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Designing an mHealth Application to Support Horse Owners in Assessing Their Horse's Health Status – Results of a Usability Test

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Abstract. Introduction: Existing research agrees that a well-thought design of the user interface is a key point for an mHealth application for animal owners, supporting them obtain information and make decisions regarding their pet's specific situation. However, there is currently a lack of specific advice on the design of such an application. **Methods:** As part of a user-centered design (UCD) process, a formative, explorative usability test with n=5 users was conducted for collecting design ideas. The test was conducted for two applications that were already available on the market. **Results:** The need of supporting comprehensive information input in guided processes that can be adapted to the individual level of knowledge, was identified as a key aspect. **Conclusion:** In this paper, recommendations for the design of a suitable user interface are suggested to support application developers and designers.

Keywords. mHealth, telehealth, animal owners, horse owners, veterinary medicine

1. Introduction

Applications designed for the suspected diagnosis and/or triage in human medicine exhibit promising developments [1]. Nevertheless, a systematic literature review by the authors indicates that such systems are scarcely available for animal owners, particularly within equine medicine. Instead, animal owners frequently rely on the Internet as an information source [2], which poses several risks associated with incomplete or unverified information [3]. These risks are particularly significant given that many pet owners lack specialized knowledge in animal health [4]. A dedicated mobile Health (mHealth) application to support pet owners in obtaining information and making decisions regarding their pet's specific situation may have the potential to improve the current situation. For instance, in an online survey, 75% of horse owners stated that they

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would like to use an application to support decisions regarding their horse's need to be seen by a vet [5].

Currently, there is limited and very general advice regarding the user interface design of mHealth applications for pet owners. However, existing research agrees that a well-conceived design of the user interface is crucial for a good application [6]. In the following, a usability test upon existing websites with the goal of supporting the decision whether or not to call a veterinarian for a pet animal is described. The aim of this horse owner-focused study is highlighting design aspects from existing applications that should be included or excluded from a user (animal owner) perspective. From this analysis, guidelines for the design of a user-centered interface for a mobile veterinary health application like the one referred to above will be developed, that could then be used for the development of a mHealth application prototype for veterinary laypeople.

2. Methods

2.1. Study Design

A formative, explorative usability test was conducted with a mixed methods-approach incorporating a thinking aloud-session, qualitative questions regarding system usage, a quantitative questionnaire based on the System Usability Scale (SUS) [7], as well as additional questions addressing respondents' perceptions of various usability aspects (see Table 1). Systems for the usability test were identified through an online search, focusing solely on those systems targeted directly to pet owners with the goal of decision support regarding the need for a veterinarian. Systems did not need to be comparable in terms of specific functionalities but rather in their overall intended outcome. Due to the limited availability of systems for horse owners, the usability test was extended to all types of pet animals. The search identified two websites, Petriage [8] and Horse Side Vet Guide [9], matching the targeted outcome and were thus included in the usability test. The study design was pre-tested and adjusted according to the feedback received.

2.2. System Descriptions

2.2.1. Petriage Website

The Petriage website [8] provides decision support for users by allowing them to create a cat or dog profile with various information regarding the animal in general (e.g. name, species, age, sex, weight, medical history and human-pet relationship info). Users can then enter multiple observed symptoms of their pet, after which the system presents a list of suggested symptoms known to the system. From this list, the user is prompted to select all that apply before selecting a main symptom from the final list. The system subsequently asks several additional questions about the selected primary symptom (e.g. vital signs, severity, energy level, discomfort level, begin of symptom appearance, frequency of symptom appearance and specific questions related to the symptom). All of this information is entered using scales, dropdowns, radio buttons, and numerical input. Upon confirmation of a summary of all inputs, the system provides the user with a color-coded situational assessment of the urgency of visiting a veterinarian.

2.2.2. Horse Side Vet Guide Website

The Horse Side Vet Guide website [9] provides decision support by guiding the user through a process that begins with selecting the sex of their horse. Users are then prompted to choose a perspective from which to view their horse to be able to select a symptom, or alternatively choose a from a list of suggested scenarios their horse may be in. When selecting a perspective, users must first choose a body region, followed by a specific body part, before selecting the symptom of concern. The user is then presented with an urgency assessment and a summary of that symptom, along with associated symptoms, suggested actions, an explanation of a veterinarian's possible actions and recommended further reading.

