Designing for the Lived Experience of Time

Visually Representing Time as a Means for Students to Disincentivize Procrastination

Gloria Jing
Department of Graphic and Industrial Design
College of Design | North Carolina State University
April 29th, 2021
Submitted in partial fulfillment
for the degree of Master of Graphic Design

Denise Gonzales Crisp, Committee Chair
Professor of Graphic Design, Director of Graduate Programs

Dr. Matthew Peterson, Committee Member
Assistant Professor of Graphic Design

Helen Armstrong, Committee Member
Professor of Graphic Design

Program Statement on the Master of Graphic Design Final Project

This document details a final project, which in design is commonly referred to as a graduate "thesis," at North Carolina State University. The work was defined in a 3-credit course in a fall semester, and executed in a 6-credit course in the following spring semester. The Master of Graphic Design is a terminal professional degree with a research orientation, but like the MFA and MDes, it is not a primary research degree. This is a discovery-based investigation. Cash (2018) describes the process of building scientific knowledge as a cycle between theory building and theory testing. The theory building mode includes (1) discovery and description, (2) definition of variables and limitation of domain, and (3) relationship building (pp. 88–89). This investigation is restricted to the theory building mode. The theory testing mode includes (4) prediction, testing, and validation, and (5) extension and refinement (p. 89). While experts may have been consulted, this investigation does not entail any testing with human subjects, and it does not endeavor to prove anything; all assertions are tentative and speculative.

See: Cash, P. J. (2018). Developing theory-driven design research. *Design Studies, 56,* 84–119.

Abstract

Procrastination has remained a pervasive issue within the academic context. This is further exacerbated in the Covid-19 pandemic, which highlights a need for students to successfully adapt to online asynchronous course environments. However, few studies exist that explore alternative temporal representations of scheduling to bolster motivation and orient students to a future time perspective during task planning and execution. This investigation reframes time perception to help college students mitigate self-regulatory failure by including multiple perspectives and explorations of the relational aspects of time within a 3D environment. Beyond procrastination, this investigation points to the exciting design possibility of tackling recurring issues through slight shifts in perspective.

Acknowledgments

My Chair — Denise; Thank you. There are so many words that I cannot put here but you single-handedly changed my experience here in the program.

My Committee — Helen and Matt; your encouragement has always been greatly appreciated. I will take your invaluable knowledge alongside me in the future.

My Other Instructors — I have learned so much from each of your classes.

My Cohort — I am continually inspired by you all.

My Friends & Family — I would not be here without you. Thank you for all of your support and unwavering kindness.

My Husband — Matty, thank you for the countless hours guiding me through thesis discussions, giving ideas and encouragement. You are and will always be my favorite person to procrastinate with.

Table of Contents

"You can't just turn on creativity like a faucet. You have to be in the right mood. What mood is that? Last-minute panic."

—Bill Watterson

1

Introduction

For many students, college represents the beginning of many firsts — the potential first access to a reliable and stable internet source, the first opportunity to meet people from all walks of life, and the first taste of freedom. However, with the price of freedom comes a whole new level of confusion and new distractions. Students are constantly struggling with balancing their course work, attending exciting clubs, socializing with new-found friends, eating well-balanced meals, and getting enough sleep. It is incredibly easy to get swept up into these new, exciting experiences and temporarily forego schoolwork. Students have the best intentions of completing their schoolwork. Despite this, approximately 80-95% of students procrastinate and 50% do so on a recurrent basis (Steel, 2007). And it makes sense, given the difficult nature of schoolwork. Often, it is much easier to acquiesce to exciting experiences such as an enjoyable club session rather than a cumbersome, potentially frustrating homework session.

To add to the enticing nature of college experiences, procrastination is further exacerbated within the current climate. In 2019–2021, amidst a confusing COVID-era landscape where traditional learning environments are not feasible, schools have looked to online environments to deliver curricula. Students can complete assignments anytime within their own busy schedules. However, with the responsibility on the student to self-direct their learning,

avoiding procrastination often requires a level of self-regulation that many students do not possess.

In asynchronous courses, students must allocate time to complete assignments. To track their work, many students utilize time management or calendar applications. One existing application, Google calendar, is a prime tool for students to track daily, weekly, and monthly activity. Users input tasks that are customizable and can incorporate new activities that crop up during a school day. However, one issue with overreliance on the calendar is that the emphasis falls on optimizing time management. Rather than considering the lived experience of time, calendars focus on efficiency at slotting in tasks and doing work. A student's entire day, then becomes segmented into time-slotted tasks of classes, extracurriculars, and new events. Instead of considering how a student might feasibly balance their lives, the calendar emphasizes the next event or task to attend to.

But what are the drawbacks of a missed event? What if it takes longer than anticipated to complete an essay or study session? If so, this means readjusting the schedule for new tasks and potentially missing new opportunities. If the student continually misses events, he or she can become caught in a vicious cycle where the student views schoolwork as aversive tasks, which then leads to further procrastination.

To rectify this issue, one common method points to better time management, but it is increasingly difficult to do so when school activities are demanding and time-consuming.

Existing time management skill sets, then, are incredibly useful tools for tackling procrastination and there are numerous ways to do so. Google searches yield applications that track down time-inefficient activities, while others attempt to motivate students by gamifying tasks. These applications may be helpful in combating procrastination; however, the sheer number of applications can also be overwhelming. Rarely do these applications attempt to address emotions felt in-the-moment. When students view an activity as aversive, their mentality shifts towards the present or past. Therefore, to expand upon these existing applications, what if we attempted to reconfigure the way we view time while doing the tasks? How then can we combat procrastination by designing an experience for the lived reality of time?

Asynchronous Courses: A course structure where students access lectures anytime.

Synchronous Courses: Students attend lectures along with the instructor.

Jing | Introduction

2

Problem Space

2.1 Problem Statement

Procrastination is a perpetual issue within the academic realm. Procrastination is often described as the "voluntary delay"of "an intended course of action despite expecting to be worse off for the delay" (Steel, 2007, p. 66), while "academic procrastination," specifically denotes study-related tasks and activities (Steel & Klingsieck, 2016). Procrastinators often have heightened stress which can lead to course dropout, low student engagement, and poor academic performance (Pogorskiy et al., 2018).

Procrastination is broadly considered an issue of self-regulation. One model by Barry J. Zimmerman (2002) introduces a three-pronged cyclical self-regulation model that includes forethought, performance, and self-reflection phases (Loeffler et al., 2019). Forethought consists of preemptive goal planning and task analysis; performance incorporates in-situ self-monitoring mechanisms; and self-reflection encourages post self-evaluation measures. Notably, students struggle with every single phase, excluding goal-setting (Loeffler et al., 2019). While goal-setting is a vital part of successfully completing course work (Epton et al., 2017), listing goals is not enough to spring students into action (Koestner et al., 2002). This phenomenon, where students make goals but do not follow through, is often referred to as the "intention-behavior gap" (Sheeran & Webb, 2016).

But to address this gap is to acknowledge that procrastination is a complex issue with multiple facets to consider and a multitude of ways to investigate it. Some addressals look to the individual's traits and often reference the five-factor model (extraversion, agreeableness, openness, conscientiousness, and neuroticism) (Steel, 2007). Others categorize procrastinators into individual problem areas. For example, individual struggles vary on a case-by-case basis; some students may have issues with time management whereas others might have trouble regulating their emotions or succumb to fear (Loeffler et al., 2019).

Furthermore, procrastination is intensified in online asynchronous courses. For one, the courses demand a greater amount of self-regulation. Without a teacher to physically remind students to engage in course content, the courses are less forgiving and rely more on participation rates; thus weak participation rates directly translate into lower scores on exams and overall grades (Levy, 2007; Stoessel et al., 2015). Online learning environments also impede students' ability to allocate mental and motivational resources to a task (Pogorskiy et al., 2018). There is a larger amount of risk associated with online courses and it is harder for a student to course-correct within the process (Pogorskiy et al., 2018). Partially, procrastination stems from a lack of social presence that students feel when required to participate within environments that feel exclusionary (Klingsieck et al., 2012). Without strong social presence, students are more hesitant to actively participate in discussions which leads to lower learner outcomes.

However, another issue stems from how students perceive and self-regulate time usage. One way to conceptualize time through history is to refer to philosophical notions of time; for example, Aristotle denotes time as existing when there is change. Newton, on the other hand, would consider time to be "constant, consistent, immutable, and universal, like graph paper underpinning the cosmos (as cited by Buzzo & Merendino, 2015). According to Conceptual Metaphor Theory, our current conceptions of abstract domains such as time can be represented through metaphor (Leone et al., 2018). A common set of metaphors is the Moving-Ego Metaphor (MEM) and the Moving-Time Metaphor (MTM). Through this understanding of time as metaphor, we can begin to unravel the idea that people are ascribed to categorizations of time, in this case, placed within MEM or MTM ideologies (see Figure 3.1.1 and description) and have difficulty transitioning to fluidly represent time to conceptualize the future.

Phillip Zimbardo's *Time Perspective Theory* outlines this phenomenon. Within the future-time metaphor, people have three different orientations: past, present, and future (see Figure 3.1.2. and description). Research has found that people often procrastinate when they are past and present-oriented rather than future-oriented (Stolarski et al., 2019).

Therefore, an exciting design possibility lies in mediating these inherent complexities of managing time. My investigation weaves together the intersection of linear time representation, self-regulation, and time orientation that exemplifies opportunity ripe for exploration.

2.2. Justification

Often, time is conceptualized through the calendar system. This traditional grid system enforces the economization of time, and makes the representations of time fitting a calendar-orientation rather than a user-orientation.

> "The calendar simultaneously represents the personal and the public, work and home, value and scarcity, mechanical and experiential time. The digital calendar in its common form creates a mechanical grid of equidistant hours, days, weeks, months and years, divided into convenient slots of spaces into which to insert pre-booked activity. On initial evaluation this appears at odds with the lived time it represents (Buzzo & Merendino, 2015)."

The calendar forces people to make transactions that favor efficiency over other lived experiences. It does not represent time as a complexity that considers the messy, the inefficient, the experiential, all in one.

I do not suggest that the calendar system is flawed, as it is a cultural association that we have lived with and operated on for ages. Or that other experiences utilizing the calendar are irrelevant and do not already combat an incredibly complex issue. Rather, this investigation attempts to add on to existing tool sets such as the calendar system.

By creating design tools and technologies that enable the user to address situation-dependent and customizable interfaces for procrastination, I attempt to enhance user agency. The calendar system and its subsequent association with conventional time management strategies is at the core of my investigation, because it often problematically presents an individual's procrastination level to be stable no matter the circumstance. However, research has revealed that procrastination is fluid to the situation, fluctuating

based on the individuals' emotions, contextual cues, and task characteristics (Loeffler et al., 2019). By exploring design systems that visually represent alternative temporal representation that take the form of sensorial and fluid experiences, we begin to account and design for lived experiences of time.

2.3. Annotated Bibliography

Temporal Representation

There are many strategies for representing time, ranging from an economical calendar system that segments time into daily, weekly, and monthly chunks, to photography stills that utilize motion-capture (Buzzo & Merendino, 2015). One way to conceptualize time is through discussing metaphor (Leone et al., 2018). This includes the Moving-Ego Metaphor (MEM) and the Moving-Time Metaphor (MTM) to represent how time is both temporally and spatially represented via ego placement (Duffy et al., 2014). In MTM, the ego is fixed with events moving to the ego whereas in MEM, the ego moves towards stationary events. Through an understanding of how time is represented, we can begin to transition away from normal conventions and instead, think about how to represent time as a lived experience.

Pedagogical Agents & Strategies

In online asynchronous environments, social isolation is a key contributor to procrastination (Klingsieck et al., 2012). Both pedagogical agents — human and non-human — employ strategies to facilitate social presence as a core component to address procrastination, though they differ in strategy. Teachers may employ cooperative learning by making students work together in small groups to enhance learning (Johnson et al., 1991). By cooperatively working, this approach facilitates unique opportunities that typically would not exist in a competitive or individual environment (Jiao et al., 2011). Virtual agents, on the other hand, employ strategies that focus on the individual level that attempt to motivate the students through personalized anecdotes about particular struggles. Furthermore, to aid in individual assessment, guidelines for virtual agents disclose practices for avatar appearance, design, and other considerations (Kim & Baylor, 2008).

Transitional Difficulties

Self-regulation issues are mediated through multiple factors. Among these are the role of time perspective, affect, and locus of control (Choy & Cheung, 2018). One particular difficulty arises within the competing narrative of time perspectives. Often, people engage in temporal discounting, fixating on present circumstances and neglecting potential future consequences (Kissel, 2020). Zimbardo lays out his time perspective inventory where individual proclivities group mental categorizations of time into the past, present, or future time perspectives (Stolarski et al., 2019). Research suggests that people who adopt the future time perspectives are less likely to procrastinate than their past and present adopting peers. Furthermore, there exists two categorizations of time perspective: the state and trait perspectives, which invites the possibility for people to gradually transition between the past, present, and future perspectives (Stolarski et al., 2019).

Behavioral Change

Psychological theories of behavior change indicate motivations for why people want to change for their well-being. In the case of academic procrastination, motivation is fueled by fear of failure in receiving bad grades or poor learning outcomes. However, sources of motivation fluctuate. For example, the Precaution Adoption Process Model provides procrastination stages: unaware of issue, unengaged by issue, deciding about acting, deciding to act, acting, and maintenance (Bhattacharya et al., 2018). Along this continuum, there are also pivotal moments of epiphany where individuals allow themselves to be more susceptible to change. To facilitate these changes, various strategies such as subliminal priming occur, where information is presented in a way that is not consciously perceived but still processed. With regards to procrastination, combining subliminal priming with directed focus prompts decisions and commitment. (Caraban et al., 2018).

Temporal Representation

Title	Citation
Time and time again: The many ways to represent time	Allen, 1991
Temporal representations in human computer interaction	Buzzo, 2017

Not all days are equal	Buzzo & Merendino, 2015
Moving through time: The role of personality in three real-life contexts	Duffy et al., 2014
The influence of time perception on intertemporal preferences and its psychological mechanism.	Jin, 2020
Time drawings: Spatial representation of temporal concepts	Leone et al., 2018
Time after time: The psychological reality of the ego- and time-reference-point distinction in metaphorical construals of time.	Núñez et al., 2006

Pedagogical Agents & Strategies

Title	Citation
Using the technological, pedagogical, and content knowledge framework to design online learning environments and professional development.	Doering et al., 2009
Academic procrastination and the performance of graduate-level cooperative groups in research methods courses	Jiao et al., 2011
Cooperative learning: Increasing college faculty instructional productivity	Johnson et al., 1991
A virtual change agent: Motivating pre-service teachers to integrate technology in their future classrooms	Kim & Baylor, 2008
Procrastination in a distance university setting	Klingsieck et al., 2012
Utilising a virtual learning assistant as a measurement and intervention tool for self-regulation in learning	Pogorskiy et al., 2018
Participation in online courses and interaction with a virtual agent	Song et al., 2019

Transitional Difficulties

Title	Citation
A mental imagery intervention to increase future self-continuity and reduce procrastination.	Blouin-Hudon & Pychyl, 2016
Time perspective, control, and affect mediate the relationship between regulatory mode and procrastination	Choy & Cheung, 2018
Procrastination and the extended will	Heath & Anderson, 2010
Exploring the functionalities of imagining the future in relation to the time span between present and future self in the daily life of university students	Kissel, 2020
Fostering self-regulation to overcome academic procrastination using interactive ambulatory assessment	Loeffler et al., 2019
Procrastination, consideration of future consequences, and episodic future thinking	Rebetez et al., 2016
Writing about personal goals and plans regardless of goal type boosts academic performance	Schippers et al., 2019
Putting time in a wider perspective: The past, the present, and the future of time perspective theory	Stolarski et al., 2019

Behavioral Change

Title	Citation
Understanding pivotal experiences in behavior change for the design of technologies for personal wellbeing	Bhattacharya et al., 2018
Exploring the feasibility of subliminal priming on web platforms	Caraban et al., 2018
The Intention-Behavior Gap	Sheeran & Webb, 2016

Figure 2.3.1 Annotated Bibliography

2.4 Definition of Terms

Below is a clarification of terms used throughout the document.

- ***Procrastination:*** "The voluntary delay of an intended course of action despite expecting to be worse off for the delay" (Steel, 2007, p. 66).
- ***Academic Procrastination:*** The postponement of school-related topics such as completing projects, assignments, and study sessions.
- ***Self-Regulation:*** Self-governance in performing and maintaining goals and actions.
- ***Affect:*** The user's feelings or mood during an experience.
- ***Intention-behavior gap:*** Students' inability to transfer intentions and goals into feasible action.
- ***Moving Ego Metaphor (MEM) & Moving Time Metaphor (MTM):*** Both describe how time is dependent on the ego; In MTM the ego is fixed with events moving to the ego. In MEM, the ego moves towards stationary events.
- ***Priming, Subliminal Priming & Supraliminal Priming:*** The process of introducing users to multiple stimuli, where the first stimulus influences the user's response to subsequent stimuli. Subliminal priming occurs when the stimulus is barely perceptible on a conscious level. In juxtaposition, supraliminal priming occurs when stimulus is consciously perceived.
- ***Asynchronous & Synchronous Courses:*** Course structures that vary by delivery. In asynchronous courses, students access lectures anytime. In synchronous course environments, students attend lectures along with the instructor.

2.5. Assumptions and Limitations

Assumptions: The current investigation exists in a time where asynchronous courses have not been given the same attention as traditional synchronous courses. Thus, I assume that self-regulation will be a recurrent issue in future asynchronous courses where there is less instructor and peer guidance for deadline reminders and participation. Given these circumstances, I assume that students have the appropriate technological confidence and accessibility to succeed. Furthermore, this investigation assumes that people are willing to self-identify and address their procrastination; thus, they would be willing to interact with an interface and attempt to experience time in new situations.

Limitations: This investigation addresses time representation through a pair of metaphors: MEM and MTM. However, I acknowledge that this is one possible framework to represent time. For example, in section 2.1, I briefly address Aristotles and Newton's methodology of viewing time. I am not an expert on time and have only chosen the MEM and MTM representation of time through research. Furthermore, any priming techniques in my research questions are compiled from existing principles. I do not intend to generate new priming techniques; instead, I explore the design potential of current priming applications.

Throughout my document, I reference terms such as behavior change and priming. I understand that there are multiple interpretations of what these terms entail and I explicitly outline that I suggest change. Priming then, is used for beneficial purposes and is not indicative of influencing the user in a manner that they do not accept. Furthermore, I do not suggest that the user undergoing my proposed investigation will magically shift their entire perspective. In fact, I cannot promise any change at all to a process that is largely a product of the mind. Thus, I determine that any positive change in lessening procrastination is a success. However, even in the best case scenario where the user has drastically lessened their procrastination, it is possible that they will revert back to their previous stage and engage in more procrastination. Through this investigation, I establish systems that will embrace the user at any point in time and encourage them to continue to combat procrastination.

2.6. Precedents

By sifting through existing time management software, I investigated how the current technological landscape attempts to combat procrastination. Each precedent was evaluated according to its current methodologies in relaying time. I have grouped these precedents into task management, association, mental health, and alternative temporal applications. For the mental health applications, I investigated the particularities of language fitting such a nuanced issue, and considered the type of exercises appropriate for in-the-moment episodes versus moments of self reflection. Whereas in the time management applications, I observed how applications tracked and automated time. In the association applications, I focused on how students compartmentalized information capturing as a way to ease the studying process. Finally, I picked unique representations of time (i.e. non-standard ways of viewing time, juxtaposed against conventional methods such as the calendar system) for my alternative temporal precedents. These investigations culminated into considerations for future study.

Behavioral Change

Google Calendar (Figure 2.6.1) is a standardized collaborative platform that allows users to coordinate with organizations and other users to plan meetings and manage individual tasks. It offers a daily, weekly, and monthly time view to allow full customization for the user to create individual calendars for a variety of uses.

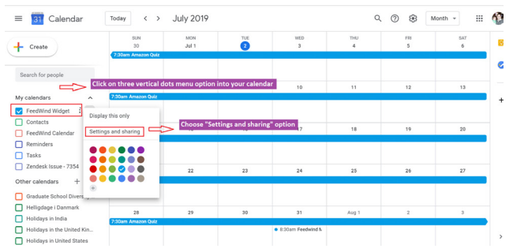


Figure 2.6.1: Google Calendar

Hourstack (Figure 2.6.2) is a collaborative time-tracking platform that enables users to visualize time frames on respective team-based tasks. It boasts a robust report overview, allowing users to gauge how long a repetitive task will last. Furthermore, it creates weekly reports to see which members of your organization are top-trenders for productivity.

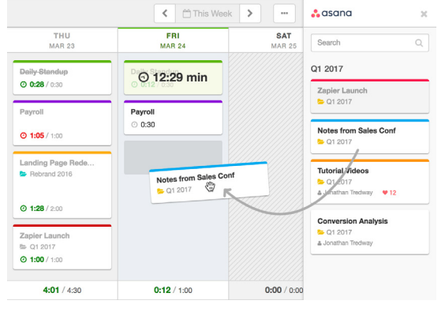


Figure 2.6.2: Hourstack

Forest (Figure 2.6.3) is an app that targets phone addiction. It incentivizes users to maintain focus on important tasks by growing virtual trees, which then translate into real planting orders. Users set time limits for different types of virtual trees and engage with real-world leaders in a friendly competition to collectively boost productivity and sustain the environment.

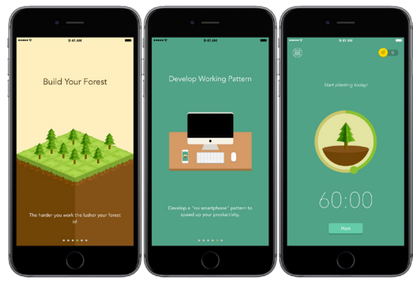


Figure 2.6.3: Forest

Finish (Figure 2.6.4) prioritizes individual tasks into short-term, mid-term, and long-term by utilizing an intuitive formula based on individual task inputs. It distinguishes itself from applications due to its automated task system, with individual customization that takes away some of the frustration of manually inputting each individual task.

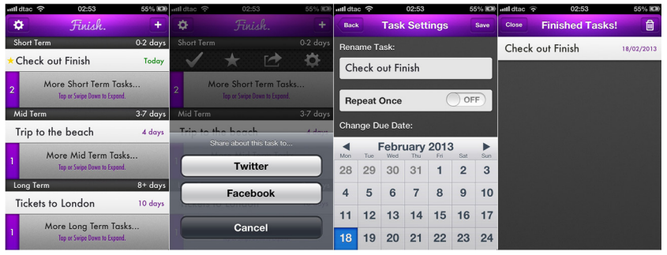


Figure 2.6.4: Finish

Association

Mindly (Figure 2.6.5) enables users to quickly capture ideas and plan through the power of association. Through a simplified hierarchical framework, users focus on capturing the essence of the idea, rather than spending time organizing the concepts together. By attributing individual nodes to new ideas, users mentally establish connections in a succinct, visualized manner. Each node can be expanded on and customized to the user's liking.

