment of chatbots' usefulness? What are potential linguistic differences in conversations with chatbots or humans when anger or shame are evoked?
Target group	Test subjects recruited via internal university website with vaccination appeal
Method	Laboratory experiment
Key content	State of research Emotions and affect are relevant when it comes to the acceptance and evaluation of artificial intelligence chatbots in health-related topics. Studies suggest that chatbots are perceived as less suitable by people who feel anger or annoyance. Anger can cause people to want to vent their emotions. For this reason, interacting with a chatbot proves to be unsatisfactory. In contrast, artificial intelligence chatbots are suitable when people feel ashamed or when sensitive health-related topics are involved. Chatbots are viewed positively because they provide non-judgmental assistance and can encourage people to talk more openly about their problems or questions. Research design To answer the research question, a laboratory experiment is conducted in this study, varying the experimental conditions in terms of the perceived conversation partner and the emotion evoked. The emotions are artificially activated in the course of the experiment. Questions with a sexual reference that the participants must answer are designed to evoke feelings of shame. Technical difficulties with the online questionnaire are simulated to trigger feelings of anger. A control group is not confronted with any situations that trigger shame or anger. Satisfaction with the interaction and perceived usefulness were measured after the interaction with the chatbot or the human being. Results Participants in the anger condition of the experiment who interact with a chatbot are significantly less satisfied with the interaction compared to the

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	control group and the participants in the shame condition. In contrast, the interaction satisfaction is significantly higher among people with feelings of anger when they communicate with a human contact person instead of a chatbot. No significant differences can be observed for individuals in the shame condition compared to the control condition. An interaction effect can be observed depending on the intensity of anger: when anger is low, there is no significant difference in how participants rate the interaction between the chatbot and a human being. However, significant differences can be identified when anger reaches a moderate level. An analysis of communication based on the number of words reveals that people in the experimental group with feelings of shame write significantly fewer words than those in the anger and control groups when they believe they are talking to a human being. When they believe they are conversing with a chatbot, there are no significant differences between the three experimental groups.
Conclusions for AP 2	The evaluation and acceptance of artificial intelligence chatbots in health-related topics may depend on the emotional context of the users. Artificial intelligence chatbots are less suitable when people experience emotions such as anger. On the other hand, chatbots can encourage users to talk more openly about their concerns and be more communicative than with human contact persons when dealing with shame-related topics.
Limitations	The authors acknowledge limitations in measuring emotions, as manipulation or activation is difficult to achieve. The present study also addresses vaccination, which is a fundamentally polarising topic. The interpretation of the results must also be considered in light of the small number of cases.

Appendix: Main survey questionnaire (german)

The original questionnaire is included below.

Begrüßung

Vielen Dank für Ihre Bereitschaft, an dieser Umfrage teilzunehmen. Bitte lesen Sie zunächst die folgenden Informationen durch.

Wir führen zurzeit eine Befragung zum Thema Kommunikation durch. Der Fragebogen wird etwa 15 Minuten Ihrer Zeit in Anspruch nehmen.

Im Rahmen der Befragung wird ein kurzes Video zu sehen sein. Für dieses Video benötigen Sie keinen Ton. Bitte stellen Sie jedoch sicher, dass Sie bei der Beantwortung des Fragebogens eine stabile Internetverbindung haben.

Die Teilnahme an der Studie ist freiwillig. Die im Rahmen dieser Studie erhobenen Daten werden vertraulich behandelt. Die von Ihnen übermittelten Daten enthalten keine identifizierenden Merkmale und lassen sich keiner bestimmten Person zuordnen.

Wenn Sie mit der Teilnahme einverstanden sind, klicken Sie zum Starten der Befragung bitte hier: <Button „Befragung starten“>

Block S: Erweiterte Soziodemografie

S1 [Alter]

Wie alt sind Sie?

[offene numerische Angabe, ganze Zahlen zwischen 0 und 99, Screenout wenn <16]

___ Jahre

S2 [Geschlecht]

Welchem Geschlecht ordnen Sie sich zu?

1 weiblich

2 männlich

3 divers

S3 [Schulabschluss]

Welchen höchsten allgemeinbildenden Schulabschluss haben Sie?

Falls Sie noch zur Schule gehen, geben Sie bitte an, welchen Schulabschluss Sie anstreben.

