Requirements Engineering Elicitation for Mobility Assistance Dogs: Meeting Canine User Needs Through Technology Enabled Interpretation

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Abstract

Current requirements engineering methods are heavily reliant on verbal techniques, which are inaccessible to non-verbal users, such as mobility assistance dogs (MAD). Findings from a recent pilot study, conducted at a MAD training facility, show that the elicitation of canine stakeholder needs while in training is highly dependent on employee interpretation. This paper promotes the use of technology in support of meeting canine user needs, as suggested by the emerging field of Animal-Computer Interaction (ACI), by enabling trainers and employees to accurately elicit and interpret canine stakeholder requirements.

1 Introduction

Current requirement engineering (RE) methods are heavily reliant on verbal techniques for eliciting stakeholder expectations of technological applications [1]. However, in the case of special groups - including people with cognitive impairments, young children and animals - the baseline for verbal capability has a high level of variance, and in some cases such a capability is non-existent, as in the case of dogs. Since they routinely interface with the built environment on behalf of their assisted humans, MAD are widely recognized within the ACI community as technology users [2]. In order to design interfaces that can better support their work, ACI researchers have started to investigate MADs' interactions with the built environment, and the training processes that the dogs undertake to learn their work skills and be matched with a human partner [2]. In this regard, developing accessible requirements elicitation techniques for those who do not possess verbal capabilities - such as MADs in training - is vital to meeting their needs.

Most RE methods include some form or other of interpretation [3]. However, when it comes to other species, the complexity of interpretation increases due to differences in cognitive, physiological and sensory capabilities between elicitors (humans) and users (dogs) [2]. In the case of MADs, the result of the training stage of their development is used to identify a compatible placement with a disabled individual and their living environment. Hence, the methods used to assess MADs' behavior and temperament to match them within a partnership are highly influential on their future.

This paper reports preliminary findings from a recent pilot study using ethnographic methods to investigate the current MAD training and matching assessment processes, and their reliance on employees' ability to interpret canine behavior. Although, employee practices are carefully designed to utilize objective assessment

criteria, they may still be open to instances in which inaccurate interpretations of canine behavior(s) may result in the misrepresentation of MAD stakeholder needs.

2 The Study

2.1 Aim

The aim of the pilot study was to gain an overall understanding on processes and interactions involved in whelping, training, matching and placing MADs with clients, as a means to identify areas that may directly impact their wellbeing and performance. This early work is part of doctoral research within the project Dog-Smart Homes: Portable Controls Optimized for Mobility Assistance Dogs, whose objective is to improve the performance and wellbeing of MAD partnerships.

2.2 Participants, Data Collection Methods and Study Limitations

The fieldwork was conducted at the facilities of Dogs For Good (DFG), a UK-based charity focused on *"creating partnerships between people living with disability and specially trained assistance dogs."* [4]. During the week long study the researcher interviewed 13 staff members who work within the areas of training and development, and service support and administration, 1 MAD dog partnership, and 1 puppy volunteer, as well as extended observations of 3 MADs in training. Data collection methods included observation, shadowing, participatory research, semi-structured and contextual interviews, which were recorded, based on participant preference, in the form of photography, audio, and video. The processes observed during the study represent common examples of operations within the industry [5] [6].

The ethnographic data collection methods and analysis of this study were limited in as much as all interviews were mediated through the researcher. In addition, the study is based within a particular context, that of DFG, which although a common example of MAD industry operations is still a particular charity, with characteristic processes, roles and methods.

2.3 Data Analysis

Coded interview guides were created in advance containing nominal categories such as interviewee name, role, and time employed at DFG and focused on categories of inquiry regarding: employee past experience, reason for working at DFG, role and responsibilities at DFG, role challenges and successes, information management, canine behavior, and their individual experience in interacting with MADs.