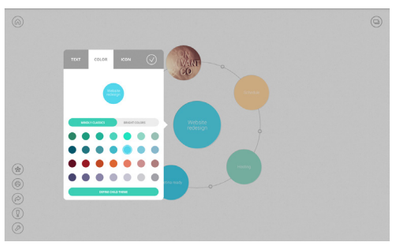


Figure 2.6.5: Mindly

Nototo (Figure 2.6.6) is a to-do list app that relies on the method of loci — where humans possess an innate ability to remember information attached to visual and spatial details. Often, memory palaces equate personal bits of data in a room that allow users to mentally walk through their homes and remember pieces of information based on their association to personal memories. Nototo organizes tasks and notes through different islands that the users customize. Users will have to categorize their own islands which may be time-consuming; however, the time spent further categorizing strengthens the association that users will be able to remember their notes.

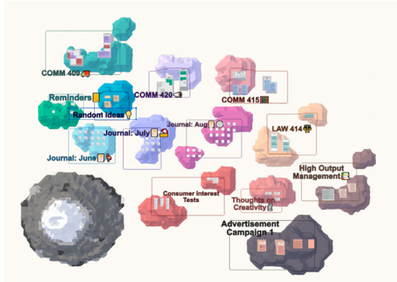


Figure 2.6.6: Nototo

Mental Health

Motivational Agents and Avatars (Figure 2.6.7), a study that explores how users relate to avatars while learning mathematics. Through these 3-D avatar representations who share their own personal struggles, users relate and feel an affinity towards these counterparts to motivate them.

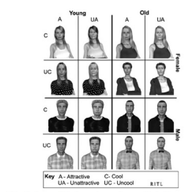


Figure 2.6.7: Motivational Agents & Avatars

What's Up (Figure 2.6.8) is an app that utilizes cognitive behavioral therapy and acceptance commitment therapy methods to help users cope in the moment or direct users to forums to discuss their concerns. It categorizes complex topics into chunks such as direct interventions and coping strategies.

Figure 2.6.8: What's Up

Alternative Temporal Representations

Your Life in Weeks (Figure 2.6.9) is a data visualization chart that maps out the average human lifespan in weeks. Users can input their age and get an indication of how much time has elapsed within their lifespans. Although potentially panic-inducing, this represents a strategy to elicit action through fear. Other common applications for this time chart are to compare your lifespan to other famous individuals who share their own personal struggles.

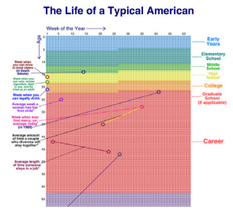


Figure 2.6.9: Your Life in Weeks

The Horse in Motion (Figure 2.6.10) is an experiment done by Edweard Muybridge. In 1878, he was commissioned by California governor Leland Stanford to ascertain whether there was a moment in time when all four of a galloping horse's limbs would be airborne. While he was able to successfully confirm that the horse limbs were airborne, his stop motion capture photographs established new methods of determining time.

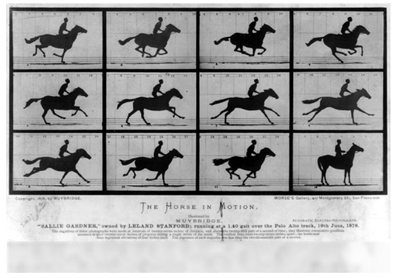


Figure 2.6.10: The Horse in Motion

SIGCHI Conference 2015 Prototype (Figure 2.6.11) exists in tandem with other quick experiments meant to reconsider how we view the calendar. The prototype attempts to allocate variable time slots and distinguish between personal and work time. Each divider represents a weekday with an adjustable pin system to reconfigure time at the user's discretion.

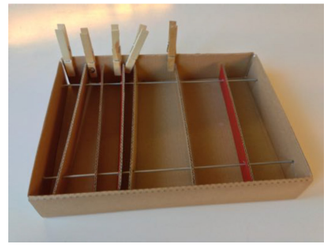


Figure 2.6.11: SIGCHI Prototype

John Cage 4′33″ (Figure 2.6.12) is a blank composition. It consists of three movements, indicated by opening and closing a piano lid. Cage attempts to challenge the notion of what constitutes music by generating music from the audience in situ. Furthermore, it establishes another way to visually perceive time through musical scores.

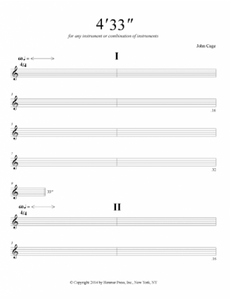
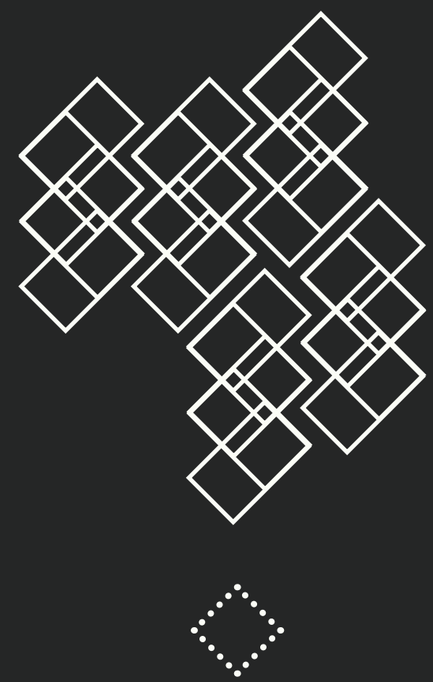


Figure 2.6.12: 4′33″

From these precedents, I have gathered a few overarching themes:

- In apps, time is typically represented through the calendar system, grouped into hours, days, weeks, and years.
- Apps that deviates outside the normal calendar convention typically focus on a task-based workflow
- Language in mental health apps is personable, firm, and reassuring.
- Time can be represented in alternative manners through motion capture, a blank music score, and other visualization strategies.



3

Investigation Plan

3.1 Conceptual Framework

Conceptual Metaphor Theory

According to conceptual metaphor theory, concepts are understandable through metaphor; where "abstract domains (i.e. target domains, like time or numbers) are mapped onto more concrete domains (i.e., source domain, space)" (Leone et al., 2018, p.11). Commonly, we see these associations with metaphors in everyday language. For example, two common time metaphors are the Moving-Time (MTM) and Moving-Ego (MEM) metaphors (Núñez et al., 2006). In MTM, future events move towards a stationary observer, depicted in the phrase: "Christmas is approaching." In MEM, the observer moves towards stationary future events, encapsulated in the phrase: "We are approaching Christmas." Of interest, research has shown that individuals who commonly adopt MEM tend to procrastinate more than MTM adoptees (Duffy et al., 2014). Thus, by focusing on the ways MEM individuals can reframe their time conception towards MTM, procrastination can theoretically be lessened and reframed.

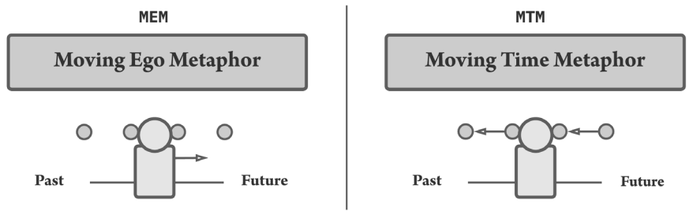


Figure 3.1.1: MTM & MEM metaphors, synthesized/adopted from Núñez et al., 2006

Time Perspective Theory

Time perspective is categorized into three time horizons: past, present, and future. These are further compartmentalized into respective time perspectives below (Stolarski et al., 2019):

- ***Past-positive*** individuals view the past warmly.
- ***Past-negative*** individuals associate the past as traumatic.
- ***Present-fatalistic*** individuals adopt a futile, hopeless attitude towards future events.
- ***Present-hedonistic*** individuals focus on activities that will gratify them in the moment.
- ***Future-negative*** individuals assume the future will be worrisome.
- ***Future-positive*** individuals prescribe hopeful future outcomes. Thus, they procrastinate less than their past or present counterparts.

According to Time Perspective Theory, time perspective consists of two types: state and trait temporal perspectives. In state time perspective, users can fluidly move between time categories when attention is directed towards a particular time orientation. However, in the trait temporal perspective, the user's habitual tendencies position them in a stationary time orientation (Stolarski et al., 2019).

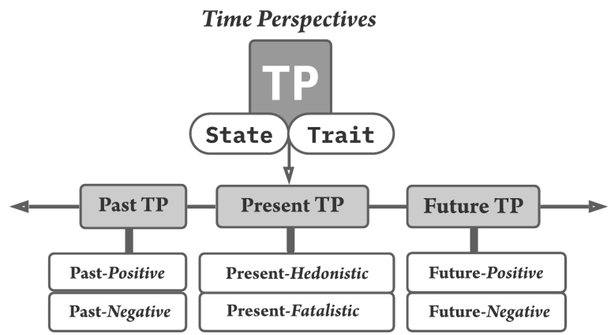


Figure 3.1.2: TP theory; synthesized /adapted from Stolarski et al., 2019

Priming

Subliminal priming exposes individuals to barely-perceptible stimuli. In the MEM and MTM metaphors, priming individuals with spatial cues can trigger source domains (Núñez et al., 2006). Thus, MEM individuals can momentarily transition to a MTM frame of thinking. Priming can transition users between state and trait time perspectives (Stolarski et al., 2019).

Conceptual Framework

This investigation addresses how priming impacts the state temporal perspective along with the MEM and MTM classifications to incentivize a change in procrastination.

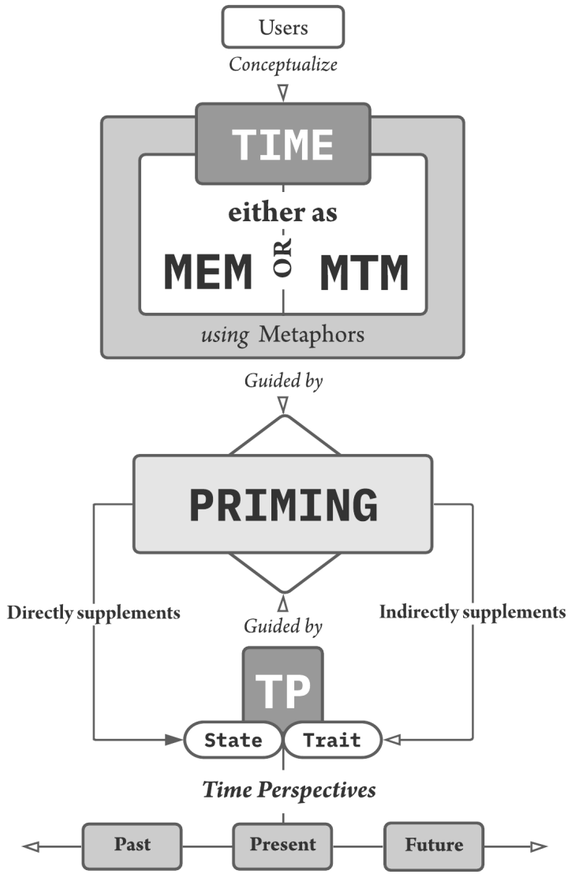


Figure 3.1.3: A synthesis of conceptual metaphor theory and time perspective theory, addressing that priming guides time perspective and time representation — two important facets in procrastination.

3.2. Research Questions

The Investigation centers around a primary research question and four subquestions that address how design specifically plays a role in addressing procrastination. Subquestions 1-3 address different facets of the digital interface, whereas Subquestion 4 synthesizes the previous subquestions.

Research Question

How can the design of a multimodal digital interface facilitate a sense of progression for undergraduates experiencing difficulty in balancing course work to moderate procrastination by adopting a future time perspective?

Subquestions

1. How can alternative temporal representations utilize past, present, and future orientation aspects to visualize time?
2. How can priming cues prepare and encourage students to shift from a past or present to future time orientation?
3. How can a social presence indication encourage positive reinforcement to aid user mood across low to high-stress situations?
4. How can a multimodal interface leverage the self-regulation phases — preparation, performance, and appraisal — to disincentivize procrastination?

3.3. Investigation Model

The investigation model focuses on three self-regulation phases — preparation, performance, and appraisal — which were derived from Pogorskiy's synthesis of multiple self-regulated learning models, inclusive of Zimmerman's model referenced in section 2.1 (Pogorskiy et al., 2018). Respectively, the preparation phase refers to goal setting; performance relates to self-monitoring; and appraisal suggests self-evaluation (Pogorskiy et al., 2018). For the purposes of this investigation, I have re-interpreted these phases in a new context as follows: The preparation phase prepares students to embrace alternative time perception as a set up for the performance phase, where they experience novel time perceptions. Afterwards, the appraisal phase incorporates self-evaluation through personal and community strategies, as evidenced in Studies 4.1 - 4.4.

To clarify, Subquestion 1 precedes the user, existing as a personal exploration to generate temporal representations, while Subquestions 2-4 address the user.

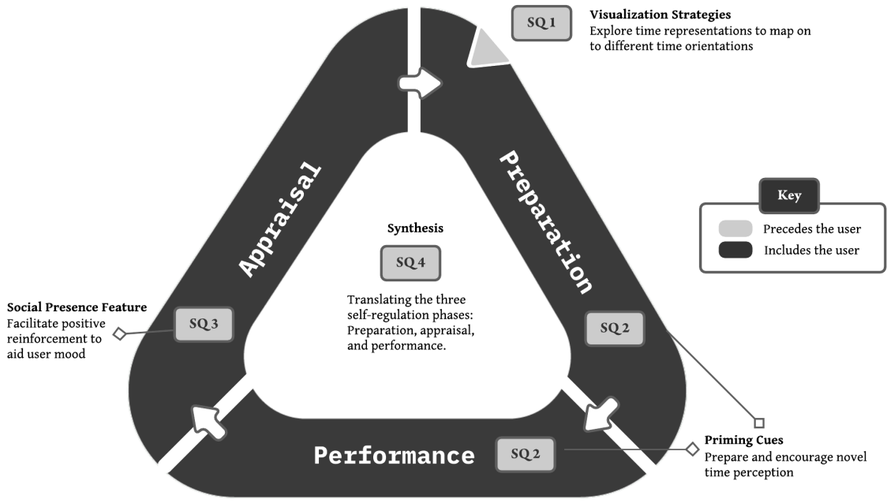


Figure 3.3.1: Investigation model derived from a synthesis of existing self-regulated learning models (Pogorskiy et al., 2018).

3.4. Scenario

Figure 3.4.1: Natalie's Schedule

Natalie is a first year engineering student at North Carolina State University. She has five classes: two Chemistry (CH 101& CH 102), two Engineering (E101 & E115), one English (ENG 101), and one Calculus (MA 141) class. This year, her Intro to Computing class (E115) and Academic Writing class (Eng 101) are online, asynchronous courses.

To prepare for tests, Natalie has attended classes, briefly reviewed concepts, and completed homework assignments. She has had issues acclimating to her course load, whilst balancing time on the weekend to attend clubs and spend time with friends. Across all five classes, she had to juggle various web assignments, lectures, quizzes, practice questions, and studying sessions. Natalie also has difficulty in allocating time to keep up with papers and assignments in her hybrid courses, while finding time to study for her chemistry and math courses. She has tried out various calendar apps, but often miscalculates the amount of time studying sessions will take and eventually neglects to try. She has had a hard time motivating herself to continue in her study sessions and often gets distracted while working.

This scenario focuses on the time between Natalie's first and second batch of exams, after she has just found out that she has performed poorly on her first exams. She attributes these failures of self-regulation to her poor high school study habits, as she was considered a gifted student and never developed proper studying techniques.

Natalie installs the virtual system to help boost her grades. Upon opening the interface, she is asked to input her current class load. The system automatically creates a proposed schedule based on Natalie's inputs on how much time she wants to dedicate towards each activity. Natalie reviews the suggested schedule and begins her first study session.

4

Studies

Students can procrastinate in myriad ways — whether from distraction, low motivation, or fear. Thus, I have created three mini-scenarios (refer to section 4.4 Culmination), that align with the three self-regulation phases — preparation, performance, and appraisal — to identify key moments throughout a student's day that may prompt them to procrastinate (Pogorskiy et al., 2018). Though not exhaustive, these studies hypothesize prototypical solutions to combat procrastination.

4.1. Generating Temporal Representations

Study One addresses how time can be transposed and contextualized to a student's study environment. The primary goal is to produce an idea bank of possibilities for novel temporal representations. Subsequently, these ideas focus on breadth and are not meant to be fleshed out; rather, they provide key insights for future studies. Furthermore, this study exists in an exploratory space where the student, i.e. Natalie, is not interacting directly with my interface. However, student interactions are simulated to address how an exploration's interface may realistically function.

Generation

To frame my explorations, I charted past, present, and future characteristics (Figure 4.1.1). I then generated a responsive model to begin investigating possibilities. Within the four quadrants, temporal representations are categorized based on an abstract-to-concrete form continuum and a perception continuum of familiar-to-unfamiliar levels. A middle line emphasizes that there are varying degrees of form and perception. As users explore and experience new temporal representations, their familiarity to new experiences continually shift. As such, the model constantly shifts depending on the student's comfort level within the interface. An explanation and example follows in Figure 4.1.2.

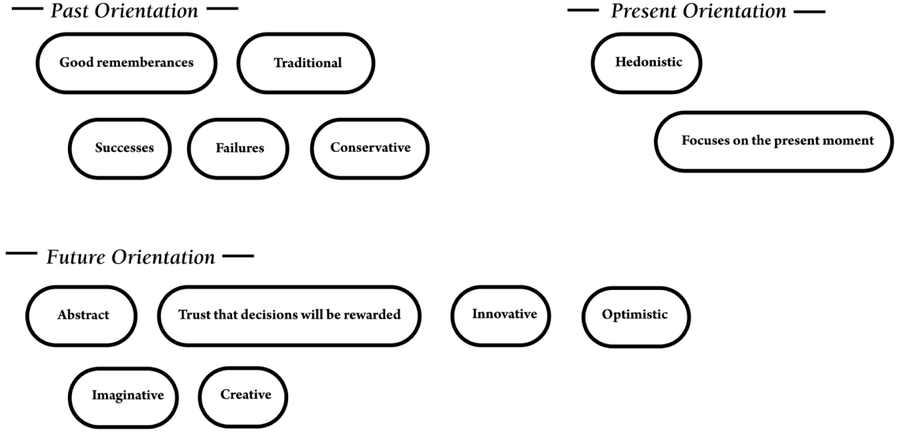
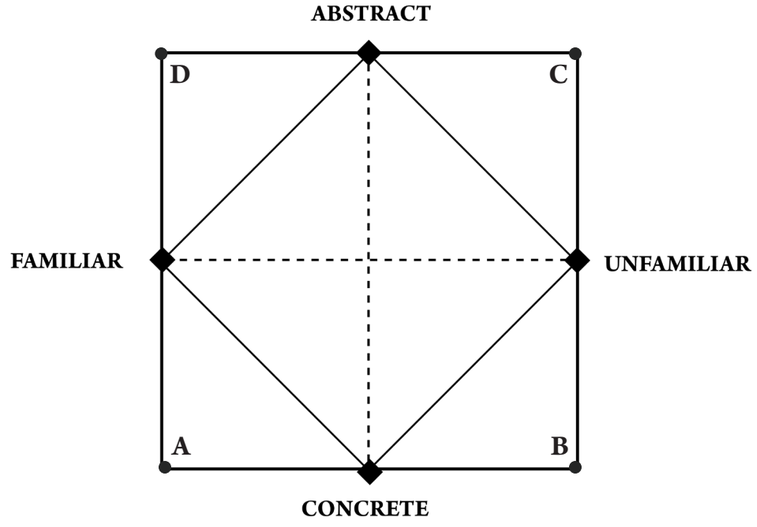


Figure 4.1.1: Past, present, and future characteristics



A. Concrete/ Familiar: Calendars B. Concrete / Unfamiliar: Sundials C. Abstract/ Unfamiliar: John Cage's musical scores D. Abstract / Familiar: Edweard Muybridge's horses	
Form Continuum (Abstract to Concrete)	Concrete: Representation typically has one singular conclusion drawn and points to something visually seen
	Abstract: Representation can infer multiple meanings or interpretations
Perception Continuum (Familiar to Unfamiliar)	Familiar: Denotes an experience that users are comfortable with seeing or utilizes modes that they are accustomed to (i.e. visuals over auditory sounds)
	Unfamiliar: Denotes an experience that users are not used to seeing and/ or experiencing.

Figure 4.1.2: A generalized model to propagate idea generation.

Exploration

Gamification

The following explorations highlight different ways to represent time. Explorations A & B apply varying degrees of gamification to motivate students to focus and continue on their study sessions. Through activities such as cooking (Figures 4.1.3 - 4.1.5) and reclaiming geographical locations (Figure 4.1.6), students will feel inclined to continue completing assignments for an extrinsic reward system. In both premises, as students successfully complete schoolwork, they are rewarded in kind with either ingredients to continue cooking or progress towards claiming territories.

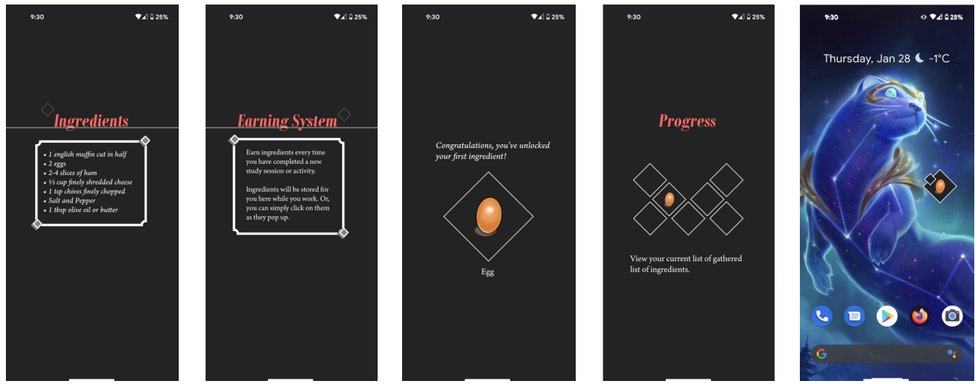


Figure 4.1.3: Exploration A — Explains the earning system of accumulating ingredients to begin cooking.

