Distributed Cognition in Geriatric Telepsychiatry

Sean W. Hansen
Rochester Institute of Technology
shansen@saunders.rit.edu

Janis L. Gogan
Bentley University
jgogan@bentley.edu

Ryan J. Baxter
Bentley University
rbaxter@bentley.edu

Abstract
We report on a geriatric telepsychiatry consultation service provided by a tertiary-care hospital to rural nursing homes located up to a few hours’ drive away. Our case study analysis applies distributed cognition theory to highlight the interplay of social, structural, and temporal distribution of cognitive tasks associated with the telepsych service. Our findings yield a range of useful guidelines for the design of new telemedicine systems and other clinical collaboration tools.

1. Introduction

With improved broadband penetration and declining hardware costs, telemedicine is increasingly seen as a mechanism for specialist physicians at “hub” hospitals to provide expert consultations to clinicians at resource-constrained rural “spoke” clinics and hospitals. We report on a geriatric telepsychiatry consultation service provided by a tertiary-care hospital (“RuralHub”) to rural nursing homes located up to a few hours’ drive away. On-site interviews with clinicians, administrators, and technical personnel at RuralHub and two nursing homes explored participants’ views of the benefits and challenges of this “telepsych” service. Our case study findings are discussed in light of distributed cognition theory, which aims to describe how knowledge is collectively created by systems comprised of humans and the artifacts that they use [24].

Complex work tasks frequently require information sharing among multiple human and non-human entities, working with artifacts (words or pictures on paper or screen, sound captured on a recorder, video on a screen, etc.) that represent reality with varying degrees of fidelity. From the perspective of distributed cognition, collaborative decision-making processes are simultaneously embedded in a social context and embodied in artifacts [23, 27]. For example, in healthcare, clinicians, patients, and family members may collectively contribute facts, opinions, or knowledge about a patient’s condition to influence what course of treatment is prescribed and whether and how it is followed. In addition to these social dynamics, human participants rely on information from various sources, such as blood pressure cuffs, tests results, vital-signs monitors, and clinical notes in a patient’s chart.

RuralHub’s telepsych service uses interactive video-conferencing equipment designed for telemedicine. The consulting psychiatrist believes this rich communication medium extends his ability to provide a high-quality consultation. Relevant data such as the patient’s medical history, medications lists, laboratory reports, clinician notes, etc. are exchanged via leaner asynchronous media such as US mail, email, and facsimile transmission, as well as via telephone conversations.

Our analysis of the RuralHub telepsych service yielded useful design guidelines for new telemedicine systems and other clinical collaboration tools. Before proceeding to a discussion of our research methodology and findings, we provide a brief overview of the primary theoretical framework employed.

2. Theory of Distributed Cognition

The theory of distributed cognition (DCog) arose from studies of teamwork on complex tasks like marine navigation [24], air traffic control [19], and engineering projects [42]. A key observation from these settings is that information processing activities are not localized to individuals but distributed across a group. Researchers further argue that much of a group’s cognitive workload is “shouldered” by their technical artifacts. DCog breaks with cognitive science (the discipline from which it emerged) in its unit of analysis. While cognitive science aims to understand cognition in terms of intelligent computational processes inside an individual’s mind, DCog asserts that the metaphor of “cognition as computation” can be fruitfully extended to understand cognitive processes reflected in broader information-processing systems composed of multiple individuals and artifacts. Thus, DCog expands the unit of cognitive analysis from that of the individual to that of an entire system attending to a specific objective.

The notion of cognition as “the propagation of representational state across representational media” [24: p. 118] is a central facet of DCog research conducted in a variety of collaborative contexts [1, 26, 43]. Representational state refers to “a configuration of the elements of a medium that can be interpreted as a representation of something” [24: p. 117]. In a given task, representational states are reflected in such diverse embodiments as internal memory, language, facial cues, diagrams, and device settings. In each case, the
relevant representational medium (e.g., the human mind, an external artifact) may change as the representational state propagates from one to another.

