ABSTRACT

MANTOOTH, RENAE. The Influence of Physical Space on Academic Place: The Multi-Use Informal Learning Environment in Higher Education. (Under the direction of Dr. Celen Pasalar).

Informal learning environments on college campuses serve as crucial spaces outside of the formal classroom and home to support undergraduate student needs. However, the utility of place-based campus experiences has been called into question as ‘work from anywhere’ is more commonplace and virtual courses become accessible. Because college students spend the majority of their time outside of the formal classroom engaging in coursework it is important to consider how informal learning spaces, such as the college union, support informal learning related activities. College unions are traditionally known as the living room of the college campus and recent research has investigated how the physical nature of these spaces build community (Johnson, 2017; Maxwell, 2016), but less is known about how they support informal learning related behaviors and cultivate a sense of belonging in college students. This dissertation addresses this gap in literature, in order to provide empirical findings for evidence-based design efforts while establishing how the college union is a meaningful academic place for undergraduate students. The purpose of this three-article dissertation is to establish the transdisciplinary conceptual framework, academic place, and apply it to two empirical studies with differing methodological approaches to investigate how college unions support informal learning and cultivate a sense of belonging in undergraduate students.

The first article organizes environmental, personal, perceptual, and behavioral factors associated with informal learning spaces in higher education in order to expand our understanding of how these spaces contribute to the experience of undergraduate students. Academic place is rooted in the notion that physical space organizes functional objectives of an
organization (Hillier & Hanson, 1984) and connections students associate with the built environment can offer rich and meaningful experiences (Rapoport, 1982).

The second article employs a causal-comparative case study and utilizes space syntax, isovists, and behavior observation methods to explore how the design of college unions, Talley Student Union (TSU) at North Carolina State University and Gatton Student Center (GSC) at the University of Kentucky, support informal learning behaviors. Similar patterns at both college unions reveal fewer stationary activities occur in gathering spaces when frequency of movement is higher. Dining behaviors are likely driven by adjacency to retail dining, and talking behaviors favored highly integrated gathering spaces in both college unions. Similar global and local patterns are observed in terms of behavior groups at TSU, but this was not the case at GSC.

The third article hypothesizes a serial mediation model to investigate how perceptions of social interactions and a pluralistic orientation explain the relationship between preferences for spending time at the college union and a sense of university belonging. A random sample of undergraduates at North Carolina State University (n = 221) and the University of Kentucky (n = 202) were electronically surveyed during the Fall of 2019. Findings indicate that student preferences for spending time outside of class at their college union encourages positive social interactions and fosters more openness to different worldviews. These factors in turn, promote a stronger sense of university belonging for undergraduate students in both samples.

This dissertation demonstrates how a transdisciplinary approach with differing methodological approaches can conceptualize research concerned with higher education facilities. This dissertation demonstrates how college unions are academic places to support informal learning-related activities and can cultivate a sense of belonging in college students.
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The Influence of Physical Space on Academic Place: The Multi-Use Informal Learning Environment in Higher Education

by

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North Carolina State University
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For Mom and Dad.
BIOGRAPHY

Renae Mantooth grew up in a small, rural town in western Kentucky and earned her bachelor’s degree in Interior Design from the University of Kentucky. Renae’s internship as a facilities designer for the university during her undergraduate career prepared her for a full-time role after graduation where she planned, managed, and designed spaces for post-secondary learning and teaching. While working as a space planner and facilities designer, Renae earned a Master of Science in Educational Psychology, also from the University of Kentucky. This degree provided her the necessary tools to inform evidence-based design and data driven decisions in her practice as a designer of higher education environments. Following the completion of her M.S., Renae turned to North Carolina State University to pursue doctoral studies which greatly expanded the depth and breadth of her understanding of and contribution towards Design Research.
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First, I wish to acknowledge that this dissertation work was completed on the occupied land of the Shawnee, Eastern Band Cherokee, Tuscarora, and Catawba peoples. This research investigates two buildings constructed on stolen land and it is necessary to acknowledge their position in settler colonialism, as well as my own commitment to seek deeper truths. Reconciliation of colonization requires systemic change.

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CHAPTER 1: Introduction

Higher education facilities are drastically changing to accommodate diverse student needs, recruitment demands, and state of the art technology. While some argue that increased enrollment in online and distance courses has reduced demand for formal academic space (Mazoué, 2012), there has been over a 10% growth in campus built space in the last decade (Sightlines, 2017). While physical environments on a college campus serve the practical purpose of housing a variety of academic related activities, buildings also serve a crucial role in expressing the vision and values of the institution (Kenney, Dumont, & Kenney, 2005). University administrators are consistently responding to student needs through architecture and the design of the built environment. However, these design decisions are often not grounded in empirical evidence (Blackmore et al., 2011; Temple, 2008) and there is clear need for data driven design for a fiscal, ecological, and socially sustainable world.

Problem Background

Evidence-based design for education environments has gained momentum in recent years, as there is an escalating recognition that designed environments may significantly influence student and teacher attitudes, perceptions, and behavior (Blackmore et al., 2011). The body of knowledge that is concerned with the role of the physical environment in the context of K-12 schools is substantial (Cleveland & Fisher, 2014; Evans, 2006; Weinstein, 1979) but fewer studies have rigorously investigated the built environment in higher education. Specifically, research on multi-use and open informal learning spaces is sparse, but necessary to ensure that these spaces enhance the student experience while demonstrating fiscal responsibility by the college or university (Ayres, 2018) and supporting institutional efforts for retention and persistence (Mayhew et al., 2016). However, the COVID-19 pandemic has escalated
administrators’ concern for the role of the built environment in higher education. As more courses move to a virtual learning format, how can both current and future facilities better meet student needs in an ever-changing world?

In order to design higher education facilities to have the greatest impact on student needs, empirical research on how the built environment influences learning and teaching is necessary. In addition, learning behaviors are rapidly changing as work from anywhere has become the new norm and spaces outside of the formal classroom space are critical for academic and emotional wellbeing. A particular space that often houses many of these informal learning environments is the college union. According to the Association of College Unions International (2020), “the college union advances a sense of community, unifying the institution by embracing the diversity of students, faculty, staff, alumni, and guests. We bolster the educational mission of the institution and the development of students as lifelong learners by delivering an array of cultural, educational, social, and recreational programs, services, and facilities” (para. 1). College unions have widely remained open, even on campuses that have primarily transitioned to remote learning for safe practices during the COVID-19 pandemic, demonstrating the importance of these spaces for college students. It is clear that the college union is a crucial space to meet student needs, but less is known about how the college union, as an academic place, contributes to the experience of undergraduate students.

**Study Purpose**

The purpose of this dissertation is to first establish a transdisciplinary framework in order to investigate two college unions as an academic place, to ultimately understand the implications college unions have on undergraduate self-beliefs and informal learning related behaviors. This dissertation addresses this gap in the knowledge base with a three-article format. The first article
posits a transdisciplinary framework that synthesizes theory from educational psychology, environmental psychology, architecture, and higher education administration to address how the function, utility, and understanding of buildings on a college campus transcend those disciplinary boundaries to operationalize the relationship between people and the environments they are nested within. The second article employs a comparative case study research design to analyze and synthesize differences, similarities, and patterns of spatial properties and informal learning related behaviors at two college unions in the southeast United States. The third article investigates how university belonging can be cultivated in undergraduates through a pluralistic orientation, quality social interactions, and preferences for spending time outside of class at the college union. The collection of these papers demonstrates the transdisciplinary nature of the interaction between students, facilities, and the socio-cultural environment on a college campus in a North American context.

*Academic Place* is the conceptual framework posited in the first article that organizes and operationalizes undergraduate student motivation within campus environmental systems to conceptualize the dynamic nature between people and place. The first article of this dissertation outlines, synthesizes, and posits the conceptual framework, academic place, that can be adopted for environment-behavior studies within the context of higher education. Place is a socio-spatial concept that elucidates the meaning individuals associate with their physical environment (Ittelson, et al, 1974). It can be argued that everything on a college campus is designed. From curriculum, to space, to organizational culture, university campuses are meticulously crafted to reach predetermined goals. While these goals may look different within each element of the system, a shared mission often drives how these phenomena are designed. Academic place posits how relevant factors, constructs, and variables are related, specifically to understand how
designed environments could better support undergraduate students. By adapting constructs associated with social cognitive theory, the social ecological model, and campus ecology place, I offer an agentic perspective on campus ecology.

The second article of this dissertation applies a portion of academic place to a comparative case study research design. In this study, the environment is operationalized through space syntax and isovists techniques to explore the relation between spatial properties and informal learning related behaviors of undergraduate students. Two college unions, Talley Student Union at North Carolina State University and Gatton Student Center at the University of Kentucky are the two cases involved in this investigation. Six locations in each building were purposefully selected for systematic behavioral observations. Findings elaborate on the similarities and differences of observed behavioral patterns, including stationary behaviors, movement, and interactions and if there are local accessibility group differences of these patterns. In addition, behavioral group differences are examined to investigate whether informal-learning related behaviors show preferences for spatial properties. Results are discussed by incorporating implications of global integration of the two college unions, along with how the functional program of each college union influence student behavior in two college unions.

A sense of belonging, or connectedness to one’s institution, has shown to be related to academic and emotional wellbeing (Tinto, 2015). Higher education administrators are consistently adopting tactics to foster this elusive construct to support undergraduate students. Even though literature on the importance of belonging is vast (Strayhorn, 2012), little research has been done to investigate how the physical environment influences a sense of university belonging in college students. To address this gap, the third article of this dissertation posits a serial mediation model, derived from the academic place conceptual framework, that explores
how quality social interactions and a pluralistic orientation explain the relationship between students’ preferences for spending time outside of the formal classroom at their college union and undergraduates’ sense of belonging. Furthermore, this analysis delves into how academic places, such as the college union, encourage exposure to others and an openness to diverse worldviews.

**Study Significance**

This dissertation contributes a transdisciplinary conceptual framework for empirical research that is concerned with environment-behavior studies within the context of higher education. I applied this framework, academic place, to an investigation on two college unions with methodological roots in architectural studies as well as a study with methodological roots in educational research, in order for findings to cross disciplinary borders in pursuit of knowledge associated with supportive informal learning spaces. Accordingly, higher education administrators, architects, interior designers, facility managers, campus planners, and student affairs staff benefit from this new knowledge on how college unions influence informal learning related behaviors and a sense of belonging in college students. This dissertation illustrates how physical environments organize social systems to shape informal learning related behaviors and cultivate a sense of belonging in college students.
References


CHAPTER 2: Article 1

Academic Place as a Framework: An Agentic Perspective on Campus Ecology

Abstract

This paper provides a transdisciplinary conceptual framework that organizes factors associated with supportive informal learning spaces for college students. The proposed framework synthesizes major tenets from social cognitive theory, the social ecological model, and campus ecology helping to understand the meaning of informal learning spaces in higher education. Academic place is a holistic framework that transcends disciplinary borders to understand the reciprocally determinant relationship between environmental qualities, personal factors, environmental cues, and behaviors and transactions within informal learning spaces. It is an agentic perspective on campus ecology in that it encourages researchers and practitioners to recognize and account for student level differences, and how these differences factor into the function and perception of learning spaces. The goal of the proposed framework, academic place, is to provide an organization mechanism that promotes supportive and inclusive informal learning spaces for all college students.
Introduction

Interior environments in higher education settings are increasingly considered as dynamic systems due to multiple user groups their associated needs, technologies, space typologies, and design elements that factor into the overall experience of a building (Strange & Banning, 2015). Many stakeholders (e.g., students, administrators, facility managers) are affected by the construction or renovation of a new building on a college campus; while each of these stakeholders may be united on the overall goal of a project, they may ultimately have different lenses that can manifest in opposing priorities. Further, the physical environment that makes up a college campus communicates the values of that higher education institution. “The meaning of the physical campus and the message it sends to students, faculty, staff, and visitors is fundamental to achieving every part of the institutional mission” (Kenney, Dumont, & Kenney, 2005, p. 73). This study proposes a transdisciplinary framework to understand the meaning of an academic place by discussing the relationships between environmental qualities, personal factors, perceptions of environmental cues, and transactions with the learning environment (see Figure 2.1).

Technological advances for learning, diverse user groups, and more recently, conditions due to the COVID-19 pandemic have challenged the design of educational facilities. The repurposing of libraries, college unions, as well as other social or third spaces on higher education campuses builds a strong case for evidence-based design (Fisher, 2019). Data driven design is defined by how the design of educational architecture and interiors is informed through empirical evidence while simultaneously visioning unique user needs throughout the design process. In recent years, evidence-based design processes have radically shifted how hospitals are designed resulting in faster healing rates, reduction of stress on medical staff (Kaelin &
Okland, 2018), and improved patient healing (Bosch & Lorusso, 2019). Similar attention should be given to higher education settings in support of educational initiatives – both informal and formal learning. To begin to normalize this practice, the knowledge base for education environments must be substantially expanded. This paper provides a transdisciplinary framework that can be utilized to align design research efforts and inform the future design of informal learning environments on higher education campuses.

The intent of this paper is not concerned with the evaluation of higher education learning environments in a formal sense, such as the post occupancy evaluation. Rather, this paper provides a conceptual framework linking environmental and personal attributes to understand how environments can better support college students. Interior spaces have historically been defined by boundaries imposed, space typologies present, and meanings associated with the form and function of the built environment. The increased permeability between spatial systems and technological advances requires a reconceptualization of how we understand interior environments and the relationships people have with those spaces (Stokols, 2018a). The lack of an overarching explanatory theory in design (Rapoport, 2008) requires design researchers to “reinvent the wheel” and is an impediment to a foundational knowledge in the field, often forcing design decisions to be reactionary rather than preemptive. This acknowledgement, that good design should be preemptive, in addition to the notion that qualities of the environment and individual differences equitably contribute to human behavior, is the foundation for this conceptual framework.

This paper first unpacks why a transdisciplinary mindset is important for the understanding of higher education settings. The philosophical underpinnings of this framework are explained and situated within the field of higher education. The next section provides a brief
overview of the study of human motivation through a social cognitive lens and discusses why this theory is both relevant and lacking for framing inquiry into higher education settings. Then, theoretical underpinnings of foundational ecological models are explored, illustrating how these approaches inform academic place as a conceptual framework. Finally, the organization of the major components of academic place are positioned, and applications to research and practice concerned with informal learning spaces on a college campus are discussed.

**Figure 2.1**

*Proposed Academic Place Conceptual Framework*

**Reflexivity Statement.** I became increasingly interested in how the built environment can be used as a tool for specific outcomes early on in interior design school. This curiosity drove me to pursue a master’s degree in educational psychology as I was fascinated with the design of spaces that promote learning processes. The first few months of this experience were transformative in that they shaped the way I look at not just design research, but the field of
design. I was constantly getting hung up on folks outside of my discipline misunderstanding my
design jargon and how hard it was for me to break discipline specific norms. Even as I began to
plan my first research project for my master’s thesis, my advisor and I would spend countless
hours being intentional about the words we were using, or not using, to communicate our cross-
disciplinary ideas. As I learned more about the study of student motivation, I found myself
circling back to put my role as a designer to express these motivation concepts through the
planning, design, and strategy of the design projects I was concurrently working on. Adapting
principles of motivation theory to the design of the built environment in practice is what
ultimately led to this conceptual framework. Furthermore, this work is rooted in practice with the
intent of designing equitable and supportive education environments for this generation.

Towards a Transdisciplinary Mindset

To further develop the knowledge base around the design of informal learning
environments, a transdisciplinary mindset must be woven through the fabric of our
understanding on how higher education environments not only spatially organize institutional
efforts, but also how they influence students, faculty, and staff. Architecture does not just
provide shelter to its users, but it sets the stage for all activities of everyday life, both meaningful
and mundane. This is not to say that architecture is deterministic. However, people and their
actions cannot be separated from the physical phenomenon in which they reside. Many
metaphors have been used to describe architecture over the past century; architecture as machine,
arboriculture as language, architecture as organism, architecture as landscape, and architecture as
being (Benedikt, 2020) but those are design focused conceptualizations of built environments.
Through environment behavior studies, architecture is viewed as a vital component in human-
environment relationships, in conjunction with the nuance and complexity of the people it
surrounds. The concept of academic place adopts the idea that “form must express function” (Lefebvre, 1991) in that physical space is nonverbal communication to its users, no matter how much that communication varies between people, as any cultural artifact does.

In recent years, the disconnect between research about the built environment and the practice of designing our everyday environments is declining due to evidence-based design efforts and client driven expectations for researchers in practice. However, within the field of design, there are language and nuance differences that stand in the way of data driven design. It is imperative that a common language is spoken between those who conduct research to understand how the built environment influences people and those that design those environments. To strengthen our understanding of the relationships between people and place, there is need for a framework that will be instrumental to those that are designing higher education environments, as well as to those that are conducting research about higher education environments.

The purpose of a transdisciplinary framework is to transcend the boundaries of a particular disciplinary perspective (Jahn, Bergmann, & Keil, 2012). Higher education facilities should be informed by the wealth of knowledge that exists within the disciplines of educational psychology, higher education, and organizational psychology, in addition to environment behavior fields. While existing frameworks exist operationalizing relationships between people and place, there is not a substantial framework that relates these disciplines into a coherent whole within the context of higher education. “Transdisciplinarity concerns that which is at once between the disciplines, across the different disciplines, and beyond all disciplines. Its goal is the understanding of the present world, of which one of the imperatives is the unity of knowledge”
(Nicolescu, 2014, p. 19). This understanding allows designers to make informed, evidence-based decisions for a more sustainable and equitable future.

**Inquiry World View**

Frameworks to conceptualize the process of transdisciplinary research emphasize the importance of reflexivity. By understanding the role of the researcher, or the practitioner, there is the inherent assumption that research is not value free. Research through a pragmatic lens accounts for context and is grounded in a real-world setting. A pragmatist approach implies practical value, in that both meaning and objective truth contribute to the understanding of a phenomenon. A pragmatic philosophy holds that human behavior cannot be separated from previous experiences, beliefs, and thought (Kaushik & Walsh, 2019). Pragmatism, as a research paradigm, is focused on the nature of experiences in the real-world contexts that they occur. Pragmatism is the rejection of idealism and asserts that meaning is derived from experience. This paradigm is an appropriate lens for higher education environments because pragmatic theories must also be grounded in practice and are not abstract representations of phenomenon. That being said, this pragmatic approach implies the proposed framework to evolve as people evolve, and our understanding of experiences shift.

“Pragmatism can be construed as a philosophy of flux in the sense that it regards the world as emergent and never fully finalized” (Dalsgaard, 2014, p. 146); this notion of evolving knowledge underpins Dewey’s philosophy of pragmatism. This state of flux encourages a reciprocally determinant relationship between phenomena within the realm of inquiry while also leaving room for appropriate research quality standards addressing the fit to the research question. Deweyan pragmatism rejected the dualism between positivist and constructivist ways of knowing and emphasized that knowledge arises from active adaptation of people to their
environment. Dewey did not believe that scientists passively view the world and describes how thought leads to action (or hypothesis) which leads to more observation plus action, and so on. Dewey’s view of knowledge generation and his philosophy of learning are an “interactive naturalism” with emphasis on the interactive relationships between human beings and the environment in which they live (Sharpe, Simon, & Levine, 1991).

There is a long history of pragmatic thinking in an educational context. William James, a Pragmatist and the father of American Psychology, shaped our current understanding of the purpose for education, the role of the teacher, and the pluralistic nature of learning (Pajares, 2003). John Dewey’s educational works posited knowing as a way of doing in that knowledge is obtained through experience (Biesta, 2015). The works of both James and Dewey postulate a connection between knowledge generation and the process of learning, providing a paradigmatic lens that is fit for both research into and practice of the design of higher education environments. As higher education facilities have become more complex to serve a variety of student and campus needs, a framework that organizes the factors that contribute to the overall experience of these places for college students should capture the dynamic nature between people and place. With a pragmatic lens, this framework is grounded in the real-world context of where college students live, work, and learn.

**Social Cognitive Theory in Higher Education**

Social cognitive theory (SCT) is an agentic theory of motivation developed by Albert Bandura (1986) that theorizes the development of different human capabilities and rejects the study of motivation from a one-sided determinism (Bandura, 1989a). This theoretical model was developed to organize Bandura’s notion of a triadic reciprocal causation of personal factors, environmental influences, and behavioral outcomes on human development (see Figure 2.2).
Personal factors refer to student level constructs such as feelings, thoughts, actions, and identity. Environmental influences refer to external factors such as teachers, institutions, and socio-cultural constructs. Behavioral outcomes refer to actions the student takes such as academic performance, interactions, and activities. Bandura’s early works were concerned with identifying patterns of behaviors and how they are continually regulated by the self and other external influences.

Bandura (1971) theorized that learning happens from direct experience, through modeling, and by regulatory processes. The concept of reciprocal influence between personal, environment, and action systems is at the heart of social cognitive theory and what set this theory apart from dominant thought at the time. SCT was developed as a rejection of Behaviorism which suggested that human action could be minimized to understanding stimulus (reward or consequence) and response (action). Bandura (1971) theorized that human development can be understood through the interdependence of contextual factors, relationships, and self-regulatory processes (Bandura, 1971).

**Figure 2.2**  
*Bandura’s (1986) Social Cognitive Theory*
Personal Factors and Behavioral Outcomes. The relationship between personal factors and behavioral outcomes describe how students’ expectations, beliefs, and feelings shape their actions and behaviors. In turn, past actions and experiences influence how they feel, think, and believe. Our behaviors are determined by both our capabilities and what we think we are capable of in an educational context (Bandura, 1997). A large body of research has investigated this two-way relationship and has found that student self-beliefs tend to predict how a student performs in an academic setting. In academic settings, personal factors such as belonging, are related to how students engage (Osterman, 2000).

Behavioral Outcomes and Environmental Influences. The next two-way segment describes the reciprocal relationship between behavioral outcomes and environmental influences. This means that peoples’ actions shape the environment while the environment shapes their behavior. “People are both products and producers of their environment” (Bandura, 1989a, p. 4). The environment primarily refers to socio-cultural conditions and relationships under this theoretical lens. For example, in a higher education setting, students may change their behavior when certain others, such as their professors, are present. This change in behavior then influences that social environmental context.

Environmental Influences and Personal Factors. The last two-way segment in the triadic model, personal factors and environmental influences, describe how the social environment may respond to personal observable characteristics (e.g. race, gender, age), along with how these social environmental influences may affect the way people feel, think, and believe (Bandura, 1989a). This notion of triadic reciprocal determinism asserts an ongoing feedback loop that directs human motivation. What individuals think they are capable of and their actual capabilities are products of the integrated nature of the environment and what they
have done prior. The social cognitive theoretical framework suggests that learners have a
different sense of their own capabilities within the environment that influence varying outcomes.

**Self-Efficacy.** A primary factor in social cognitive theory is self-efficacy. Perceived self-efficacy is the answer to the question, *can I do this?* Self-efficacy refers to an individual’s confidence in their ability to do a certain task. Due to the reciprocally determinant relationship between personal, environmental, and behavioral factors – self-efficacy is a personal capability belief that is found to contribute to action. More specifically, personal capability beliefs mediate the relationship between what is known and what is performed (Bandura, 1986). Perceived self-efficacy influences both the choice and the level of motivation a person has for a particular task (Bandura, 1997).

**Agency.** Self-efficacy is a mechanism within the “self-system” which enables individuals to *exercise a measure of control* over their thoughts, feelings, and behaviors (Pajares, 1996). This agentic perspective of human motivation is one of the clearest separations from its roots in Behaviorist theory. Several decades ago, B.F. Skinner (1938) developed the theory of operant conditioning that emphasized a stimulus-response relationship for human motivation. Behaviorist theory was primarily concerned with objective observable behaviors because human thought and emotion could not be objectively measured (Watson, 1913). This dominant view of psychology, for the majority of the twentieth century, did not take into account the capacity to control one’s thought, motivation, or action. Agency is integral to the social cognitive theoretical framework because, “persons are neither autonomous agents nor simply mechanical conveyors of animating environmental influences. Rather, they make causal contribution to their own motivation and action within a system of triadic reciprocal causation” (Bandura, 1989b, p. 1175). This agentic perspective of human motivation could provide a more in depth understanding of how informal
learning environments support college students by acknowledging the sense of control students have over their learning spaces.

Even though environmental influences encompass one of three major tenets of SCT, the physical environment has rarely been considered under this theoretical lens. For a more transdisciplinary and holistic understanding of the reciprocally determinant relationship between people and places, research into student motivation should be expanded to not only be inclusive of, but also emphasize the physical environment as a major concern. Proshansky (1974) stated, “no corpus of knowledge about human behavior and experience can be complete or fully meaningful without the inclusion of concepts and principles relevant to the influence of physical settings regardless of how much or how little they contribute to the variance in such behavior and experience” (p. 541). Human existence is always situated in a physical setting and designed educational environments have been shown to shape behavior and influence student attention/distraction, learning outcomes, and mood (Gifford, 2007).

**Theoretical Perspectives in Environment-Behavior Studies**

Environment-behavior studies span a vast number of disciplines, such as environmental psychology, social ecology, sociology, anthropology, and human geography (Wapner, 1997), as well as design specific fields of architecture, landscape architecture, planning, and interior design. There is not an overarching explanatory theory of environment-behavior studies due to the historical and multidisciplinary nature of the field (Wener, 2008). Many theories and perspectives contribute to our understanding of the environment-behavior relationship, such as ecological psychology, ecological systems theory, and space syntax theory. While each of these overarching perspectives have contrasting emphasis and approaches to understanding the
relationship between environment and behavior, all have informed the organization of academic place as a conceptual framework.