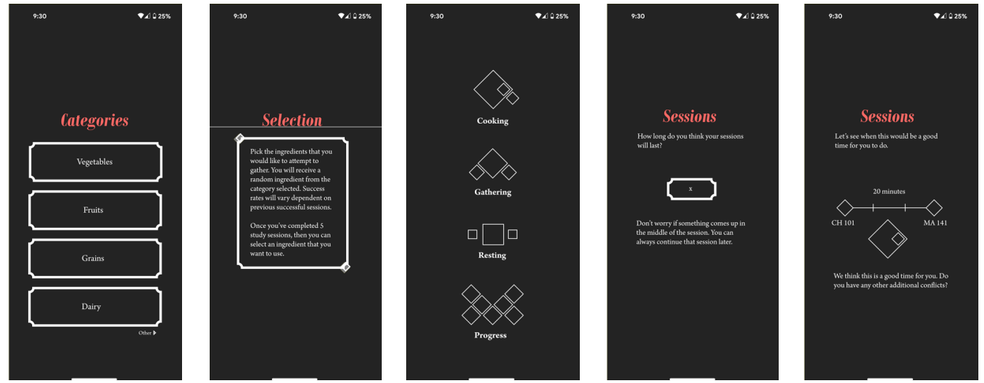


Figure 4.1.4: Exploration A — Planning and scheduling a session to earn ingredients. Students have the option to pick which ingredient category to gather and the success rate depends on their rate of real-life study. More successful real-life study sessions denote more ingredients gathered to be cooked.

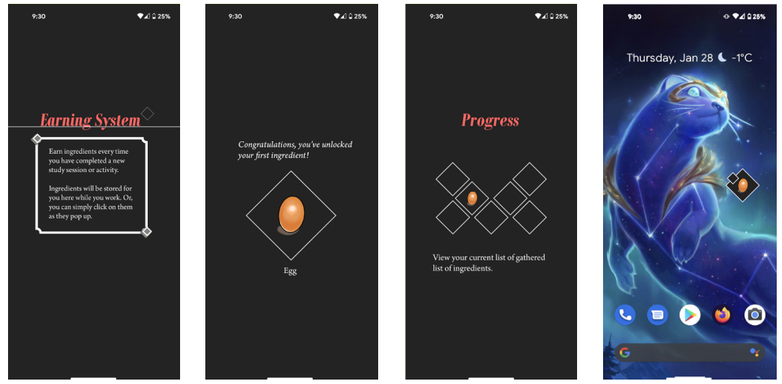


Figure 4.1.5: Undergoing a study session and reviewing progress. During the study session, the student's time progression would be marked by the diamond filling up and the ingredients gathered from the successful or unsuccessful haul. Within the month, students can track their progress.

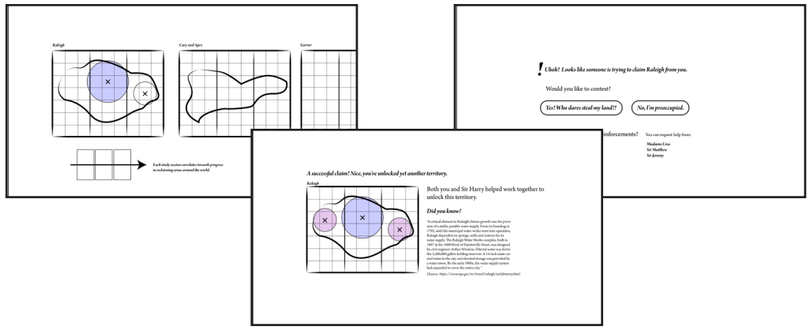


Figure 4.1.6: Exploration B — Depicts how a student would reclaim territories as a way to gamify and incentivize successful studying sessions. Students would have the option to compete with others and collaborate with their peers on claiming geographical areas.

Presence-in-the-moment

Explorations C and D (Figures 4.1.7-4.1.8) test degrees of distraction, ideally situated within an in-situ study or writing session.

Exploration C (Figure 4.1.7) explores a complex art scene, signaling time passing through the addition or subtraction of new elements. As a student becomes distracted, the interface slowly becomes more complex in-real-time as a subtle way to coax the student back on task. In this way, the progression of the art piece replaces a conventional clock or timeline, with a reward after each work session.

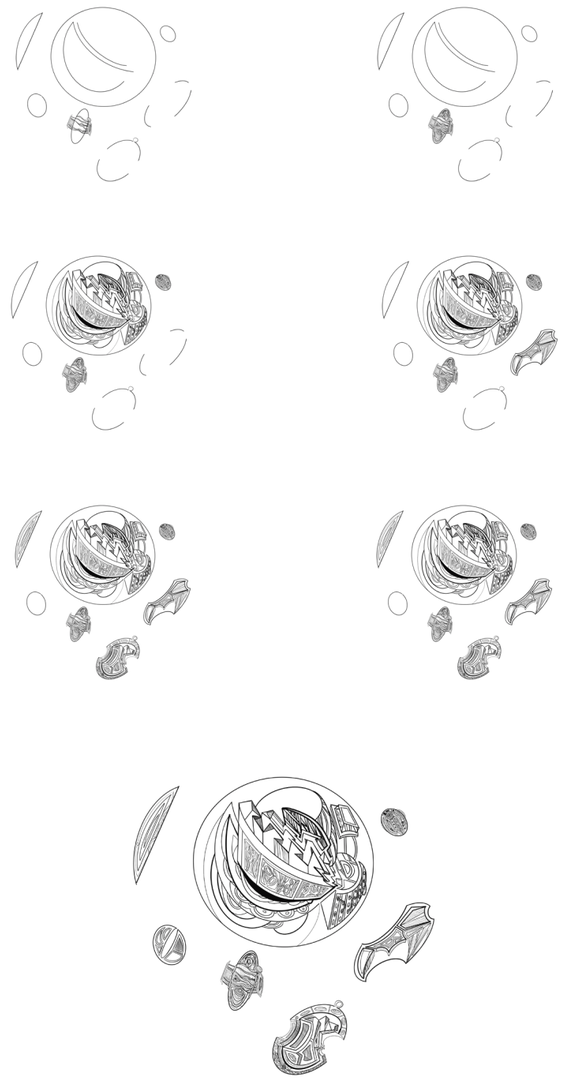


Figure 4.1.7: Exploration C — Art shapes study to focus on the present. View this animation: https://college.design.ncsu.edu/thenfinally/jing/ArtShapes.mp4

Exploration D (Figure 4.1.8) centers on a fluid, transferable shift between past, present, and future orientations through an abstract leaf compilation. By viewing the scene, viewers are incentivized to focus on the present, observing the differing leaves over time. Through a series of questions that accompany the image, students are prompted to focus on plants and leaves rather than other distractions.

Figure 4.1.8: Exploration D — Flower Stitches.

Through these studies, comprehension and abstraction issues arose. While abstract ideas were conceptually interesting to visually explore, they may distract or cause confusion. Thus, some concreteness must be necessary for a student to provide relevancy; students should be able to easily interact with a system, understand what they are interacting with, and comprehend how design choices would help alleviate distraction. If unclear, additional interface choices may contribute to a student's cognitive load and should be avoided.

Relational Time

Explorations E, F, and G concern the relational aspect of time. Exploration E (Figure 4.1.9) discerns automated options for optimal time compartmentalization within a student's day. While some activities may be rigid (i.e. class sessions), others are contingent upon the student's whims and necessary tasks to accomplish (i.e. meals and hanging out with friends). This exploration emphasizes the availability of future potential options to mitigate schedule indecision.

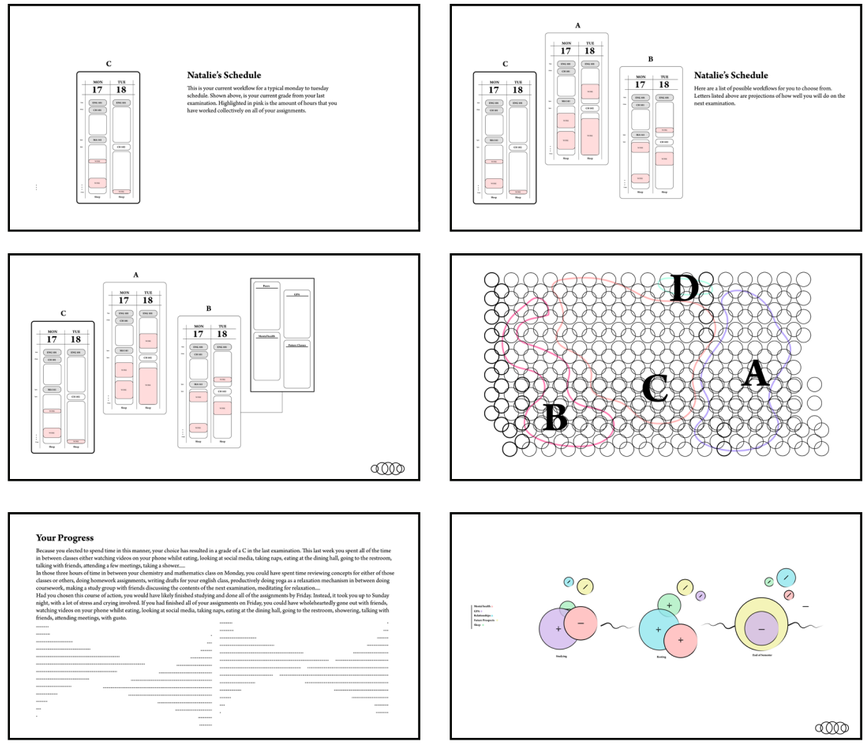


Figure 4.1.9: Exploration E — The schedule assets view of an interface, which provides a relational view where the student picks an achievable grade and understands how that impacts other aspects such as their GPA and mental health.

Exploration F (Figure 4.1.10) implements a way to view time through the metaphor of a piece of thread. Through modifying and changing the piece of thread, one could truncate or elongate aspects of time and that could be applied towards any situation. For example, if the student wants to feel closer towards the past, they can pull the two threaded ends together to physically depict how the past and current present interact. Likewise to engage with the future, students can pull the two threaded ends further apart to physically feel a sense of time passing between multiple events.

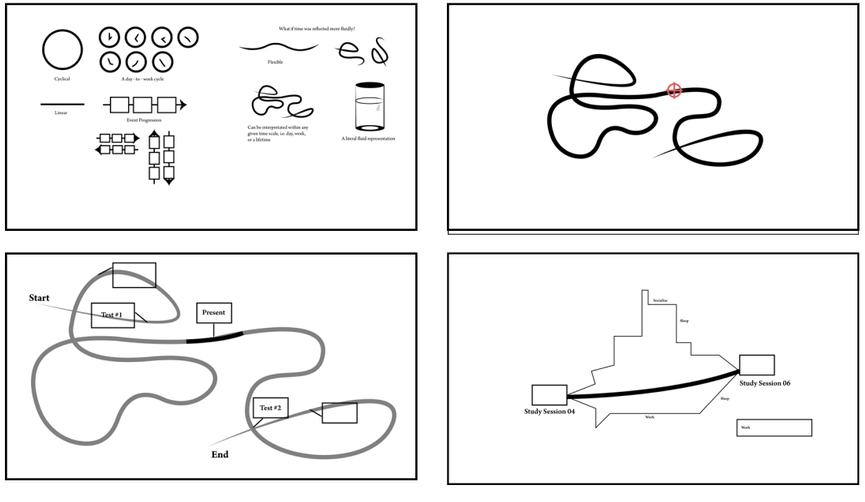


Figure 4.1.10: Exploration F — Threaded time.

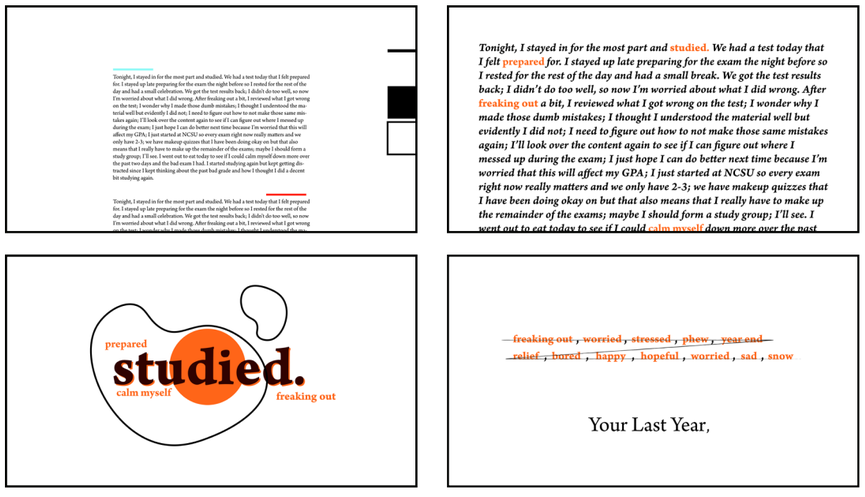


Figure 4.1.11: Exploration G — Wordstream, where the student journals their thoughts out across a series of days, weeks, and years.

Finally, in exploration G (Figure 4.1.11), time is depicted through a positive reinforcement journaling mechanism that motivates students to continue studying. Students track their past, present, and future selves through quick self-reflection sentences after each successive day.

Expansion

From the previous explorations, relational time categorically felt the most fruitful and I began expanding and contextualizing these initial ideas.

Exploration E1 (Figure 4.1.12) expands on Exploration E's (Figure 4.1.9) attempts to optimize scheduling. Customization emerged as a key theme to help increase user agency. Students should have the ability to freely adjust timetables to eliminate felt-pressures within a calendar system. If an unexpected change occurs (i.e. an unplanned event or less-than stellar study session), students can quickly incorporate impromptu changes without sacrificing their time resetting schedules.

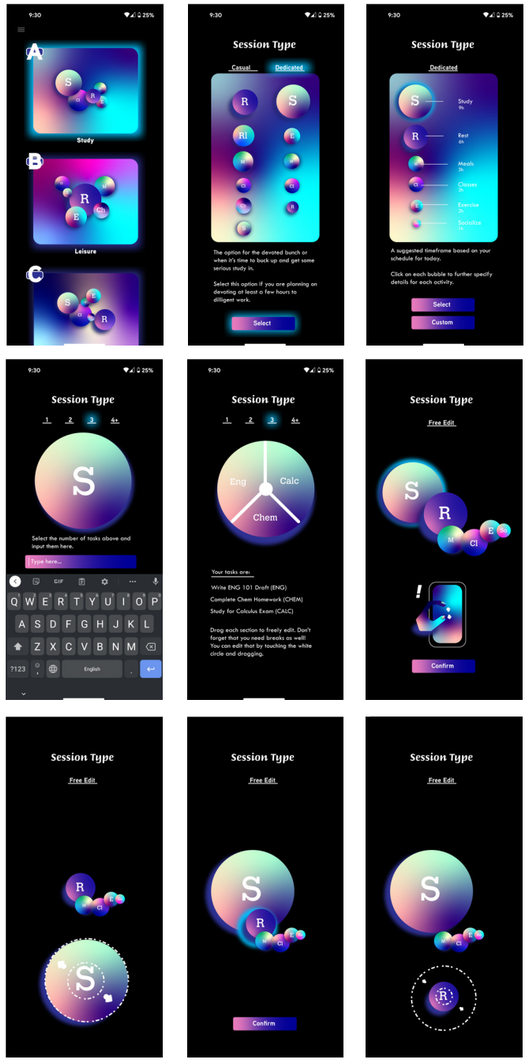
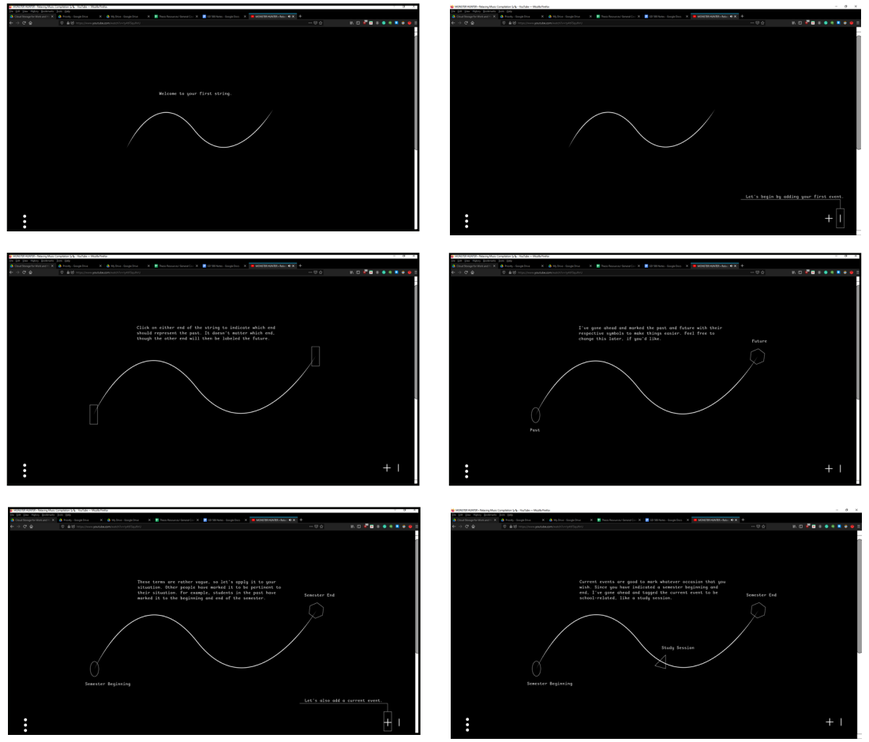
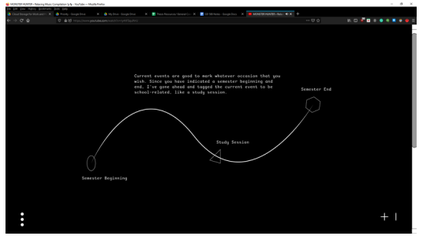


Figure 4.1.12: Exploration E1 — Expansion of the schedule assets to incorporate the relational aspect of adjusting time frames. Students can select the session type — dedicated or casual — and delineate tasks according to those bubbles. By resizing bubbles, their schedules will be adjusted accordingly.

For Exploration F1 (Figure 4.1.13), I expanded on the threaded nature of time in Figure 4.1.10. After physical experimentations with threads, it was readily apparent that a hypothetical online interface would be better suited for students on account of lack of material and time investment. Physical tying of knots would be time-costly, onerous, and non-repeatable each time during a study session. An online interface; however, would be helpful to track events.





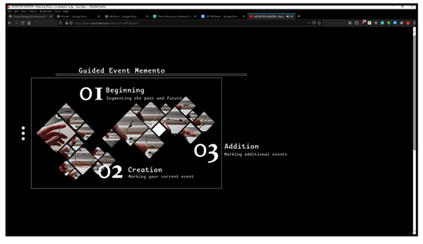


Figure 4.1.13: Exploration F1 — Expansion of threaded time to explore how thread interacts in a digital space. My physical explorations then culminated into an instructional video for the student to follow along if they chose to make a physical artifact. The student is walked through adding events, marking the current state, and engaging an idle state while working on a study session.

Exploration G1 (Figures 4.1.14 - 4.1.17), expands on the previous wordstream idea (Figure 4.1.11) and introduces a virtual agent. While virtual agents are typically utilized in academic contexts to provide personalized anecdotes to motivate students to study, the agent here guides students in selecting representational words. By allowing the agent to suggest words along with student input, new word combinations may emerge. The appearance of the agent also plays a role in student receptivity to the interface — a human-like versus a machine-like agent may elicit different reactions. Overall, an agent had its benefits, as it could serve as the motivational guidance for users in place of their physical teachers within an online space.

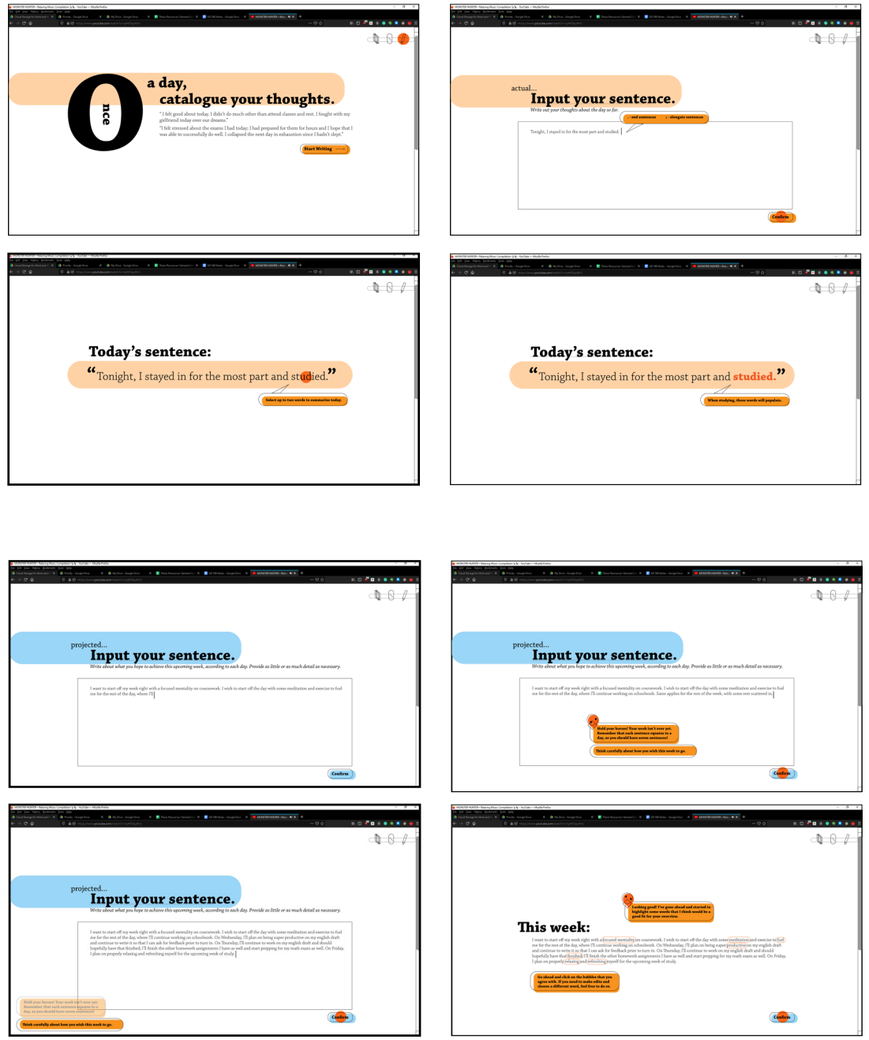


Figure 4.1.14: Exploration G1 — The introductory setup

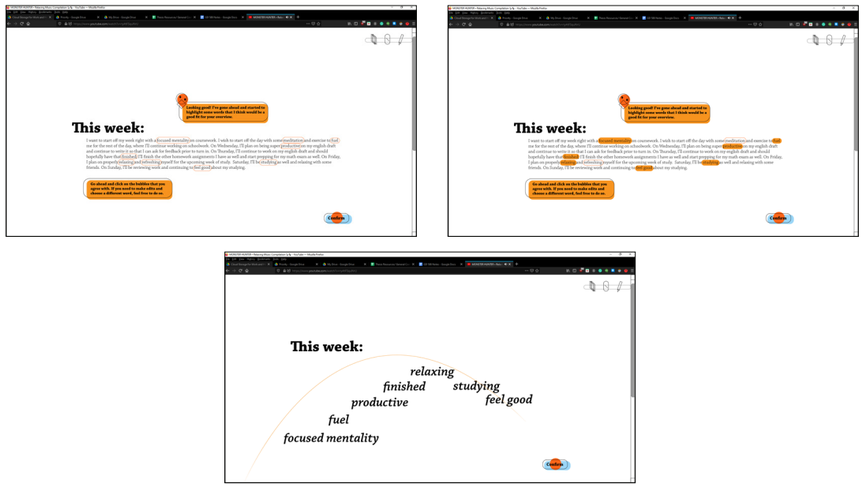


Figure 4.1.15: Exploration G1 — The introduction of the virtual agent walking through a projected week, where the student speculates on the most optimistic outcome of what they wish to accomplish that week.