Video and audio recordings were transcribed as individual files for every participant. Subsequently, the file content was categorized into individual text cells and coded with participant identifiers and those established in the interview guides. Content that did not fall into any of the pre-established codes was categorized under the heading "other", and was then reviewed in order to identify emerging content themes among the various participants [7] [8].

The result was a consolidated content database that allowed the researcher to review each content cell and allow a secondary categorization into content relating to: A) Functional DFG Interactions: all content regarding any process, method or activity carried out by DFG in order to complete any part of the whelping, socializing, training, matching, placement or aftercare of MAD, and/or client application, selection, matching and placement; and B) MAD and Human Interactions: all content pertaining to specific instances where any participant was engaged in an interactive experience with another participant or a MAD.

This secondary categorization of the individual content cells by type of interaction was used to create a variety of analysis documentation, including a database of notable canine behaviors of detailed descriptions of episodes in which canine behaviors elicited value-based verbal assessments on the part of the study participants and/or the researcher. The episodes are indicative of employee intent to ensure objectivity, yet illustrate the importance that employee interpretation has in accurately representing MAD stakeholder needs. This paper uses one of the incidents from the database, identified as Incident F, as a means to show how the elicitation of canine stakeholder needs while in training is highly dependent on employee interpretation.

3 Incident F Background

3.1 Focus on Training and Matching

To prepare them for the services offered by DFG, dogs identified as potential MADs partake in purposefully designed training and development programs. These services extend during the working lifespan of a MAD and include the following stages: breeding, socialization, training and matching, placement with client, partnership aftercare, and retirement. Based on the amount and influence of assessments and human intervention observed, services carried out during the MAD training and matching phase have the most influence on how their future will unfold; as it is here that their suitability and aptitude for working as MADs is assessed, and used to match them with their human partners.

At approximately 18 months of age, dogs that have been living with volunteer socializers come back to DFG and are placed with temporary boarders while undergoing a 16-week training program. During this time they are taught the necessary skills to develop from well-behaved companion dogs to specialized MADs. MAD training and matching activities are guided by a total of 11 assessments, complemented by constant observation and discussion of the dogs behavior and development by charity staff and, in certain occasions, also by their temporary boarders, potential clients and future caretakers. The number, variety and frequency of assessments being performed evidence the complexity involved when eliciting and assessing training requirements for MADs.

3.2 Kennel Behavior/Training Request (KBTR) Assessment

One of these assessments is the KBTR form, essentially an incident report form, used between MAD trainers and kennel staff to clearly identify potential behavior issue(s) exhibited by MADs in order to quickly and consistently intervene and resolve said behavior(s). These forms are designed to collect very detailed data to enable trainers to identify exactly whether kennel staff intervention is warranted. The information recorded includes: (a) name of the dog, (b) name of trainer and allocated kennel staff; (c) the date in which the behavior was observed; (d) the description of the behavior or reason for the request; (e) the request itself; (f) the date in which the issue and dog are to be reviewed; (g) signatures and dates confirming the discussion of the potential behavior issue between trainer and kennel assistant; (h) and the date in which the request was submitted to the management, signed by the trainer, and health and welfare manager. All staff at DFG are constantly observing MADs in training and are in a position to highlight any behavioral issues. If this happens, they are encouraged to alert the MAD's assigned trainer and describe the incident.

4 Incident F Description

During the study, while waiting in the training and instructor office, a large room outfitted with hot desk tables where employees come and go continuously and MADs in training (no more than 3) are kenneled throughout the day, the researcher observed one dog in training (Dog A) pacing and whining. Hearing the whining, a few employees offered calming feedback and a toy. Shortly afterwards, Dog A whined again. Even though, to the researchers knowledge, the whining had just started, one of the employees (Employee A) expressed concern and called Dog A's trainer (Trainer A) to alert them to this behavior.