2.3. Participants

Participants were recruited through written invitations sent to a horse stable in Berlin and to the personal networks of the authors. Individuals were eligible for the study if they were at least 18 years old and owned at least one horse, as well as at least one cat and/or dog in the time span of the last two years before the study.

2.4. Study Conduction

The study was conducted in individual sessions with each participant in a private room. At the beginning of each session, participants received an explanation of the study's objective and were asked about their previous experience with and attitude toward similar (digital) systems. Participants were then handed a test vignette for a dog or a cat depending on their animal ownership. They were instructed to use the Petriage website on a provided smartphone to determine whether and if so, how urgent, a veterinary should be visited with their pet from the vignette. Participants were asked to think aloud during their interaction with the mobile website. Both, audio and smartphone screen were recorded. After completing the task, either by stating they had found the necessary information or by indicating they could not complete the task using the system, they were handed the study questionnaire. Subsequently, participants received a second test vignette involving a horse to carry out the testing procedure once again, this time using the Horse Side Vet Guide website. Finally, participants were asked a few demographic questions regarding their gender and age group.

2.5. Data Analysis

The audio and screen recordings of each study session were manually transcribed. An evaluation was conducted to determine whether participants felt they had successfully completed the task. The written transcripts of each session were used to mark different aspects: positive and negative usability aspects, as well as the use of undo/take a step back-functionality, faults a participant mentioned in their thinking aloud, and questions asked or support used during the interaction with the websites. Aspects were named, grouped and assessed with regard to their severity (using an adapted version of the scale by Barnum [10]). Subsequently, design solutions and recommendations for a new app to be developed were suggested using ISO norms and mHealth design guidelines [11–16].

3. Results

3.1. Demography and System Statistics

The usability test involved five participants (gender: female n= 4; male n = 1 | age: 18-30 years n = 3; age 31 – 50 years n = 2). Regarding effectiveness, all participants obtained a situation assessment for their test vignette and felt they had resolved their task when using the Petriage website. One participant noted that, on their own, they may have discontinued using the system before receiving the situational assessment. On average, support was sought for 2.4 times (min. 1; max. 4). Participants' SUS scores ranged from 87.5 to 52.5, with a median of 82.5.

In terms of effectiveness, when using the Horse Side Vet Guide website, all participants got a situation assessment for their test vignette, but only two of them felt they had resolved their task. On average, participants sought assistance 1.2 times (min. 1; max. 2). The SUS score ranged from 80 to 22.5, with a median of 52.5. Table 1 presents a summary of the results from the additional questions, which were initially presented to the participants in German.

Table 1. Average ratings of the quantitative user survey regarding the usability of the Petriage and Horse Side Vet Guide websites.

Item	Average rating for the Petriage website	Average rating for the Horse Side Vet Guide website
Scale: very hard (1) – rather hard (2) – neither easy nor hard (3) – rather easy (4) – very easy (5)		
Overall, this task was…	3.6	3.2
Scale: totally disagree (1) – disagree (2) – neither agree nor disagree (3) – agree (4) – totally agree (5)		
I am satisfied with the time I spent on this task	4.8	3.8
I am satisfied with the functionality provided when completing this task.	4.2	3
Scale: completely false (1) – rather false (2) – partly true (3) – rather true (4) – completely true (5)		
The terms and designations used in the system (e.g. the names of the selection options/animal characteristics) are immediately understandable to me.	3.6	4
The system allows me to complete work steps (e.g. entering information) in the order that seems most suitable to me.	4	4.2
The results generated by the system are presented or put out in such a way that they meet my requirements (e.g. through a clear grouping, an attractive visualization).	4.2	3
It is immediately obvious to me what effect my inputs have.	3.8	3.8
The system offers me the opportunity to undo work steps if it is useful for completing my task.	3.75	3.25
I found navigating within the system to be easy.	4.6	3.8
The system's user interface is visually appealing.	4.6	3.2
I found the presentation of the information displayed on the screen to be clear and concise.	4.6	3
When I was working with the system, errors occurred (e.g. that symptoms could be selected that should have been excluded based on previous entries).	1.8	1.33

3.2. Usability Findings

There were several usability findings identified in the study for both websites. Tables 2 and 3 show the findings that, in the authors' opinion, are strongly related to the specific

usage context of an application to support the decision as to whether and how promptly an animal needs to be examined by a veterinarian.

