

Distraction or Life Saver? The Role of Technology in Undergraduate Students' Boundary Management Strategies

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Previous¹ research has shown that communication technologies may make it challenging for working professionals to manage the boundaries between their work life and home life. For college students, however, there is a less clear definition of what constitutes work and what constitutes home life. As a result, students may use different boundary management strategies than working professionals. To explore this issue, we interviewed 29 undergraduates about how they managed boundaries between different areas of their life. Interviewees reported maintaining flexible and permeable boundaries that are not bounded physically or temporally. They used both technological and non-technological strategies to manage different life spheres. Interviewees saw technology as a major source of boundary violations but also as a boundary managing strategy that allowed them to achieve better life balance. Based on these findings, we propose design implications for tools to better support the boundary management processes of undergraduate students.

CCS Concepts: • **Human-centered computing** → **Human computer Interaction(HCI)** → Empirical studies in HCI

KEYWORDS

Boundary management; life balance; undergraduate student; college student

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1 INTRODUCTION

Everyone has different social roles, commitments, and spheres of life (e.g., family, work, friends). Managing the boundaries between one's multiple roles and life spheres has been always challenging, but never more so than today. Many studies point out that computer-mediated communication (CMC) tools increase boundary flexibility and permeability [18,27]; as a result, people cross different role and life spheres more easily today than they did in the past.

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However, there is little consensus about the influence of mobile and CMC technologies on work-life conflict and balance [18]. For example, Towers et al. [52] pointed out that increased flexibility with respect to time and location of work makes it easier to accommodate both work and family. At the same time, such technologies may increase employer expectations about time available for work, which could have negative consequences such as overwork and decreased psychological well-being [e.g. 18,25,36,40].

Most previous research on technology and boundary management practices has focused on working professionals with a family [26,43,48] and examined their work-home interference or conflict [6,7]. However, many of these studies were based on a dichotomous conception of life spheres: people were either in a work role or in a home/family role. Little attention has been paid to boundary management in populations such as undergraduate students whose life boundaries are transient or not yet settled [1].

As most 'wired generation' in history, extensive technology use is a key characteristic of the current undergraduate student population [31,54]. Recent research [49] found that the U.S. undergraduate student population has a higher rate of home broadband access, wireless online access, and technology gadget ownership than either the average adult or the young non-student population. This suggests that as digital natives [45], the contexts and ways that undergraduate students today construct and manage life boundaries may differ from the ways working professionals do.

In this paper, we investigate the interplay between technology and life boundaries in a sample of undergraduate students at a large U.S. university. Understanding how undergraduates create, maintain and manage their life spheres in connection with technology could yield valuable insights into current practices of boundary management, and how this generation of digital natives will want to manage their life boundaries once they are out of college and part of the workforce. Specifically, we aim to address three research questions:

- What are the characteristics of life boundaries of undergraduate students?
- What strategies do undergraduate students use to manage life boundaries?
- How does technology influence undergraduates' perceptions of their life balance?

To address these research questions, we interviewed 29 undergraduate students at a large U.S. university. We sought to gain grounded understandings of the life boundaries of undergraduate students by covering diverse life spheres – not only academia but also social, family and extracurricular spheres. We also explored the role of technology in setting and managing these boundaries. On the basis of our findings, we suggest ways that technology can be better designed to meet the boundary management needs of undergraduate students.

2 RELATED WORK

In this section, we first describe boundary theory and discuss types of boundary management strategies. Then, we examine ways that boundary management has been discussed in the human-computer interaction (HCI) literature. Finally, we explore the ongoing discussion about the influence of technology on boundary managing and work-life balance.

2.1 Boundary Theory and Boundary Management Strategy

Boundary theory [3,41] focuses on the ways people create, maintain and manage boundaries between work and personal domains. A boundary management strategy consists of, "the principles one uses to organize and separate role demands and expectations" [32,44]. Together these concepts provide a framework for understanding how people manage conflicting work and personal demands in particular ways [44]. In previous literature, boundary management has been related to personal work/life balance [46] since the choice of boundary management strategy can have positive or negative consequences for an individual's perceived life balance [6].

Boundaries differ in permeability and flexibility [28], and these two factors affect individual role transitions and boundary management practices [3]. Boundary permeability reflects the extent to which an individual might be psychologically and/or behaviorally engaged in one domain while physically located in another domain or at times that are traditionally devoted to another domain [29]. Permeability also includes interruptions by thoughts and behaviors associated with another role while one is acting in a particular role

[44]. For example, when work boundaries are permeable people can contact their family or friends during work hours. Boundary flexibility is the capacity of the boundary to be moved temporally or physically [44]. If a role has a highly flexible boundary, this role can be done in multiple locations and at any time, so it encompasses the where and when in which a role can be enacted [44].

Boundaries between life spheres differ in thickness [3,6,40] depending on their permeability and flexibility. Thin boundaries are permeable and flexible, allowing life spheres to shift and blend easily. In contrast, thick boundaries are impenetrable and inflexible, creating strict segmenting between life spheres. Creating and maintaining thick boundaries (a “segmenting strategy”) decreases role blurring but it increases the effort needed to cross boundaries. Creating and maintaining thin boundaries (an “integrating strategy”) renders boundary crossing easy but increases blurring between roles and life spheres [3].

The concepts of boundary and boundary management have been widely applied to professions such as teleworkers [21] or information technology workers [38] in management studies. In the field of HCI, the issue of ‘life boundary’ has also been explored extensively. Nipper-Eng [41] conceptualized “home” and “work” as a continuum that people could either integrate or separate by managing physical or cognitive boundaries. In addition, Salazar [48] revealed diverse types of boundaries that university professionals utilized to work at home, such as space, time, and psychological boundaries. Grimes and Brush [26] focused on how working parents’ use digital calendars to manage their dual roles as parents and employees. Leshed et al. [34] examined farm families who integrated their home and work lives completely. Work-life balance and boundary management have also been discussed in the context of email practices. For example, Cecchinato et al. [7] explored how different professions manage work and personal email and how their boundary strategies facilitate the transition between work and personal life.

