



# The In Between

Cognitive Ergonomics Evaluation in Public Spaces:  
A Cultural-Affordance-Based Approach

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Cognitive Ergonomics Evaluation in Public Spaces:  
A Cultural-Affordance-Based Approach

by

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interactive objects

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# ABSTRACT

This research explores the intersection between industrial and interaction design principles to create engaging interactive objects for public in-between spaces. It emphasizes not only designing with the body but also the mind, acknowledging the diverse cultural and social backgrounds of individuals. Employing a research-through-design approach with the creation of discursive artefacts, the study develops a cultural-affordance-based framework for cognitive ergonomics evaluation. This descriptive and reflective methodology departs from deterministic models, fostering cultural and social sensitivity in design for diverse populations. Three affordance typologies are proposed to understand user-object interactions in these spaces where affordances become invitations to action, information for response tuning, and identity forged through social practice. Finally, the D.O.O.R. evaluation, a four-stage process involving deconstructing interactions into non-contact and contact phases, embracing unexpected insights during field observations, associating implied operations through semantics, and employing a cognitive ergonomics evaluation scale to refine designed affordances in an object, is introduced to guide designers in implementing these concepts to reduce the burden of cognitive friction in users. This research aims to contribute to the creation of cultural sensitivity in the design and engagement with objects in public spaces, enriching transient encounters for a wider range of users.

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# DEFINITION OF TERMS

In this research, the following terms are defined and used as follows:

## Affordances

Possible actions for interactions dependent on both capability of user and object.

## Cognitive ergonomics

The field of human factors and ergonomics that deals with the mental processes involved in interactions.

## Cultural affordances

Affordances determined by the shared knowledge, values, and practices of a specific culture or context. These affordances influence how one might perceive, interpret, and interact object affordances within a specific culture.

## Interactive objects

Any object that shifts from one state to another, either transforming from one form to another or moving from one position to another, through direct user input.

## In-between spaces

A public space that offers a gateway of transition from one location to another.

## Public spaces

A space of congregation where a diverse group of people intersect with each other in a space at one point of time.

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# NOTE TO THE READER

My original title a year ago was supposed to be “In the Lost Hour” as a tribute to the time of midnight, the hour lost to most people as they are fast asleep. Yet, this lost hour is the brief intersection when my late father and I would meet every night. In the height of the pandemic, my father, a hardworking teacher, would sleep early in the evening and wake up by midnight to have a cup of coffee and begin working on grading students’ papers and preparing for his classes until the sun rises and he goes to school. I, on the other hand, would stay up all night finishing my design projects, not having slept yet, in preparation for my class at eight in the morning. In this brief point of a chance encounter, our two times, two worlds, would align and intersect for but a moment and then we’d get back to our respective works. Now as I am in a different time zone, my mother, who is also a teacher, would usually wake up by midnight to prepare for her classes. This lost hour is now the only time we’d get to call with one another, further expanding the number of meaningful encounters I have in this lost hour of midnight to more than one person I hold dear in my life.

As an international student, I’ve done a lot of shifting in the past two years, moving my life to this foreign land with attempts to learn, unlearn, and relearn in the context of this new place I now live in. What I used to think about the world was but a small bubble in this vast diverse world that I have yet to fully explore. I know I am not alone in thinking this as my fellow classmates in the MDes cohort have also had their respective worlds shifted and changed, looking at this familiar unfamiliarity in our newly expanded bubbles. You only get to learn your culture deeper than you already thought and knew once you have been displaced from it and view it from the perspective of an outsider as you try to adapt to this new foreign culture you are placed in.

The themes of this research look at the point of shifting states, be it an object shifting from one state to another by means of transformation or translation as a response to user input or a person shifting how we act in one context onto another in a different cultural context. I look at public spaces of passage such as doorways, trains, and buses where people congregate and meet but for a moment with other people, rich in diverse cultures and experiences, before making their way onto their intended destinations. I explore how we interact with the objects in these in-between spaces.

# CHAPTER 01: INTRODUCTION

This thesis has come to be born through my practice in human factors design—looking into the physiological and psychological considerations in the design of objects. I have always been fascinated and interested in observing physical interactions with things in our everyday lives. These interactions have become passive and unnoticed by many, but they greatly influence how we might engage with the world around us. As designers, I believe we have a role to play in mediating this communication between users and designed objects, especially in heavily diverse populated spaces. With that, I aim in this research to look at interactive objects—objects that change and transform from one state to another when provided user input—and how we engage with these said interactive objects in public spaces with the hope that as designers, we may design more intuitive user interactions in harmony with both the body and the mind in such diverse and dense spaces.

