Exploring requirements and alternative pet robots for robot assisted therapy with older adults with dementia

M. Heerink[1,2], J. Albo-Canals[2], M. Valenti-Soler[3], P. Martinez-Martin[3], J. Zondag[1], C. Smits[1] and S. Anisuzzaman[4]

[1]Windesheim University of Applied Sciences, Almere/Zwolle, The Netherlands. [2]LIFAELS La Salle, Ramon Llull University, Barcelona, Spain, [3]CIEN Foundation and CIBERNED- Alzheimer Center Reina Sofía Foundation, Madrid, Spain, [4]Dignis Lentis, Zuidlaren, The Netherlands
m.heerink@windesheimflevoland.nl, jalbo@salle.url.edu, mvalenti@fundacioncien.es, pmartinez@fundacioncien.es, jori.zondag@windesheimflevoland.nl, chm.smits@windesheim.nl, sp.anisuzzaman@lentis.nl

Abstract. Robot assisted therapy has been applied in care for older adults who suffer from dementia for over ten years. Strong effects like improved interaction and signs of a higher sense of wellbeing have been reported. Still it is unclear which features are needed and which robotic pets would are suitable for this therapy. In this explorative research we interviewed 36 professional caregivers, both experienced and inexperienced in relationship to RAT and compiled a list of requirements. Next, we used this list to compare commercially available robotic pets. We found that many pet robots are usable, although seal robot Paro meets the requirements best, being superior on sustainability, realistic movements and interactivity. Finally, a test with alternative pets showed that different subjects were attracted to different pets and a subsequential questionnaire revealed that some caregivers were not only willing to try alternatives for Paro, but also suggesting that alternative pets could in some cases be more suitable.

1 INTRODUCTION

For more than a decade, research has been done on the use of robotic pets for older adults suffering from dementia, suggesting this is a successful form of therapy [1-4]. Although most research has been done in Japan and with the same seal shaped robot called Paro, it is generally assumed that therapeutic use of robotic pets improves mental and physical wellbeing of older adults with dementia and results in a more active interaction of the subjects with their environment [5].

Although there are some alternatives [6-10], Paro is by far the most widely used robotic pet for this purpose. This could be due to the fact that Paro is the only robotic pet that is both especially developed for this purpose and commercially available. However, Paro is quite an investment since it costs close to five thousand dollars [11]. Eldercare professionals that would like to try working with a robotic pet but have a

adfa, p. 1, 2011.

very limited budget may look for alternatives. These would be pet robots meeting the requirements that make them suitable for robot-assisted therapy in dementia.

In this explorative study we want to elicit and specify these requirements by focusing on professional caregivers working with older adults who suffer from dementia. These caregivers may have experience with similar types of interventions, like using real pet animals, stuffed animals or other techniques that stimulate the senses for which the term'snoezelen' is used. Snoezelen is also called or Multi-Sensory Stimulation (MSS), and is a widely used and accepted approach to nursing home residents suffering dementia [12].

The caregivers that are subject to our study may or may not be familiar with robot-assisted therapy. If they are not, this could be due to the unfamiliarity of the possibilities of this form of therapy, but also by inaccessibility to practical guidelines: for caregivers who are interested in applying this therapy, there are hardly any practical guidelines available on how to use which type of robot in which state of dementia, how to deal involve family members and how to respond to any negative responses. It could in that case very well be that comprehensible set of guidelines would lead to a wider application of robot-assisted therapy.

Caregivers who are familiar with robot-assisted therapy - and especially the ones who have applied it - may give different responses when asked for the requirements for a suitable robot.

This paper presents the results of an explorative study. The goal was to elicit and specify requirements according to professional caregivers for a pet robot that can be used in therapeutic interventions with older adults suffering from dementia. Moreover, we wanted to establish how familiarity with this form of therapy and the experience of applying it would influence the elicitation and specification of these requirements.

Fig. 1. Paro

In our present study, we wanted to map (a) the familiarity of robot-assisted therapy for professional caregivers in Spain and the Netherlands, (b) the need for guidelines

by professional caregivers in Spain and the Netherlands, (c) produce an inventory of requirements for a suitable robot according to these caregivers and (d) produce a comparison of available pet robots based on these requirements (e) describe professionals'reactions to the use of pet robots in a small experiment.