Table 2. Context-specific usability issues of the Petriage website.

ID	Finding	Severity[2]	Design solutions/ recommendations for a new app to be developed
		Petriage	
P1	Users cannot see that all the symptoms they enter textually are processed further.	4	Use a graphical representation of the influence of the symptoms on the overall result given (e.g. Sankey chart)
P2	Users cannot or only with difficulty answer questions in the system (e.g. about the level of discomfort of their animal, the frequency of displaying a symptom, the severity of a symptom or a level of detail).	3	Do not make the question mandatory or leave it out (if possible for the assessment), provide an explanation to support the assessment, specify a lower level of detail in the answer options (first have questions answered with a lower level of detail; e.g. "How is the animal's appetite?" normal/higher than normal/lower as normal and if "normal" is not specified, provide another field to select the percentage of reduction, for example, which is not mandatory -or- reduce the number of items in the scale)
P3	Users cannot or only with difficulty enter specific symptoms (since, for example, only general malaise was noticed).	3	Offer an additional questioning process for this case, in which symptoms of general malaise (fatigue, loss of appetite, etc.) are narrowed down for further assessment
P4	Users cannot answer a question or can only answer it with difficulty (because they lack a reference value, e.g. about the color of the mucous membrane or breathing rate).	3	Specify reference value (e.g. normal (rose-colored), normal (x breaths/minute), increased (x - y breaths/minute), etc.), provide images
P5	Users cannot quickly find the relevant pre-existing conditions of their animal in the list provided by the system.	2	Group pre-existing conditions and gradually reduce the selection circle, e.g. via rough category (digestive tract, musculoskeletal system, etc.), refined category (e.g. hooves, back, etc.) and selection of the disease
P6	Users cannot tell why they have to answer a question (e.g. about worsening symptoms or mucous membrane color).	2	Provide an explanation via a “Why is this important?” link (recommendation: through a popup field)
P7	Users do not receive any information about how they should behave in the current situation (first aid/instructions for behavior).	~	Add information
P8	Users perceive the assessment of the situation provided by the system as not credible compared to their own assessment (which is based on previous experience).	~	Use graphical representation of the influence of the symptoms on the overall result, provide a possibility of displaying the reasons for the assessment (e.g. reduced thirst can quickly lead to dehydration; since it is greatly reduced and has already been present for 3 days, go to the vet immediately)
P9	Users do not receive a suspected diagnosis of their animal's situation.	~	Add information
P10	Users can clearly see the limits of the system.	+	
P11	Users can select detailed pre-existing conditions for their animal.	+	

Table 3. Context-specific usability issues of the Horse Side Vet Guide website.

ID	Finding	Severity[2]	Design solutions/ recommendations for a new app to be developed
	Horse Side Vet Guide		
H1	Users cannot find the specific symptom they are looking for.	4	For symptoms that the users were not able to find in the system, add an additional process (e.g. behind a corresponding "I can't find my symptom" link) that narrows down/describes the missing symptom (especially for wounds)
H2	Users cannot find a symptom they are looking for in the expected region of the body.	4	If necessary, assign symptoms to more than one area of the body, check the assignment through tests (e.g. card sorting), add a text search function as an alternative input option
H3	Users cannot tell which stages a symptom can include (since the images sometimes only show very advanced symptom stages).	1	Provide images of different intensity stages
H4	Users cannot enter any information about their horse's disease history.	~	Add input
H5	Users cannot select multiple symptoms at the same time.	~	Add input
H6	Users cannot enter information about the horse's body temperature.	~	Add input
H7	Users can view images of symptoms known to the system.	+	
H8	Users can select their animal's symptoms via an image representation of the horse's body.	+	
H9	Users can select a specific situation in which their horse currently is.	+	
H10	Users can view and select symptoms similar to the currently selected symptom.	+	
H11	Users receive a hint from the system to contact their pet doctor with information regarding their horse's specific situation (e.g. sending a photo).	+	

3.3. Design Recommendations from the Usability Findings

All usability findings presented in this paper can be categorized according to specific aspects of the usage context analysis relevant to the use case [5], as follows:

