Contributions of user tests in a Living Lab in the co-design process of human robot interaction

Marion Olivier, Stéphanie Rey, Dimitri Voilmy, Jean-Gabriel Ganascia

Contributions of user tests in a Living Lab in the co-design process of human robot interaction

Olivier Marion, Rey Stéphanie, Voilmy Dimitri, Ganascia Jean-Gabriel

Abstract— **In the context of an aging population, technological tools such as socially assistive robots (SARs) have made their appearance as tools to assist the work practices of care teams in contact with the elderly. We want to show the contribution of user tests in a Living Lab in the process of co-designing such tools. These tests allow both technical problems to be highlighted and Human-Robot Interactions (HRI) to be studied in an iterative way. We conducted tests with elderly users as well as teenagers, to analyze the strategies used by users of the system. This also allowed us to observe the first emotional reaction and the first interaction modality (tactile or vocal) provoked by robot. Based on these observations, we propose perspectives for a better HRI.**

I. Introduction

Demographic projections inform us that by 2030, one out of six people will be 60 years old and over. This increasing ageing population leads us to rethink, and to question, our care system. Frailty is a reversible state, unlike dependence, and adapted support would make it possible to prevent the loss of autonomy for the elderly.

The emergence of social robotics offers new perspectives of support in establishments welcoming frail people (retirement homes, day care centres, independent living facilities, etc.). But how are these technologies really perceived, accepted, and used? Moreover, these robots remain confined to the research domain and several gaps in the state of the art remain to be explored (section II).

II. Related Work

Four characteristics are usually put forward to define an emerging technology [3, 9–11] : 1) the disruptive technology shows an “innovative character, a significant technological advance, partially achieved or in the making”[2]. 2) The uses of an emerging technology are still unclear and undifferentiated, and consequently so are the ways in which they are appropriated. 3) Limitations remain on the massive development of its application. 4) The technology offers the promise of a transformation of the economic and social context in which the technology will be introduced.

For [5], Socially Assistive Robots (SARs) would support the caregiving process. They categorize these robots as social when communication is possible. There is no strict definition of SAR but [6] describe them as the intersection between the socially interactive robot and the assistive robot, emphasizing the importance of social interaction.

Some research on social robotics, has focused on guidelines for making a social interaction robot more “sociable” [7, 8]. It suggests several points that require corroborating scientific studies:

- Use social communication conventions - understandable and intelligible to all users
- Avoid the “uncanny valley” [9] in robot design.
- Use near-natural movements (with fluidity)
- Balance function and form (correlation between the robot’s capability and appearance)
- Provide the machine with emotional communication
- Make the robot as autonomous as possible
- Develop the robot on the limits of the human - its use must respond to a real problem determined before the introduction of the robot
- Facilitate the development of the robot's own identity - the robot becomes its own actor, participating in the “social scene” (as defined by Goffman [10]).

At present, social robots remain emerging technologies still confined to the research community and several problems are highlighted [11]. The methodologies applied to research on robots in elderly care are vague and not very replicable [12] so they are not very appropriate for long-term real-life trials [13]. The lack of robustness is also recurrent with the use of robots and can influence their acceptance [14]. The elderly are a specific population, and individual health issues can make it difficult to tailor the tests [15]. Finally, the lack of long-term studies is often reported [12, 17].

The use of participatory design (PD) is encouraged in the field of science and technology studies, because of the fit and mutual influences between the social context, the technology, and then the use of the technology [18, 19]. In contact with particular public PD allows better identification of the existing expectations and problems to co-construct usage scenarios for this technology [20,21].

However, before introducing the machine in an ecological environment, it is important to test it in the laboratory with real users to improve the design prototype iteratively.

The Living Lab approach provides a realistic environment and a user-centred innovation approach for the evaluation and development of a technology [24, 25]. The objective is to present the prototype directly to the user to foster collaboration and allow multiple iterations in the innovation process [23]. The user tests in Living Lab also allow the researcher to understand the user better by offering the possibility to reflect on his use of the technology (through self-confrontation interviews for example) [24].