In the following section we will present the project of which this study is a part. Next, we will discuss the used questionnaire and respondents subsequently we will present the results of (a) questions on experience and guidelines and (b) the requirements inventory. After drawing some preliminary conclusions from this, we will compare a few alternative robots guided by these requirements and present a small user study in which we looked for the first response of residents suffering from moderate dementia and caregivers in a care institution.

2 New Friends Framework

The "New friends, old emotions" project is a Dutch-Spanish collaboration which targets the accessibility of robot-assisted therapy for caregivers that work with older adults suffering from dementia. Its first aim is to establish the need for guidelines for robot-assisted therapy by professional and informal caregivers.

Furthermore, the project targets an inventory of (1) experiences that some caregivers already have with robotic pets, (2) available pet robots and their suitability for this form of therapy, and (3) practices by caregivers that can be related to this form of therapy (e.g. using stuffed animals, real pets and activities that otherwise stimulate the senses of the subjects). Moreover, it aims to use the findings of these studies to provide guidelines and to offer supportive workshops for robot-assisted therapy.

The consortium that carries out this project consists of Dutch and Spanish institutions that have technical experience with (pet) robots, experience with field studies concerning older adults, or specific expertise in both studying and working with older adults suffering from dementia. Also a part of the consortium is eldercare institutions in different cities of the Netherlands. The project management is carried out by the Robotics research group of Windesheim Flevoland University of Applied Sciences in Almere, the Netherlands.

3 Developing a requirements list

To establish our goal, we decided to gather both qualitative and quantitative data from questionnaires completed by caregivers that worked in eldercare institutions in the towns of Almere, Lelystad and Zuidlaren in the Netherlands and in the city of Madrid in Spain. Both in the Netherlands and in Spain, some caregivers had no experience in working with a pet robot, while others had worked with Paro.

The 17 caregivers from the Netherlands were all professionals, aged 19 to 61. They had a lower or higher professional education and they were all female. The 20 caregivers from Spain were aged 21 to 58. They were also female professionals except for one, and their education varied from lower professional to university.

The respondents were asked to fill out the questionnaire individually. This questionnaire (Table 1) consisted of (a) questions on knowledge of and experience with robot-assisted therapy and (b) the need for guidelines and (c) questions on requirements for suitable robots. Four of the questions (in Table 1 these are questions 3 to 6) were actually statements to be replied to on a five point Likert scale, indicating the extent to which they agreed (absolutely agree – agree – neutral - not agree - absolutely not agree). The espondents were aware that the answers on this scale corresponded with an attributed score, varying from 5 (totally agree) to 1 (totally not agree).

Table 1. Questionnaire items

1. Have you ever heard, seen or read about the use of a pet robot for older adults suffering from dementia?		
2. Have you ever used such a robot?		
Yes:	2a. Did you use specific directives? Yes: which ones and how did you get them? No: Why not? Would you like to have directives?	2b. Did you involve family members? Yes: Did it go well? Did you use directives? No: Would you want to? Why would or wouldn't you?
No	2c. Would you like to work with it? 2d. What would hold you back or stimulate you?	
Please indicate how much you agree with the following statements:		
3. I believe that activities with pet-like robots may increase the quality of life for people suffering from dementia.		
4. I (would) like to work with such robots		
5. I find it important that there are directives for interventions with such robots		
6. These directives should also make it possible for family members to do these interventions		
7. What possibillities and properties should suitable pet robot have?		
a. What features and qualities are necessary?		
b. What features and qualities are desirable?		
c. How do you expect that older people respond to these properties?		
d. Which expressions are important? (eg facial expression wagging tail etc)		
e. Why?		
8. What possibillities and properties should a suitable pet robot certainly not have?		

After the questionnaires were filled out, the respondents elucidated their answers in a conversation with one of the researchers. These were recorded.

4 Questionnaire results

4.1 Familiarity and guidelines

Most caregivers were more or less familiar with robot-assisted therapy. Of course, those from Madrid had even applied it, but nine out of eleven from the Netherlands had seen a short television documentary on this subject. Four of them compared it to their own experiences with real pets. In one case this was a dog, but the other three who all worked at the same eldercare institution in the city of Lelystad, reported that

they kept a cat on their floor that they made to look like a real street with houses in the seventies. They reported positive effects of cuddling sessions with the cat, but also expressed that a robotic cat would be more beneficial, since it would always be willing to be cuddled.

Four other caregivers reported the use of stuffed animals to be more or less familiar, but even more the practice of "snoezelen", which aims to evoke emotions by stimulating the senses. They expected robot-assisted therapy to be beneficial since it could also evoke emotions.