Antwortoptionen

1 Ohne Abschluss

2 Volksschulabschluss, Hauptschulabschluss

3 Mittlere Reife, Realschulabschluss (Fachschulreife)

4 Polytechnische Oberschule (POS) mit Abschluss 8. Klasse

5 Polytechnische Oberschule (POS) mit Abschluss 10. Klasse

6 Fachhochschulreife (Abschluss einer Fachoberschule etc.)

7 Abitur (Hochschulreife) oder Erweiterte Oberschule (EOS) mit Abschluss 12. Klasse oder Berufsausbildung mit Abitur

8 einen anderen Schulabschluss

S4 [Bundesland]

In welchem Bundesland leben Sie?

Antwortoptionen

1 Baden-Württemberg

2 Bayern

3 Berlin

4 Brandenburg

5 Bremen

6 Hamburg

7 Hessen

8 Mecklenburg-Vorpommern

9 Niedersachsen

10 Nordrhein-Westfalen

11 Rheinland-Pfalz

12 Saarland

13 Sachsen

14 Sachsen-Anhalt

15 Schleswig-Holstein

16 Thüringen

S6 [Haushaltsgröße]

Wie viele Personen leben ständig in Ihrem Haushalt?

(Sie selbst und auch Kinder eingeschlossen)

Antwortoptionen

1 1

2 2

3 3

4 4

5 5

6 6

7 7

8 8

9 9

10 10 oder mehr

99 keine Angabe

[S7 Kinder]

Haben Sie Kinder unter 18 Jahren?

(Mehrfachantwort möglich)

Antwortoptionen

1 Nein (exklusiv)

2 Ja, leben ständig in meinem Haushalt.

3 Ja, leben teilweise in meinem Haushalt.

4 Ja, leben nicht oder nicht mehr in meinem Haushalt.

99 keine Angabe (exklusiv)

[S8 Schwangerschaft]

[Wenn S2 Geschlecht =1 (weibl.)]

Sind Sie derzeit schwanger?

Antwortoptionen

1 Ja

2 Nein

99 keine Angabe

[S9 Stillen]

[Wenn S7 Kinder = 2 oder 3 oder 4 und S2 Geschlecht =1 (weibl.)]

Stillen Sie zum aktuellen Zeitpunkt?

Antwortoptionen

1 Ja

2 Nein

99 keine Angabe

[S10 Chronische Erkrankungen]

Haben Sie eine chronische Krankheit oder ein lang andauerndes gesundheitliches Problem?

Damit gemeint sind Krankheiten oder gesundheitliche Probleme, die mindestens 6 Monate andauern oder voraussichtlich andauern werden.

Antwortoptionen

1 Ja

2 Nein

99 keine Angabe

S12 [Risikobereitschaft]

Inwiefern stimmen Sie den folgenden Aussagen zu?

Items

[randomisierte Reihenfolge]

_1 Risiken machen das Leben erst spannend.

_2 Ich versuche jedes Risiko zu vermeiden – man kann nicht vorsichtig genug sein.

_3 Bei Risiken entscheide ich häufig aus dem Bauch heraus.

_4 Wenn es um Risiken geht, die ich nicht sicher einschätzen kann, versuche ich mich so gut wie möglich zu informieren und diese Informationen dann sorgfältig abzuwägen.

Antwortoptionen

1 1 stimme überhaupt nicht zu

2 2

3 3

4 4

5 5 stimme voll und ganz zu

Intro

Im Folgenden geht es um das Thema Kommunikation und Chatbots.

Ein Chatbot ist ein System, das eine Kommunikation in natürlicher Sprache zwischen einem Menschen und einem Computer ermöglicht. Chatbots gibt es zum Beispiel in Form von Buchungs- und Serviceassistenten oder auch als Sprachassistenten wie Siri oder Alexa, als Dialogsystem wie ChatGPT oder auch in verschiedenen Beratungssituationen, bei dem man einem Chatbot Fragen stellen kann und er diese beantwortet.

Bitte beantworten Sie die folgenden Fragen allein auf Basis Ihrer persönlichen Einschätzung.

Block A: Technikverständnis, Künstliche-Intelligenz-Erfahrung / Chatboterwartung

A1 [Nutzungsdauer]

Wie oft haben Sie in der letzten Woche die folgenden Anwendungen genutzt, egal ob privat oder beruflich?

Items

_1 einen Computer oder Laptop

_2 ein Smartphone

_3 ein Tablet

_4 einen Chatbot (Kommunikation mit einem technischen System, z.B. Buchungs- und Serviceassistenten, sprachgesteuerte Assistenten, ChatGPT)

Antwortoptionen

1 mehrfach täglich

2 täglich

3 mehrmals die Woche

4 einmal die Woche

5 seltener

6 nutze ich nie

99 keine Angabe

A2 [Wissen Künstliche Intelligenz]

Items

_1 Wie schätzen Sie ihr Wissen über Künstliche Intelligenz ein?