III. Project and Aims

Our project consists in introducing a social robot into an institution for elderly people in order to study its impact on social interaction and its acceptation, as in the case of an emotional robot [25]. With these observations in ecological environments, we seek to fill the gap in field data on long-term studies identified in the state of the art.

We use a 3-step method of the experimental sociological approach to design a human-robot interaction [14, 26]:

- analysis of human-human interaction (HHI) in the situation
- development of the robot based on the previous analysis
- observation of the human-robot interaction

In this paper, we want to show that, before introducing the robot in the ecological environment, user testing in the Living Lab environment is an iterative step in this process to improve the prototype. The observation of these tests allows us to design the use of the technology better.

We will explain the previous work leading to the user tests in Living Lab, which we will then describe. Then, we will show what we have observed and conclude with the contributions of these tests towards the design of a social mobile robotics solution.

IV. Prior Works

To co-design the use of the robotic platform Tiago (developed by Pal Robotics) we conduct an ethnographic study, before the introduction of the machine, correlated to a participative approach. From these observations, use cases emerged. It was then necessary to prioritize these use cases. We will detail this process in this section and then focus on the contribution of user tests.

A. Define use cases from cultural probes, interviews, and immersion

The first phase of our study was devoted to the observation of social behaviours and actual work practices [10, 11] in a medico-social institution in the field of geriatrics.

After combining cultural probes [29] and interviews, we identified recurring and problematic themes in the situated activity of healthcare professionals [30]. Immersions in the field [25, 29] were added to the methodology to identify key moments for inserting the robot into work practices.

From the analysis of the data collected (cultural probes, interviews, and observations), we extracted several scenarios or use cases.

1) **The welcome robot**: the talking machine is placed at the entrance and welcomes and greets the people it meets. It also encourages people to move towards the snack table, thus making the passage more fluid.

2) **The information robot**: it is able to start a conversation with “small talk”: time, date, weather, news of the city, menu or even planned activities.

3) **The motivational robot**: depending on the time of day, the robot motivates people to go to a certain place, such as the dining room when it is almost noon, or the common room when it is time for an activity.

4) **The robot that repeats barrier gestures in place of the caregivers**

5) **The robot that stimulates** by addressing a confused person at the table to encourage them to eat

6) **A guide robot** that can be asked for directions

7) **A robot proposing individual games** on its tablet (memory games, calculations, etc)

8) **A robot as a support** for group activity, directed by the animator it asks questions like in the game “Who Wants to Be a Millionaire?”.

B. Development and prioritization of scenarios with focus groups

In order to prioritize these use cases, we organized focus groups [32]. For our scenarios, we described each situation and asked for participants' reactions. We listed the negative and positive verbatims expressed about each situation, which allowed us to eliminate some scenarios.

In addition, an "ethics scale" was constructed: each person was encouraged to place the scenarios (numbered) on a scale ranging from “*I feel very uncomfortable with this situation*” to “*I have questions about this situation*” to “*I feel completely comfortable with this situation*”.

The collection of data on use scenarios (ethical scale, positive and negative verbatims) during these focus groups allowed us to discard some use cases to focus on 4 scenarios:

- The information robot
- The welcome robot
- Individual games
- Group games

As the robot is equipped with a touch tablet on its "torso", a second focus group was also organized to co-design the graphical interface. The addition of the touch interaction modality appeared to be essential during the ethnographic immersion in order to avoid the exclusion of people with deafness problems. We went to establishments welcoming elderly people with touch tablets (similar to the one of the robot). We organized "tablet workshops" so that the participants could manipulate and give us their feedback directly. Several iterations were necessary to arrive at the current interface.

V. Methodology

Thanks to the feedback from field experiments, we developed a user test scenario where the robot welcomes a person (or a group) at the entrance of the experimentation room (“welcome robot” scenario). A second phase of this scenario leads the user to interact with the robot (“information robot” scenario). The observation of these user tests allows the design prototype to be improve and to initiate a study of interactions with the machine. They are first carried out in a realistic environment, within a Living Lab [33] and then, in a second step, we will place them in a real environment within institutions welcoming elderly people.

The objective of this Living Lab approach was to create a functional prototype by revealing all the technical problems. This also allowed us to collect data on the social acceptability of this robotic tool in a geriatric institution, in pre and post interviews.