While there has been extensive discussion about boundary management for decades in the diverse fields, most research has typically focused on full-time working professionals with families [19,43]. In addition, most studies conceptualized people’s life spheres in a dichotomous way, as work vs. home, which were believed to be socially ‘institutionalized’ [3,33]. Given these institutionalized conceptions of work and home, boundaries were regarded as static or stable [33]. Also, boundary management strategies were seen as tied to spatial and temporal movements [3] such as commuting between home and office.

There is still little understanding of the boundary management practices of transitional, unconventional, or newly emerging populations [43]. Undergraduate students are one group whose life boundaries are in a state of flux [1,2] as they change and refine their identity, roles, work, and social relations [1,53]. Adapting to college life is a complex process of integration into new academic and social environments. At the same time, undergraduates strive to maintain their existing social connections and support systems [24,51]. Undergraduates often need to adopt new boundary management strategies as they become engaged in a greater diversity of roles [12,56]. A dichotomous view of work vs. home life does not readily capture the diverse nature of undergraduates’ life boundaries and management practices.

2.2 Technology, Work-Life Balance and Boundary Management

Many studies point out that CMC tools increase boundary flexibility and permeability, thereby allowing people to cross roles and life spheres more easily. There has been much discussion about how such technologies influence individual boundary management and work-life balance, particularly with respect to working professionals and work-family conflict. However, there is little consensus about the effects of technologies on these processes. Golden and Geisler [22] argued that information and communication technologies could be a resource for boundary management. In contrast, Williams et al. [55] emphasized negative consequence of technology such as the creation of unrealistic expectations for employees, which could result in higher stress and a sense of overload.

The undergraduate student population has received substantial research attention in the HCI and higher education literature with respect to general technology use [31,49], the influence of technology on academic achievement [10,30] and psychological well-being [14,23,35]. Some research, such as [11,50], explored the use of communication tools between college students and their parents. They revealed that such technology played an important role in mediating relationships and sharing emotional support during the process of transition

from adolescent to emerging adults. However, there is little understanding of how technology is involved in undergraduates' boundary management practices.

As Dén-Nagy [17] has pointed out, the existing literature has typically treated individuals as suffering from the impacts of technological development. This might be true to some degree, but we must balance our perspective by examining the possibility that technology can also be an effective tool for boundary management. In the current research, we aim to step away from technological determinism and instead explore the dynamics between technology and undergraduates' boundary management practices. Specifically, we address three research questions: (1) What are the characteristics of life boundaries of undergraduate students? (2) What strategies do undergraduates use to manage these life boundaries? And (3) How does technology use shape undergraduates' perceptions of their life balance?

3 RESEARCH METHOD

We conducted semi-structured interviews to gain in-depth understanding of the boundary management strategies of college students. We first asked interviewees about their major, academic year and general technology use (e.g. device ownership, CMC tool use, etc.) Then, we asked questions such as "How do you feel about your classes in this semester?" and "Please explain your typical weekday/weekend during semester" and let them gradually explain the details of each of their life spheres. We also asked them to explain the ways they managed their schedules. Lastly, we asked interviewees to recall any recent conflicts between life spheres they had experienced and to describe how they handled the situation.

Participants consisted of 29 undergraduate students (9 male, 20 female; mean age: 21.4 years old; age range: 18 - 40) at a large U.S. research university. The demographic backgrounds of participants were Caucasians (64%), Asian Americans (17%), Hispanics (7%), African American (3%) mixed race (3%) and international students (7%) from Taiwan and India. Participants were recruited through a campus participant recruitment system and compensated with extra class credits. Participants were invited to the lab space for interviews on campus. We interviewed Freshmen (2), Sophomores (9), Juniors (10) and Seniors (8). They were from diverse majors: social science major (10), Computer/Information Science (10), Biology (3), Business (3), and others (3). All reported owning a smartphone and laptop, and 7 of 29 owned a tablet. Interviews were conducted in person and lasted 35-60 minutes. Except one participant who did not consent to audio-recording, interviews were audio-recorded and transcribed. During each interview, one researcher conducted the interview while the other took the notes.

Based on the field notes and transcriptions, we iteratively coded the data in Atlas.Ti [58] using a Grounded Theory [8] approach. First, we conducted an open coding process in which codes were assigned to significant instances and references. Four researchers independently coded the data before comparing them. Next, we analyzed the concepts and categories from our initial coding to find patterns and interesting or important themes iteratively. In order to gain an in-depth understanding, we elaborated our coding schemes and analyzed relevant quotes to build rich descriptions and concrete examples of diverse boundary management strategies.

4 FINDINGS

In this section, we first explore how undergraduates conceptualize their life domains in order to gain a better understanding of their boundary management needs. Next, we investigate the characteristics of boundaries situated in undergraduates' school environments. We then explicate three typical boundary management practices reported by our interviewees; 'Demarcating social boundaries', 'Defending academic boundaries' and 'Organizing temporal boundaries'. Lastly, we discuss interviewees' perceptions of the role of technology in their boundary management practices.

4.1 Conceptualization of Life Domains

We first mapped out the typical life domains that our interviewees reported to be engaged in and their self-reported role identities (see Figure 1). This map is not intended to be exhaustive or characteristic of every interviewee but rather to capture the general themes reported by our participants. In mapping the separate

roles and life domains that participants reported, we schematized the relations and the overlaps between domains following the diagramming logic for depicting inter-role relations used by Blake et al. [3] and Clark [13].