_2 Wie gut fühlen Sie sich über Funktionsweise und Einsatz von Künstlicher Intelligenz informiert?

_3 Inwiefern erkennen Sie, wenn Künstliche Intelligenz eingesetzt wird?

Antwortoptionen

1 sehr schlecht

2 2

3 3

4 4

5 sehr gut

A3 [Einschätzung KI]

Nun möchten wir Ihnen Fragen zu neuen Technologien im Zusammenhang mit dem Internet stellen. Wie ordnen Sie die folgenden Aussagen ein: Sind diese richtig oder falsch?

Es geht hierbei nur um Ihre persönliche Einschätzung.

Items

[randomisierte Reihenfolge]

_1 Künstliche Intelligenz (KI) bezeichnet digitale Anwendungen, die selbständig Entscheidungen treffen können und lernfähig sind. (richtig)

_2 Um eine Aufgabe zu lernen, benötigen KI-Systeme nur sehr wenige Daten, um an die Leistung von Menschen heranzukommen. (falsch)

_3 Künstliche Intelligenz (KI) kann große Mengen an Daten analysieren und Muster darin erkennen. (richtig)

_4 Künstliche Intelligenz (KI) kann jede Aufgabe übernehmen, die ein Mensch ausführen kann. (falsch)

_5 Künstliche Intelligenz (KI) kann in bestimmten Bereichen wie Bilderkennung oder Sprachverarbeitung besser abschneiden als Menschen. (richtig)

_6 Künstliche Intelligenz (KI) kann ständig dazulernen, wenn sie mit neuen Daten versorgt wird. (richtig)

_7 Künstliche Intelligenz (KI) funktioniert immer perfekt und macht keine Fehler. (falsch)

_8 Künstliche Intelligenz (KI) basiert auf Algorithmen, die mathematische Modelle und Statistiken verwenden. (richtig)

Antwortoptionen

1 richtig

2 falsch

99 weiß nicht

A4 [Interesse Künstliche-Intelligenz-Chatbot]

Inwiefern interessieren Sie sich für Chatbots?

Antwortoptionen

1 1 überhaupt nicht interessiert

2 2

3 3

4 4

5 5 sehr interessiert

A5 [Themen Künstliche Intelligenz]

[Filter: Wenn A1 _4 (Chatbot) ungleich „nutze ich nie“]

Für welche der folgenden Themen haben Sie Chatbots schon einmal genutzt?

Items

[randomisierte Reihenfolge]

_1 Gesundheit oder Ernährung

_2 Politik, Gesellschaft oder Nachrichten

_3 Produkt- oder Kaufberatung

_4 Soziale Beziehungen

_5 Kommunikation mit Behörden

Antwortoptionen

1 1 gar nicht

2 2

3 3

4 4

5 5 sehr häufig

99 keine Angabe

A6 [Erwartungen]

Welche Aspekte wären für Sie im Allgemeinen bei einem Chatbot wichtig, damit Sie diesen verwenden würden?

Items

[randomisierte Reihenfolge]

_1 Die Nutzung des Chatbots sollte einfach möglich sein, ohne technische Vorkenntnisse.

_2 Die Nutzung des Chatbots sollte anonym möglich sein.

_3 Der Chatbot sollte möglichst menschlich wirken.

_4 Die Antworten des Chatbots sollte auf vertrauenswürdige Quellen verweisen.

_5 Der Chatbot sollte möglichst auf meine Bedürfnisse reagieren.

_6 Die Antworten des Chatbots sollten aktuell sein.

_7 Der Chatbot sollte empathisch und einfühlsam sein.

_8 Die Informationen aus dem Chatbot sollten der Wahrheit entsprechen.

_9 Der Chatbot soll die vom Benutzer eingegebenen Daten nicht sammeln.

_10 Bei weiteren Fragen sollte der Chatbot Kontaktdaten zu einem menschlichen Ansprechpartner zur Verfügung stellen können.

Antwortoptionen

1 1 gar nicht wichtig

2 2

3 3

4 4

5 5 sehr wichtig

Block B: (Vor-)Wissen Strahlung, Selbstwirksamkeit

B1a [Vorwissen gestützt]

Nun möchten wir einmal näher auf das Thema Radioaktivität und Strahlenschutz eingehen.

Haben Sie von Radioaktivität schon einmal gehört oder gelesen?