In a pre-interview we explained to the volunteers the way the session would be conducted and collected their consent for the audio and video recordings. We explained the context of the scenario: the person had to imagine the robot as being placed in a day care centre for elderly people with cognitive disorders.

Then, the experimenter directed the participant to the robot where he/she was left alone, at first without information, to interact with the robot. Once the person seems to finish his interaction or if he makes the request to the experimenter, the latter gives him indications such as: you can ask for the weather forecast, you can ask for the horoscope, you can interact in a tactile way on the screen.

During the post-interview, we discussed several aspects with the person:
- The test in a general way
- Her/his appreciation of the robot in general
- The robot's voice
- The distance between the person and the machine
- The navigation of the machine
- The speech spoken by the robot
- The tactile interaction
- Ideas for improvement

We also allowed ourselves the possibility of reviewing the video of the test with the participants in self-confrontation to question these aspects and to collect their feelings on the spot.

We invited participants to come and test this scenario in the Living Lab. Teenagers on an observation internship at the Living Lab participated in this process first, then seniors came to contribute. We decided to test with teenagers because they were an easily accessible resource and, in addition, they are potential future family caregivers. Moreover, it is not uncommon to see teenagers visiting their grandparents in a retirement home. In the establishment we visited, we also met young adults (18 years old) on a short contract to accompany the elderly in their daily lives (civic mission).

Twelve people performed this test : A total of eight teenagers aged between 14 and 15 years and four people aged between 75 and 90 years. Three tests were done with pairs of users (two with teenagers and one with elderly people) and six with single users. On average, the tests with the robot lasted less than ten minutes.

During the first tests, the prototype was not stable (with software and audio/video equipment problems) and needed a controlled environment. We conducted these tests in an experimentation room where the participants had access to the experimenter and the engineer who secured the robot with a real-time remote intervention if necessary (1st Session).
Once we improved the prototype, we were able to migrate the tests to a realistic environment represented by an experimental apartment (control apartment) [23], where the research team could observe in the adjoining control room and was therefore no longer in contact with the participants (2nd Session).

VI. FINDINGS

1) 1st Session: time-lag and engagement

During the first tests we observed a permanent problem with the robot. When the user made a vocal request, the robot had a time-lag between 10 and 13 seconds before answering or sometimes failures in the vocal recognition, and no answer at all. We observed that the user would then turn his attention to the experimenter present in the room for each response, allowing a mutual orientation towards the shared interactional space [34]. Research on Intelligent Voice Assistants (IVAs) in an ecological environment [35] have also shown, that there is a “user’s work” of repetition and reformulations that can lead to the abandonment of the system if it is not responsive. To avoid abandonment, Goffman informs us that “*it is advisable to avoid too long silences*” [36] in order to preserve the actors' engagement in the interaction. The robot being considered as an actor in the triad of user-robot-researcher interaction, during long silences, to preserve face[1] in the presence of the robot, the user turns to the researcher to find a solution in order to maintain his commitment in the interaction.

To overcome this technical problem, we added sentences spoken by the robot that did not necessarily require answers (*responses* as defined by [16]): “*Hello, I welcome you*” “*My name is Tiago, I am a robotic assistant*”. We also added a sentence encouraging the user to speak louder: “*Sorry, I didn't quite understand, can you speak louder?*” Then we looked for the source of the problem by modifying the microphones and the speech recognition. We finally improved the time-lag, which is now between 3 and 4 seconds.

We will observe, when the robot is in situation in the institution, how the user will adapt: will the system provide "user work" by requiring the user to learn the art of talking to a conversational machine as with home IVAs [35]?

2) 2nd Session: chatbot iterations

During the sessions in the experimental apartment, the user could no longer solicit the research team and was therefore encouraged to interact with the robot. During these sessions, we observed that there was no more loss of attention due to the time-lag of the robot. However, we couldn’t predict everything the user will say to the machine, so this participatory design step allowed us to iterate and learn from each test :

- For example, one person requested the opening of the newspaper (this is a button present on the graphical interface) while we had not yet worked on feeding the chatbot about city information.