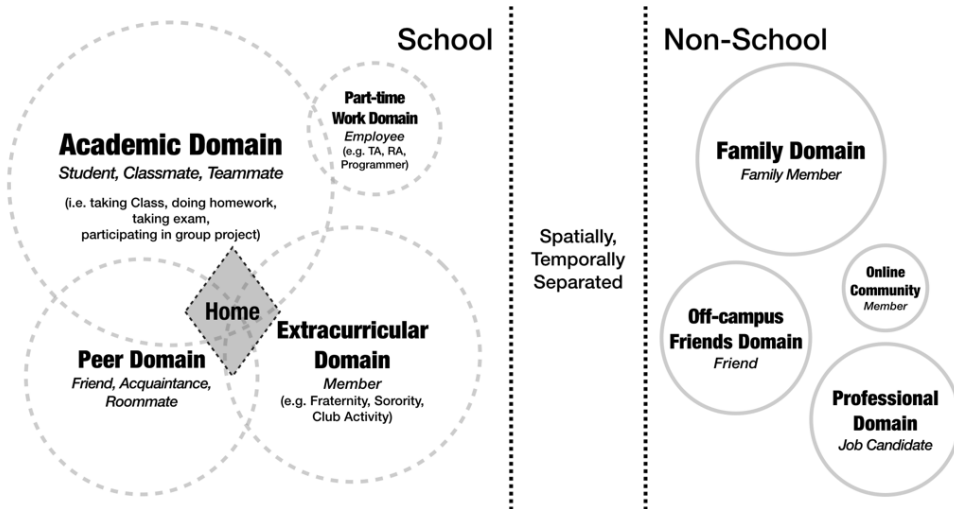


Figure 1 Conceptualization of Life Domains

We found that the conventional dichotomy of work vs. home used in most previous research on boundary management did not fit the life spheres of our undergraduate interviewees. Due to the academic setting, and the fact that most participants lived on or near campus, the conventional meaning of ‘home’ did not apply. Also, the ‘work’ domain from previous literature could not be combined well with the undergraduate student environment. Rather, we concluded that a life boundary between school vs. non-school domains would be more useful when considering students’ boundary management practices during the academic semester.

4.1.1 School vs. Non-School

The *school domain* here refers to the combination of activities, relations and roles that participants held in school or in relation to school. It includes academic activities, extracurricular activities, part-time jobs and social relations created through school-related activities. As a student, interviewees reported taking an average of 4.8 classes per semester. Extracurricular activities such as fraternities and sororities, hobbies or career-based clubs were also an important part of college life. On average, participants reported being involved in 2 clubs. Also, about one third of our interviewees had part-time jobs either on or off campus as a teaching assistant or part-time programmer. Lastly, all interviewees said they were actively engaged in their social lives with their friends, classmates and roommates.

In terms of the *non-school domain*, participants reported maintaining connections with the social domains they had before they entered the university, such as family and off-campus friendships. Although clear physical and sometimes temporal separation was established between school and non-school domains, participants still actively engaged with non-school domains through communication technologies including phone/video calls, social media, instant messenger (IM) and so forth. A few participants also said they participated in online communities. Especially among participants in their senior year, some specified themselves as a job candidate who had been job hunting online.

Interestingly, *home space* was not perceived by our interviewees as the same as the conventional meaning of home/family nor as a separate entity from other life domains. Except two participants who lived by themselves, the majority of interviewees lived in communal residences such as on/off-campus dorms or fraternity houses with 3 to 35 housemates (Median: 5). Interestingly, there was substantial variability in how

interviewees conceptualized their home space. For example, those who lived with many housemates in a sorority house thought of their home as a social domain:

The nice thing for me is that I live with my friends, so we'll all sit around and do homework together. It's like an overlap. You're getting stuff done, but you're also talking. (P22: Female, Sophomore)

However, those who preferred to work in their room viewed their house as an extension of the academic domain. One interviewee who considered her room as a place just for sleeping thought her residence was like a “dry lodging”.

As can be seen from Figure 1, the school domain as a whole encompassed many overlapping social roles and life domains, including *student in an academic environment, friend, roommate, member of an extracurricular club* and so forth. However, non-school domains were more discrete, with minimal overlap between them. By mapping the roles and life domains that participants reported, we determined that these undergraduate students were involved in multiple roles and life spheres in and out school. Furthermore, the conventional conceptualization of life domains such as work and home could not accurately describe the dynamics of these undergraduates' lives.

4.2 Characteristics of Boundaries

In this section, we characterize the boundaries situated in undergraduate's school environments by using the two major components of boundaries: flexibility and permeability. It is important to understand the characteristics of undergraduate' life boundaries, because such understandings help us comprehend how and why they chose to employ specific boundary management strategies.

4.2.1 High Flexibility

While previous studies suggested that certain physical environments were typically associated with certain roles [3] (e.g. office space: employee; home space: spouse, parent), this clear-cut relationship between spaces and roles did not hold for our undergraduate interviewees. For them, physical settings, with the exception of classrooms, were highly flexible in terms of which roles and life spaces they were used for. For example, the school library could serve as an academic domain and social domain at the same time when a student did homework with friends in library.

I usually go to the library with friends. Even when I go alone to [library], a lot of people I know go to that library, too. So I still always run into people, so it's still like a pretty social thing. (P9: Female, Junior)

Temporal flexibility was not as high as physical flexibility, because most parts of interviewees' daily schedules were routinized. Most weekday schedules were centered around fixed class schedules. However, before, after or between classes, participants allocated times for other activities such as working part-time job or attending extracurricular club meetings.

However, before this routine was settled, interviewees had some flexibility because they could make choices about how to organize their schedules, for example by choosing which and how many courses to take and which extracurricular activities to engage in. The flexible nature of these routines allowed them to experiment not only different life schemes, but also different life priorities, by making periodic adjustments to their routines.