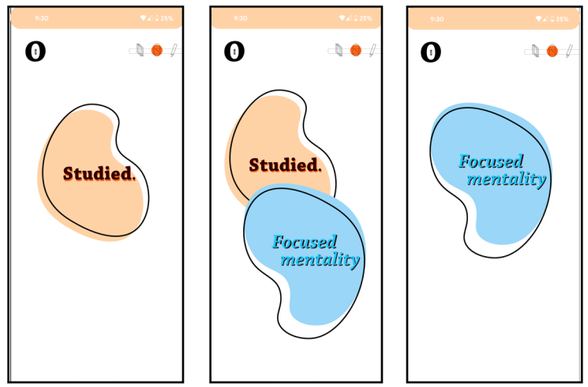


Figure 4.1.16: Exploration G1 — The idle states of the application, where the student should not be distracted by the interface. Words from the previous journaling entries will gradually be replaced by the optimistic outcomes to motivate students.

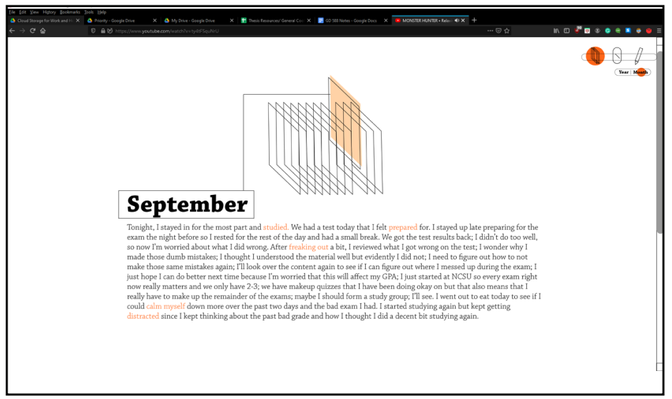


Figure 4.1.17: Exploration G1 — The appraisal stage where the student reviews their progress across a course of multiple months and years.

Study Insights:

- × Tackling a complex issue such as time representation is easier through multiple small-scale studies. Focusing on producing something novel can sometimes backtrack progress and hinder the creative process.
- × Virtual agents are beneficial in guiding students to replace their physical teacher counterparts in an online environment. If included in a system, special consideration to appearance and student receptivity are encouraged.
- × Students should always have ways to impact and control the space to highlight user agency. This is especially vital in an abstract concept such as time perception.

4.2. Preparation and Performance: Priming

Study Two addresses possible ways priming can transition students from a past or present orientation to a future orientation. I do not imply; however, that future orientations could not become "more future-oriented" or "efficient." Rather, these studies focus on past or present orientations as future-oriented students procrastinate less. I also acknowledge that visual representations of future-oriented solutions do not necessitate progress or equate to success. After all, the current calendar system could arguably be a future-oriented solution to represent time. The calendar system operates on a level where students continually plan activities and envision future events. However, the calendar system also has downsides, as students become quickly bogged down by tasks and may feel constrained. Thus, it is important to consider all orientations when drafting new ways to represent time; however, this study primarily navigates past and present orientations. It is also equally important to consider a wide variance of possible future-oriented solutions and draw conclusions from how effective a solution might be through usage and testing.

Overall, through designing and postulating potential solutions, I study facets of what constitutes a successful priming scenario. Throughout my investigation, I consider when an appropriate time for a priming session occurs and whether there should be a dedicated priming session at all.

Priming can consist of multiple subcategories such as semantic, visual, perceptual, olfactory and conceptual priming. Priming can also be categorized into two general types of subliminal and supraliminal priming. Subliminal priming specifically connotes priming that cannot be consciously perceived, whereas supraliminal priming can be consciously perceived. The threshold between consciousness and subconsciousness lands at approximately less than 500 ms and marks the distinction between supraliminal (greater than 500/ms) and subliminal (less than 500/ms) (Elgendi et al., 2018). Drawing from this knowledge, I study facets of what constitutes an effective priming session and derive conclusions.

Visual Exploration Phase

In Exploration H, I considered the affordances of an idle screensaver (Figures 4.2.1 - 4.2.2). Presumably, its usage would be most appropriate in-situ when a student is working or writing a paper. Rather than an intervention system that repeatedly engages the student, this exploration serves as a deadline nudge without an anxiety-inducing countdown.

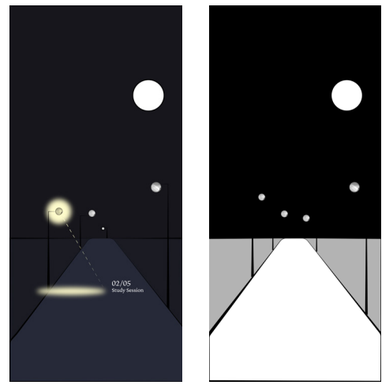


Figure 4.2.1: Exploration H — An idle screen phase showcasing different ways of traveling through time. These visualize different ways of ambiguously traveling down a pathway from a first person perspective.

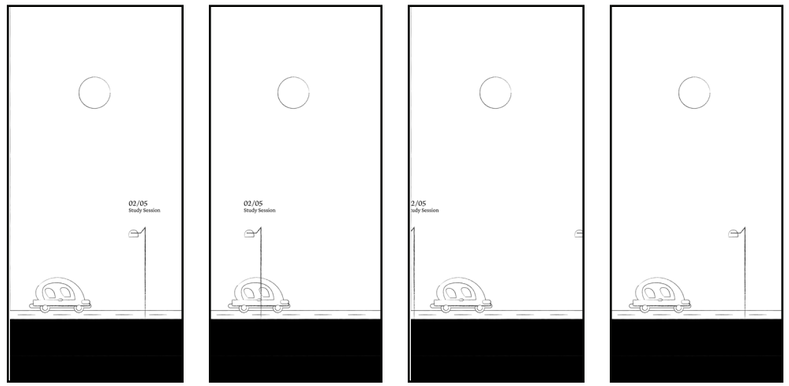


Figure 4.2.2: Exploration H — An idle screen phase showcasing different ways of traveling through time. This perspective adopts a horizontal method of travel where a car passes by street lamps of activity to get to a desired destination (i.e. a deadline or exam).

Exploration I (Figures 4.2.3-4.2.2.4) makes a student's future self more tangible. Through a temporal representation where workload is personified into flowers or balloons, the student can freely interact with their present and future selves, choosing when to offload or shoulder work. Initially, I represented these tasks negatively, where the student would eventually be "crushed" by the weight of their workload. In this way, the student is subtly primed into taking proactive action so that their future self is not crushed, without necessitating a specific moment of priming. While fear of failure may be a motivational force at times, it may not be suitable for many types of procrastinators who already feel the burden of starting and completing tasks. Thus, I shifted to a positive representation of popping balloons. As the student increases tasks, their avatar slowly lifts up away from the scene. As tasks are completed, students are rewarded for their efforts by digitally popping balloons.

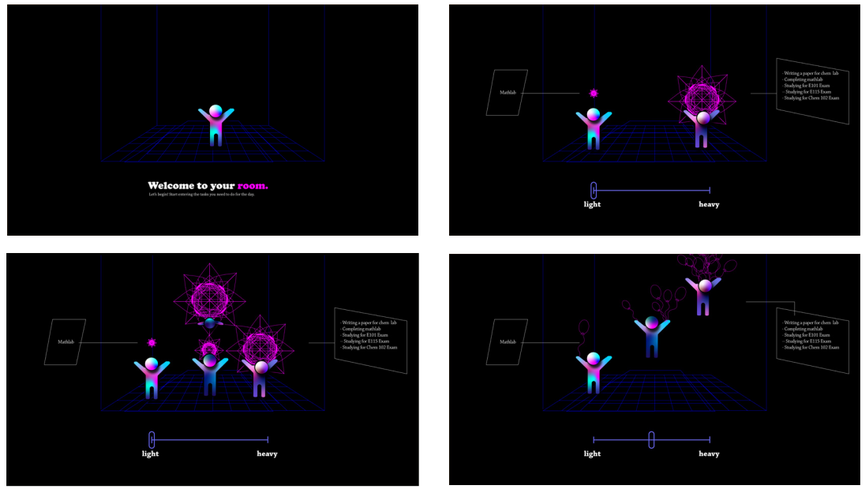
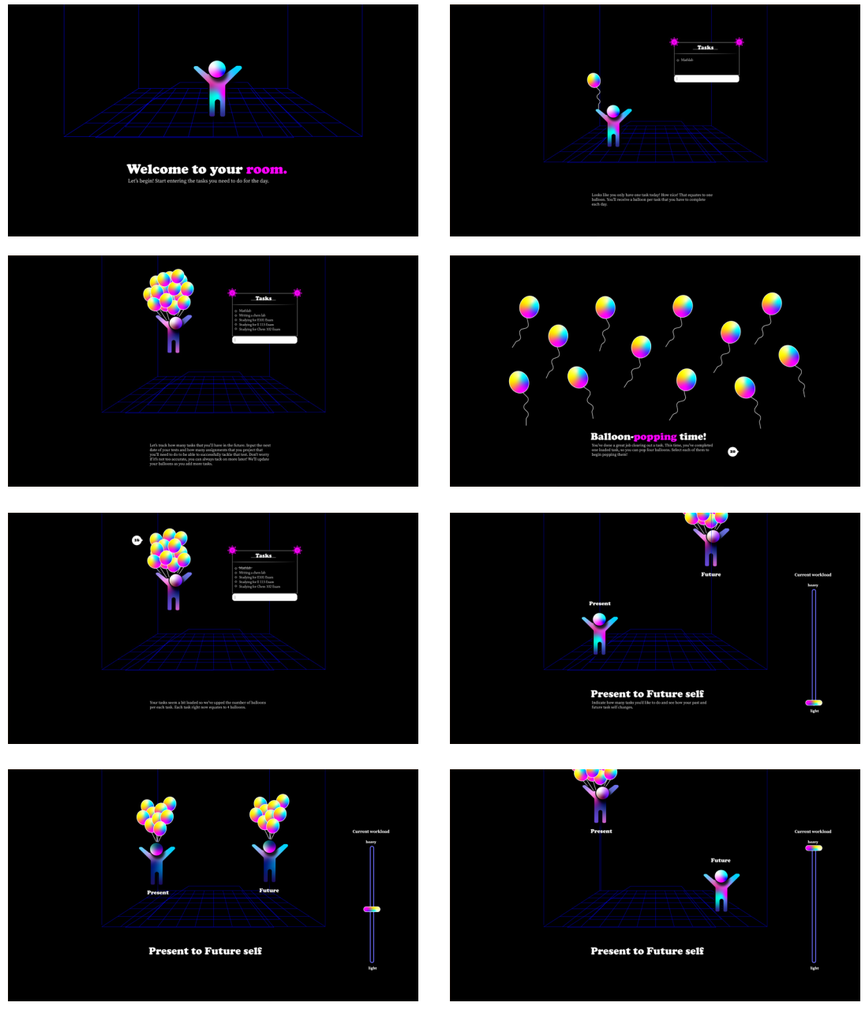


Figure 4.2.3: Exploration I — Visual exploration where time is represented as a flower. The more workload the student has, the heavier they will feel. Eventually, with too much workload, the student will become "crushed" by the flower shape. To compensate for this heavy imagery, the last screenshot speculates on how a more positive metaphor of balloons emphasizing the user tasks was generated (v1).



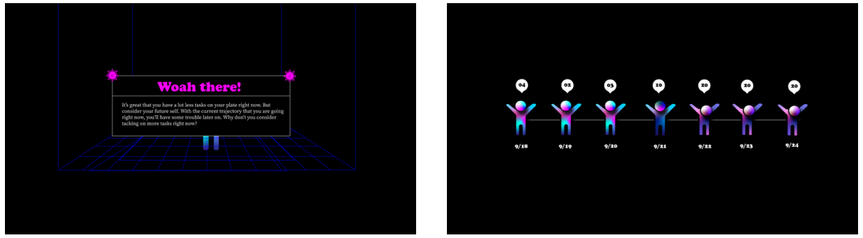


Figure 4.2.4: Exploration I — An expanded version of the balloon system. Students can plan for future workload activity and upon completion of a task, will be awarded with a popping balloon session. Students can also review activity and speculate how a week's workload will look like in the future to plan how much work they would like to do to preserve their future or present self.

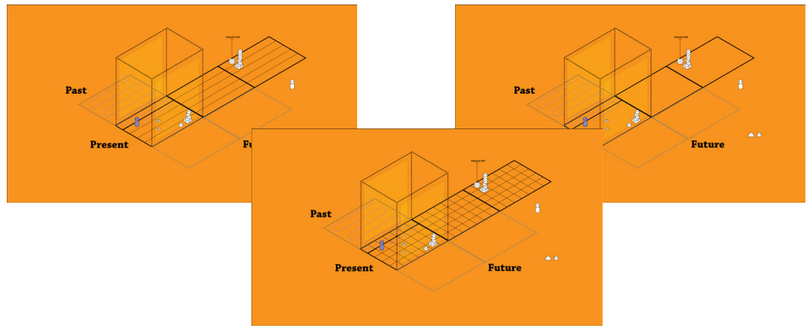


Figure 4.2.5: Exploration J — Time as a box model, where a box represents chunks of time. Within a box (equating to one month's time), students can customize time perception into days, weeks, or whole months.

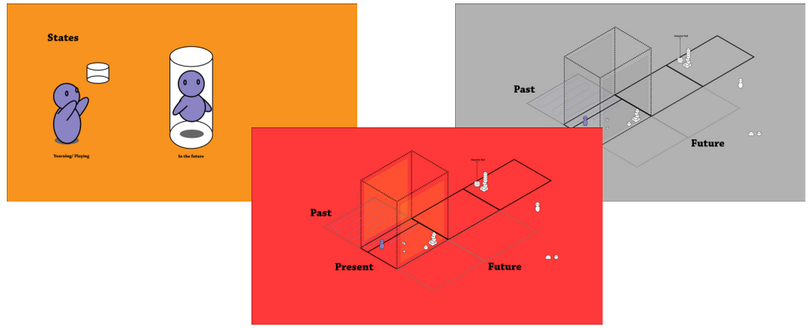
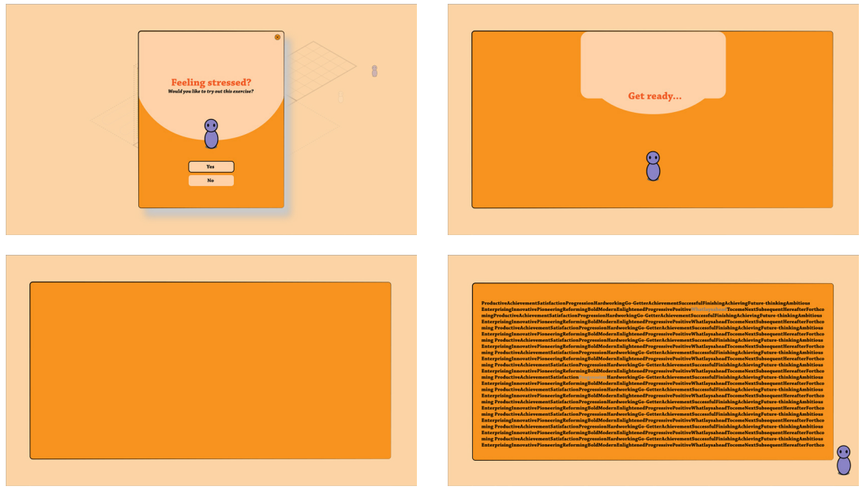


Figure 4.2.6: Exploration J — The background color choice was explored along with quick phases of how the human figure would react to incorporate subtle priming mechanisms. For example, while the student is working, the agent can move around within the space and is not confined to a particular time period. When they move over to the future, that also serves as a supraliminal subtle prime mechanism for the student as well.



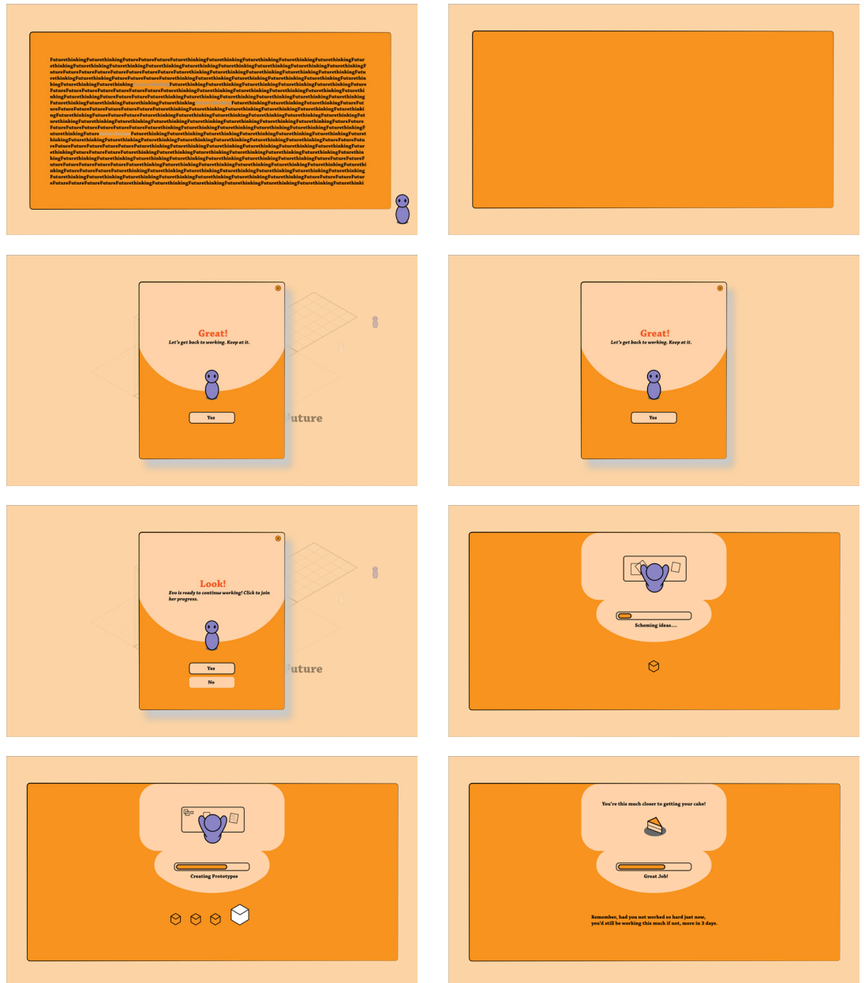


Figure 4.2.7: Exploration J — An obvious example of priming. Students would opt-in to attempting an exercise where subliminal words would pop up that reference the future. Furthermore, students can work alongside the human figure as they continue working and receive motivational pop ups when they are resting or working in future sessions.

Exploration J (Figures 4.2.5-4.2.7) visualizes how a calendar system could be 3D mapped into an isometric space, where each day, week, or year was categorized into blocks of time. Through this exploration, I explore aspects of subtlety where minute detail became embedded into an overall supraliminal, subtle priming mechanism. This reinforces the idea that priming does not have to occur at key intervals of time where activity is happening (i.e. the interface reacting or the user sitting down for a dedicated priming session). Rather, every element within the interface coalesces into part of a subtle priming experience. Customization, then, also heavily contributes to increasing user agency and influencing priming effectiveness. Figure 4.2.6 demonstrates the influence of color on users, as red can be construed as an anxiety-coloration. Similarly, grey is a neutral color. By shifting the background color, students could be subtly primed to view the interface as positive, negative, or neutral.

Furthermore, the box model demonstrates the flexibility of having potential options for the student. By shifting the perspective of a day, week, or month, this allows the student to utilize familiar or unfamiliar ways of navigating time. Within a month system, for example, the perspective shifts to incorporate a “top-down” view of the box model and uses the familiar calendar mechanism to showcase events in time. Students can then revert to this isometric view if they wish to relationally associate events within subsequent months or years.

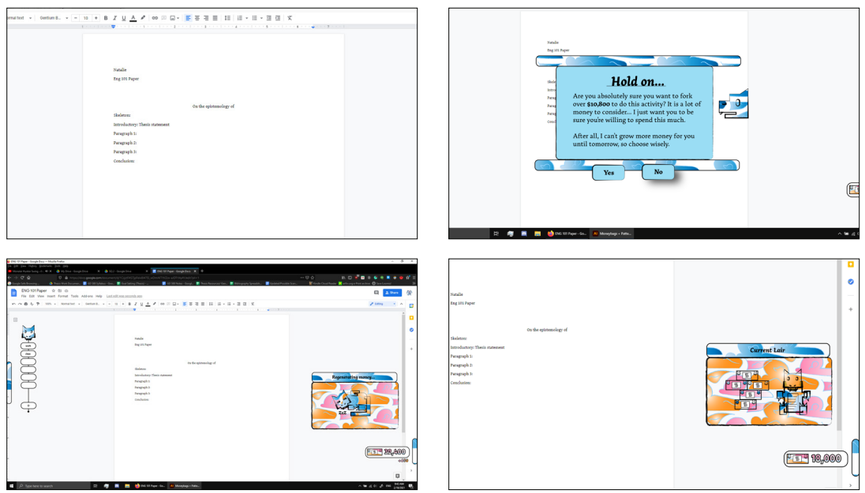


Figure 4.2.8: Exploration K — A visual moneybag system where time is categorized into money. A little dragon guards the student's time treasury, and each time a distraction pops up, the dragon will ask the student if they are willing to sacrifice the time for that particular activity.