- Another person asked for the day's weather, which the robot then gave her, after which she asked it for the next day's weather, which we had not anticipated.

- When asking for the horoscope the robot sometimes included homonyms and therefore did not answer consistently: for example, “*Lyon*” instead of “*Lion*”.

Each test represents an iteration allowing us to highlight the problems and find short-, medium-, and long-term solutions for future tests and thus improve the chatbot in an iterative way.

3) Human-robot interaction observations

a) Reformulations

Beyond these technical issues, we have observed that ordinary interactions are problematic for these conversational systems, notably because of reformulations, hesitations, stopping and resuming the request. However, we can also see that the user adapts and implements strategies with the system.

The following sequence (Figure 1), taken during a test with an elderly couple, shows that the woman makes a request that is reformulated by her husband because the robot takes time to answer (the opening of the weather page can be longer than just a vocal answer). They share a joint attention towards the machine and their co-presence is involved in the accomplishment of the "weather command". For her second question she makes a request using the indexical term “tomorrow”. After a hesitation she specifies her request in order to be better understood by the system.

```
1. Mrs :  So   uh well we'll ask for the weather
2.              (touch the "weather" touch button)
           (Silence 3")
3. M: What's the weather like today?
           (Silence 4")
4. Robot: (opening the weather page on the tablet)
5. Robot:  [Today, in Troyes, we have cloudy skies. It is 6°C
and we will have wind gusts up to 2 m/s.
6. Robot: Feel free to ask me again if you don't understand.
7. Mrs.: No thanks (.) and tomorrow (.) what will the weather
be like?
```

Figure 1 Extract from the test (translated version)

b) First emotional reaction

For voice interaction, a chatbot within the robot is used. After converting the useful information contained in the sound signal into textual form, the agent tries to understand the meaning and intentions of the user through a natural language understanding process. Once the intentions of the user are detected, the agent starts the process of response generation, which will match a relevant response to the context or the data for example.

During the second session, the robot responded quickly, but sometimes it considered the wrong intention and did not meet the user's expectations. For all the testers, whether they were teenagers or elderly people, we observed the same reaction to this lack of relevance in the interaction: the user laughed.

Joy, laughing or smiling are face-maintaining reactions in order to maintain a peaceful relationship [13, 39]. The face is assimilated (by Goffman [10]) to an adaptation to the interaction by a figurative practice, or a line of action, adopted by the actor according to the situation.

c) Anthropomorphism and interaction modality

Anthropomorphism is the subject of many studies in the field of HRI. The work of Mori [9] established the hypothesis of a correlation between the degree of anthropomorphism and the acceptability of a robot, without however having proven it empirically. This research illustrates the limits of anthropomorphism, with the "Uncanny Valley". The theoretical curve of robot acceptance indicates that the more humanoid the design, the more the robot is accepted. If we go beyond a certain point in the resemblance, we are in the "Uncanny Valley": the resemblance is then so astonishing that it becomes strange, and this time the acceptance drops.

In the case of the machine we use, the Tiago robot recognizes the shape of a head and follows it with its eyes.

Another tendency we observed is the orientation of the user’s gaze towards the head of the robot when he/she addresses it (figure 2). While when the robot responds, or during moments of silence, the user will be more likely to observe the touch screen. These head movements create an interactivity of the machine with the user since the robot gives the illusion of a head that reacts according to its actions. We can extrapolate this illusion of the robot as a social actor that aligns itself interactionally with the user [38].

We noticed a notable difference among the two different audiences that are teenagers and elderly people. The teenagers unanimously favoured tactile interaction for their first request, while the elderly made their request by voice.

We see here a difference in the appropriation of the technologies with different barriers for the elderly population (fear of doing it wrong, not used to the tactile modality, etc.). This also reinforces the importance of a robust vocal interaction for this population.

Figure 2 The user looks at the robot while addressing it

4) Contributions of user tests

As we have seen in the previous points, user testing has real benefits that we can separate into two categories. The first one is the emergence of technical problems allowing an iterative improvement of the prototype. The second one is based on the observations of the human-robot interaction and the strategies developed by the user to adapt to the system.