4.2.2 High Permeability

Participants reported that they maintained very permeable boundaries between their life domains because many of these domains were interrelated, overlapped and tangled within school domains. For example, as mentioned earlier, some interviewees saw their home as an academic location. Therefore, in transitioning from one life domain to another, there was no clear rite of role transitions [3] that usually entails multiple changes in temporal, physical, and/or social boundaries. For example, at library they could interact with friends (social) while doing homework (academic).

Another reason that boundaries were high permeable was that interviewees used a wide variety of CMC tools on their smartphones and laptops. For non-school domains such as family, these technologies were the

primary ways to keep connections and interact with physically separated life spheres. However, because of geographical and temporal differences, non-school domains (e.g. family sphere) sometimes intruded into school domains in uncontrollable ways due to CMC use:

[My parents] call me at very inconvenient time. For example, my mom calls me at 12am at night, because it's 9pm there so I just ignore her. [...] She called when in afternoon during the work meeting, so I declined call. And she got upset. So just shot her quick text 'work, call you after'. (P8: Female, Junior)

Also, some preliminary coordination work was often needed to address time differences, as in P12's case.

I tried to do some FaceTime, but my friend is in Australia and the time difference is pretty significant. So it was hard to coordinate with that. [...] Because she doesn't have a class on Wed in Australia time, that means 10pm Tuesday is the perfect time because it is 12pm on Australia on Wednesday. We figured out that through texts. (P12: Female, Senior)

Even within school domains, participants said that CMC played an important role in getting involved in multiple roles and life spheres. For example, extracurricular club members shared emails and group chats both for activity related tasks such as planning and coordinating and for socializing. Therefore, we could see many roles and social domains were virtually mediated by various communication tools. This prevalent use of communication tools for a wide variety of social domains made interviewees' life boundaries very permeable by allowing one domain to easily interrupt another.

In summary, we found that our participants' life boundaries could be characterized as very flexible in that a certain role was rarely bound by specific physical and temporal settings. Also, the permeability between life spheres was very high because (a) many life spheres in the school domain overlapped cognitively as well as physically, (b) many communication tools mediated a wide range of social domains including not only non-school but school domains. The combination of highly flexible and permeable boundaries led to high role integration, which yielded highly blurred boundaries.

Boundary theory [3] argues that blurred boundaries make transitions between roles relatively easy and frequent, but these transitions can happen uncontrollably and unpredictably, which can force unwanted role shift or create undesired interruptions. Also, boundary theory posits that high integration leads individuals to segment their social domains by creating and maintaining boundaries.

As predicted by boundary theory, participants reported many kinds of consequences due to the highly integrated nature of their boundaries, including interruption, distraction, concerns about uncontrollable boundary crossing, and role overload. However, participants did not think that blurred boundaries were necessarily negative. Rather, they perceived that their life boundaries were mostly flexible and permeable by nature and that the integration of these domains had been achieved naturally and easily without much effort. On the other hand, when they wanted to segment and maintain thicker boundaries for certain purposes, it required more effort and coordination.

In the following section, we provide the details of the influences of participants' blurred boundaries and their boundary management strategies.

4.3 Demarcating Social Boundaries by Multiple Communication Channels

One of the most prevalent consequences of blurred boundaries reported by our interviewees were concerns about unwanted boundary crossings. Many life domains, including both on and off campus domains, were actively mediated by multiple communication technologies. Due to the extensive mediation of life domains through CMC, many participants carefully managed their audience, availability, information and self-disclosure across various communication channels.

The most frequently mentioned strategy for addressing these concerns was using different communication channels for different life domains. For example, some interviewees used video chats only for their closest friends. Collaboration tools such as *Slack* were utilized only among class group members. International students used the localized messenger tools such as *WeChat* (China) or *Kakaotalk* (Korea) only for communicating with their family members and home friends. For example, P15 said that he communicated by

exchanging short voice messages in *Wechat*, because it could be difficult for his parents to type in Chinese letters using mobile devices.

I mainly use WeChat for my parents, because that is the easiest one for my parents. Especially, [we use] 'hold to talk'. (P15, Male, Junior)

Their motives for using separate communication channels for different social domains included the technological affordances of particular tools and a desire to manage their audience and contents.

In terms of technological affordances, communication channels designed to share rich messages, that is, those that were more visual and synchronous such as Snapchat and Skype, were used in more intimate relationships. Text based channels such as Email and *GroupMe* (Group chat service) were used for more purposeful activities in academic and extracurricular domains. Consistent with Media Richness theory [16], richer channels were reserved for more personal and intimate connections.

For snapchat it's primarily for five of my closest friends who snapchat each other. [...] GroupMe, I use it for group projects of class projects or other clubs stuff like that. (P8: Female, Junior)

I have like thirty friends in my Snapchat ... because that's more of an individual basis so you talk to people one-on-one rather than Facebook it's just a feed ... you just have small acquaintances, you say hello, you wave, but Snapchat's your friends you can send embarrassing pictures to. (P20: Female, Sophomore)

However, the richness of channels was not the only reason why interviewees used different channels for different life domains. Additional considerations were related to the potential boundary intrusion situations. Text messages and phone calls were used mostly for narrower groups of social relations such as family and close friends, whereas Facebook and GroupMe were used for less intimate acquaintances. Sharing phone numbers with someone was considered intimate and private since text messages and phone calls allowed for wider and immediate availability because an Internet connection was not needed. In addition, phone information implied a longevity to the relationship that they did not want to commit to, and thus phone use might facilitate boundary intrusions.

