

# The Distant Gardener: What Conversations in the Telegarden Reveal about the User Experience of Telepresence

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## ABSTRACT

Telepresence – a unique form of human-computer interaction – presents the user with sense-data that corresponds to a remote physical reality, and allows the user to perform a remote physical action. In this study, we sought to understand the human experience of a specific instantiation of telepresence. We analyzed 3 months of online chat (347 participants, 22,952 postings) in the Telegarden: a community garden that allows users to plant and tend seeds in a remote garden by controlling a robotic arm through a web-based interface. Results showed that (1) conversations focused less on nature (13%) and technology (22%) and more on human relationships (69%); (2) as individual participation increased, conversation about nature and about technology shifted from inside to outside the Telegarden; and (3) patterns of conversation appeared to follow patterns of physical activity in the Telegarden. Discussion focuses on the depth and quality of participants' telepresence experience.

## Author Keywords

Conversation analysis, human-robotic relationship, nature, online community, online chat, robotics, telepresence, user experience, values, Value Sensitive Design

## ACM Classification Keywords

H.1.2 [Models and Principles]: User/Machine Systems – *Software psychology*; H.4.3 [Information Systems Applications]: Communications Applications – *Bulletin boards*; I.2.9 [Artificial Intelligence]: Robotics; K.4.2 [Computers and Society]: Social Issues.

## INTRODUCTION

Telepresence presents sense-data that corresponds to a remote physical reality, and allows the remote user to perform a physical action and see the results. One telerobotic installation – a telegarden – was developed at the University of Southern California in 1995 under the co-direction of Ken Goldberg and Joseph Santarromana. In 1996 the Telegarden was moved to the Ars Electronica Center in Linz, Austria, where it remained online until August of 2004 [3, 8]. The garden itself is a small plot encircling an industrial robotic arm (see Figure 1). A web-based interface allows users to activate the robotic arm, view the garden through a camera mounted on the robotic arm, change the view, plant a seed, water it, and (if one is a successful gardener) water the resulting plant on an on-going basis. Many thousands of remote users have interacted with the Telegarden in such ways.

Potentially, users' interactions with the Telegarden embody some of the human experience of gardening itself. For example, Schultz [7] in *Garden Design Magazine* writes "though drained of sensory cues, planting that distant seed still stirs anticipation, protectiveness, and nurturing. The



Figure 1. The Telegarden. Co-directors: Ken Goldberg and Joseph Santarromana. Project team: George Bekey, Steven Gentner, Rosemary Morris, Carl Sutter, Jeff Wiegley, Erich Berger. (Photo by Robert Wedemeyer.)

unmistakable vibration of the garden pulses and pulls, even through a modem." Yet, it remains an open empirical question whether such writing conveys more writer's exuberance than fact in terms of the user experience of the Telegarden.

In addition to creating one of the first (if not the first) telepresence installation, the designers of the Telegarden sought to foster community (not unlike a community garden) by making users aware of each other, and aware of the impacts of their actions on the garden and other users. Toward this end, the site provided information about who is currently visiting the site, what they are doing, and what actions members have taken in the garden recently. In addition, the site had a corresponding chat room, where users could engage – as in many chats – about topics relevant to the installation, and any other topic of choice.

Building on principles of Value Sensitive Design [1], the purpose of this study was to investigate users' experience and conceptions of the Telegarden. We did so by conducting a line-by-line analysis of 3 months of chat discourse. Three overarching questions structured our analysis. First, to what extent did the Telegarden actually engage members in nature-oriented experiences, and of what form? Second, to what extent did members experience connection with other distant gardeners in the Telegarden? Third, did members' experience change depending on whether they frequented the Telegarden often or seldom?

## METHODS

### Data Source

Data was collected from an archive of postings to the Telegarden chatroom, located on the Telegarden website. A 3-month (13-week) period, comprised of 22,952 postings, was selected for coding. These 3 months represent a period of robust use and exploration of the Telegarden site, soon after the installation was relocated to Austria.