Following these first observations, we were able to make some observations for a better HRI:

- The time-lag of response to the user's request should not exceed 3 seconds
- If the time-lag is higher, a movement (opening an application in the tablet in our case) can maintain the user's attention
- Laughing and smiling are social acts allowing the construction of social structures and this could be a future track for the development of IHR: could the robot recognize this reaction and respond to it? [37]
- Vocal interaction seems to be the interaction modality to be privileged for the elderly, however, the duplicate tactile interaction seems important to us not to exclude people with deafness problems

5) Limitations

In this pilot study we can highlight some limitations: i) The sample size is not large, especially for the target audience of the elderly, although this is consistent with the recommendations of Nielsen [39] (3 to 5 users). The indications mentioned could be studied on a larger scale to be more consistent. ii) These laboratory tests allowed us to improve the prototype and to observe the interactions with the user. However, the ecological environment being much less controlled, the next step will reveal the behaviours in real situations, probably very different from the behaviours in test situation. In a real situation, will people react differently? Will they turn away from the technology more easily? How will the robot be socially integrated?

VII. Discussion and Conclusion

As we have shown in this article, user tests in laboratories are good tools to improve the system and also produce feedback from users about the system. They also allow us to question the user's understanding of the machine and the strategies they develop in its interaction.

Finally, the differences in behaviour between teenagers and elderly people show the importance of having the system tested by real users. The particularities of each user are important to consider from the first phases of the projects, especially when it comes to a specific public such as the elderly.

As explained by Veloska & al. [35], concerning Intelligent Voice Assistants observed in homes, "*these systems generate the illusion of a natural conversation, which has the consequence of blurring their limits and their real possibilities of comprehension, and on the other hand, of leading users to implicitly attribute to them capacities that they do not possess*".

In the case of the robot, in addition to this conversational illusion, its presence is an insertion in the social space. We will see during the insertion of the robot in an institution welcoming elderly people if they are really "cheated" by the machine. These questions join other interesting notions such as user adaptation and situated acceptance [40] leading to adoption or abandonment of the technology .

Acknowledgment

We would like to thank all the volunteers who participated in the user tests: teenagers as well as elderly people.
We also thank the proof-readers of this article for their contribution.

Appendix

Transcription convention

Conventions	Meaning
M :	Continuation in turns of speech
[	Interruption and overlap
(Silence)	Break between speeches
(.)	Pause less than 1 second
(*touch the screen*)	Actions and gestures

Bibliography

[1] M. Anastassova, « L'analyse ergonomique des besoins en amont de la conception de technologies émergente: le cas de la Réalité Augmentée pour la formation à la maintenance automobile », phdthesis, Université René Descartes - Paris V, 2006. Consulté le: 19 janvier 2022. [En ligne]. Disponible sur: https://tel.archives-ouvertes.fr/tel-00340103

[2] M.-É. Bobillier Chaumon, « Technologies émergentes et transformations digitales de l'activité : enjeux pour l'activité et la santé au travail », *Psychologie du Travail et des Organisations*, vol. 27, nº 1, p. 17-32, mars 2021, doi: 10.1016/j.pto.2021.01.002.

[3] J. Kjeldskov, « Human-Computer Interaction design for emerging technologies: Virtual Reality, Augmented Reality and Mobile Computer Systems », 2003.

[4] É. Loup-Escande et J.-M. Burkhardt, « Évaluer l'utilité dans le contexte des technologies émergentes pour identifier des besoins latents : éléments issus d'une analyse des interactions en situation d'usage », *Activités*, nº 16-2, Art. nº 16-2, oct. 2019, doi: 10.4000/activites.4554.

[5] R. Kachouie, S. Sedighadeli, R. Khosla, et M.-T. Chu, « Socially Assistive Robots in Elderly Care: A Mixed-Method Systematic Literature Review », *International Journal of Human-Computer Interaction*, vol. 30, p. 369-393, 2014, doi: 10.1080/10447318.2013.873278.

[6] D. Feil-Seifer et M. Matarić, *Defining Socially Assistive Robotics*, vol. 2005. 2005, p. 468. doi: 10.1109/ICORR.2005.1501143.

