

Evaluating (Dis-) Continuity in Pedestrian Environments: A Comparative Case Study of Two North Carolina State University Campuses

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Abstract

This research studies pedestrian-oriented environments in a university context utilizing the theoretical constructs of "(dis-) continuities of space" developed by Mark Fried (2000). The case study is the still developing Centennial Campus of NC State University. In exploring the association of Fried's (dis-) continuity concept with space, we employ a correlational research design where space is the independent variable and continuity is the dependent variable. Continuity of space is approached in both direct and negative-induction way. We study spatial configuration objectively with variables such as distance between spaces, spatial barriers for pedestrian movements, and physical and functional layout of campus spaces and we use a survey instrument for subjective data collection. Conclusions show that the spatial structure of campus environment is a significant factor in continuities of space and proximity and barrier variables have a combined and enhanced effect on the level of physical and social continuity of space in neighborhood scale.

Literature review

A review of literature on campus environments reveal three different groups of published research. The first group consists of studies that concentrated on large scale planning of campus facilities, and mostly has focused on technical problems and issues of form (e.g. Association of University Architects, 1972).

The second group literature contains studies related to cognition of campus spaces by students, faculty and staff. Since Lynch (1960), Siegel and White (1975), it has been argued that complete spatial knowledge of a local environment requires the acquisition of the landmarks available in the space and the transfer type of (via maps or experience) spatial information (Allen et al., 1978; Hirtle & Sorrows, 1998). Familiarity (e.g. Kaplan, 1973; Evans, 1980; Garling, 1989) was counted as an important factor for memory retrieval that plays important role while developing cognitive maps. Enriched by a well-established theoretical background that was simply outlined above, issues

related to way-finding (eg. Abu-Ghazzeah, 1996) and navigation (e.g. Hirtle & Sorrows, 1998) made the significant body of the campus literature in this group.

The third group of studies is concerned with the actual use of campus space. Compared to two other groups of literature, studies in this group are rare. Abu-Ghazzeah (1999) emphasized the paucity of research about how individuals use the outdoor environment in campus settings. Cooper-Marcus and Wishermann (1990) studied the design of outdoor spaces in a number of campuses in the United States and made observations about how people use such spaces. Asking respondents to identify the buildings where they regard as home buildings in the campus; Cooper-Marcus and Wishermann (1990) investigated how this affected one's use of campus outdoor spaces.

Theoretical background

Human-environment interactions are complex. There is a continuous interplay of numerous variables at different levels in these interactions. Understanding the relations among these variables is important in broadening our understanding of how people perceive and use their physical/spatial environments to guide future design opportunities more effectively. This necessitates integration and utilization of physical, social, and environmental dimensions of space.

The theoretical framework of our study is built on Fried's (2000) "continuity" and "discontinuity" concepts of environment, or in his words "place" where he considers environment as both a social and a physical construct. Fried (2000) defines "continuous place" as environment where successful convergence of "space as a physical construct" and "space as a social network" is observed. Conversely, unsuccessful convergence of these implies the "discontinuous place" concept. According to Fried, perception of space as a social network is built on attachment experiences and spatial identity. When these social aspects coincide with the physical aspects of space, especially in local and neighborhood scales, that locality presents continuity. However, an improper balance introduces the concept of discontinuity. Originating from these notions, our study focuses on N.C. State University's Centennial Campus. Whereas Fried approaches continuity and discontinuity of space concepts from a phenomenological perspective, we utilize what can be called a post-positivist theoretical perspective.

Conceptual framework and research questions

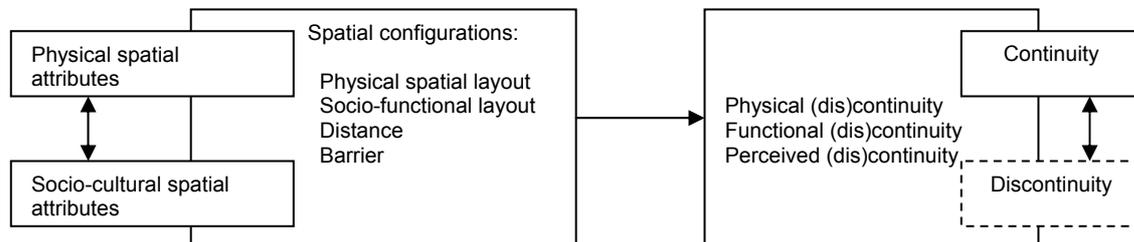
This research studies the relationship between space and continuity. Space, as the independent variable, was measured by two sets of indicators: physical and spatial attributes and socio-cultural and environmental attributes. The space-related variables were spatial configurations, defined as spatial elements and

the relationships among them, spatial layout, and distances and barriers between campus spaces.

