mPath: Facilitating Human Interaction

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ABSTRACT
As the "baby-boomer" generation approaches retirement, the United States will enjoy a significant increase in the number of senior citizens. Issues involving seniors are likely to rise to the forefront of national consciousness. A primary concern for this population is the loss of companionship, which can contribute to isolation, depression, and decreased socialization [9]. A concept for a data management service – *mPath* – is proposed to combat isolation among seniors. mPath works with administrators of assisted-living facilities to oversee an ad-hoc volunteer network. Interacting with residents, these volunteers assess social relationships and emotional reactions, quantifying for the computer their qualitative observations. The system examines accumulated data over time to reveal anomalies, highlight trends and anticipate future responses. Administrators may choose to act upon that information. The overall effect is to increase the social well being of seniors in an unobtrusive manner.

Author Keywords
Senior citizens, empathic, motivation, predictive algorithm, group activity, transparency, administration.

ACM Classification Keywords
H5.m. Information interfaces and presentation (e.g., HCI): Asynchronous interaction, Computer-supported cooperative work, Evaluation/methodology.

INTRODUCTION
Consider Mrs. Worthington. She is a resident of an assisted-living facility in America. Mrs. Worthington's health took a bad turn following the death of her husband two years earlier, a loss that also claimed her self-confidence and sapped her courage. Despite the best efforts of a staff serving 200 other seniors, she spends more and more time sitting alone in her room. Visitors are few, and she is mostly unaware of the activities and services available to her through the facility. Mrs. Worthington watches as changing shifts and job turnover remove familiar faces, often forcing her to repeat the same answers to the same questions. Concern from the staff is increasing, but the effectiveness of their interaction decreases with every failure to engage her with others.

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Imagine an ideal response to her predicament. The care facility overcomes staffing problems by eliciting help from other residents and the community at large. The most important information Mrs. Worthington provides is shared in a simple manner with people already aware of her existing needs and interests. It becomes easier to achieve an authentic connection in subsequent visits. Furthermore, group activities are centrally published with listings growing more and more relevant to residents over time. As she becomes engaged in her local community, Mrs. Worthington's sense of isolation diminishes and her health improves. In fact, she eventually serves as a liaison between administrators and residents helping to connect with new seniors arriving under similar conditions.

This is the mission of mPath, a central data bank designed to help those who help our senior citizens. mPath reduces isolation among seniors by facilitating better interaction between humans.

Everyone Benefits
Utilizing client software, a subscription data management service, and a cycle of social and administrative tasks, mPath benefits everyone involved.

The Administrator
As leaders in the organization, *administrators* maintain full access to mPath software, including resident profiles. Since the administrator is responsible for the social health of these consumers, computer analysis of recorded observations may be viewed to assist in decision making. Informed by the identified trends, they adjust group activity schedules to meet the needs of the local population. By relying on the computer and a network of volunteers, the administrator becomes effective and efficient at combating isolation.

The Volunteer
An individual employed by the organization to interact regularly with consumers is a *volunteer*. A volunteer may be paid, or simply a willing donor of time. By noting and recording observations about resident seniors, volunteers serve as a human interface between mPath and consumers. Volunteers prepare for interactions with residents, review relevant computer analysis, and put themselves in a position to enjoy an authentic relationship.

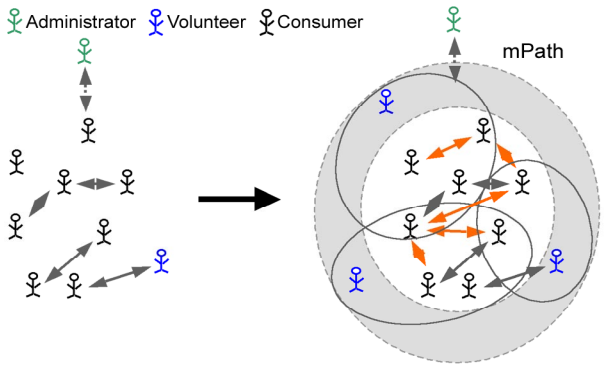

Figure 1. Working transparently with staff, mPath facilitates growth in the social network. The administrator uses analysis from mPath to manage an ad-hoc network of volunteers and cultivate authentic connections.