[7] B. R. Duffy, « Anthropomorphism and the social robot », *Robotics and Autonomous Systems*, vol. 42, nº 3-4, p. 177-190, mars 2003, doi: 10.1016/S0921-8890(02)00374-3.

[8] C. Breazeal, « Toward sociable robots », *Robotics and Autonomous Systems*, vol. 42, nº 3-4, p. 167-175, mars 2003, doi: 10.1016/S0921-8890(02)00373-1.

[9] M. Mori, K. MacDorman, et N. Kageki, « The Uncanny Valley [From the Field] », *IEEE Robot. Automat. Mag.*, vol. 19, nº 2, p. 98-100, juin 2012, doi: 10.1109/MRA.2012.2192811.

[10] E. Goffman, *La mise en scène de la vie quotidienne*, Les éditions de minuit., vol. 1. la présentation de soi. 1973.

[11] S. Payr, F. Werner, et K. Werner, « Potential of robotics for ambient assisted living », 2015.

[12] R. Bemelmans, G. J. Gelderblom, P. Jonker, et L. de Witte, « Socially Assistive Robots in Elderly Care: A Systematic Review into Effects and Effectiveness », *Journal of the American Medical Directors Association*, vol. 13, nº 2, p. 114-120.e1, févr. 2012, doi: 10.1016/j.jamda.2010.10.002.

[13] F. Amirabdollahian *et al.*, « Accompany: Acceptable robotiCs COMPanions for AgeiNG Years — Multidimensional aspects of human-system interactions », in *2013 6th International Conference on Human System Interactions (HSI)*, juin 2013, p. 570-577. doi: 10.1109/HSI.2013.6577882.

[14] D. Heylen, B. van Dijk, et A. Nijholt, « Robotic Rabbit Companions: amusing or a nuisance? », *J Multimodal User Interfaces*, vol. 5, nº 1, p. 53-59, mars 2012, doi: 10.1007/s12193-011-0083-3.

[15] S. Payr, « Virtual Butlers and Real People: Styles and Practices in Long-Term Use of a Companion », in *Your Virtual Butler: The Making-of*, R. Trappl, Éd. Berlin, Heidelberg: Springer, 2013, p. 134-178. doi: 10.1007/978-3-642-37346-6_11.

[16] K. Pitsch, « Répondre aux questions d'un robot: Dynamique de participation des groupes adultes-