Antwortoptionen

1 Nein

2 Ja, ich glaube schon

3 Ja, auf jeden Fall

99 weiß nicht

B1b [Wahrgenommene Informiertheit]

[Filter: Wenn B1a ungleich 1]

Radioaktivität bedeutet, dass Stoffe spontan zerfallen, sich in andere Stoffe verwandeln und dabei Energie in Form von Strahlung freisetzen. Radioaktivität sieht und spürt man nicht. Strahlung kann gefährlich für den Körper sein.

Wie groß schätzen Sie Ihre Kenntnisse über Radioaktivität ein?

Antwortoptionen

1 1 sehr gering

2 2

3 3

4 4

5 5 sehr groß

B2 [Selbstwirksamkeit]

Wie sehen Sie das: Indem ich mich entsprechend verhalte bzw. bestimmte Vorkehrungen treffe, kann ich mich vor Radioaktivität schützen.

Antwortoptionen

1 stimme überhaupt nicht zu

2 2

3 3

4 4

5 stimme voll und ganz zu

99 weiß nicht

Block C: Informationsquellen, Bekanntheit BfS

C1 [Informationsquellen]

Inwiefern vertrauen Sie den folgenden Quellen ganz allgemein bezogen auf deren Informationen rund um das Thema Strahlung?

Items

_1 Fernsehen/Radio

_2 Soziale Medien wie z.B. Instagram, Facebook, X (ehemals Twitter)

_3 Internet (allgemein)

_4 Zeitung/Zeitschrift

_5 Expertinnen und Experten aus der Wissenschaft, Universitäten

_6 Staatliche Einrichtungen, Behörden wie z.B. Ministerien, Bundes- oder Landesämter

Antwortoptionen

1 1 vertraue ich überhaupt nicht

2 2

3 3

4 4

5 5 vertraue ich voll und ganz

98 nutze ich nie

99 keine Angabe

C2 [Bekanntheit BfS]

Kennen Sie das Bundesamt für Strahlenschutz (BfS), wenn auch nur dem Namen nach?

Antwortoptionen

1 Ja

2 Nein

3 Bin mir nicht sicher

C3 [Bekanntheit Webseite BfS]

[Filter: Wenn C2 ungleich 2]

Haben Sie die Webseite des Bundesamtes für Strahlenschutz (BfS) schon einmal besucht?

Antwortoptionen

1 Ja

2 Nein

3 Bin mir nicht sicher

Block D: Experiment (Dialog)

Im Folgenden zeigen wir Ihnen ein Szenario zum Thema Radioaktivität. Stellen Sie sich vor: Auf Grundlage von diesem Szenario möchten Sie sich mit Hilfe eines Chatbots vom Bundesamt für Strahlenschutz (BfS) weiter informieren.

Bitte sehen Sie sich das nachfolgend gezeigte Szenario und die Informationsrecherche über den Chatbot möglichst genau an.

Zufällige Zuteilung nach der least fill-Methode in die folgenden Experimentalgruppen:

Experimentalgruppe 1.A.1: Filter: Einspielen Szenarienbeschreibung 1 + Einspielen Dialog 1

Experimentalgruppe 1.A.2: Filter: Einspielen Szenarienbeschreibung 1 + Einspielen Dialog 2

Experimentalgruppe 1.B.1: Filter: Einspielen Szenarienbeschreibung 1+ Einspielen Dialog 3

Experimentalgruppe 1.B.2: Filter: Einspielen Szenarienbeschreibung 1 + Einspielen Dialog 4

Experimentalgruppe 2.A.1: Filter: Einspielen Szenarienbeschreibung 2 + Einspielen Dialog 5

Experimentalgruppe 2.A.2: Filter: Einspielen Szenarienbeschreibung 2 + Einspielen Dialog 6

Experimentalgruppe 2.B.1: Filter: Einspielen Szenarienbeschreibung 2 + Einspielen Dialog 7

Experimentalgruppe 2.B.2: Filter: Einspielen Szenarienbeschreibung 2 + Einspielen Dialog 8

Szenarienbeschreibung 1 [Filter: Für Experimental-Gruppen 1.A.1/ 1.A.2/ 1.B.1/ 1.B.2]:

Stellen Sie sich vor…

Sie leben in einem an Frankreich angrenzenden Bundesland, wie z.B. Rheinland-Pfalz oder Saarland. In Frankreich ist es in einem Kernkraftwerk zu einem Unfall gekommen. Das Kraftwerk ist rund 12 Kilometer von der deutschen Grenze entfernt. Im Radio haben Sie gehört, dass bislang noch keine Radioaktivität in die Umwelt freigesetzt wurde. Aufgrund der Art des Störfalls, der derzeitigen Wetterlage und der aktuellen Wettervorhersage gehen die Fachleute des Bundesamts für Strahlenschutz (BfS) davon aus, dass im Falle einer Freisetzung radioaktiver Stoffe innerhalb der nächsten Stunden radioaktiv belastete Luftmassen Teile von Rheinland-Pfalz und des Saarlandes erreichen könnten.