There are so many people that I know in class and school that I don't know that well to have their number, but I know well enough that we're friends on Facebook. ... I think it's easier to not have 100 contacts in your phone. I don't want to load up my phone with people who I might need to contact in the next year, but after, I'm never gonna talk to them again. (P23: Female, Sophomore)

In contrast, interviewees considered GroupMe to be the least intimate channel because there was little risk of exposing their personal information. Since GroupMe provided flexible options to add people to a group without having to “friend” each individual, there was less perceived risk that boundaries would be violated. Therefore, it was primarily used for larger group communication such as extracurricular clubs or for task-oriented groups like class project teams.

I actually think GroupMe is pretty incredible, because it's not quite as personal as asking people for their phone numbers. (P8: Female, Junior)

While some communication technologies such as Snapchat and Skype carried strong associations with certain social domains, Facebook was perceived as a ‘catch-all’, a light-weight channel that included a wide variety of social domains and relations, from family and close friends to acquaintances and work mates. Most participants thought that having this general channel for connecting with almost every kind of social relation in one place was effective and useful.

I can just open up Facebook, open up three different chat windows, and they're all doing different things, all different purposes, all different aspects of life. That's great. (P29: Male, Sophomore)

It was somewhat counter-intuitive that interviewees made use of Facebook for such wide purposes since Facebook profiles and status updates may contain many personal details. Since it was hard to figure out and manage their audience selectively, Facebook use could possibly facilitate unwanted boundary crossings by

exposing too much personal information. To manage this unwanted consequence of blurred boundaries on Facebook, interviewees said they rarely posted about personal topics. Instead, their posts were limited to more general topics such as event promotions and they reserved more personal information for other channels such as Snapchat because they had greater control over the audience.

Comparing to Facebook, Snapchat is a lot easier to direct to your audience. You can kind of trust the interface to only show your snap to that person and not to mutual friends on Facebook. (P29: Male, Sophomore)

In summary, our interviewees used some communication tools such as Snapchat as a boundary marker that demarcated different social relations. Some channels carried strong associations with different social domains. This partitioning of life domains via technology is one way they were able to manage these domains in the absence of the physical and temporal shifts found in the workforce [3] (e.g. commuting between home and work around work-hours). In demarcating boundaries by using multiple channels, participants considered the richness of the technology and the intimacy of the social relationships within a life sphere. On the other hand, in case of Facebook, participants purposefully integrated and blurred the boundaries between different social relations regardless of relational closeness or different types of connections (e.g. family, colleague, acquaintance). While they appreciated having the unified channel for interacting with almost anyone, they tried to prevent the unwanted consequences of blurred boundaries by not posting anything or posting only general stuffs on their status updates.

4.4 Defending Academic Boundaries from Distraction

The most frequently mentioned consequences of blurred boundaries were interruption, distraction and difficulties in self-regulation. Smartphone notifications from multiple communication channels were mentioned as primary distractors. Interviewees also mentioned 'self-interruption' [15], their own habitual messages and checking of social media, as a source of distraction.

Messaging apps, social messenger apps are super distracting. Every night and every morning, I'm checking my email, Instagram, texts whatever, so that's a bad habit. I feel like always checking those things is a distraction as well for time management. (P10: Female, Junior)

My phone might be going off if a GroupMe is exploding with messages while I'm working, so I would lose attention when I'm doing work and look at it. (P27: Female, Sophomore)

Participants utilized various strategies for separating themselves from unwanted and uncontrollable distractions. A common strategy was non-use or disconnection from the Internet by setting their smartphones on "Do not disturb" and "Airplane" mode temporally.

I'll put it [phone] on "Do not disturb" so I won't get notifications and then I'll check it during study breaks every hour maybe. (P15: Male, Junior)

As more enduring strategies, some interviewees (8/29) said they established cognitive boundaries between devices by limiting the main use of each. Many interviews said their smartphone was rarely used for academic purposes, but they used it for more social purposes or for breaks, which created boundaries between academic (work) and social (non-work). This management strategy aligned with Fleck et al.'s findings [20] that people used multiple devices to create boundaries between work and non-work.

My phone is pretty much just to talk to my friends. But my computer is mainly for school work. (P21: Female, Sophomore)

Furthermore, about one third of our interviewees had tried or used 'blocker' applications to limit the access to certain applications and websites temporally or permanently.

I blocked Facebook on my Google Chrome for work so I don't go on. If I log on to Safari, I am going onto Facebook and looking at it. When I go out to Safari, it is like my time to distract myself. It is my reward. Sadly, sometimes it didn't work. I opened both browsers. (P13: Female, Sophomore)

In discussing these strategies, participants established conceptual separation between devices or made use of technological features (e.g. airplane mode, blocker apps) to reduce distractions. However, these methods of separating life domains are, as found in the account from P13 shows, fairly easy to overcome.

4.4.1 Boundaries Maintaining by Location and Social Influence

In addition to smartphone notifications and self-interruption as a source of distraction, the overlapped nature between academic and social boundaries could become a source of interruption. Since the majority of participants lived with housemates, they often perceived their living place as a social place. To secure the academic boundaries from social influence, they often created thick spatial boundaries by not bringing academic work into their living place and doing their schoolwork in school locations such as the library. For example, P1, who lived in a fraternity house with 30 people suggested interaction with his housemates may interfere with the study plan.

Working at home, it's not like the best work environment. Cause there's more than one person home to hang out and like, 'shoot the breeze.' (P1: Male, Junior)

On the other hand, a smaller number of interviewees (5/29) preferred to use their homes as studying places because either they did not like the quietness of libraries or they felt confident that they would not be influenced by social domains when in their living spaces. For example, P3, who lived with her three closest friends, did not think her roommates were a source of interruption.

