Self-Organization in Housing Choices of Persons with Disabilities

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ABSTRACT. Complexity theory provides a promising exploratory framework for demonstrating quantifiable improvements of disability interventions. This paper introduces concepts of complex systems theory and applies one particular underlying concept, self-organizing, to a program providing housing and other support services to persons with disabilities. Using this specific component of complexity theory provides a beginning point to explore how consumers and their allies made choices on where their homes would be located.

KEYWORDS. Complexity theory, exploratory self-organization, disability, consumer choice, community inclusion

As complexity theory gains acceptance as a paradigm to complement social work's person in environment perspective, applications remain few. With complexity's view of an iterative, dynamic and adaptive internal processes (Warren, Franklin, & Streeter, 1998) we have the possibility to explore and learn more of how consumers, represented as agents, possess the ability to learn in order to adapt to emerging struc-

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tures and become more complex (Kauffman, 1995; Prigogine, 1996). The use of complexity theory, particularly the concept of self-organization, remains rare in human services (Hudson, 2000). While complexity theory, also know as complex systems theory, in recent decades has evolved within the natural sciences, its assumptions pose significant challenges to social research and evaluation (Patton, 2002).

This paper reviews basic concepts of complex systems theory and applies these to an organization working in partnership with persons with disabilities in order to develop and provide housing options. While disability oriented social work research typically attempts to test the impact of specific interventions, larger scale interventions also desiring methods to identify quantifiable improvement need more robust methods. Human behavior will always remain complex and we therefore require a vast range of methods to better understand these complexities (Nahri, 2002). Social work models must account for more than the simple cause and effect explanations of human behavior (Halmi, 2003). Experimental and quasi-experimental approaches often lack the flexibility to identify underlying structures in what appear to be either disorderly or chaotic organizational data sets. Because limitations occur when observing emerging organizational behaviors, alternative exploratory means supporting social work's person-in-environment paradigm need further attention (Potocky-Tripodi & Tripodi, 1999). Current human behavior in the social environment textbooks focus primarily on general systems theory (Schriver, 2004; Zastrow & Kirst-Ashman, 2004). This paper presents an exploratory analysis as a promising approach to understand how people with disabilities self-organize when choosing housing.

This paper focuses on one aspect of complex systems, self-organizing behavior, however, defining a complex system involves identifying several components (Lewin, 1992). The 1915 Flexner report to the National Conference of Charities and Correction provided social work with the first theoretical concept of self-organizations. In this document the interrelationships of science, learning, and self-organizing were identified. Recent advances use components including the agent (typically the consumer of services), the various choices these agents can make, the dynamics within the environment, the availability of a feedback mechanism to assist in decision-making, an underlying self-organizing structure within which all these phenomena occur, and the resulting emergent behavior (Cambel, 1993; Axelrod, 1997; Holland, 1995; Holland, 1998). Table 1 summarizes these components for this application.

TABLE 1. Complexity Systems Components and Their Application

Component	Application
Agent-based	Person with a disability
Heterogeneous	Choice of housing options
Dynamic	Preferences and choices in housing options change over time
Feedback	Individual planning meetings where consumers with more support had more opportunities to be included in community
Self-organizing	Comsumers with less support need to live closer together where as consumers with more supports were more randomly dispersed in community
Emergent behavior	Patterns of where individuals choose to live

These components in this application are agent-based because the focus centers on the individual consumer and his/her family and allies. Heterogeneity of choices expresses itself by the various housing options and locations available for the agent. The complex system displays dynamic tendencies because decisions on where to live are continually changing (Waldrop, 1993) in regard to the housing choices available. The feedback for individual and organizational decision-making includes information provided on available home locations in order to assist the consumer and his/her allies decide on the best option. While self-organization refers to the synthesis of information used by consumers and their allies in order to reach the emergent behavior (Johnson, 2001) as represented by the housing trend. Individuals or small groups use networks of personnel contacts and contractual relationships to bring together the resources needed for each venture (Hendry, 1999).

Complex systems have several dimensions that can be both different and interconnected within organizational settings (Senge, 1990; Hudson, 1998). Human service organizations are closely connected to the larger social environment through an evolving network of relations with the complexity of the real world and relations with other individuals (Zhu, 1999). The push-pull forces encountered by an organization reflect how consumers internalize the impacts of the interventions provided to them. Social workers and consumers use both negative and positive feedback in their decisions for future programming. Positive feedback includes an organization's ability to use information outside the system. This continues until limits are reached. Negative feedback aids in keeping an organization in equilibrium and routinely functioning (Proehl, 2001).

The pattern of how housing units are clustered together based on their size represents the emergent behavior occurring from the aforementioned components. This emergent behavior is the resulting dependent variable. Because the organization continually worked in partnership with consumers and their allies to locate and develop housing and support services, the organization's staff members supporting the consumers were assumed to have high levels of adherence to the values of inclusion. This facilitated the ability to create options (Balcazar, MacKay, Murphy, Keys, Henry, & Bryant, 1998). In a study using a geographic approach (Wolf-Branigin, LeRoy, & Miller, 2001), autocorrelation served as a proxy for self-organization. This self-organizing behavior, or spatial autocorrelation, can be represented by spatial dependencies (Wolf-Branigin, 2002; Anselin, Florax, & Rey, 2004). The analytical framework included variables related to involvement in person-centered planning, number of unrelated persons living with the individual, and level of earned income.