Equestrians want the uniqueness of their animal's situation to be recognized by the application. This pertains to P1, P11, H1, H4, H5, H6 and H9 from Tables 2 and 3. Recommendations for designing a suitable system include: Allow the users to describe the specific situation (e.g. the type of accident) their horse is or was in. Enable the input of all vital signs, detailed symptoms and detailed medical history of their horse, and explicitly show (e.g. through a Sankey chart) how this information has influenced the system's evaluation. Provide a guided process for narrowing down symptoms that users

[2] 0 – no usability problem; 1 – cosmetical problem (solve if it is easy and when there is time left); 2 – minor problem (low priority, but needs to be solved); 3 – major problem (significant impact on the usability of the system); 4 – catastrophe ("show stopper") [10]; ~ – comment by the participants which can refer to both a usability and functionality problem; + – positive usability finding

were not able to describe or match to the systems suggestions. This is particularly important for wounds and other lesions, whose urgency depends on their exact location, type etc.

Equestrians may have only little veterinary knowledge, but can recognize when something is wrong with their animal without knowing what this may be. This pertains to P2, P3, P4, H3, H7 and H10 from Tables 2 and 3. Summarized recommendations are: Include meaningful images for symptoms that describe the look and especially possible stages (even early ones) to the users. Facilitate the identification of similar symptoms to help users find the best possible match. Provide the users with reference values regarding normal behavior, values, etc. as they may not know what the normal state should be. If concrete assessments regarding animal symptoms should be given (like the amount of reduced appetite), provide them with a guided process to determine this assessment through easier questions, starting at a low level. Keep in mind that users may not be able to give high level assessments or that those might be wrong. Furthermore, provide a possibility to guide the users through a process of determining where a feeling of the animal being unwell may come from (e.g. fatigue, loss of appetite), to make a situation assessment possible.

The equestrians' primary goal is to ensure their horse's well-being. This relates to P7, P10 and H11 from Tables 2 and 3. Design recommendations include: Clearly define the application's limits so users know when to trust the application and when to consult their veterinarian. Do this beforehand, and in case of a specific evaluation process requiring further assessment by an expert. If the consultation of an expert is recommended, provide the users with hints about what they should tell (information) or send (photos, videos) to their veterinarian. In every case, provide the users with specific and easy-to-understand instructions for their behavior in the current situation (e.g. first aid-actions, signs to look out for, etc.)

Equestrians have unique mental models, interpretations, and decision-making processes. This pertains to P8, P9 and H2 from Tables 2 and 3. Design recommendations include: Show which inputs influenced the system's evaluation and what quality-assured knowledge was used to decide on the urgency of the case (like "Reduced thirst can quickly lead to dehydration. Since your animal shows greatly reduced thirst that is already present for 3 days, go to the vet immediately."). If possible, offer a suggested diagnosis or an information summary that enables them to verify with other sources. Ensure the input process allows for symptom reporting according to the user's individual level of knowledge. If symptoms are grouped by body regions or body systems, make sure that the groups match the equestrians understanding, e.g. through card sorting. Include an alternative text input option for flexibility.

When a horse may be unwell, equestrians experience an emotional and stressful situation where they may not react calmly or take much time answering system questions. This relates to P5, P6 and H8 from Tables 2 and 3. Design recommendations include: Avoid unnecessary questions in the application. Explain to the user why questions, whose importance some users may not know, are relevant to the evaluation. This should not disturb the user's flow. Also, enable users to select symptoms from a visual representation of the horse's body to facilitate and fasten the input.

4. Discussion

4.1. Discussion of Results

Compared to the general population of equestrians, the participants of this usability study were overall a bit younger than the equestrian age average. The gender distribution was similar to the one seen in amateur sport [5].

The SUS of the Petriage website was rated between "ok" and "excellent", with an average rating of "good". In contrast, the Horse Side Vet Guide website received lower ratings, ranging from "awful" to "good", with an average rating of "ok" [17]. The higher SUS rating for the Petriage website could be explained by the more structured flow the authors identified in the Petriage website. The higher rating of the Horse Side Vet Guide website in questions of ease of use and understanding of what is happening may be due to the simpler structure of the evaluation process that was identified by the authors, which focuses on one main symptom. The Petriage website, on the other hand, received higher ratings for its suitability to the context specific (complex) requirements and needs [5]. This is also part of the usability findings. For the Horse Side Vet Guide website, several usability findings were related to users not being able to enter all the information they found relevant for the situation at hand (H4, H5, H6). In contrast, for the Petriage website several usability problems connected to the complexity of questions (P2, P3, P4, P6) and to the understanding of the evaluation result (P8). This can be attributed to the equestrians' limited knowledge regarding the veterinary field and vocabulary, as well as their wish for a situation to be handled as unique [5].