2.1. Forms of Cognitive Distribution

Building on these observations, DCog makes three assertions regarding the processes of thought in action [24, 25]. First, cognitive processes may be distributed across members of a social group, with each member playing a specific role with respect to processing information and initiating action. Secondly, cognitive processes involve the interplay of internal and external structure. While traditional cognitive science focuses on internal thought processes, DCog highlights the ways that social actors integrate physical elements of the environment (e.g., aspects of the natural setting and/or artifacts designed to support a particular cognitive task) into their thought processes. Thirdly, cognitive processes are distributed temporally; outcomes of earlier actions can influence the cognitive processes enacted in later tasks. These three facets of distributed cognition (social, structural, and temporal distribution) are closely linked in practice. For example, the distribution of cognition over time may rely on both social transmission (e.g., team interaction) and physical artifacts (e.g., legacy systems, IS architectures) as memory supports. Similarly, socially-distributed cognition is just as likely to employ both internal and external structures as individually-intensive cognitive tasks.

2.2. Distributed Cognition in Healthcare

With its emphasis on the interplay of internal and external structure, DCog has been repeatedly employed by researchers in information systems, computer science, software engineering, and other disciplines [2, 15] especially in studies of human computer interaction and computer supported collaborative work [23, 43, 53]. It has also been used in studies of healthcare collaboration [38, 52], with research emphasizing the growing role of IT as a class of powerful cognitive artifacts [36]. A DCog perspective can inform the design and development of more effective IT solutions in healthcare [54], and more effective adoption [4].

Hazlehurst et al. [20] argue that prior research on healthcare systems design relied too heavily on an individualistic decision-making approach, leading to a misperception of the foundations of effective performance in clinical collaboration and consequent systems design flaws: “These misunderstandings can become incorporated into technologies and processes intended to enhance that performance but often having a much different effect” [20: p. 226]. Thus, application of DCog may yield better designs of clinical systems.

Healthcare researchers have applied DCog to study how analog and digital cognitive artifacts support activities in surgical scheduling [36], acute care [37], and emergency department management [54]. Observing that nurses juggle multiple data sources and other artifacts to make telemedicine visits work in chronic care for diabetes management, Kauffman et al. [28] conclude that the integration of legacy clinical information systems and patient health records would improve the telemedicine experience.

3. Telepsychiatry

Telepsychiatry is “the delivery of psychiatric services over distances, especially via interactive video conferencing” [30]. A virtual session may take place between psychiatrist and patient, or patients may be accompanied by family members, nurses, social workers, and/or a local physician, while the remote psychiatrist may be joined by residents or other clinicians.

About 50 telepsych services now operate in the United States and 14 in Canada [21]. Chronic shortages of trained psychiatrists motivated investments in the last two decades [e.g., 22]. Especially in rural areas the supply of psychiatrists is insufficient, particularly in sub-specialties such as pediatric psychiatry [12, 31] and geriatric psychiatry [34, 40, 41]. Telepsych has been tested across various rural settings [10] and correctional facilities [18]. It has been successfully used with a wide variety of diagnostic groups such as cancer patients suffering from depression [9], veterans with post-traumatic stress disorder [45], patients with panic disorder and/or agoraphobia [6], Alzheimer’s and other memory impairment [40], schizophrenia [3], and other mental-health conditions [35].

Studies find that telepsych is comparable to conventional treatment in outcomes, patient satisfaction and adherence to a treatment regimen, and cost [44]. Some psychiatrists report that telepsych can be superior to face-to-face sessions, particularly when dealing with patients prone to violence or who are afraid to leave home for treatment [51]. Many other studies report positive results, but challenges and limitations have also been noted, with some research suggesting that telepsych creates “an impersonal atmosphere” [12] and that it is problematic for elderly patients with sensory impairments [34], when treating uncooperative or paranoid patients [31], or in emergencies [12].