Exploration K (Figure 4.2.8) represents time perception as money. Each day is compartmentalized as 86,400 seconds. Therefore, every activity necessitates decisions about how users can be frugal. When students are deciding on an activity, a prompt will ask students whether they would like to continue that activity, or whether that amount of money "lost" is beneficial to them. While interesting to visualize, logistically, this exploration presents problematic situations. For one, fear is a motivator which could potentially be beneficial; however, this kind of representation suggests heightened anxiety. While design choices were made to attempt to offset a countdown (such as a softer, playful style), I believed that no amount of watering down the system would be able to alleviate a countdown system's elicited anxiety.

Study Insights:

- There do not need to be explicit key moments of priming; rather, everything that makes up the system serves to introduce priming.
- Eliciting fear is a motivator to do work; however, sometimes too much fear will end up creating more harm.
- Priming should be deliberate and subtle. If too obvious or done poorly, it can easily go into the realm of advertising where students feel that they are being sold a product rather than an experience that attempts to benefit them.
- Task representation is vital as positive or negative connotations can hinder or help a student.

4.3. Analysis: Social Presence

While the previous investigations ran the gamut and encompassed higher fidelity concepts to experience time, social presence was the most fruitful to investigate conceptually. Thus, I chose to encompass lower fidelity concepts within Study Three to probe questions for implementation in Study Four.

I generated quick concepts into how a social presence ideology could be incorporated into a system. Rather than create entirely new concepts from scratch similar to previous studies, it was more pertinent to derive principles from generalized ideations to culminate into an area of study within an idealized prototype.

Through these quick explorations and ideas, evaluation could be categorically demonstrated through both personal and outside presence (i.e. peers). Support could also be explored through multiple forms of representational abstraction. Within these, ideas such as avatars, icons, and real-life pictures all portray different arenas of social presence. Furthermore, the level of interaction was also important to achieve a fine balance between distraction and social presence.

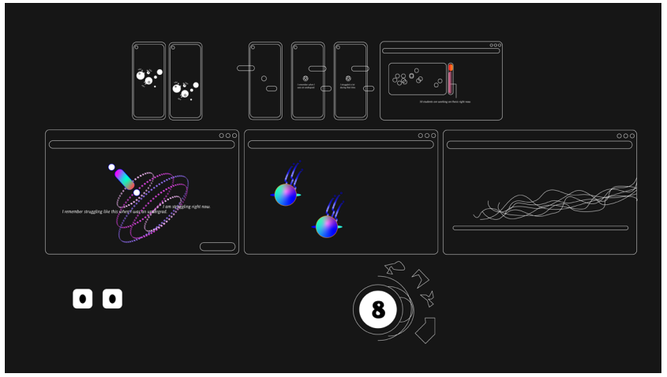


Figure 4.3.1: Exploration L — Ideations exploring how social presence could be represented within a space across mobile and desktop platforms. Social presence could be encompassed through language paired with an abstract pill shape or be represented through waves of hair moving and undulating across the screen.

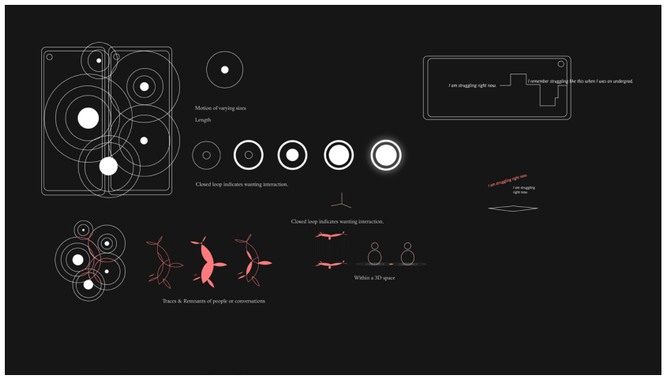


Figure 4.3.2: Exploration L — Detailed ideations further examining the traces idea. These explorations expand on how traces could be felt on a mobile application along with a transition into a 3D environment.

While a conversation may be an effective way to generate motivation, it also distracts the student from their tasks.

This investigation studies how traces can symbolize social presence beyond a virtual avatar. For inspiration, I observed how wolves hunted in packs. In snow capped areas, for example, when an animal left behind footprints, it was a physical remnant of the animal's presence. From my observations, I gathered insights into how I could transition these physical remnants into a digital platform.

Study Insights:

- × Evaluation can be individual or communal. Individual evaluation incorporates self-reflection whereas communal evaluation extends beyond the individual. A study buddy, for example, may provide external evaluation that can reinforce and uplift an individual if they are not feeling well.
- × Distraction should be heavily emphasized and placing constraints on how much interaction is important to indicating social presence for procrastination
- × Traces and remnants of a person are just as much an indication of social presence as an avatar.

4.4. Culmination

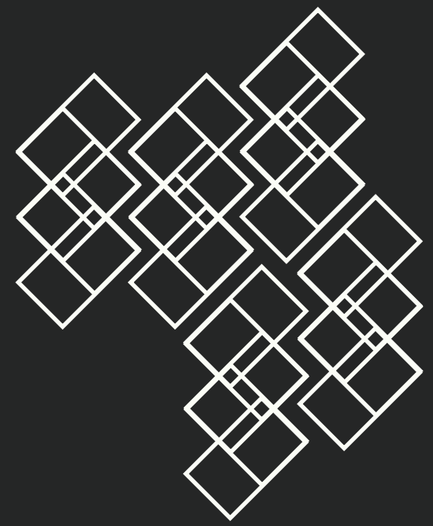
From these previous studies, I have generated a working prototype. It is important to consider that UI choices here are not meant to depict finalized prototypical sections that connote a product meant to be utilized within a business setting. Suggestions here are speculative and UI elements suggest how a user might experience time through customization and moving within the space. Likewise, the particular design choices here are meant to suggest solutions. Understandably, every UI element choice here could also theoretically be scrutinized to be more functional and efficient.

The scenario below unfolds following Natalie's experience.

Scenario 01:

Natalie has a small 20-minute break before her next E101: Engineering online class. While she is setting up for her weekly lectures, she quickly opens up the system to track her schedule and see what upcoming assignments she has. She has used the interface a few times before and has grown accustomed to the system, understanding that there is a distinction between the task view and priority view, where the task view tracks upcoming tasks and the priority view tracks the focused item with the largest amount of time.

Natalie plans on undergoing an intensive nine-hour study session. However, after measuring her energy levels today, decides that she would like to adjust the amount of time spent studying. With her mouse, she drags her study bubble, resizing the bubble to be smaller (Figures 4.4.3 - 4.4.4). After some back and forth, she decides that six hours seems more reasonable. She can also incorporate additional breaks if necessary and adjust each subsection duration (Figure 4.4.5). After incorporating her breaks, she realizes that she only has to study for three hours rather than her initial nine-hour conception. Comforted by this fact, she goes to her next class.



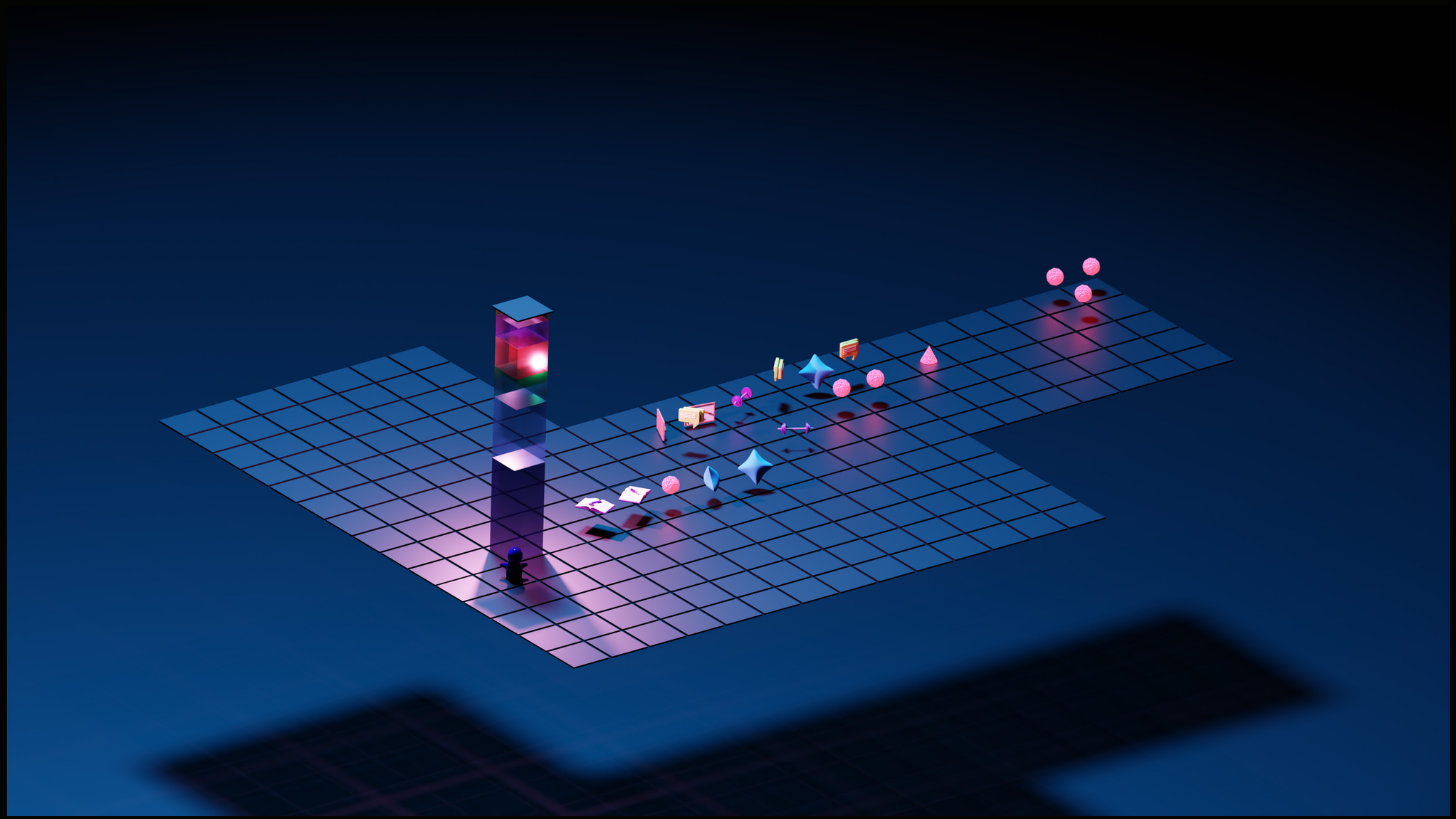


Figure 4.4.1: Animation depicting Natalie's daily bar schedule, list of upcoming priorities, and associated deadlines. To view this animation, please refer to: https://college.design.ncsu.edu/thenfinally/jing/WaterFluidBar_Ortho.mp4

Jing | Studies

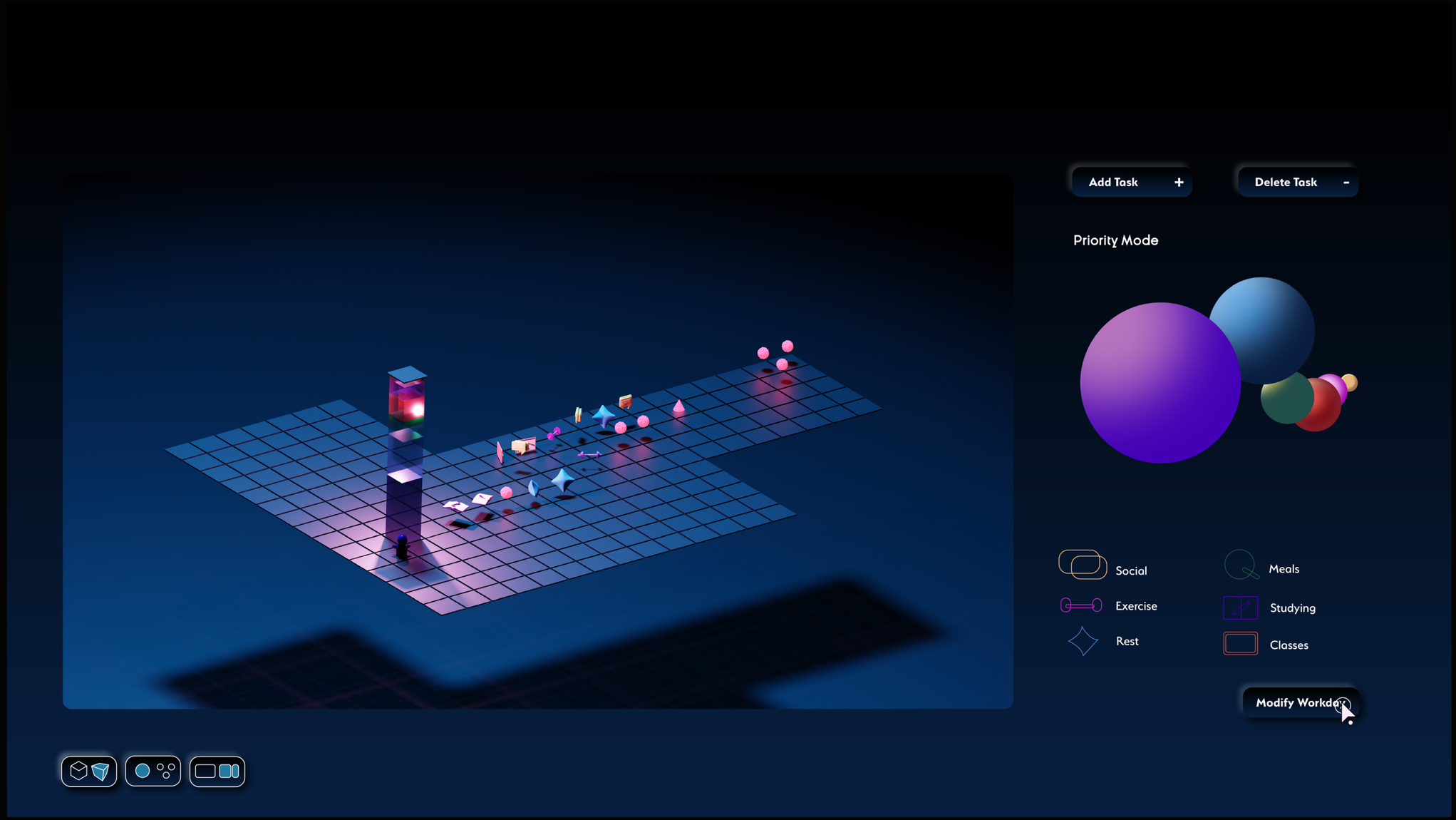


Figure 4.4.2: UI screenshot, sectioned into two views with the 3D interface on the left and customizable priority bubbles on the right.

Jing | Studies

Jing | Studies

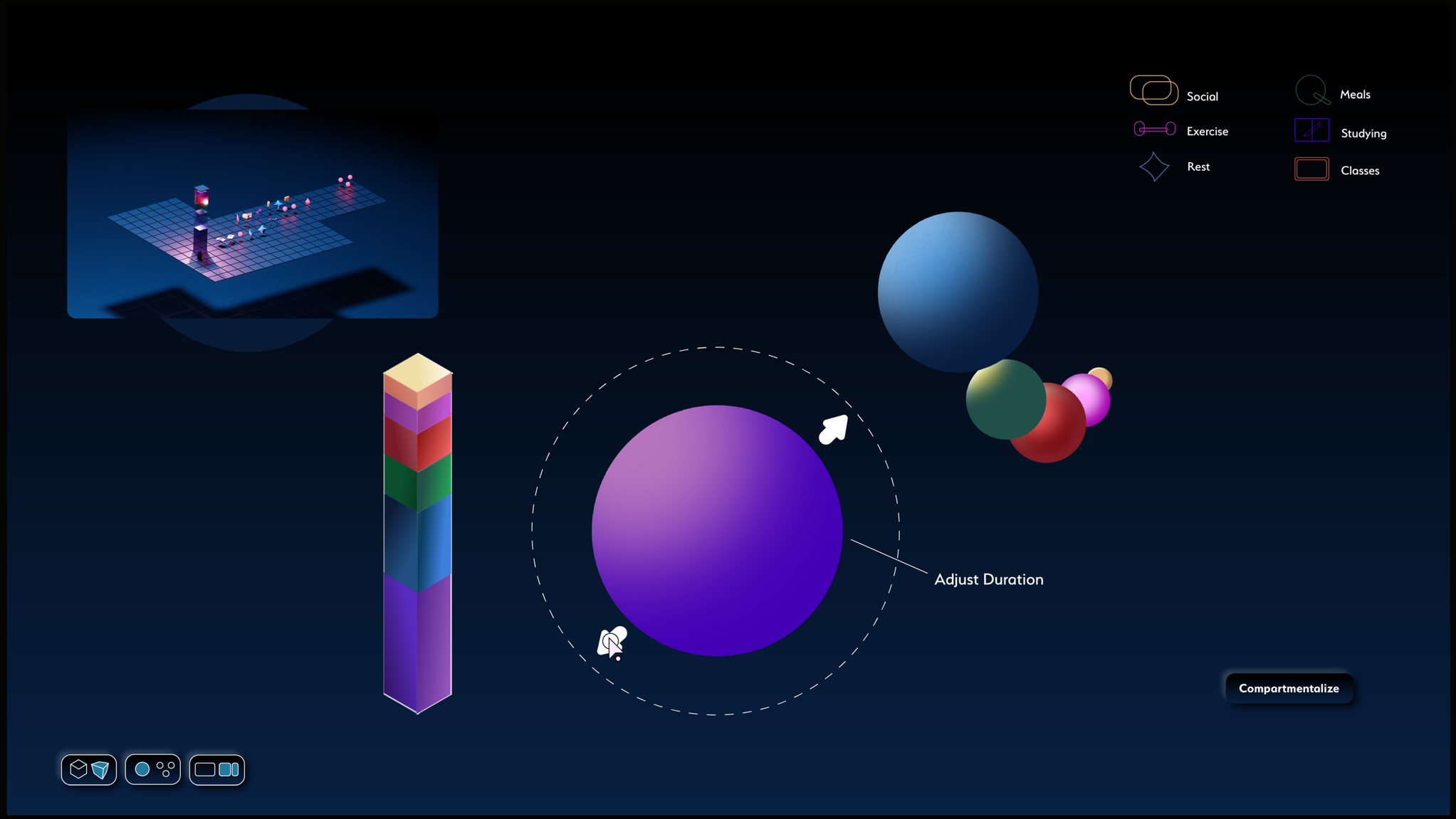


Figure 4.4.3: Adjustable bubble view — Bubbles will update based on the student's prompts of resizing and will be reflected within the 3D view.

Jing | Studies

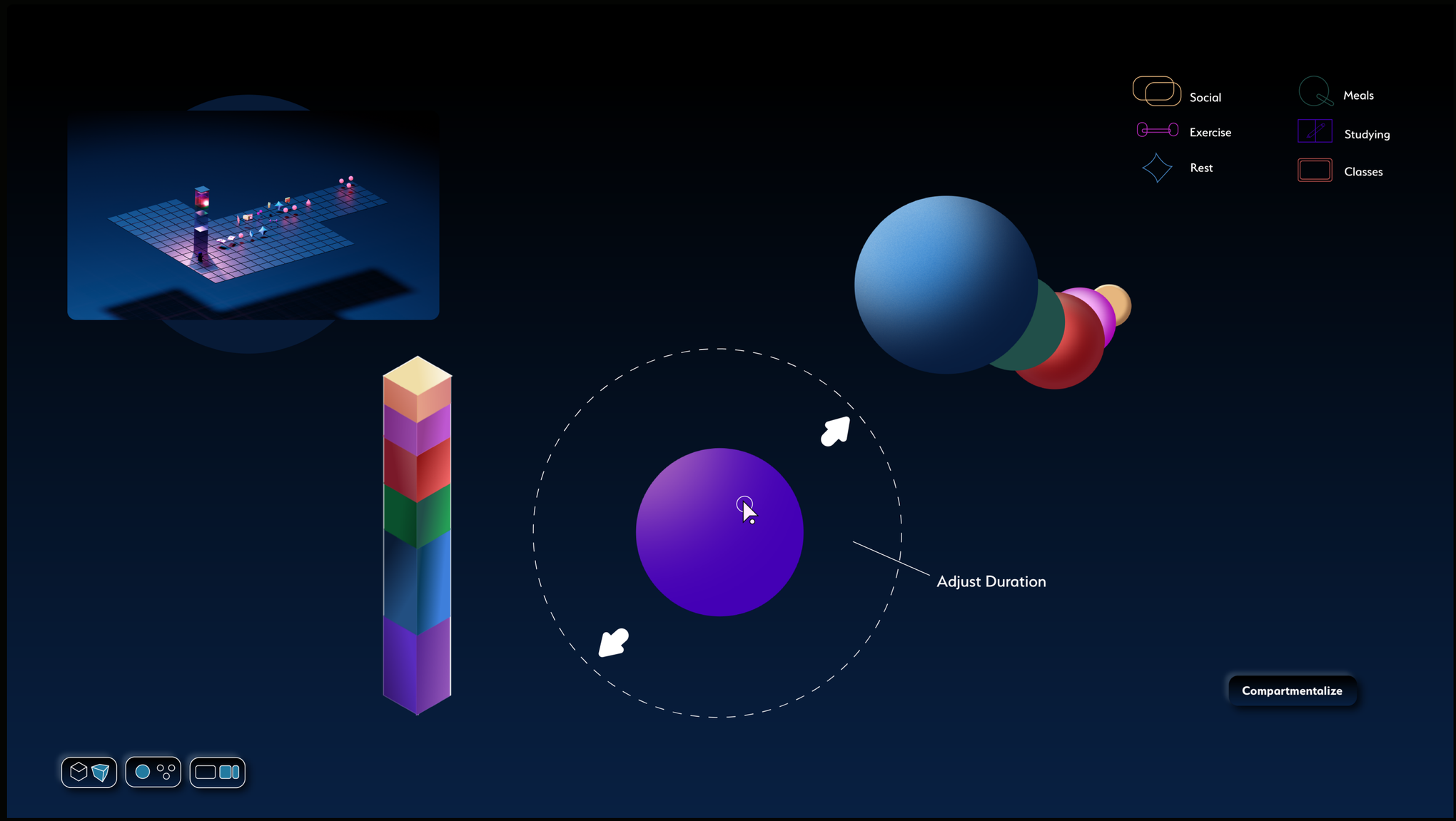
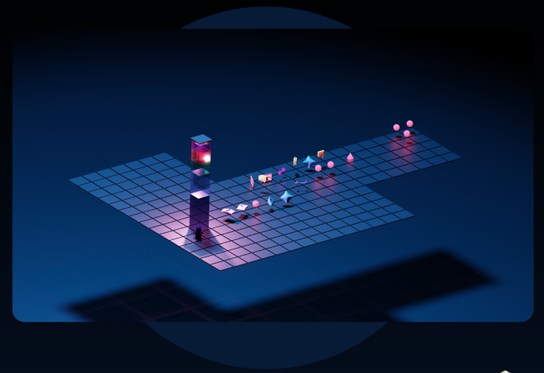
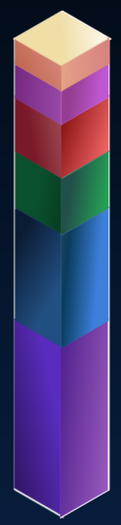
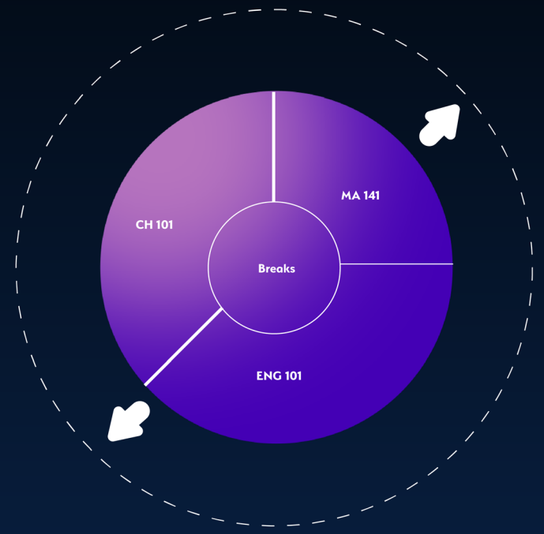


Figure 4.4.4: Bar change with an adjustable bubble size. By clicking and dragging, Natalie can adjust how much time is allocated for each priority.