**Ecological Psychology and Behavior Settings**

Ecological psychology is a theoretical perspective concerned with distinguishing between the knower and the known. This theoretical perspective enforces the idea that the physical nature of behavioral settings can predict and primarily influence the experiences humans have. William Mace (1977) summarized this theoretical perspective by stating, “ask not what’s inside your head, but what your head’s inside of” (p. 43). Human behavior is radically situated in environmental settings; human experiences cannot be separated from its context. In terms of ecological psychology, behavior settings are “characterized by specific place and time boundaries, and human and non-human components organized in such a way that regularly occurring activities can be carried out relatively smoothly” (Wicker, 2003, p.115). The focus of ecological psychology is concerned with understanding physical settings of environments to help predict the behavior that will occur in them.

The consideration of the physical environmental dimension to human behavior was the most notable contribution to psychology and design research from Barker and Wright (Bechtel, 2000). Roger Barker and Herbert Wright shared a common fundamental belief that the physical environment and behaviors that happen within that environment are mutually exclusive. This standpoint was rather radical during the 1960s, specifically because psychologists, like Skinner and Pavlov, had the shared fundamental understanding that behavior is only dictated from the mind. Barker was a student of Kurt Lewin whom developed Field Theory in the 1940s, which posits that behavior is a function of the environment and the individual (Lewin, 1951). Ecological psychology was a turning point in people-environment studies and a catalyst for the
understanding that the physical environment might be just as important to understand as the mind itself.

Ecological psychology was a divergent perspective in the mid-twentieth century because it challenged the lack of reality in the experimental laboratory setting, implying that research findings were not valid because context was not considered. The concept of behavior settings was established by documenting everyday life in a natural setting. “Behavior settings are organized activities with specified time and place boundaries” (Kirmeyer, 1979, p. 311).

Grounding environment-behavior studies within the real-world context underpins the academic place conceptual framework, to understand the relationship between students and supportive informal learning environments. When looking through the lens of ecological psychology, cognitive and emotional processes were only considered when they were manifested in overt behaviors.

**Theory of Affordances.** James Gibson’s (1979) approach to ecological psychology emphasized the perceptual nature of people within their environments. This theory posits that aspects of the physical environment send information to people and how people perceive those cues determine their behavior within that environment. This concept of ecological affordances describes the relationship between people and their physical environments as perceivable opportunities for action. The physical environment does not create affordances, rather the concept of affordances describes the relation between people and their physical environment. These perceptions of opportunity are an integral piece of academic place because affordances also speak to how different people may have different perceptions of the opportunities for action within an environment. For example, one student may see a lounge chair situated adjacent to a major circulation path as an excellent opportunity to relax between classes. On the other hand, a
A different student may perceive that same lounge chair as an opportunity to wait to meet up with a friend before they head to class. When looking through an academic place lens, the same physical component can afford many different behaviors. Differing student needs, values, and perceptions determine what that action will be. However, a common critique of Gibson’s theory of affordances is that this framing is quite narrow and situation specific, inhibiting research into larger systems that may make the relationship between people and their environments more complex.

**Ecological Systems Theory**

Around the same time Gibson was establishing his theory of affordances, Urie Bronfenbrenner established an ecology theory of human development. Ecological systems theory posits that humans are embedded within microsystems, mesosystems, exosystems, a macrosystem, and the chronosystem (Figure 2.3; Bronfenbrenner, 1979). This framework allows researchers to examine how individuals are nested within environmental systems. This framework facilitates research into the interconnectedness between people and the many layers of their environments. The *microsystem* is the direct environment of a person and the *mesosystem* is when two or more microsystems interact. For example, a college students’ residence hall and their classrooms are direct environments where they are actively apart, but when their parents come to visit campus and interact with their roommate, this constitutes a mesosystem. The *exosystem* refers to environments that are not directly related to, but still influence the student. An example of an exosystem is their parent’s workplace. The *macrosystem* refers to the cultural context that the other systems are embedded within and the *chronosystem* is the change of those systems over time.
**The Social Ecological Model.** A recent framework expanded on ecological systems theory to include the symbolic understanding of the environment, along with the nature of the material or physical. In other words, it is not just what can be objectively measured about the environment, but also the meaning people associate with the physical world that influences the transactive nature between individuals and their environments (Stokols, Lejano, & Hipp, 2013). Conducting research under this paradigm implies that 1) human environments are multidimensional structures, 2) multiple levels of analyses and methodologies are utilized, 3) people are jointly influenced by the multifaceted layers of the physical and socio-cultural environment, and 4) inquiries are transdisciplinary (Stokols et al., 2013). A social ecological approach is primarily concerned with the transactions between people and their surroundings, specifically the dynamic and embedded nature of individuals within contexts (Stokols, 2018a). Transactions are a result of both behavior and knowledge which require a transdisciplinary
approach to understanding complex problems in an increasing complex world. Transactions between people and their environments are not static but rather dynamic processes of adaptation (Stokols et al., 2013). Often, social ecological research is action oriented. The pursuit to understand these transactions across varying dimensions can allow for transformation and change within various communities and circumstances.

**Campus Ecology.** The campus ecology framework was developed to organize issues within higher education environments by providing specific context to issues on campus. This perspective brought a fresh approach to designing campus spaces as dominant thought in higher education that addresses campus concerns through investigating student centric issues. The early premise of this work is that issues that arise on a college campus were understood through student focused issues and did not consider the environment itself. Campus ecology was first developed by Strange and Banning in 1974 but regained momentum for campus planning efforts in the early 2000s. Campus ecology, as a concept, is frequently delivered as a course in graduate programs affiliated with higher education. Graduate students are trained to understand how college campuses can be studied through three components; organisms/inhabitants, settings/environments, and activities/behaviors. The purpose of this framework is to understand the relationships between people, the environment, and behavior in order to support goals of student growth and development (Banning, 2012).

Strange and Banning (2015) developed a campus design matrix after the culmination of three decades of research under this lens. This matrix addresses three questions; 1) what components are involved, 2) what is the impact of the design, and 3) what is the intended focus? The purpose of this matrix is to understand current conditions, but also informs the future design of spaces (Strange & Banning, 2015). This framework is extremely useful to understand the
collective influences that components of the environment have on purposes of the higher education institution, although there is not a sufficient framework for understanding how individual student differences should be considered in a campus ecological system. Because campus spaces set the tone for how students interact and engage (Clauson & McKnight, 2018), the meanings students associate with these spaces is often different (Qingjiu & Maliki, 2013). It is important to understand how student level differences influence the campus ecology design matrix. Academic place can expand on the campus ecology framework to provide an organizational structure that positions student personal factors just as influential as both the physical and social environments on behavior.

Towards Supportive Physical Learning Spaces

Universities are increasingly pressed to answer why higher education matters by demonstrating their effectiveness to policy makers, the government, and society (Upcraft, 2003). There is a plethora of evidence that suggests higher education promotes the public good and benefits the economy, but government funding has decreased over the past several decades (Mitchell, et al., 2019). The college experience fosters competencies tangential to the disciplinary knowledge that formal education provides, including student leadership, self-concept, independence, identity development, multiculturalism, moral reasoning, etc. (Mayhew, et al., 2016). While it is relatively clear how college provides space to nurture these qualities, it is important to further understand the meaning students associate with that environment through a transdisciplinary lens, in pursuit to heighten these positive outcomes. Supportive learning spaces should promote safety and inclusion, encourage participation and involvement, and build community (Strange & Banning, 2001).
**Making Meaning.** Similar to how our physical bodies are linked to our psychological identity, the overarching concept of *place* describes the identity of a physical space. Whether that physical space be a city, a house, or a college campus, *place* describes the cultural meaning that is associated with physical attributes, which is understood through peoples’ perceptions of that space. Furthermore, place on a college campus is connected to, and often an expression of, the institution’s mission (Kenney et al., 2005). The term academic place specifies the institutional context to the identity of the physical nature of a college campus. Academic place, as an agentic perspective on campus ecology, posits a framework that organizes the reciprocal and dynamic relationship between environmental qualities, environmental cues, personal factors, and transactions that occur within learning environments.

A fundamental aspect into the inquiry of people-environment relations is the disconnect between design intention and user experience (Rapoport, 1982). Academic place offers a framework to conceptualize the meaning that everyday users of environments associate with their learning spaces. Further, academic place can also be used to aid designers in understanding how designed environments influence the meaning students associate with their learning environment. “Meanings of spaces and places are not universally shared. Beyond knowing how to behave and what to expect from particular settings, environmental meaning includes symbolic and affective associations between the individual and various parts of the physical environment” (Proshansky, Fabian, & Kaminoff 1983, p. 67). This diversity in meaning, and the transactional nature between students and their learning environments is important to consider because it asserts that individual differences, and the control students have over their environments, plays an important role in this dynamic relationship.
Meaning associated with the physical environment has been measured through several related constructs. Place identity, place attachment, and sense of place are all psychological constructs that describe a person’s connection to a particular place. Place-identity describes the knowledge and feelings that people develop through experiencing spaces (Proshansky, et al., 1983). Place attachment describes the emotional bond between a person and a place (Low & Altman, 1992). On the other hand, sense of place describes how people relate to and feel about their environment (Nanzer, 2004). Conceptions of the physical world manifest themselves in cognition and help define everyday experience and behavioral outcomes (Proshanksky, et al., 1983). The development of the connection to place has been linked to community building and other aspects that shape the college experience outside of formal learning (Kenney et al., 2005). However, there is little understanding on how academic self-beliefs influence the meaning associated with students’ informal learning spaces on a college campus. This gap in knowledge can be addressed through a transdisciplinary framework.

**Academic Place as a Conceptual Framework**

The aim of the proposed academic place framework is to contribute to the understanding of the role of environmental qualities, personal factors, environmental cues, and behavior in order to create supportive informal learning spaces on college campuses. This framework has been conceptualized by integrating key concepts from social cognitive theory, the social ecological model, and campus ecology. Academic place pulls from the reciprocally determinant social cognitive model of causation in that each key subsystem; environmental qualities, personal factors, environmental cues, and behaviors reciprocally influences the other in pursuit of supportive informal learning spaces (see Figure 2.1). Further, this framework emphasizes the importance of student self-beliefs and agency over educational initiatives and environmental
conditions when investigating the influence of the environment on behavior (and vice versa). Academic place builds from the social ecological model by nesting key factors within each subsystem that can be operationalized to understand people-environment relationships. Campus ecology informs this framework by situating it within the ecological context of higher education that can be used to organize initial stages of the design process. Academic place is a framework for designers and planners, in addition to serving as a conceptual model to organize research about designed environments.

Figure 2.1
Proposed Academic Place Conceptual Framework

The following description of academic place uses the college union as an example of how this framework can be applied to the understanding of supportive informal learning spaces. College unions are an excellent precedent as they provide space for students to socialize, learn, collaborate, and relax. Further, the intentional student centric planning and cohesion with the
university’s mission, manifested in the design of space, and realized through the management of facilities provides an excellent model for how transdisciplinary efforts support college students.

**Personal Factors**

Stemming from social cognitive theory, the self-system is comprised of self-beliefs, student needs, identity, and agency. The nested nature of these layers within the subsystem is not hierarchical, rather an illustration of how different variables are nested within the self. Self-beliefs, individual needs, and identity are surrounded by agency, describing the locus of control students have over each component. By isolating these components of the self, we can understand how individual differences may influence the relationship with the environment and behaviors that occur. Within the context of informal learning spaces on a college campus, motivation to go to a space, such as a college union, could be largely dependent on whether or not that place meets student needs. Student needs differ, and whether those are met through organization efforts and facilities management (e.g. services offered, programs organized, hours of operation) or designed affordances (e.g. proximity to amenities, ambience, furniture and technology) they play into the decision making for the usefulness of informal learning spaces. In addition, decision making can be influenced by whether or not students see their own identity reflected within that space.

**Self-beliefs.** Self-beliefs are important to investigate for human-environment relations because “the beliefs individuals hold are excellent indicators of what people choose, what they perceive and experience, and ultimately what they do” (Usher, 2015). Constructs such as domain specific self-efficacy (confidence in ability), university belonging (connectedness to one’s institution), and pluralism (openness to diverse worldviews) are examples of self-belief variables that can be measured to understand how the self-system contributes to how students may interact
and engage within a learning environment. Investigating relationships between self-beliefs, environments, and ultimately behavior in those spaces could inform how to better support college students. Furthermore, student involvement at a college union is positively related to university belonging (Lang, 2020).

**Needs.** The student needs component of the self-system gives space to account for and understand differing personal, career, and academic needs. Students do not have the same expectations and needs for college because differing backgrounds, socioeconomic status, educational ambitions, etc. can influence how students expect college to help them meet their goals. For example, the college union provides a space to meet students’ economic (Willis, Maxwell, & DeSawal, 2020), social (Lang, 2020), and academic (Rullman, Schermer, & DeSawal, 2020) needs. Through an academic place framework, designers and researchers can recognize those needs and connect them to design intention to provide the proper tools for students to accomplish their goals.

**Identity.** The next component, identity, accounts for how differing backgrounds, demographics, orientations, religions, etc. represent the self-system. It is well established that students tend to engage in activities that are consistent with their identities (Reitzes & Burke, 1980). More recent research indicates that identity centrality is related to goal commitment, institutional commitment, and intention to persist (Bowman & Felix, 2017). Identity centrality asks the question, *who am I?* Intersecting identities, and the development of those while in college is a fundamental part of the development of college students. Students’ identities should be reflected in supportive learning spaces to create welcoming environments (Kirby et al., 2020).

**Agency.** Albert Bandura (2016) posits four properties of agency. The first being intentionality, the second is forethought, the third is self-reactiveness, and the fourth is self-
reflectiveness. This agentic perspective on campus ecology emphasizes how a student’s self-influence contributes to their own goals and outcomes (Bandura, 2016). This notion of agency also acknowledges how levels of control differ based on systemic societal structures and individual characteristics. An agentic perspective on student motivation influences how the relationship between people and their environments is understood due to the level of control people have over themselves, their environments, and the interaction between the two. Prior work illustrates how both individual agency and a designed environment work together to achieve shared goals and values in an academic setting (Alleman, Holly, & Costello, 2013).

**Environmental Qualities**

The environmental subsystem is an extension of the social ecological model, illustrating how components of the environment are nested within each other. Learning spaces have social, physical, and virtual environmental qualities that are situated within a socio-cultural context. Academic place organizes environmental qualities by situating the social layer encompassed by the physical layer which is nested within the virtual layer and all are confined by the socio-cultural assumptions of the specific context. This nested environmental subsystem describes how different aspects of the environment are interrelated.

The physical nature of a college union can dictate where the body goes (functional), what the body senses (bioclimatic), and the distinct style of the informal learning space (aesthetic). If a student meets up with a friend at her college union, the social dynamic of their relationship is bounded by the physical nature of that space. Further, if that student then engages in a video chat with her family that is at home, her family can experience the physicality of the college union, even though the family’s physical layer is their house and are experiencing her college union virtually. There are socio-cultural assumptions that determine if that behavior is appropriate.
within that space and what is expected of her. By investigating the environmental qualities of the places in which we occupy, we can gain a better understanding of how different layers of the environment interact and influence human behavior and motivation.

**Social.** The social layer of the environment subsystem refers to students’ relationships with others. Building from social cognitive theory, the social environment includes social modeling, social persuasion, social practices, and instruction (Bandura, 1989). Academic environments on a college campus are inherently social spaces, therefore it is important to consider the social nature of these places when organizing concepts related to creating supportive learning environments for college students. Building community at a place like the college union has been widely studied in recent years (e.g., Johnson, 2017, Maxwell, 2016, Smyth, 2016, Harrington, 2014) and demonstrates how social aspects of the environment are instrumental in creating supportive informal learning spaces.

**Physical.** The physical layer of the environment subsystem refers to the architecture, furniture, and other physical components that construct the physical learning space and is comprised of three dimensions. Both, Heitor, and Medeiros (2013) operationalize the bioclimatic dimension as light conditions, acoustics, air quality, and temperature/humidity; the functional dimension as usability, accessibility, and flexibility; the aesthetic dimension as space complexity, visual richness, architectural language, physical appearance, color, materials, and textures. There is overlap between each dimension and all three dimensions should be accounted for when designing interior environments. This provides a robust framework for research inquiry and findings that utilize this understanding of the physical layer can be easily translated into the design process. McLane & Kozinets (2019) found that spatial characteristics such as proximity to main entrance, configuration, visual accessibility, flexibility of furniture, views to the outside,
and visual aesthetics contribute to the formation of place-attachment for college students at student life centers. In addition, Both et al., 2013 found that spatial design support enables flows of information, communication, and knowledge demonstrating the importance of the physicality of supportive learning environments.

**Virtual.** With relatively recent technological advancements, it is important to consider the virtual layer when evaluating the environmental qualities of interior environments. Place based experiences are rarely “unplugged” and cyber technologies have the potential to change the way a user experiences an interior space (Stokols, 2018b). In addition, the virtual layer has blurred the boundaries between work and home. Due to the rise in cyber technologies, and more recently the COVID-19 pandemic, college courses are no longer confined to access in a geographical sense. “Across many different realms of everyday life, indoor environments have become increasingly polyfunctional, as their boundaries have been rendered more permeable and fluid by cyber technologies” (Stokols, 2018b, p. 33).

**Socio-Cultural.** The socio-cultural layer refers to the social ecological model’s conception of the social environment. According to Stokols (1995), this aspect of the environment refers to culture, economics, and political concerns that systemically shape all other conceptions of the environment. The recognition of the role societal norms and values plays in the formation of place is crucial to understand the context to create supportive learning environments. As student populations become more diverse, it is critical that the college union promotes inclusion for all (Banks, Hammond, & Hernandez, 2014). Spaces that are specific to marginalized groups do more than just create gathering spaces for underrepresented groups. The political and cultural meaning those spaces holds for students contribute to the socio-cultural assumptions of that institution (Kirby, et al., 2020).
Environmental Cues

The next subsystem within academic place describes the nonverbal messaging communicated by the environment to students. Both social and physical aspects of the learning environment inform students on opportunities for action within that space. Within the proposed framework, the interaction between personal factors and environmental qualities are reciprocally determinant and inform how students perceive the learning environment. Environmental cues can be conceptualized as the perception of affordances, or perceived opportunities for action (Gibson, 1979). Personal factors and environmental qualities together determine what is afforded to the individual. In addition, notions of co-presence and movement offer social cues to individuals about what sort of activities should happen within particular spaces. These connections between people situated in physical environments and opportunities for action is also informed by space syntax theory (Hillier & Hanson, 1984) and isovists theory (Benedikt, 1979) which discuss the interplay between accessibility, visibility, and human behavior.

Transactions and Behaviors

The last subsystem organizes the relationship between transactions and behaviors that occur within informal learning spaces in relation to personal factors, environmental qualities, and environmental cues. Environmental cues ultimately determine what the transaction is within that learning environment. This mechanism provides a continuous feedback loop because as people learn what their environments afford them, it also determines future transactions and behaviors within that space or a similar space. Further, these behavioral patterns then reciprocally determine the environment and personal subsystems. Within this framework, behaviors are conceptualized as interactions and patterns of use. “Behavior can be considered to be a goal-directed attempt by an organism to satisfy needs that are perceived and cognitively organized”
(Lang et al., 1974). Understanding student behavior in learning spaces allows designers and researchers to make connections between the reciprocally determinate variables within the system in order to create supportive learning spaces.

**Conclusion**

Higher education spaces, specifically multi-use informal learning spaces, such as college unions, libraries, and learning commons, facilitate fundamental activities that contribute to the overall college experience. The success of informal learning spaces on a higher education campus is dependent on the design, management, and alignment with the academic mission of the institution (DeSawal, Hammond, & Barrett, 2020) which demonstrates the pragmatic and contextual underpinnings of the academic place framework proposed by this study. Informed through a thorough review of the literature from multiple disciplines, this conceptual framework adapts the major tenets of social cognitive theory, the social ecological model, and campus ecology to organize how supportive informal learning environments can be sustained for college students. Academic place provides a transdisciplinary model that accounts for the dynamic and contextual nature of higher education facilities. Table 2.1 lists the major components of academic place and provides example potential indicators that could be used to operationalize each component. Academic place can be a powerful framework that brings together the fields of educational psychology, environmental psychology, higher education, and architecture.
Table 2.1
Summary of Academic Place Components and Examples of Potential Indicators

<table>
<thead>
<tr>
<th>Academic Place Subsystem</th>
<th>Example Potential Indicator(s)</th>
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<tr>
<td>Environmental Qualities</td>
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<tr>
<td>Social</td>
<td>Quality of Interactions with Others</td>
</tr>
<tr>
<td>Physical</td>
<td>Spatial Configuration, Air Quality, Furniture Layout</td>
</tr>
<tr>
<td>Virtual</td>
<td>Social Media Usage, Video Call Platform</td>
</tr>
<tr>
<td>Socio-Cultural</td>
<td>Politics, Societal Norms</td>
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<tr>
<td>Personal Factors</td>
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<tr>
<td>Self-Beliefs</td>
<td>Self-efficacy, Belonging</td>
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<tr>
<td>Needs</td>
<td>Financial, Connectedness</td>
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<tr>
<td>Identity</td>
<td>Gender, Sexuality, Race</td>
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<tr>
<td>Agency</td>
<td>Empowerment</td>
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<tr>
<td>Environmental Cues</td>
<td>Perceptions of Privacy, Perceptions of Safety</td>
</tr>
<tr>
<td>Transactions and Behaviors</td>
<td>Interactions, Patterns of Behavior</td>
</tr>
</tbody>
</table>

Academic place is a conceptual framework that should be utilized by designers, educators, and researchers to create supportive learning environments. The usage of this framework can help design practitioners plan projects that consider how each design decision may help or hinder the design of supportive learning spaces by acknowledging and accounting for diverse student needs, identities, and self-beliefs. Educators could also use this framework to utilize the physical environment as a tool to help meet academic outcomes. Design researchers could employ this framework to explore and explain relationships between students and learning spaces in order to expand the knowledge base that is concerned with the intersection between person and place. Lastly, educational researchers could utilize this academic place framework to further expand the breadth of knowledge on student learning and motivation in order to understand how the design of physical environments plays a role in college students’ personal and academic development.
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CHAPTER 3: Article 2

Making Use of the Spaces In-Between: The College Union as a Place for Informal Learning

Abstract

Informal learning is both an activity (Rogoff, et al., 2016) and a space typology (Morieson, et al., 2018). Prior research on informal learning spaces in higher education is within the context of the academic library (Walton & Matthews, 2018) and less is known about the relationship between the spatial properties of college unions and informal learning related behaviors of undergraduate students. This research study addresses this gap by investigating how gathering spaces within two college unions are utilized for informal learning related activities and how the spatial properties of each gathering space are related to usage patterns in order to explore how the design of college unions may support informal learning. Six gathering spaces of high, mid, and low levels of connectivity were purposefully selected for systematic behavior observations at Talley Student Union (TSU) at North Carolina State University and Gatton Student Center (GSC) at the University of Kentucky. Distribution of informal learning related activities are presented and investigated by time of day. Patterns reveal fewer stationary activities occur in gathering spaces when frequency of movement is higher. There were no differences in face to face interactions based on connectivity levels at TSU, however frequency of interactions decreased as connectivity level decreased at GSC. Reading was the most common informal learning related behavior observed at TSU whereas talking was at GSC. Dining behaviors are likely driven by adjacency to retail dining and talking behaviors favored highly integrated spaces in both college unions. Similar patterns in global and local spatial properties are observed in terms of usage patterns at TSU but this was not the case at GSC. Design implications are discussed.
Introduction

What constitutes the college experience is a persisting topic of discussion as higher education administrators face difficult decisions on how to adjust operations to safe practices for COVID-19, while maintaining some sense of normalcy and fiscal sustainability (Blankenberger & Williams, 2020; Friga, 2020; Hartocollis, 2020). The conversation has primarily focused on comparing physical distancing face-to-face (F2F) conditions versus virtual formats of instruction (Durden, 2020). On average, a traditional college student with a full-time course load is in a formal learning setting at least 12 hours per week and they are expected to spend two to three times that outside of class on coursework. While participating in formal instruction is an important component of an academic success, student directed modes of learning in informal campus facilities, such as college unions, are also critical for academic success (Cox, 2017) and have shown to extend into workplace preparedness (Taylor, Beltramini, & King, 2017). The focus of the current study is to investigate how students use two college unions in regard to informal learning, and to investigate patterns of spatial properties in relation to usage patterns.

Through environmental psychology literature, it is clear that the physical learning environment can guide psychological processes (Maxwell & Evans, 2002; Evans, 1995; Lang, et al., 1974) and behavioral patterns are linked to spatial characteristics (Hillier & Hanson, 1984; Wineman & Peponis, 2010). The built environment influences perceptions and behaviors in education settings (Marchand et al., 2014; Maxwell, 2010; Weinstein, 1979). Hence, investigating how spatial accessibility influences informal learning related behaviors can enable designers and planners to create spaces that enhance the student experience. Furthermore, the concept of space is physical, mental, and social (Lefebvre, 1991). This research situates itself
with the premise that the purpose of architecture is to 1) provide material objects to shelter users, 2) represent social order, and 3) be tools and products of individual thought (McLane, 2013).

Scholars have investigated how the built environment influences learning and teaching in a variety of settings, contexts, and disciplines. The focus of this study is to explore how people use gathering spaces in two college unions and to what degree spatial properties influence patterns of use. College unions have evolved to be places that house a variety of programmatic activities, including student services administration offices, student organization spaces, along with a wide variety of dining and retail spaces (CAS, 2019). Furthermore, incorporating the space typology of informal learning space has become a priority for campus planners as these spaces have demonstrated to be crucial places for undergraduates to socialize, study, collaborate, and relax (Walton & Matthews, 2018). Toward this end, we first review the existing body of literature related to informal learning from both environmental psychology and design research traditions as well as highlight spatial analytical methods; space syntax and isovists analysis. Research questions are then presented and a rich description of the two cases investigated and methodology is described. Lastly, findings of the comparative case study are reported through discussions of the observed relationships between college union spatial planning, behaviors, and ultimately, informal learning in university college unions.