Thanks to declining hardware costs and improved usability, many technical hurdles reported in earlier studies (e.g., video quality [12], auditory delays [11]) are less problematic today. Financial impediments do persist: “Equipment, maintenance, and transmission

---

1 To conform to length restrictions we minimized citations in this section; further references are available from the authors.
costs often are not covered by existing reimbursement plans and thus translate into additional provider costs” [7: p. 964]. Research reveals other adoption barriers and factors warranting further study prior to widespread application in clinical settings [3]. One study concludes: “Knowing where and when to employ telepsychiatry appropriately will require studies of differential effectiveness across applications, clinical contexts, and psychiatric disorders.” [16: p. 1525].

4. Research Design

The study reported here is part of a broader study, conducted from 2008 to 2010, of technical, administrative, and operational aspects of patient-present telemedicine consultation services provided by RuralHub. The Geriatric Telepsychiatry Service was examined from the perspectives of clinical, administrative, and technical staff at RuralHub and two nursing homes (NHome1 and NHome2) that utilized the service (with three organizations involved, it is an “embedded cases” study [47]).

Data were gathered by means of documentary sources and semi-structured, on-site interviews with six people at RuralHub and eight at the two nursing homes (14 total; see Table 1). In spring 2008 during a two-day visit we conducted the RuralHub interviews. The Medical Director of Telemedicine, a psychiatrist, described current telemedicine services and pilot tests in psychiatry, dermatology, trauma, and pediatrics. We interviewed five individuals with technical or administrative roles, and various clinicians in several departments (the latter interviews are not listed in Table 1 because they are not relevant to telepsych). We thus learned about the geriatric telepsych service provided to 11 nursing homes (more have since been added). In 2008 psychiatry and dermatology accounted for most of RuralHub’s telemedicine consultations.

In fall 2009 we gained access to two participating nursing homes. Since all participating facilities primarily serve the elderly, the two sites in our study were representative of the broader group in terms of average age of patients covered by telepsych. The mean and median number of beds at the 11 nursing homes were 105 and 75, respectively (smallest site had 15, largest had more than 300). NHome1, at the median size with 75 beds, was located about 3 hours’ drive from Rural Hub. NHome1’s parent hospital had used RuralHub telemedicine service for vascular surgery consultations and other needs for a long time and requested that RuralHub provide a telepsych service, which was launched in 2003. NHome2, at the mean size with 105 beds, was about one hour from RuralHub. NHome2 was affiliated with a hospital that had used other RuralHub telemedicine services; it began to participate in the telepsych service a few years after NHome1.

Ranging in length from 30 and 90 minutes, all interviews were recorded and professionally transcribed. We explained to participants that our purpose was to explore benefits, challenges and issues in telepsych. Administrative and technical personnel were asked to describe implementation challenges and solutions and to offer opinions regarding current technical and operational choices and future requirements/wishes.

![Table 1. Summary of interviews](image)

<table>
<thead>
<tr>
<th>Site</th>
<th>Interviewees</th>
</tr>
</thead>
<tbody>
<tr>
<td>RuralHub</td>
<td>Psychiatrist and Telemedicine Director</td>
</tr>
<tr>
<td>560 beds</td>
<td>Director of Clinical Support Services</td>
</tr>
<tr>
<td>March 2008</td>
<td>Manager of Telehealth Operations</td>
</tr>
<tr>
<td></td>
<td>Telemedicine Event Coordinator</td>
</tr>
<tr>
<td></td>
<td>Technical Support Specialist</td>
</tr>
<tr>
<td></td>
<td>Grant Administrator</td>
</tr>
<tr>
<td>NHome1</td>
<td>Social Worker</td>
</tr>
<tr>
<td>75 beds</td>
<td>Nurse 1</td>
</tr>
<tr>
<td>Nov 2009</td>
<td>Nurse 2</td>
</tr>
<tr>
<td>NHome2</td>
<td>Director, Dementia and Special Care</td>
</tr>
<tr>
<td>105 beds</td>
<td>Director, Social Services</td>
</tr>
<tr>
<td>Nov 2009</td>
<td>Director, IT and Facilities</td>
</tr>
<tr>
<td></td>
<td>Nurse</td>
</tr>
</tbody>
</table>

Clinical interviewees were asked to describe one or more telepsych sessions they had experienced, their recollection of the patient’s condition, decisions required and care provided during and after the session, and how they felt during consultations. We further probed their thoughts on barriers to, and facilitators of, telemedicine and alternative ways to address the shortage of rural psychiatrists. All interviews were conducted in pairs, with one researcher focusing on questioning while the other took extensive field notes.