Nun haben Sie Fragen und möchten sich weiter informieren. Auf der Webseite des Bundesamts für Strahlenschutz (BfS) finden Sie einen Chatbot, der Ihre Fragen beantwortet.

Bitte schauen Sie sich das Szenario möglichst genau an. Nach dem Lesen können Sie die Befragung mit dem Weiter-Button wie gewohnt fortsetzen.

Szenarienbeschreibung 2 [Filter: Für Experimental-Gruppen 2.A.1/ 2.A.2/ 2.B.1/ 2.B.2]:

Stellen Sie sich vor…

beim Transport radioaktiver Stoffe von einem Forschungszentrum in München zu einer Firma in Berlin ist eine Kapsel mit radioaktivem Material in der Größe einer Streichholzschachtel verloren gegangen. Der Transport erfolgte mit einem LKW und der Verlustort ist unbekannt. Erst bei Ankunft in Berlin wurde festgestellt, dass die Kapsel fehlt. Wie es dazu kam, ist bisher ungeklärt. Im Radio haben Sie gehört, dass das Bundeskriminalamt (BKA) in Kooperation mit der Nuklearspezifischen Gefahrenabwehr (NGA) des Bundesamts für Strahlenschutz (BfS) ermitteln, um den Verbleib der Kapsel zu klären und mögliche Risiken zu minimieren. Die Suche nach der radioaktiven Quelle wird mit Hochdruck vorangetrieben, um die Bevölkerung vor einer möglichen Exposition durch das stark strahlende Material zu schützen.

Nun haben Sie Fragen und möchten sich weiter informieren. Auf der Webseite des Bundesamts für Strahlenschutz (BfS) finden Sie einen Chatbot, der Ihre Fragen beantwortet.

Bitte schauen Sie sich das Szenario möglichst genau an. Nach dem Lesen können Sie die Befragung mit dem Weiter-Button wie gewohnt fortsetzen.

Hinweistext Desktop-Variante: Damit alle Inhalte des Videos gut verständlich sind, kann das Video bei Bedarf pausiert und über den Webbrowser in einer größeren Ansicht betrachtet werden.

Hinweistext mobile Variante: Für eine optimale Ansicht des Videos empfehlen wir, das Smartphone ins Querformat zu drehen. Selbstverständlich können Sie das Video aber auch im Hochformat abspielen.

Block E: Bewertung Chatbot

E0a [Störungsfreiheit]

[nur für interne Prüfung]

Wurde Ihnen der gerade im Video gezeigte Dialog mit dem Chatbot störungsfrei dargestellt?

Antwortoptionen

1 Ja

2 Nein

3 Bin mir nicht sicher

E0b [Aufmerksamkeitscheck]

[nur für interne Prüfung]

Um welches Thema ging es in dem gezeigten Dialog?

_1 Erdbeben (und Schutzmaßnahmen)

_2 Unfall in einem Kernkraftwerk (und Schutzmaßnahmen) [Filter: Für Experimental-Gruppen 1.A.1/ 1.A.2/ 1.B.1/ 1.B.2]

_3 Verlorene radioaktive Quelle (und Schutzmaßnahmen) [Filter: Für Experimental-Gruppen 2.A.1/ 2.A.2/ 2.B.1/ 2.B.2]

_4 Hitzewelle (und Schutzmaßnahmen)

E1 [Bewertung Chatbot offen]

Sie haben gerade einen Dialog mit einem Chatbot zu einem Unfall in einem Kernkraftwerk [Filter: Für Experimental-Gruppen 1.A.1/ 1.A.2/ 1.B.1/ 1.B.2] / zu einer verlorenen radioaktiven Quelle [Filter: Für Experimental-Gruppen 2.A.1/ 2.A.2/ 2.B.1/ 2.B.2] gesehen.

Wie empfanden Sie diesen insgesamt?

Bitte notieren Sie alles, was Ihnen einfällt (positiv sowie negativ).