enfants dans les rencontres avec un robot guide de musée », *Réseaux*, vol. N°220-221, nº 2, p. 113, 2020, doi: 10.3917/res.220.0113.
[17] L. Suchman, « Located accountabilities in technology production », *Scand. J. Inf. Syst.*, vol. 14, nº 2, p. 91-105, sept. 2002.
[18] T. Bratteteig et I. Wagner, « Unpacking the Notion of Participation in Participatory Design », *Comput Supported Coop Work*, vol. 25, nº 6, p. 425-475, déc. 2016, doi: 10.1007/s10606-016-9259-4.
[19] H. R. Lee *et al.*, « Steps Toward Participatory Design of Social Robots: Mutual Learning with Older Adults with Depression », in *Proceedings of the 2017 ACM/IEEE International Conference on Human-Robot Interaction*, New York, NY, USA, mars 2017, p. 244-253. doi: 10.1145/2909824.3020237.
[20] S. Moharana, A. E. Panduro, H. R. Lee, et L. D. Riek, « Robots for Joy, Robots for Sorrow: Community Based Robot Design for Dementia Caregivers », in *2019 14th ACM/IEEE International Conference on Human-Robot Interaction (HRI)*, mars 2019, p. 458-467. doi: 10.1109/HRI.2019.8673206.
[21] K. L. H. Ting, M. Derras, et D. Voilmy, « Designing Human-Robot Interaction for Dependent Elderlies: a Living Lab Approach », présenté à Proceedings of the 32nd International BCS Human Computer Interaction Conference, juill. 2018. doi: 10.14236/ewic/HCI2018.142.
[22] D. Voilmy, « Les living labs et la conception participative : l'exemple d'ActivAgeing », *Retraite et societe*, vol. 75, nº 3, p. 125-136, 2016.
[23] S. Budweg, M. Lewkowicz, C. Müller, et S. Schering, « Fostering Social Interaction in AAL: Methodological reflections on the coupling of real household Living Lab and SmartHome approaches », vol. 11, nº 3, p. 30-35, nov. 2012, doi: 10.1524/icom.2012.0035.
[24] K. Lan Hing Ting et M. Lewkowicz, « From Prototype Testing to Field Trials: The Implication of Senior Users in the Evaluation of a Social Application », *Procedia Computer Science*, vol. 67, p. 273-282, janv. 2015, doi: 10.1016/j.procs.2015.09.271.
[25] M.-L. Carrion-Martinaud et M.-É. Bobillier-Chaumon, « Présence de robots dans les ehpad. Mieux vivre la séparation familiale », *Dialogue*, vol. n° 217, nº 3, p. 45-56, oct. 2017.
[26] K. Yamazaki *et al.*, « Prior-to-request and request behaviors within elderly day care: Implications for developing service robots for use in multiparty settings », in *ECSCW 2007*, L. J. Bannon, I. Wagner, C. Gutwin, R. H. R. Harper, et K. Schmidt, Éd. London: Springer London, 2007, p. 61-78. doi: 10.1007/978-1-84800-031-5_4.
[27] D. Randall, R. Harper, et M. Rouncefield, « Fieldwork for Design: Theory and Practice », Springer Science&Business Media., 2007, p. 332. doi: 10.1007/978-1-84628-768-8.
[28] K. Schmidt, « Practice and technology: On the conceptual foundations of practice-centered computing », in *Socio-Informatics: A Practice-Based Perspective on the Design and Use of IT Artifacts*, 2018, p. 47-103.
[29] B. Gaver, T. Dunne, et E. Pacenti, « Design: Cultural probes », *interactions*, vol. 6, nº 1, p. 21-29, janv. 1999, doi: 10.1145/291224.291235.
[30] M. Olivier, D. Voilmy, J.-G. Ganascia, K. L. H. Ting, et S. Rey, « Combiner cultural probes et entretiens avec des soignants pour co-concevoir une solution robotique mobile sociale », présenté à JETSAN 2021, 2021.
[31] A. Crabtree, *Designing Collaborative Systems: A Practical Guide to Ethnography*. Springer Science & Business Media, 2003.
[32] J. Kitzinger, « Introducing Focus Groups », *BMJ: British Medical Journal*, vol. 311, nº 7000, p. 299-302, 1995.
[33] D. Voilmy et J. Duchene, « Living Lab ActivAgeing - Developing home-based social and healthcare solutions for the elderly using participatory design », *Studia Informatica Universalis*, vol. 11, nº 2, p. 63-68, 2013.
[34] L. Suchman, « Plans d'action: problèmes de représentation de la pratique en sciences cognitives. », in *Les formes de l'action: Sémantique et sociologie*, vol. 1, 1990, p. 149-170.
[35] J. Velkovska, M. Zouinar, et C.-A. Veyrier, « Les relations aux machines « conversationnelles »: Vivre avec les assistants vocaux à la maison », *Réseaux*, vol. N°220-221, nº 2, p. 47, 2020, doi: 10.3917/res.220.0047.
[36] E. Goffman, *Les rites d'interaction*. Les Editions de Minuit, 1974.
[37] L. Béchade, « L'humour dans les interactions sociales homme-robot », phdthesis, Université Paris Saclay (COmUE), 2018. Consulté le: 11 mars 2022. [En ligne]. Disponible sur: https://tel.archives-ouvertes.fr/tel-01826449
[38] E. Goffman, *Forms of Talk*, Les Editions de Minuit. 1981. Consulté le: 14 mars 2022. [En ligne]. Disponible sur: https://www.upenn.edu/pennpress/book/715.html
[39] J. Nielsen, *Usability Engineering*. Morgan Kaufmann, 1994.
[40] M.-E. *Bobillier Chaumon, « L'acceptation située des technologies dans et par l'activité : premiers étayages pour une clinique de l'usage », Psychologie du Travail et des Organisations, vol. 22, no 1, p. 4-21, mars 2016, doi: 10.1016/j.pto.2016.01.001.*