I do not go to the library. I don't like the pressure of everyone around you that's doing a lot of work and you feel like you're ultimately slacking. I've always worked from home. My roommate actually also always works from home. It's not too loud in our apartment. (P3: Female, Senior)

Different preferences for integrating or separating home from academic places may be related to how much interviewees perceived their housing setting was overlapped with social domains. Depending on situational factors and individual preference, they chose to maintain their spatial boundaries either in integrating or separating ways.

4.5 Organizing Temporal Boundaries in Daily Lives

Interviewees often reported 'role overload' [5,47] as a major consequence of their overlapped and blended life domains. Interviewees frequently reported difficulties in managing multiple commitments because they felt that they did not have enough time or attention to address all their responsibilities. Being involved in too many roles in a given semester sometimes made them feel overwhelmed as in P24's case:

This semester has actually been a rollercoaster. I got involved in 3 new clubs this semester, and I also have a job on campus, so it was like that balancing on top of the 3 extra activities has been hard. My schoolwork wouldn't be that bad if it wasn't for those activities. (P24: Female, Sophomore)

Organizing temporal boundaries between different roles (e.g. what kinds of roles and activities that they choose to involve in, decide when and how much time they would spend on each activity) was especially important for our interviewees. Since their temporal rhythms of school lives kept changing because of different class schedules and activities each semester, they were forced to organize, manage and readjust their temporal routines periodically.

Some participants (8/29), particularly juniors and seniors, reported that setting and readjusting priorities helped them resolve role overload issues to some extent. Once they decided to prioritize and commit to one or two of their roles over all others, they could effectively reduce other activities that they considered as lower priorities. By establishing priorities, they could gain more time to concentrate on what was important to them.

The priorities that our respondents identified varied, but in general, most had academic achievement as their one of highest priorities. However, these priorities tended to change depending on their experiences and reflection about their past academic years. Readjusting their priorities included both expanding and narrowing down the life spheres they were willing to get involved in. For instance, P1 experienced negative effects from

over-emphasizing academic achievement. Once he learned that his priorities could be harmful, he readjusted his life priorities to include a social and personal life, too.

I know that schoolwork is important to do well because, that's why I'm here for. But, if I'm in the library 24/7 and killing myself, that's not good for my health and just like going insane is just not worth it. That has definitely happened to me in previous semesters, there've been a few stretches of like a week straight and I'm just like, 'Okay, take a step back, like, re-evaluate.' And I think just prioritizing that one test or one night out isn't gonna be the difference-maker in my life. That moment is the something that allows me to balance things well. (P1: Male, Junior)

Also, new situations such as job-seeking period could drastically change respondents' priorities and temporal rhythms. Some seniors like P5 prioritized job interviews over social and academic activities because her identity as a job-seeker was her highest priority.

This semester has been so different because I dropped the stuff that I used to do. I had to do much stuff because I was traveling every weekend [for job interviews]. In the past, I played horse polo and was in the clubs so had lot more meetings and events. [...] This year, I try to have time with my friends sometimes like dinners, but I can't. (P5: Female, Senior)

As they changed, refined, and adjusted how they managed their time throughout their college years, most interviewees (27/29) reported that they actively developed their own schedule and task management schemes. As strategies to organize the temporal boundaries of their daily lives, they usually used time management tools such as digital or paper calendars and to-do lists.

In adjusting to the new schedule of each semester, such tools worked as a signal to move between roles or spaces (e.g. class → extracurricular club meeting → part-time job). For those who used digital calendars, they appreciated the event reminders as external signals of different roles and commitments. For those who preferred paper planners and notes, they said hand writing allowed them to plan and remind themselves of different commitments.

I have a weekly TA meeting so I have a notification on my phone for that. It's a recurring event in my Sunrise calendar that I created a while ago, so every 15 minutes before, it says you have a meeting. (P7: Male, Junior)

I'm always holding paper and writing down and editing my to-do lists. It comes more naturally to me than trying to edit things virtually. (P8: Female, Junior)

Especially in managing multiple social roles and commitments, some participants (6/29) employed different colors in digital calendars to demarcate boundaries in classes, workload, and social commitments and thereby better manage priorities. The schedule items for higher priority commitments (e.g. P18: Lab stuffs) were usually marked with 'Harsher' colors, such as brown and red.

I chose brown for research because it's a darker color and I tend to be doing research more on my time. (P18: Female, Senior)

The schedule items with lower priorities were marked with 'softer' colors, such as yellow or sky blue. By differentiating the colors of different types of activities, they believed that they could prioritize and manage multiple commitments effectively.

However, some participant (8/29) complained that using these tools remained to be effective only for tracking deadlines for existing commitments, but did not help them estimate time and efforts required for different commitments or to have a better sense of life balance.

I used to try to use [Google calendar] but it did not work for me. Because I only have what the work is and the due date. I can't really schedule my time because I only know some little information and I don't know when I should start. (P14: Female, Junior)

[My calendar] helps me to manage things but it doesn't help me balance. (P11: Female, Senior)

Another struggle in managing time was the coordination required for group scheduling. It was one of the most frequently reported issues since on average our participants had two courses with group projects and engaged in two extracurricular activities. Because their individual schedules were already packed and idiosyncratic, it took much effort and time to coordinate group meeting times. P5 even expressed this process like a ‘competition’.

Another meeting with 5 people, we can never meet and it is really frustrating. I can meet Thursday and Friday and next person says Saturday and Sunday. And next person says Monday and Tuesday. We have not had once meeting with all of our members because it is like competition. (P5: Female, Senior)

To coordinate the group schedules, they usually used online scheduling tools such as “Whenisgood” or “Doodle” to determine everyone’s available time slots and find a time that all members could attend. However, as P10 and P1 said, some were reluctant to provide details about their free time to just ‘colleagues’, making coordination difficult.:

It is hard to coordinate all schedules usually because we are not all friends, we are just colleagues. When I sent out a ‘Whenisgood’, I got all responses literally, there is no time not even a one-hour block. (P10: Female, Junior)

It is annoying to fill out all my availability because I do not want to let them know all my free time (P1: Female, Senior)

4.6 Technology, Life Balance, and Boundary

In Table 1, we summarized the boundary management strategy types we identified among our interviewees, along with their underlying motivations and perception towards technology. Technology was perceived as both a resource and a challenge for boundary management and life balance: some participants thought technology was major source of distraction while others thought technology was a key way to create, maintain, and manage proper boundaries.

