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Memorable Places on Campuses Across Generations

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Abstract

This study explores the method of recording memorable places and highlights the peak recollection spots of college town universities across generations--prospective, present current, and past students. The chosen campus areas are the University of Massachusetts Amherst and Cornell University. Ninety participants produced mental maps based on memory, including landmarks, meaningful places, paths, landscapes, and anything they associated with the campus. Following Lynch's methods, elements from sketch maps were mainly were landmarks (87%). Current students had a higher percentage of buildings recalled, but fewer landscapes recalled than prospective students and alumni. Adapting from Appleyard's methods, over four-fifths of student populations provided spatial dominant maps, which indicated more substantial stages of spatial knowledge. Categorizing by functional aspects, the highest recollection of all students was landscape and roads (28%), exceeding academic buildings (25%). The researcher counted an element from sketch maps that demonstrated at least one stage of spatial knowledge development, and extracted and transformed it into digital maps. The collective memory-significant maps presented different patterns of recall frequency among student subgroups of the three student generations. The top three places with the highest intensities were iconic buildings and adjacent landscapes at the core campus. Memory intensity did not diminish equally as distance increased from the central zone. The Hot Spot Analysis, utilizing the Getis-Ord-Gi* statistic and inverse distance weighting (IDW), revealed different patterns of hot spots among generations. A landscape landmark served as a memorable hot spot in every subpopulation of all three generational groups. This innovative method could serve as an additional tool in bridging the gap between practical and theoretical knowledge, enabling the recording of intangible memory aspects into databases and measurable plans. Other campuses could implement the procedure and include the memory-significant assessment to design institutional environments that meet diverse student perceptions.

Keywords

Memorable place; Mental map; Collective memory; Campus planning; Hot Spot analysis

1. Introduction

What notable places do students remember? Where are meaningful places on campuses? Do prospective, present current, and past students have similar collective memorable places? Planning pioneers established the groundwork of legibility over a half-century ago. Lynch (1960) and Appleyard (1969) connected psychological knowledge with urban planning by implementing verbal recall, trip recall, and map recall to retrieve human perception of a city. They created a theoretical framework for understanding imageability and architectural attributes affecting memorability. Yet in practice, planners rarely utilize the mental map to identify memorable places because of challenges in interpreting sketch maps.

In environmental psychology and human geography, Altman & Low (1992), Tuan (1977), and Relph (1976) significantly contributed to the notable theory, Place Attachment, describing individual emotional bonds to physical environments. Relph (1976) explained that the identity of place comprises three interrelated components—physical features, functions, and meanings. A common approach to documenting places and historical buildings focuses on in-depth physical details and locations. Architects and planners often record inventory data associated with heritage sites and landmarks through field surveys and expert judgments. Memory-related contexts and events were sometimes captured in written reports but not maps. Without a doubt, mapping is valuable for revealing spatial data and providing visuals for all stakeholders.

While universities across the United States have faced declining enrollment trends in the past decades (National Center for Education Statistics, 2025), understanding diverse user perceptions could play an important role in university success recruitment strategies. Community inputs should not only occur at a later stage in large-scale projects. Campus planners should review all data, including meanings and memories, before developing any-scale projects. Therefore, we need to obtain a database of memory-place significance to provide a foundation for analytical thinking that will benefit campus master plans.

The focus on place identity has changed from social science to place marketing in architecture, hospitality, leisure, sport, and tourism (Peng et al., 2020). Recent studies investigated the memory of iconic architecture and city branding (Waters et al., 2024; Zamparini & Lurati, 2023). Numerous researchers explored memorable places in nature and the tourist industry (e.g., Anaya & Lehto, 2023; Sthapit et al., 2023). However, universities and their inhabitants differ from neighborhoods, cities, or tourism. Focusing on higher education cohorts across generations and populations, this paper studied two college town campuses that function similarly to small cities and comprise diverse areas such as academics, libraries, dormitories, administration, student services, athletics, and recreational facilities. To facilitate the study implementation, it was decided that suitable sites should not involve too much cognitive loading, such as large metropolitan areas. In making a manageable study, the focus areas would ideally be comparable to those when Lynch investigated the central region of three cities —Boston, MA, Jersey City, NJ, and Los Angeles, CA— around 4.0 km by 2.4 km. (or 2.5 miles by 1.5 miles). Therefore, the population survey participants would have comprehensive knowledge of the campus community, and the researchers could obtain adequate information to analyze the perception of memorable spatial environments.

Many studies have incorporated only partial populations and focused on specific participant groups, such as architecture students who can draw well. No researchers have investigated a practical model for acquiring a memorable collective map from various diverse disciplines and comparing subgroups within the broader campus population. This study aims to fill the practical knowledge gaps by exploring mental sketches in mapping memorable places, revealing differences across generations, and using visualization tools to translate intangible aspects into databases and measurable plans. Campus policy and planning could use the findings

to design and manage institutional environments that meet diverse student perceptions and address challenges from enrollment drops related to a declining enrollment.

1.1 Research Questions and Objectives

A place cannot contain meaning without memory. In environmental contexts, meaning refers to "thoughts, feelings, memories, and personal interpretations evoked by a particular space" (Schroeder, 1991; Smaldone, 2006). When a group of students share experiences, individual perspectives shape collective memories. Collective memories are more stable and persistent in change. Each student subgroup cohort has slightly different memorable places due to various purposes and experiences. Therefore, a particular functional aspect of a place would be more resonant with the memory of one group cohort than another.

The research questions are addressed herein, considering the different information students include on sketch maps and the location of the collective memorable places and peak recollection spots. There are three specific objectives in understanding the memorable places of college town universities. The first objective is to explore mental map exercises and investigate the information from student subgroups. The second objective is to reveal the intensity of recalled places and create memory-place significant maps representing all student cohorts, prospective students, current students, and alumni. The third objective is to identify each student group's cohort's strong collective memory areas and hot remembrance spots.

1.2 Theories

Memory and spatial knowledge involve several theoretical foundations. Tulving (1972, 1985) described the distinction between semantic and episodic memory, which explains how spaces obtain meanings. Semantic memory stores knowledge about the world, such as architectural styles and historical facts. Episodic memory encompasses personal experiences in particular times and spatial contexts (Tulving, 2002). It is subjective and connects to individual experiences of places, such as watching sunsets on the hill and socializing at events in the quadrangle. The integration of information from semantic memory with episodic memory creates individual experiences and incorporates them into collective memory.

The pioneer theories related to people and place in the urban planning field were developed during the 1960s and 1970s. Kelvin Lynch first introduced the concept of legibility and identified five key elements of city image: path, node, edge, district, and landmark. His study developed sophisticated methods to investigate the legible environment by analyzing three factors: identity, structure, and meaning (Lynch, 1960). Later, Donald Appleyard developed a predictive tool to determine why buildings are known. The study investigated recall frequencies and the intercorrelations between building attributes: form, visibility, and significance (Appleyard, 1969).