Jing | Studies







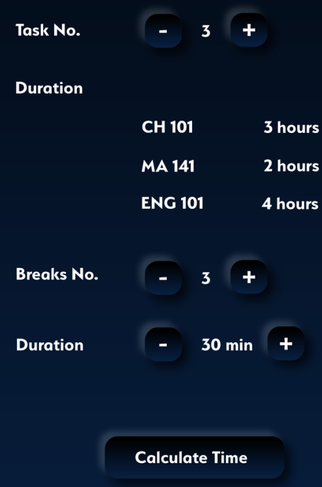


Figure 4.4.5: Bar view customizing the compartmentalizations of Natalie's study time. Here, Natalie chunks her study sessions into pockets of time to allocate for her three subjects: CH 101, MA 140, and ENG 101. Breaks can be assigned and calculated to give Natalie an accurate representation of how much studying actually occurs.

To overcome her previous bad grades, Natalie has proactively decided to form a new study group. Their study group meets weekly on Fridays at 5pm. After her study session, Natalie returns home and begins working on more coursework. As she is studying, she wants to track and confirm whether she is on a good path to studying for future chapters. Feeling like she needs a quick mental break and immerse herself into her current study trajectory, she switches over to the perspective view. Here she is more easily able to understand and track just how much time she needs to study for the rest of the semester.

In perspective view, Natalie walks up to her priority view bar to observe how much time she is investing in each of her items (Figure 4.4.6). She then decides to take a walk along, observing her next study session and priorities (Figure 4.4.7). She is able to choose her current study session, which then populates the screen with her current workload. She wishes to check how many calculus tasks she has today, and notices that she has three: her webassign, textbook chapter, practice problems for her upcoming exam (Figure 4.4.10). She then continues walking along and examines other priorities that are next-up-in line. To motivate herself, she first seeks out her next gym session priority, understanding that with the upcoming deadlines, she may not be able to utilize proper workout sessions (Figure 4.4.11). After which, she determines how long she will have spatially until her final deadlines which are two months away. While two months felt like a long time, the walk along the interface felt a lot shorter than she anticipated.

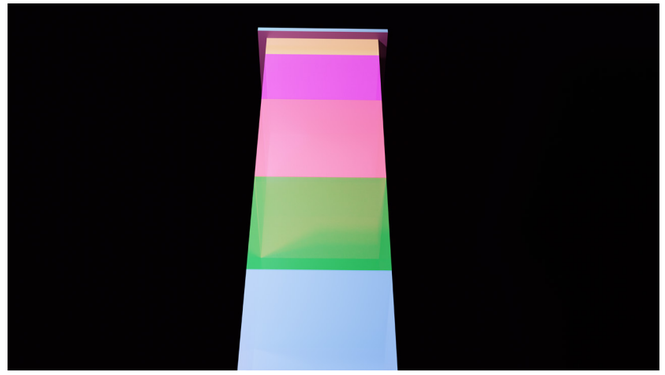


Figure 4.4.6: Perspective view of Natalie's priority view bar filling up to indicate her daily activities. Each fluid subsection depicts one of her priorities within that day with variable sections that fluctuate depending on her whims. If she adjusts these tasks, the bar will fluidly adjust in-real-time as well. View this animation:
https://college.design.ncsu.edu/thenfinally/jing/WaterFluidBar_Perspective.mp4

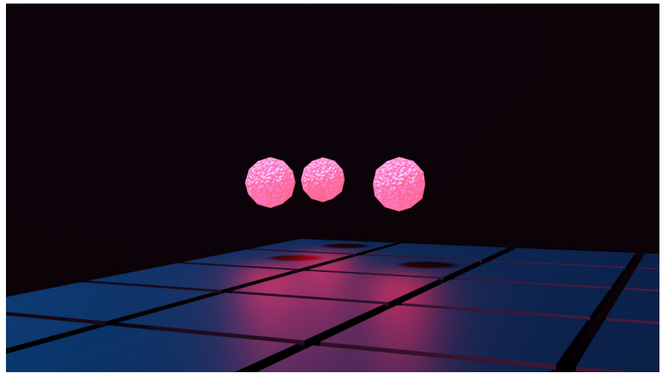
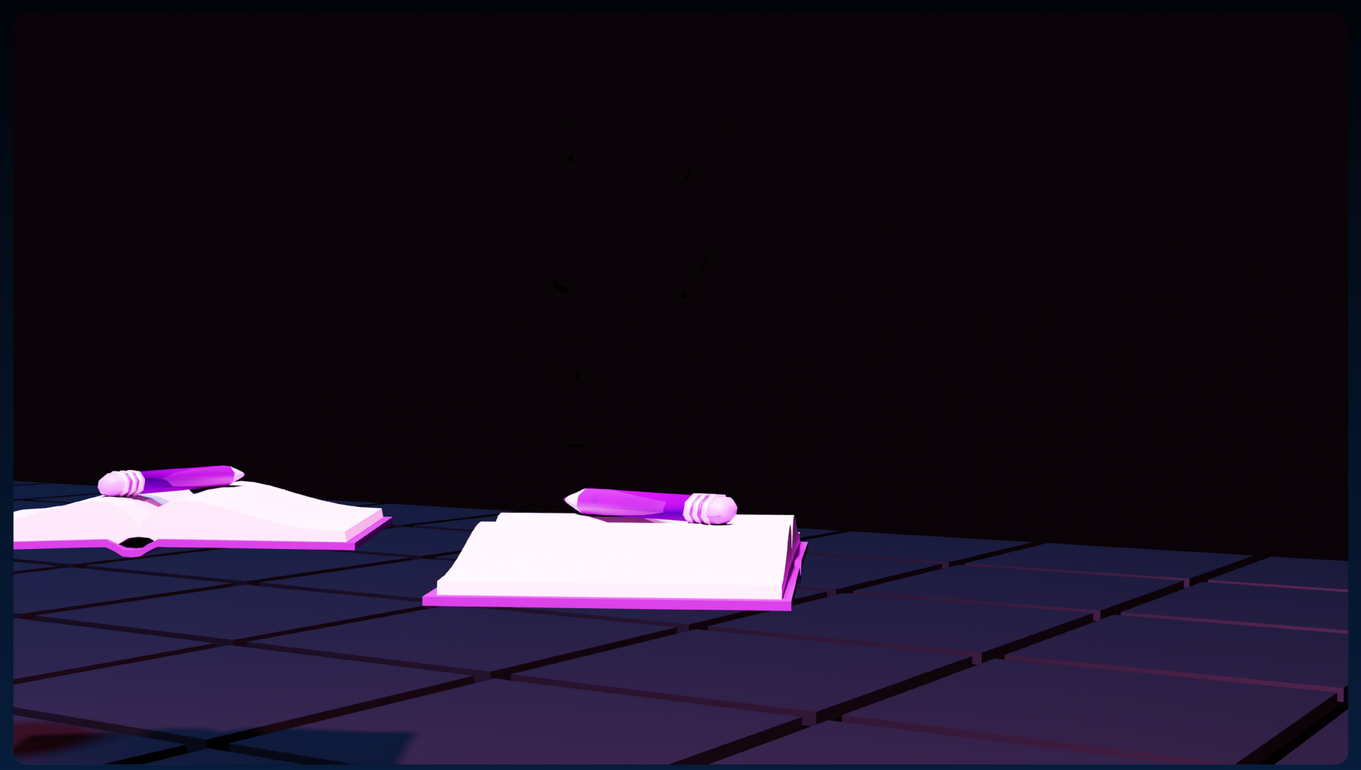
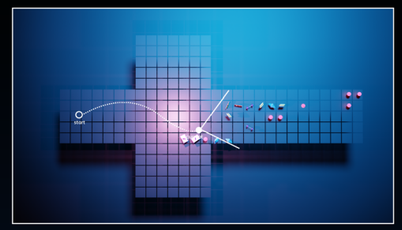


Figure 4.4.7: Animation in perspective view, depicting Natalie's trek through her assignments in a virtual space. To view this animation, please refer to:
https://college.design.ncsu.edu/thenfinally/jing/SpaceTrek_Perspective.mp4





Priority View

Deadlines

Semester End

Social

Meals

Exercise

Studying

Rest

Classes

Current Emphasis:

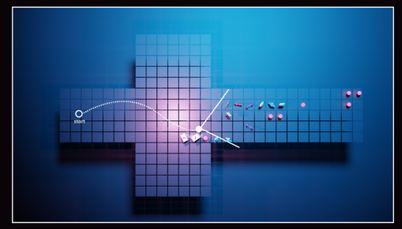
☐ Show all selected

☐ Hide Markers

Figure 4.4.8: Key moment of pause, where Natalie can peruse her tasks on a particular day. This depicts a split-view screen where the 3D interface is on the left and key information on the right.

Jing | Studies

Jing | Studies



Priority View

Current Emphasis:

☐ Show all selected
☐ Hide Markers

10/27

18 Tasks

Days left: 18
To Emphasis 1: Resting

Days left: 48
To Emphasis 2: End of Semester

Days left: 2
To Current Day)

Figure 4.4.9: Key moment of pause; Full-view mode to aid immersion into the space. Natalie can select certain priorities to focus on under the current emphasis tag. Once selected, directional markers will visually guide her towards that particular emphasis. In this example, she has set a priority to be a rest day which occurs within 18 days.

Jing | Studies

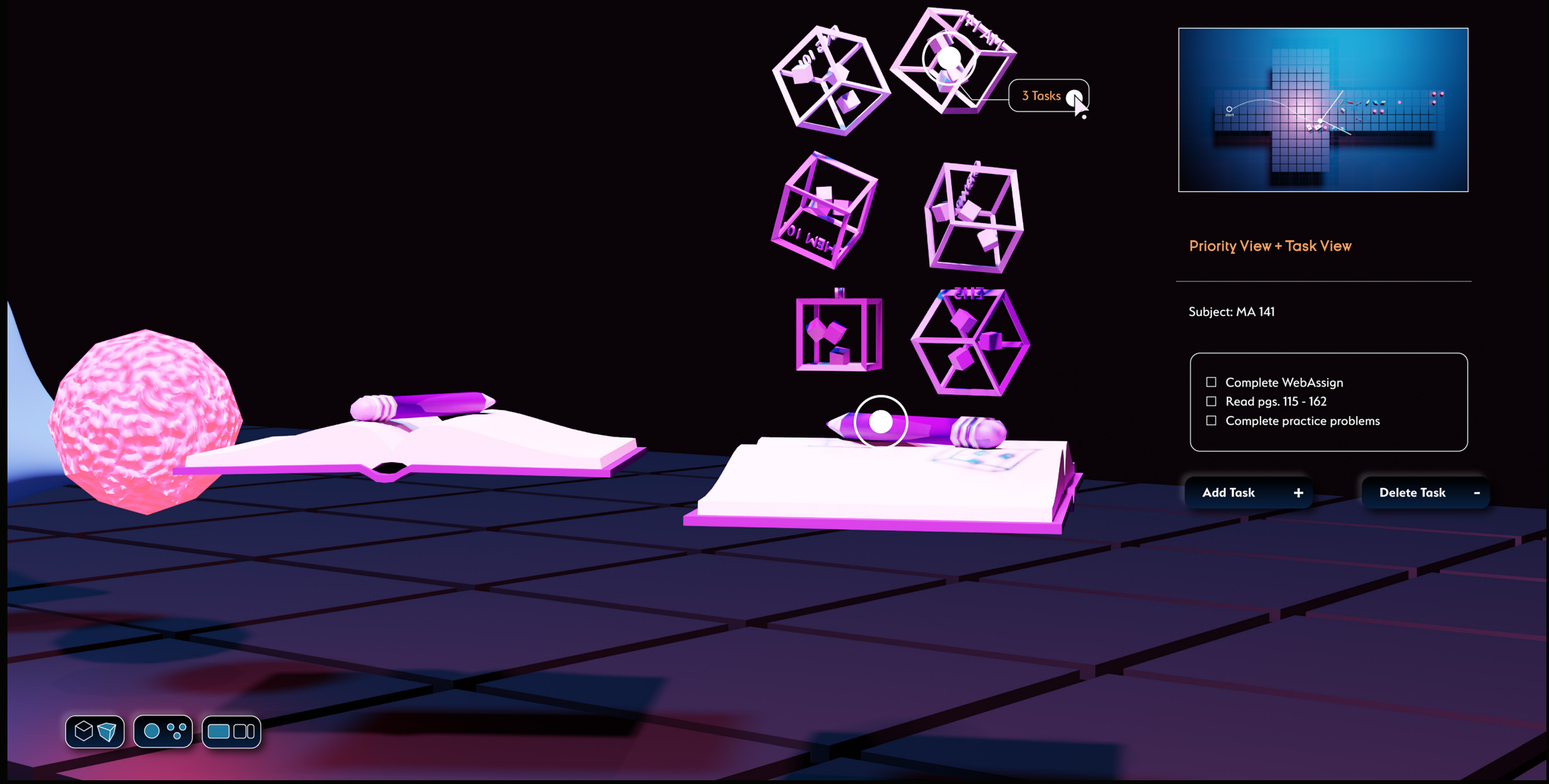
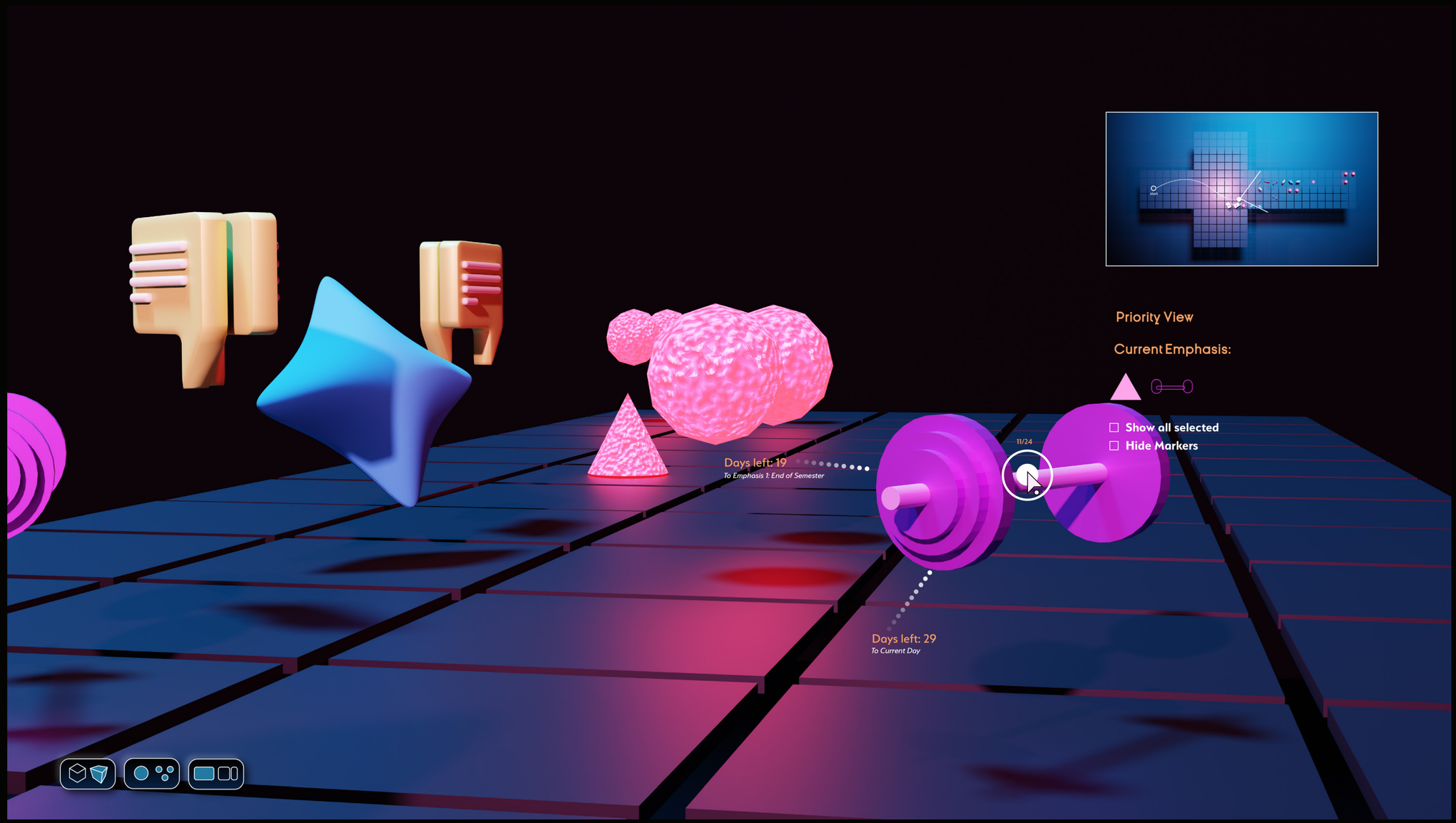


Figure 4.4.10: Transitional screen between task view and priority view. Here, Natalie can view the assortment of tasks that she has during this particular study session. Each see-through cube represents each of Natalie's subjects, with each mini-cube representing the tasks that she has within each subject. These may vary in size depending on how large the task is equated within the context of other tasks for easy viewing.



Jing | Studies

Figure 4.4.11: Another key moment of pause; this time, the UI indicates what an activity without tasks compartmentalized visually displays as.

With that in mind, Natalie decides to see how she can compartmentalize further study sessions. Rather than observe each through a monthly trajectory, she decides to utilize the stacking feature of the interface (Figures 4.4.12 - 4.4.14). Within seconds, the months vertically accumulate and Natalie can view her priority tasks beneath her. Here, she can utilize the space (Figure 4.4.15). By clicking on the right hand side she can adjust the level of the bars (Figures 4.4.16 - 4.4.18). To incentivize herself to see how many tasks would be stacked closer together, she decides to lower both levels of the bars, to also spatially feel that the tasks are closer than anticipated. Satisfied, she closes the interface and continues working.