Although methodologies for assessing patterns, networks and interactions have been used to measure access to services for the general public, its use in assessing accessibility and inclusion for people with developmental disabilities remains limited. The benefit of incorporating location or spatial data into planning becomes apparent as approximately 80% of organizational databases have some location element (Hutchinson & Daniel, 1995). Using a complexity approach, as represented by spatial autocorrelation for this population, provides a potentially useful method for understanding relationships and interactions (Orland, 1988; Gettis, 1991).

The continually emerging context of community inclusions within the disability field is evidenced by self-determination, individualized budgets and consumer-focused planning techniques (Nerney, Crowley, & Kappel, 1995). As people with disabilities are encouraged to explore and connect with their community, seek new experiences, learn how to live, work, recreate and go to school with non-disabled peers they continue to be afforded greater opportunities to become fully participating citizens. The interest in such decentralized planning approaches grew from a concern that professionals in government-funded organizations were often unable to provide the personal commitment people need as they become more involved in their community (Wolf-Branigin, Wolf-Branigin, & LeRoy, 1998). These concerted efforts have extended to assist people interested in securing community jobs and housing. This has resulted in more people with disabilities who work and live in increas-

ingly more independent employment and housing settings (Braddock, 2002) and striving toward the goal of full inclusion.

METHOD

Sample and Data Collection

The randomly selected sample (N = 294) came from the organization's database. This organization supported persons with disabilities move from institutions to their community. They currently reside in a variety of community options, including supported living, shared lives, foster and adoptive families, and small group homes. Secondary data collected from the organization's database included the location of the home and the number of non-related people with disabilities who lived in the same home as the person. This process used address matching to identify the longitude and latitude coordinated. Data was collected on their residence and number of non-related people (with disabilities).

Data Analysis

Research procedures included collecting data at the individual consumer level, mapping of this data in a two dimensional space, and conducting inferential analyses. Two inferential methods were used to analyze the data, quadrat analysis to measure spatial autocorrelation and a two-step cluster analysis.

Spatial autocorrelation. To initially measure spatial autocorrelation, data were plotted into one of 30 cells of equal size, creating a six by five grid. The internal twelve cells were used in the autocorrelation analysis. Cells located on the edges of the region were not entered into the analysis, but were used solely to obtain measures of autocorrelation for the internal cells (Bailey & Gatrell, 1995). To assure accuracy of the longitude and latitude coordinates, a map with both addresses and coordinates was used to check reliability. Coordinates for longitude and latitude related to each individual's home, were plotted to three decimal points.

Quadrat estimates for the purpose of identifying autocorrelation were obtained using both rook and queen methods (Bailey & Gatrell, 1995). First a grid was overlaid on the region under study. The rook method averaged the cells immediately above, below, and to the right and left of the cell under study. The queen method averaged all of the surrounding

cells for comparisons to the cell under investigation. A goodness-of-fit test was used to determine whether surrounding grid cells induced spatial autocorrelation.

Cluster analysis. The two-step cluster analysis explored whether natural groupings or clusters of homes occurred based on the number of individuals residing in the homes. A log-likelihood distance measure was used to create probability distributions of the variables. Clustering criterion, to assess whether homes were spatially dependent based on number of people residing within each location. Initially four clusters were created; one-person homes (n = 43), two- to four-person (n = 64) homes, five-person homes (n = 62), and six- to eight-person homes (n = 125). Distance measures were based on a log-likelihood approach with the assumption in independence between variables.

RESULTS

The mean home size was 4.56 and a median of 5.0 persons. Males and females comprised 56% and 44% of the sample, respectively. This was consistent with the organization's overall ratios. Quadrat estimates ascertained the goodness-of-fit using the actual counts in each quadrat and two methods used to measure spatial autocorrelation (rook and queen). The results of the index of dispersion tests ($df = 11$, $\alpha = .05$, $\chi^2 = 19.675$) were not significant and indicate that the move from the actual quadrat counts ($\chi^2 = 17.959$) to the rook method ($\chi^2 = 6.153$) and finally queen method ($\chi^2 = 4.155$) produced continually lower values. This indicated that smoothing occurred and the absence of autocorrelation.

In the two-step cluster analysis, convergence was achieved in ten iterations, with the minimum distance between initial centroids of .471. Following the two-step procedure, cluster sizes were, cluster 1 (one-person) N = 37, cluster 2 (two to four-person) N = 34, cluster 3 (five-person) N = 41, cluster 4 (six to eight-person) N = 30, and Outlier N = 151. The ANOVA results for longitude and latitude variables were $\chi^2 = 4.137$, $df = 3$, $F = 483.192$, and $p = .000$; and $\chi^2 = .890$, $df = 3$, $F = 134.616$, and $p = .000$, respectively. The cluster centers are summarized in Table 2.