All caregivers except for one expressed a need for guidelines and stated that robot-assisted therapy would be far more widely applied if these would be commonly available. Some indicated that guidelines were especially needed for dealing with unexpected responses that could also occur with similar activities that evoke emotions. They indicated that occasionally robotic pets could evoke anger, panic or sadness. Moreover several caregivers from the Netherlands reported that some related activities would occasionally evoke resistance, reluctance or even animosity by family members who experienced it as humiliating or insulting to see their fathers or mothers playing with stuffed animals. This could also be expected if it were robotic pets. A set of guidelines should also include directives on how to deal with this. The one caregiver who indicated that no guidelines were needed stated that she expected that this form of therapy would hardly be applied and that developing guidelines would be a waste of time and effort.

As Table 2 shows, the scores on the four Likert scale statements were generally "agree" or "totally agree". For each statement there were only one or two "neutral" scores.

Table 2. Descriptive statistics of s cores on items 3 to 6

	Minimum	Maximum	Mean	Std. Deviation
Item 3	3	5	4,19	,525
Item 4	3	5	4,39	,599
Item 5	4	5	4,64	,487
Item 6	2	5	4,11	,887

Table 3 shows an analysis of the differences between caregivers with and without experience with Paro: none of the questions resulted in significant answers.

Table 3. Difference in experience for items 3 to 6

	Item 3	Item 4	Item 5	Item 6
Mann-Whitney U	154,000	116,000	141,000	143,000
Sig (2-tailed)	,784	,112	,449	,547

Table 4 shows the (Spearman) correlation on the scores for items 3 to 6 plus age of the caregivers. There is significance for the correlation between and between Items 3

and 4, 4 and 5 and 5 and 6. The first correlation is a predictable one: the more caregivers believe in using pet robots, the more they are willing to work with it. The second one is remarkable: the ones who are willing to work with it, generally think they could benefit from good directives. The third indicates that caregivers who think they could benefit from guidelines also think it is good to work with family members.

Moreover, there is a strong correlation between Age and Item 6. This could indicate that older caregivers are more willing to involve family members than younger ones.

Table 4. Correlation items 3 to 6 and Age

		Item 3	Item 4	Item 5	Item 6	Age
Item 3	Correlation	1,000	,392*	,255	,321	,188
	Sig. (2-tailed)	.	,017	,127	,053	,265
Item 4	Correlation	,392*	1,000	,328*	,233	-,003
	Sig. (2-tailed)	,017	.	,047	,165	,986
Item 5	Correlation	,255	,328*	1,000	,368*	-,151
	Sig. (2-tailed)	,127	,047	.	,025	,372
Item 6	Correlation	,321	,233	,368*	1,000	,447**
	Sig. (2-tailed)	,053	,165	,025	.	,006

4.2 Requirements

We had asked the caregivers to indicate which requirements were necessary and which ones were desirable. In order to quantify the results some preferred pet characteristics were combined by the researchers. For example, some caregivers indicated the skin should be soft, some said it should be furry and some indicated it should be 'pettable like a real animal skin'. All these were categorized under 'soft pettable fur' (listed as requirement 1).

Answers that were given to question 8 were processed in a similar way, since they consistently were the reversed versions of the positive expressions. For example, it was often indicated that the robot should not be noisy which is essentially the same as requirement 3 (mechanical parts are noiseless) and a remark 'It should really not be to breakable' could be categorized under 12 (can withstand rough handling). All these requirement counts that where derived from answers to question 8 where categorized as necessary.

In many cases pet features were mentioned repeatedly, both as necessary and desired features and sometimes even again in reversed descriptions answering question 8. In that case, the requirement was only counted once as a necessary feature.

One participant simply stated that the robotic pet should stimulate the user. We did not count this as a requirement, because this is already one of the principle goals of robot-assisted therapy.

Table 5 shows the results of this count, for the caregivers that had worked with Paro (Exp) and the ones with no such experience (Not), followed by the total counts.

Note that each cell contains the counts for necessary (before the slash) and desired (after the slash) requirements.

The 'soft pettable fur' was mentioned in different characterizations by most caregivers of the group with no experience and many of them mentioned appropriate sounds and noiseless mechanical parts. Some mentioned detachable fur (which is actually hardly found for robotic pets).