_____OPEN

E2 [Bewertung Chatbot Inhalte]

Inwiefern stimmen Sie den folgenden Aussagen zum gerade gezeigten Chatbot zu?

Items

[Abfragen in Themenblöcken, Rotation der Items innerhalb des Blocks]

Block Performance/Funktionalität

_1 Der Chatbot ist benutzerfreundlich.

_2 Die Anweisungen des Chatbots zu dessen Bedienbarkeit sind klar.

_3 Der Chatbot antwortet zügig, ohne Verzögerung.

_4 Der Chatbot ist kompetent.

Block Gestaltung/ Charakter des Chatbots

_5 Der Chatbot ist empathisch.

_6 Die Verwendung von Emojis in Chatbots finde ich gut. [Filter: Für Experimental-Gruppen 1.A.1/ 1.B.1/ 2.A.1/ 2.B.1]

_7 Der Chatbot ist sympathisch.

_8 Der Chatbot ähnelt einem menschlichen Gesprächspartner.

_9 Der Chatbot ist frei von Voreingenommenheit.

_10 Die optische Gestaltung des Chatbots spricht mich an.

Block Ethik und Datenschutz

_11 Der Chatbot macht deutlich, woher er seine Informationen bezieht.

_12 Der Chatbot ist als Chatbot, also nicht menschlicher Akteur erkennbar.

_13 Der Chatbot wahrt die Privatsphäre der Nutzenden.

_14 Der Chatbot übermittelt glaubwürdige Informationen.

Block Inhalt/Informationsqualität

_15 Die Informationen des Chatbots sind aktuell.

_16 Ich habe das Gefühl, dass der Chatbot mir bei der Beschaffung von Informationen geholfen hat.

_17 Ich vertraue den Antworten des Chatbots.

_18 Die Antworten des Chatbots sind leicht zu verstehen.

_19 Ich würde dem Rat des Chatbots Folge leisten.

_20 Ich würde die Informationen des Chatbots an meine Familie und Freunde weitergeben.

_21 Ich würde mich zukünftig wieder an diesen Chatbot wenden.

Antwortoptionen

1 1 stimme überhaupt nicht zu

2 2

3 3

4 4

5 5 stimme voll und ganz zu

E3 [Human Computer Trust Scale Ausschnitt]

Bitte denken Sie nochmal an den Dialog mit dem Chatbot, den Sie gerade gesehen haben: Inwiefern stimmen Sie demnach den folgenden Aussagen zu?

Items

[randomisierte Reihenfolge]

_1 Ich fühle mich allgemein unsicher, wenn ich mit Chatbots interagiere.

_2 Ich glaube, ich muss bei der Verwendung von Chatbots vorsichtig sein.

_3 Ich fühle mich verletzlich, wenn ich mit einem Chatbot interagiere.

_4 Ich kann den vom Chatbot bereitgestellten Informationen stets vertrauen.

Antwortoptionen

1 1 stimme überhaupt nicht zu

2 2

3 3

4 4

5 5 stimme voll und ganz zu

E4 [Zukünftige Nutzung Chatbot]

Wie wahrscheinlich ist es, dass Sie in einer radiologischen Notfallsituation einen Chatbot nutzen würden, wenn er zur Verfügung stünde?

Antwortoptionen

1 1 sehr unwahrscheinlich

2 2

3 3

4 4

5 5 sehr wahrscheinlich

E5a [Gründe Nutzung]

[Filter: Wenn E4=4,5]

Sie haben gerade angegeben, dass Sie sich vorstellen können, einen Chatbot in der radiologischen Notfallsituation zu verwenden. Beschreiben Sie bitte kurz warum.

_____OPEN

E5b [Gründe Nicht-Nutzung]

[Filter: Wenn E4=1,2,3]

Sie haben gerade angegeben, dass Sie sich (eher) nicht vorstellen können, einen Chatbot in der radiologischen Notfallsituation zu verwenden. Beschreiben Sie bitte kurz warum nicht.

_____OPEN

S5 [Postleitzahl]

Zum Abschluss möchten wir Sie noch um die Beantwortung statistischer Fragen bitten.

Wie lautet die Postleitzahl Ihres Wohnortes?

(Fünfstellige Zahl zulassen)

99 keine Angabe

[S11 Haushaltsnettoeinkommen]

Wie hoch ist das gesamte monatliche Nettoeinkommen aller Personen in Ihrem Haushalt nach Abzug von Steuern und Versicherung?

Bitte denken Sie dabei auch an Renten, Pensionen sowie sonstige Einnahmen.