## BACKGROUND

Industrial design has played a pivotal role in the emergence and development of interaction design as a field of its own. Valtonen and Akoglu unfold how interaction design had emerged and grown within industrial design organizations through anecdotes from industrial and interaction designers (2014). The understanding of interaction design among industrial design practitioners varies even to this day where some may see a clear definitive line that separates the two while others may see them through an interdisciplinary lens. This difference in perspectives is also seen with other design disciplines as well, where some may view design as an interdisciplinary field not needing distinctions between its respective areas while others believe the opposite. In the context of most formal design education foundations, however, mine included, the distinction between areas such as visual communication, industrial design, and interaction design is more prominent in attempts of specializing the learning and development of skills and perspectives of student designers to that of the core pillars upheld in actual practice in these respective areas. This separation is also seen in the use of specific job titles and descriptions by industry for each respective design area in attempts of filtering the skillsets employers are looking to hire for a design role amidst a vast ocean of design practices. Despite this divided nature, however, different areas of design still find ways to be informed and influenced by one another, even extending beyond the field of design itself to other disciplines (Leavy, 2014) where other fields may draw on creative practices to address social issues while designers in return get to understand better the world they are designing for.

Jean Baudrillard critiques society as a system of signs where no singular thing in modern day stands on its own anymore, as the complexity of the collection of objects now creates a meaning that is different from the mere utility and function of the singular, granular object (2005). With the emerging complexity in objects, the clear distinction between hardware and software, the key factors that one might consider to separate interaction design from industrial design in a more traditional sense, has started to blur where designers from both fields would come to learn from each other's expertise and best practices (King & Chang, 2016). Baudrillard then continues to say that these collections of objects are portrayed as a homogeneous system of signs that translate and relate everyday life into modular constructs through things (2005), placing them into roles and relationships where objects start becoming isolated by their function as a single cog in this complex machination meant to serve its respective role in the system. Its succeeding meaning is then dictated by either a designer's intention or a user's interpretation of the object that ultimately converges into a cultural system comprised of an amalgamation of functions within a single unified network or social niche.

With such diversity in the world, interactions become varied depending on social context thanks to the cultural assumptions and interpretations we possess. Throughout history, cultural evolution has time and time again altered the physical, cognitive, and social factors of how we live as a response to culturally-constructed environments (Henrich et al., 2010). Designing objects then with a one-size-fits-all mindset may put additional burden on users' attention and decision-making (MacLean, 2008) when interacting with objects as Ramstead and others suggest that most of what humans do are learned socially and are reflected by the shared sets of expectations people have in a culture (2016). This resulting burden also applies to objects that ask for user input to provide clarity with the succeeding steps in a procedural interaction that reveals its parts bit by bit. If we were to remove clear signifiers that incite what possible actions, to which touchpoints, and to what extent our interactions with objects will be, it would result in confusion and a recurring process of trial-and-error to understand how to interact with an object that may need additional learning and a different interpretation.

## COGNITIVE ERGONOMICS

Inquiry and practice in the field of ergonomics in design for a time mostly focused on physical considerations and factors of how one reaches, holds, picks up, and operates an object (Zhang et al., 2019). This has since, however, evolved and expanded beyond just physical ergonomics and has extended to exercise psychology in its practice (March, 1994; Marras & Hancock, 2014).

Cognitive ergonomics refers to the branch of ergonomics that deals with the mental processes that take place in our interaction with things from memory, perception, sensory-motor response, and how we might be affected by the interaction (Colovic, 2011; Zhang et al., 2019). In contrast to physical ergonomics, which is a main priority for the design of physical products in industrial design, that deals with anatomical, anthropometric, and biomechanical characteristics of humans (Colovic, 2011) along with the physical actions involved in the interaction, the former aims to apply cognitive psychological knowledge in order to appropriate user-object interactions to the user's cognitive abilities and limitations to make the user interface of a system more intuitive and clear (Chen et al., 2022).