The Consumer

Borrowed from the health care industry to imply a choice of service [5], the term *consumer* describes the ultimate beneficiary of mPath – a senior in need of meaningful human connection. Consumers are served by an entity responsible for their socialization, such as an assisted-living residence, government agency, charitable organization or church. Isolation decreases as human interaction improves.

Transparent and Tangible Companionship

Observational assessment techniques and predictive algorithms comprise the backbone of mPath. The network leverages the strengths of humans (contextual recognition and translation) and of computers (calculation and data storage) to improve connections between people.

Volunteers, trained to evaluate an individual's response to their environment, record observations in mPath. Every interaction with a consumer begins with established, transferable knowledge of prior exchanges, communicated through summary sheets. It is as if someone focused exclusively on the well being of a single person and is thus able to prepare others to converse with that individual.

The computer is capable of remembering everything absent of judgment. Over time, it examines the accumulating data and alerts administrators to aberrant responses and interesting trends. mPath highlights for administrators both potential issues to be addressed and positive connections to be reinforced. By advising decision-makers in this manner, mPath becomes a crucial member of the facility staff.

This level of empathy is achieved without requiring seniors to use technical tools. Shadowing studies and preliminary usability exploration indicated a discomfort with computer interaction. As experience and interest in emerging technologies evolves, however, seniors may demand access to the system through digital interfaces. For today's seniors, mPath is most effective as a computer companion utilizing a human interface.

DESIGN ARGUMENT

After investigating the affected populations, several brief conceptual ideas were explored as solutions to the problem of virtual companionship. As research and prototyping of a social scheduling tool moved forward, interviews were conducted with administrators experienced in motivating senior citizens to become more socially active. Interface prototypes were also shared with both active seniors at a local chapter of Retired Seniors Volunteer Program (RSVP) and residents of a local elderly care facility.

Throughout, a modified form of Rational Unified Process (RUP) was utilized to elaborate conceptual ideas. Characterized as a scalable, iterative cycle of four distinct phases, RUP is a methodology to attack major risks and welcome changes to requirements early in the project life cycle. The process strives for a "living" product that emphasizes stability as the system evolves [7]. Each component of development (research, usability, interface design, assessment methodology, etc) followed its own iterative process within the greater mPath development cycle. This iteration has provided the design team with ample opportunity to revisit and strengthen the system.

Focus groups featuring participants with diverse but relevant backgrounds will augment in-depth testing of the assessment methodology (CTM valuation) central to the mPath system. Further usability testing of volunteer and administrator toolbox interfaces will be undertaken, and a pilot mPath program may be established.

Analysis of Senior Citizen Population

Senior Citizens are currently a declining population, comprising less of the population in 2000 than they did in 1990 [12]. The decline in percentage population, however, is not a product of lowered life expectancy but rather a glut in younger demographics. Adults from the post-war population explosion in the 1940s and 1950s are on the verge of entering the 65-and-older crowd, which will quickly reverse the trend. We can expect a resurgence of the senior population over the next decade [13].

Socialization is a declining attribute of the senior population, and the risks of isolation are growing more significant. According to a 2004 study published by Demos about homebound seniors in the U.K., social networks display a 'poor get poorer' property. Those with little family contact will have fewer friends [8]. These seniors are less likely to make friends, belong to an organization or participate in activities. Isolation also breeds health risks.

The tools that facilitate connection in this modern age – computers, instant messaging, cell phones, tablet PCs, video conferencing – are frequently unavailable to our oldest citizens. Where the technology is present, the motivation to utilize these high-tech gadgets or the funds to purchase these devices is not evident. The need for companionship persists while the skills to connect with others atrophy [6].

Analysis of Assisted-Living Facilities

The best weapon against senior isolation is family contact, but socialization is made difficult by living arrangements. This is particularly true in the West, where homes spanning three generations represent a mere .07% of all households [10]. In 2002, 10.5 million older persons (including 41% of elderly women) lived alone. That percentage increases with age [11]. This is due to cultural emphasis on independence and rising costs of health care.