Figure 4.4.12: Animation depicting a perspective view of tasks stacking up upon Natalie. While visibly a little daunting, the animation introduces the ability for Natalie to move horizontally and vertically to track how she wishes to navigate the space and view her priorities. To view this animation, please refer to: https://college.design.ncsu.edu/thenfinally/jing/Flying_Perspective.mp4

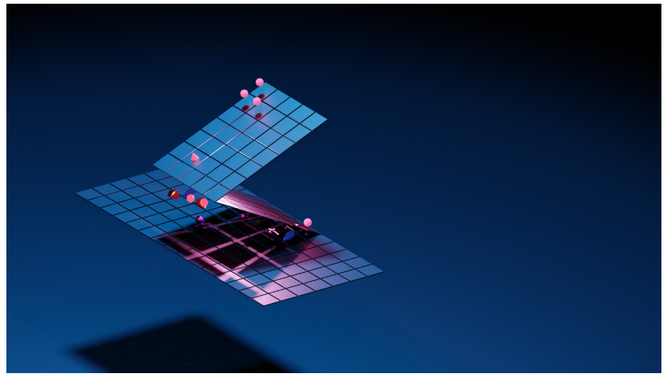


Figure 4.4.13: Part 1 — Animation depicting an orthographic view of the tasks stacking up on Natalie. This view gives another perspective into how the priorities stack and provides a better understanding of how the levels are distributed and how each month can be readjusted within the space. To view this animation, please refer to: https://college.design.ncsu.edu/thenfinally/jing/Forward_Ortho.mp4

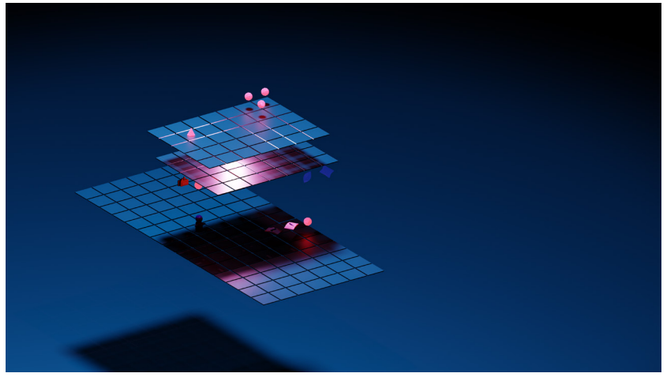
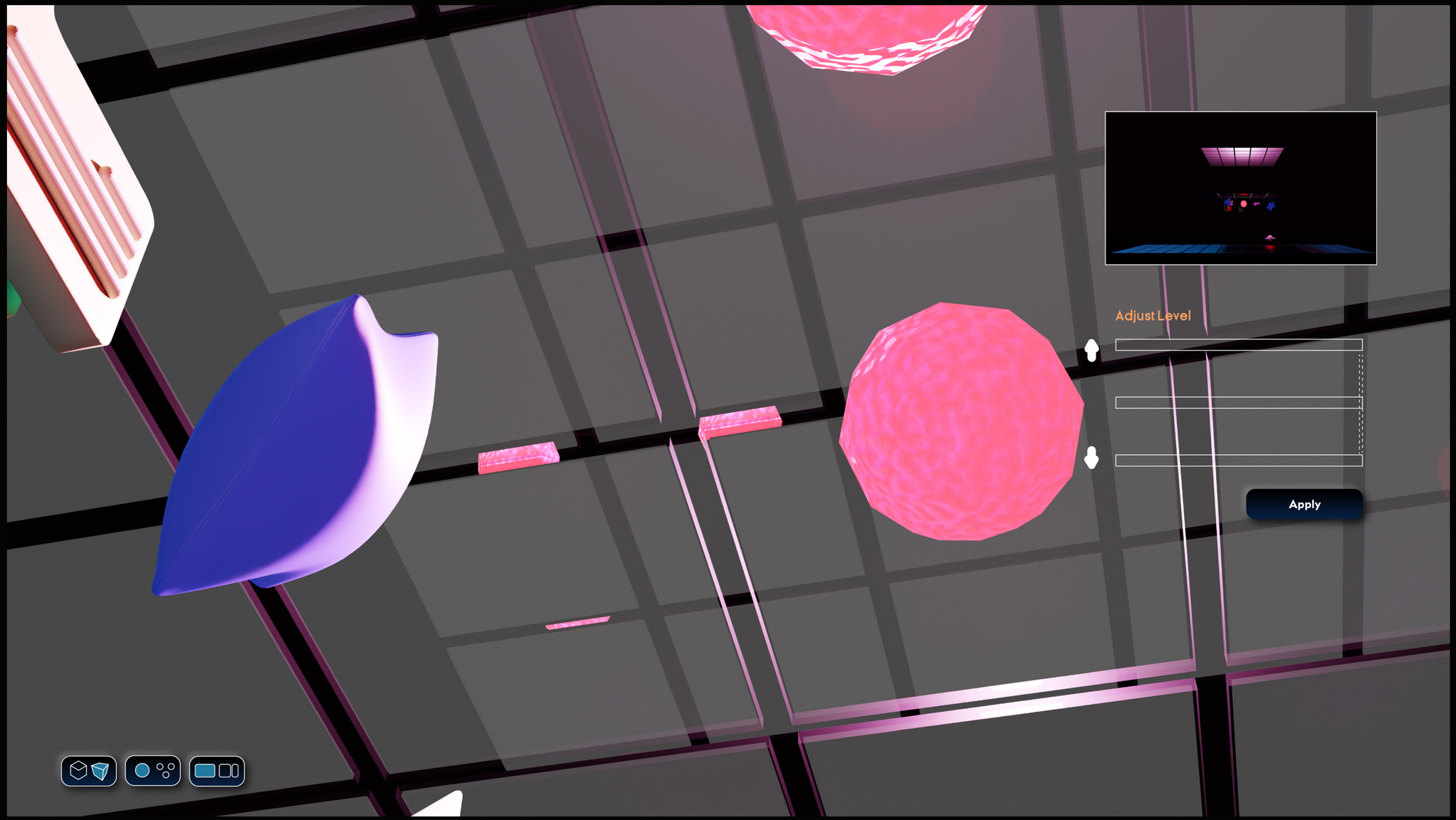
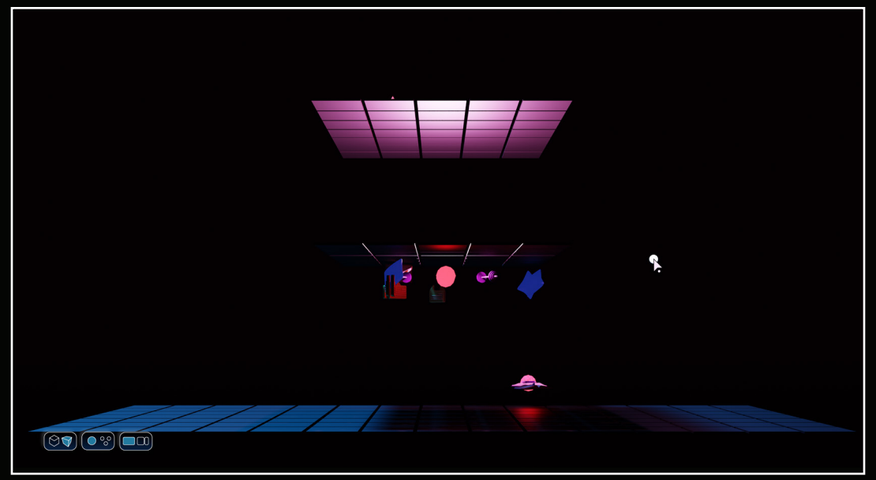


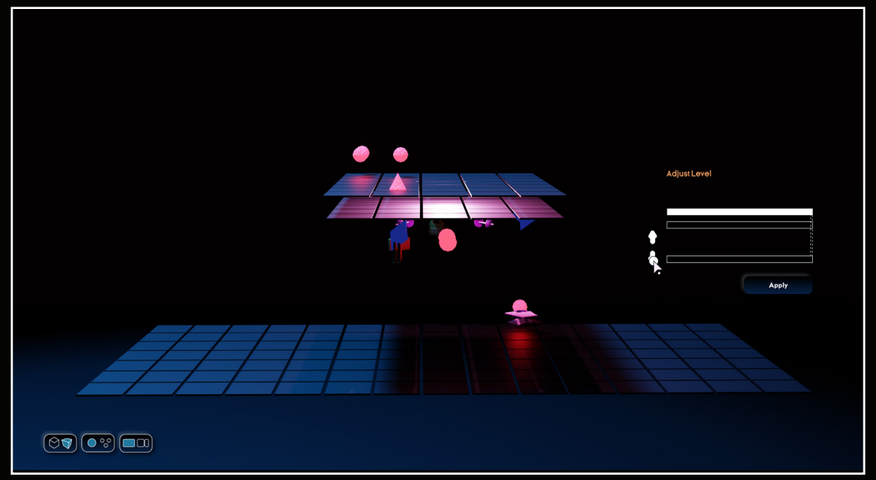
Figure 4.4.14: Part 2 — Animation depicting an orthographic view of the tasks stacking up on Natalie. This series explores how the levels and months can be moved and adjusted according to Natalie's whim. View this animation: https://college.design.ncsu.edu/thenfinally/jing/Down_Ortho.mp4



Jing | Studies

Figure 4.4.15: The perspective view of the priorities in an opaque setting. Opacity can be viewed in this way so that Natalie, in perspective, can see future months while also maintaining a holistic view through the upper-right hand screenshot showcasing the level system.





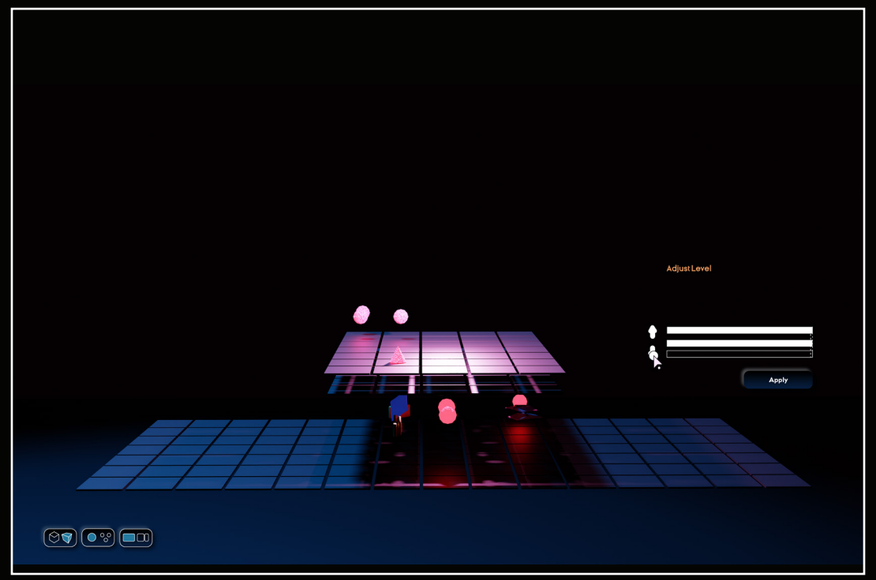


Figure 4.4.16 - 4.4.18: Screenshots depicting Natalie's choice to space out her monthly tasks up against each other to see how far apart spatially they are and to feel like they are closer than she anticipated.

Scenario 03:

For her ENG 101 course, Natalie has to focus on writing a larger research paper at the end of the course. To build up to the topics that she is writing about, she is working on a succession of smaller research papers. She is currently drafting thoughts on paper two; however, writing has never been her strong suit. Thus, she is constantly drifting in focus and has to reset herself multiple times throughout the process to continue writing. Whilst doing so, she starts to become overwhelmed and thinks that she cannot continue.

While she is feeling a bit overwhelmed, she notices that her study buddy appears from her group sessions (Figure 4.4.20). The study buddy pops in subtly and moves around to see how Natalie is doing and then exits the interface. Before the buddy leaves; however, Natalie notices that they have left a small notice for motivation (Figure 4.4.21). Though Natalie still feels a bit overwhelmed, she feels a little comforted knowing that her real-life study buddy virtually visited her and wishes her good luck on her examinations.

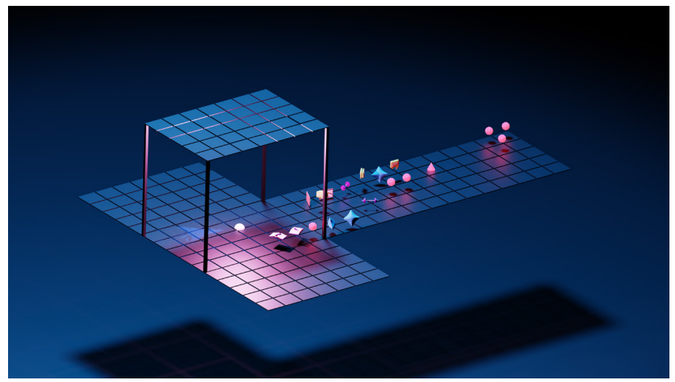


Figure 4.4.19: Animation where the study buddy moves fluidly through the space. The study buddy can move around and check out what Natalie's current priorities and tasks are for the day and check in to see how she is doing. View the animation: https://college.design.ncsu.edu/thenfinally/jing/StudyBuddy_Ortho.mp4

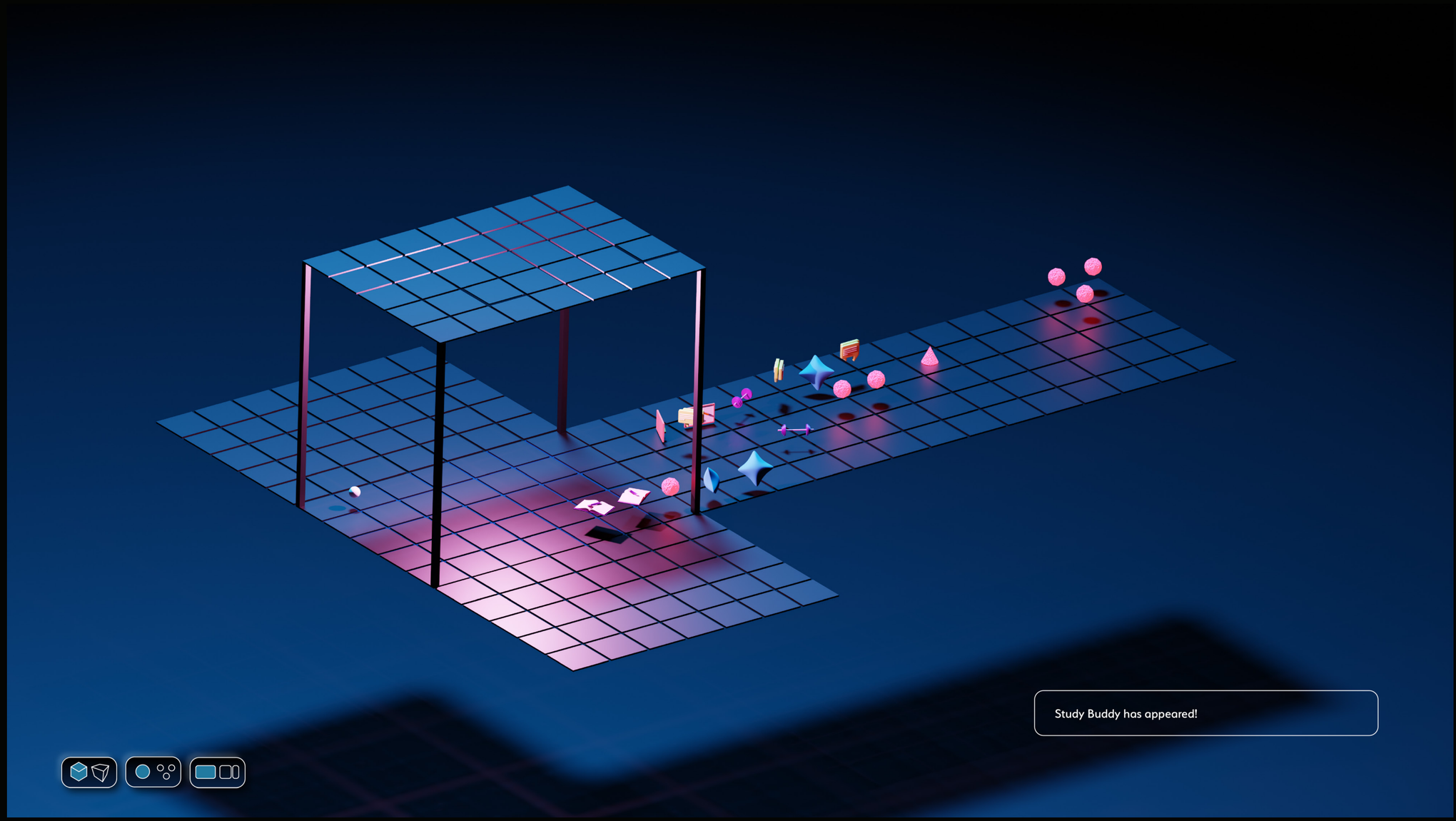
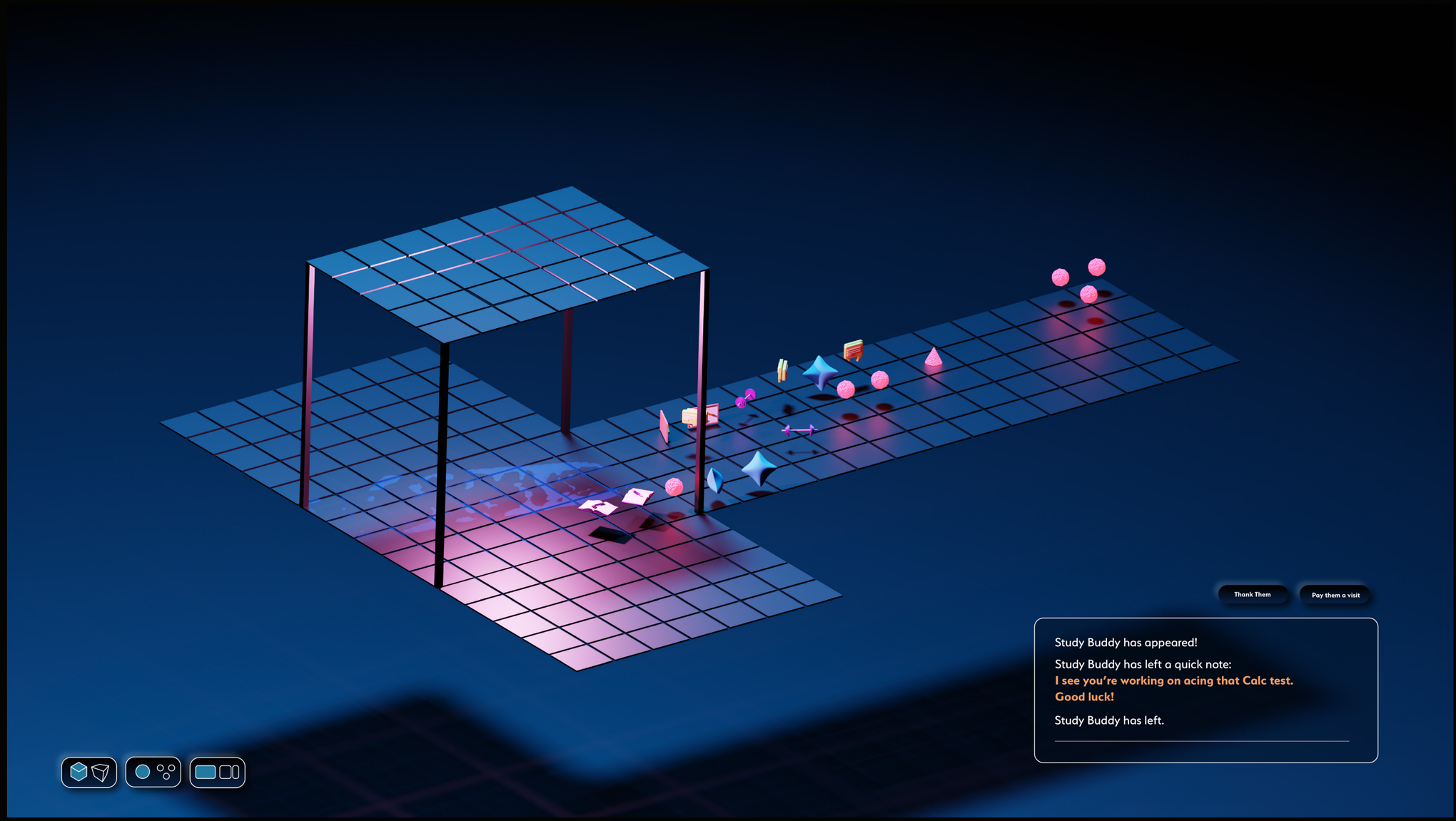


Figure 4.4.20: Study buddy appearance.

Jing | Studies



Jing | Studies

Figure 4.4.21: Study buddy notification log tracking what notes are tagged that the study buddy has left for Natalie.

When she is feeling a little better, she thinks that now is a good time to evaluate and see how she has done throughout her last weeks of studying. Prior to her current study session, she had input a few markers tracking on how well she did on her studying sessions (Figure 4.4.25). Now curious about her progress, she transitions to the top-down evaluation log and views the animation to see her accumulated tasks. This is beneficial for future planning so that she can assess and predict past and future workloads (Figure 4.4.26).

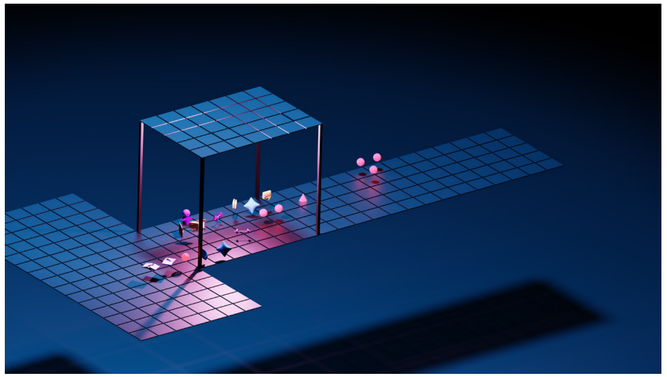


Figure 4.4.22: Animation depicting the monthly view changing. This correlates to the MTM representation priming cue to subtly shift Natalie's perspective following the floor moving towards the ego, in this case, Natalie's representation. View the animation here: https://college.design.ncsu.edu/thenfinally/jing/MovingMonth_Ortho.mp4

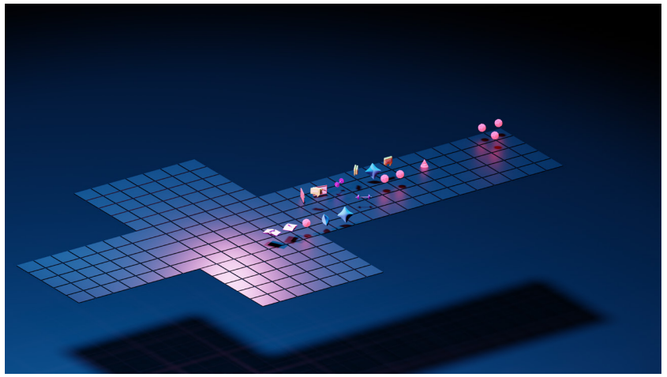


Figure 4.4.23: Evaluation animation where each priority can physically be stacked within one month to categorize tasks similar to the stacking animation above (Figure 4.4.16 - 4.4.18). To view this animation, please refer to:
https://college.design.ncsu.edu/thenfinally/jing/MovingEval_Ortho.mp4

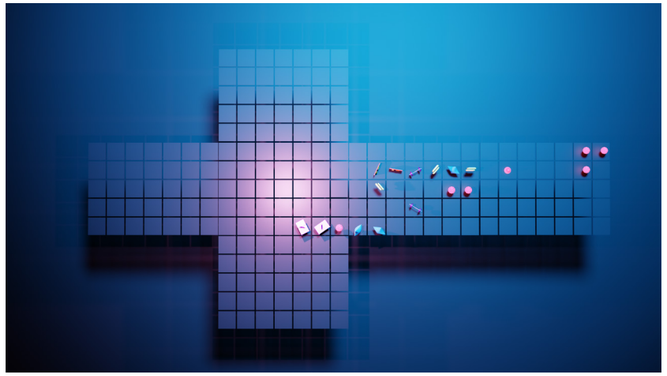


Figure 4.4.24: Top-down view of the month categorization. This view aims to give perspective for Natalie to understand and make the association between tasks prescribed within a monthly view as other calendar applications and how they can be manipulated within this space. To view this animation, please refer to:
https://college.design.ncsu.edu/thenfinally/jing/MovingEval_Topdown.mp4

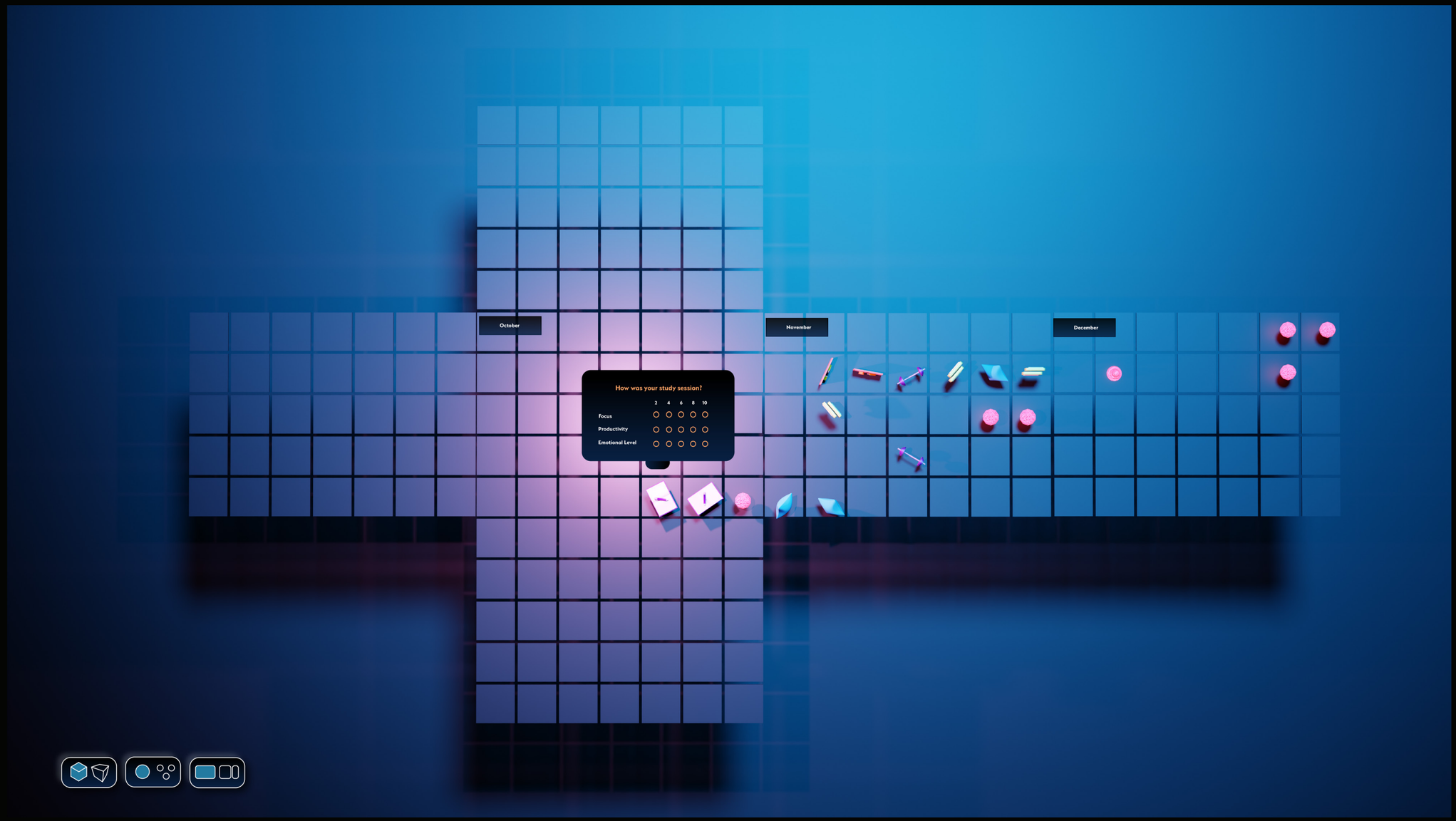


Figure 4.4.25: Way to help evaluate progress during her study sessions.