Due to the diversity in cultural expectations and experiences, there may be confusion as to how users might perceive and interpret how to respond and interact with an object that may differ with the designer's intention in how Michel de Certeau in *The Practice of Everyday Life*,

distinguishes producers' dominant role that dictates the 'proper' use of things from that of consumers' subordinate role that only allows one to use things as per their original intention (1984). This makes users unable to comprehend how to interact with the object and potentially reject their use of the object in what Alan Cooper calls "Cognitive Friction (CF)" (Chen et al., 2022; Cooper, 2004). For users, the appearance of an object is important in persuading them in the decision to purchase and use said object, while for designers, it mainly serves as a basis for its user interface to relay the message they wish to convey to consumers. Thus, being able to heighten the clarity and understanding of how one might interact with an object using cognitive ergonomics helps the user interface of a system by aiding user's perception of what affordances, what possible actions, are capable of being performed when interacting with objects.

## AFFORDANCE

The term affordance was first used by J.J. Gibson to argue that objects have innate clues on how to use them and it is simply the user's job to perceive them (2014). This reduced the cognitive gap between users and objects which quickly drew attention of fields such as Engineering Design, Human-Computer Interaction (HCI) and Industrial Design (ID) (Chen et al., 2022). It has become among the foundational design principles for HCI and ID introduced by Don Norman together with discoverability, feedback, conceptual models, signifiers, object mappings, and constraints (2013).

The term affordance as it is currently used in design research and practice, however, has diverged from Gibson's original ecological concept that is descriptive in nature (2014) to one that is prescriptive of the condition of the user. Norman's perspective on the concept is that of interpreting the perceived information with reference to the ability of users to perceive the affordances embedded in an object. Ramstead and others (2016) argue that affordances are both descriptive (same with Gibson's) and prescriptive (akin to Norman's perspectives) in nature because they specify what actions and perceptions are situationally appropriate and expected by others in a social niche or context.

The sheer number of possible outcomes of interaction, however, cannot all be accounted for by the designer as interacting with designed objects allows users to unlock innumerable sequences of possible actions to accomplish whatever end-goal the user may have in mind,



which may differ from person to person and their respective social contexts. There is an infinite number of affordances present to a user upon interacting with an object and it is only a matter of which of these pre-existing affordances are perceived to be the most appealing for the user based on their individual, personal, and social circumstances seeing as an object's identity is dynamic and continuously shaped by connections and engagements it forms with other entities in contexts that are moulded through personal and social histories (Mitchell, 2011).

## WHO IS THE WORLD DESIGNED FOR?

*“How we meet the built environment depends on both bodies and worlds”*

(Hendren, 2020)

Affordances in Industrial Design are often used to support user actions without the need to require the use of users' memory in inferring and interpreting action when interacting with an object (You & Chen, 2007). This framework makes designers shift focus and prioritize users' actions over their mind, which makes designing more streamlined and structured. This, however, may in turn lead to designers, possibly unbeknownst to even themselves, to simply dictate how their designs are supposed to be used, taking control of how the object is to be perceived and interacted with by the user. Now, I ask who the world is designed for? Would everyone have a common understanding and way of interacting with every designed object in existence? Would people interact with an object in a public space the same way? No, I argue that affordances become contextual as semantic content is materialized through culturally shared expectations (Ramstead et al., 2016) and this expectation that comes with familiar things requires significant time to reveal certain entanglements of memory and desire that slowly become habitual (Highmore, 2010). Through repeated performance of functional operations within a specific social context (Mitchell, 2011), objects gain meaning that may be personal to an individual or social group.

In combating this unaccounted multitude of affordance interpretations, users interpret and 'read' the signifiers built into objects, to understand their function (Baber, 2003). It is through these product semantics that we understand how to respond to objects. Only when we have action goals in mind do we look for affordances consciously. Otherwise, we would be flailing like fish out of water, trying to figure out how an object operates and what we can do with it by means of trial and error (Baber, 2022).

Through time and learning, affordances and semantics become learned in relation to the context of use they exist in that relativizes the information perceptible to be shaped by social norms and conventions (de Carvalho, 2020; Ramstead et al., 2016; Sun & Suthers, 2023). These so-called cultural affordances arise as a social understanding of knowledge and action accepted in specific conditions in certain environments (Baggs, 2021; de Carvalho, 2020; Rietveld et al., 2019). And once we have established notions of what operations are available in the interaction with objects, through recognition-primed decision-making (Baber, 2022), we pick out relevant cues in the interaction and interpret them based on recognized patterns and experiences, resulting in decision-making and the definition of appropriate action to be enacted becoming intuitive for the individual based on their experiences and knowledge in meaning making and association.