Transcripts were prepared for analysis as follows: at least one interviewer listened to the recording and compared it with the transcript, inserting corrections (e.g., spelling of names, medical terminology) and interview segment identifiers to facilitate subsequent coding. Some contextual field notes were also added to the transcripts (e.g., explanations of terminology).

4.1. Data Analysis

We utilized the constant-comparative method [49] to analyze the data, iterating between preliminary findings from the interview data, public materials (public relations announcements, web pages), and materials provided by participants (brochures, conference presentations, etc.). Several forms of coding were done:

- Factual coding of key events and facts (e.g., cost of equipment, date of first telepsych consultation). Information obtained in interviews was triangulated against publicly-available documents such as web
pages, presentation materials, news accounts, and RuralHub doctors' published research.

- Open coding categorized interview segments into new themes or sub-themes suggested by the data but not anticipated a priori.
- Comparative coding of interview segments with previously-identified themes from earlier rounds of analysis (in this embedded-cases study and other studies in our broader program of research on health informatics). Our analysis included grouping the findings in themes and sub-themes based on prior theory.

Several passes were made through the data to accomplish this coding and to support a process of interpretation (identifying linkages across and between themes; probing into the significance of events, opinions, and contextual aspects). At least two researchers separately coded all transcripts, after which we met to identify areas of overlap or difference in the coded themes and consolidate them into broader themes or break them out into narrower sub-themes. Each author revisited the transcripts again with these themes and sub-themes in mind to substantiate or refute them.

4.2. A Geriatric Telepsychiatry Service

Medicare requires that nursing homes give their patients access to psychiatric services. Some homes are able to arrange for visiting psychiatrists, but this option is not feasible in some remote areas served by RuralHub. Before the telepsych service was offered, patients were transported out of the nursing home facility for routine psychiatric care (e.g., treatment of pre-existing psychiatric conditions, issues associated with moving into the nursing home, medication side effects). For an elderly individual, a short trip to a nearby facility can be arduous, even in good weather.

All telepsych consultations were done by the same psychiatrist from his RuralHub office. Nursing homes used portable IP-based video-conferencing equipment with a 24-inch flat panel screen, video camera mounted on a pivoting device, speakers, and a headphone for patients who are hard of hearing. Once or twice a month, each facility was assigned a block of time for the telepsych service. Before the telepsych service was conducted in a multi-purpose room (in one nursing home this room otherwise serves as a beauty parlor/barber shop). As a respondent noted, “It’s usually a good atmosphere and they’re not taken out of familiar territory”). A one-hour consultation is scheduled for initial evaluations; follow-up sessions are up to 30 minutes. In between clinics, the psychiatrist is available by email and phone.

Before a consultation, the psychiatrist receives background information about the patient, usually via fax. He has a brief telemedicine consultation with a nurse and/or social worker, to go over this material and to learn their impressions of the patient’s status on that day. Next, the patient is brought in, and usually a nurse and/or social worker remain in the room with the patient; one or more family members may also be present. If requested, the patient may have some time alone with the psychiatrist as well.

The psychiatrist controls a video camera remotely from his RuralHub office, training the camera on any participant and zooming in or out. He stated that nursing home patients and staff seemed to be unaware of the camera after the first minute of the consultation, and interviews at NHome1 and NHome2 supported this observation (one nurse stated, “Most residents forget they’re talking to a TV … We forget, too.”). During consultations the psychiatrist asks questions based on several standardized depression scales and checks for other indicators regarding the patient’s state of mind, physical symptoms, and behavior. Other aspects of the conversation are improvisational in tone and content.

The psychiatrist, who recalled that before he started doing this he was a “telemedicine skeptic,” is now a strong advocate. He was enthusiastic about several aspects, including the ability to modify the telemedicine setup with assistive technologies, such as the use of headphones for hearing-impaired patients (“We get a big bang for our buck with the amplified headphones”). He was especially impressed with his ability to unobtrusively zoom the camera in (“I can see tears forming much sooner; I can see a twitch in the corner of … the face”) or to focus on a participant other than the patient (such as a spouse) when asking an “emotionally charged” question (such as “How is your sex life?”).