Later on, while interviewing Trainer A regarding canine behavior, and specifically how trainers interpret and assess MADs' behavior during training, the following comments were made:

Trainer A: *"This afternoon the fact that Employee A called me and told me Dog A was quite stressed in the office, I dont know what it was that particularly caused that. I took Dog A out this morning, I did not take Dog A out at lunch but it's not like I usually do. It's not like there is much change. I did pop into the office but then I have done that many times before. I don't know. Was there lots going on or very little going on? Did Dog A need to toilet? Because there are so many things we don't see. Had Dog A been on a walk or not? Is Dog A then anticipating other things? But the fact that we came in here and within a few minutes Dog A fell asleep or has been asleep the whole time, you know it could have been very isolated to that situation. If Dog A was still pacing here I would be like, oh maybe Dog A has an upset tummy or what has happened today, then send an email, has anything been different? Have there been any changes? The fact that Dog A has just come out and slept. Who knows?"*

5 Findings

5.1 Incident Impact on Trainer and MAD

Based on study observations, interview data and the above mentioned database of canine notable behaviors analysis document, incidents such as the one described above are a common occurrence. Trainers are not always present when the MADs they are training exhibit behavior(s) that could be construed as KBTR assessment worthy. Thus, they are left to find clues, discern the validity of employee accounts, and run through a mental inventory of possible reasons as to what might have affected the dogs. On their part, non-verbal MADs are unable to offer an explanation and are entirely dependent on the trainers' ability to accurately interpret the incident, which is highly influenced by the trainers knowledge of canine behavior, as well as DFG staff and processes.

5.2 Accurate Interpretation

On this occasion, Trainer A knew enough about MADs and Dog A to accurately discern and assess the behavior in a context-aware manner (i.e. keeping her knowledge of Dog A's usual temperament in mind and thinking about Dog A's usual daily activities) and to realize that filling in a KBTR request was not necessary. An inexperienced trainer might have misinterpreted the behavior and filled out a KBTR request which would have caused staff time to be wasted on addressing a non-existent issue. More importantly, it could have impacted Dog A's progress during training, due to either unnecessary requests for further assessment and/or intervention, or inaccurate associations between Dog A and anxious behavior.

5.2.1 Clear Interpretation

Furthermore, the observation of this episode highlights the importance of employees clearly and unambiguously interpreting canine behavior. During the call between Trainer A and Employee A, words were used to describe the behavior of Dog A without Trainer A having witnessed the behavior or without it being recorded (i.e. on video). This exchange evidences an assumption that both Trainer A and Employee A are versed in the vocabulary used to describe MAD behavior, and more specifically MAD behavior within the organizational context of DFG. Getting to know, align on, and reach a common understanding of descriptive vocabulary used within a specific domain (e.g. canine, assistance dog, MAD, Dog A) and context (e.g. canine training, assistance dog training, MAD training, DFG training) requires experience. A new employee might witness behavior from Dog A that they might describe as anxious, when the dog might just be excited. This too could cause wasted time and effort on the part of DFG staff members, and - again most importantly - a recorded instance in a KBTR of misrepresented behavior attributed to Dog A, which could impact on how and with whom the dog is ultimately matched.

5.2.2 Explicit Interpretation

Finally, in our records of the incident reported above, the researcher noted down, when Employee A phoned Trainer A, Dog A's whining as *"just having started"*. However, in Employee A's account to Trainer A, there was no mention of the duration of the whining, only its frequency. While this might appear to be a minor piece of information, its inclusion or omission implies important assumptions on the part of all human interpreters of Dog A's behavior. For example, the researcher interpreted the behavior as a non-issue due to it having just begun, even though it might have been ongoing throughout the day without the researcher being aware of it. On the other hand, employee A assumed the frequency of the whining was enough to call Trainer A, even though Dog A might be prone to intermittent whining spouts that end as quickly as they begin. As a result, Trainer A might have assumed that Dog A had been whining frequently, and for a long time, conflicting with their prior knowledge of Dog A's whining spouts, as mentioned above. In this episode, the information being implicitly assumed by all human witnesses opens possibilities for reaching a misleading interpretation. Mitigation of assumptions could come either from knowing how to accurately assess and discern MAD behavior, as mentioned in 5.2, or from knowing what information to elicit from employees that witness a notable behavior incident. Regardless, the result for Dog A is based on Employees A's previous knowledge of MAD behavior in general, rather than Dog A's specific circumstances, which could lead to the dogs behavior being misinterpreted.