Continuity, as the dependent variable, was considered in both direct and negative-induction way. Rather than measuring the continuity concept in isolation, we argue that by measuring discontinuity we can understand how continuous a space is. This negative induction to the subject is more reliable since the concept of continuity - in terms of its indicators - is rather hard to operationalize. However, discontinuity indicators are more accessible by reading the spatial attributes. Therefore, uniting the continuity and discontinuity concepts increases the clarity of the research findings since the use of triangulation is fundamentally crucial in the research design (Groat & Wang, 2002).

Continuity variables used were on connectivity of spaces, which were studied with the indicators such as intensity of use, spread of use, and perceptions of continuity. Continuity perceptions were measured with physical and socio-functional continuity evaluations. User evaluations were used as subjective and perceptual indicators of space usage. Especially for pedestrian environments, the use of space and its related perceptual and subjective indicators were considered critical to understanding the continuity of these areas.

Figure 1. Conceptual framework of research design.



Methodology

This study utilizes a correlational research methodology. The indicators discussed above were studied in a two-prong approach. This way, the use of both objective and subjective measures of space gave us a higher level of triangulation, which improves both internal and external validity of the study (Guba, 1981).

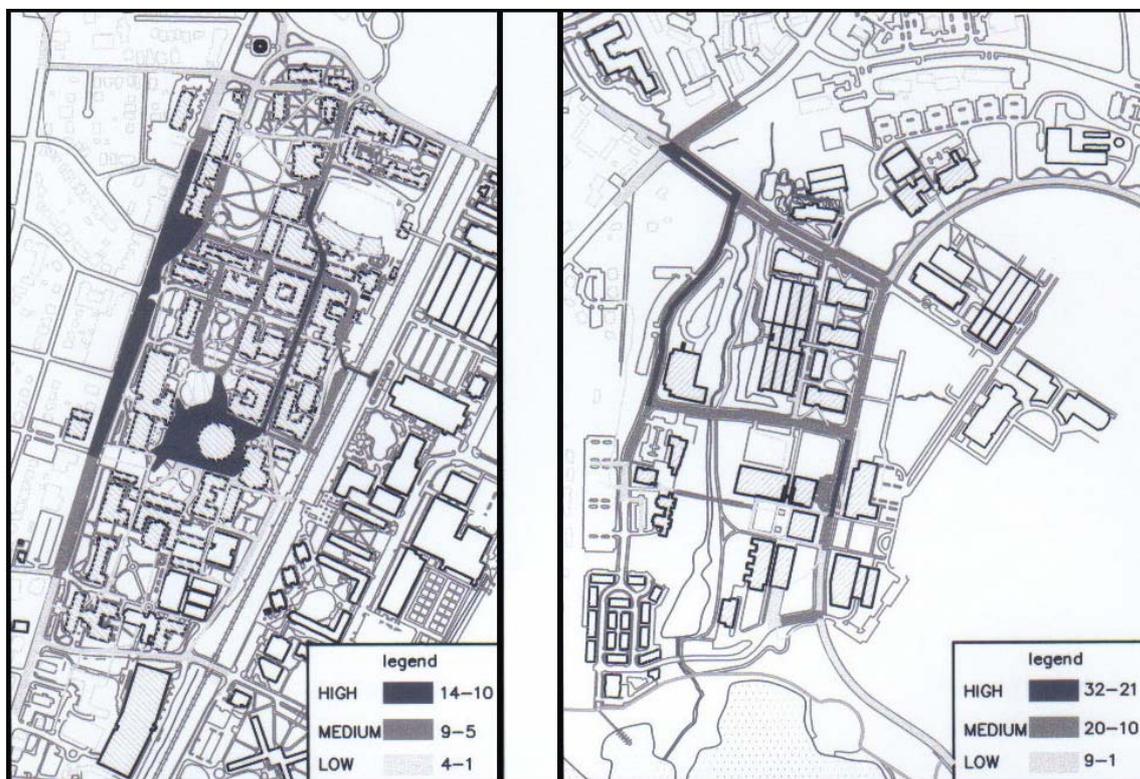
Data for the research was collected through both objective and subjective means. Objective data was gathered by studying different variables of spatial configuration using site plans. These were physical and functional plan layout, distances between these destinations and barriers to users' movement. Subjective data was collected through a survey where users' perceptions of the campus environment were measured. A total of 54 respondents from Centennial Campus and 45 from Main Campus participated in this interviewer-guided survey, which had two parts: a questionnaire part and a visual mapping

part. Questionnaire part was used to identify user profiles, evaluations and perceptions of the users of the campus environment. Visual mapping part identified the use of the campus environment by the respondents in terms of two main categories: the use of campus elements and the use of connector spaces between these used spaces.