We may conclude that most caregivers were familiar with robot-assisted therapy. Moreover, they were generally quite willing to apply it if they did not already do. Remarkably they easily linked this form of therapy to familiar activities, like working with real pets, stuffed animals and sensory stimulation. Also, caregivers generally agreed on the need for guidelines.

Table 5. Requirements for caregivers with and without experience with Paro

Requirements	Exp	Not	Total
1. Soft pettable fur	2/-	11/1	13/1
2. Appropriate responses/sounds	4/1	8/7	12/8
3. Looks like a real life pet	5/1	4/1	9/2
4. Mechanical parts are noiseless	-/-	7/2	7/2
5. Young or innocent looking.	4/-	3/1	7/1
6. Nice/not scary	1/-	6/1	7/1
7. Huggable (right size cuddle with)	-/-	6/-	6/-
8. Realistic movements (fluent/natural)	1/-	4/2	5/2
9. Adaptable (shut functions on/off)	1/-	2/2	3/2
10. Autonomous system	-/1	3/-	3/1
11. Mobile (easy to take with you)	2/-	2/-	4/-
12. Can withstand rough handling, solid	1/-	2/-	3/-
13. Easy to use	2/-	3/-	5/-
14. Variety of behaviors and sounds	2/1	1/-	3/1
15. Fur is detachable (to be washed)	1/-	2/-	3/-
16. Cartoonish appearance	-/-	1/-	1/-
17. Flashy/draws attention	-/-	1/1	1/1

Looking at the generated list of requirements we see that a soft pettable fur is mentioned often especially by the caregivers without experience. Remarkable is that the noiselessness of the mechanical part is only mentioned by caregivers without experience.

This list contains 17 items that can be prioritized according to the necessity as indicated by the participants, but also by the frequency of the combined categories. We chose to list them in Table 5 only by the frequency of the necessity.

5 Exploring alternative robotic pets

To explore alternative pets, we selected a few alternative robotic pets and set up a small user study. Subsequently we interviewed the involved caregivers.

5.1 Strategy

We made an inventory of commercially available robotic pets and selected a seal puppy and a cat. Next to realistic looking pet robots, we wanted to use more cartoon-ish designed pets and selected a baby dinosaur and a bear.

The seal puppy is produced by WowWee, and is an example of the Alive Baby Animals series. Its current price is €35.- and it has the appearance of a Paro seal robot, but is much smaller and lighter. Moreover it is limited in functionality compared to Paro: it can only open and close its mouth and produce baby seal cries. Its mechanical parts are also much noisier.

Fig. 2. Used pet robot – clockwise: Seal puppy, Pleo, Bear and Cat (Cuddlin Kitty)

The cat is a 'FurReal Friends Lulu Cuddlin Kitty', produced by Hasbro. The cost is €60.-. She has a lying position and responds to caressing by shutting her eyes briefly and by making a purring sound. After being petted for a longer time, she lifts her leg and turns on her back so her chest and belly can be petted. When the user stops this, she turns back in her original position. She has multiple sensors in head, back, chest and belly and a microphone. She detects voice and responds to it by meowing. Its mechanical parts are as noisy as the Baby Seal.

The dinosaur is a Pleo robot. It is in fact a baby Camarasaurus, which has just hatched. This means it still has to develop skills and personality when it is received. Its development depends on how it is fed and treated (petting a lot makes it nicer). It features two microphones that are used for voice detection, a camera which is used to localize people and objects and multiple touch sensors on the head and back which make it responsive to petting. Its mechanical parts are much less noisy compared to the previous pets.

The bear is a robot that has been developed by the Robotics Research group of Windesheim Flevoland University of Applied Sciences. It is a regular stuffed bear

equiped with a robotic frame made with Arduino, which can easily be transferred to other stuffed animals. This makes it possible to test different embodiments. Moreover, the functionalities (which are still limited at this time) can be turned on and off independently which will enable us in a later stage to establish the importance of each feature. The bear also has WIFI connectivity, so it can be remotely controlled in a wizard-of-oz setup.

We thus had four robots that could all be categorized according to the attributes 'familiar' and 'life like': the seal is not familiar as a pet, but life like; the cat is both life like and familiar; the bear is familiar but not life like and Pleo is neither. However, as Table 6 shows, we have to bear in mind that the available functionalities of the four pets have more differences than these. Nevertheless, they are all more or less comparable to Paro, although Paro fits most requirements and is far superior in weight (it is much heavier – according to some caregivers it is even too heavy) and interactivity to any of the alternative robots.