6   Discussion

The KBTR episode illustrates the complexity encountered by DFG employees in accurately interpreting canine behavior(s) in order to elicit and to meet user needs for MADs in training. Such thorough practices rely on numerous assessments, staff knowledge, and employee experience – yet they remain open to the risk of behavioral misinterpretation, leading to possible misrepresentation of MAD stakeholder needs. In this respect, meeting MAD user requirements could be further supported through technology that promotes human-animal communication, as proposed by researchers within the emerging field of ACI, by supporting the process of human interpretation of canine behavior(s).

6.0.1   Vocal Activity Monitor

For example, behaviors that result in vocal expression, such as whining or barking, are usually behaviors that need to be highlighted during MAD training, due to their possible effect on clients, and implications for public access. Here, taking advantage of the fact that MADs in training work to specific schedules, where their activities are closely tracked, the dogs could be outfitted with non-invasive vocal activity monitors to track frequency and duration of vocalizations throughout the day. By knowing the context the dog was in, and their vocal patterns and behaviors, the activity monitor could create an individual profile for dogs. The profiles could then be used to establish individual vocal baselines and thus inform an accurate assessment of the impact the behavior could have on the dog's ability to work as a MAD. In addition, if recorded behavior was out of range of the individual's profile, the monitor could prompt trainers and employees to record the incident, thus enabling a more objective assessment of the behavior. Furthermore, behavior that was unusual to a particular dog could enable trainers to quickly identify new requirements and adjust the dog's training experience.

6.0.2   Vocabulary Standardizer

Another instance where technology could support human interpretation of MAD stakeholder needs is by supporting the standardization of terminology used when recording information about MAD behavior witnessed by employees. For such a system to work DFG would need to invest time on the discussion and definition of detailed behavior descriptions. Once this DFG behavior descriptive language was defined, it could then be coded and specific descriptors could be associated with a range of linguistic expressions more or less commonly used to describe the same behaviors within the dog and/or MAD training industry. This initial linguistic mapping would still allow DFG employees to choose their preferred expressions when describing a particular canine behavior and thus develop their own tailored vocabulary profile linked to standard descriptors. When recording their written assessments into digital formats -a common practice within the industry, their vocabulary could be traced back to the standard descriptors thus improving the consistency of language usage and interpretation within the organization. In addition, by highlighting any substitutions, the envisaged system could prompt employees to notice the adjustments made by the system thus promoting the future usage of the standardized DFG behavior terminology. This could facilitate the interpretation of MAD user needs by fostering the use of a standardized vocabulary across all assessments and among all DFG employees, thus enabling a more consistent and accurate interpretation of MAD behavior.

Due to the non-verbal nature of MADs communication, the impact of human interpretation on MAD training service needs cannot be avoided. However, as exemplified above, ACI researchers could develop inclusive RE approaches aimed at mitigating human impact on MADs through the deployment of technologies that better support humans elicitation and interpretation of MAD stakeholder specifications. Thus, we suggest that technological applications such as the ones described above should be further investigated.

7   Conclusions

The findings of a recent pilot study suggest that eliciting and meeting the needs of MADs in training are impacted by employees' ability to accurately, clearly and explicitly interpret their behavior and thus determine if and with whom a dog is placed within a partnership. Lack of accuracy, clarity and explicitness could potentially lead to flawed assessments and thus to inappropriate decisions for a dogs future. Further research into how technology might support accurate human interpretation could lead to the development of RE approaches and toolkits that support more accessible requirements elicitation techniques, helping researchers and practitioners meet the needs of non-verbal users such as MADs.

7.0.1 Acknowledgments

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