**Informal Learning Spaces**

Informal learning environments encompass a broad set of behaviors, structures, and spaces, both physical and virtual. On the other hand, it is relatively straightforward to categorize formal learning environments across disciplines. Typically, there is a curriculum, lesson plan, instructor, and designated space with reoccurring meetings at similar times (Brooks, 2011). In contrast, informal learning environments are often controlled by the learner and house a variety
of behaviors. An informal learning environment could be a science museum, a public library, or even passive learning that happens when exposed to new information (e.g., podcasts, news) in a variety of contexts. This study utilizes the definition of informal learning spaces on a college campus as defined by Harrop & Turpin (2013), “non-discipline specific spaces frequented by both staff and students for self-directed learning activities” (p. 59).

In recent years, informal learning spaces have been intentionally programmed into campus planning efforts as administrators recognize the importance of the spaces in between residence halls and classrooms buildings (Jamiesolitybin, 2009). On a college campus, informal learning spaces are libraries, meeting rooms, lounge areas, student commons, etc. where students tend to gather to socialize, study, relax, and collaborate with their peers. Often times, these spaces will have a wide variety of flexible furniture, WIFI connection, and electric outlets. Students may use these spaces to spend a few minutes catching up on email or even an entire afternoon writing a research paper. As technology has advanced and work from anywhere is more accessible, universities are responding to this need by providing spaces to not only recruit incoming students, but also for retention and timely graduation purposes.

**Informal Learning related Behaviors.** Informal learning spaces on a college campus organize a variety of activities and behaviors to meet student needs. Students need a place outside of class to study or collaborate with their peers while utilizing a variety of technology. Activities associated with informal learning need not be academic in nature and social aspects of college enhance learning and skill development (Pascarella & Terenzini, 2005). For example, restoration behaviors (e.g., leisure, meditation) are also considered as expected student behaviors that take place within informal learning environments. Essentially, informal learning
environments must provide space for students to socialize, relax, collaborate, and study and all of these activities contribute to the overall college experience (Jamieson, 2009).

**The College Union as Architecture to Support Student Needs**

Student union, student center, academic life building, etc. are all terms to describe a similar building typology that provides services, amenities, and spaces primarily for student use on a college campus. For the purposes of this study, *college union* is used as the operational term for these buildings as described by ACUI (2020), “traditionally considered the living room, the college union enhances the student experience and cultivates an enduring connection to the institution” (para. 3). College unions are distinctive from other buildings on a typical American college campus because the student-centered focus is at the core of their mission which influences not only services and amenities provided, but also to facilities and operational maintenance, while fostering a sense of connectedness or belonging to the overall institution.

The college union is a place on a college campus that is designed to support informal learning. The college union is an exemplary building typology due to the heightened emphasis on matching spatial design to organizational purpose. Through many precedents, it is clear how matching institutional priorities to the design of the physical environment through intentional spatial programming leads to constructive post occupancy outcomes of college unions. Past research that has investigated the intersection between physical space and student outcomes within the college union has primarily been centered around the creation of a community (Camputaro, 2017; Maxwell, 2016; Rullman & Harrington, 2014). However, there is a need to understand how the design of the physical space in a college union not only creates community, but also encourages a sense of belonging, promotes diversity and inclusion, and supports learning outcomes (DeSawal & Yakaboski, 2014). The focus of this study is to expand this
knowledge base by exploring how the college union supports informal learning, particularly for undergraduate students.

**A Place for Community**

As community is an indicator of student success, and the college union is a place to foster community through physical space (Maxwell, 2016), it is important to understand how social informal modes of learning are influenced by the spatial properties of college unions. Prior research has revealed that college unions are a critical place on a college campus to foster community among students. Maxwell (2016) conducted a qualitative case study on the planning process and post occupancy of a college union renovation in the southwest United States. As a result, two themes - sense of place and gathering space, emerged. For participants that were involved in the design planning process, they emphasized connecting the built environment to something larger than themselves and this manifested in a place that fosters belonging for all that were part of that community. Gathering spaces, were also created for students to gather and connect. In this study, Maxwell (2016) observed that students were primarily in social groups, while they were using these gathering spaces within the college union. This observation revealed that gathering spaces created an “intersection of physical space where activities occur and where relationships are fostered” (p. 97).

Another recent study conducted by Camputaro (2017) also investigated how the college union develops students’ sense of community through photo-elicitation methods and interviews. This study explored the intersection between the organizational and physical environments of the college union to develop a sense of community in college students. Results indicate that a home-like feeling, encouraged interactions through design, lasting memories, and a student-centered culture at the college union shaped students’ sense of community to their institution. There is an
abundance of information on how the role of the college union (as an organization) should foster community and these two studies are particularly novel because they investigated how the physical nature of the college union fosters community. The college union is primarily a place for students because “the intention developed around the construction of a college union facility may contain services, support, programs, and offices designed to mitigate feelings of isolation and enhance feelings of belonging” (Rullman & Harrington, 2014, p. 44). At the very core of these facilities is to cultivate a sense of belonging to the larger institution as a whole. The current study aims to add to this knowledge base by investigating not only how students use college unions for informal learning, but also how the design of the physical space contributes to these behaviors.

Socialization Spaces for Informal Learning

Even if students are studying alone in a space like the college union, this act is inherently social as being present in a public space gives life to a college campus in the same way Jane Jacobs (1961) asserted this in urban public spaces. Similar to the concept of third place, college unions provide a place outside of the home and the formal classroom settings for students to interact and engage (Kuh, et al., 2010). Because the college union is an informal learning environment and its users elect to be there on their own volition (dissimilar to formal learning environments which are assigned), the inherent social nature of these spaces could inform our understanding of how the spaces are utilized. This study builds on this understanding of social learning spaces by investigating user behavior in conjunction with analytical measures of the physical environment.

Understanding how space is configured and perceived in educational environments is important for a number of reasons. Firstly, it can aid designers of these spaces in matching
design intention with design outcome. In addition, breaking space down into discrete units allows educational design researchers to understand what implications the design of learning environments has on learners. For example, Pasalar (2004) found that the layout of single-story school buildings was more likely to foster social interactions among middle school students than multi-floor buildings. In higher education settings, evidence suggests that the configuration and permeability of learning facilities influence students to unintentionally and involuntarily engage in learning activities (McLane, 2013). Furthermore, research into the layout of museum settings revealed that spatially guided movement is influenced by accessibility and visibility and these relationships are stronger the more visually coordinated and spatially grouped elements are (Wineman & Peponis, 2010).

The term gathering space is rooted in the historical purpose of the college union as the living room of the college campus. Furthermore, the prevalence of these gathering spaces is similar to a town square or plaza in that open space is provided in-between various amenities. Gathering spaces in college unions are intentionally designed to serve as a space between classrooms where students go to socialize, collaborate, study, or relax. Gathering spaces have been identified as third places on a college campus; a place between home and work that provides space to gather and interact that are often connected to one’s identity (Oldenburg, 1999). The primary intention of these spaces is to be easily accessible, promote social interaction and engagement, and meet student needs. Prior research has found gathering spaces to be fundamental in fostering activity and building community (Maxwell, 2016). The intent of this study is to capture those spaces in between classes, that students choose to go to on their own volition, for a variety of purposes that serve informal learning related behaviors.
Spatial Planning for Informal Learning in College Unions

College unions are more than just facilities and the design of the physical environment alone cannot describe the holistic influence of a place on learners’ experiences (Rullman & Harrington, 2014). Further, if buildings are classified by their purpose, rather than strictly spatial form, we must acknowledge that buildings should evolve as people do (Sailer, 2015). Architectural theory that adopts this mindset is found in both space syntax (Hillier & Hanson, 1984) and isovist (Benedikt, 1979) literature. Space syntax analysis is concerned with the study of the underlying structure or pattern of spatial connections whereas isovist analysis describes the perceptual nature of experiencing the physical world. Theory behind space syntax techniques posit that people use space to organize themselves, meaning that physical space is configured, and this configuration is a physical manifestation of societal functioning. “Social structure is inherently spatial and inversely that the configuration of inhabited space has a fundamentally social logic” (Bafna, 2003, p. 18). Isovist theory draws a distinction between the perception of objects and environments because environments have a “surrounding character” in that space is not empty, defined by visible surfaces, and people are immersed in the environment (Benedikt, 1979).

The application of space syntax to analyze spatial characteristics of interior architecture has gained momentum in recent years as there is an acknowledgment of its predictability for occupant movement, spatial adjacencies, and linking to functional outcomes such as productivity, social engagement, and collaboration. As buildings become more complex, some argue that the use of analytic tools could provide a better understanding of how space functions and thus, how spatial characteristics influence the overall experience of a place. While space syntax methods have revealed connections between spatial form and educational outcomes in a
variety of contexts, there is a dearth of understanding within learning environments literature in comparison to healthcare and workplace facilities. This study is concerned with two concepts of spatial characteristics, accessibility and visibility. Accessibility describes how space is configured while visibility describes what can be seen from a particular vantage point.

**Accessibility.** Accessible spaces are defined by their level of depth compared to other spaces in the system (Klarqvist, 1993). Space syntax representations of accessibility, specifically the axial line map, represents where people can move through space by creating topological maps of convex spaces (e.g., rooms, corridors, streets, etc.). Understanding the potential for movement through space, specifically spaces that are relatively open and public like gathering spaces in college unions, uncovers structural patterns of spatial layout by analyzing how isolated or accessible informal learning spaces may be within the larger building. A highly connected and integrated space privileges more movement than those that are not (Hillier et al., 1993) and this increased level of movement allows for more social exposure to undergraduate students, therefore indicating a critical space for informal learning related behaviors. “The more a space is integrated, the greater the chances that it will be more densely occupied by moving people” (Peponis, Ross, & Rashid, 1997, p. 344). On the other hand, spaces that are more isolated imply lower noise levels and less foot traffic, which some students may seek out to engage in more focused or head’s down work. The integration core of each building is understood as the top 10% integration values and the lowest 25% integration values indicate the most isolated (Hillier & Hanson, 1984).

Accessibility is often measured through integration. The global measure of integration is the notion of depth as topological distance that describes how many axial lines are connected to every single line in the system. Whereas integration radius 3 is a localized measure of
accessibility in that it considers connections to other axial lines in any direction that are a maximum of three steps away from an origin axial line. Details on how integration is calculated can be found in Appendix A. Integration is a useful measure for how a spatial location is positioned when considering the overall building whereas the integration radius 3 describes its immediate surroundings that has implications for localized user experience. Previous research has shown that people unfamiliar with a space rely on local perceptions of accessibility but as they learn a setting the global understanding is more predictive of user movement (Haq & Zimring, 2003). Furthermore, connectivity is a static local measure that describes the number of immediate neighbors that are directly connected to a space (Klarqvist, 1993). This local measure describes how many spaces are directly accessible from a particular space of interest.

**Visibility.** As accessibility describes where people can move in space, visibility is concerned with what people can see. This visual information, that a given bounded and configured space allows a situated observer, is a pre-condition for social interaction (Giddens, 1984). What people can see when they are in space is related to how people behave, therefore it is important to understand how visual information informs learner behavior, and how learner behavior informs visual information. An isovist refers to “a body of space visible to and from a point” (Benedikt, 2020, p. 66). As people move through space, they see differing isovists. Isovists remain constant while people’s position in the world changes. Co-presence refers to how visible other people are from a path (Rashid, et al., 2006) which is determined by the isovist field they are within. The connection between architecture form, learner behavior, and social interactions informs how students may experience a space due to what they can see.

Visibility is often measured as *area* which is a local isovists measure. Area measures how much space can be seen from a particular point in an interior environment that is determined by
spatial form (Benedikt, 1979). Visual barriers define the difference between open and closed space (Dara-Abrams, 2006). In addition, it is not just how much space can be seen, but what is seen from a given vantage point. Details on how visibility is calculated can be found in Appendix A. Area is a useful localized measure that analytically describes how much space is visible to a student when they are located in a particular space. This measure is useful for this study because it allows us to quantify how open a gathering space may be and is connected to multiple factors relevant to college union space use such as safety (Kellom & Nubani, 2018), co-presence (Doxa, 2001), and environmental stressors (Knöll, et al., 2015).

The Current Study

This study contributes to the understanding of human-environment relations by examining the relationships between spatial properties (i.e., connectivity, integration, isovists area) and informal learning related behaviors (i.e., reading, writing, dining, relaxing, talking), movement, as well as interaction. Academic place, a framework that is an agentic perspective on campus ecology, provides the conceptual framing for this study. An agentic perspective on campus ecology posits that individuals have control over their thoughts, feelings, and actions (i.e. agency) within the socio-ecological context that they are nested within. This conceptual framework synthesizes social cognitive theory (SCT) developed by Albert Bandura (1989), the social ecological (SE) model refined by Stokols (1995) with roots in ecological systems theory (Bronfenbrenner, 1979), and campus ecology (Strange & Banning, 2001) which is a systems approach specific to the organizational context of higher education facilities, operation, and management. The utility of this synthesis lies within the notion that architecture on a college campus must respond to both the individual (student) motivation and the social system it spatially organizes. The focus of this study is to investigate the relationship between the physical
nature of the environment and behaviors associated with informal learning. This relationship is reciprocally determinant meaning that it is not just the environment that shapes behavior, but behavior also shapes the environment (see Figure 3.1).

**Figure 3.1**
*Conceptual Framework Organizing Reciprocal Relationship between Environment and Behavior*

For college students, a large portion of their academic journey is situated outside of a formal classroom setting. As learning occurs in a variety of contexts for college students (in the home, a café, the formal classroom space) it is important to understand how undergraduate students use these spaces, and how the design of the physical environment supports those behaviors. Informal learning spaces provide a physical environment between the home and the
formal classroom for learning to occur. The inherent social nature of these spaces is the focus of this study because the college union provides a physical environment that manifests institutional values through the design of the built environment while providing a place to meet student needs. “Campus structures, styles, and patterns have often served as visible manifestations of deeper institutional beliefs or as signals of future institutional directions” (Peterson & Spencer, p. 10, 1990). The purpose of this study is to understand how patterns of behavior within gathering spaces at two college unions compare and how spatial properties of two college unions relate to informal learning related behaviors of undergraduate students. Three primary research questions (RQ) guided this study:

RQ1: What usage patterns (informal learning related behaviors, movement, interactions) are observed at two college unions?

RQ2a: What is the relationship between stationary behaviors, movement, and interaction?

RQ2b: Are there differences in behavior, movement, and interaction by local accessibility, as measured by connectivity?

RQ3: Do stationary informal learning related behavior groups differ according to accessibility (as measured by global and local integration) and visibility (as measured by area) properties of gathering spaces?

**Methodology**

**Research Design**

A causal-comparative case study research design was used to address the three research questions. Two buildings were selected and analyzed during Fall 2019: Talley Student Union (TSU) at North Carolina State University (NC State) and Gatton Student Center (GSC) at the University of Kentucky (UK). These buildings were chosen due to similar student demographics.
at each institution, operational and facilities management, and recent renovation plus expansion completion. In addition to these similarities, interior spatial arrangements of the two college unions are distinct from each other which provides insight into how accessibility may influence informal learning related behaviors within gathering spaces. The purpose of this causal-comparative case study research design is to analyze and synthesize differences, similarities, and patterns of behavior between three levels of connectivity gathering spaces at two college unions to better understand how the college union supports informal learning.

**Talley Student Union, North Carolina State University**

Talley Student Union was originally built in 1972 and a $120 million renovation plus expansion was completed in 2015. This building is 283,000 total square feet, on NC State’s central campus, and is five stories with a central atrium that visually connect floors 2-5 (see Figure 3.2.1). There is no formal classroom space in this building but houses three of the university’s campus community centers - Multicultural Student Affairs; the Gay, Lesbian, Bisexual and Transgender Center; and the Women’s Center (see Figure 3.2.2 for spatial distribution of the functional program). Total square feet allocation by primary space type is presented in Table 3.1 and illustrates the student focused nature of this facility. The overall layout of the building is radial in nature such that each wing of the building spirals from the central atrium. All major circulation paths in this building double as gathering spaces in that there is a plethora of both flexible and permanent seating components, primarily in social groupings. In addition, those major circulation paths that double as gathering spaces are the most central and linked areas which is accessible by students, while the service-oriented spaces are isolated areas and not accessible to students.
Figure 3.2.1
Talley Student Union Central Atrium
Figure 3.2.2
Talley Student Union Functional Program Map by Floor
**Gatton Student Center, University of Kentucky**

The Gatton Student Center $201 million renovation and expansion was completed in 2018, connecting two historical buildings on UK’s campus; the original UK student center built in 1938 and alumni gym built in 1924. This building has a linear layout and expands several blocks at 378,000 total square feet on UK’s north campus. A central social stair accessibly connects the first floor to the second floor but the terraced nature of the atrium interrupts visibility from one floor to the next (see Figure 3.3.1). The first floor of the building is typically accessed from the south side of the building and this space is primarily allocated to dining facilities, administrative offices, and a fitness center. The fitness center vertically extends into the second floor of the building where student organization offices, banquet halls, and the bookstore are also located. Space on the third floor of GSC is allocated to a formal ballroom, cinema, and meeting rooms. Similar to TSU, there is no formal classroom space in GSC, and the Martin Luther King Center is located at the heart of this building (see Figure 3.3.2 for spatial distribution of the functional program). However, the major circulation paths are traditionally corridor in nature and do not offer a variety of seating along the circulation paths. The most accessible spaces are major circulation paths that run east to west in plan view and do not double as gathering spaces. However, the most accessible spaces are not entirely accessible to students as a service corridor on the first floor connects the most spaces but requires keyed access.
Figure 3.3.1
*Gatton Student Center Social Stair*
Figure 3.3.2
Gatton Student Center Functional Program Map by Floor
Table 3.1
Space Type and Square Footage Allocation of Talley Student Union and Gatton Student Center

<table>
<thead>
<tr>
<th>Space Type</th>
<th>Approximate Square Feet</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>TSU</td>
</tr>
<tr>
<td>Food Service</td>
<td>42,390</td>
</tr>
<tr>
<td>Ballroom Facilities</td>
<td>15,471</td>
</tr>
<tr>
<td>Conference/Meeting Rooms</td>
<td>14,265</td>
</tr>
<tr>
<td>Bookstore</td>
<td>41,814</td>
</tr>
<tr>
<td>Campus Recreation</td>
<td>0</td>
</tr>
<tr>
<td>Theater/Auditorium</td>
<td>23,813</td>
</tr>
<tr>
<td>Recreation/Entertainment</td>
<td>109</td>
</tr>
<tr>
<td>Lounge Space</td>
<td>18,800</td>
</tr>
<tr>
<td>Academic</td>
<td>0</td>
</tr>
<tr>
<td>Student Organizations</td>
<td>12,591</td>
</tr>
<tr>
<td>Administrative</td>
<td>8,684</td>
</tr>
<tr>
<td>Retail Space and Campus Community Centers</td>
<td>10,329</td>
</tr>
<tr>
<td>Special/Miscellaneous</td>
<td>10,536</td>
</tr>
<tr>
<td>Total</td>
<td>198,802</td>
</tr>
</tbody>
</table>

*Note. Talley Student Union (TSU), Gatton Student Center (GSC)*

Procedures

First, spaces within each college union were identified by establishing a site criterion and connectivity parameters through axial line analysis. This study focused on gathering spaces, or the spaces in-between, that are publicly accessible to students and offer a variety of furniture to accommodate informal learning. Once the observation sites were identified, accurate furniture locations were mapped onto each gathering space to ensure accuracy of physical components in the observation locations. Next, 100 total hours of field observations at six gathering space site locations in each building were conducted over the course of two weeks (one per building) in the Fall of 2019 by the primary investigator and research assistants. An observation protocol was
developed, research assistants were trained, and protocol was strictly followed to maintain internal consistency (reliability) and validity.

**Observation Site Location and Space Sampling**

As both cases, TSU and GSC, have a plethora of gathering spaces, it was important to define and systematically select spaces for observation that provided variation in the main spatial characteristic of interest (e.g., connectivity) and a representation of the overall building plan. To establish which floors of each building would be considered for behavioral observations, each floor was first surveyed for (1) the presence of informal (unassigned) space, (2) that is openly accessible to the public, and (3) offers a variety of furniture. These three criteria define gathering space in the college union for the purposes of this study. TSU floors 2, 3, 4, and 5 and GSC floors 1 and 2 meet this criterion (see Table 3.2 for matrix) and therefore are considered in the next phase to establish which gathering spaces would be observed.

**Table 3.2**

*Gathering Space Criterion Matrix*

<table>
<thead>
<tr>
<th>Gathering Space Criterion</th>
<th>Floors</th>
<th>TSU</th>
<th>GSC</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>Informal Space</td>
<td>-</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>Open Access</td>
<td>-</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>Variety of Furniture</td>
<td>-</td>
<td>X</td>
<td>X</td>
</tr>
</tbody>
</table>

*Note.* Talley Student Union (TSU), Gatton Student Center (GSC)

**Thresholds of Connectivity.** Connectivity describes how many spaces are directly adjacent to a given gathering space (Hillier & Hanson, 1984). By sampling for thresholds of connectivity, a range of space adjacencies are accounted for. This measure of connectivity is
important when analyzing the interior of multiuse learning environments because it describes the spatial boundaries imposed on public gathering spaces that need to accommodate circulation, socializing, and spaces for focused learning (Capillé & Psarra, 2014). Two spaces of high, medium, and low connectivity values were identified and selected through axial line analysis using DepthmapX software. The range of connectivity values for all gathering spaces within TSU were 1-15 and 1-12 for GSC. Spaces that fell within high-, mid-, and low- tertiles of each range were determined and used for on-site observation (See: Table 3.3.1 for distribution of TSU connectivity values; Table 3.3.2 for distribution of GSC connectivity values; Figure 3.4.1 for gathering spaces that were observed at TSU; Figure 3.4.2 for gathering spaces observed at GSC; Appendix D for detailed floorplans of TSU; and Appendix E for detailed floorplans of GSC).

**Gathering Spaces at Talley Student Union**

**High Connectivity.** The two gathering spaces at TSU that are considered to have high connectivity were determined as TSU Location 3 and TSU Location 4. TSU Location 3 is located on the third floor and is located on the central atrium. Similarly, TSU Location 4 is on the fourth floor, just above the third location. In fact, there is an overhang from Location 4 down to Location 3, vertically connecting the two spaces. The furniture in these two spaces is quite similar in that there are high top tables for groups of four flanked along the glass partition that opens into the greater atrium. The main elevator and the central atrium stairwell are directly accessible to both of these spaces.

**Medium Connectivity.** TSU Location 2 is located on the second floor at the base of the central atrium and TSU Location 6 is on the top floor, adjacent to the central atrium. TSU Location 2 had a long lounge furniture piece, along with three large round tables with four chairs each. A coffee shop and the university bookstore are directly connected to TSU Location 2 and
several exterior entry points are in view from this area. On the other hand, TSU Location 6 is at
the very top of the atrium, situated between the fraternity and sorority life center and the
women’s center. The majority of furniture in TSU Location 6 is individual lounge seating, along
with one high top table with four chairs.

**Low Connectivity.** TSU Location 5 and TSU Location 1 are gathering spaces with low
connectivity values. Both of these locations are not adjacent to the central atrium, unlike the
other four gathering spaces observed in TSU. TSU Location 5 is located on the fourth floor at the
end of a long corridor, on the other side of banquet space. TSU Location 1 is adjacent to retail
dining. TSU Location 5 has a mixture of lounge furniture and worktables whereas there is no
lounge furniture in TSU Location 2. An exterior entry point is located within each space.
Figure 3.4.1
Talley Student Union Observed Gathering Spaces by Connectivity Threshold
**Gathering Spaces at Gatton Student Center**

**High Connectivity.** GSC Location 3 and GSC Location 5 are the most connected gathering spaces. Both of these spaces are adjacent to the central atrium. GSC Location 3 is on the second floor where the lower floor and social stair is visible from all points in the gathering space. GSC Location 5 is at the base of the social stair and the central atrium. GSC Location 3 is directly adjacent to the Martin Luther King Center and several exterior entry points stem from this location. GSC Location 5 has a major entry point, along with being located between retail dining and buffet style dining.

**Medium Connectivity.** The two gathering spaces at GSC considered to have medium connectivity are GSC Location 4 and GSC Location 6. GSC Location 4 also doubles as break out space for the large banquet hall in the building and a major circulation path does not pass through this space. GSC Location 6 is called the “Cat’s Den” and is adjacent to retail dining. GSC Location 4 has a large variety of lounge furniture whereas GSC Location 6 is primarily low top tables that seat four people. Entry points to the building are adjacent to these spaces but not within each gathering space.