Other well-known groundbreakers included "Urban Vitality" (Jacobs, 1961) and "Life Between Buildings" (Gehl, 1971). Later, Proshansky (1978) introduced the Place-Identity theory as an element of self-identity in relation to the physical environment in which people have lived. Rachel Kaplan and Stephen Kaplan (1989) focused on the impact of nature on people. They embraced Lynch's concept of legibility to incorporate more structure and defined a legible space as an easy place to understand and remember.

Since 2006, the number of articles on place identity topics in academic journals has increased significantly (Al-Alwan et al., 2022). While place identity refers to the self-concept connection to a particular place, place attachment is the positive emotional connection to a place. Scannell and Gifford (2010) originated the widely known concept of place attachment, using the person-process-place organization framework.

1.3 Recent People-Place Research in University Settings

People-place theories have prospered in urban planning. A college town campus is like a small city and comprises complex person-environment relationships with unique cultures and identities. In contrast to a city, a large portion of the campus population is students. Most universities have on-campus facilities mimicking city services, while student-oriented businesses surround off-campus life. However, living and learning in college towns differs from residing in small towns and cities. Several papers have studied the positive psychological impacts that contributed to the overall success of campus environments and sustainability (e.g., Hajrasouliha, 2017; Strange & Banning, 2015; Wurianturi et al., 2022). In design-related fields, many have investigated landscape preferences (e.g., Akhir et al., 2018; Hami & Abdi, 2021), degrees of satisfaction (e.g., Alhusban et al., 2019; Jun, 2003), urban forest (e.g., Anantsuksomsri et al., 2024), and impacts on mental health (e.g., Ding et al., 2024; Liu et al., 2018; J. Zhang et al., 2024). Most planners implemented mental maps to obtain student memories and interpreted them using Lynch's methods (e.g., Alptekin, 2017; Topcu & Topcu, 2012; Turk et al., 2015).

Psychology papers related to person-process-place theory highly emphasize the person and individual differences (Lewicka, 2011). While architecture and planning focus on the built environment, psychologists examine internal cognitive and emotional processes, such as spatial knowledge acquisition, scene recognition, memory, and well-being (e.g., Afrooz et al., 2018; Ishikawa & Montello, 2006). Many papers in management, social sciences, and education disciplines have investigated the impacts of campus visits on college choice to identify core factors affecting meaningful places and changing needs in higher education (e.g., Hanan, 2013; Sandström & Nevgi, 2020). To this day, the collective perceptions of memorable campus places across generations have not been adequately explored.

1.4 Recall Methods

An interpretation of architecture is a subjective understanding of the environment involving five stages: stimulation, organization, interpretation, memory, and recall. Recall involves mental effort to retrieve past information and the ability to remember without being prompted. Recognition involves mental familiarity and the ability to recognize data an individual has seen before.

To recall memory, Lynch (1960) and Appleyard (1969) utilized three recollection methods: verbal recall, trip recall, and map recall (Table 1). Both studies requested free sketches covering all remembered features on a blank paper. Map recall could gain richer data than verbal recall because maps capture spatial relationships. The process of spatial knowledge development involves three stages--landmark knowledge, route knowledge, and survey knowledge (Siegel & White, 1975). Even though the type of sketch maps from Appleyard's study were mainly route-likeness maps, the map recall method revealed the highest number of features compared to verbal and trip recalls (Appleyard, 1969, 1970). To lessen cognitive efforts, an alternative approach provided a map and let people mark either edges, districts, roads, nodes, or landmarks (e.g., Oyama, 2024; Turk et al., 2015). A few studies utilized map recall of landscape (e.g., Otto et al., 2024). No study used mental maps to investigate landscapes and buildings together.

Map recall often involves smaller sample sizes. Verbal recall usually accommodates larger sample sizes and mainly reveals individual feelings and satisfactions. The trip recall was less utilized due to its time-consuming nature. The recognition method involves various prompted mediums -- photographs, video, virtual reality-- and often asks participants to rate on the Likert scale. Several studies use mixed methods (e.g., Patjantawiwat & Natakun, 2022).

Table 1. Methods related to perception study: verbal recall, map recall, and trip recall.

Methods	References	
Recall	Verbal	Al-Alwan et al., 2022; Anaya & Lehto, 2023; Appleyard, 1969;Ishikawa & Montello, 2006; Jessup-Anger et al., 2022; Jun, 2003; Lewicka, 2008; Lynch, 1960; Pociunaite & Zimprich, 2023
	Map	Afrooz et al., 2018; Al-Alwan et al., 2022; Alptekin, 2017; Appleyard, 1969; Jun, 2003; Lynch, 1960; Ishikawa & Montello, 2006; Oyama, 2024; Patjantawiwat & Natakun, 2022; Topcu & Topcu, 2012; Turk et al., 2015
	Trip	Afrooz et al., 2018; Appleyard, 1969; Ishikawa & Montello, 2006; Lynch, 1960

2. Method

Figure 1 presents the study method flowchart from site selection, sampling, data collection, and data analysis.

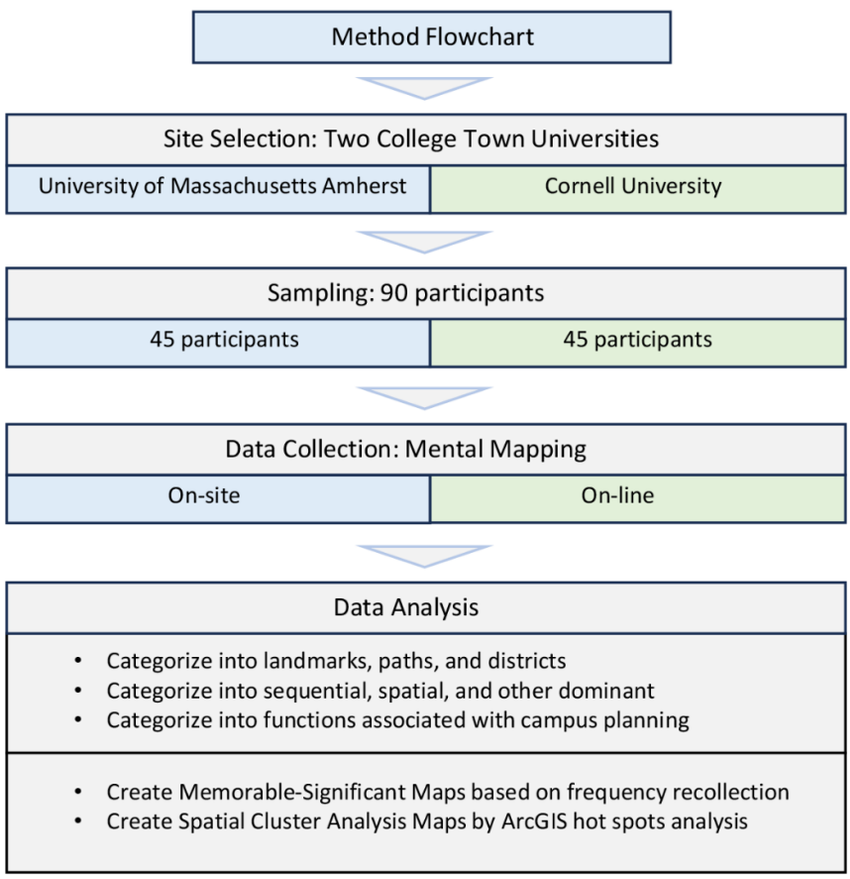

Figure 1. Method Flowchart.