These findings align closely with identified requirements for mHealth applications for animal owners [6]. However, aspects such as the simple presentation of information, questions, etc. to facilitate understanding by laypeople still remain unresolved.

Many of the usability findings mentioned can also be found in a systematic literature review on the usability of symptom checkers in human medicine. Here, too, perceived limited input options, difficulties in entering all relevant information on the current situation and difficulties in understanding the information presented were identified as relevant usability factors [18].

In a usability study on the design of an electronic health diary for children, kept by parents and thus analogous to the third-party anamnesis process of pet owners [19], users requested detailed step-by-step instructions [20]. This mirrors the usability problems related to the complexity of questions, highlighting a clear need for action in this area.

The use of easily understandable language in mHealth applications is extensively discussed in relevant literature. Similar problems were noted in several usability studies related to third-party anamnesis in human medicine [21–24]. Recommendations for mHealth development, such as those in [16], emphasize writing for clinical laypeople at a maximum reading level of sixth grade, avoiding technical jargon or possibly unknown acronyms.

The design recommendations for this usability test were developed using guidelines from human medicine mHealth applications. All recommendations in this study were derived from applicable norms or guidelines, suggestions from study participants, and the authors' expertise in the usability field. However, it is important to note the potential influence of users attempting to apply their human medicine experiences to animal health, which must be carefully managed in application design to minimize errors [5]. This is particularly critical because individuals with low health literacy are more likely to use such systems [18].

All designs that were suggested based on these aspects should be tested with users in future studies. Given the apparent similarities between other animal owners and equestrians [5] and the eligibility criteria of the study, the findings may be applicable not only to equestrians, but also to applications targeting other types of pet animals.

4.2. Discussion of Methods

The usability test was conducted with a mixed-methods approach, allowing the authors to collect opinions and ideas of the users, while simultaneously contextualizing them through an overall quantitative evaluation of system usability by the same participants. The study was conducted with five testers, a number generally considered sufficient to uncover most usability issues [25]. However, it is possible that some usability problems may have been overlooked due to the number or selection of testers.

As participants were handed a test vignette to conduct their given task in the systems, and therefore were not able to rely on their own impression of a real-life situation, it is possible that this might have influenced inputs to and/or outcomes of the tested systems. Despite this, using test vignettes are recognized to be effective for providing information to study participants [26] and were thus preferred over using individual cases from participants' memories, where the outcomes were already known.

The study transcripts were analyzed independently by two of the authors, with several authors involved in interpreting the results. Consequently, missing important aspects in the data analysis is highly unlikely.

5. Conclusion

This study explored the current state of usability of the limited applications available for pet owners to triage their animals. The results will help in a targeted approach for the design of mHealth applications that support the decision whether or not to call a veterinarian from the viewpoint of a veterinary layperson, like most horse owners and similar user groups.

Several critical aspects were identified for an application’s success in this specific context. Key recommendations for designers and developers include providing the opportunity to consider or provide comprehensive information regarding the animal and its current situation, implementing guided processes for the input of several types of high-level information, and offering various explanations to enhance user understanding of the application's process and underlying knowledge. This guidance will enable not only the authors, in their development of a prototype, but also designers and developers of similar applications, to make well-informed suggestions for the design of applications that support the decision as to whether or not and how promptly an animal needs to be examined by a veterinarian.

Declarations

Ethics

In accordance with the Declaration of Helsinki, all study participants were adequately informed about the study and gave their written consent. The study was reported to the Ethics Committee of Technische Universität Dresden (application no. SR-EK-129032024).

Conflict of Interest

The authors declare that there is no conflict of interest.

Author Contributions

LH, JW, BS: study design; LH, JW: data collection and data analysis; LH, JW, IJ: data interpretation; LH: manuscript writing; LH, IJ, BS, MS, DM: substantial revision of the manuscript. DM, BS, MS: contribution towards the resources. All authors have approved the manuscript as submitted and take responsibility for the scientific integrity of the work.

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