The standardized questionnaire section assessed campus users' preferences in and satisfaction with the physical and the social constructs of the campus environment through responses to 18 multiple-choice questions. Safety, traffic intensity, social interaction, and effectiveness of way-finding elements for cognition were the primary aspects uncovered in this part. On the other hand, a single 12-item matrix question was designed to have the respondents identify the level of importance they attached to specific elements of the campus environment. These two main parts were then analyzed in relation to the general profile questions on the gender and occupation of the users, and their tendencies in the use in daily life.

In the second part the survey, a campus map was used for respondents' visual mapping. The main purpose was to assess the intensity of use of different campus spaces and the connector spaces between these to uncover the relationships of these to the data gathered from the other part of the survey.

Figure 2. Mapping results for the two campuses (left: Main Campus, right: Centennial Campus). Overall intensity of use was analyzed in ordinal scale for the two campuses. The numbers in the legend refer to the total number of respondents using that particular route. Maps not to scale.



Data analyses

Data obtained were then analyzed to develop an understanding of the different types of continuities and discontinuities we outlined in the conceptual framework of the study, earlier. This involved a two-prong approach. First, we determined the negative aspects of the campus environments by the indicators assessed. Then, we developed the boundaries of various continuities and discontinuities through the objective and subjective measures.

The ordinal level data of the questionnaire was treated quantitatively in a 5-point scale from 2 (strongly agree) to -2 (strongly disagree). *StatCrunch*TM [Integrated Analytics, LLC] and *SAS*TM [Statistical Analysis Software, V8 (8.2) - SAS Institute Inc., Cary, NC, USA] software were used for statistical analysis of the data. For nominal variables, categories were combined to form agree, neutral and disagree groups and these were analyzed in a 3x2 contingency table using a Chi-squared distribution. This provided the associations of user profiles with the subjective data taken. General and individual level tests were conducted.

Visual mapping data was combined using *AutoCad*TM [AutoCad 2002 - AutoDesk] software by forming different layers for each respondent. Separate respondent level analysis in relation to other parts of the survey data given by individuals and also an overall evaluation were made to understand the spatial associations of the variables.

Objective data of spatial configurations such as distance and barrier analyses were studied. The distances to the nearest neighborhood courtyards were measured objectively using site plans. Barriers, defined as the number of streets with vehicular traffic to be crossed following the shortest route to reach these places were counted using these site plans. Also, the spatial configurations in terms of both physical and socio-functional layout were analyzed. The relations of these were then combined with other findings to make comparisons and develop conclusions.

Findings for Centennial Campus

We developed 95% confidence intervals for the users' evaluations and perceptions of campus environments. Our analyses showed that the level of preference to walk on campus, i.e., preference for walking over driving short distances, was in the slight to moderate level. Spending time outdoors was strongly preferred. Wayfinding was not seen as a problem at moderately to strongly easy range. Overall safety perception was positive with a moderate safe average. Pedestrian facilities received an average of slightly satisfied level. However, vehicular traffic perception, social interaction perception, satisfaction with parks and open spaces, and public social places was found to be problematic, as the responses received in the negative or the interval ranged from positive to negative. These indicators were considered as crucial to understanding their relations to other variables and further examined.

User profiles in terms of gender and occupation were analyzed with their associations of these evaluations. The analysis showed that gender did not have any significant association with any of these variables. However, occupation of the respondents was found to be significantly related to the evaluations and perceptions in some categories. Occupation (student and employee) was analyzed in a 3x2 contingency table in relation to 3 categories of ratings (disagree, neutral and agree). The results showed that there was an association of occupation and satisfaction of social public places. Cafes, coffee shops, student centers etc., as examples of the indoor social places were rated at dissatisfaction levels by student users compared to staff users (p-value <0.01). Also, the correlation matrix developed showed that there was moderately strong correlation between respondents' satisfaction of public social places and parks and outdoor open places. These items were concluded as important elements of campus environment in the objective analysis of (dis-)continuities.