**Low Connectivity.** Both GSC Location 1 and GSC Location 2 are gathering spaces considered to have low connectivity. GSC Location 1 connects the first floor to the second floor, while having a main entry point and the entrance to the recreation center. GSC Location 1 has informal soft benches, along with seats along the windowsill. GSC Location 2 is the only gathering space that you must pass through a doorway to enter. GSC Location 2 also serves as break out space for the ballroom adjacent to the gathering space. Formal lounge furniture fills GSC Location 2 and there is a building entry point in this gathering space.
Figure 3.4.2
Gatton Student Center Observed Gathering Spaces by Connectivity Threshold
### Table 3.3.1
Spatial Properties of Observed Gathering Spaces at Talley Student Union

<table>
<thead>
<tr>
<th>Location</th>
<th>INT</th>
<th>INT R3</th>
<th>CONN</th>
<th>AREA</th>
<th>Square Feet</th>
<th>Seats</th>
<th>Map</th>
</tr>
</thead>
<tbody>
<tr>
<td>Location 1</td>
<td>0.966</td>
<td>1.403</td>
<td>3</td>
<td>0.38</td>
<td>1,699</td>
<td>73</td>
<td></td>
</tr>
<tr>
<td>Location 2</td>
<td>1.218</td>
<td>2.668</td>
<td>10</td>
<td>0.70</td>
<td>2,228</td>
<td>24</td>
<td></td>
</tr>
<tr>
<td>Location 3</td>
<td>1.374</td>
<td>3.231</td>
<td>15</td>
<td>0.44</td>
<td>2,220</td>
<td>36</td>
<td></td>
</tr>
<tr>
<td>Location 4</td>
<td>1.322</td>
<td>3.110</td>
<td>15</td>
<td>0.30</td>
<td>1,351</td>
<td>40</td>
<td></td>
</tr>
<tr>
<td>Location 5</td>
<td>0.938</td>
<td>1.545</td>
<td>4</td>
<td>0.13</td>
<td>1,568</td>
<td>28</td>
<td></td>
</tr>
<tr>
<td>Location 6</td>
<td>1.018</td>
<td>2.310</td>
<td>8</td>
<td>0.32</td>
<td>1,594</td>
<td>22</td>
<td></td>
</tr>
</tbody>
</table>

**Note.** The value of the primary axial line in each gathering space is represented for global integration (INT) and local integration (INT R3), and connectivity (CONN). Area is the average value of each gathering space.
Table 3.3.2
Spatial Properties of Observed Gathering Spaces at Gatton Student Center

<table>
<thead>
<tr>
<th>Location</th>
<th>INT</th>
<th>INT R3</th>
<th>CONN</th>
<th>AREA</th>
<th>Square Feet</th>
<th>Seats</th>
<th>Map</th>
</tr>
</thead>
<tbody>
<tr>
<td>Location 1</td>
<td>1.229</td>
<td>1.625</td>
<td>3</td>
<td>0.44</td>
<td>2,380</td>
<td>30</td>
<td>1</td>
</tr>
<tr>
<td>Location 2</td>
<td>1.326</td>
<td>2.333</td>
<td>3</td>
<td>0.61</td>
<td>2,996</td>
<td>55</td>
<td>2</td>
</tr>
<tr>
<td>Location 3</td>
<td>1.431</td>
<td>2.968</td>
<td>11</td>
<td>3.64</td>
<td>3,421</td>
<td>39</td>
<td>3</td>
</tr>
<tr>
<td>Location 4</td>
<td>1.212</td>
<td>2.362</td>
<td>8</td>
<td>1.32</td>
<td>3,496</td>
<td>81</td>
<td>4</td>
</tr>
<tr>
<td>Location 5</td>
<td>1.353</td>
<td>2.543</td>
<td>9</td>
<td>1.11</td>
<td>2,210</td>
<td>47</td>
<td>5</td>
</tr>
<tr>
<td>Location 6</td>
<td>1.439</td>
<td>2.362</td>
<td>7</td>
<td>1.03</td>
<td>2,642</td>
<td>96</td>
<td>6</td>
</tr>
</tbody>
</table>

Note. The value of the primary axial line in each gathering space is represented for global integration (INT) and local integration (INTR3), and connectivity (CONN). Area is the average value of each gathering space.
Observation Protocol

The observation protocol was developed based on the five elements for behavioral mapping developed by Proshansky, Ittelson, and Rivlin (1970). The first step established the base map. TSU and GSC floor plans were obtained from the facilities departments at each university and cleaned to only include interior elements that were relevant for behavioral observations.

The second step defined behavioral categories. Informal learning related behaviors were initially adapted from the Learning Space Toolkit’s (2020) learning space taxonomy with broad activities categories that include focus, create, collaborate, share, and socialize. Initial pilot testing revealed that more specific behaviors should be identified that are associated with the activity categories and separate activity and behavior criterion should be recorded to capture the variety of behaviors happening within each gathering space.

Table 3.4
Behavior Observation Criteria

<table>
<thead>
<tr>
<th>Category</th>
<th>Codes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Activity</td>
<td>Sitting</td>
</tr>
<tr>
<td></td>
<td>Standing</td>
</tr>
<tr>
<td></td>
<td>Walking</td>
</tr>
<tr>
<td></td>
<td>Laying</td>
</tr>
<tr>
<td>Behavior</td>
<td>Talking</td>
</tr>
<tr>
<td></td>
<td>Dining</td>
</tr>
<tr>
<td></td>
<td>Reading</td>
</tr>
<tr>
<td></td>
<td>Writing</td>
</tr>
<tr>
<td>Social</td>
<td>Alone</td>
</tr>
<tr>
<td></td>
<td>In a Pair</td>
</tr>
<tr>
<td></td>
<td>In a Group</td>
</tr>
<tr>
<td></td>
<td>Relaxing</td>
</tr>
</tbody>
</table>

An observation schedule was developed in the third step to capture a “typical week” in the semester. Student schedules are weekly based and atypical weeks (e.g., finals, holidays, etc.) were avoided and the distribution of time slots took into account class schedules (M, W, F and T, Th) by ensuring a slot from 8am to 8:30pm for each grouping was covered. Each session was divided into 25-minute time intervals, including 15-minute actual observation time to provide a
snapshot of the behaviors happening in each space, and one round of observation for six
gathering spaces took a total of 2.5 hours. Observations were completed systematically to ensure
consistency of observation procedures and to capture a representative schedule of a full week.

An observation procedure was developed in the fourth step and the software BMapIt was
used with mobile tablets to record all mapping data. One round of visual sweeps, from left to
right, were performed and a pin was dropped on the map in the location a user was located, and
activity, behavior, and social variables were recorded. After the first visual sweep, only new
users that entered the space were recorded to ensure there were no duplicate recordings.

The fifth step and final step of this process was to train observers on the protocol and pre-
test. All research assistants were trained on the protocol during the same session and a walk
through of each space was conducted to ensure comfort and familiarity with each space. Two
observers completed the protocol for each time slot throughout the entire week to ensure
reliability of findings for a total of 50 hours of observations (25 hours in one week per observer)
at each college union.

Data Analysis

The first research question is concerned with understanding the distribution of informal
learning related behaviors, movement, and interaction at each college union. Behavior mapping
analysis developed by Sanoff and Coates (1971) is used to understand total occupancy and types
of stationary behaviors at each location. Occupancy is measured by the total frequency of people
observed in each gathering space and reported by time of day (morning, mid-day, early
afternoon, late afternoon, and evening). Stationary usage patterns are the frequency of each
behavior observed in a gathering space and measured through the distribution of total counts of
informal learning related behaviors (reading, writing, talking, dining, relaxing), movement, and interactions.

The purpose of the second research question is to investigate the relationship between frequencies of stationary behaviors, movement, and face to face interactions and if there are group differences in accessibility of gathering spaces, as measured by connectivity within each of the dependent variables. Mean counts of stationary behaviors, movement, and interactions are reported. A Pearson’s correlation analysis was conducted to investigate the relationship between the dependent variables. To answer the second part of the second research question, frequencies of stationary behaviors, movement, and interactions were compared across study areas to examine if there were differences across three categories of local accessibility, which was a guiding criterion in selection of study areas (i.e., low, medium, and high connectivity). Differences across low, medium, and high connectivity spaces were investigated with separate analysis of variances (ANOVA) for each dependent variable. Means and standard errors of stationary behavior, movement, and interaction counts are reported.

To explore the spatial properties of stationary usage patterns, the third research question asks whether informal learning related behavioral patterns differ based on the global integration, local integration, and local visibility characteristics of gathering spaces. Global integration and local integration represent accessibility and are measured with axial line analysis, while visible area represents local visibility and is measured with point isovists analysis. Stationary behavior characteristics, the independent variable, are determined by informal learning related behaviors, meaning that all observed behavior combinations are separated into categorical groups as the independent variable. Behavioral group differences are investigated with separate ANOVA tests for accessibility and visibility measures. Spatial property means and standard errors are reported.
Findings and Discussion

Patterns of usage in two college unions were analyzed separately, discussing the distribution of activities, the relationship between informal learning related behaviors, movement, and interaction, along with the spatial properties of gathering spaces. Patterns and findings are discussed to compare gathering spaces in order to understand the different spatial uses in relation to accessibility and visibility at TSU and GSC.

Distribution of Activities

Total frequency counts of users in each gathering space were aggregated by time of day and are displayed in Figure 3.5 to partially answer the first research question - what usage patterns (informal learning related behaviors, movement, interactions) are observed at two college unions?

Figure 3.5
Occupancy Counts of each Gathering Space by Time of Day, Sorted by Connectivity Thresholds
At TSU, the distribution of usage is relatively equitable throughout the day in each gathering space. However, lower occupancy frequency was observed at TSU Location 4 in the evening which is likely due to lower circulation counts. Distribution of usage tends to be equitable throughout the day for only GSC Locations 1 and 5. These two spaces were primarily used as circulation paths (see Table 3.5). GSC Location 1 was a main entry/exit point for the building and the entrance to the fitness center is also located in this gathering space. GSC Location 5 served as overflow for students waiting in line to enter the adjacent dining hall. Early (22.6%) and late afternoon (24.8%) were the busiest times of day at TSU whereas midday (24.2%) and early afternoon (22.1%) were the busiest at GSC.

**Total Occupancy Counts.** The most connected spaces had fewer total occupancy counts at TSU than the mid and low connectivity gathering spaces. However, at GSC the most connected spaces had the highest occupancy counts. For the full week of observations, TSU was slightly more utilized than GSC in that the total number of users observed at TSU was 3,216 and at GSC was 3,078. TSU Location 5 was the least utilized gathering space at TSU due to about one tenth (11.3%) of observations are attributed to this informal learning space, but it is also the smallest and offers the least amount of seating options of the six gathering spaces at TSU. At GSC, Location 2 was the least utilized in that only 5.6% of total observed users were in this gathering space. Both of the least utilized spaces are considered to have low connectivity values. TSU Location 2 was the most utilized space but almost two thirds (62.4%) of those observed were circulating through each space. Similarly, GSC Location 5 was the most utilized space in terms of overall counts but only one quarter (27.5%) of those observed were stationary within the space. Face to face social interactions tend to be above 40% frequency in all observed gathering spaces in TSU, other than TSU Location 6. Dissimilarly, only three gathering spaces at GSC had...
levels of social interaction above 40% frequency; GSC Locations 2, 5, and 6. The most frequent informal learning related behaviors at TSU were reading (39.1%) and talking (37.3%). Similar patterns were observed at GSC where about one fifth (19.9%) of users were reading and about one third (33.8%) were talking.
| Informal Learning related Behaviors | Dining | | | Reading | | | Relaxing | | | Talking | | | Writing | | | Movement | | | Interaction | |
| | Sum | % | Sum | % | Sum | % | Sum | % | Sum | % | Sum | % | Sum | % | Sum | % | Sum | % | Sum | % |
| Talley Student Union | 372 | 11.2 | 1304 | 39.1 | 44 | 1.3 | 1244 | 37.3 | 423 | 12.7 | 1368 | 41.0 | 1458 | 43.7 |
| Location 1 | 264 | 37.5 | 258 | 36.6 | 8 | 1.1 | 337 | 47.9 | 59 | 8.4 | 149 | 21.2 | 370 | 52.6 |
| Location 2 | 35 | 4.5 | 199 | 25.7 | 7 | 0.9 | 306 | 39.6 | 37 | 4.8 | 482 | 62.4 | 325 | 42.0 |
| Location 3 | 18 | 3.8 | 245 | 51.8 | 3 | 0.6 | 195 | 41.2 | 93 | 19.7 | 134 | 28.3 | 249 | 52.6 |
| Location 4 | 29 | 5.3 | 268 | 48.6 | 12 | 2.2 | 173 | 31.4 | 126 | 22.9 | 187 | 33.9 | 222 | 40.3 |
| Location 5 | 14 | 3.9 | 164 | 45.2 | 8 | 2.2 | 126 | 34.7 | 56 | 15.4 | 153 | 42.1 | 159 | 43.8 |
| Location 6 | 12 | 2.5 | 170 | 36.0 | 6 | 1.3 | 107 | 22.7 | 52 | 11.0 | 263 | 55.7 | 133 | 28.2 |
| Gatton Student Center | 150 | 4.8 | 614 | 19.9 | 311 | 10.1 | 1040 | 33.8 | 269 | 8.7 | 1635 | 53.1 | 1196 | 38.9 |
| Location 1 | 5 | 0.8 | 44 | 0.7 | 15 | 2.4 | 148 | 24.1 | 9 | 1.5 | 545 | 89.1 | 152 | 24.8 |
| Location 2 | 7 | 4.0 | 47 | 27.0 | 35 | 20.1 | 61 | 35.1 | 17 | 9.8 | 40 | 23.0 | 70 | 40.2 |
| Location 3 | 19 | 2.8 | 153 | 22.6 | 65 | 9.6 | 240 | 35.5 | 53 | 7.8 | 362 | 53.6 | 248 | 36.7 |
| Location 4 | 9 | 2.1 | 169 | 39.1 | 88 | 20.4 | 99 | 22.9 | 93 | 21.5 | 98 | 22.7 | 116 | 26.9 |
| Location 5 | 48 | 6.0 | 93 | 11.6 | 14 | 1.8 | 351 | 43.9 | 36 | 4.5 | 580 | 72.5 | 381 | 47.6 |
| Location 6 | 62 | 16.2 | 108 | 28.1 | 94 | 24.5 | 141 | 36.7 | 61 | 15.9 | 10 | 2.6 | 229 | 59.6 |
Stationary Usage Patterns. When analyzing the aggregate of only stationary behaviors, TSU \((n = 1,968)\) was utilized over a third \((37.3\%)\) more than GSC \((n = 1,433)\). Reading was the most common behavior at both TSU and GSC. At TSU, more than half \((60.4\%)\) of stationary behaviors involved reading as an informal learning related behavior compared to about one third \((37.6\%)\) at GSC. Of the total stationary informal learning related behaviors observed, only 2.2\% of users were relaxing at TSU. Whereas at GSC, this number was much higher at 20.2\%. The least frequent behavior at GSC was dining at 8.4\% of observed users even though there is retail dining adjacent to GSC Location 5 and GSC Location 6.

Table 3.6
Counts of Total Informal Learning Related Behaviors by Building

<table>
<thead>
<tr>
<th>Informal Learning Related Behaviors</th>
<th>Dining</th>
<th></th>
<th></th>
<th>Talking</th>
<th></th>
<th>Writing</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Sum (%)</td>
<td>Sum (%)</td>
<td>Sum (%)</td>
<td>Sum (%)</td>
<td>Sum (%)</td>
<td>Sum (%)</td>
<td>Sum (%)</td>
<td></td>
</tr>
<tr>
<td>Talley Student Union</td>
<td>362</td>
<td>18.4</td>
<td>1188</td>
<td>60.4</td>
<td>44</td>
<td>2.2</td>
<td>868</td>
</tr>
<tr>
<td>Gatton Student Center</td>
<td>120</td>
<td>8.4</td>
<td>539</td>
<td>37.6</td>
<td>289</td>
<td>20.2</td>
<td>477</td>
</tr>
</tbody>
</table>

When analyzing the distribution of stationary behaviors within each gathering space, all behaviors were observed at each gathering space but there is some variation in terms of how often each behavior was observed within those spaces. Average variation of behaviors was calculated to compare the distribution of each behavior within each gathering space to the aggregate of informal learning behaviors in all gathering spaces within each building. At TSU, the average variation of stationary usage patterns was highest for the least connected spaces. Similarly, GSC Location 1 was the least connected space and also had the highest average
variation of behaviors from all gathering spaces observed. No other patterns were observed in terms of usage patterns and all gathering spaces at both college unions tend to have similar stationary usage patterns.

**Figure 3.6**
*Stationary Usage Patterns Sorted by Connectivity Threshold of Gathering Spaces in Talley Student Union (TSU) and Gatton Student Center (GSC)*

**Stationary Behavior, Movement, and Interactions by Connectivity Threshold**

The first part of the second research question (RQ2a) asks if there is a relationship between counts of stationary behaviors, movement, and face to face interactions within gathering spaces at two college unions. Results of a Pearson’s correlation analysis indicates there is a significant negative relationship between movement and stationary behaviors at TSU ($r = -0.183$,}
Results of this analysis reveal that higher flows of movement through gathering spaces correlate with fewer students utilizing those gathering spaces to perform informal learning related behaviors and this relationship was stronger for students at GSC. This finding is important to consider as the majority of the gathering spaces are located within or directly adjacent to programmed circulation paths within each building.

There is a significant positive relationship between stationary behavior counts and face to face interactions at TSU ($r = .713, p < .001$) and GSC ($r = .409, p < .001$). This relationship reveals that as more students utilize a gathering space, the more they tend to interact with others. On the other hand, students tend to be alone the less a gathering space is utilized. Similarly, the more a gathering space is utilized for movement, more students tend to walk with others (TSU: $r = .311, p = .001$; GSC = $r = .464, p < .001$). In both cases, more interaction among students tend to happen when frequencies of stationary behaviors and movement increases.

### Table 3.7
**Pearson Correlation Coefficients between Stationary Behaviors, Movement, and Interactions**

<table>
<thead>
<tr>
<th></th>
<th>Talley Student Union</th>
<th></th>
<th></th>
<th></th>
<th></th>
<th>Gatton Student Center</th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>$M$</td>
<td>$SD$</td>
<td>1 2</td>
<td>$M$</td>
<td>$SD$</td>
<td>1 2</td>
<td>$M$</td>
<td>$SD$</td>
</tr>
<tr>
<td>3. Interactions</td>
<td>12.15</td>
<td>9.00</td>
<td>.713***</td>
<td>.311***</td>
<td>9.97</td>
<td>8.27</td>
<td>.409***</td>
<td>.464***</td>
</tr>
</tbody>
</table>

* ***$p \leq .001$, **$p \leq .001$, *$p \leq .05$*

Observed gathering spaces were analyzed based on connectivity threshold categories to investigate to what degree local accessibility informs usage patterns. To answer the second part of the second research questions (RQ2b) three separate ANOVA tests were conducted for each
building to investigate local accessibility group differences on stationary informal learning related behaviors, movement, and interaction. Table 3.8 includes means and standard deviations of stationary behaviors, movement, and interaction separated by connectivity thresholds within each college union.

**Stationary Behavior Counts.** At TSU, the three local configuration groups do not have the same frequency of stationary behaviors, \( F(2,118) = 5.87, p = .004, \eta^2 = .091 \), indicating that 9.1% of the variance in stationary behaviors can be attributed to connectivity groups. Fisher’s LSD comparisons indicate that medium connected gathering spaces (\( M = 12.50 \)) have fewer stationary behaviors than both the high (\( M = 1.74 \)) and low (\( M = 1.74 \)) connected spaces at TSU. Similarly at GSC, findings reveal that there are differences in stationary behavior counts based on connectivity level, \( F(2,118) = 27.53, p < .001, \eta^2 = .032 \). Meaning that 3.2% of the variance in stationary behaviors is accounted for by the given connectivity level groups. However, Fisher’s LSD comparisons revealed that medium connected gathering spaces (\( M = 1.74 \)) privileged more stationary behaviors (\( M = 17.70 \)) than those high (\( M = 13.10 \)) and low connected gathering spaces at GSC, the opposite of TSU.

The medium connectivity gathering spaces at TSU had the least number of available seating options whereas the medium connectivity gathering spaces at GSC had the highest number of seating options among the six gathering spaces observed at GSC (see Table 3.3.1 and Table 3.3.2). While there were no patterns observed across cases in terms of stationary behavior counts and thresholds of connectivity, patterns were observed across cases in terms of the amount of furniture available for students to utilize while engaging in informal learning related activities.
**Movement.** Findings reveal there are differences in movement based on connectivity levels at both TSU ($F(2,118) = 22.82, p < .001, \eta^2 = .281$) and GSC ($F(2,118) = 38.43, p < .001, \eta^2 = .396$). Effect sizes indicate that 28.1% of the variance in movement at TSU and 39.6% of the variance in movement at GSC is due to connectivity levels. Fisher’s LSD post hoc tests indicate a significant difference between medium connected gathering spaces at TSU which privileged more movement ($M = 18.62$) than those high ($M = 8.03$) and low ($M = 7.55$) gathering spaces. On the other hand, medium connected gathering spaces at GSC privilege less movement ($M = 2.70$) than both high ($M = 23.55$) and low ($M = 14.62$) connected gathering spaces and this is a statistically significant difference.

For those medium connectivity gathering spaces at TSU where fewer stationary behaviors were observed, more movement was observed. This same pattern is seen at GSC in the high and low connectivity gathering spaces, further indicating that as more stationary behaviors are observed, less people move through the gathering spaces. The effect sizes were quite large for movement, indicating that connectivity level in each gathering space likely contributes to the number of students that utilize gathering spaces for circulation. However, more movement was observed in the medium connectivity space at TSU whereas the least movement was observed in the medium connectivity spaces at GSC. This finding is similar to Sailer’s (2015) findings when investigating movement flows through the British Library. She found that local accessibility is not a good predictor of movement through the building. In complex multi-use buildings like college unions, movement is not assumed to be random when the program of the building is strong (Capillé & Psarra, 2016).

**Interactions.** ANOVA results indicate that there are no differences in frequency of interactions by connectivity group at TSU, $F(2,118) = 0.44, p = .647, \eta^2 = .007$. However,
results reveal that at GSC, there are significant differences in frequency of social interactions by connectivity level groups, $F(2,118) = 21.42, p < .001, \eta^2 = .268$ indicating that 26.8% of the variance in frequency of interactions is accounted for by connectivity level. Fisher’s LSD comparisons revealed that significantly more social interactions occurred in highly connected spaces ($M = 15.73$) than in medium ($M = 8.63$) and low ($M = 5.55$) gathering spaces at GSC.

There were no significant differences between the frequency of interactions at TSU in different gathering space groups but interactions at GSC do exhibit a spatial pattern. As gathering spaces are less connected to other spaces in GSC, students tend to utilize them more when they are on their own. More than half (53.6%) of students engaging in stationary informal learning related behaviors at TSU were interacting with others and there were no statistically significant differences between groups of gathering spaces. This indicates that at TSU, how connected a gathering space is does not matter in terms of the likelihood of face to face interactions. The findings at GSC support previous work, that interactions among students is in part determined by spatial factors (McLane, 2013).
Table 3.8
Means and Standard Deviations of Stationary Behaviors, Movement, and Interactions Observed by Connectivity Groups

<table>
<thead>
<tr>
<th></th>
<th>Stationary Behaviors</th>
<th>Movement</th>
<th>Interaction</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>( M )</td>
<td>( SD )</td>
<td>( M )</td>
</tr>
<tr>
<td>Talley Student Union</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>High Connectivity</td>
<td>17.58</td>
<td>6.31</td>
<td>8.03</td>
</tr>
<tr>
<td>Medium Connectivity</td>
<td>12.50</td>
<td>5.13</td>
<td>18.62</td>
</tr>
<tr>
<td>Low Connectivity</td>
<td>19.13</td>
<td>13.40</td>
<td>7.55</td>
</tr>
<tr>
<td>Gatton Student Center</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>High Connectivity</td>
<td>13.10</td>
<td>8.39</td>
<td>23.55</td>
</tr>
<tr>
<td>Medium Connectivity</td>
<td>17.70</td>
<td>9.10</td>
<td>2.70</td>
</tr>
<tr>
<td>Low Connectivity</td>
<td>5.03</td>
<td>5.11</td>
<td>14.62</td>
</tr>
</tbody>
</table>

Spatial Properties by Informal Learning Related Behavior Groups

The third research question is concerned with investigating if there are differences in behavior groups based on their spatial properties of gathering spaces at two college unions. Results of the ANOVA tests indicate that behavior groups differ according to global integration scores of each gathering space at both TSU \((F(13,1928) = 16.19, p < .001, \eta^2 = .098)\) and at GSC \((F(16,1328) = 4.84, p < .001, \eta^2 = .055)\). The significant differences between behavior groups according to the global integration scores indicate that students sought out specific spaces for specific behaviors (Sailer, 2015). However, this is a generally small effect because 9.8% of the variance in integration score can be attributed to behavior groups at TSU and 5.5% at GSC.

At TSU, all behavior groups that include dining are lower than the mean global integration value, and the opposite is true at GSC. This finding is likely due to the location of gathering spaces that are adjacent to retail dining. For example, TSU Location 1 is directly
adjacent to retail dining and has a low global integration score (0.966) compared to the other spaces in the building. Whereas retail dining is situated between GSC Location 5 and GSC Location 6 (see Tables 3.3.1 and 3.3.2) which have higher than average global integration scores. This finding is likely driven by the functional programming of the space, rather than measures of accessibility.

Further, the behavior groups that include talking at GSC were higher than the mean global integration value and this was also the case at TSU, except for the behavior groups that also include dining which is likely due to the previous finding. Students that were talking, either on the phone or to others physically present, indicate that the more integrated a gathering space is, the noisier it may be. This finding indicates there is a global integration spatial pattern to those informal learning related behaviors that involve talking as an informal learning related activity. On the other hand, the activities that involved relaxing, excluding dining, had global integration values lower than the mean for GSC but this wasn’t the case at TSU. This contrast, between talking as a highly integrated activity versus relaxing as a more isolated activity indicates that students do tend to use gathering spaces differently based on their level of accessibility. However, no other patterns were observed in terms of global integration and the other informal learning related activities of writing and reading are distributed equitably in terms of global integration scores of gathering spaces.