2.1 Site Selection

The key criteria of campus selection are scale, boundary, and variety. The focus areas should be manageable and comparable to Lynch's study. The settings should have a clear boundary, not be embedded and dispersed into the fabric of large cities. Therefore, college town campuses would provide a better study area than city universities integrated into metropolitan areas. The environments should contain various architectural styles, landscape features, and functional areas.

This research intends to study phenomena. Therefore, the data collection processes utilized two campuses to strengthen the research design, reduce potential bias, and enhance the generalizability of the findings. The two site selections are the University of Massachusetts Amherst and Cornell University (Figure 2). University of Massachusetts Amherst is the largest public research university in New England. It was founded in 1863 on 5.87 square kilometers (1,450 acres) and is in the picturesque Pioneer Valley. The university has over 31,000 students in 109 undergraduate, 77 master's, and 48 doctoral programs. Over 14,000 students live in 62 residence halls, organized into seven residential areas: Central, Northeast, Orchard Hill, Southwest, Sylvan, North Apartments, and Commonwealth Honors College Residential Community. The campus appearance is variable, with a mix of innovation hubs and notable brutalist architecture.

Cornell University is a private research university based in Ithaca, NY. It was founded in 1865 on 3.0 square kilometers (745 acres) with views of downtown Ithaca and Cayuga Lake. The university has over 26,000 students, eight undergraduate colleges, and seven graduate divisions on its main Ithaca campus. Over 55% of undergraduate students live on campus. Residential areas at the North Campus mainly house first-year residents, while upper-level students reside on West Campus. The campus has ten national historic landmarks and notable buildings with blended architectural styles situated on the East Hill between two beautiful gorges.

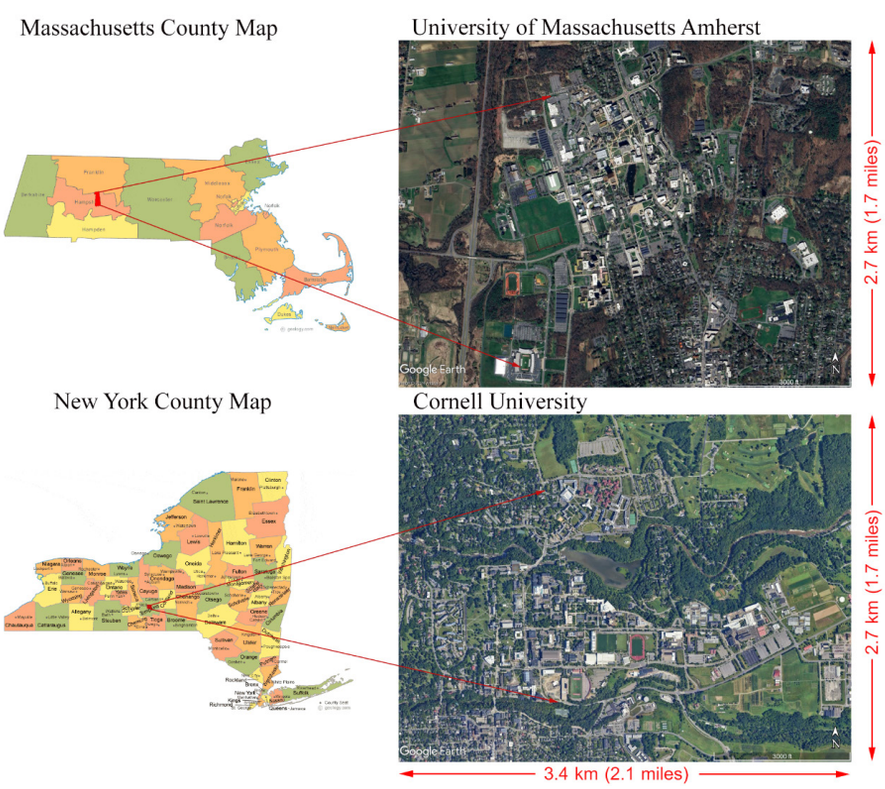

Figure 2. Location of the University of Massachusetts Amherst and Cornell University Map data: https://geology.com/state-map/massachusetts.shtml, https://geology.com/county-map/new-york.shtml, Google Earth, 2024.

2.2 Population and Sampling

A total of 90 participants were distributed equally across three generational groups. The sampling strategy captured a cross-sectional representation of students: 30 from prospective students, 30 from current students, and 30 from alumni.

Prospective students (n=30) were matriculated students. These participants knew the institutions, via virtual tours or campus visits, yet the first semester had not started.

Current Students (n=30) were actively enrolled at the time of study or recently graduated, less than 1 year. The samplings captured a wide variety of academic levels and disciplines. At the University of Massachusetts Amherst, fifteen 15 samples of current students had studied there for one semester to six years. Fifty-three percent studied at UMass for less than two years, and forty-seven percent for over two years. At Cornell University, fifteen current students had studied for one to four years. Fifty-three percent studied for less than one year, and forty-seven percent for over one year.

Alumni (n=30) were former students who had completed their degrees more than 1 year prior to the study. UMass Amherst alumni participants graduated in the years ranging from 1992 to 2023, or from 1 to 32 years ago. Cornell alumni participants graduated between 1984 and 2015, or from 9 to 40 years ago.

2.3 Sampling Procedures and Data Collection

This study used the mental mapping exercise to obtain data on memorable places, including buildings and landscapes. Compared with previous mental mapping studies, such as Appleyard's study at Ciudad Guayana, Venezuela, which had only 12% university participants, this research population is in higher education, which implies higher conceptual skills and the ability to use basic sketches and diagrams. The limitation of drawing ability would not be a significant barrier in the context of focusing on the expression, not artistic quality. In this study, units of measurement were prospective students, current students, and alumni. The dependent variable was the frequency of recollection.

The first step was giving an introduction, which included an invitation to join this study because they are students of the university. The purpose is to understand memorable places on campuses. All participants are anonymous and volunteer. They have the right to withdraw from the research at any moment. The methods comply with the Helsinki principles for human subjects. After participants had decided to take part in the study, they were asked to spend 5-10 minutes drawing a mental map of the campus, based on memories and perceptions, including landmarks, meaningful places, paths, landscapes, and anything they associated with the campus.