As a wrap-up interview question, we asked interviewees to explain how they perceived their life balance. As noted in the quotes from P2, interviewees thought life balance consisted of managing both academic and social aspects of their lives, which is very similar to the classic definition of work/life balance: ‘satisfaction and good functioning at work and at home with a minimum of role conflict.’ [13]

I always managed to get all my schoolwork done, so I still have time to hang out with people, talk to my parents. I am pretty well-organized so I’m pretty well balanced in that because I know what I need to get done. (P2: Male, Senior)

At the same time, they thought it was crucial to have some strategies for the life balance such as (a) being aware of different demands in their life, (b) regulating themselves so as not to be influenced by distractions and (c) making good choices in allocating their limited time and energy resources. Interviewees indicated that they needed to learn better self-regulation and organizing skills in order to achieve better life balance.

A better life balance? I think doing what you have to do on time, instead of procrastinating. I think procrastinating is probably the most important thing to get rid of. (P19: Female, Junior)

Lastly, we asked students whether they thought technology helped them to be more or less balanced. More than half of participants (17/29) answered that technology had a negative influence on their life balance. They perceived the extended permeability by communication technologies to be the major source of distraction that hindered them.

Not using technology as much has helped me balance my life. For me, the more I use technology the more I lose focus. If I’m on FB or texting people while working, it drags out the whole process. (P9: Female, Junior)

On the other hand, a smaller number of participants (8/29) said technology positively impacted their life balance. They appreciated the increased permeability of boundaries that communication technologies facilitated, because it allowed them to be involved in both in and out school domains easily.

It's a lot easier to contact friends even if your friend's four billion miles away from you, you can still contact them. And also in terms family life it's also easy to just use technology to like contact them So I think that's also what makes technology helpful. (P29: Male, Sophomore)

Several (3/29) also mentioned that time management tools were crucial for managing multiple commitments.

[My] calendar helps me all the time, it is like my life saver. Otherwise I would forget 100% of things going on. (P3: Female, Senior)

Table 1 Summary of Boundary Management Strategy Types, Motivations and Perception toward Technology

Motivation	Descriptions	Perception toward Technology
1. Demarcating Social Boundaries		
While connected, preventing unwanted boundary crossing	Using different communication channels for different social domains (e.g. Snapchat)	+ Technology as primary means to involve in multiple life spheres + Technology as means to integrate/segment boundaries between different social domains - Technology as something vulnerable in boundary crossing
	Managing contents and audience while including multiple social domains into one place (e.g. Facebook)	
2. Defending Academic Boundaries		
Securing academic domains from distraction and interruption	Temporal technology non-use and Internet disconnection (e.g. airplane mode)	+ Technology as boundary segmentation resource - Technology as a major distraction and interruption source
	Cognitive separation between devices (e.g. social vs. academic device)	
	Using Blocker applications	
	Boundary maintaining by location and social influence (e.g. study at library vs. home)	
3. Organizing Temporal Boundaries		
Managing multiple commitments	Setting and readjusting priority	+ Technology as an effective tool for managing multiple commitments - Technology as a subsidiary (but not a major) means in achieving life balance
	Managing schedules using calendars	
	Coordinating group schedules using online scheduling tools	

** Positive perception toward technology (i.e. resource for boundary management) marked with + signs and negative perception toward technology (i.e. challenges for boundary management) marked with - signs*

5 DISCUSSION

Our study investigated how undergraduate students at a large U.S. research university manage their life boundaries. Interviewees reported juggling multiple life spheres. To manage the highly permeable and flexible boundaries of college lives by nature, participants actively employed boundary management such as demarcating social boundaries via multiple CMC channels, defending academic boundaries via conceptual

device separation and defensive technological features, and organizing temporal boundaries via time management tools and readjustment of life priorities.

By explicating their boundary management practices, we discovered that technology was perceived both as a resource and as a challenge for boundary management and life balance. Technology-mediated connectivity allowed our interviewees to manage multiple roles effectively. They could switch between life domains simply by using different communication technologies (e.g. after sending a class-related email to a professor, they might talk to friends on Snapchat), or they could be involved in multiple life spheres at the same time (e.g., texting to their mother during class). However, this extensive connectivity made them susceptible to interruptions from other social domains.

These findings suggest some questions for future technology and HCI research: what aspects of current technology facilitate and what aspects hinder the development of boundary management of undergraduates? How can technology be designed to improve students' life balance?

In answering those questions, we needed to revisit the characteristics of life boundaries that undergraduate participants stated. Interviewees reported maintaining flexible and permeable boundaries that are not entirely bounded physically or temporally; there was no clear-cut relationship between space, time and roles because there were few stable physical or temporal boundaries. Rather, they saw their lives as comprised of multiple domains, including school and non-school domains, that were loosely defined and technologically mediated. Also, they perceived their life boundaries were transient, progressive and dynamic because they had to plan and implement new life schemes by each academic semester because of different class schedule and life priorities.

These characteristics were very different from the findings and the assumptions of previous literature on working professionals since most of them presumed that life boundaries were socially 'institutionalized' and stabilized [3,33]. This finding calls for further exploration of the boundary management practices of understudied populations such as adolescents, single parents, or the retirees. Also, it suggests that researchers and system designers need to take into account a wider variety of life domains rather than focusing home vs. work dichotomy.