Simultaneous confidence intervals for both the longitude and latitude variables showed that the one-person, two- to four-person, five-person clusters, and the outlier clusters fell within the 95% intervals. The six to eight-person homes fell outside the 95% confidence interval on both

longitude and latitude. As shown in Table 3, the 6- to 8-person cluster was highly variable and indicated that homes were widely dispersed from the group centroid (mean location of the cluster).

DISCUSSION

Overall results indicate that the agents (represented as persons with a disability), who were living independently, resided in the more densely populated portions of the region. Their choice of housing options tended to occur closer to transit lives so that they could more freely travel to their employment, educational, and other settings. The cluster analyses, representing the emergent pattern, demonstrated that larger homes had greater mean distances from their respective group centroid (the mean location within a cluster). These greater distances potentially indicate more isolation from the community at large. This was especially true for the three and four person homes.

TABLE 2. Cluster Analysis

Initial Cluster Centroids*				
	Cluster			
	1 (1-person)	2 (2 to 4 persons)	3 (5 persons)	4 (6 to 8 persons)
Longitude	.3758	.6642	.7549	.9022
Latitude	.4524	.8411	.9108	.4634
Final Cluster Centroids				
Longitude	.3133	.4924	.1639	.9328
Latitude	.5451	.7532	.7603	.5968

*Convergence achieved in ten iterations, minimum distance between initial centroids .471.

TABLE 3. Cluster Profiles

Cluster Size	Mean Latitude	Latitude S.D.	Mean Longitude	Longitude S.D.
1-person	.6913	.0877	.2074	.13615
2 to 4 persons	.6753	.0706	.2714	.12297
5 persons	.6166	.0962	.2729	.11364
6 to 8 persons	.5811	.0739	.1322	.15678
Outlier (-1)	.6600	.1454	.2314	.28331

This dispersion may be attributed to larger homes possibly having their own transportation and therefore could be located further from public transportation often found in the more densely populated areas. Group centroids likewise indicated that all people who were living independently resided in the more densely populated areas. The use of feedback, as defined by people having more established support systems, was represented by the number of family members and non-professional staff at their planning meetings. Nonlocal processes, as represented by a county ordinance requiring that group homes be located at least 500 feet apart from each, possibly played a role in the housing pattern. As analyses using similar approaches occur, evaluators and researchers need to attend to similar nonlocal issues (Hudson, 2004).

While this may appear contrary to the hypothesis, homes with more unrelated persons living in them may have had financial resources allowing for greater dispersion. Placement of homes likewise may have resulted from political and zoning issues which led to larger residences being located is less populated areas. This dispersion may be interpreted as isolation as opposed to the random dispersion of smaller homes. People living alone or with fewer unrelated persons appear to benefit from residing in more populated areas of the region. This may have reduced the likelihood of being more physically dispersed but having more random dispersion patterns. This finding suggests that the more included the person is in the community, the more likely that individual would have individuals (allies and supporters) who took an interest in that person and would attend important life planning functions.

Social work researchers in the disability field benefit by adopting a complex systems approach into their skill sets. Rigorous exploratory computer modeling methods including simulations approaches provide new insights into the underlying structure of social work phenomenon. This paper demonstrates that applications of complexity provides a promising tool for organizations created to increase community inclusion. Further development of these models may include approaches such as empirical and hierarchical Bayesian methods because of their probabilistic nature, and to a lesser extent small area estimation. An additional and possibly integral interest includes the use of appropriate robust statistical methods for organizational decision-making. This issue again remains vital in applications related to disabilities and behavioral health where relatively small samples are available.

As social work researchers adopt spatial and complexity approaches, rigorous methods including the use of simulation models will provide new insights into human service phenomenon. Having the tools and ex-

pertise to program and interpret these models will be essential. Statistical approaches including hierarchical linear modeling (HLM) and structural equation modeling in the form of exploratory factor analysis likewise appear appropriate. Available options within a spatial analytic approach include standard linear and logistic regression, exploratory spatial data analysis, and cluster and discriminant analyses. More advanced users will want to incorporate simulation models.

This exploratory investigation suggests several venues for future research. These include adopting a network analysis approach and integrating GIS databases into such analyses. While network path analysis, which would require the integration with a GIS, may potentially account for greater measures for measuring interactions and accessibility to services used by the individual, three potential problems arise. The first concerns the assumed identical levels of accessibility within regions by individuals, even though this in practice would be unlikely. The second involves trips which may occur as sequential activities during a person's daily activity rather than a single trip, therefore, producing inaccurate estimates. The final concern is that spatial-temporal constraints may limit opportunities in the environment for the identified population.

The application of autocorrelation and spatial statistics to measure self-organizing behavior provides valuable information to human service decision-makers as they measure impacts of inclusion programming and activities. Although exploratory analyses are contrary to more traditional hypothesis testing statistical approaches, appears appropriate for use at human service organizational levels where the primary concern is the internal use of information that likely will not be generalized.

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