The sketch maps were acquired during the summer of 2024 after universities released their admission decisions. At the University of Massachusetts Amherst, participants (n=45) were recruited using random onsite sampling from 14 locations during orientation events before the Fall semester began. Two staff members approached potential participants randomly and screened for eligibility based on their status as prospective students, current students, or alumni. For Cornell University participants (n=45), the study utilized a snowball online sampling method. The initial approach was to identify participants through institution networks and reception events. Eligible individuals were contacted electronically and requested to refer others. The procedure continued until the target sample size was reached.

2.3 Data Analysis

To understand the information from sketch maps, the researcher used three classification methods. The first procedure followed Lynch's theory, which focused on the key elements of city image, then added the categorization of landmarks into buildings and landscapes. The second method was using descriptive methods, adapted from Appleyard's method, to describe data received from student subgroups. Under the third method,

elements were grouped into different functions associated with campus planning: outdoor landscape and roads, academic, dormitory, cultural and historical, library, dining, administration and student services, athletics and recreation, maintenance support facilities, and college town.

In finding the collective memorable places, the researcher extracted information from sketch maps and transformed them into a database of memorable-significant maps corresponding with the percentage of recollection. The main criterion was that each element must demonstrate at least one stage of spatial knowledge development: landmark knowledge, route knowledge, or survey knowledge. A building must be correctly identified with an official or informal name. The misspelling was considered acceptable. A feature must be related to a pathway or another place. One sketch object without any relation was not justifiable. The location of an object must be adequate. All recalled elements - buildings, places, paths, and landscapes - were depicted digitally on a base map with scale. This digital process disregards the distorted distance between elements. The intensity of each element depended on the frequency of recalls. This step would present the composite maps of all participants and each group.

In the end, the study used the ArcGIS Pro application to identify peak recollection spots on the map. The hot spots analysis (Getis-Ord-Gi*) evaluated each feature with the context of its neighbors, measured significant spatial clusters of high or low value, and presented hot and cold spots. This conceptualization of the special relationships parameter value tool was a fixed distance band of 100 meters with the Euclidean distance method. The input field was frequency recalls from sketch maps. A high value (hot spot) has had a high z-score and small p-value, while a low value (cold spot) has had a negative z-score and small p-value. After that, an inverse distance weighted (IDW) tool was used to interpolate a raster surface from points with x-y coordinates. This technique disregarded the z-coordinate and yielded the best results when sampling was sufficiently dense. Patterns in the spatial distributions of recollection spots among the generations will be observed, identified, and explored.

3. Results

3.1 Data from Sketch Maps

Following Lynch's methods, elements from sketch maps were mainly landmarks (78%)—buildings (62%), and landscapes (16%) -- while paths (13%) and districts (10%) had secondary frequency recollection. Comparing the recalled percentages of student subgroups, generational cohorts from Table 2, current students recalled buildings (70%) more than prospective students (55%) and alumni (52%). On the contrary, current students recalled landscapes (11%) less than prospective students (21%) and alumni (20%). Prospective and past students presented their information more frequently than current students.

Table 2. Recollection places are categorized into landmarks, paths, and districts.

Student Subgroups	Landmarks				Paths		Districts		Total Recalled
	Buildings		Landscapes						
Prospective Students	151	55%	57	21%	32	12%	33	12%	273
Current Students	652	70%	107	11%	111	12%	64	7%	934
Alumni	303	52%	116	20%	86	15%	79	14%	584
Total	1,106	62%	280	16%	229	13%	176	10%	1,791

Adapting from Appleyard's methods, sketch maps were mainly spatial dominant, while sequential and functional dominant were secondary. As detailed in Table 3, current students (7%) provided lower sequential dominant maps compared to prospective students (23%) and alumni (13%). Their maps involved fractions or chains of connections with intersections, significant turns, and landmarks. Recalled movements displayed circulations, ranging from main roads to zig-zag walkways, straight passages, and curved directions (Figure 3). Though the routes were not named, the configuration allowed pinpointing of a specific path. Most buildings and landscapes between journeys were often skipped and unrecorded. Memory markers and destination buildings were mainly displayed on both sides of the movement systems. In contrast, one current student presented beginning and destination buildings linked with a curved walkway, naming nine elements on the left side but zero on the right side of the path. Beyond the building names, alumni often elaborated and explained their memorable places, and drew heart shapes in special places.

Table 3. Recollection elements are categorized into sequential, spatial, and other dominant.

Student Subgroups	Sequential Dominant		Spatial Dominant		Other Dominant	
Prospective Students	7	23%	23	77%	0	0%
Current Students	2	7%	27	90%	1	1%
Alumni	4	13%	24	80%	2	3%
Total	13	14%	74	82%	3	3%

From Table 3, spatial dominant maps were mainly from current students (90%), followed by alumni (88%) and prospective students (77%). Figure 3 presents examples of spatial dominant maps, considerably emphasizing the positions of adjacent elements and districts. Prospective students often produced scattered or clustered elements with weak connections. Half of the prospective students drew buildings grouped together with no identified circulation. However, the element positions were reasonably sufficient to locate spatial relationships with other components. Only a few buildings had arrangements that were placed incorrectly.