Behavior groups do not differ for either of the local measures of configuration \(F(16,1328) = 1.05, p = .395, \eta^2 = .013\) and visibility \(F(16,1328) = 1.52, p = .0835, \eta^2 = .018\) at GSC. However at TSU, behavior groups significantly differ for both integration radius 3 \(F(13,1928) = 24.66, p < .001, \eta^2 = .143\) and visibility area \(F(13,1928) = 16.38, p < .001, \eta^2 = .099\). Even though there is not a significant difference between behavior groups according to
local spatial properties, dissimilar spatial patterns are observed between global and local measures at GSC (see Table 3.9.2). This indicates that global accessibility of gathering spaces is driving the distribution of informal-learning related behaviors at GSC, rather than the local measures. In addition, this disconnect between global and local properties at GSC is possibly due to a large portion of the integration core is not accessible to students. On the other hand, local spatial properties of behavior group patterns observed at TSU reflect the same patterns observed for the global measure of integration. At TSU, talking behaviors tend to happen in spaces that are more locally integrated and have higher rates of visibility, revealing the same patterns as global integration.
Table 3.9.1
Means and Standard Deviations of Spatial Properties by Behavior Groups at Talley Student Union

<table>
<thead>
<tr>
<th>Behavior Groups</th>
<th>Count</th>
<th>$M$</th>
<th>SD</th>
<th>$M$</th>
<th>SD</th>
<th>$M$</th>
<th>SD</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dining</td>
<td>73</td>
<td>1.045</td>
<td>.135</td>
<td>1.810</td>
<td>.656</td>
<td>1.421</td>
<td>1.592</td>
</tr>
<tr>
<td>Reading</td>
<td>523</td>
<td>1.147</td>
<td>.170</td>
<td>2.410</td>
<td>.702</td>
<td>2.368</td>
<td>1.449</td>
</tr>
<tr>
<td>Relaxing</td>
<td>38</td>
<td>1.141</td>
<td>.170</td>
<td>2.400</td>
<td>.693</td>
<td>2.339</td>
<td>1.452</td>
</tr>
<tr>
<td>Talking</td>
<td>403</td>
<td>1.160</td>
<td>.173</td>
<td>2.401</td>
<td>.739</td>
<td>2.476</td>
<td>1.604</td>
</tr>
<tr>
<td>Writing</td>
<td>38</td>
<td>1.192</td>
<td>.171</td>
<td>2.622</td>
<td>.663</td>
<td>2.338</td>
<td>1.108</td>
</tr>
<tr>
<td>Dining, Reading</td>
<td>80</td>
<td>1.057</td>
<td>.152</td>
<td>1.892</td>
<td>.711</td>
<td>1.476</td>
<td>1.471</td>
</tr>
<tr>
<td>Dining, Relaxing</td>
<td>6</td>
<td>1.080</td>
<td>.188</td>
<td>1.996</td>
<td>.865</td>
<td>1.133</td>
<td>.819</td>
</tr>
<tr>
<td>Reading, Writing</td>
<td>312</td>
<td>1.190</td>
<td>.179</td>
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Total                     | 1942  | 1.141  | .176| 2.329  | .762| 2.153  | 1.477|

Note: Mean values equal to or larger than the average of all gathering spaces are highlighted in red. Global integration (INT) and local integration (INTR3) was calculated by the primary axial line in each gathering space. Visible area was measured by is the average value of each isovist in the gathering space.
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Total 1345 1.351 .093 2.490 .295 2.085 1.582

*Note.* Mean values equal to or larger than the average of all gathering spaces are highlighted in red. Global integration (INT) and local integration (INTR3) was calculated by the primary axial line in each gathering space. Visible area was measured by is the average value of each isovist in the gathering space.
Figure 3.7.1
Talley Student Union Global Integration Map

Min: 0.461
Mean: 0.902
Max: 1.528
Figure 3.7.2
Gatton Student Center Global Integration Map
Figure 3.8.1
Talley Student Union Local Integration R3 Map
Figure 3.8.2
Gatton Student Center Local Integration R3 Map

Min: 0.333  Mean: 1.714  Max: 3.886
Limitations and Future Directions

As no other studies have empirically investigated informal learning behaviors in the college union and the methodology employed was also novel, there are several limitations to this study. This comparative case study purposefully selected gathering spaces within two college unions in order to gain an understanding of how diverse spaces in-between are utilized for informal learning. Because these spaces were initially selected based on connectivity levels, variance in the other syntactic and visibility measures for analysis is lacking. For example, local visibility findings demonstrated the same patterns as local integration, therefore not allowing differentiation between local accessibility versus local visibility local measures. Future work should ensure there is variance between these local measures before observations are conducted.

Next, this study was limited in part, by only investigating two cases that were quite different in terms of building spatial layout. Future work could utilize this methodology and expand to more college unions for generalizability. In addition, because the researchers aimed to unobtrusively collect observation data in order to not influence the behavior setting, the protocol was quite general and did not allow for more nuanced understandings of informal learning activities. Future work should couple onsite interviews with systematic behavior observations to provide a rich and more nuanced description of how students use gathering spaces.

Conclusion

While there is recent research that has investigated how college students use informal learning spaces (e.g., Kim, Bosch, and Lee, 2020), no studies to date have explored how spatial properties of gathering spaces in college unions relate to usage patterns. The college union provides a space outside of the classroom and away from home to support informal learning activities and students choose these spaces for a variety of reasons which was observed in this
study through spatial use patterns. College unions spatially organize banquet halls, student organization offices, retail dining, bookstores, etc. and the spaces in-between these student centric amenities are increasingly important to not just provide a space to build community (Maxwell, 2016), but also for students to engage in informal learning activities. Even though this study was conducted pre COVID-19 pandemic, findings can inform current management of gathering spaces in college unions in addition to serving as evidence for future planning initiatives for university administrators.

It is important to note that several of these gathering spaces were shuffled throughout the week of observations to also serve as event and break out space. By virtue of their “in-betweenness” gathering spaces in college unions are likely the most utilized spaces within this building typology, especially when looking at daily cycles of space usage. Results from this study indicate that gathering spaces were used similarly throughout the day, from 8am until 8:30pm for TSU but not at GSC. While this study did not investigate the operations and management aspect or usage of programmed spaces in college unions, future work could investigate the life of these buildings to pay particular attention to how operations and management inform the open, multi-use gathering spaces to meet more than just student needs for informal learning activities.

To encourage more stationary interactions related to informal learning, how circulation runs through gathering spaces should be considered. In both cases, regardless of spatial properties, when more movement was observed, fewer students utilized those gathering spaces for stationary informal learning related activities. In addition, it is important to note that GSC had 56% more seating options for students in the gathering spaces than were in TSU. But at TSU, 37% more students were observed engaging in informal-learning related activities than at
GSC. Just because the gathering spaces are provided to students, does not mean that students will use them. Lastly, it was clear across cases that proximity to retail dining determined dining behaviors in the gathering spaces. While this may seem intuitive, it is important to note that students were engaging in other informal learning related behaviors and these spaces do not serve as simply places to eat. While students may primarily be in those spaces to eat, they flow into academic oriented activities in these gathering spaces. Synthesis of these findings indicate that when designing gathering spaces for informal learning within college unions, it is important to consider (1) connection to major circulation paths, (2) availability and type of furniture offered, and (3) how functional program drives usage. Ultimately, these gathering spaces serve many purposes.

While patterns of spatial properties of gathering spaces were observed within each building, spatial patterns observed across college unions were inconsistent. This could be due to a number of reasons. Namely, a large portion of the integration core is a service corridor and not accessible to students in GSC. On the other hand, the integration core is in the heart of TSU, on the third and fourth floors directly adjacent to the central atrium and accessible by students. This could also indicate why TSU encouraged more social interactions than GSC. In addition, there were significant behavior group differences when considering both global and local spatial measures of gathering spaces at TSU but this was not the case at GSC. These cases were initially chosen due to similar functional programs, along with related operational management techniques. However, the overall layout of each building is quite different (TSU is radial and GSC is linear) and the results from this study indicate how this may have influenced pattern of use. Similarly, students utilized GSC to relax quite often, but this behavior was rarely observed
at TSU. Future work could investigate how college unions and their spatial properties encourage restoration behaviors.

**Design and Practical Implications**

Both college unions are well utilized spaces on each college campus. Results of this study reveal how spatial properties influence usage patterns and can help inform the design of future campus facilities that serve as a third place for students. A notable contrast between the gathering spaces at each college union is the overall size of each gathering space. While scale was not particularly investigated in this research, notable patterns emerged. The gathering spaces observed at GSC were 17,145 total square feet while at TSU, only 10,660 total square feet. Because TSU was also 37% more utilized for informal learning related stationary behaviors than GSC, this indicates that smaller and more frequent gathering spaces could better suit student needs for informal learning activities.

Furthermore, all furniture in every gathering space at GSC, except GSC Location 6, offered only lounge furniture for students but there was a good mix of lounge furniture and worktables at TSU. If gatherings spaces are to serve students for more than just places to relax and socialize, it is important to recognize the informal learning activities that happen within gathering spaces at college unions and offer furniture that meets a wide range of behaviors. Likewise, recognizing that different levels of accessibility also afford different behaviors is important to consider when designing or reconfiguring college unions. For example, this study found that in both college unions, as more people move through space, less people engage in stationary informal-learning related behaviors. Being strategic with the furniture layout to guide circulation around the gathering space, rather than through it, could lead to accessible and well utilized gathering spaces within college unions.
Because there were inconsistencies between patterns observed across cases, it is important to consider the overall context of the college union when planning for informal learning related activities. For example, face to face interactions did not differ based on connectivity level group differences at TSU but at GSC, face to face interactions were less frequent as connectivity levels decreased. There was a mismatch between furniture groupings offered in the gathering spaces at GSC and the interactions observed. For example, in GSC Location 3 which has high connectivity, there were primarily lounge seats that did not accommodate groups and in GSC Location 2 which has low connectivity, there was only lounge furniture situated for social interaction. On the other hand, at TSU where there were no differences in the amount of social interactions based on connectivity levels, a variety of both single and group furniture layouts were offered.

To conclude, this research study has demonstrated the importance of gathering spaces in college unions and offers insight into how spatial properties influence patterns of use. Ultimately, the college union is not only a place for informal learning, but the understanding of how unions are utilized in terms of informal learning behaviors is the major contribution of this study. At a time when higher education administrators are focusing considerable attention on spatial factors at a macro level, findings of this study should serve as a reminder of the importance of micro-level spatial factors and how they influence informal learning. This study fills that gap by adding to our understanding of how and why spatial properties in college unions influence informal learning related behaviors. This study provides a foundation for how future investigations can further explore the complexity of multi-use informal learning spaces through physical attributes, while providing evidence to inform the design of college unions.
References


Oldenberg, R. (1999). The great good place: Cafes, coffee shops, bookstores, bars, hair salons, and other hangouts at the heart of a community. Cambridge, MA: Da Capo.


http://www.isovists.org/user_guide/


CHAPTER 4: Article 3

The College Union as a Place to Cultivate University Belonging through Social Interactions and Diverse Worldviews

Abstract

The aim of this paper is to explore the underlying processes of how university belonging can be cultivated through informal learning spaces on a college campus, such as college unions. A serial mediation analysis was conducted to examine the relationships among undergraduate students’ informal learning space preferences, quality of interactions, pluralism, and university belonging. Two random samples of undergraduate students that attend North Carolina State University and the University of Kentucky were investigated. Findings indicate that student preferences for spending time outside of class at their college union encourages positive social interactions and fosters more openness to different worldviews. These factors in turn, promote a stronger sense of university belonging for undergraduate students in both samples. This study provides a deeper understanding of students’ connections to the built environment of informal learning spaces and how that relates to institutional goals while suggesting design implications and future directions for investigating this relationship.
Introduction

Questioning the importance of the built environment in higher education is not a new inquiry (e.g., Shill & Tonner, 2004). This line of questioning has amplified in recent months as more classes move to a virtual format, physical distancing requirements are implemented, and campus facilities largely remain vacant during the COVID-19 pandemic. However, past research shows that the traditional, place based, college experience enhances both educational and personal growth (Strange & Banning, 2015). If academic instruction can be delivered virtually without sacrificing rigor, what is the future of classroom buildings, student services facilities, and libraries on higher education campuses? If architecture is not required, or the necessity for physical space is drastically reduced for the new era of teaching and learning, should we rethink the role of the built environment within our academic institutions? Given the relative importance of physical attributes that sustain undergraduates’ learning, socializing, collaborating, and relaxing, it is critical to explore the latent role of the built environment as an agent to cultivate university belonging for undergraduate students.

It is widely accepted in higher education that knowledge should not be delivered to students by means of the instructor, rather knowledge should be co-constructed between learner, peer, and teacher (Gibbs, 1988). This dominant pedagogical paradigm has also manifested in the design of physical learning environments in recent years, namely, active learning classrooms and flexible gathering spaces. These spaces are commonplace in university settings as an architectural response to shifting pedagogies, but little empirical research has informed the design of higher education spaces (Painter et al., 2013; Blackmore et al., 2011). The focus of this study is to expand on this knowledge base by investigating how informal learning environments,
specifically two college unions, may enhance the student experience by cultivating a sense of university belonging in undergraduates.

Universities are increasingly allocating facilities budgets to the creation of informal learning spaces (Sightlines, 2017). By definition, informal learning spaces are non-discipline specific physical environments that aim to contribute to the overall student experience on a college campus (Harrop & Turpin, 2013). Informal learning environments, such as living learning communities, college unions, and university libraries, are increasingly important in terms of supporting university values, academic success, and student wellbeing (Lippincott, 2006; Whiteside, Brooks, & Walker, 2010). There is a growing need for university administrators to make evidence-based decisions for strategic planning in the development of higher education facilities (Jamieson, et al., 2000) due to the considerable influence these spaces have on undergraduate students. In addition, evolving budgetary concerns and the changing nature of experiential teaching and learning expectations on college campuses heighten the urgency for this work.

**Background**

The college union has often been referred to as the living room of the college campus (Fagan, 1989) because as a place, it provides a space in between residence halls and formal classrooms for undergraduates to learn, socialize, and relax. According to the Association of College Unions International (ACUI), the role of the college union is to be student-oriented, advocate for inclusivity and equity, educate students in social responsibility and leadership, and provide gathering spaces for college students (ACUI, 2020). As campuses evolved with innovative technologies and diverse people, the college union adapted to become a place for learning, belonging, and community (Rullman & Harrington, 2014). Additionally, the college
union generates revenue for the institution while enhancing unique student experiences through student employment and experiential learning (Willis, 2014). These student employment opportunities, made possible by the college union, create educational experiences for career-readiness (Willis, Maxwell, & DeSawal, 2020).

In terms of facilities, college unions are distinctive from other buildings on a typical American college campus because the core of their mission is service to students. This student-centric mindset influences not only services and amenities provided, but also how facilities operate and are maintained. The cohesive management, operation, and design of the physical environment fosters a sense of connectedness or belonging to the overall institution. The college union is typically comprised of a wide range of spaces to serve campus, community, and student needs such as study rooms, recreational facilities, student organization offices, exhibit spaces, conference facilities, dining services, and retail stores (CAS, 2019). The aim of this study is to consider how undergraduate students’ preferences for spending time outside of class at their college union contributes to their sense of university belonging by also considering the quality of their social interactions at the college union and their perceptions of how open they are to worldviews different than their own as potential mediators.

**The College Union: Architecture for Student Engagement**

While it is the primary focus of this research study, the college union is not just a physical space that provides access to study rooms, dining options, bookstores, and student organizations. Rather, the college union is a place whose very existence is the product of building community (Bickford & Wright, 2006). To build community, the college union is a collection of people, programs, and services to support faculty, staff, and students at universities. This connection between operations, mission, and physical space provides an excellent case to
investigate how the built environment influences perceptions of undergraduate students. Furthermore, the college union is a third space, as it is serves as a physical environment outside of the home and classroom where students to go to be with others (Oldenberg, 1989).

**Theoretical Framework: Agentic Perspective on Campus Ecology**

The theoretical framework that guides this study synthesizes social cognitive theory (SCT), the social ecological (SE) model, and campus ecology (CE) for an agentic perspective on campus ecology. SCT is a theory of human motivation that emphasizes the dynamic and reciprocal interaction between personal, behavioral, and environmental factors (Bandura, 1989). A SE perspective has roots in ecological systems theory that is concerned with the multiple physical and socio-cultural environmental dimensions that determine human behavior (Stokols, 1995). Campus ecology provides a model that organizes the complexities of campus settings (Strange & Banning, 2001). These three models can be used in a complementary fashion to provide a framework that operationalizes the integrated nature of human-made environments that serve a specific purpose – to support undergraduate students.

SCT emphasizes the interactive relationship between personal, behavioral, and environmental influences (Bandura, 1989). However, the physical environment is not typically considered in research that utilizes SCT as a framework for inquiry. SE provides a conceptual model that emphasizes the embedded nature of humans within systems. CE takes that one step further by situating it within the unique context of higher education institutions. SE and CE highlight the transactions that happen between a person and the socio-ecological system in which they are a part. The dynamic relationship between personal characteristics and environmental factors of SCT could help explain the influence environmental design can have on human thought and action. Particularly, the notion of agency, or the locus of control students have over
their environments is the theoretical underpinning that drives this study. According to the ecological paradigms, the surrounding physical environment cannot be separated from a sense of one’s self within it.

SCT, SE, and CE are concerned with people, behaviors, and environments. SCT posits that individuals have control over their thoughts, feelings, and actions and ecological models emphasize the embedded nature of a person within a layered context through a transdisciplinary lens. The integration of these frameworks is vital for this study because the higher education environment has multiple contextual layers that are social (e.g., interpersonal relationships), physical (e.g., spatial configuration), virtual (e.g., online learning platform), and socio-cultural (e.g., cultural value) and all influence the student experience. The relationship between the environmental system and the self-system is reciprocally determinant, adapted from SCT. Reciprocal determinism means that students’ self-beliefs, needs, and identity all influence their learning environments where students must actively regulate their own motivation and learning related behaviors. This relationship between environment, student, and behavior provides the theoretical foundation for the current study.

**Informal Learning Space Preferences, Campus Climate, and University Belonging**

The first question guiding this research study is: What is the relationship between preferences for spending time outside of class in college unions and perceptions of university belonging, when accounting for perceptions of a welcoming campus climate? The parameters imposed by the design of the physical environment sets the stage for the relationship between preferences for informal learning spaces and student self-beliefs. Where a student chooses to spend their time outside of class is a function of the autonomy they have over their environment and this sense of control has been shown to have positive academic, personal, and wellbeing
outcomes (Bandura, 2006). One self-belief construct that is the focus of this study is *University Belonging*. Students’ sense of university belonging is a construct that is concerned with the perception of their relationship with others, specifically in an academic context. Furthermore, *Campus Climate* is a construct concerned with student perceptions of the institution socio-cultural environment that relates to a sense of belonging, especially for students that identify with a minority group (e.g., Budge, Dominguez, & Goldberg, 2020, Wells & Horn, 2015, Stebleton et al., 2014). Campus climate has been shown to influence social interactions among college students (Locks, et al., 2008) and is closely connected to students’ sense of belonging (Cheng, 2004). To identify the unique contribution that informal learning space preferences have on a sense of belonging, perceptions of a welcoming campus climate serves as the control variable for this study to account for any confounding effects. By investigating the relationship between informal learning space preferences and university belonging, this study explores how the design of the physical environment may influence student self-beliefs.

**Informal Learning Space Preferences**

Recent research has investigated the physical nature of informal learning spaces, primarily through student preference and mapping data. Harrop and Turpin (2013) explored student informal learning space preferences through a mixed methods case study. Their findings offer an ‘informal learning space typology’ and conclude the design of these spaces should incorporate nine attributes (destination, identity, conversations, community, retreat, timely, human factors, resources, and refreshment). The function of preference for a place is a byproduct of the interaction between a person, a place, and the broader socio-cultural context (Milligan, 1998). Specifically, in higher education environments, students choose physical learning environments that match their learning related activities and expectations (Beckers, Van der
Voordt, & Dewulf, 2016). Understanding these preferences and the choice mechanism are latent and important when planning and designing formal and informal learning spaces on college campuses.

To explore how college students choose informal learning spaces, Vo (2015) used a grounded theory technique to develop a model through observations at ten informal learning environments situated in campus libraries, residence halls, student centers, and academic halls. Vo (2015) found that balancing academic and social factors, the nature of learning tasks, physical attributes, and facility management all affected how students chose which informal learning spaces they would use. Furthermore, private zones within social spaces were the highest preference but space selections were dynamic in that decisions were based on situational needs and control over distractions (Vo, 2015). Kim, Bosch, and Lee (2020) conducted a post-occupancy evaluation on an academic library to understand student behavior and perceptions of the physical environment. Similarly, Kim et al. (2020) observed students primarily spending time alone in these informal settings. They posit that even though the design intention of the library space was to encourage active and collaborative team-based learning, student expectations are misaligned with the utility of these informal spaces such that group study tables used for individual study activities and survey responses corroborate this observation.

**University Belonging**

College students’ sense of belonging, or one’s connectedness to their institution, is a construct that answers the question, *do I belong here?* Students’ sense of belonging addresses both the social context that they are part of and who they can be within that context (Walton & Brady, 2018). In an educational setting, a sense of belonging can predict persistence (Hausmann, Schofield, & Woods, 2007) academic outcomes, and well-being (Walton & Cohen, 2007). Few
studies have investigated how the architecture of college unions address this organizational intention. However, issues of how design can increase a sense of belonging has gained traction in recent years. For example, Whettingsteel, Oliver, and Tiwari (2020) conducted a participatory action research study with Australian Aboriginal boarding school students and found that interior design can increase students’ sense of belonging. Results indicate that psychological constructs associated with attachment to a physical space, particularly third spaces, were notable for participants in the study and show potential to be applied in other applications that are concerned with using interior design to foster a sense of belonging to an educational institution.

Another recent study explored how spatial knowledge of a university campus influences a sense of belonging in undergraduate students. Alawakhi, Chandrasekera, and Yang (2011) utilized student perception surveys to measure a sense of belonging. Even though it was a small sample size of 63 and those surveyed were only from an architectural studies department, landmark and route knowledge did significantly predict a sense of belonging. These results indicate that familiarity and comfort with an educational institution may influence students’ sense of belonging, but more research is needed to explore this nuanced topic. Recent studies that have explored the intersection between physical space and belonging provide initial evidence that the physical learning environments can foster a sense of belonging.

**Campus Climate**

Campus climate is a psychological construct concerned with perceptions of interactions, behaviors, and circumstances that create the socio-cultural environment at an institution for higher education (Henry, Fowler, & West, 2011). According to Hurtado and colleagues (1998), campus climate refers to the history of inclusion/exclusion, structural diversity, psychological climate, and behavioral climate. Past studies commonly use this notion of campus climate,
especially when addressing its influence on historically underrepresented groups. The current study conceptualizes environment as the synthesis of physical, virtual, and socio-cultural contexts. Therefore, campus climate operationalizes the socio-cultural context for college students and is held constant in this model to focus on the relationship between informal learning space preferences and university belonging, leading to the first hypothesis of this study.

**Hypothesis 1:** Preferences to spend time outside of class at a college union will be positively related with university belonging such that students who prefer using their college union for formal and informal learning activities are high in university belonging, when accounting for perceptions of welcoming campus climate.

**Social Interactions and a Pluralistic Orientation**

Although preferences for spending time outside of class at the college union is expected to relate to university belonging, the mechanisms underlying this relationship require further exploration: Why and how do informal learning space preferences lead to a greater sense of university belonging on a college campus? The theoretical framework guiding this study posits that how a student thinks, feels, and believes informs their social interactions, which is shaped by the physical environment. Students’ perception of the *Quality of Interactions* that they have on campus can reinforce messaging about what types of behaviors should and should not happen in an academic setting. In addition, a pluralistic orientation is developed throughout college and exposure to diverse others increases this outcome (Denson & Ing, 2014). Because the purpose of this study is to investigate how the college union can cultivate university belonging among
college students, it is important to consider how students’ openness to diverse worldviews, or *Pluralism*, may inform that relationship due to the increasingly diverse nature of college unions.

**Quality of Interactions**

A portion of the National Survey for Student Engagement (NSSE), developed to measure student participation in college, is concerned with the quality of interactions in the campus environment. “College environments characterized by positive interpersonal relations promote student learning and success. Students who enjoy supportive relationships with peers, advisors, faculty, and staff are better able to find assistance when needed, and to learn from and with those around them” (NSSE, 2020). The social relationships that are formed in college can have a lasting impact on student development. However, a more encompassing understanding of environment can be addressed as people associate meaning with different physical environments, in addition to their social environments. Symbolic physical settings, such as college unions, not only create places for social gathering and academic activities, but also often represent institutional values (Clauson & McKnight, 2018). In turn, those social interactions that happen within such settings contribute to the meaning students associate with those places. Past research has found that social interactions students have with their peers and faculty influence a students’ sense of belonging (Hoffman, et al., 2003).

*Hypothesis 2:* The positive relationship between students’ preferences to spend time outside of class at their college union and university belonging is mediated by perceptions of quality of interactions occurring in their college union, when accounting for perceptions of welcoming campus climate.
The next aim of this research is to investigate whether pluralism mediates the relationship between informal learning space preferences and a sense of university belonging, when controlling for campus climate. This study asserts that a higher preference to spend time outside of class at the college union is positively associated with self-perceptions of others (pluralism), which in turn is connected with university belonging. *Pluralism*, or one’s openness to world views different from their own, is relevant to this study because of the diverse perspectives that are found on a college campus. Exposure to diverse groups of people is heightened at a central hub like the college union because it provides amenities and facilities that are regularly accessed by students, faculty, and staff (Rullman, Schermer, & DeSawal, 2020). While belonging is concerned with how much one feels like they fit in at their institution, *pluralism* is concerned with how accepting they are of different worldviews (Engberg & Hurtado, 2011).

**Pluralism**

Pluralism orientation describes one’s openness to diverse world views, cultures, and groups of people (Rockenbach, et. al., 2016). The college campus is a place where individuals that belong to differing religions, ethnicities, sexual orientations, genders, and physical abilities come into contact every day. Even if students are not directly connected to people that are different from them, there is a great amount of passive exposure to diversity in the university setting (Rullman et al., 2020). “A diverse student body provides students with important opportunities to build the skills necessary for bridging cultural differences and may cultivate their capacity for other important learning” (Hurtado, 2001, pp. 188–189). However, only providing spaces for diverse students to come together is not enough, but is an important first step in curating meaningful interactional diversity (Pascarella et al., 2014). Attitudes toward diversity is a self-belief construct that could be a major determinant of human behavior because
personal beliefs are rules for action (James, 1908). A pluralistic orientation could influence the relationship between preferences to spend time at the college union and university belonging because it provides insight into how comfortable students may be in a physical space that offers exposure to diverse others.