After the consultation with the patient, the psychiatrist will usually meet briefly again with the social worker and nurse to discuss the recommended treatment plan (e.g., new medications, adjusted doses). The psychiatrist writes these recommendations so they can be forwarded to the patient’s local primary-care physician, who is responsible for ordering medications and other aspects of the treatment plan.

5. Findings

Analyzing the RuralHub telepsych service from the perspective of DCog reveals several key insights for the functioning of this distributed cognitive system. In particular, we highlight two sets of core findings: 1) evidence of cognitive distribution in RuralHub’s telepsych service and 2) distributed cognitive dynamics that the current structure of the service enables or inhibits.

5.1. Cognitive Distribution at RuralHub

In this section we describe evidence of the three distinct (but interrelated) forms of cognitive distribution: social, structural, and temporal [25].
Social distribution. The most prominent form of cognitive distribution in the telepsych service is the social distribution revealed in the diverse contributions made by distinct roles within the system. While a given individual can enact multiple roles within the system (see also Section 5.2), how the cognitive workload is divided is critical to the system’s functioning and ensuring access to vital information sources. Distinct roles observed in the telepsych case, and the primary tasks associated with each, are summarized in Table 2.

<table>
<thead>
<tr>
<th>Role</th>
<th>Task Responsibilities</th>
</tr>
</thead>
<tbody>
<tr>
<td>Patient</td>
<td>Provide personal perceptions and evidence of mental states; Complete evaluation tasks</td>
</tr>
<tr>
<td>Psychiatrist</td>
<td>Probe the mental state; Direct evaluation tasks; Render evaluation</td>
</tr>
<tr>
<td>Family members</td>
<td>Provide information regarding patients’ past experiences and recent behavior</td>
</tr>
<tr>
<td>Nurses</td>
<td>Manage patient attention; Engage psychiatrist when intervention is needed</td>
</tr>
<tr>
<td>Social workers</td>
<td>Provide background information and impressions; Render behavioral support</td>
</tr>
<tr>
<td>Technical support</td>
<td>Set up and maintain video-conference system</td>
</tr>
<tr>
<td>Primary care physician</td>
<td>Enact recommendations (e.g., change medication type or dosage)</td>
</tr>
</tbody>
</table>

The social distribution reveals differences in dependence and centrality for various roles. While patient, psychiatrist, nurse, and social worker are central to the cognitive effort of evaluating and improving a patient’s mental state, family members, technical support, and primary care physicians tend to be peripheral. The critical insight is that all roles (central and peripheral alike) possess some information or authority essential to the proper functioning of the system.

Structural distribution. Various artifacts are essential in carrying out a telepsych consultation; they represent both key sources of information and the media through which the “propagation of representational state” (i.e., understanding a patient’s mental health needs) is achieved. Artifacts differ in their informational content and technical sophistication. Key types of system artifacts are summarized in Table 3.

From the DCog perspective, the critical insight is that these artifacts are not simply conduits of communication. Rather, they bear a portion of the system’s cognitive workload (e.g., memory – medical histories, notes; evaluation – depression scale, paper and pen) and can alter how issues are perceived (i.e., representational state) by participants. In one salient example of artifact use, the psychiatrist relies on his remote manipulation of the digital camera to focus on selected aspects of a consultation (e.g., the patient’s hands when completing an evaluation task, a family member’s reaction to a question). This enables the psychiatrist to discern more information than relying on explicit verbal responses to a statement or question.

Temporal distribution. Temporal distribution of cognition is achieved through both social and structural mechanisms. Prior to a consultation, the psychiatrist confers privately with nurses and social workers (and occasionally patient’s family members) to achieve an understanding of a patient’s past behaviors and mental states. Similarly, notes, medical histories, and session recordings enable the cognitive system to draw on past experiences (and project to future evaluations) in the assessment of the patient’s needs.