Assisted living facilities offer a housing alternative for older adults who may need help but do not require the intensive medical care provided by nursing homes [11]. The Assisted Living Federation of America (ALFA) boasts over 5,000 members and 40 state affiliates and estimates more than one million Americans currently live in one of the 20,000 centers nationwide [14].

This is an international trend. Developing nations are expected to comprise 80% of the 60-and-over population by 2050, when the elderly population eclipses two billion [11]. A decade ago, nursing homes were foreign institutions for China and India. As the world's middle class expands, however, mistakes the U.S. made in cultivating isolation threaten to be repeated abroad [4]. America is returning from that journey of self-discovery by increasing Aging In Place programs and refocusing senior care facilities toward personalization. Even so, assisted-living centers face the new challenges that come with increased utilization.

Emphasize Human Interaction

Care providers actively address the issue of social health but need help in fulfilling that mission. Technology is not a solution in itself. Obstacles that feed isolation as one ages cannot be overcome by forcing upon seniors technical metaphors with which they have little experience. Rather, technology best addresses the problem when delivered through a medium seniors crave: human interaction [1].

In this case, the implementation is a tool to centralize the management and promotion of social events and services. Beyond the efficiency gains of an electronic schedule, the system also attempts to measure the effectiveness of each activity. Administrators use this cumulative information to shape activities, meeting residents' needs while anticipating the best opportunities for future interaction.

Empathic Prediction

To calculate such predictions, the computer requires a quantitative value of qualitative assessments. This demands not only the normalization of subjective observation but also a focused methodology to identify behavior deemed important and relevant to improving human connection.

Volunteers work to quantify resident behavior. They identify both an emotional measure and the triggering condition for a senior's reaction to their environment. Whether assessed through direct conversation or group dynamics, this follows the assumption of Keith Oatley's communicative theory.

According to Oatley, the mind is comprised of parallel processors, each governed by a consciousness exerting control. The mechanisms to communicate this control include two aspects: detection of conditions, and production of actions. Each condition has a distinct action. Embedded in the identified *emotion mode* – Happiness, Sadness, Fear and Anger [2] – are its trigger and an expected reaction..

To quantify these observations in a meaningful way, the assessment must concentrate on clearly positive and negative responses to triggers. Modern psychology accepts that people tend to code experiences in this manner [3], with neutral responses being functionally meaningless to mPath. A 5-point Likert scale is adopted by the volunteer to subjectively determine how positive or negative the reaction. This generates a measured value – the *Consumer Trigger Measure* (CTM) – which may be processed by mPath and tracked over time.

Predictive algorithms are calculated by the computer and focus on identifying aberrant responses. This alerts the administrator about issues that might be addressed (negative) and existing connections that may be enhanced (positive). Such analysis may be applied to the publication of group activities, addressing communal responses to specific triggers, attending to the needs of a specific individual, or evaluating the contribution of a volunteer. Since people can serve as triggers, it is also possible to identify catalysts in the resident population who may serve to inspire participation by others.

Effects of mPath

The subjective nature of an individual assessment serves as a "micro-ethnography," where the reliability of the data is a factor of both time and multiple perspectives. Mistakes in recording observations are of limited detriment since mPath offers its analysis merely as suggestion, rather than enforcing a restriction upon participation. Whether an aberrant value is the result of a real change in the consumer's well-being or an artificial read by a volunteer during an interaction, the primary course of action will be a discussion with the consumer to confirm accuracy.

The act of data collection itself is a boon to administrators seeking to improve socialization among residents. By definition, each assessment mandates an interaction between the consumer and another human being. The authenticity of that human connection improves over time, as more people begin conversations with an empathic understanding of previous emotional responses.

Computers allow trends to be tracked over time. This has relevance not only in establishing a baseline by which to compare individual deviations from the norm, but also in measuring progress in the battle against isolation. Further, deep relationships emerge in this complex system that can project future areas of concern or opportunities to form new connections. A known link to a trigger brings with it the potential to establish recorded responses to its periphery.