Past research has primarily focused on the development of a pluralistic orientation while students are in college, but this study investigates how diverse worldviews, as an input, influence a sense of university belonging. Pluralism has primarily been studied as an outcome of the college experience, but this study is concerned with how it may influence the relationships between informal learning space preferences and university belonging for current undergraduate students in order to grasp how this elusive construct plays a role in the college experience. For example, a student may prefer to go to their college union to engage in study behaviors, but if they are not very pluralistic, it is likely to decrease a sense of belonging in a place that celebrates diversity. Acknowledging that levels of pluralism might mediate the relationship between preferences for informal learning spaces and belonging, allows this study to expand the knowledge base between pluralism as an input and belonging as an outcome in order to understand how the college union can cultivate a sense of belonging in college students.

**Hypothesis 3:** The positive relationship between preferences to spend time outside of class in college unions and university belonging should be mediated by pluralism, when accounting for perceptions of welcoming campus climate.

Higher education institutions can foster a sense of belonging among students through more frequent interactions with diverse peers (Trolian & Parker, 2018), supportive campus
climates (Hurtado & Carter, 1997), and culturally engaging campus environments (Museus, Yi, & Saelua, 2017). Therefore, university administrators should factor in how physical learning environments can foster this sense of belonging by creating opportunities for positive interactions with diverse others. Aligned with the theoretical framework considered for this study, personal factors reciprocally influence both behavior and the physical/social environments. Therefore, we hypothesize that interactions in these environments, along with perceptions of their own pluralistic orientation, can mediate the relationship between students’ preferences for informal learning spaces on campus and university belonging.

Hypothesis 4: The positive relationship between preferences to spend time outside of class at college unions and university belonging is serially mediated by quality of interactions and pluralism, when controlling for campus climate.

In other words, if the mediation is framed in terms of a path model, as depicted in Figure 4.1, there should be an indirect path between informal learning space preference and university belonging through quality of interaction at college unions and pluralism (sequentially).
Research Methods and Data Collection

Site Selection

This research study employs a correlational research design in two contexts. The first case involves Talley Student Union (TSU), which is located on the main campus at North Carolina State University (NC State) in Raleigh, NC. The second case, Gatton Student Center (GSC), is located on the main campus at the University of Kentucky (UK) in Lexington, KY. Each site was selected due to the similarities in operational management and recent completion of renovations and expansion efforts in each respective college union. Both facilities have received the ACUI Excellence in Facility Design Award that recognizes the architectural design of college unions for facilitating community building and student learning. Both universities are
publicly funded land grant institutions with an undergraduate population of 25,973 at NC State and 22,236 at UK that are both predominantly White institutions.

**Participants and Procedures**

The data for this study were collected from undergraduates at two Research I higher education institutions located in the southeastern United States. A random sample of all undergraduates on both campuses were surveyed electronically at the end of the Fall 2019 semester. Each campus administration provided a random sample of 3,000 email addresses that belonged to current undergraduate students. Students were initially contacted via email to participate in the study, with two follow up emails over a two week span for those that had not yet participated, resulting in a response rate of 7.3% for the NC State sample and 6.7% for the UK sample.

Participants in the study \( (n_{\text{NC State}} = 221, n_{\text{UK}} = 202) \) are representative of the population in terms of demographics, academic class, and major and those that had reported they had never been to their college union were excluded from the analysis \( (n_{\text{NC State}} = 3, n_{\text{UK}} = 2); \) see Table 4.1. The online survey included a battery of validated instruments that measure campus climate, undergraduate self-beliefs, and demographic information. The Simple University Belonging Scale (Toland, et al., 2019) and the Pluralism Orientation Scale (Rockenbach, et al., 2016) were utilized to measure undergraduate self-beliefs associated with a supportive learning environment. Campus climate items were adapted from the Interfaith Diversity Experiences and Attitudes Longitudinal Survey (IDEALS, 2020) survey and quality of interactions specific to the college union were adapted from the National Survey of Student Engagement (NSSE, 2020).
Table 4.1  
Demographic Characteristics of Each Sample

<table>
<thead>
<tr>
<th>Demographic Categories</th>
<th>NC State University</th>
<th>University of Kentucky</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gender</td>
<td>n = 221</td>
<td>n = 196</td>
</tr>
<tr>
<td>Ciswoman</td>
<td>126 (57%)</td>
<td>153 (78.1%)</td>
</tr>
<tr>
<td>Cisman</td>
<td>88 (39.8%)</td>
<td>40 (20.4%)</td>
</tr>
<tr>
<td>Transwoman</td>
<td>0 (0%)</td>
<td>1 (0.5%)</td>
</tr>
<tr>
<td>Transman</td>
<td>4 (1.8%)</td>
<td>1 (0.5%)</td>
</tr>
<tr>
<td>Genderqueer or Nonbinary</td>
<td>3 (1.4%)</td>
<td>1 (0.5%)</td>
</tr>
<tr>
<td>Race/ethnicity</td>
<td>n = 218</td>
<td>n = 201</td>
</tr>
<tr>
<td>African American or Black</td>
<td>15 (6.9%)</td>
<td>17 (8.5%)</td>
</tr>
<tr>
<td>Native American, American Indian, or Alaskan Native</td>
<td>0 (0%)</td>
<td>1 (0.5%)</td>
</tr>
<tr>
<td>Asian or Pacific Islander</td>
<td>21 (9.6%)</td>
<td>21 (10.4%)</td>
</tr>
<tr>
<td>Hispanic/Latino/Latinx</td>
<td>6 (2.8%)</td>
<td>4 (2.0%)</td>
</tr>
<tr>
<td>White/Caucasian</td>
<td>158 (72.5%)</td>
<td>142 (70.6%)</td>
</tr>
<tr>
<td>More than one Race</td>
<td>18 (8.3%)</td>
<td>16 (8.0%)</td>
</tr>
<tr>
<td>Academic Class</td>
<td>n = 220</td>
<td>n = 201</td>
</tr>
<tr>
<td>Freshman</td>
<td>41 (18.6%)</td>
<td>62 (30.8%)</td>
</tr>
<tr>
<td>Sophomore</td>
<td>48 (21.8%)</td>
<td>48 (23.9%)</td>
</tr>
<tr>
<td>Junior</td>
<td>50 (22.7%)</td>
<td>45 (22.4%)</td>
</tr>
<tr>
<td>Senior</td>
<td>64 (29.1%)</td>
<td>40 (19.9%)</td>
</tr>
<tr>
<td>Fifth Year Senior</td>
<td>17 (7.7%)</td>
<td>6 (3.0%)</td>
</tr>
</tbody>
</table>

Measures

Mean scores were calculated for all continuous variables, including informal learning space preference, quality of interactions at college unions, pluralism, campus climate, and university belonging. Descriptive statistics and correlations for all variables are depicted in Table 4.2.

University belonging, the dependent variable for this study, was measured with nine items from the Shortened University Belonging Scale (Toland et. al., 2019) adapted to be specific to each university setting (e.g., “Other students at NC State/UK like me the way I am”).

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Students rated their self-reported perception of belonging with responses that varied from 1 (\textit{strongly disagree}) to 5 (\textit{strongly agree}). An EFA yielded one factor grouping for university belonging therefore, a mean score for belonging was calculated, (NC State: $\alpha = .888$; UK: $\alpha = .884$).

Informal learning space preference for TSU/GSC, the predictor variable for this study, was measured with eight items that were crafted to tap into whether students prefer to spend their time outside of class at their college union. Participants were asked to rate how likely they were to spend time outside of class studying, socializing, relaxing, and collaborating on their own or with peers in their college union. Responses varied from 1 (extremely unlikely) to 5 (extremely likely) with an option to report that they have never been to their college union. An exploratory factor analysis (EFA) yielded one factor grouping for informal learning space preference therefore, a general preference score was created (NC State: $\alpha = .827$; UK: $\alpha = .849$).

Quality of interactions at the college union, a self-reported perception measure, was the first mediator variable for this study. This variable was measured with four items (NSSE, 2019) that were adapted to be relevant to the physical context (e.g., “Indicate the quality of interactions with Student Services Staff at Talley Student Union”). Responses varied from 1 (\textit{extremely negative}) to 5 (\textit{extremely positive}). An EFA yielded one factor grouping for quality of interactions therefore, a general perception of quality of interactions score was created (NC State: $\alpha = .856$; UK: $\alpha = .859$).

To measure Pluralism, participants were prompted, “Please consider your belief about worldviews and indicate the extent to which you agree with the following” and included 11 items (Rockenbach et. al., 2016) and is the second mediator variable for this study. Examples of the pluralism items are ‘Truth exists in worldviews other than my own’ and ‘We can overcome
many of the world’s major problems if people of different worldviews work together’. Participants rated their level of agreement from 1 (strongly disagree) to 5 (strongly agree). An EFA yielded one factor grouping for pluralism therefore, a mean score for pluralism was calculated, (NC State: $\alpha = .881$; UK: $\alpha = .910$).

Campus climate, a self-reported perception of the socio-cultural environment measure, has been shown to predict students’ sense of belonging. To account for this potential confounder on university belonging, campus climate is controlled for in this study. The Welcoming Campus Climate scale (IDEALS, 2020) was used to measure the control variable with eight items that were adapted to be relevant to the population (e.g., “This campus is a welcoming place for people of different religions”). Responses varied from 1 (strongly disagree) to 5 (strongly agree). An EFA yielded one factor grouping for campus climate therefore, a mean score for campus climate was calculated, (NC State: $\alpha = .891$; UK: $\alpha = .871$).

**Data Analysis**

Data were collected through Qualtrics and cleaned using SPSS. All analyses were conducted separately for the two samples. Prior to conducting analyses associated with each hypothesis, data were first screened for univariate and multivariate outliers. No outliers were identified and only participants that have been to their college union were included in the analyses. Correlational analyses were then conducted to examine the bivariate associations between all variables in the study (see Table 4.2).
### Table 4.2
*Means, Standard Deviations, and Correlation Coefficients by Sample*

<table>
<thead>
<tr>
<th>Variable</th>
<th>M</th>
<th>SD</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>NC State University</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1. University Belonging</td>
<td>3.85</td>
<td>0.71</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2. Pluralism</td>
<td>4.35</td>
<td>0.55</td>
<td>0.406**</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3. Campus Climate</td>
<td>4.04</td>
<td>0.76</td>
<td>0.474***</td>
<td>0.252***</td>
<td></td>
<td></td>
</tr>
<tr>
<td>4. Quality of Interactions at TSU</td>
<td>4.15</td>
<td>0.66</td>
<td>0.584***</td>
<td>0.339***</td>
<td>0.339***</td>
<td></td>
</tr>
<tr>
<td>5. Preference to Spend Time Outside of Class at TSU</td>
<td>3.50</td>
<td>0.90</td>
<td>0.328***</td>
<td>0.248***</td>
<td>0.112</td>
<td>0.218***</td>
</tr>
<tr>
<td><strong>University of Kentucky</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1. University Belonging</td>
<td>3.76</td>
<td>0.73</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2. Pluralism</td>
<td>4.26</td>
<td>0.62</td>
<td>0.377***</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3. Campus Climate</td>
<td>4.05</td>
<td>0.69</td>
<td>0.505***</td>
<td>0.264***</td>
<td></td>
<td></td>
</tr>
<tr>
<td>4. Quality of Interactions at GSC</td>
<td>4.05</td>
<td>0.72</td>
<td>0.396***</td>
<td>0.379***</td>
<td>0.271***</td>
<td></td>
</tr>
<tr>
<td>5. Preference to Spend Time Outside of Class at GSC</td>
<td>3.24</td>
<td>1.02</td>
<td>0.247***</td>
<td>0.067</td>
<td>0.206***</td>
<td>0.288***</td>
</tr>
</tbody>
</table>

***p ≤ .001, **p ≤ .01, *p ≤ .05

As no prior research has investigated how informal learning space preferences predict belonging, a linear regression was then conducted to investigate the relationship between the independent and dependent variables. Next, a serial mediation analysis was conducted in which the indirect effect of informal learning space preference on university belonging through quality of interactions at TSU/GSC (i.e., the $a_1$-$b_1$ path; Figure 4.1), through pluralism (i.e., the $a_2$-$b_2$
path; Figure 4.1), and through both quality of interactions at TSU/GSC and pluralism (i.e., a1-d12-b2 path; Figure 4.1). Assumptions were first checked by analyzing linearity, independence, normality, and equal variance through descriptive statistics and scatter plots. All path coefficients were calculated using regression analysis with the PROCESS plug-in for SPSS developed by Hayes (2018). This approach to mediation uses bootstrapping to approximate the sampling distribution of the indirect effect and to generate confidence intervals for these effects. The indirect effect is considered significant if the confidence intervals do not pass zero (Hayes, 2018).

Results

The bivariate relationships between informal learning space preference for TSU/GSC, quality of interactions at the college union, pluralism, campus climate, and university belonging were examined with Pearson’s correlations (see Table 4.2). All variables were significantly correlated except for informal learning space preferences and campus climate ($r = .112, p = .098$) in the NC State sample and informal learning space preferences and pluralism ($r = .067, p = .343$) in the UK sample.

To test the first hypothesis, preferences to spend time outside of class at a college union will be positively related with university belonging, a regression analysis was conducted to first test the total effect of informal learning space preference for both TSU and GSC on university belonging. Diagnostics indicate that Tolerance is high and VIF is low in both models for each sample, indicating collinearity is not problematic between the predictors. When campus climate is kept constant, a one unit increase in informal learning space preference at TSU leads to a .218 increase in university belonging, $F = 46.92, p < .001$. Findings were similar, but not as strong, for the UK sample such that when controlling for campus climate, a one unit increase in informal learning space preference at GSC leads to a .106 increase in university belonging, $F = 37.37, p <$
.001. Results of the regression analyses confirm Hypothesis 1. Results indicate that as preferences to spend time outside of class at the college union increase, so does a sense of belonging for students at both universities.

The second hypothesis was tested with a simple mediation analysis conducted using ordinary least squares path analysis, quality of interactions indirectly influenced the positive relationship between informal learning space preferences and university belonging for both the NC State and UK samples. As can be seen in Tables 4.3.1 and 4.3.2, students that have higher preference to spend time outside of class at their college union have higher perceptions of the quality of their interactions at the college union (NC State: $a_1 = .135, p = .006$; UK: $a_1 = .164, p = .004$), and students with more positive perceptions of their interactions at their college union have a greater sense of university belonging (NC State: $b_1 = .423, p < .001$; UK: $b_1 = .197, p = .006$). Results of the bootstrap confidence interval of the indirect effect (NC State: $a_1 b_1 = .057$; UK $a_1 b_1 = .032$) were entirely above zero for both samples (NC State: .0017 to .105; UK: .007 to .068) indicating an indirect effect of preferences on belonging, through quality of interactions while controlling for campus climate, confirming Hypothesis 2.

The next simple mediation analysis in the model, testing the third hypothesis, indicates pluralism orientation indirectly influences the relationship between informal learning space preferences and university belonging for the NC State sample, but not for the UK sample. The direct path between preferences to spend time at the college union and pluralism orientation for undergraduates at NC State was positive ($a_2 = .102, p = .010$) but this relationship was not significant for the UK sample ($a_2 = -.054, p = .154$). However, the more open students are to other worldviews, the more they feel like they belong to their university (NC State: $b_2 = .170, p = .029$; UK: $b_2 = .193, p = .011$). For the NC State sample, the indirect effect ($a_2 b_2 = .017$) of
preference for TSU/GSC on university belonging through pluralism was significant because the bootstrapped confidence interval was .0012 to .0404 and did not cross zero. On the other hand, the confidence interval does contain zero for the UK sample indicating that pluralism orientation was not a significant mediator of the relationship between informal learning space preference and university belonging, when controlling for campus climate only partially confirming Hypothesis 3.

To test the fourth hypothesis, a sequential serial mediation analysis was conducted. The indirect path from informal learning space preference to university belonging through both quality of interactions at the college union and pluralism was significant for both the NC State sample (indirect effect = .006, CI = .0003, .0159) and the UK sample (indirect effect = .009, CI = .0015, .0223), confirming Hypothesis 4. The overall regression models were significant for both samples, explaining 48% of the variance in university belonging for the NC State sample (see Table 4.3.1) and 37% of the variance in university belonging for the UK sample (see Table 4.3.2).
Table 4.3.1

NC State Sample Regression Coefficients, Standard Errors, and Model Summary for the Sequential Serial Mediation Model

<table>
<thead>
<tr>
<th>Antecedent</th>
<th>M₁ (QINT)</th>
<th>M₂ (PO)</th>
<th>Y (SUBS)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Path</td>
<td>Coefficient</td>
<td>SE</td>
</tr>
<tr>
<td>X (PREF)</td>
<td></td>
<td>a₁</td>
<td>0.135</td>
</tr>
<tr>
<td>M₁ (QINT)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>M₂ (PO)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Constant</td>
<td></td>
<td></td>
<td>2.564</td>
</tr>
<tr>
<td>Campus Climate</td>
<td></td>
<td>0.275</td>
<td>0.066</td>
</tr>
</tbody>
</table>

\[ R^2 = 0.1482 \]
\[ R^2 = 0.1835 \]
\[ R^2 = 0.4789 \]

\[ F(2,215) = 15.493, p < .001 \]
\[ F(3,214) = 12.416, p < .001 \]
\[ F(4,213) = 42.817, p < .001 \]

Note. PREF: Preference for spending time outside of class at the college union, QINT: Quality of interactions when at the college union, PO: Pluralism orientation, SUBS: Simple university belonging scale. Controls: campus climate, M₁: First mediator, M₂: Second mediator.
Table 4.3.2

UK Sample Regression Coefficients, Standard Errors, and Model Summary for the Sequential Serial Mediation Model

<table>
<thead>
<tr>
<th>Antecedent</th>
<th>M₁ (QINT)</th>
<th>Consequent</th>
<th>M₂ (PO)</th>
<th>Y (SUBS)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Path</td>
<td>Coefficient</td>
<td>SE</td>
<td>p</td>
</tr>
<tr>
<td>X (PREF)</td>
<td>a₁</td>
<td>0.164</td>
<td>0.056</td>
<td>.004</td>
</tr>
<tr>
<td>M₁ (QINT)</td>
<td></td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>M₂ (PO)</td>
<td></td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Constant</td>
<td></td>
<td>2.583</td>
<td>0.361</td>
<td>&lt;.001</td>
</tr>
<tr>
<td>Campus Climate</td>
<td></td>
<td>0.229</td>
<td>0.083</td>
<td>.007</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>R² = 0.1250</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>F(2,191) = 10.401, p &lt; .001</td>
<td></td>
<td>F(3,190) = 14.440, p &lt; .001</td>
</tr>
</tbody>
</table>

Note. PREF: Preference for spending time outside of class at the college union, QINT: Quality of interactions when at the college union, PO: Pluralism orientation, SUBS: Simple university belonging scale. Controls: campus climate, M₁: First mediator, M₂: Second mediator.
Discussion

People tend to react to their physical environments through associations of activities (Rapoport, 1990). This study defined informal learning related activities as studying, socializing, relaxing, and collaborating. Students’ preference ratings to spend time at their college union to do those activities, either alone or with others, operationalized students’ preference for the college union as an informal learning space. As college unions are designed to accommodate many activities, students must choose whether that place can meet their needs and many factors determine that relationship. Through an agentic perspective on campus ecology as a conceptual framework, this study investigated how preference for doing informal learning related activities at the college union contributes to students’ sense of belonging to their university. The intention of this study was to expand the knowledge base around how designed environments may relate to outcomes that are associated with promoting a positive college experience for undergraduates. As the world has quickly transitioned to rely heavily on virtual interactions due to the COVID-19 pandemic, it is timely for us to evaluate how physical places contribute to the overall student experience. By associating measures that are specific to the built environment (i.e. informal learning space preferences and quality of interactions) with other student experience variables (i.e. pluralism, campus climate, and university belonging), this research unpacks this dynamic relationship.

Understanding how designed environments influence a sense of belonging in college students is important because belonging is related to academic motivation, social acceptance, and wellbeing (e.g. Parr, 2020; Freeman, Anderman, & Jensen, 2007). Furthermore, universities across the US are investing in ways to cultivate a sense of belonging in their students (Supiano, 2018). As hypothesized, the study found that in both samples, higher preferences for spending
time outside of class at the college union predicts higher rates of university belonging. Because students have the agency to decide where they engage in informal learning activities outside of the formal classroom, those that prefer to spend their time at the college union ultimately feel more connected to their institution than their peers that don’t share this preference.

This first initial finding could be due to several reasons associated with the architectural design of the college union along with the presence of student-oriented organizations located in these facilities. The college union, in both contexts, is heavily branded through its architecture to reinforce an institutional presence. Recent work discusses how students’ surroundings are one of the four domains of a students’ sense of belonging to their university (Ahn & Davis, 2019). In addition, areas on campus that reflect diverse and intersecting identities promote positive wellbeing, specifically for students that identify with historically underrepresented groups (Bonnell, 2020). Because space organizes human activities (Hillier & Hanson, 1984) administrators must consider the nonverbal cues architecture communicates to students. Furthermore, both college unions that were investigated in this study are homes for varying student organizations and activities. The very presence of these organizations and student participation in them can make students feel that they are a part of something (Camputaro, 2018). This feeling of connectedness in turn has positive outcomes that help students meet their goals.

The next finding was that ratings of the quality of interactions at the college union significantly mediates this relationship between informal learning space preference and university belonging for both samples. This finding speaks to the nested layer of learning environments; the physical setting shapes social interactions and those social interactions partially determine the process in how preferences for an informal learning space cultivates a sense of belonging in college students. Prior work in education settings have explored the
relationship between the physical and social environments primarily through observation methods (e.g., Sailer, 2015; Pasalar, 2003). The current study expands on this knowledge base by addressing how those social interactions influence a sense of belonging in college students. A recent study posits that four factors associated with the built environment contribute to a sense of belonging, namely one of those being how interiors facilitate social interactions (Whettingsteel, et al., 2020). This study provides further evidence for the dynamic relationship between the physical environment, the social environment, and a sense of belonging. This finding highlights the dynamic relationship between person and environment, and that the environment cannot be simply viewed as just architecture or just social relationships within education settings.

The next research question asked whether pluralism explains the relationship between informal learning space preferences and university belonging. The hypothesis that pluralism would mediate this relationship is grounded in the notion that the college union is a place where people of different religions, worldviews, races, and cultures come together on a daily basis for a variety of reasons. How open students are to interact with people that have differing worldviews may influence students wanting to spend time at the college union and therefore students’ sense of belonging. This was the case for the NC State sample, but not for those students that attend UK. Factors such as how often students frequent their college unions and how familiar they are could likely explain the different results of each sample.

Students surveyed were asked how frequently they attend their college union and almost half (46.2%; Figure 4.2) of NC State undergraduates reported that they visit TSU at least once per day, while 38.1% of participants reported that they visit GSC every day. Furthermore, TSU reopened after renovation in 2015 and GSC reopened after the completion of the renovations in 2018. NC State undergraduates have been able to utilize TSU during their entire time at college
whereas Juniors and Seniors at UK spent the first two to three years of their college experience without GSC. It possible that GSC is still new to students on UK’s campus and has not been intertwined into their daily routine the way that TSU has for NC State students. Alawakhi and colleagues (2011) found that spatial knowledge leads to a sense of belonging, providing insight into how familiarity with a space may influence psychological constructs for college students.

**Figure 4.2**
*Percentage of Frequency of Use Reported by Undergraduate Students*

For the NC State sample, if someone isn’t very pluralistic, they may likely feel uncomfortable in a space that promotes diverse interactions and amplifies differing voices, therefore explaining how lower preferences to spend time at the college union leads to a lower sense of university belonging. This is in line with recent work that positions the college union as a place to develop diverse perspectives (Rullman, Schermer, & DeSawal, 2020). Other positive
outcomes, such as belonging, could be cultivated by providing interventions to promote a pluralistic orientation while in college.

Interestingly, when there was not a direct path from informal learning space preference for the college union and pluralism, the serial mediation model was significant for both samples. This builds on the understanding that interaction with diverse peers increases an overall pluralistic orientation (Engberg, Meador, & Hurtado, 2003). The significant indirect path of the serial mediation model describes how place-based social interactions, along with openness to diverse others, explain the relationship between preferences for the college union and university belonging. It is worth noting that this three-path mediation model was significant for both samples and could further explain how a place like the college union contributes to the overall student experience by taking into account preferences, interactions, relation to others, and connectedness to one’s institution. To foster a sense of belonging, student-oriented spaces on campus should operate in such a way that meets student needs for learning related activities, to optimize engagement with others, and to encourage diverse perspectives and interactions. This study may help administrators and facilities planners understand how buildings like the college union are crucial for creating supportive learning spaces.

**Implications and Limitations**

The theoretical significance of this research is twofold. First, this study further illustrates the importance of places like the college union on a higher education campus. By situating this research to be place-based, the context of the physicality of college union is considered and provides more insight into the meaning associated with physical learning environments. Next, this adds evidence that an agentic perspective on campus ecology provides a conceptual model to understand the dynamic relationship between students and their learning environments. In
addition, this research draws attention to the importance of how physical settings foster a sense of belonging.

Results of this study contribute to a more comprehensive understanding of how a greater sense of belonging can be fostered in college students through place-based experiences. By first providing a physical space that encourages quality interactions with diverse others, a sense of belonging to one’s institution is strengthened. University administrators can look to the program, management, and operations of college unions and adopt this student centric strategy to other campus facilities in order to create more inclusive and supportive learning environments on college campuses. As demonstrated in this research, designers can intentionally create space that encourages quality interactions with diverse peers in order to cultivate a sense of belonging for end users. Both designers and college union administrators should make deliberate efforts in ensuring an abundance of multicultural educational experiences for undergraduate students in part, to enhance a sense of belonging, but also to prepare students for a multicultural world post-graduation (Umbach & Kuh, 2006).