Ramstead and others (2016) developed a framework on cultural affordances informed by Grice's theory of meaning (1957) that is later refined and termed as 'intention-based semantics' (Levinson, 2000; Sperber & Wilson, 1986; Tomasello, 2014) where they argue that humans behave according to how they expect others would expect them to behave in a given situation. This highlights the dependence of certain affordances on the social and cultural normativity and the shared expectations that are determined by meaning making and association in each cultural context.

It is akin to the comparison of Space and Place as concepts where the former is physical, while the latter is social (Dourish, 2004; Tuan, 1977). As designers, we should be more aware of the weight our design implications hold when centred on place (the context) rather than simply the space (the physicality)—designing for interaction as opposed to the physicality of a space that would assume to generalize every context of use and interaction with the same or similar object. Different contexts will reflect an emergence of practice (Dourish, 2004) where shared knowledge and behaviour would also emerge from people's common experiences over time depending on the community the practice is in.

Upon arriving in Vancouver, as it was my first time out of the Philippines, I immediately took notice to the differences in how some objects are designed and used which differed from what I would observe back home. A door hook where one hangs objects such as clothes and towels reflect the culture of housing in these two very different worlds. In the Philippines, most door hooks are screwed on the back of doors themselves, while my observations here in Vancouver tell me that there should be as little to no damage to the physical space as much as possible, resulting in hooking the device on top of doors instead of screwing them in place. This is an interesting comparison between cultures that highlights the housing culture in Vancouver which emphasizes the moving nature of people, usually not staying in a single residence for an extended period of time. This is in stark contrast to the culture of settling down in the Philippines where owning your very first residence is a huge milestone and will most likely be one's only residence for their lifetime which will even be passed onto their next of kin.

The contextualizing of the design and use of objects is evident in a multiplicity of cultural differences. In certain conditions, however, located in the in-between spaces of transition where a diverse population of people from different backgrounds may congregate together for a moment may not have ample time in developing this familiarity and contextual consideration with regards the objects situated in it.



**Figure 1.** Screw-on door hooks (above) and hanging door hook (below).

## SIGNIFICANCE OF THE STUDY

This research investigates our roles as designers in facilitating the engagement and stimuli-response communication of users and objects in public in-between spaces. It highlights designing not only for the body, but also for the mind in the field of industrial design taking great care to be sensitive to diverse cultural and social mental models of individuals.

Different components in an interactive system interact in predictable ways according to how they are constructed. However, users are less predictable. They might have different goals in mind from that of the designer's intention as they explore the various affordances that would present themselves based on the individual context of use as well as personal background and prior experiences of the user that they would associate with certain perceptible cues.

Using an affordance-based design approach to investigate cultural affordances in order to evaluate cognitive ergonomics would allow designers to better understand potential interactions and responses between a diverse population of users in public spaces that may not be aligned with the type of interaction the designer may have originally intended, which may present the conflict of confusion to users.

Developing a sensitivity to cultural and social considerations by looking through the lens of affordances in design allows for designers to be more inclusive in catering to the needs and expectations of diverse user groups, create easy-to-understand and intuitive interfaces for users coming from different cultural backgrounds, and consider adapting designs to a specific cultural context in which it will be used in. Cultural affordances provide a lens through which individuals may interpret the world around them and in embracing and considering these affordances, designers can create experiences that are not only functional but also culturally sensitive and meaningful to a wider range of users.

# CHAPTER 02:

## RESEARCH DEVELOPMENT

Through this research, I hope to create a more conscious awareness for designers on how we might approach interaction, especially physically and tangibly, in the public domain where our designs might meet several interpretations from people of various cultures and experiences. With this, I hope designers look not only at our physical design considerations but also the perceptual and cognitive which may be contextual and social especially in highly populated spaces to become more inclusive and culturally sensitive of the needs and expectations of diverse user groups while creating intuitive design interfaces that are easy to understand and interact with by a broader range of users.



## RESEARCH OBJECTIVE

How might we consider the cognitive ergonomics of interactive objects in public in-between spaces to heighten cultural sensitivity in designing for diverse populations?