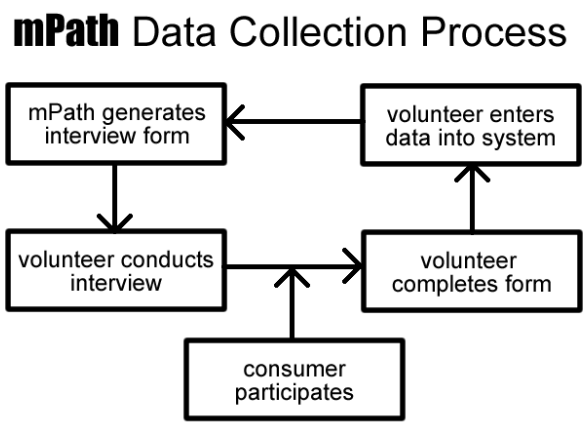

Figure 2. The iterative mPath data collection process.

ITERATIVE KNOWLEDGE

To combat growing isolation among senior citizens, mPath improves the opportunity for authentic connection by leveraging the ability of human beings to mine meaning from the context of observed behavior. This is an iterative process increasing knowledge with each assessment.

Assessment Strategy

The process begins with a conversation. One or more volunteers visit a consumer to initiate a casual, but directed interaction. In some cases, such as the initial registration interview, an administrator will facilitate the conversation. During the exchange, the volunteer observes and records any strong responses by the consumer to a given topic. The volunteer's highest priority, however, is to connect with the consumer in an authentic manner.

Observations are collected at group activities, scheduled by the administrator for the purpose of socially engaging the facility's residents. One or more volunteers are recruited to attend these functions and assist consumers. A more passive experience for the volunteer than one-on-one conversation, attendance is an opportunity to observe noteworthy behavior between consumers.

Observations are recorded as a *Consumer Trigger Measure (CTM)*, a numerical value representing the positive/negative degree of the consumer's reaction to a trigger. A trigger may take the form of a place, person, date, activity, physical problem, or any definable concepts to which the consumer expresses an emotional reaction. The emotional mode constitutes the measure and is limited to Oatley's list: Happiness, Sadness, Fear and Anger. After the interaction concludes, the volunteer authenticates to the mPath software application. Using handwritten notes or memory, the volunteer records the response data and descriptive notes using a simple interface.

As more observations are quantified, mPath's ability to extract meaning from the data improves. Dynamic reports and graphic representations reveal insights that may be applied toward the next interaction with the consumer.

Administrative Decisions and Actions

Strong connections and anomalies most likely to impact the success of the social network are isolated by mPath. The two service roles are thus empowered to help consumers participate in meaningful activities, form and enhance social connections, and attempt to resolve emotional and social obstacles to human interaction.

For volunteers, the goal is to improve future conversations. Equipped with a summation of critical knowledge acquired from prior observation, the volunteer begins a conversation with an awareness of the other's perspective and heightened sensitivity to the needs of that person. New information accumulates and propagates. Since the system invokes an ad-hoc network of human volunteers, advance knowledge of the consumer benefits an emerging relationship.

For administrators, time and resource constraints are overcome by viewing mPath reports. While volunteers concentrate on individual needs, the administrator is freed to optimize the activity schedule for the entire community. Details of events are massaged while sampling a collective response culled from known consumer data.

For consumers, the cumulative benefit is a simple list of suggested activities with personal appeal. Each published activity immediately generates a guest list of consumers most likely to enjoy the event, setting or topic. A trip to the mall to shop with Mrs. Smith on Wednesday afternoon, for example, may anticipate positive interest from anyone who likes Mrs. Smith, shopping at the mall, or doing things on Wednesday afternoons.

mPath does not circumvent humanity. The computer does the legwork for deeper analysis, highlighting interesting data not readily apparent to those laboring without the system. Decisions remain a human domain.

BUSINESS CASE

Although this concept might impact all seniors on a global scale, mPath targets domestic assisted-living facilities advocating for senior citizens to improve their social health. The monthly fees for a centralized service and software licensing are assumed by the organization, not the individual health care consumer. As the population of senior citizens doubles over the first three decades of this century, computer skills will improve and provide ample opportunities to expand mPath to include pervasive devices.

There is also a widespread financial benefit to society. By reducing the problems caused by isolation among senior citizens, health care costs diminish. *Delayed discharge*, where a senior is fit to leave the hospital but has nowhere appropriate to go, costs Britain's National Health Service an estimated 170 million pounds and 1.7 million lost bed days annually [8]. In America, 12.5 million seniors were discharged from hospitals in 2002 after being admitted three times more often than the generation following them. On average, a senior spent $3,586 annually on health [11].