This study was exploratory in nature due to no previous work that has investigated the relation between place-based preferences for informal learning activities, quality of interactions, pluralistic orientation, and university belonging. Therefore, future work should expand on these findings to understand how student characteristics play a part in the development of belonging of college students. In addition, more robust structural equation modeling techniques could be used now that relationships between these variables are established. Only the undergraduate student population was considered for this study and future work could include how the college union supports graduate students, faculty, and staff. This study contributes to the understanding of how the college union cultivates a sense of belonging and future work should investigate how
designed elements and attributes may inform this relationship. In addition, longitudinal work should be conducted to investigate how using the college union over the course of a college students’ career may enhance a pluralistic orientation as an outcome of the college experience.

**Conclusions**

The present study extends the understanding of how informal learning space preferences foster a sense of belonging through quality of interactions and perceptions of openness to other worldviews. This study indicates that college unions can cultivate a sense of belonging in college students through positive social interactions and a pluralistic orientation. As the world has paused to reevaluate the role of physical space in our daily activities, due to the COVID-19 pandemic, the results of this study emphasize the importance of place-based experiences to instigate positive student outcomes. Because preferences for spending time outside of class at the college union are directly related to quality of interactions and university belonging while pluralism helps explain these relationships, it is important to consider how the design of physical spaces can create opportunities for interaction with diverse peers to ultimately enhance students’ connection to their own institution.

By approaching the understanding of how the built environment influences a sense of university belonging, a more holistic view of the college experience is uncovered. The physical environment on a higher education campus is not just a setting for action; rather, it has an active role in how much students feel like they belong to their academic institution. This investigation into college student beliefs, that are related to their views of the world, how they belong, and ultimately the interactions that happen in physical spaces, contributes to the understanding of how designed environments should be intentionally crafted to emphasize a collective diversity of students.
In conclusion, the present study contributes to our understanding of the connections between preferences to spend time at the college union, quality social interactions that occur in the college union, pluralism orientation, and university belonging in undergraduate students at two universities. This study provides empirical evidence that the college union cultivates a sense of belonging in college students through social interactions and students’ self-beliefs of their openness to worldviews different from their own. This study provides insight into how the built environment can play a role in university wide initiatives to create inclusive and welcoming spaces for all students to belong.
References


Retrieved from https://www.acui.org/rolestatement


CHAPTER 5: Conclusion

The purpose of this dissertation was to enhance the understanding of how an academic place, such as the college union, influences informal learning related behaviors and cultivates a sense of belonging in undergraduate students. Although decades of research have established that the physical learning environment shapes user behavior and wellbeing (Maxwell, 2018), less is known about higher education learning spaces, specifically informal learning spaces (Temple, 2008). This dissertation aimed to address this gap in knowledge by first establishing a transdisciplinary conceptual framework and employing two research studies with distinctive methodologies in order to explore how the built environment plays a part in the overall undergraduate student experience at college. College unions have traditionally been understood as the living room of the college campus and this study demonstrates how college unions serve more than just this function; primarily as places to meet the needs of informal learning related activities while demonstrating how the college union can cultivate a sense of belonging in college students.

The first article of this dissertation, found in Chapter 2, aimed to establish a conceptual framework that transcends the disciplinary borders of educational psychology, environmental psychology, architecture, and higher education administration. This conceptual framework organizes personal factors, environmental qualities, perceptions of environmental cues, and behaviors within and transactions between the environment. This framework posits an agentic perspective on campy ecology to emphasize the transactional and reciprocally determinant relationship between the nested layers of the environment and student level personal factors. This framework adapts social cognitive theory (Bandura, 1989), the social ecological model (Stokols, 1995), and campus ecology (Strange & Banning, 2001) to provide a holistic framework that
organizes factors with the goal of understanding the meaning of the campus built environment. Academic place can be utilized by researchers or design teams to conceptualize and understand how campus facilities influence students, and vice versa.

The second article of this dissertation, found in Chapter 3, applies a causal-comparative case study research design to investigate two college unions; Talley Student Union at North Carolina State University and Gatton Student Center at the University of Kentucky. This article utilizes the academic place framework with a methodology traditional to architectural studies in order to explore the reciprocally determinant relationship between environment and behavior within the context of the college union. The purpose of this article was to understand how students utilize gathering spaces within two college unions for informal learning related activities, how those are shaped by the built environment, as well as how certain behaviors show preferences towards global and local spatial properties. Findings indicate that college unions are in fact social spaces, living up to the notion as the “living room” of each campus. However, the majority of students use these spaces on their own. Findings associated with circulation patterns, furniture type, and spatial properties will be discussed further in the following section to expand on both design and research implications.

In Chapter 4, I proposed a serial mediation model to investigate how preferences for spending time at college unions leads to a sense of university belonging as the third article of this dissertation. Utilizing academic place as the conceptual framing for this study, self-report data of student preferences to engage in informal learning related activities at their college union, quality interactions, pluralism, and belonging were measured through survey data and analyzed through linear regression. A random sample of students at each institution were surveyed and the data were analyzed separately for each sample of undergraduates. Results of this study indicate that
the more students prefer to spend their time outside of class at their college union engaging in informal learning related activities, the higher their perception is of quality social interactions and fosters more openness to different worldviews. These factors in turn, promote a stronger sense of university belonging for undergraduate students in both samples. Findings associated from each individual path analysis will be discussed in further detail to elaborate on both research and design implications. Results of this third article indicate how college unions, as an academic place, can cultivate a sense of university belonging through social interactions and a pluralistic orientation.

In the following sections, I discuss research and design implications of each study and how they inform the academic place as a conceptual framework for both research and practice of designing higher education spaces.
<table>
<thead>
<tr>
<th>Finding</th>
<th>Research Implication</th>
<th>Design Implication</th>
</tr>
</thead>
<tbody>
<tr>
<td>In college unions, when more movement was observed, fewer stationary behaviors were observed.</td>
<td>Past research has found that spaces that privilege more movement increase chance encounters (McLane, 2013) but</td>
<td>Designers should find a balance; gathering spaces should be directly connected to major circulation paths but route circulation around gathering spaces to encourage more informal learning.</td>
</tr>
<tr>
<td></td>
<td>this study found that discourages stationary behaviors</td>
<td></td>
</tr>
<tr>
<td>College unions are social spaces but the majority of students are not engaging with others.</td>
<td>Builds off previous findings that students seek informal spaces to be “alone together” (Kim, Bosch, &amp; Lee, 2020). At Gatton, the least utilized zones had social lounge furniture groupings.</td>
<td>Furniture in gathering spaces should accommodate both groups and individuals, lounge furniture and worktables, allowing for flexibility and student driven adjustable spaces.</td>
</tr>
<tr>
<td>Behavior groups differed globally for both Talley and Gatton, however local patterns don’t match global patterns at Gatton.</td>
<td>Usage patterns are driven by global configuration at Gatton, indicating a weak programme building (Capille &amp; Psarra, 2013) whereas similar global and local spatial patterns were observed at Talley.</td>
<td>Planning informal learning spaces with a strong programme can lead to more interactions and distribute informal learning behaviors throughout the entire building, but more isolated spaces afford restoration behaviors.</td>
</tr>
<tr>
<td>Pluralism did not explain the relationship between preferences and belonging for those students at Kentucky but did for NC State.</td>
<td>In a predominantly White sample, findings were inconsistent and future work should address how this relationship may change through how frequently students visit their college union.</td>
<td>To encourage exposure to diverse others, the most accessible spaces should be open to students, as observed in Talley.</td>
</tr>
<tr>
<td>The serial mediation models were significant for both samples.</td>
<td>By providing a physical space that encourages quality interactions with diverse others, a sense of belonging to one’s institution is strengthened.</td>
<td>Designers can intentionally create space that encourages quality interactions with diverse peers in order to cultivate a sense of belonging for end users.</td>
</tr>
</tbody>
</table>
**Research Implications**

This dissertation contributes to the knowledge base in terms of providing a conceptual framework to understand factors that contribute to the meaning of an academic place, how informal learning behavior usage patterns are related to spatial properties at two college unions, and how the college union can cultivate a sense of belonging in undergraduate students. The purpose of this dissertation was to establish a transdisciplinary conceptual framework that organizes factors associated with higher education environments and use that framework to inform two empirical investigations into how the college union contributes to the undergraduate student experience. This work demonstrates how studies in two differing methodological traditions (architectural studies and educational psychology) can successfully conceptualize research concerned with higher education facilities and the reciprocally determinant relationship between environmental qualities, personal characteristics, perceptions of the environment, and behaviors that occur. Lastly, this work builds on previous findings (Capillé & Psarra, 2014; Sailer, 2015) on how functionally programmed spaces defy the traditional notions of integration measures predicting movement and more work should be conducted to expand on this notion, by taking into account the in-betweenness of gathering spaces in addition to other physical attributes that inform space usage.

**Design Implications**

Academic place can also serve as a framework for organizing the pre-design process of higher education facilities to ensure design intention matches design outcome. Further, results of the second study reveal that spaces that privilege more movement are good for chance encounters (McLane, 2013) but are less supportive of stationary informal learning activities. This distinction is important for designers to keep in mind as these gathering spaces serve as third
places for undergraduates. Finding the balance between privileging movement and supportive informal learning spaces is crucial for the success of these spaces. In addition, while college unions are incredibly social spaces, a large majority of students were also there on their own. Particular attention should be given to balancing furniture pairings that accommodate both groups and students on their own, while providing flexibility for reshuffling the space to support events that are happening in the college union or for safe practices of physical distancing due to a global pandemic. In addition, findings from the third article corroborate the notion that college unions are social spaces and students’ perceptions of their interactions there partly explain their sense of university belonging. Similarly, when planning for informal learning, strategizing how diverse folks can come together (passively and actively) can also heighten a sense of belonging to the institution. Designers should create gathering spaces that meet student needs for informal learning by reducing major circulation through spaces, rather gathering spaces should be directly adjacent to major circulation paths to increase likelihood of chance encounters of diverse others in order to cultivate a sense of belonging in college students.
References


Appendix A. Integration and Area Measures

Integration is determined by first calculating Mean Depth ($\bar{D}$) by “assigning a depth value to each space according to how many spaces it is away from the original space, summing these values and dividing by the number of spaces in the system less one (the original space)” (Hillier & Hanson, 1984, p. 108). Then, dValue is calculated which is the standardized relative asymmetry (RA) of each to account for the number of lines in each system where $k$ is the total number of lines and is expressed as:

$$dValue = \frac{2\left\{k \left[ \log_2 \left( \frac{k + 2}{3} \right) - 1 \right] + 1 \right\}}{(k - 1)(k - 2)}$$

Lastly, the integration score is calculated as the real relative asymmetry (RRA) of a line which is a normalized equation of $\bar{D}$ expressed as:

$$Integration \ (HH) = \frac{dValue(k - 2)}{2(\bar{D} - 1)}$$

Area is a measure bound to real size that describes the volume of a space. The Isovist_App calculates this measure using the mean radial length ($L_i$) squared for every point in the plan and “the outcome is multiplied by Pi and the number of samples in one full cycle to give an absolute value of area” (McElhinney, 2020, p. 21). First, radial length ($L_i$) is calculated through radial intersection coordinates ($X_i, Y_i$) and the coordinates of the point in the plan ($X_v, Y_v$) and expressed as:

$$L_i = \sqrt{(X_i - X_v)^2 + (Y_i - Y_v)^2}$$

Then, area is calculated through the radial length ($L_i$), total number of radials samples ($n$) and expressed as:

$$A_v = \frac{\pi}{n} \sum_{i=1}^{n} L_i^2$$
Appendix B. Talley Student Union Observation Sites

TSU Location 3, High Connectivity

TSU Location 4, High Connectivity

TSU Location 2, Medium Connectivity

TSU Location 6, Medium Connectivity

TSU Location 5, Low Connectivity

TSU Location 1, Low Connectivity
Appendix C. Gatton Student Center Observation Sites

GSC Location 3, High Connectivity  GSC Location 5, High Connectivity
GSC Location 4, Medium Connectivity  GSC Location 6, Medium Connectivity
GSC Location 1, Low Connectivity  GSC Location 2, Low Connectivity
Appendix D. NC State University Institutional Review Board Approval

Dear Celen Pasalar:

Date: September 25, 2019
IRB Protocol 20263 has been assigned Exempt status
Title: The Influence of Physical Space on Academic Place:
The Multi-Use Informal Learning Environment in Higher Education
PI: Pasalar, Celen

The research proposal named above has received administrative review and has been
approved as exempt from the policy as outlined in the Code of Federal Regulations
(Exemption: 46.101. Exempt d.2). Provided that the only participation of the subjects is
as described in the proposal narrative, this project is exempt from further review. This
approval does not expire, but any changes must be approved by the IRB prior to
implementation.

1. This committee complies with requirements found in Title 45 part 46 of The
   Code of Federal Regulations. For NCSU projects, the Assurance Number is:
   FWA00003429.

2. Any changes to the protocol and supporting documents must be submitted and
   approved by the IRB prior to implementation.

3. If any unanticipated problems or adverse events occur, they must be reported
to the IRB office within 5 business days by completing and submitting the
unanticipated problem form on
   the IRB website: http://research.ncsu.edu/sparcs/compliance/irb/submission-
guidance/.

4. Any unapproved departure from your approved IRB protocol results in non-
   compliance. Please find information regarding non-compliance

Please let us know if you have any questions.
Appendix E. University of Kentucky Institutional Review Board Approval

EXEMPTION CERTIFICATION

IRB Number: 54728

TO: Rebekah Radlke
School of Interiors
PI phone #: 859-494-4684
PI email: rebekahradlke@gmail.com

FROM: Chairperson/Vice Chairperson
Nonmedical Institutional Review Board (IRB)

SUBJECT: Approval for Exemption Certification

DATE: 11/13/2019

On 11/12/2019, it was determined that your project entitled "The Influence of Physical Space on Academic Place: The Multi-Use Informal Learning Environment in Higher Education" meets federal criteria to qualify as an exempt study.

Because the study has been certified as exempt, you will not be required to complete continuation or final review reports. However, it is your responsibility to notify the IRB prior to making any changes to the study. Please note that changes made to an exempt protocol may disqualify it from exempt status and may require an expedited or full review.

The Office of Research Integrity will hold your exemption application for six years. Before the end of the sixth year, you will be notified that your file will be closed and the application destroyed. If your project is still ongoing, you will need to contact the Office of Research Integrity upon receipt of that letter and follow the instructions for completing a new exemption application. It is, therefore, important that you keep your address current with the Office of Research Integrity.

For information describing investigator responsibilities after obtaining IRB approval, download and read the document "PI Guidelines to Responsibilities, Qualifications, Records and Documentation of Human Subjects Research" available in the online Office of Research Integrity/IRB Survival Handbook. Additional information regarding IRB review, federal regulations, and institutional policies may be found through IRB’s web site. If you have questions, need additional information, or would like a paper copy of the above mentioned document, contact the Office of Research Integrity at 859-257-9428.
Appendix F. NC State Undergraduate Student Informed Consent Form

Principal Investigator: Renae Mantooth, rnmantoo@ncsu.edu
Faculty Point of Contact: Dr. Celen Pasalar, celen_pasalar@ncsu.edu

You are invited to take part in a research study that will be part of dissertation work. Your participation in this study is voluntary. You have the right to be a part of this study, to choose not to participate, and to stop participating at any time without penalty. The purpose of this research study is to gain a better understanding of your experience as an undergraduate student at North Carolina State University, specifically in terms of how Talley Student Union contributes to your self-beliefs, informal learning related behaviors, and frequency of use. We will do this through an online survey. You are not guaranteed any personal benefits from being in this study and there are no anticipated risks associated with your participation. You may want to participate in this research because your responses can help us understand how the design of the built environment influences your academic and social interactions on campus.

Specific details about the research in which you are invited to participate are contained below. If you do not understand something in this form, please ask the researcher for clarification or more information. A copy of this consent form will be provided to you. If, at any time, you have questions about your participation in this research, do not hesitate to contact the PI, Renae Mantooth via email at rnmantoo@ncsu.edu, Dr. Celen Pasalar via email at celen_pasalar@ncsu.edu, or the NC State IRB Office via email at irb-director@ncsu.edu or via phone at (919) 515-8754.

The purpose of the study is to understand your experience as an undergraduate student at NC State and specifically how Talley Student Union may or may not contribute to that experience. You are eligible to participate in this study if you are over the age of 18 and are a current undergraduate at NC State. You cannot participate in the study if you do not consent or are under the age of 18.

The following survey will take approximately 10-15 minutes to complete. At any moment during the survey, you can close the form and your responses will not be recorded. The information that you share with us will be held in confidence to the fullest extent allowed by law. Protecting your privacy as related to this research is of utmost importance to us and your participation in this study is not a course requirement and your participation or lack thereof, will not affect your class standing or grades at NC State. Data generated about you in this study will be completely anonymous. Unless you give explicit permission to the contrary, no reference will be made in oral or written reports which could link you to the study. If you are open to participating in future research or would like to enter the drawing for one of four $30 Amazon gift cards, and the early deadline drawing for an additional one of twenty $15 Amazon gift cards, we will ask you to provide your email address, but this information will not be tied to your survey responses to
maintain anonymity.

By signing this consent form, I am affirming that I have read and understand the above information. All of the questions that I had about this research have been answered. I have chosen to participate in this study with the understanding that I may stop participating at any time without penalty or loss of benefits to which I am otherwise entitled. I am aware that I may revoke my consent at any time.

I consent to research <insert Qualtrics button>
I do not consent to research <insert Qualtrics button>
Appendix G. University of Kentucky Undergraduate Student Informed Consent Form

Principal Investigator: Renae Mantooth, rnmantoo@ncsu.edu
Faculty Point of Contact: Dr. Celen Pasalar, celen_pasalar@ncsu.edu
UK Faculty Point of Contact: Prof. Rebekah Radtke, rebekah.radtke@uky.edu

You are invited to take part in a research study that will be part of dissertation work. Your participation in this study is voluntary. You have the right to be a part of this study, to choose not to participate, and to stop participating at any time without penalty. The purpose of this research study is to gain a better understanding of your experience as an undergraduate student at the University of Kentucky, specifically in terms of how Gatton Student Center contributes to your self-beliefs, informal learning related behaviors, and frequency of use. We will do this through an online survey. You are not guaranteed any personal benefits from being in this study and there are no anticipated risks associated with your participation. You may want to participate in this research because your responses can help us understand how the design of the built environment influences your academic and social interactions on campus.

Specific details about the research in which you are invited to participate are contained below. If you do not understand something in this form, please ask the researcher for clarification or more information. A copy of this consent form will be provided to you. If, at any time, you have questions about your participation in this research, do not hesitate to contact the PI, Renae Mantooth via email at rnmantoo@ncsu.edu, Prof. Rebekah Radtke via email at rebekah.radtke@uky.edu, Dr. Celen Pasalar via email at celen_pasalar@ncsu.edu, or the NC State IRB Office via email at irb-director@ncsu.edu or via phone at (919) 515-8754.

The purpose of the study is to understand your experience as an undergraduate student at UK and specifically how Gatton Student Center may or may not contribute to that experience. You are eligible to participate in this study if you are over the age of 18 and are a current undergraduate at UK. You cannot participate in the study if you do not consent or are under the age of 18.

The following survey will take approximately 10-15 minutes to complete. At any moment during the survey, you can close the form and your responses will not be recorded. The information that you share with us will be held in confidence to the fullest extent allowed by law. Protecting your privacy as related to this research is of utmost importance to us and your participation in this study is not a course requirement and your participation or lack thereof, will not affect your class standing or grades at NC State. Data generated about you in this study will be completely anonymous. Unless you give explicit permission to the contrary, no reference will be made in oral or written reports which could link you to the study. If you are open to participating in future research or would like to enter the drawing for one of four $30 Amazon gift cards, and the early deadline drawing for an additional one of twenty $15 Amazon gift cards, we will ask you to
provide your email address, but this information will not be tied to your survey responses to maintain anonymity.

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I consent to research <insert Qualtrics button>
I do not consent to research <insert Qualtrics button>
Appendix H. NC State Undergraduate Student Survey
Survey Title: Talley Student Union and the Undergraduate Student Experience

Preference of Informal Learning Spaces

When considering how you spend your time outside of class, how likely are you to…
[1: Not At All Likely; 5: Extremely Likely]

1. Study (e.g., write a paper, read books) on your own at…
   a. D. H. Hill Library
   b. Hunt Library
   c. Talley Student Union
   d. Witherspoon Student Center
2. Study (e.g., do your homework, review notes) with friends/classmates at…
   a. D. H. Hill Library
   b. Hunt Library
   c. Talley Student Union
   d. Witherspoon Student Center
3. Socialize (e.g., Snapchat, Twitter) online at…
   a. D. H. Hill Library
   b. Hunt Library
   c. Talley Student Union
   d. Witherspoon Student Center
4. Socialize (e.g., converse, play games) with friends/classmates at…
   a. D. H. Hill Library
   b. Hunt Library
   c. Talley Student Union
   d. Witherspoon Student Center
5. Relax (e.g., read for leisure, listen to a podcast) on your own at…
   a. D. H. Hill Library
   b. Hunt Library
   c. Talley Student Union
   d. Witherspoon Student Center
6. Relax (e.g., watch movies, take a walk) with friends/classmates at…
   a. D. H. Hill Library
   b. Hunt Library
   c. Talley Student Union
   d. Witherspoon Student Center
7. Collaborate (e.g., Google Hangouts, Zoom) online at…
   a. D. H. Hill Library
   b. Hunt Library
c. Talley Student Union
d. Witherspoon Student Center

8. Collaborate (e.g., work on a project) with classmates/teachers at…
   a. D. H. Hill Library
   b. Hunt Library
c. Talley Student Union
d. Witherspoon Student Center

**Talley Student Union**

How often do you go to Talley Student Union?
1. Multiple times per day
2. Once a Day
3. Every Few Days
4. Once a Week
5. Two or Three Times a Month
6. Once a Month
7. Once or Twice a Semester
8. Never

What about the physical environment of Talley Student Union makes you want to go there? (select top three reasons)
1. Decoration and Artwork (e.g., colors, patterns, textures)
2. Flexibility of Spaces (e.g., personal control of spaces)
3. Furnishings (e.g., mobile whiteboards, seating arrangements)
4. Light Conditions (e.g., daylight from windows)
5. Noise Levels (e.g., quiet acoustics)
6. Overall Feel of the Space (e.g., atmosphere, visual appeal)
7. Proximity to Amenities (e.g., student orgs, rec center)
8. Proximity to Classes
9. Proximity to Dining Options
10. Technology Access (e.g., Wi-Fi, electric outlets)
11. Thermal Comfort (e.g., temperature, humidity)
12. N/A

**D. H. Hill Library**

How often do you go to D.H. Hill Library?
1. Multiple times per day
2. Once a Day
3. Every Few Days
4. Once a Week
5. Two or Three Times a Month
6. Once a Month
7. Once or Twice a Semester
8. Never

What about D.H. Hill Library makes you want to go there? (select top three reasons)
1. Decoration and Artwork (e.g., colors, patterns, textures)
2. Flexibility of Spaces (e.g., personal control of spaces)
3. Furnishings (e.g., mobile whiteboards, seating arrangements)
4. Light Conditions (e.g., daylight from windows)
5. Noise Levels (e.g., quiet acoustics)
6. Overall Feel of the Space (e.g., atmosphere, visual appeal)
7. Proximity to Amenities (e.g., student orgs, rec center)
8. Proximity to Classes
9. Proximity to Dining Options
10. Technology Access (e.g., Wi-Fi, electric outlets)
11. Thermal Comfort (e.g., temperature, humidity)
12. N/A

Hunt Library

How often do you go to Hunt Library?
1. Multiple times per day
2. Once a Day
3. Every Few Days
4. Once a Week
5. Two or Three Times a Month
6. Once a Month
7. Once or Twice a Semester
8. Never

What about Hunt Library makes you want to go there? (select top three reasons)
1. Decoration and Artwork (e.g., colors, patterns, textures)
2. Flexibility of Spaces (e.g., personal control of spaces)
3. Furnishings (e.g., mobile whiteboards, seating arrangements)
4. Light Conditions (e.g., daylight from windows)
5. Noise Levels (e.g., quiet acoustics)
6. Overall Feel of the Space (e.g., atmosphere, visual appeal)
7. Proximity to Amenities (e.g., student orgs, rec center)
8. Proximity to Classes
9. Proximity to Dining Options
10. Technology Access (e.g., Wi-Fi, electric outlets)
11. Thermal Comfort (e.g., temperature, humidity)
12. N/A

Witherspoon Student Center

How often do you go to Witherspoon Student Center?
1. Multiple times per day
2. Once a Day
3. Every Few Days
4. Once a Week
5. Two or Three Times a Month
6. Once a Month
7. Once or Twice a Semester
8. Never

What about Witherspoon Student Center makes you want to go there? (select top three reasons)
1. Decoration and Artwork (e.g., colors, patterns, textures)
2. Flexibility of Spaces (e.g., personal control of spaces)
3. Furnishings (e.g., mobile whiteboards, seating arrangements)
4. Light Conditions (e.g., daylight from windows)
5. Noise Levels (e.g., quiet acoustics)
6. Overall Feel of the Space (e.g., atmosphere, visual appeal)
7. Proximity to Amenities (e.g., student orgs, rec center)
8. Proximity to Classes
9. Proximity to Dining Options
10. Technology Access (e.g., Wi-Fi, electric outlets)
11. Thermal Comfort (e.g., temperature, humidity)
12. N/A

Informal Space Behaviors

When you are on campus and in-between classes (not in your residence hall or at work), what do you spend the majority of your time doing? (select top three behaviors)
1. Browsing Social Media
2. Collaborating with Peers
3. Dining
4. Doing Homework Assignments
5. Exercising
6. Participating in Extracurriculars (e.g. Greek life, student orgs)
7. Preparing for Classes
8. Meeting with Faculty, TA, Tutor
9. Practicing Self-Care (e.g., physical and mental well-being)
10. Socializing with Friends
11. Studying
12. Other (please specify) 

**Welcoming Campus Climate**

Please consider aspects of diversity at NC State and indicate the extent to which you agree with the following

[1: Strongly Disagree; 5: Strongly Agree]

This campus is a welcoming place for…

1. People of Different Religions
2. Politically Liberal People
3. Politically Conservative People
4. Gay, Lesbian, and Bisexual People
5. Nonbinary, Genderqueer, and Transgender People
6. People of Different Socioeconomic Backgrounds
7. People of Different Races
8. People from Different Countries

How do you think the physical environment of Talley Student Union contributes to the campus climate at NC State? [open ended]

**Simple University Belongingness Scale**

Please consider your experience at NC State and indicate the extent to which you agree with the following

[1: Strongly Disagree; 5: Strongly Agree]

1. Other students at NC State take my opinion seriously.
2. People at NC State are friendly to me.
3. I am included in lots of activities at NC State.
4. Other students at NC State like me the way I am.
5. I like to think of myself as similar to others at NC State.
6. Professors in my classes care if I am absent.
7. I feel like I matter to people at NC State.
8. People at NC State really listen to me.
9. I feel like my ideas count in my classes.