Table 6. Alternative robots fitting the requierements

Requirements	Seal	Bear	Cat	Pleo	Paro
1. Soft pettable fur	+	+	+	+/-	+
2. Appropriate responses/sounds	**+**	**+/-**	**+**	**+**	**+**
3. Mechanical parts are noiseless	+/-	+/-	-	+/-	+/-
4. Young or innocent looking.	**+**	**+**	**+**	**+**	**+**
5. Nice/not scary	+	+	+	+/-	+
6. Huggable (right size cuddle with)	**+**	**+**	**+**	**+**	**+/-**
7. Realistic movements (fluent/natural)	+	+/-	+/-	+/-	+
8. Looks like a real life pet	**+/-**	**+/-**	**+**	**-**	**+/-**
9. Adaptable (shut functions on/off)	-	+	-	-	+
10. Autonomous system	**+**	**+**	**+**	**+**	**+**
11. Mobile (easy to take with you)	+	+	+	+	+/-
12. Can withstand rough handling, solid	**-**	**-**	**-**	**-**	**+**
13. Easy to use	+	+	+	+	+
14. Variety of behaviors and sounds	**-**	**-**	**-**	**+**	**+**
15. Fur is detachable (to be washed)	-	-	-	-	-
16. Cartoonish appearance	**-**	**+**	**-**	**+**	**-**
17. Flashy/draws attention	+/-	+/-	+/-	+/-	+/-
+/-	**4**	**6**	**4**	**2**	**8**

5.2 Experimental procedure

We set up a session of one hour with fifteen patients who suffered moderate dementia. They were sitting in a circle as would be usual for group activities, when a caregiver presented the first robotic pet (the cat) to each participant for approximately one minute. The participant could take the robot on his or her lap, touch it and talk to it. When presenting it, the caregiver asked if the participant liked the robot and if he or she thought it was real. After it had been presented to all participants, the next robot was presented (subsequently the seal, the bear and the dinosaur). Researchers were

able to observe the responses. They specifically noted smiles caresses, hugs, kisses and talking directed to the robotic pet, and also the response (if any) to the questions of the caregiver.

5.3 Interviews

We interviewed eleven caregivers (nurses and therapists) that were present at the department where we carried out the experiment. They were not only able to see the pet robots we used, but also to pick them up and explore the interaction. All of them had experience with robot-assisted therapy, using Paro.

They were asked to rate the suitability of each of the used pet robots for therapy activities by rating it on a scale from one (absolutely suitable) to five (absolutely not suitable). Subsequently they were asked to elucidate their rating.

5.4 User study results

Table 7 shows only a part of the responses we observed. First of all, we felt unable to record the smiles (as has been done in related studies [13]), since we could often not differentiate between a smile caused by the caregiver and a smile caused by the robot and some participants were simply smiling during the entire session.

Also responses to caregivers questions caused some difficulty, since many participants gave no verbal reply to it. For the cat, three participants said it was real and four participants said it was not real. The seal was claimed to be real by one person and not real by four. After the cat and the seal were presented, the caregiver stopped asking this question.

Table 7. Patient responses to the robotic pets

	Pleo	**Cat**	**Seal**	**Bear**
like	6	12	13	6
caress	6	10	11	4
talk	1	7	4	2
hug	0	0	3	6
kiss	4	0	4	0

When analyzing the responses, we noticed that there were clear differences between the participants. Where some responded to the cat and not to the seal, for others the response was the other way around. And some did response more to the bear than to other robotic pets.

Table 7 shows that the seal and the cat scored the highest amount of patients'response, especially on 'likes' and 'caresses'. The cat scored the most 'talks' and the bear the highest amount of hugs. Pleo scored lower on most counts except for kisses, which is in line with the often mentioned requirement of 'looking like a real life pet' in Table 5. We also noted that four participants indicated to be scared of it. This was something that none of the participants indicated with any of the other pet

robots except for one participant with the cat: she indicated that she had always been afraid of cats.

5.5 Caregiver interview results

To process the rating scores appropriately so that a higher score would indicate a higher appreciation, we reversed them.