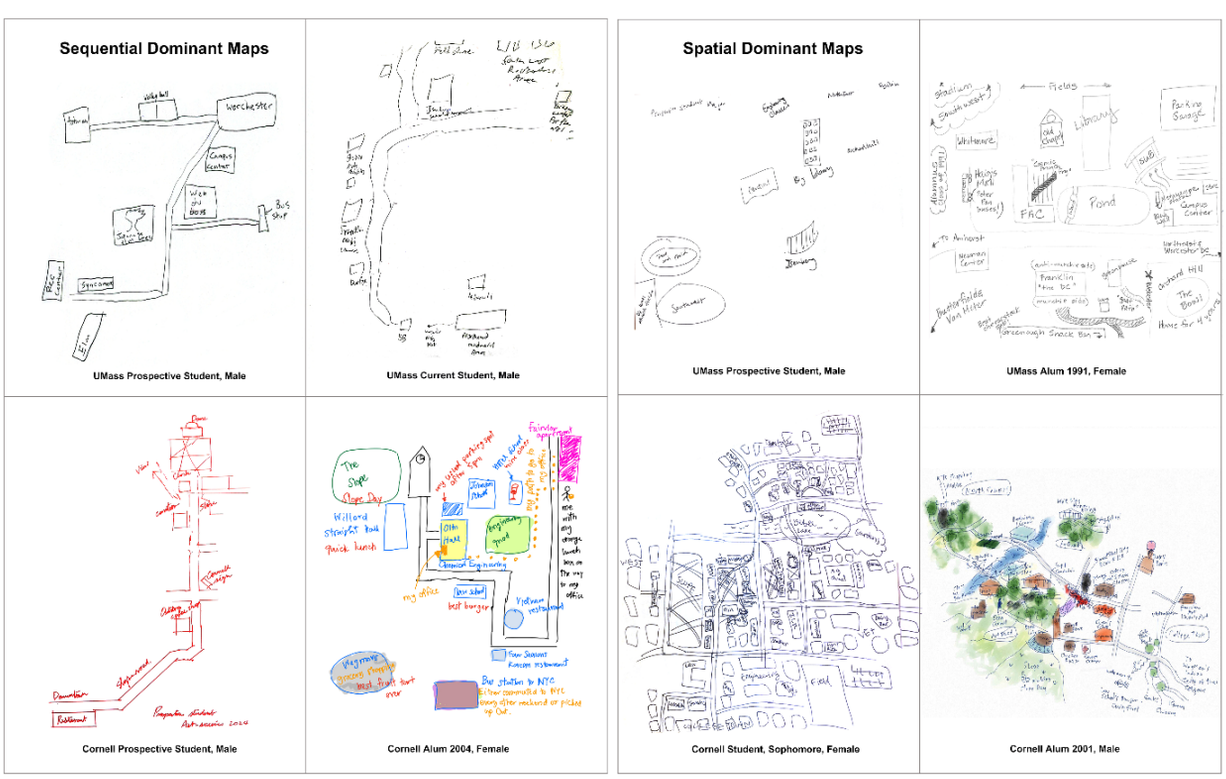

Figure 3. Examples of sequential and spatial dominant maps from both universities.

Current students generated more comprehension and accuracy in locations. Places, nodes, and districts were associated with drawn linkages, ranging from parts of main circulations to detailed walkways. Some included rich awareness of shortcuts and special components with written labels. Labels were also were used for distant districts, mainly at the periphery. Some extended knowledge by using arrows to indicate the direction to a faraway district. Three students drew maps in 3 dimensions three-dimensional maps, highlighting distinct characteristics of places. One student sketched the distant mountain range as a background. Many used irregular crisscross lines to represent quadrangles and placed several buildings to form a rectangular quad. Respondents wrote the building names where they could recall. They left them blank, used question marks, or wrote "I forgot" where they could not remember names. There were also were attempts to describe buildings instead of naming them. Some used colors and various text sizes to highlight importance.

Alumni generally produced fewer elements than current students. Still, they often expressed explicit memories, such as "sunset walk to the apartment, goat path, the steps, the bowl, the most beautiful magnolia trees, dragon day, and slope day." Some incorporated vivid activities and several focused elevation differences. Alumni frequently recorded specific notes and utilized heart shapes more than prospective and current students. Many alumni included both on and off-campus memorable features that were related to food. Alumni used arrows indicating directions to major roads, other towns, and a faraway city.

Three participants used a different technique that did not fit into sequential or special dominant types. They displayed one chosen element at the center and branched outward, like a mind map structure focusing on functions and activities.

Following functional aspects directly aligning with campus planning contexts, Table 4 presents memorable places categorized into outdoor landscapes and roads, academic, dormitory, cultural and historical, library, dining, administration and student services, athletics and recreation, maintenance support facilities, and college town. The outdoor landscape and roads received the highest recollection of all students (28%). The prospective students and alumni recalled landscapes and roads more than academic buildings. On the contrary, the highest frequency from current students was in academic buildings (17%).

Table 4. Memorable places. Places are categorized into different functions associated with campus planning.

University	Respondents	Landscapes and Roads	Academic	Dormitory	Culture and History	Library	Dining	Admin and services	Athletics and Recreation	Parking and maintenance	College town and others
UMass	Prospective	17	9	24	2	11	11	14	12	3	0
	Current Students	48	73	15	9	13	18	21	15	3	0
	Alumni	65	33	34	16	11	9	28	13	9	8
	All students	130	115	73	27	35	38	63	40	15	8
Cornell	Prospective	66	27	15	17	11	6	12	6	1	9
	Current Students	165	237	105	47	33	50	42	30	2	8
	Alumni	137	67	19	40	22	17	23	9	0	23
	All students	368	331	139	104	66	73	77	45	3	40
Both	Prospective	5%	2%	2%	1%	1%	1%	1%	1%	0%	1%
	Current Students	12%	17%	7%	3%	3%	4%	4%	3%	0%	0%
	Alumni	11%	6%	3%	3%	2%	1%	3%	1%	1%	2%
	All students	28%	25%	12%	7%	6%	6%	8%	5%	1%	3%

3.2 Memorable-Significant Maps Corresponded with the Percentage of Recollection

Table 5 shows the statistical overview of recollection counting from the student subgroups. Cornell current students had very strong recollections, with a minimum of 18 and a maximum of 108 elements per participant, while UMass prospective students had low recollections, ranging from 1 to 11 elements. Calculating data from both universities, the means of recalled components were 9.27 for prospective students, 19.47 for alumni, and 31.13 for current students.

Table 5. Summary of recalled counts from sketch maps.

University	UMass			Cornell		
Populations	Prospective Students	Current Students	Alumni	Prospective Students	Current Students	Alumni
Min. recalled	1	3	6	5	18	10
Max. recalled	12	26	32	32	108	43
Total counts	109	215	226	169	719	358
Mean	7.27	14.33	15.07	11.27	47.93	23.87
Median	7	15	15	8	44	22
Std deviation	2.76	7.63	7.40	8.07	23.98	11.10

Collective recall elements were overlaid to produce memorable significant maps from students at the University of Massachusetts Amherst and Cornell University (Figure 4). The maps present landmarks, meaningful places, paths, and landscapes that students remembered. The grayscale ranging from 0 (white) to 100 (black) corresponds with the percentage of recollection.

The highest collective memory represents the peak remembrances at the institution's iconic buildings and adjacent landscapes. The top five recalled places at the University of Massachusetts Amherst were the Du Bois Library (78%), Campus Pond (60%), Campus Center (60%), Student Union (49%), and Worcester Dining Center (49%). The main pedestrian road, the Ellis Way, could link the top five elements together. All respondents recalled 114 elements in total. UMass alumni produced 82 elements, the highest number of memorable places, while the current students generated 65 elements. UMass prospective students drew 40 elements. At UMass Amherst, prospective students produced some paths, districts, and a few buildings. Current and former students remembered many more complete paths, districts, and buildings, mainly in the Central and East areas.