### Coding

To develop a coding system for the Telegarden chat data we drew on methods from developmental psychology for coding qualitative interview data [4] that have recently been extended to online discourse [2]. The coding system (manual) was first generated from postings in the archive outside the 3 month period selected for coding. Once finalized, the coding manual was used to code the 3-month data set.

All 22,952 posts within the 3-month period were coded although posts written in a foreign language or that were exact repeat postings (which was common due to the slow response of the server) were later removed from the quantitative analysis, leaving a total of 16,504 posts. If a single post included several instances of a single category, that category was coded as "used" only once. It was possible for several codes to apply to a single post, to

Conversational Category	Percentage of Postings
<b>1. Relationship with Nature</b>	<b>13</b>
1.1 Experience of Telegarden as Garden	6
<i>1.1.1 Geography</i>	1
<i>1.1.2 Watering</i>	2
<i>1.1.3 Planting</i>	2
<i>1.1.4 Overcrowding</i>	1
<i>1.1.5 Other</i>	2
1.2 Nature Beyond the Telegarden	7
<i>1.2.1 Gardening in General</i>	0
<i>1.2.2 Weather</i>	3
<i>1.2.3 Seasons</i>	1
<i>1.2.4 Environmental Issues</i>	1
<i>1.2.5 Other</i>	3
1.3 Other	0
<b>2. Relationship with Technology</b>	<b>22</b>
2.1 Experience of Telegarden as Technology	9
<i>2.1.1 Robot.</i>	0
<i>2.1.1.1 Artifactual Description</i>	0
<i>2.1.1.2 Biological Description</i>	0
<i>2.1.1.3 Agency</i>	0
<i>2.1.1.4 Social Standing</i>	0
<i>2.1.1.5 Moral Standing</i>	0
<i>2.1.1.6 Other</i>	0
<i>2.1.2 Interface Widgets and Gizmos</i>	5
<i>2.1.3 Interaction Design</i>	1
<i>2.1.4 AEC Staff Intervention</i>	1
<i>2.1.5 Other</i>	3
2.2 Technology Beyond the Telegarden	13
2.3 Other	0
<b>3. Relationship with Humans</b>	<b>69</b>
3.1 Experience of Telegarden as Community	13
<i>3.1.1 Friendship and Interpersonal Support</i>	2
<i>3.1.2 Inclusion/ Welcoming/ New User</i>	2
<i>3.1.3 Origin Stories/ History</i>	2
<i>3.1.4 The Chatroom and Chat</i>	5
<i>3.1.5 Other</i>	3
3.2 Social Life Beyond the Telegarden	58
<i>3.2.1 Identification</i>	1
<i>3.2.2 Friendship Beyond the Telegarden</i>	1
<i>3.2.3 Family</i>	2
<i>3.2.4 Work</i>	3
<i>3.2.5 Travel/ Vacation</i>	2
<i>3.2.6 Chit-Chat</i>	45
<i>3.2.7 Other</i>	8
3.3 Other	0
<b>4. Uncodable</b>	<b>7</b>

Note: The percentages reported in **bold** refer to usage of the overarching category; percentages in plain text refer to the next sub-level in the hierarchy; and percentages in *italics* refer to the lower levels. Within each level of the hierarchy, postings that contained more than one sub-category are only counted once in the overarching category.