Case Studies

The following sample case studies illustrate the range of target groups likely to encounter mPath:

- **Rodney Ranger** – The new Happy Gardens Residence director is self-conscious about the dwindling attendance in some cultural activities for seniors and vows to do something to reverse that trend. A budget-conscious governing board will start axing programs if participation doesn't go up. Rodney worries that the events aren't appealing to the older generation. He also suspects no one reads his newsletter.
- **Cindy Louis** – Cindy is the leader of a regional senior volunteer organization. Her roster suffered too many deaths in the past year, and she is having difficulty recruiting replacements. Participation is vital since every hour of volunteer work entitles the group to federal matching funds. Cindy has several volunteer resources but lacks the staff and technical expertise to make things more efficient. Budget cuts are coming up … again.
- **George Martin** – A new arrival moves from Florida into an assisted-care residence in Indiana. A grandson attends nearby Indiana University, but George has no other family or friends nearby. The grandson occasionally visits, but not enough to prevent George from becoming depressed from his new isolation. He used to be quite active, until his hip gave out. The facility administrator has been unable to connect with George on her routine visits with him. She doesn't know what is wrong.
- **Martha Shannon** – Not ready to receive full-time care at a nursing home, Martha is a disabled senior who wants to play bingo at the VFW. Transportation issues and her complicated medical condition discourage it, however. People in her facility would like to help, but no one has much time. Martha doesn't know anyone in the local community or where to go to look for other options. She misses her bingo games.

Legal Liability and Consumer Acceptance

Due to the presence of personal information, which may include medical conditions or diagnosis, it is mandated that the consumer provide a release of such information for the purpose of promoting better connection through mPath. Failure to sign an agreement need not prevent the consumer from registering as a member, but it should limit what information is stored in the central service.

In addition, technical precautions should be taken to insure the data from misuse. The data should be secure, backed up and completely pruned at the appropriate time. If the consumer wishes to have a copy of all data collected, efforts should be made to accommodate that request. It is imperative that high ethical standards are maintained when access to consumers' personal profiles is granted.

Further research is needed to understand the nature of consumer resistance to this process, if any. It is important to communicate the role mPath will play in their lives, enhancing existing practices conducted by care providers.

CONCLUSION

mPath system assumes a daunting task: the improvement of social well-being via the quantification and mining of data related to emotional responses. However, by keeping people at the forefront of the decision-making process, the risks associated with this challenge will be minimized.

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REFERENCES

1. Active Aging Strategy Reference Group. 2003. A Sport and Recreation Queensland Initiative, 12-13.
2. Beaudoin, Luc. August 1994. Goal Processing in Autonomous Agents. University of Birmingham, 29-30.
3. Bradburn, Norman. 1969. *The Structure of Psychological Well-Being*. Chicago, IL: Aldine, 54.
4. Brownell, Ginanne, and Power, Carla. Dec. 6, 2004. The Golden Age. *Newsweek International*.
5. Carlson, Robert P. May-June 1998. The Emergence of the New Health Care Consumer, Part 1. *Physician Executive*. Panel Discussion.
6. Haralambous, Betty, Osborne, Deborah & Fearn, Marcia. July 2003. Participation in Physical Activity Amongst Older People. Victorian Department of Human Services, State of Victoria.
7. Kroll, Per & Kruchten, Philippe. 2003. Rational Unified Process Made Easy: A Practitioner's Guide.
8. McCarthy, Helen & Thomas, Gillian. June 2004. Home Alone. Demos, 16-17.
9. Shaughnessy, John J. July 28, 2002. Aging Baby Boomers Reshaping Society. *The Indianapolis Star*.
10. U.S. Census Bureau, Census 2000. Multigenerational Households for the United States, special tabulation.
11. U.S. Dept of Health & Human Services, Admin. on Aging. 2003. A Profile of Older Americans.
12. Broward Cnty Urban Planning & Redevelopment http://www.broward.org/urbanplanning.
13. MarketResearch.Com. http://www.marketresearch.com.
14. Assisted Living Federation of America. http://www.alfa.org.