5.2. Distributed Cognitive Dynamics

While social, structural, and temporal modes of cognitive distribution are apparent in the telepsych case, a critical question remains: How does this distribution of cognitive processes inform our understanding of the system’s efficacy? DCog suggests a number of features that can reinforce or undermine system effectiveness, including the presence of redundant knowledge, clarity of propagation mechanisms, transparency of action, and simplification of information processing. While these concepts are implicit in DCog theory [24, 25], the labels employed are those of the researchers.

Knowledge redundancy. DCog proposes that a collaborative system is more robust when there is re-
dundant knowledge [24], since failure (or elimination) of one element can be compensated for by other members’ knowledge. So, if a team member goes on leave, other members’ understanding of that individual’s role and function can compensate for the “lost” individual. Knowledge redundancy in the telepsych system is pursued through conversations between the psychiatrist and nurses/social workers, training of various members on the entire telepsych process (including equipment set-up), and ancillary observation by psychiatric residents. The following statements by participants illustrate this knowledge redundancy:

“We do presentations to staff or in-services to family groups, and [an administrative assistant] has learned how to hook that equipment up so that if I’m not around, other folks can do those things. It’s all about cross training people when it comes to it.” – System Administrator

“One of our divisional clerks is used to hooking [the equipment] up. She goes over and gets it. If she’s not around, then their tech support would come do it … [The nurse] knows how to do it in a pinch.” – System Administrator

Clarity of propagation mechanisms. Because DCog reflects “the propagation of representational state across representational media,” for a system to function effectively, it should be clear to all members how understanding progresses inter-subjectively [27]. This concept includes an awareness of how one’s own role contributes to the system’s broader functioning. The telepsych participants made an effort to achieve a shared understanding through exchange of perspectives and collective engagement. For example:

“I always find it neat where afterward [the psychiatrist] will say, ‘I was using the camera and I focused in, looking at her tremor, and it was different from the last time I saw her. And then I said this and she changed her behavior.’” – Social Worker

“In traditional consultations, only the patient] would go to the appointment. So we wouldn’t have that connection. We also wouldn’t get the feedback for a while … We wouldn’t hear what the practitioner feels, what they think. We get a lot more from [the telepsych process]. We know exactly what they think.” – Social Worker

As the latter quotation indicates, the creation of a shared experience was perceived by participants as one of the primary benefits of the telepsych process.

Transparency of action. Since collaboration participants function as a cognitive system, individual members benefit from being able to “see” what others are doing [29, 39]. As in the concept of collective mind [50], participants engage in “heedful interrelating,” their actions only make sense in relation to others’ activities. Computer interfaces used in such contexts should reinforce transparency – “letting the semantics of action speak through the interface” [29: p. 16].

Transparency of action is explicitly supported through direct discussions between telepsych participants and collective engagement with the technology. This dynamic is seen in the following statements:

“[The psychiatrist] educated me at that time and gave me some examples of how he might move the camera slightly to someone else in the room, other than the person who he was having a consult with. He might be more interested in the reaction to a question of a family member or a spouse that’s sitting in there.” – System Administrator

“I’d met [the psychiatrist] at conferences and we’ve talked in other settings, but it’s been 9 months since I’d seen him face-to-face. But it’s as though I’d seen him three weeks ago because we see each other on telemedicine. I guess that’s just one of the things that I’m in awe of, is that it is transparent.” – Social Worker

However, the telepsych case also revealed instances when transparency is actively inhibited, particularly with respect to the perceptions of patients:

 “[Clinical team members] will meet with both [patients and family members] and then ask the resident to leave and meet with the family afterwards.” – Nurse

“[The psychiatrist] controls the camera on his end, so he can zoom in without anybody even knowing.” – Nurse

This apparent tension between the benefits of transparency and a need for some asymmetry of information may suggest that the context of psychiatry – and perhaps telemedicine and clinical care in general – engenders some unique DCog issues.