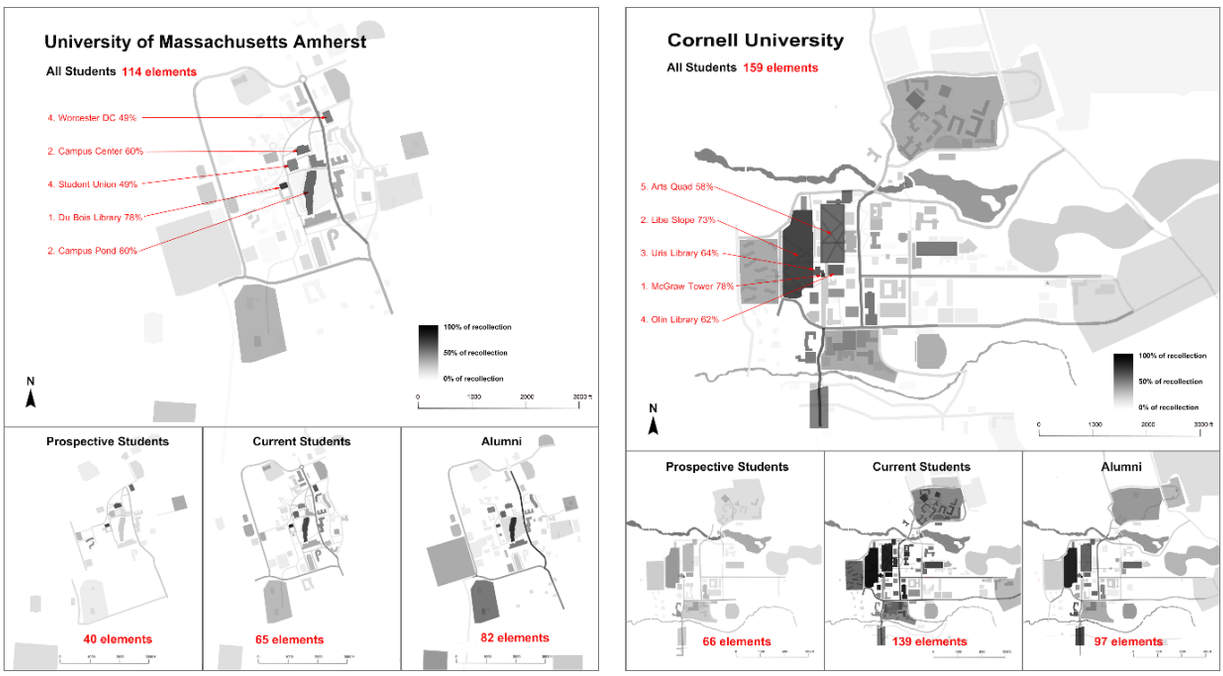

Figure 4. The University of Massachusetts Amherst and Cornell University have memorable and significant maps created by all students, prospective students, current students, and alumni.

The top five recalled places at Cornell University were the McGraw Tower (78%), Libe Slope (73%), Uris Library (64%), Olin Library (62%), and Arts Quad (58%). The top five elements were spatially connected. Two out of five elements were simple green outdoor landscapes. A total of 159 elements were mentioned: 139 from current students, 97 from alumni, and 66 from prospective students. Prospective students could recall fewer elements, and one-fourth of their memorable places were landscapes. The rich information from the current students revealed accurate spatial maps of almost the entire area of the institution. Alumni drawings had fewer buildings but extended to college towns and places beyond the campus. Alumni presented memorable places using the form of larger areas or districts more than current students.

3.3 Spatial Cluster Analysis Maps

The Hot Spot Analysis, utilizing the Getis-Ord-Gi* statistic and inverse distance weighting (IDW), identified significant clusters of peak recollection spots at the two universities. The hot spot analysis maps revealed overlapping zones that could represent the core reminiscence destination of prospective, present, and former students. These maps exhibited similar and dissimilar sites of prime memorable zones among generations. From Figures 5 and 6, the red areas displayed hot spot zones and the blue areas indicated cold spot zones.

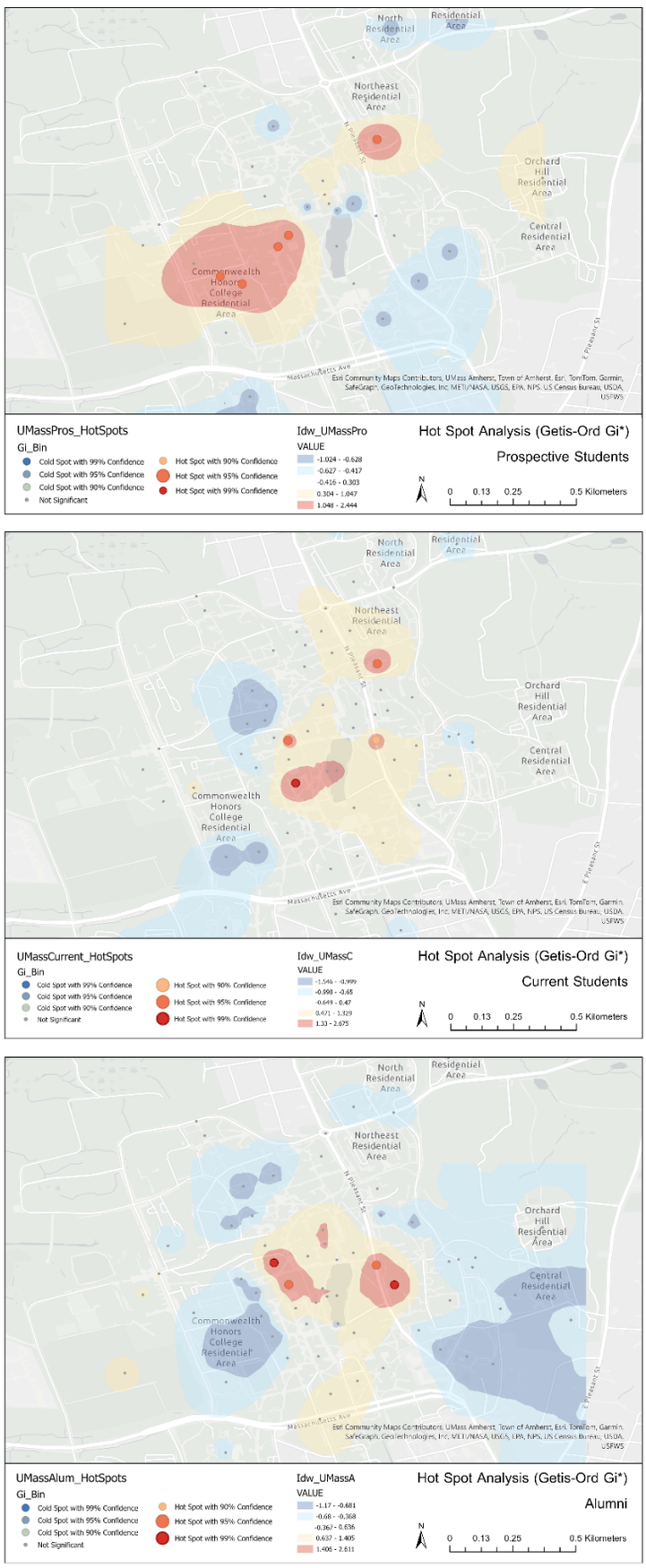

Figure 5. Spatial cluster analysis maps at the University of Massachusetts Amherst.