Data from the 12-item importance table was analyzed in both general and respondent-level ordinal (more crucial to less crucial range) rankings. Associations of these to the respondent profiles were analyzed focusing on occupation as an important variable to have affect on. The results showed that when the items were treated in ordinal scale, three main campus elements were associated with occupation. Faculty and staff users rated outdoor courtyards and benches as more crucial components of their daily lives than student users. On the other hand, students rated library as a crucial component of their daily lives compared to faculty and staff users. When these findings were combined with the questionnaire findings, interpretation made was as follows: Even though students were less satisfied or dissatisfied with social places and correlated parks and open spaces on campus, in the ratings, the difference was due to the ordinal assessment of campus elements by user groups. Students found academic related campus elements more crucial than faculty and staff. Moreover, faculty and staff were neutral to slightly satisfied with the parks and open places, and they found these as crucial components. This is an important to result in the understanding of continuity with its variance with respect to different user groups. Continuity in this sense is not only physical or social, but also varies for different user groups.

In visual mapping it was seen that, overall, there is a variation in the intensity of use of campus elements and connector spaces. In parallel streets some were much more heavily used than others, even though the spatial layout was thought to offer more in the others. For example, streets surrounding parking lots were more used than streets surrounding campus buildings and open areas. The relation of occupation and gender to the spread of use was studied. Women were seen to have less spread than men in the use of campus environment. Employees were seen to have much more spread than students. Also a locational map of respondents was studied to observe if this had any

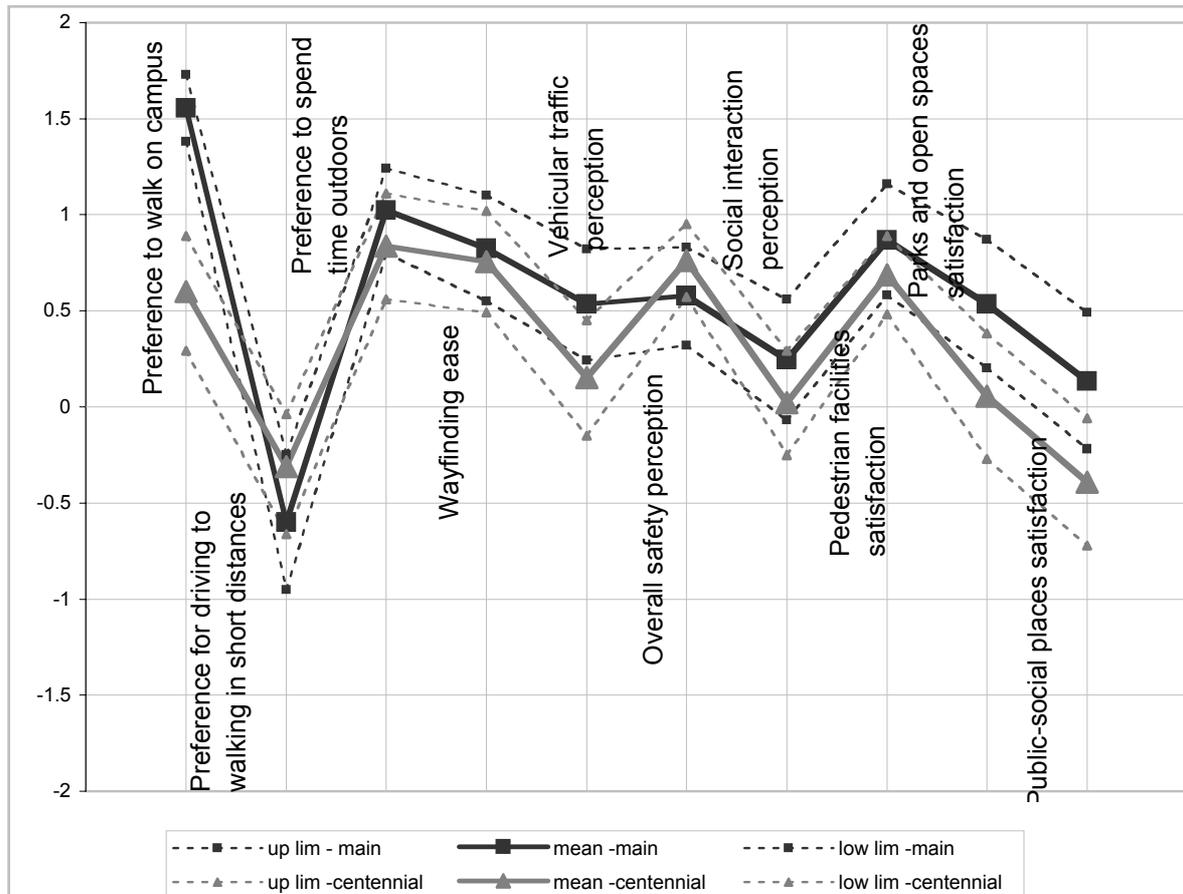
associations to the spread of use, uniting the distance and barrier analyses. This showed that location of some campus buildings and the spatial layout were important factors in the spread of continuity. Distance did not have a separate effect in the spread, but barrier and distance had a combined effect. Streets with vehicular traffic surrounding the building neighborhoods had a barrier effect hindering the spread of use outside these areas. Courtyards those were defined by the surrounding buildings seemed to have higher intensity of use compared to others. Also, functional continuity of campus elements was found important. Within the barrier-free zones, users, in order to reach different functions their neighborhoods did not offer, tended not to consider distance as a problem.