Simplification of information processing. Prior DCog studies in complex work environments highlight the value of simplified information processing (e.g., “speed bugs” in cockpits [27], the pelorus in marine navigation [24]). Simplification is achieved by offloading portions of the cognitive workload to structural elements. In the telepsych context, simplification strategies appeared to be limited, which suggests to us that there are opportunities for system design enhancements (see also Section 6). Individual participants made relatively little use of the artifacts with an eye to simplifying information processing, although an exception to this observation was the way in which the psychiatrist used simple “paper-and-pen” evaluation tasks:

“[The psychiatrist] might ask them to hold up a pencil or hold out three fingers. He’ll have them write out their name and he’ll zoom in on that.” – Social Worker

“Part of the dementia screening is having people perhaps draw a clock [or] write a sentence. So, we give them the paper and pen and [the psychiatrist] zooms right in so he can see what they’re doing.” – Social Worker

Instead of relying solely on the patient’s description of their mental state, the psychiatrist used simple artifacts to transform the process of verbal interpretation into a process of observation.
These various cognitive dynamics reveal how the distribution of knowledge and action enables the broader system to improve the participants’ collective understanding of a patient’s mental health needs. However, the case study findings also suggest areas where information systems designs could be enhanced to support this objective more thoroughly. We next turn to this design-oriented perspective.

6. Discussion

Our analysis illustrates the value of DCog for understanding telepsych service delivery. However, ultimately the power of this theoretical perspective lies in the insights it offers for enhancing the service.

6.1. Implications for Telepsychiatry Design

What implications does DCog analysis have for the design of telepsych services? Analysis of the RuralHub case suggests several possible system enhancements.

System integration. One apparently inefficient aspect of the RuralHub telepsych service is the lack of system integration (not a unique telemedicine challenge [28]). We observed minimal integration between RuralHub’s clinical information systems and those of the participating nursing homes. The pre-consultation work of transmitting information from nursing home to RuralHub relied largely on transmission of files via facsimile, emails, or U.S. mail. This fragmented exchange process gives rise to redundant data entry, limited digital search capability, and significant manual coordination requirements.

While this inefficient system could conceivably support knowledge redundancy, our interviews offered no examples to support this idea. It does seem likely that the lack of integration led to sub-optimal transparency of action. For example, were there a fully integrated electronic patient medical record that included clinician notes, the psychiatrist would have greater access to information regarding the patient’s mental state history, as well as the medical treatments the patient had received. These findings imply that the effectiveness of the telepsych service could be greatly enhanced through a focus on systems integration within the network of participating institutions, including the capability for electronic storage, imaging, and exchange of all patient documentation.

Video recording and annotation. As noted above, RuralHub practitioners had recently started to record the telepsych consultations, initially using video cassettes and more recently DVD recording. Despite the relatively low level of technical sophistication, the recording practice was viewed as a key enhancement of the process. The consulting psychiatrist noted:

“What’s neat is that you can take this recorded interaction and then a day or two later ... say to a colleague, ‘You know I’m wondering, is this Parkinson’s disease or tardive dyskinesia or both? I’m wondering if you could take a look at this.’ Plus we can use [the recording] for teaching our residents and medical students some of the things that I just mentioned: ‘Watch what I do now before I ask this next question. I panned over to the wife or the husband and then asked the question. Now watch the expression on his face.’ Boom - then it happens. You can use it for teaching in non-real time.”

DCog analysis suggests that further benefits can be achieved through a move to digital video capture and storage. By increasing access to recordings by the entire clinical team, this would increase knowledge redundancy, create greater transparency of action, and foster clarity around the psychiatrist’s process of evaluation and interpretation. Adding video annotation functionality [14, 33] for the psychiatrist and/or other clinicians would enhance the ability to communicate with, and direct the attention of, fellow team members [54]. This would improve collective understanding and also help to simplify information processing by “offloading” some memory functions onto the technology.

Developing collaborative infrastructure. As noted above, the flow of communication into and from the clinical collaboration is quite fragmented. Telepsych participants could benefit from creation of a collaborative online environment to support exchange of formal and informal information [8, 46, 48]. Online collaboration platforms create a common “space” for sharing ideas and interpretations – a distributed cognitive exchange process that Boland and Tenkasi [5] refer to as “perspective making and perspective taking.”