As Table 8 shows, the highest score was for the baby seal robot. The caregivers indicated that they were charmed by its simplicity and softness. Two caregivers even indicated that they liked it more than Paro, because it was lighter, easier to use, more mobile and because they would be less afraid to break it or have it broken. The second highest score was for the cat. Caregivers liked it because it was a realistic representation of an animal that could be referred to as a pet (contrary to all the other pet robots). However, they disliked its movements that were 'too robotic'. The third highest score was for the bear, which was often considered appropriate, but too limited in functionalities and too big. The lowest score was for the Pleo. Many caregivers found it cute, but not familiar enough and 'too reptilious'.

Table 8. Patient responses to the robotic pets

	Total	Minimum	Maximum	Mean	Std. Deviation
cat	49	3	5	4,18	,751
seal	46	3	5	4,45	,688
pleo	39	2	4	3,00	,775
bear	33	3	5	3,82	,751

6 Conclusion, discussion and future research

A first conclusion from the first part of this research is that most caregivers are willing to work with, or at least explore robot-assisted therapy with people suffering from dementia.

A second conclusion could be that furry skin, appropriate response and a silent operating mechanism are the most important requirements according to caregivers. However, much more research can be done on these requirements, for example by focusing on their specification. We could take this list and ask caregivers to attribute a weight to them.

A third finding of this study is that many caregivers spontaneously linked robot-assisted therapy to activities like working with real pets, stuffed animals and evoking emotions by stimulating the senses (snoezelen). When developing guidelines we could indeed learn from caregivers' experiences with these activities and establish if they could be applied to the use robotic pets.

A fourth conclusion is that some older adults in a stage of moderate dementia differ in their response to different types of pet robots. Further research could specify this and establish if there is a predictable pattern (a typology of patients linked to a typology of pet robots) or even that a caregiver should have a collection of different pet robots rather than one specific one.

Finally we conclude that caregivers are open to alternatives to Paro for robot-assisted therapy in dementia and that some of them may even prefer an alternative. This invites us to further explore these alternatives and research the importance of different requirements.

Acknowledgment

We thank the management and caregivers working at De Overloop and De Archipel in Almere, De Enk in Zuidlaren and at De Hanzeborg in Lelystad as well as the staff of the Alzheimer Center Reina Sofia Foundation, Madrid. We are very grateful for their time.

References

1. Wada, K. and T. Shibata, *Robot Therapy in a Care House-Its Sociopsychological and Physiological Effects on the Residents.* Robotics and Automation, 2006. ICRA 2006. Proceedings 2006 IEEE International Conference on, 2006: p. 3966-3971.
2. Wada, K. and T. Shibata, Living With Seal Robots—Its Sociopsychological and Physiological Influences on the Elderly at a Care House. Robotics, IEEE Transactions on [see also Robotics and Automation, IEEE Transactions on], 2007. 23(5): p. 972-980.
3. Inoue, K., K. Wada, and R. Uehara. How Effective Is Robot Therapy?: PARO and People with Dementia. in 5th European Conference of the International Federation for Medical and Biological Engineering. 2012. Springer.
4. Bemelmans, R., Verslag pilot-onderzoek Paro, 2012, Hogeschool Zuyd.
5. Broekens, J., M. Heerink, and H. Rosendal, The effectiveness of assistive social robots in elderly care: a review. Gerontechnology journal, 2009. 8(2): p. 94-103.
6. Stiehl, W.D., et al. The Huggable: a therapeutic robotic companion for relational, affective touch. in Consumer Communications and Networking Conference. 2006. Las Vegas, Nevada, USA.
7. Sherwood, T., F. Mintz, and M. Vomela, Project VIRGO: creation of a surrogate companion for the elderly. Conference on Human Factors in Computing Systems, 2005: p. 2104-2108.
8. Kriglstein, S. and G. Wallner, HOMIE: an artificial companion for elderly people. Conference on Human Factors in Computing Systems, 2005: p. 2094-2098.
9. Furuta, Y., et al. Subjective evaluation of use of Babyloid for doll therapy. 2012. IEEE.
10. Boon, B., pilot health care scottie. 2009.
11. Japantrendshop.com. Japan trend shop Paro. 2013; Available from: http://www.japantrendshop.com/paro-robot-seal-healing-pet-p-144.html.
12. Spaull, D., C. Leach, and I. Frampton, An evaluation of the effects of sensory stimulation with people who have dementia. Behavioural and Cognitive Psychotherapy, 1998. 26(1): p. 77-86.
13. Robinson, H., et al., Suitability of Healthcare Robots for a Dementia Unit and Suggested Improvements. Journal of the American Medical Directors Association, 2013. 14(1): p. 34-40.