**Table 1. Percentage of postings by conversational category (postings = 16,504; number of members posting = 347)**

Conversational Category	1 <sup>st</sup> Qrtl. R = {1-2} P = 140	2 <sup>nd</sup> Qrtl. R = {3-6} P = 313	3 <sup>rd</sup> Qrtl. R = {7-21} P = 941	4 <sup>th</sup> Qrtl. R = {22+} P = 15110	p-value
<b>1. Relationship with Nature</b>	<b>20</b>	<b>17</b>	<b>18</b>	<b>15</b>	<b>.315</b>
1.1 Experience of Telegarden as Garden	16	13	13	8	.005
1.2 Nature Beyond the Telegarden	3	3	6	7	.004
1.3 Other	1	1	1	0	n/a
<b>2. Relationship with Technology</b>	<b>9</b>	<b>25</b>	<b>21</b>	<b>21</b>	<b>&lt;.0005</b>
2.1 Experience of Telegarden as Technology	5	19	14	10	<.0005
2.2 Technology Beyond the Telegarden	4	5	7	12	<.0005
2.3 Other	0	1	0	0	n/a
<b>3. Relationship with Humans</b>	<b>72</b>	<b>63</b>	<b>70</b>	<b>69</b>	<b>.301</b>
3.1 Experience of Telegarden as Community	20	16	17	13	.166
3.2 Social Life Beyond the Telegarden	52	49	55	57	.123
3.3 Other	0	0	0	0	n/a
<b>4. Uncodable</b>	<b>7</b>	<b>7</b>	<b>6</b>	<b>6</b>	<b>.911</b>

Notes: (1) When postings contained material from more than one category, all categories were coded; thus the sum of the percentages of postings across categories maybe greater than 100. (2) The percentages reported in **bold** refer to usage of the overarching category; percentages in plain text refer to the next sub-level in the hierarchy. Within each level of the hierarchy, postings that contained more than one sub-category are only counted once in the overarching category. (3) p-values were obtained using weighted least squares ANOVA to compare mean percentages across the four quartiles. Statistically significant differences are highlighted in gray.

**Table 2. Percentage of postings for each quartile by conversational category (R = range of postings per member; P = number of postings per quartile)**

account for the expression of a range of topics and attitudes within one statement.

**Reliability**

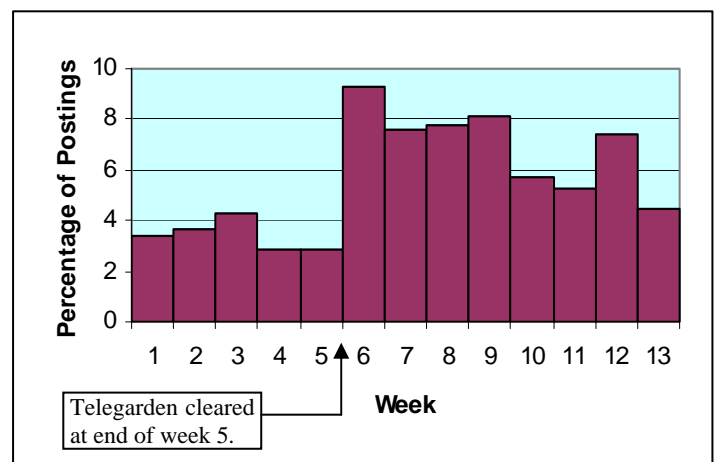
To assess reliability of the coding system, an independent scorer trained in the use of the coding manual recoded 15% of the total postings (3,452 postings) across the 3 month period. Intercoder reliability was assessed through testing Cohen’s kappa at the .05 significance level. All tests were statistically significant. For the lowest level of the coding hierarchy,  $k = .70$ , and for the highest level of the coding hierarchy,  $k = .82$ .

**RESULTS**

**Conversational Categories in the Telegarden**

As shown in Table 1, three overarching categories of conversation in the Telegarden characterized most of the discourse: 1. *Relationship with Nature* (13%) referred to members’ discussion of actual nature (often connected to gardening) within and beyond the Telegarden. As members wrote: “It’s fun to sometimes catch site of a lady bug crawling about in the soil”; “What is cool is that we are moving and I can take my garden with me!” We coded for but found no (0%) evidence of dialog that plants deserved care or respect, or statements of members talking to their plants. 2. *Relationship with Technology* (22%) referred to members’ discussion of technology within and beyond the Telegarden. As members wrote: “The image to the left is one you use to shift the robot... you can tell if the space is occupied by the green dots.”; “aren’t you just a bit amazed you can actually control a robot in a foreign country through the use of a computer from the comfort of your own home?” We coded for but found no (0%) evidence of dialog about the biological, mental, social, or moral