Antwortoptionen

1 unter 1.000 Euro

2 1.000 bis unter 2.000 Euro

3 2.000 bis unter 3.000 Euro

4 3.000 bis unter 4.000 Euro

5 4.000 bis unter 5.000 Euro

6 5.000 bis unter 6.000 Euro

7 6.000 bis unter 7.000 Euro

8 7.000 bis unter 8.000 Euro

9 8.000 Euro und mehr

99 keine Angabe

Abschluss

Vielen Dank für Ihre Teilnahme!

Appendix: Codeplan (german)

The code plan contains the codes that were reassigned after coding and go beyond the precodes. In some cases open entries could also be assigned directly to the existing precodes.

E1_1 [Bewertung Chatbot offen]

Sie haben gerade einen Dialog mit einem Chatbot zu einem Unfall in einem Kernkraftwerk gesehen.

Wie empfanden Sie diesen insgesamt? Bitte notieren Sie alles, was Ihnen einfällt (positiv sowie negativ).

100 Datenschutz: Summe aus 101 bis 102

101 positiv

102 negativ

200 Links und Verweise: Summe aus 201 bis 302

201 positiv

202 negativ

300 Informationsqualität: Summe aus 301 bis 309

301 bis 304 (Summe) positiv

305 bis 309 (Summe) negativ

400 Verständlichkeit und Sprache: Summe aus 401 bis 403

401 positiv

402 bis 403 (Summe) negativ

500 Emotionaler Eindruck und Tonalität: Summe aus 502 bis 509

502 bis 504 (Summe) positiv

505 bis 509 (Summe) negativ

600 Allgemein: Summe aus 601 bis 603

601 positiv

602 bis 603 (Summe) negativ

700 Design und Aufmachung / Gestaltung des Chatbots: Summe aus 701 bis 703

701 positiv

702 bis 703 (Summe) negativ

800 Sonstiges

801 bis 802 (Summe) negativ

Sonderkategorien

98 Unpassende Antwort; keine Chatbotbewertung

99 Keine Antwort

E1_2 [Bewertung Chatbot offen]

Sie haben gerade einen Dialog mit einem Chatbot zu einem Unfall in einem Kernkraftwerk gesehen.

Wie empfanden Sie diesen insgesamt? Bitte notieren Sie alles, was Ihnen einfällt (positiv sowie negativ).

100 Datenschutz: Summe aus 101 bis 102

101 positiv

102 negativ

200 Links und Verweise: Summe aus 201 bis 302

201 positiv

202 negativ

300 Informationsqualität: Summe aus 301 bis 309

301 bis 304 (Summe) positiv

305 bis 309 (Summe) negativ

400 Verständlichkeit und Sprache: Summe aus 401 bis 403

401 positiv

402 bis 403 (Summe) negativ

500 Emotionaler Eindruck und Tonalität: Summe aus 502 bis 509

502 bis 504 (Summe) positiv

505 bis 509 (Summe) negativ

600 Allgemein: Summe aus 601 bis 603

601 positiv

602 bis 603 (Summe) negativ

700 Design und Aufmachung / Gestaltung des Chatbots: Summe aus 701 bis 703

701 positiv

702 bis 703 (Summe) negativ

800 Sonstiges

801 bis 802 (Summe) negativ

Sonderkategorien

98 Unpassende Antwort; keine Chatbotbewertung

99 Keine Antwort

E5a [Gründe Nutzung]

Sie haben gerade angegeben, dass Sie sich vorstellen können, einen Chatbot in der radiologischen Notfallsituation zu verwenden. Beschreiben Sie bitte kurz warum.

1 Besser als menschlicher Kontakt; Mensch könnte nicht besser helfen

2 Informationsbeschaffung/Informationszugang/Informationsquelle (allgemein); erste Information; allgemeine Informationen

3 Vergleich/Validierung (Chatbot als zusätzliche Informationsquelle)

4 Erreichbarkeit (immer verfügbar; auch bei überlasteten Hotlines erreichbar)

5 Schnelligkeit (schnelle Informationsbeschaffung; keine Warteschleifen; sofortige Antwort)

6 Einfache Bedienung (Informationsbündelung; spart eigene Recherchezeit, weniger Arbeitsaufwand, verständliche Sprache, niedrige Einstiegshürden)

7 Aktualität und Qualität der Informationen; Zugang zu aktuellen und neuen Informationen; Detailliertere Reaktion auf Situation; angepasste Antworten auf spezielle Fragen; Relevante Informationen für individuelle Situationen; hilfreich; kompetent; nützlich; Verweis auf weitere Quellen