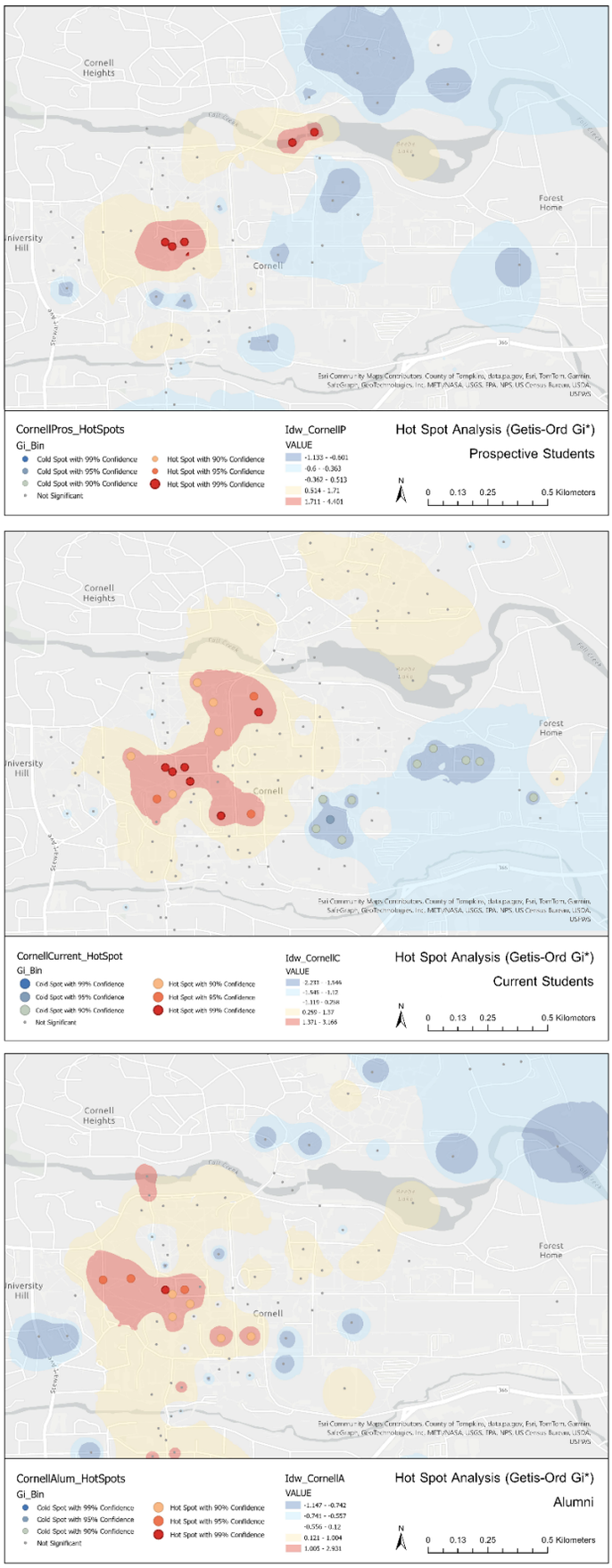

Figure 6. Spatial cluster analysis maps at Cornell University.

Figure 5 uncovered the unique clusters among generations at the University of Massachusetts Amherst. UMass prospective students reported two clusters of hot spots with 95% confidence. One big cluster was at the iconic library, nearby historic tree, and the honor residential houses (Du Bois Library, Japanese Elm Tree, Elm House, and Sycamore House), while a small cluster was at the famous dining center (Worcester DC).

UMass current students' hot spots are comprised of four scattered clusters. A hot spot with 99% confidence was at the campus historic building (the Old Chapel). Two hot spots with 95% confidence were the notable dining center (Worcester DC) and the landscape element (the Big Red Chair). One hot spot with 90% confidence was the campus's central circulation (Pleasant Street).

UMass Alumni had two clusters around the campus pond. Two hot spots with 99% confidence were academic buildings. Another top spot with 95% confidence was the library's iconic building and campus main circulation. There were three buildings (Du Bios Library, Science Building, and Machmer Hall) and one main road.

Figure 6 illustrates distinctive clusters from the student subgroups at Cornell University. Cornell prospective students reported two clusters of hot spots with 99% confidence. The campus core cluster included three buildings (McGraw Tower, Uris Library, and Olin Library), while another cluster was at the spectacular natural area (Fall Creek and Waterfall).

Cornell's current students' hot spot appeared to be one big cluster connecting six hot spots with 99% confidence, three with 95% confidence, and five with 90% confidence. Twelve hot spots were buildings with various functions--the iconic tower, libraries, lecture halls, laboratory, cafeteria, hotel, and chapel. Two hot spots were the slope with panoramic views (Libe Slope) and the pedestrian node (Ho Plaza).

Cornell alumni's hot spots included one big cluster at the campus core and several small clusters. There was one hot spot with 99% confidence, three hot spots with 95% confidence, and five hot spots with 90% confidence. Four of the six buildings' hot spots had very distinguished architectural styles: Romanesque Revival and Victorian Gothic. The hot spots included three connecting landscape features (Libe Slope, Baker Pole, and Ho Plaza).

4. Discussion

4.1 Findings

The recalled elements were mainly landmarks, like other studies. However, subclassifying buildings and landscape landmarks revealed the different memorable places of student subgroups. Recollections of buildings were from 55% of prospective students, 70% of current students, and 52% of alumni, while recollections of landscapes were from 21% of prospective students, 11% of current students, and 20% of alumni. For recalled buildings, the increasing percentages might be associated with higher familiarity, while the decreasing percentages might be connected to a longer non-exposure period. For recalled landscapes, the result could correspond with a psychological perspective theory in the book Experience of Nature, which states that a natural environment as a source of interest and fascination may change after repeated exposure and gaining familiarity (Kaplan & Kaplan, 1989). The intensity of the remarkable feelings for visitors could become less impressive for inhabitants.

Lynch's cognitive mapping method favors participants with strong spatial-visual drawing skills and often utilizes only students with architectural or design-related backgrounds. However, this study used the mental mapping exercise with the whole college population and found that it could be a predictable and reliable tool for assessing spatial knowledge. The sketch maps from college students presented data primarily as spatial

maps (82%), which yielded more profound knowledge than the sequential maps. This contrasts with Appleyard's study at Ciudad Guayana, Venezuela, where the results had more sequential dominant maps (75%) and limited spatial maps (25%). Most college student populations in this study produced mainly survey-like maps, while general populations in Venezuela provided predominantly route-like maps. Survey knowledge is the later stage of development after route and landmark knowledge (Siegel & White, 1975). By comparing educational backgrounds, the respondents of Appleyard's study possessed lower education-- 5% no education, 51% primary, 32% secondary, and 12% university (Appleyard, 1970). Hence, higher education might significantly impact the complexity of information in the context of places and networks beyond routes. Moreover, the reminiscence bump also contributes to better recall of memories from early adulthood, around ages 10-30, than other periods (Munawar et al., 2018).