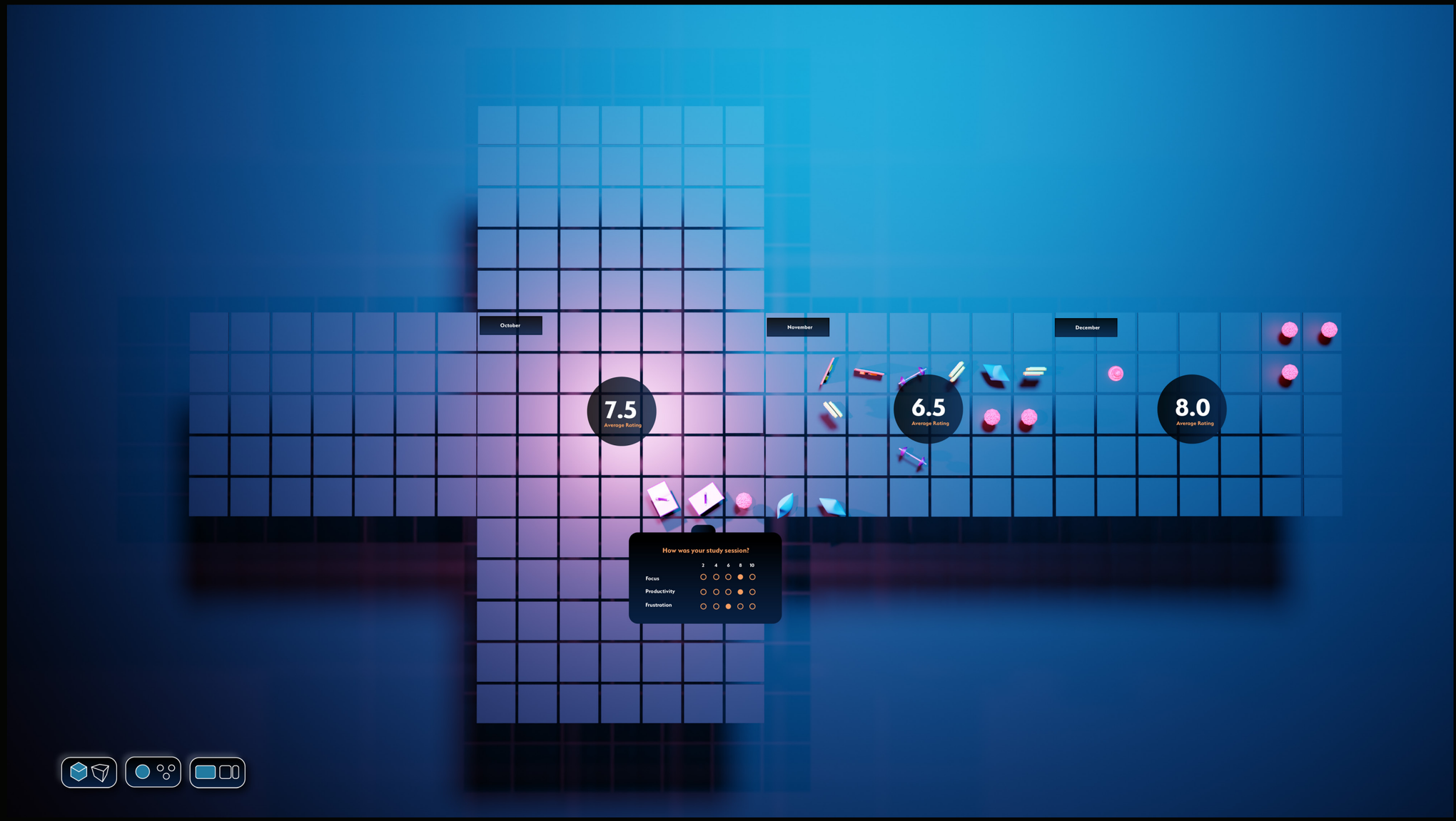


Figure 4.4.26: A long-term way to evaluate progress and see how each section averages out depending on Natalie's self-driven scores.

5

Discussion

5.1. Design Principles

Through my design investigations, a list of transferable insights below suggest design principles. While each principle has stemmed from my own experimentations with a focus on procrastination, they can extend into broader design applications.

× **Mitigate cognitive load:** Students who procrastinate can easily become overwhelmed, especially those with busy course loads who do not have the mental space to readjust time slots if unexpected circumstances occur. Thus, a designed system should explicitly cater for quick interactions that focus on ways to help the user complete a task. Thus, the easier the system is able to acclimate to a particular situation and anticipate the user's needs at that particular time, the more receptive users would be to initiate and continue utilizing the system. Designers should examine ways to automate tasks to alleviate a user's need to necessitate certain ideas. If possible, designers should calculate exactly how many decisions and activities a user would have to get to their intended action. If an action is unnecessary, snip it out (Studies 4.1, 4.2, 4.4).

- **Reinforce subtlety:** Every decision should be closely scrutinized during a systems process. In terms of priming, every facet should be considered to see how a user would interact with the system. Representation of key elements should also accurately reflect and be consistent. For example, colors should be controlled; if a certain color indicates an element, it should be applied with the same treatment. Once a color schema has been established, slight shifts to a color choice would implicate new ideas or decisions (Study 4.4).

- **Choose the right orientation**: While this investigation explores how a future-oriented perspective would help mitigate procrastination, each design situation varies and there is room to utilize the benefits of a past-oriented or present-oriented way of thinking. By studying how users react and their proclivities towards a certain orientation, designers can utilize this knowledge to better create experiences that would benefit users with particular needs (Studies 4.1, 4.4,).

- **Provide opportunities for joy (and some level of reward):** By creating opportunities for discovery, users should be able to enjoy the interaction. Designers should look for opportunities to spark joy in every interface that they create. If there is enjoyment, users will naturally return to their systems. For a progression-level system, designers should consider ways that a user would feel rewarded through tackling difficult coursework. While not explicit gamification, it may be something small that a user can look forward to whenever they complete an activity. Perhaps a small tidbit of joy that the user can look forward to, such as cake after a long-term study session or enticing animations that surprise the user in small ways (Studies 4.2, 4.3, 4.4).

- **Consider long-term implications:** Not every facet of every system will be necessary in long-term usage. In some situations, designers should consider ways that a system will help the user stop utilizing their interface. In terms of behaviorism, designers should address and consider that behavioral tendencies may resurface. A student might

abstain from procrastinating for a brief period of time and overtime may relapse. Designers then should incorporate strategies and ways to embrace the user at all entry points — whether they are a first-time user attempting a new system or a veteran user returning to see if they can mitigate their previous issues again (Studies 4.1, 4.2, 4.3, 4.4,).

- **Increase user agency through customization:** For something extremely abstract such as time perception, adjustability of their schedule and embracing a system that disincentivizes rigid timelines is a way to help mitigate issues (Study 4.4).

- **Emphasize balance:** Academic work activities are only one of multiple factors as to why students procrastinate. By creating a system that addresses how a student would spend their day with other essential activities, students are more likely to successfully complete their assignments. Oftentimes, it may not necessarily be that a student is struggling with their coursework and instead believe that they are not enjoying their work and feeling imbalanced in other areas of their lives. On a broader scale, designers should consider incorporating a systems-level of thinking and not simply address an immediate issue. Rather, they should consider a holistic view of a situation to investigate whether a broader solution (i.e. looking at overall life activities) would influence a narrower issue (i.e. academic difficulty) (Study 4.4).

5.2. Future Work

The following ideas represent useful inquiry for future work:

- **Explore multi sensory forms and ways of experiencing:** Auditory and other multi sensory forms of experiencing could be fruitful to individually explore or in conjunction with visual priming.

- **Dip more into the subconscious:** While this investigation primarily explores supraliminal cues within the interface level such as color,

movement, and just-in-time prompts, it explores deliberate ideation on the subliminal level in a limited capacity. In my brief exploration (Figure 4.2.8), I believed that with my limited knowledge of priming and no prior psychological background to fluidly create efficient laboratory test experiments, the priming that I had experimented with verged within a grey realm of advertising that I did not intend to. If given the opportunity and accrued knowledge, new ways to represent ideas in a balanced method where priming would appropriately behave could also be useful. How might a controlled laboratory experiment behave where the threshold of subliminal priming could be tested?

× **Generate playful interactions:** While the user is able to confidently move around in the space, I was not able to explore other nuances of activity that the avatar within the space would be able to. In my earlier explorations (Figures 4.2.5 - 4.2.8), I had envisioned ways in which the user would be able to interact with the objects spatially, such as touching, moving, and playing with the objects themselves. By considering more interactions, it presumes a new level of flexibility, control, and thinking that the user is able to exhibit. What levels of detail are necessary for the user to feel more comfortable and more in control of their time? As experiences become more fluid within the interface, would there be a disconnect between the avatar and the user? Where would the line drawn be for an interaction that is playful enough to help users understand that they have control of their time versus an interaction that further provides additional distractions?

× **User testing:** This investigation rests on the speculative nature of how a user would be primed into mitigating procrastination by adopting a future perspective shift in thinking. However, no user tests were done to determine the efficacy of the system. Only through long term user testing and access to larger amounts of data, would it be possible to even determine whether my system would be beneficial. If not, then what other ideas or insights could it bring to the table for future research to consider?

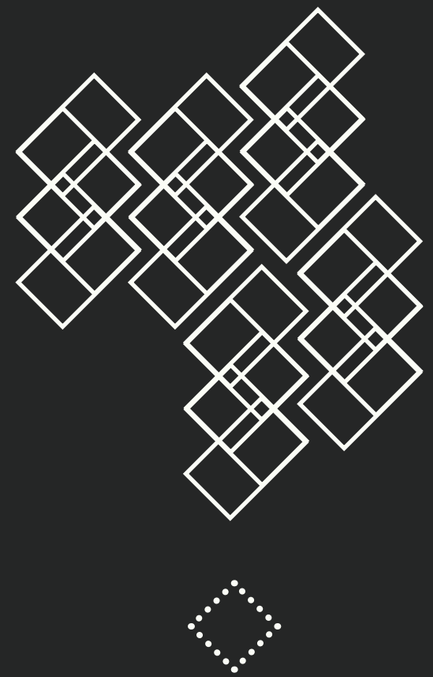
× **Think beyond a limited scope:** Throughout the interface, I considered a monthly view of time and the immediacy of three-to-four months for how the system would behave. For evaluation, longer durations would be fruitful to assess. Could the system track future years? How would the system interact with idle moments of time? How might the presence of blank months for an evaluation phase hinder or help the user through subliminal priming, or would there even be an impact?

× **Consider logistics and onboarding prompts:** Onboarding prompts were not explored. By exploring particularities and nuances of how students would input their tasks into the system, this also opens up new avenues for priming techniques. Students may, for example, find it incredibly onerous to input typical tasks into calendar applications such as google calendar, which introduces the burden of inputting tasks towards the user. However, by offloading some of that burden, or even simply assuming that there is a link between old calendar applications, there exists new opportunities for ways to compartmentalize time and mitigate cognitive load.

5.3. Conclusion

Everyone, at some point in their life, is subject to procrastination — whether that be a brief delayed respite from a studying session or a continued maladaptive response symptomatic of a larger issue of work delayance. To tackle the problem, people may turn to time management applications, emotional avenues, or other support systems within and beyond the screen.

Everyone is commonly bound in the universal struggle of juggling time. For college students, especially, who have a desire to tightly pack everything they possibly can within their four years, it is important to address the experiential nature of a 24-hour time cycle and how to achieve balance. Often, people gravitate towards standard and conventional ways to tackle time management — whether through existing calendar applications or ways to compartmentalize work loads. In juxtaposition, this design investigation looks towards conceptualizing novel ways to represent time, thereby increasing user agency to help mitigate procrastination. What began as an intensive exploration into a myriad of possibilities culminated into a distinct interpretation of a way to represent time by adding depth and dimension to the way we typically associate calendars. Time itself is an abstract concept with a plethora of possibilities waiting to be discovered. And much like there are a multitude of ways to represent and interpret time, so too do the possibilities exist to combat a tried and true problem of procrastination. While procrastination may realistically never be truly solved, by utilizing new methods of thinking about how to tackle the issue, we may soon better equip ourselves to mediate the issue.



6

References

Allen, J. F. (1991). Time and time again: The many ways to represent time. International Journal of Intelligent Systems, 6(4), 341-355. doi:10.1002/int.4550060403

Baylor, A. L. (2011). The design of motivational agents and avatars. Educational Technology Research and Development, 59(2), 291-300. doi:10.1007/s11423-011-9196-3

Bhattacharya, A., Kolovson, S., Sung, Y., Eacker, M., Chen, M., Munson, S. A., & Kientz, J. A. (2018). Understanding pivotal experiences in behavior change for the design of technologies for personal wellbeing. Journal of Biomedical Informatics, 79, 129-142. doi:10.1016/j.jbi.2018.01.002

Blouin-Hudon, E., & Pychyl, T. (2016, October 12). A mental imagery intervention to increase future self-continuity and reduce procrastination. Retrieved September 06, 2020, from https://iaap-journals.onlinelibrary.wiley.com/doi/abs/10.1111/apps.12088

Buzzo, D. (2017, October 10). Temporal representations in human computer interaction: Designing for the lived experience of time. Retrieved September 20, 2020, from https://uwe-repository.worktribe.com/output/879787

Buzzo, D., & Merendino, N. (2015). Not all days are equal. Proceedings of the 33rd annual ACM conference extended abstracts on human factors in computing systems - CHI EA '15. doi:10.1145/2702613.2732512

Caraban, A., Karapanos, E., Campos, P., & Gonçalves, D. (2018). Exploring the feasibility of subliminal priming on web platforms. Proceedings of the 36th European Conference on Cognitive Ergonomics - ECCE'18. doi:10.1145/3232078.3232095

Choy, E. E., & Cheung, H. (2018). Time perspective, control, and affect mediate the relation between regulatory mode and procrastination. Plos One, 13(12). doi:10.1371/journal.pone.0207912

Doering, A., Veletsianos, G., Scharber, C., & Miller, C. (2009). Using the technological, pedagogical, and content knowledge framework to design online learning environments and professional development. Journal of Educational Computing Research, 41(3), 319-346. doi:10.2190/ec.41.3.d

Duffy, S. E., Feist, M. I., & Mccarthy, S. (2014). Moving through time: The role of personality in three real-life contexts. Cognitive Science, 38(8), 1662-1674. doi:10.1111/cogs.12124

Elgendi, M., Kumar, P., Barbic, S., Howard, N., Abbott, D., & Cichocki, A. (2018). Subliminal Priming—State of the Art and Future Perspectives. Behavioral Sciences, 8(6).

Epton, T., Currie, S., & Armitage, C. J. (2017). Unique effects of setting goals on behavior change: Systematic review and meta-analysis. Journal of consulting and clinical psychology, 85(12), 1182–1198. https://doi.org/10.1037/ccp0000260.

Heath, J., & Anderson, J. (2010). Procrastination and the extended will. The thief of time, 233-252. doi:10.1093/acprof:oso/9780195376685.003.0014

Jiao, Q. G., DaRos-Voseles, D. A., Collins, K. M., & Onwuegbuzie, A. J. (2011, December). Academic procrastination on the performance of graduate-level cooperative groups in research methods courses. Retrieved September 10, 2020, from https://www.researchgate.net/publication/265282850_Academic_procrastination_on_the_performance_of_graduate-level_cooperative_groups_in_research_methods_courses

Jin, S. (2020). The Influence of time perception on intertemporal preference and its psychological mechanism. Open Journal of Social Sciences, 08(04), 236-249. doi:10.4236/jss.2020.84017

Johnson, D.W., Johnson, R.T., & Smith, K.A. (1991). Cooperative learning: Increasing college faculty instructional productivity. ASHE-ENC Higher Education Report No. 4.Washington, D.C.: The George Washington University, School of Education and Human Development.

Kim, C., & Baylor, A. L. (2008). A Virtual change agent: Motivating pre-service teachers to integrate technology in their future classrooms. Retrieved August 16, 2020, from https://www.jstor.org/stable/jeductechsoci.11.2.309

Kissel, V. (2020, March). Exploring the functionalities of imagining the future in relation to the time span between present and future self in the daily life of university students. Retrieved September 6, 2020, from http://essay.utwente.nl/80847/1/Kissel_BA_BMS.pdf

Klingsieck, K. B., Fries, S., Horz, C., & Hofer, M. (2012). Procrastination in a distance university setting. Distance Education, 33(3), 295-310. doi:10.1080/01587919.2012.723165

Koestner, R., Lekes, N., Powers, T. A., & Chicoine, E. (2002). Attaining personal goals: Self-concordance plus implementation intentions equals success. Journal of Personality and Social Psychology, 83(1), 231–244. https://doi.org/10.1037/0022-3514.83.1.231.

Leone, M. J., Salles, A., Pulver, A., Golombek, D. A., & Sigman, M. (2018). Time drawings: Spatial representation of temporal concepts. Consciousness and Cognition, 59, 10-25. doi:10.1016/j.concog.2018.01.005

Levy, Y. (2007). Comparing dropouts and persistence in e-learning courses. Computers & Education, 48(2), 185-204. doi:10.1016/j.compedu.2004.12.004

Loeffler, S., Stumpp, J., Grund, S., Limberger, M., & Ebner-Priemer, U. (2019, August 20). Fostering self-regulation to overcome academic procrastination using interactive ambulatory assessment. Retrieved September 06, 2020, from https://www.sciencedirect.com/science/article/pii/S1041608019300962

Nunez, R. E., Motz, B. A., & Teuscher, U. (2006). Time After time: the psychological reality of the ego- and time-reference-point distinction in metaphorical construals of time. Metaphor and Symbol, 21(3), 133-146. doi:10.1207/s15327868ms2103_1

Pogorskiy, E., Beckmann, J. F., Joksimovic, S., Kovanovic, V., & West, R. (2018). Utilising a virtual learning assistant as a measurement and intervention tool for self-regulation in learning. 2018 IEEE International Conference on Teaching, Assessment, and Learning for Engineering (TALE). doi:10.1109/tale.2018.8615130

Rebetez, M., Barsics, C., Rochat, L., D'Argembeau, A., & Linden, M. (2016, April 22). Procrastination, consideration of future consequences, and

episodic future thinking. Retrieved September 06, 2020, from https://www.sciencedirect.com/science/article/pii/S1053810016300502

Schippers, M., Morisano, D., Locke, E., Scheepers, A., Latham, G., & Jong, E. (2019, November 25). Writing about personal goals and plans regardless of goal type boosts academic performance. Retrieved September 06, 2020, from https://www.sciencedirect.com/science/article/pii/S0361476X1930428X

Sheeran, P., & Webb, T. L. (2016). The Intention-Behavior Gap. Social and Personality Psychology Compass, 10(9), 503-518. doi:10.1111/spc3.12265

Song, D., Rice, M., & Oh, E. Y. (2019). Participation in online courses and interaction with a virtual agent. The International Review of Research in Open and Distributed Learning, 20(1). doi:10.19173/irrodl.v20i1.3998

Steel, P. (2007). The nature of procrastination: A meta-analytic and theoretical review of quintessential self-regulatory failure. Psychological Bulletin, 133, 65–94. doi.org/ https://doi.org/10.1037/0033-2909.133.1.65.

Steel, P., & Klingsieck, K. M. (2016). Academic procrastination: Psychological antecedents revisited. Australian Psychologist, 51, 36–46.

Stoessel, K., Ihme, T. A., Barbarino, M. L., Fisseler, B., & Stürmer, S. (2015). Sociodemographic diversity and distance education: Who drops out from academic programs and why? Research in Higher Education, 56(3), 228-246. doi:10.1007/s11162-014-9343-x

Stolarski, M., Fieulaine, N., & Zimbardo, P. (2019). Putting time in a wider perspective: The past, the present, and the future of time perspective theory. Retrieved September 20, 2020, from HAL archives-ouvertes.fr.