8 Objektivität (keine Emotionen; keine Panikmache); sachlich; unvoreingenommen; neutral; logisch; faktenbasiert (Art der Information)

9 Vertrauenswürdig; glaubwürdig; beruhigend; zuverlässig

10 Technologieaffinität (Offenheit/Neugier gegenüber neuen Technologien; generell Vertrautheit in Chatbots)

11 Alternative; besser als keine Informationen

12 Sonstiges

97 Weiß nicht

98 Verdrückt; eigentlich würde Person den Chatbot nutzen

99 Beantwortet nicht die Frage/ keine Angabe

E5b [Gründe Nicht-Nutzung]

Sie haben gerade angegeben, dass Sie sich (eher) nicht vorstellen können, einen Chatbot in der radiologischen Notfallsituation zu verwenden. Beschreiben Sie bitte kurz warum nicht.

1 Lieber Informationen von Menschen

2 Kein Vertrauen in Chatbot; Angst vor Falschinformationen; fehlende Transparenz; Bot nur so gut wie Programmierung

3 Lieber andere Informationsquellen: Radio/Fernsehen/klassische Medien/KatWarn/andere Chatbots/Internetseiten der lokalen Behörden

4 (Technische) Unsicherheiten (Internet; Stromausfall; Erreichbarkeit)

5 In Notfallsituationen keine Zeit für Chatbots/ nicht auf den Gedanken kommen

6 Antworten nicht zufriedenstellend (insgesamt/sonstiges)

7 Antworten nicht aktuell genug/basieren nicht auf aktuellen Informationen

8 Antworten zu allgemein gehalten/ unvollständig

9 Antworten zu künstlich, unempathisch

10 Skepsis/Abneigung gegenüber Digitalisierung im Allgemeinen; fehlende technische Affinität; Unsicherheit bei Umgang mit Chatbots

11 Skepsis wegen staatlicher Kontrolle; Misstrauen

13 Informationsbeschaffung über Chatbot zu langsam/ aufwendig

14 Kennt sich selbst gut aus/ keine Informationsbeschaffung notwendig

20 Sonstiges

97 Weiß nicht

98 Verdrückt; eigentlich würde Person den Chatbot nutzen

99 Beantwortet nicht die Frage/ keine Angabe

Appendix: Overview of sample quality

Table 49 Sample quality by age and gender

Gender x age	Online interviews	
	Unweighted	**weighted**
Male aged 16 to 19 years	2.8 %	2.8 %
Male aged 20 to 29 years	7.5 %	7.5 %
Male aged 30 to 39 years	8.5 %	8.5 %
Male aged 40 to 49 years	7.6 %	7.5 %
Male aged 50 to 59 years	9.3 %	9.4 %
Male aged 60 to 69 years	7.7 %	7.8 %
Male aged 70 to 79 years	4.4 %	4.4 %
Male aged 80+ years	2.0 %	2.0 %
Female aged 16 to 19 years	2.6 %	2.6 %
female aged 20 to 29 years	6.9 %	6.9 %
Female aged 30 to 39 years	8.0 %	8.2 %
Female aged 40 to 49 years	7.5 %	7.6 %
Female aged 50 to 59 years	9.7 %	9.6 %
Female aged 60 to 69 years	7.9 %	8.0 %
Female aged 70 to 79 years	5.3 %	5.3 %
Female aged 80+ years	2.0 %	2.0 %

Table 50 Sample quality by education (grouped)

Education (grouped)	Online interviews	
	unweighted	**weighted**
low	28.3 %	29.0 %
Medium	31.0 %	31.0 %
high	40.7 %	40.0 %

Table 51 Sample quality by federal state

Federal state	Online interviews	
	unweighted	weighted
Baden-Württemberg	13.5 %	13.4 %
Bavaria	15.8 %	15.9 %
Berlin	4.5 %	4.5 %
Brandenburg	2.8 %	3.0 %
Bremen	0.9 %	0.8 %
Hamburg	2.1 %	2.2 %
Hesse	7.6 %	7.5 %
Mecklenburg-Western Pomerania	1.9 %	1.9 %
Lower Saxony	9.4 %	9.5 %
North Rhine-Westphalia	21.8 %	21.7 %
Rhineland-Palatinate	4.9 %	4.9 %
Saar	1.3 %	1.2 %
Saxony	4.9 %	4.8 %
Saxony	2.5 %	2.5 %
Schleswig-Holstein	3.6 %	3.5 %
Thuringia	2.5 %	2.5 %