Another characteristic of life boundaries that interviewees noted was that they took it for granted that their life boundaries were blurred and integrated. Many life spheres in the school domain were physically and cognitively overlapped and many communication tools mediated a wide range of social domains. As 'ubiquitous' technologies for supporting 'seamless' transition between work and home boundaries has been the focus of past research for decades [4,37], the new 'wired generation' may perceive the seamless, ubiquitous and integrating boundaries as a matter of course without any doubt.

Based on this finding, we suspect that future systems might need to support more 'segmenting practices' rather than aiming for integration. That way, users would be better able to minimize influences from other domains for the amount of time they want. As we could observe from the uses of 'blocker' application to defend academic boundaries from distractions and self-interruption, some interviewees actively tried to manage the blurred nature of their life boundaries using technology for segmentation. However, current technology for effective segmentation is under studied compared to technologies for integration. Further discussion is needed how technology could support both the boundary integration and segmentation practices flexibly.

Another notable finding was undergraduate participants strongly believed 'individual ability' was the crucial determinant in achieving better life balance. This tendency has been reported from the prior studies [9,37,44] that people perceived life balance as a matter of individual choices or responsibility while in fact one's life balance and boundaries are socially constructed and embedded [3,4,9]. In particular, undergraduate participants emphasized the importance of self-regulation and self-organizing skills to achieve better life balance. They thought they needed to catch up with different commitments from different life domains, and to regulate themselves to minimize distractions. Clearly, it is important to support individuals in the development of those skills.

However, focusing only on individual effort would be an incomplete approach to supporting better boundary management and life balance, since people's boundaries need be negotiated with physical, and social contexts [4]. Therefore, we suggest that future systems could help users recognize and consider the various

contextual factors that are involved in the creation and maintenance of boundaries, such as spatial, temporal, psychological, social, and technological. In particular, because negotiating and managing social boundaries is hard to do individually, future systems should allow users to manage and coordinate their life boundaries collectively. This implication echoes the arguments of Bødker [4] and Mazmanian and Erickson's [36].

5.1 Design Possibilities for Better Boundary Management of Undergraduate Students

Based on the findings and discussion, we explore possibilities for the design of future technologies to support the boundary management needs of undergraduate students.

To support undergraduates' needs to manage different life domains using various CMC channels, system designs should take into account the ways in which these students use particular media. Most importantly, designers should identify whether their tool is used mainly for integrating domains (e.g. Facebook) or mainly for segmenting social boundaries (e.g. Snapchat). Then, for the communication channels for integration, system designers need to consider 1) Expandability: make it easier to search and add a new connection, 2) Aggregation: provide summarized and filtered overview to catch up with many social updates and messages quickly, and 3) Audience/Content Management: provide the feedback about the message and status updates in terms of privacy, appropriateness, and (unexpected) audience. For the communication tools for segmenting social boundaries, a system needs to consider 1) Gate Keeping: make adding new connections only available only when both users agreed, and let users constantly monitor and opt in or out of their connections, and 2) Restricted sharing: put some technical restrictions on sharing messages or contents outside of their system.

To satisfy students' needs to defend their academic boundaries from interruptions and distractions, future tools might address students' ways of incorporating their technological boundaries with their conceptual and physical (spatial and temporal) boundaries. A future context-aware system might establish a desired level of Internet connection and device use by detecting nuanced ways that students move between domains. For example, one student arrived at the campus library (spatial context), as the exam week was approaching in a week (temporal context). She did not want to waste time looking at social media sites and messaging apps, but she still needed to access class sites and library pages to prepare the exams (desired technological boundary). A future system could make this kind of boundary management easier by recommending and/or automatically tailoring the desired level of technological boundaries across Internet access and device uses. As many life logging technology and sensors are available, sophisticated behavior modeling and prediction such as [39] could be used to achieve seamless 'separation' and 'transition between integration and segmentation'.

Furthermore, to meet the needs of better organizing temporal boundaries, future time management tools should take into consideration the nature of undergraduate life. Current time management tools such as calendars are effective at tracking existing commitments throughout a semester. However, even better systems might help them reflect and evaluate their time management in past semesters and allow them to plan and envision new life schemes and new priorities at the beginning of each semester. For example, there could be an open platform that students use to share and exchange feedback about their past or tentative semester schedules. Further, better class management system could provide information about the estimated time and effort required for a particular class such as average study hour, class difficulties, and group workload by making use of the collected data by other students who took this class in the past. Using those information, students could plan more manageable and realistic semester plan considering actual workload.

Lastly, to address difficulties in setting group schedules for class group projects or extracurricular activities, better group scheduling systems could be explored. Current systems for group scheduling require too much private information about one's availability and require a lot of effort to coordinate. Therefore, collaborative task and scheduling optimization technologies such as [42,57] could be considered to address privacy issues and reduce the efforts for group scheduling that could aid cooperative and democratic decision-making process.

5.2 Limitations and Future Directions

Since our study was conducted with a small number of undergraduate students in a single large research university setting in the U.S., we do not know how well our findings would apply to undergraduate students in

other cultural or academic settings. Also, our interview procedures and some interview questions might have some influence on the ways participants reported their boundary managing practices. In future study, we plan to explore how different academic, national, cultural and socioeconomic statuses shape boundary management practices.

6 CONCLUSION

We investigated the boundary management practices of a sample of undergraduate students at a large U.S. university. We first schematized and characterized the highly flexible and permeable nature of undergraduates' life domains. Based on understandings, we identified three typical boundary management patterns: demarcating social boundaries, defending academic boundaries from distractions and organizing temporal boundaries. Lastly, we found that interviewees perceived of technology as both a resource for and a challenge to their boundary management and life balance. Based on these findings, we proposed design implications for future technology to better support the boundary management processes of undergraduate students.

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