standing of the robotic arm (or robotic installation) itself. 3. *Relationship with Humans* (69%) referred to members’ discussion of an interpersonal connection among one another within and beyond the Telegarden. As members wrote: “Hi everyone I’m new!! I’m looking forward to seeing this garden grow and working with everyone to make it happen:-)”; “I am recovering from neck surgery and can not do anything. This place has been a life saver for me....almost like meeting in a community garden!! A community of world gardeners, I guess!!” We coded for insulting or abusive language (flaming) but found virtually none (.1%, 21 out of 16,504 postings, with 20 out of the 21 postings coming from a single member).



**Figure 2: Percentage of postings by week coded as Experience of Telegarden as Garden (category 1.1 in Table 1). Note: (1) The average number of postings per week was 1270.**

### Differences in Conversations with Increased Participation

To investigate how members' conversations varied with increased participation in the Telegarden, we segmented members into quartiles (four groups as evenly as possible based on the number of postings per member). As shown in Table 2, as individual participation in the chat room increased, conversation decreased about nature and technology inside the Telegarden, and increased about nature and technology outside the Telegarden.

### Conversational Response to Physical Activity in the Telegarden

On occasion, the Telegarden would become too full of plants, and the garden itself was physically cleared by the Telegarden administrators, to allow room for new plantings. One such clearing occurred during this 3-month coding period, at the end of Week 5. As shown in Figure 2, immediately after the clearing of the garden, conversations tripled (from 3% to 9%) concerning the experience of the Telegarden as garden (Category 1.1. in Table 1). For example, one member said: "Hey it works...planted my seed!!! I am really glad to see ... the "new"-new beginning of the garden...I'm sure I'll get to see alot of the oldtimers drop by now...News travels rather fast in these parts."

### DISCUSSION

Using telepresence, the designers of the Telegarden had three main objectives: (1) to integrate natural and organic elements with robots so that users could experience growth, change, and decay as well as spatial and temporal continuity; (2) to experiment in developing an online community where members could interact among themselves and with a real environment; and (3) to create a work of art in the interplay of natural beauty and technology. In broad strokes, our results suggest that the designers' first two objectives were realized (and we did not assess the third). Namely, members engaged in conversations about natural, technological, and social issues, and those conversations (almost always cordial) were responsive to members' level of participation and to physical changes in the Telegarden (e.g., clearing of the garden).

That said, several findings mitigate against over interpreting the psychological robustness of this installation. For the most part, the chat discourse seemed "thin" – lacking seeming depth that could arise in other content domains, such as medical chats focused on treatments for anterior cruciate ligament (ACL) [6] or senior online communities [5]. Too, our results showed that only 13% of the postings involved a relationship with nature, either connected to gardening within the Telegarden or any other nature discourse outside the confines of the installation. It may be that the Telegarden was more successful in connecting people to other people than connecting people to nature.

A difficult question emerges, however, of how to understand this 13% figure. The Telegarden was the first of

its kind, using rudimentary technologies with slow response time, limited capabilities, and an impoverished visual interface. Thus, the 13% figure (the percentage of posts focused on nature) could be seen as quite large, one that is likely to increase as telepresence in this content area gains in fidelity and capability.

Telepresence currently allows humans to explore the depths of the oceans (e.g., the TROV project) and to roam on the surface of other planets (e.g., the Mars Rover). It will increasingly find its way into mainstream human-computer interaction. As a case in point, a telepresence site recently made national headlines: People can go online to control, aim, and fire a real gun – perhaps a prelude to "telehunting" and "telewarfare," troubling scenarios to some. Thus different forms of telepresence support or hinder different sets of human values. Against this backdrop, our results show that the Telegarden can be viewed as an early, albeit limited, proof-of-concept that it is possible to design a telepresence installation that nurtures the human relationship with nature, and fosters connections to people and place, and responsible behavior.

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