Prospective and current students primarily provided general knowledge and facts associated with semantic memory. On the other hand, alumni offered further information beyond requested and included personal events, awe moments, routine activities, and favorite foods. These factors were connected to episodic memory, which represents a personal long-term memory tagged with feeling context. Similarly, Lynch (1960) explained that exceptional architecture and extraordinary nature with significant events could create high imageability. Tuan (1977) and Relph (1976) also mentioned that personal experiences and routine activities affect the rootedness and identity of a place. Several tourism studies confirmed that food nostalgia could connect people with places (e.g., Stone et al., 2018). As a result, functions and activities likely impact long-term memorability.

From functional aspects, the highest recollection of all students was landscape and roads (28%), exceeding academic buildings (25%). Similarly to the Education Advisory Board survey, the iconic campus landscape and environment impacted enrollment decisions, outweighing typical factors such as academic reputation, cost, and location (Education Advisory Board, 2018). Landscapes and roads must not be disregarded in campus planning and policy because they significantly affect students' memories.

The collective memorable maps present practical information for future development. The percentage of frequency discovered where the configurations of memorable elements were extending or receding. The patterns of memorable places on campus seemed to concentrate on the core campus locations, with a cluster of the strongest memories. Memory intensity did not diminish equally as distance increased from the central zone. Some happened to evolve along the main route, like a path-based formation. Some were clustered in a distinct district. Peripheral zones tended to have low memory recall because of limited exposure or lower foot traffic. However, shading the frequency percentage of the elements with different sizes could be an issue. People tend to notice a more prominent feature more easily than a smaller one. Therefore, a small size element could be easily disregarded.

The spatial cluster analysis could help visualize diverse hot spots among generations. The hot spot maps demonstrated that the overlap areas were usually in the center of the university. Different sections were separated according to the interests of each student subgroup. Prospective and current students at UMass were highly interested in the famous dining hall, which won the best campus food by the Princeton Review for eight consecutive years. The UMass dining center could be a marketing point for future and current students. The main street at UMass is the hot spot for current students and alumni, but not prospective students, which could be linked to their movement. Besides the core campus at Cornell University, prospective students had produced hot spots with the picturesque views of the creek and waterfall, which could be an advertising area for potential students. The big slope at Cornell became the hot spot for current students and alumni, which may relate to their experiences. Therefore, the memorable places of prospective students tend to connect with

natural beauty, while memorable places of current and former students are more bound with major events and routine experiences. It is necessary to point out that a landscape feature is always included as a hot spot for all groups. The free recall method allows respondents to express their meaningful landscape elements that may not be vital in campus structure, such as the magnificent tree, the big red chair, and the historic flag pole.

4.2 Limitation and Interpretation

This study had a relatively small sample size of 90 participants. When attempting to make planning decisions for the entire campus population, an institution should implement a larger sample size. Map interpretation and coding generally introduce a potential bias. Therefore, standardized protocols would be essential during data analysis to alleviate reliability concerns.

The prospective students in this study focused on incoming first-year students who had already been accepted to the college but did not begin their first semester. As such, access to this population was limited to a specific time frame. Some prospective students claimed they did not have much of an impression of an institution, as they had not been students there. Regardless of physical familiarity, they often visited the college campus at least once and possibly gathered a wealth of information from the internet. The prospective students exhibited less spatial knowledge, and the results showed fewer details. Regardless, the cognitive maps still supplied valuable insights and presented the importance of the locations. Some alumni expressed their happiness in reflecting on reminiscence and fond memories. Therefore, a university could implement the mental mapping exercise during an annual event. Yearly updated information would provide a forthcoming trend in guiding future planning.

Map recall should be widely implemented beyond students from the design field. The student population in higher education could produce map recall and provide more profound knowledge than city residents. By adding subgroups of buildings and landscapes, the results clearly show the importance of landscape in memorable places on campus. Landscapes are not just a backdrop or a decorative element but can also can shape experiences, perceptions, and memories. Therefore, including landscapes is crucial when studying memorable places.

Categorizing data into different functional aspects directly aligning with campus planning contexts helps reveal unique perceptions of prospective students, current students, and alumni. It offers a practical design direction and management tool to support higher education's specific activities or psychological needs.

The collective memorable maps could help planners locate new buildings, enhance meaningful places, and develop positive public images. Key remembrance places could be more important than architectural landmarks or decorative landscape elements. They are the silent storytellers of an institution's history, the backdrop to countless personal memories, and the anchors connecting multi-generations. The GIS spatial analysis maps would provide easy understanding for all stakeholders and present different hot spots for prospective, present, and past students. However, the IDW method needs sampling with sufficient density. A challenge may arise with small sample sizes or city campuses that disperse into large metropolitan areas. While the fixed distance of 100 meters was a suitable measure for this memorable place analysis, it should be adjusted to correspond with specific institution types and locations. For example, when using walking distance, universities in tropical climates would be shorter than in temperate climates (Janpathompong et al., 2022).

4.3 Conclusion

Well-known architects may intend to design outstanding iconic buildings, but the well-known places depend on public judgment. Mental mapping exercises can reveal memorable places in users' minds. The open-ended mental map drawing allows an individual to extend the sketch freely and gain richer data than a requested list of famous places. Holistically, the data analysis method used in this study is a novel tool to incorporate meaningful components into campus planning processes. This research added an alternative way of interpreting data from mental maps. The disposition of memory intensity would create a unique blueprint for each institution. The database of memorable-place significance maps would present intangible aspects of perception and complete a review of three interconnected components of place identity—physical features, functions, and meanings.

There are several benefits from this research. The database of memorable places across generations could guide better design decisions. By understanding what a particular group values in a location, facility management could arrange a place that resonates with specific needs. Campus planners could assess memory impact before a major renovation or expansion to avoid adverse effects on campus identity and emotionally significant locations. The collective memory-significant maps combined with hot spots from spatial cluster analysis could portray a strong memory district. This finding could be used to identify specific areas to strengthen the legibility of campus environments.

Other universities could easily implement the same method to reveal essential, memorable locations. A campus could set up a tour route to resonate with prospective students' interests. Management could select a reunion place that corresponds to alumni's top nostalgic sites, rather than just any available location. Effective budget allocation could improve student satisfaction, impact college decisions, and enhance alumni relations. Future research could consider exploring the whole university population and the essential factors affecting memorable places. Although participants were only requested to draw locations, some respondents drew physical features and noted activities related to memory. A deeper study of memory-place significance could disclose important insights about influential factors, predictive tools, and the shifting trends of memory imprints. Ultimately, a place cannot have meaning or become a symbol without memory.

Author Contributions

Conceptualization, D.J., S.A., A.M.; methodology, D.J., S.A., A.M.; software, D.J.; formal analysis, D.J.; writing-original draft preparation, D.J.; writing-review and editing, D.J., S.A., A.M.; visualization, D.J. All authors have read and agreed to the published version of the manuscript.

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Conflicts of Interest

The authors declare no conflict of interest.

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