Findings main campus

95% confidence intervals were developed for each item the questionnaire assessed. Overall level analysis showed that most of the items stayed above neutral section. Preference for driving to walking in short distances were slightly to moderately rejected by the respondents. The other two items where the confidence intervals seemed critical, that is contained both positive and negative values, were: social interaction perception and public places satisfaction. These two items were slightly agreed to neutral or very slightly disagreed. All other items were above neutral in the positive direction. Walking on campus was highly preferred. When the weather was nice, to spend time outdoors was from moderately to highly preferred. From moderate to high satisfaction was reported for pedestrian facilities. Wayfinding was not found as a problem on the moderate level. Overall safety perception was reported as slightly to moderately safe. Parks and open spaces satisfaction was reported in the slightly satisfied to moderately satisfied level. From slight to moderate level respondents agreed on the existence of too much vehicular traffic on campus.

As the second step profile based analysis was made to understand the variations – if any - between different profile groups. Students and faculty/staff groups showed differences in some items. Social interaction perception was rated higher by students than faculty and staff respondents. Parks and open places satisfaction was rated was higher by faculty/staff than student respondents. Even though the general orientation of the confidence intervals for these items seemed very different in the opposite direction, the differences were not found to be statistically significant. However, public social places satisfaction was the only item to be found statistically significant to be different for the two profile groups. Whereas students responded for slight to moderate satisfaction level, faculty and staff respondents reported an interval from strong dissatisfaction to neutral or minimal satisfaction levels.

Figure 3. Comparison between Main campus and Centennial campus for overall mean value and corresponding confidence intervals for survey response items.



Comparison

A comparative analysis of overall responses for both campuses was made. Public social places satisfaction, parks and open spaces satisfaction were both lower for Centennial Campus respondents than Main Campus ones. However the difference of Campuses for these two items were not found statistically significant at 0.05 level. Among all items two items reach the statistical significance level in difference for both campuses: Vehicular traffic perception and walking behavior on campus for short distances. Vehicular traffic perception was rated significantly higher in Main Campus than Centennial Campus. However at the same time, walking behavior on campus for short distances was significantly rated higher by Main Campus respondents than Centennial Campus respondents. This interesting finding can be interpreted as: Even though vehicular traffic perception is higher in Main Campus other factors such as spatial layout and facilities support the needs of the pedestrians so that they present a significantly higher walking behavior. At this point identification of these other factors are crucial to understand the variation on the perceived and actual continuity levels for both campus environments.

Conclusions

This study has looked at different parts of NC State University Centennial Campus to unravel the relations between continuity and spatial configurations in a pedestrian-oriented campus environment. The spatial structure of campus environment gives us clues about the connections among these units with other campus spaces and their environs. The level of these connections is considered as crucial indicators of continuity of these spaces. On the other hand, the actual use of these areas is also important to understand the perceived continuity. If a space is used more than the others, the reasons for this may be related to both social and physical features of these spaces. Objectively measurable physical features, as this study suggested, has a combined effect on some indicators of continuity especially the spread of continuity and functional continuity. Continuities also were found to be subjective and varying among user groups. Overall, our analyses suggest that neighborhoods in campus environment have to fulfill the needs of spatial and functional continuity. The level of barriers should be minimized for nearby areas in order to increase the perceived continuities or to decrease perceived discontinuities.

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