What (if anything) is it about Talley Student Union that makes you feel like you belong at NC State? [open ended]

What (if anything) is it about Talley Student Union that makes you feel like you don’t belong at NC State? [open ended]

**Pluralism Orientation Scale**

Please consider your belief about worldviews and indicate the extent to which you agree with the following

[1: Strongly Disagree; 5: Strongly Agree]

1. World religions share many common values
2. It’s important to understand the differences between world religions
3. I respect people who have worldviews that differ from my own
4. I understand the reasoning behind one or more worldviews other than my own
5. Truth exists in worldviews other than my own
6. Cultivating religious tolerance and understanding will make the world a more peaceful place
7. My faith or beliefs are strengthened by relationships with those of diverse religious and non-religious backgrounds
8. It is possible to have strong relationships with those of religiously diverse backgrounds and still strongly believe in my own worldview
9. My worldview inspires me to serve with others on issues of common concern
10. It is important to serve with those of diverse religious backgrounds on issues of common concern
11. We can overcome many of the world’s major problems if people of different worldviews work together

What (if anything) is it about Talley Student Union that makes you feel like you are welcome at NC State? [open ended]

What (if anything) is it about Talley Student Union that makes you feel like you are not welcome at NC State? [open ended]

**Shortened Warwick-Edinburgh Mental Well-Being Scale (SWEMWBS)**
Below are some statements about feelings and thoughts. Please circle the answer that best describes your experience of each over the last 2 weeks.

[1: Strongly Disagree; 5: Strongly Agree]

1. I've been feeling optimistic about the future.
2. I've been feeling useful.
3. I've been feeling relaxed.
4. I've been dealing with problems well.
5. I've been thinking clearly.
6. I've been feeling close to other people.
7. I've been able to make up my own mind about things.

In what ways does Talley Student Union contribute to your mental well-being? [open ended]

Self-efficacy for Learning Form (SELF)

Please consider your ability to indicate the extent to which you agree with the following

[1: Definitely Cannot Do It; 5: Definitely Can Do It]

1. When you miss a class, can you find another student who can explain the lecture notes as clearly as your teacher did?
2. When your teacher’s lecture is very complex, can you write an effective summary of your original notes before the next class?
3. When a lecture is especially boring, can you motivate yourself to keep good notes?
4. When you had trouble understanding your instructor’s lecture, can you clarify the confusion before the next class meeting by comparing notes with a classmate?
5. When you have trouble studying your class notes because they are incomplete or confusing, can you revise and rewrite them clearly after every lecture?
6. When you are taking a course covering a huge amount of material, can you condense your notes down to just the essential facts?
7. When you are trying to understand a new topic, can you associate new concepts with old ones sufficiently well to remember them?
8. When another student asks you to study together for a course in which you are experiencing difficulty, can you be an effective study partner?
9. When problems with friends and peers conflict with schoolwork, can you keep up with your assignments?
10. When you feel moody or restless during studying, can you focus your attention well enough to finish your assigned work?
11. When you find yourself getting increasingly behind in a new course, can you increase your study time sufficiently to catch up?
12. When you discover that your homework assignments for the semester are much longer than expected, can you change your other priorities to have enough time for studying?
13. When you have trouble recalling an abstract concept, can you think of a good example that will help you remember it on the test?
14. When you have to take a test in a school subject you dislike, can you find a way to motivate yourself to earn a good grade?
15. When you are feeling depressed about a forthcoming test, can you find a way to motivate yourself to do well?
16. When your last test results were poor, can you figure out potential questions before the next test that will improve your score greatly?
17. When you are struggling to remember technical details of a concept for a test, can you find a way to associate them together that will ensure recall?
18. When you think you did poorly on a test you just finished, can you go back to your notes and locate all the information you had forgotten?
19. When you find that you had to “cram” at the last minute for a test, can you begin your test preparation much earlier so you won’t need to cram the next time?

In what ways does Talley Student Union contribute to your ability to succeed academically? [open ended]

**Quality of Interactions at Talley Student Union**

Indicate the quality of your interactions with the following people when you are at Talley Student Union:

[1: Extremely Negative; 5: Extremely Positive, n/a]

1. Other Students
2. Faculty
3. Student Services Staff (student organizations, student government, bookstore, etc.)
4. Other Administrative Staff and Offices (student ID, student centers admin, etc.)

How would you describe, to a prospective NC State student, Talley Student Union’s role in your overall campus experience? [open ended]

**Environmentalism**

How important to you is it that campus buildings are healthy, highly efficient, and cost saving green buildings?

[1: Not At All Important; 5: Extremely Important]

The Leadership in Energy and Environmental Design (LEED) Certification provides a framework to create healthy, highly efficient, and cost-saving green buildings. Do you know whether or not Talley Student Union has received this certification?
1. Yes I do.
2. No I do not.

In terms of your daily life on campus how likely are you to…

[1: Not Very Likely; 5: Extremely Likely]
1. Change your daily routine (e.g., deny single use plastics, turn the lights down) in order to protect the environment?
2. Make sacrifices to your standard of living (e.g., accept higher prices, drive less, reduce consumption of animal products) in order to protect the environment?

Demographic Information

How do you identify in terms of your gender? (mark all that apply)
1. Ciswoman
2. Cisman
3. Transwoman
4. Transman
5. Genderqueer or Non-binary
6. Uncertain or Questioning
7. I identify using a different term (please specify) __________
8. Prefer Not to Answer

How do you identify in terms of your sexual orientation? (mark all that apply)
1. Heterosexual or Straight
2. Gay
3. Lesbian
4. Bisexual or Pansexual
5. Uncertain or Questioning
6. I identify using a different term (please specify) __________
7. Prefer Not to Answer

What is your race/ethnicity? (mark all that apply)
1. African American or Black
2. Native American, American Indian, or Alaskan Native
3. Asian or Pacific Islander
4. Hispanic/Latino/Latinx
5. White/Caucasian
6. I identify using a different term (please specify) __________
7. Prefer Not to Answer
What is your religious preference?
1. Buddhism
2. Christianity
3. Hinduism
4. Islam
5. Judaism
6. Secular/Nonreligious/Agnostic/Atheist
7. Other (please specify) ________
8. Prefer Not to Answer

Do you have any of the diagnosed disabilities or conditions? (mark all that apply)
1. ADHD (Attention Deficit Hyperactivity Disorder)
2. Autism Spectrum Disorder
3. Blindness/Low Vision
4. Brain Injury
5. Deafness/Hard of Hearing
6. Learning Disability
7. Orthopedic/Mobility Disability
8. Psychological Disability
9. Prefer Not to Answer

How would you describe your socioeconomic background when you were growing up?
1. Poor/Low Income
2. Working Class
3. Middle Class
4. Upper Middle or Professional Class
5. Upper Class/Wealthy
6. Prefer Not to Answer

In what setting did you spend most of your life before coming to NC State? (if several apply, use the most recent one).
1. Rural Area
2. Small Town (20,000 or fewer people)
3. Moderate Size City (20,0001 - 100,000 people)
4. Large City (over 100,000 people)

What is your age? (write in)

What is your Academic Class?
1. Freshman
2. Sophomore
3. Junior
4. Senior
5. Super Senior

What college do you belong to?
1. College of Agriculture and Life Sciences
2. College of Design
3. College of Education
4. College of Engineering
5. College of Humanities and Social Sciences
6. College of Natural Resources
7. Poole College of Management
8. College of Sciences
9. Wilson College of Textiles
10. College of Veterinary Medicine
11. University College (e.g., exploratory studies, ROTC)
12. Prefer Not to Answer

Where do you live?
1. On Campus
2. Off Campus Student Housing
3. Off Campus

What is your cumulative GPA?
1. 3.6 - 4.0
2. 3.1 - 3.5
3. 2.6 - 3.0
4. 2.1 - 2.5
5. 2.0 or lower
6. Prefer Not to Answer
Appendix I. University of Kentucky Undergraduate Student Survey

Survey Title: Gatton Student Center and the Undergraduate Student Experience

Preference of Informal Learning Spaces

When considering how you spend your time outside of class, how likely are you to…
[1: Not At All Likely; 5: Extremely Likely]

1. Study (e.g., write a paper, read books) on your own at…
   a. Gatton Student Center
   b. William T. Young Library
   c. The 90
   d. Your College Library (e.g., Margaret I. King Library, Lucille Caudill Little Fine Arts Library)

2. Study (e.g., do your homework, review notes) with friends/classmates at…
   a. Gatton Student Center
   b. William T. Young Library
   c. The 90
   d. Your College Library (e.g., Margaret I. King Library, Lucille Caudill Little Fine Arts Library)

3. Socialize (e.g., Snapchat, Twitter) online at…
   a. Gatton Student Center
   b. William T. Young Library
   c. The 90
   d. Your College Library (e.g., Margaret I. King Library, Lucille Caudill Little Fine Arts Library)

4. Socialize (e.g., converse, play games) with friends/classmates at…
   a. Gatton Student Center
   b. William T. Young Library
   c. The 90

5. Relax (e.g., read for leisure, listen to a podcast) on your own at…
   a. Gatton Student Center
   b. William T. Young Library
   c. The 90
   d. Your College Library (e.g., Margaret I. King Library, Lucille Caudill Little Fine Arts Library)

6. Relax (e.g., watch movies, take a walk) with friends/classmates at…
   a. Gatton Student Center
   b. William T. Young Library
   c. The 90
d. Your College Library (e.g., Margaret I. King Library, Lucille Caudill Little Fine Arts Library)

7. Collaborate (e.g., Google Hangouts, Zoom) online at…
   a. Gatton Student Center
   b. William T. Young Library
   c. The 90
   d. Your College Library (e.g., Margaret I. King Library, Lucille Caudill Little Fine Arts Library)

8. Collaborate (e.g., work on a project) with classmates/teachers at…
   a. Gatton Student Center
   b. William T. Young Library
   c. The 90
   d. Your College Library (e.g., Margaret I. King Library, Lucille Caudill Little Fine Arts Library)

Gatton Student Center

How often do you go to Gatton Student Center?
   1. Multiple times per day
   2. Once a Day
   3. Every Few Days
   4. Once a Week
   5. Two or Three Times a Month
   6. Once a Month
   7. Once or Twice a Semester
   8. Never

What about the physical environment of Gatton Student Center makes you want to go there? (select top three reasons)
   1. Decoration and Artwork (e.g., colors, patterns, textures)
   2. Flexibility of Spaces (e.g., personal control of spaces)
   3. Furnishings (e.g., mobile whiteboards, seating arrangements)
   4. Light Conditions (e.g., daylight from windows)
   5. Noise Levels (e.g., quiet acoustics)
   6. Overall Feel of the Space (e.g., atmosphere, visual appeal)
   7. Proximity to Amenities (e.g., student orgs, rec center)
   8. Proximity to Classes
   9. Proximity to Dining Options
   10. Technology Access (e.g., Wi-Fi, electric outlets)
   11. Thermal Comfort (e.g., temperature, humidity)
William T. Young Library

How often do you go to William T. Young Library?
1. Multiple times per day
2. Once a Day
3. Every Few Days
4. Once a Week
5. Two or Three Times a Month
6. Once a Month
7. Once or Twice a Semester
8. Never

What about the physical environment of William T. Young Library makes you want to go there? (select top three reasons)
1. Decoration and Artwork (e.g., colors, patterns, textures)
2. Flexibility of Spaces (e.g., personal control of spaces)
3. Furnishings (e.g., mobile whiteboards, seating arrangements)
4. Light Conditions (e.g., daylight from windows)
5. Noise Levels (e.g., quiet acoustics)
6. Overall Feel of the Space (e.g., atmosphere, visual appeal)
7. Proximity to Amenities (e.g., student orgs, rec center)
8. Proximity to Classes
9. Proximity to Dining Options
10. Technology Access (e.g., Wi-Fi, electric outlets)
11. Thermal Comfort (e.g., temperature, humidity)
12. N/A

The 90

How often do you go to The 90?
1. Multiple times per day
2. Once a Day
3. Every Few Days
4. Once a Week
5. Two or Three Times a Month
6. Once a Month
7. Once or Twice a Semester
8. Never
What about The 90 makes you want to go there? (select top three reasons)
1. Decoration and Artwork (e.g., colors, patterns, textures)
2. Flexibility of Spaces (e.g., personal control of spaces)
3. Furnishings (e.g., mobile whiteboards, seating arrangements)
4. Light Conditions (e.g., daylight from windows)
5. Noise Levels (e.g., quiet acoustics)
6. Overall Feel of the Space (e.g., atmosphere, visual appeal)
7. Proximity to Amenities (e.g., student orgs, rec center)
8. Proximity to Classes
9. Proximity to Dining Options
10. Technology Access (e.g., Wi-Fi, electric outlets)
11. Thermal Comfort (e.g., temperature, humidity)
12. N/A

College Library

How often do you go to your College Library?
1. Multiple times per day
2. Once a Day
3. Every Few Days
4. Once a Week
5. Two or Three Times a Month
6. Once a Month
7. Once or Twice a Semester
8. Never

What about your College Library makes you want to go there? (select top three reasons)
1. Decoration and Artwork (e.g., colors, patterns, textures)
2. Flexibility of Spaces (e.g., personal control of spaces)
3. Furnishings (e.g., mobile whiteboards, seating arrangements)
4. Light Conditions (e.g., daylight from windows)
5. Noise Levels (e.g., quiet acoustics)
6. Overall Feel of the Space (e.g., atmosphere, visual appeal)
7. Proximity to Amenities (e.g., student orgs, rec center)
8. Proximity to Classes
9. Proximity to Dining Options
10. Technology Access (e.g., Wi-Fi, electric outlets)
11. Thermal Comfort (e.g., temperature, humidity)
12. N/A
Informal Space Behaviors

When you are on campus and in-between classes (not in your residence hall or at work), what do you spend the majority of your time doing? (select top three behaviors)

1. Browsing Social Media
2. Collaborating with Peers
3. Dining
4. Doing Homework Assignments
5. Exercising
6. Participating in Extracurriculars (e.g. Greek life, student orgs)
7. Preparing for Classes
8. Meeting with Faculty, TA, Tutor
9. Practicing Self-Care (e.g., physical and mental well-being)
10. Socializing with Friends
11. Studying
12. Other (please specify) __________

Welcoming Campus Climate

Please consider aspects of diversity at UK and indicate the extent to which you agree with the following

[1: Strongly Disagree; 5: Strongly Agree]
This campus is a welcoming place for…

1. People of Different Religions
2. Politically Liberal People
3. Politically Conservative People
4. Gay, Lesbian, and Bisexual People
5. Nonbinary, Genderqueer, and Transgender People
6. People of Different Socioeconomic Backgrounds
7. People of Different Races
8. People from Different Countries

How do you think the physical environment of Gatton Student Center contributes to the campus climate at UK? [open ended]

Simple University Belongingness Scale

Please consider your experience at UK and indicate the extent to which you agree with the following
[1: Strongly Disagree; 5: Strongly Agree]

1. Other students at UK take my opinion seriously.
2. People at UK are friendly to me.
3. I am included in lots of activities at UK.
4. Other students at UK like me the way I am.
5. I like to think of myself as similar to others at UK.
6. Professors in my classes care if I am absent.
7. I feel like I matter to people at UK.
8. People at UK really listen to me.
9. I feel like my ideas count in my classes.

What (if anything) is it about Gatton Student Center that makes you feel like you belong at UK? [open ended]

What (if anything) is it about Gatton Student Center that makes you feel like you don’t belong at UK? [open ended]

**Pluralism Orientation Scale**

Please consider your belief about worldviews and indicate the extent to which you agree with the following

[1: Strongly Disagree; 5: Strongly Agree]

1. World religions share many common values
2. It’s important to understand the differences between world religions
3. I respect people who have worldviews that differ from my own
4. I understand the reasoning behind one or more worldviews other than my own
5. Truth exists in worldviews other than my own
6. Cultivating religious tolerance and understanding will make the world a more peaceful place
7. My faith or beliefs are strengthened by relationships with those of diverse religious and non-religious backgrounds
8. It is possible to have strong relationships with those of religiously diverse backgrounds and still strongly believe in my own worldview
9. My worldview inspires me to serve with others on issues of common concern
10. It is important to serve with those of diverse religious backgrounds on issues of common concern
11. We can overcome many of the world’s major problems if people of different worldviews work together
What (if anything) is it about Gatton Student Center that makes you feel like you are welcome at UK? [open ended]

What (if anything) is it about Gatton Student Center that makes you feel like you are not welcome at UK? [open ended]

Shortened Warwick-Edinburgh Mental Well-Being Scale (SWEMWBS)

Below are some statements about feelings and thoughts. Please circle the answer that best describes your experience of each over the last 2 weeks.

[1: Strongly Disagree; 5: Strongly Agree]

1. I've been feeling optimistic about the future.
2. I've been feeling useful.
3. I've been feeling relaxed.
4. I've been dealing with problems well.
5. I've been thinking clearly.
6. I've been feeling close to other people.
7. I've been able to make up my own mind about things.

In what ways does Gatton Student Center contribute to your mental well-being? [open ended]

Self-efficacy for Learning Form (SELF)

Please consider your ability to indicate the extent to which you agree with the following

[1: Definitely Cannot Do It; 5: Definitely Can Do It]

1. When you miss a class, can you find another student who can explain the lecture notes as clearly as your teacher did?
2. When your teacher’s lecture is very complex, can you write an effective summary of your original notes before the next class?
3. When a lecture is especially boring, can you motivate yourself to keep good notes?
4. When you had trouble understanding your instructor’s lecture, can you clarify the confusion before the next class meeting by comparing notes with a classmate?
5. When you have trouble studying your class notes because they are incomplete or confusing, can you revise and rewrite them clearly after every lecture?
6. When you are taking a course covering a huge amount of material, can you condense your notes down to just the essential facts?
7. When you are trying to understand a new topic, can you associate new concepts with old ones sufficiently well to remember them?
8. When another student asks you to study together for a course in which you are experiencing difficulty, can you be an effective study partner?
9. When problems with friends and peers conflict with schoolwork, can you keep up with your assignments?
10. When you feel moody or restless during studying, can you focus your attention well enough to finish your assigned work?
11. When you find yourself getting increasingly behind in a new course, can you increase your study time sufficiently to catch up?
12. When you discover that your homework assignments for the semester are much longer than expected, can you change your other priorities to have enough time for studying?
13. When you have trouble recalling an abstract concept, can you think of a good example that will help you remember it on the test?
14. When you have to take a test in a school subject you dislike, can you find a way to motivate yourself to earn a good grade?
15. When you are feeling depressed about a forthcoming test, can you find a way to motivate yourself to do well?
16. When your last test results were poor, can you figure out potential questions before the next test that will improve your score greatly?
17. When you are struggling to remember technical details of a concept for a test, can you find a way to associate them together that will ensure recall?
18. When you think you did poorly on a test you just finished, can you go back to your notes and locate all the information you had forgotten?
19. When you find that you had to “cram” at the last minute for a test, can you begin your test preparation much earlier so you won’t need to cram the next time?

In what ways does Gatton Student Center contribute to your ability to succeed academically? [open ended]

Quality of Interactions at Gatton Student Center

Indicate the quality of your interactions with the following people when you are at Gatton Student Center:
[1: Extremely Negative; 5: Extremely Positive, n/a]

1. Other Students
2. Faculty
3. Student Services Staff (student organizations, student government, bookstore, etc.)
4. Other Administrative Staff and Offices (student ID, student centers admin, etc.)

How would you describe, to a prospective UK student, Gatton Student Union’s role in your overall campus experience? [open ended]
Environmentalism

How important to you is it that campus buildings are healthy, highly efficient, and cost saving green buildings?
[1: Not At All Important; 5: Extremely Important]

The Leadership in Energy and Environmental Design (LEED) Certification provides a framework to create healthy, highly efficient, and cost-saving green buildings. Do you know whether or not Gatton Student Center has received this certification?

1. Yes I do.
2. No I do not.

In terms of your daily life on campus how likely are you to…
[1: Not Very Likely; 5: Extremely Likely]

1. Change your daily routine (e.g., deny single use plastics, turn the lights down) in order to protect the environment?
2. Make sacrifices to your standard of living (e.g., accept higher prices, drive less, reduce consumption of animal products) in order to protect the environment?

Demographic Information

How do you identify in terms of your gender? (mark all that apply)
1. Ciswoman
2. Cisman
3. Transwoman
4. Transman
5. Genderqueer or Non-binary
6. Uncertain or Questioning
7. I identify using a different term (please specify) _________
8. Prefer Not to Answer

How do you identify in terms of your sexual orientation? (mark all that apply)
1. Heterosexual or Straight
2. Gay
3. Lesbian
4. Bisexual or Pansexual
5. Uncertain or Questioning
6. I identify using a different term (please specify) __________
7. Prefer Not to Answer

What is your race/ethnicity? (mark all that apply)
1. African American or Black
2. Native American, American Indian, or Alaskan Native
3. Asian or Pacific Islander
4. Hispanic/Latino/Latinx
5. White/Caucasian
6. I identify using a different term (please specify) __________
7. Prefer Not to Answer

What is your religious preference?
1. Buddhism
2. Christianity
3. Hinduism
4. Islam
5. Judaism
6. Secular/Nonreligious/Agnostic/Atheist
7. Other (please specify) __________
8. Prefer Not to Answer

Do you have any of the diagnosed disabilities or conditions? (mark all that apply)
1. ADHD (Attention Deficit Hyperactivity Disorder)
2. Autism Spectrum Disorder
3. Blindness/Low Vision
4. Brain Injury
5. Deafness/Hard of Hearing
6. Learning Disability
7. Orthopedic/Mobility Disability
8. Psychological Disability
9. Prefer Not to Answer

How would you describe your socioeconomic background when you were growing up?
1. Poor/Low Income
2. Working Class
3. Middle Class
4. Upper Middle or Professional Class
5. Upper Class/Wealthy
6. Prefer Not to Answer
In what setting did you spend most of your life before coming to NC State? (if several apply, use the most recent one).
   1. Rural Area
   2. Small Town (20,000 or fewer people)
   3. Moderate Size City (20,001 - 100,000 people)
   4. Large City (over 100,000 people)

What is your age? *(write in)*

What is your Academic Class?
   1. Freshman
   2. Sophomore
   3. Junior
   4. Senior
   5. Super Senior

What college do you belong to?
   1. College of Agriculture
   2. College of Arts & Sciences
   3. College of Business
   4. College of Communications
   5. College of Design
   6. College of Education
   7. College of Engineering
   8. College of Mining, Minerals, and Natural Resources
   9. Poole College of Management
   10. Undergraduate Studies
   11. Prefer Not to Answer

Where do you live?
   1. On Campus
   2. Off Campus Student Housing
   3. Off Campus

What is your cumulative GPA?
   1. 3.6 - 4.0
   2. 3.1 - 3.5
3. 2.6 - 3.0
4. 2.1 - 2.5
5. 2.0 or lower
6. Prefer Not to Answer
Appendix J. Observation Protocol

The research team will use two tablets to access the web-based observation tool, bMapIt! that will allow them to record behavior counts and timestamp observed behaviors. There will be six locations identified for observations. Researcher 1 will start at Location 1 and Researcher 2 will start at Location 4 during each observation round. Researchers will take five minutes to get set up and take notes of the existing conditions in the space. Researchers will then record behaviors and movements for fifteen minutes. Researchers will be given five minutes to travel to the next location. One interval of observations will take a total of 25 minutes, and a total round of observations will be two and a half hours. Two rounds of observations will be completed on each day for one week (see schedule below)

Sample Observation Schedule

<table>
<thead>
<tr>
<th>Day</th>
<th>Times</th>
</tr>
</thead>
<tbody>
<tr>
<td>Monday</td>
<td>8:00 – 10:30, 6:00 – 8:30</td>
</tr>
<tr>
<td>Tuesday</td>
<td>10:30 – 1:00, 3:30 – 6:00</td>
</tr>
<tr>
<td>Wednesday</td>
<td>1:00 – 3:30, 6:00 - 8:30</td>
</tr>
<tr>
<td>Thursday</td>
<td>8:00 – 10:30, 1:00 – 3:30</td>
</tr>
<tr>
<td>Friday</td>
<td>10:30 – 1:00, 3:30 – 6:00</td>
</tr>
</tbody>
</table>

Researchers will scan the location from left to right, dropping a pin for every person observed along with the activities, behaviors, interaction, and device information for each person.

Researchers will check all that apply.

**Physical Activity**
- Walking
- Sitting
- Standing
- Laying

**Behavior**
- Talking
- Dining
- Reading
- Writing
- Relaxing

**Social**
- Alone
- In a Pair
- In a Group

**Device**
- None
- Laptop
- Tablet
- Smart Phone