A shared online environment would contribute to knowledge redundancy, transparency, and clarity of propagation mechanisms, and would represent a new and rich representational medium for system members.

Addressing dependencies. The case findings also point to social factors that must be addressed. Despite efforts to foster shared knowledge (knowledge redundancy), analysis reveals some points of vulnerability. Most notably, the telepsych service relies heavily on the knowledge and expertise of one consulting psychiatrist. Participants expressed concern about the possibility of his retirement. Other social challenges included timely access to the video-conferencing equipment and buy-in of primary care physicians. DCog cautions that overreliance on any one element is problematic because it reduces the robustness of the system and its capacity for reconfiguration [32]. To reduce such risks, RuralHub could employ such remedies as adding a second consulting psychiatrist; providing ongoing training of psychiatric residents, nurses, and social workers; maintaining multiple equipment compo-
nents; and marketing to increase awareness and understanding among primary care physicians.

The potential enhancements outlined here would help to bolster the robustness of the distributed cognitive system around telepsych service delivery, through the dynamics of augmented knowledge redundancy, greater clarity of propagation mechanisms, enhanced transparency of action, and simplification of information processing. Importantly, each of these design considerations involves some interplay of social, structural, and temporal forms of cognitive distribution. Thus, our DCog analysis yields several insights for the design of telepsych services. We do not contend that our recommendations are exhaustive, but they do illustrate the practical value that DCog offers for telepsych and may extend to other forms of telemedicine and clinical collaboration.

6.2. Limitations

Several limitations should be acknowledged. First, while our findings should prove useful for other telemedicine services, this study focused on a specific patient population and type of service delivery. Accordingly, we do not attempt to generalize broadly regarding the efficacy of specific design features across multiple categories of telemedicine services. Rather, our analysis supports theoretical or analytic generalizability [13, 55] regarding the value of DCog for understanding telemedicine usage. A second limitation is that we did not observe actual patient consultations; we relied on participants’ retrospective accounts. Our study thus reflects a “double hermeneutic” process [17]: we sought to interpret reflections of respondents who offered their interpretations of their day-to-day experiences with the telepsych service. Lastly, we examined a service provided by one psychiatrist operating out of one hub hospital. While this made it possible to compare two spokes using the same hub, we cannot rule out unusual influences in how this particular psychiatrist practices and possibly idiosyncratic use of telemedicine technology. Despite these limitations, we believe that our findings provide an accurate assessment of the most salient elements of the telemedicine service and provide sufficient data to support our interpretation of findings.

7. Conclusion

Given the declining cost of high quality telemedicine equipment and connectivity, there is growing interest for telemedicine services to improve patient access to basic and specialty healthcare. Distributed cognition theory is well suited to the study of telepsychiatry since it emphasizes both interpersonal interaction and how collaborators engage with cognitive arti-

facts. DCog has been applied in previous medical contexts, but not in telepsychiatry. Drawing on interviews in an embedded-cases study, we described how distributed cognition operates. We identified four avenues for improved distributed cognition in telepsychiatry and perhaps more generally: system integration, video annotation, collaborative infrastructure, and addressing dependencies. Our analysis suggests that such improvements both depend upon and can improve upon the telepsych service system’s knowledge redundancy, clarity of propagation mechanisms, transparency of action, and simplification of information processing.

We focused on general psychiatry for the geriatric population. Further research could apply DCog to other telemedicine services to reveal shared and distinctive cognitive structures. Such studies would help to alert professionals to features that are most essential to each telemedicine service. Other studies could employ a design science perspective in developing specific technology features (e.g., video annotation) and testing these in the laboratory and field.

8. Acknowledgements

This study benefited from financial support from Bentley University, the McDowell Research Center for Global Information Technology Management at University of North Carolina Greensboro, and the North American Case Research Association. We also gratefully acknowledge the interviewees at "RuralHub" and two nursing homes, who freely gave of their time and insights. We further acknowledge the assistance of Bentley Associate Professor Monica Garfield in the initial data collection.

9. References