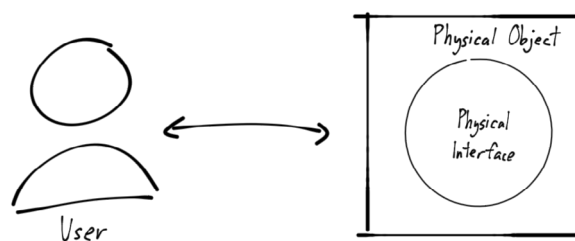
This research aims to understand how culture and context might shape how we perceive, interpret, and interact with objects in public spaces through the lens of embodied cognitive and affective inquiries to user behaviour as well as the sociocultural implications of object interactions by developing an affordance-based approach to the evaluation of cognitive ergonomics in the engagement with physical interactive objects in public in-between spaces. In investigating this research question, several questions were also kept in mind.

- What is the role of an object in its physical environment influenced by its cultural context?
- Does the structural and functional properties of an object influence users' perceptual behaviours and operational actions?
- What is the role of designers in the facilitation of communication between users and objects?

## SCOPE AND LIMITATIONS

This study situates itself in between interaction design and industrial design. Industrial design has informed interaction design in its conception as a field. This research now looks at how interaction design might inform industrial design in return after the new practices in the former have emerged and developed throughout the decades.

It focuses on interactive objects, defined in this thesis as any physical object that shifts from one state to another through direct user contact. This shift in states may be an internal transformation by the object itself or a change in position which illustrates movement by the object to accomplish user goals. The said interactive objects focused in this research are found in public in-between spaces—public domains where a diverse population of people congregate for a brief while as a transition point in between moving from one location to another, moving from one environment to another with potentially vastly different sociocultural contexts and user behaviour expectations.



**Figure 2.** User-interface-object interaction informed by Sato & Youn-Kyung Lim (2000).

With there being several models and frameworks of interactions with physical objects and their interfaces (Dourish, 2004; Sato & Youn-Kyung Lim, 2000), I will be focusing on user-interface-object interactions presented in Figure 2. This model describes the physical interface being incorporated in the object itself. It illustrates a direct and immediate causality between control actions and the resulting effects.

The user input accounted for in this research would focus on hand-contact interactions where the user's hand directly touches the object's interface to manipulate it in some way and induce an interactive response. This is because the scale of objects plays an integral role in how users might interact with them as hand-operated objects tend to involve several Artefact-User Affordances (AUAs) (Chen et al., 2022). It is also important for the user input to be performed

by the hand as the hand becomes a medium for thought which intertwines bodily movement with that of thought processing (Baber, 2022; Wilson, 1999), enabling one to better grasp (pun intended) abstract concepts by materializing them into performable actions with which one may explore.

Lastly, this study attempts to investigate and evaluate cognition in user-object interactions through a design perspective and does not seek to answer questions through a psychology and neuroscience perspective, though concepts from said fields, especially those of cognition, inspired and influenced the framing and perspective of how the research is approached. The use of affordances in interrogating the research questions of the study are observed through an industrial designer's lens, focusing on the three-dimensionality of the object interactions. In doing so, only an object's structure or form is accounted for when speaking about affordances and does not consider its colour, texture, and other design elements (Becerra, 2016) which would influence perception and interaction that may be investigated in future studies.

## METHODS

This research employs research-through-design approaches of investigations. As an industrial designer, artefact-making is a prominent part of my design and research practice. This involves designing and prototyping various objects to be tested or used as a point of discourse, adapting a modified Artefact-Centric Creation and Evaluation Methodology (Ahmed & Sundaram, 2011) that makes use of observation followed by theory building, artefact creation, and then evaluation of said artefact. This methodology is practice-led and uses the practice of making as knowledge building (Mäkelä, 2007).

## DISCURSIVE DESIGN

The artefacts created in this process of artefact-making are of a discursive design (Tharp & Tharp, 2019) nature. Their intention is typically not utilitarian in the traditional sense, but rather one that incites reflection by employing provocation in the process of making and in interacting once created. It acts as a medium for thinking while making, but also as a communication device that allows others to understand the intangible aspects of cognitive ergonomics through allowing thoughts and actions to be challenged and questioned. Emphasis on an embodied and action-oriented process in interacting with the designed discursive artefacts is given as my intention for provocation is funneled through a realization and reflection through tactile and tangible actions.

## AFFORDANCE-BASED DESIGN

An Affordance-Based Design (ABD) approach is used in this research. ABD is introduced by Maier and Fadel (2009) and further developed by Gupta and Uma Maheswari (2019) into a framework that breaks down the ABD process into a comprehensive affordance structure for the system being designed. With this, I investigate how affordances are utilized in theory and practice, both from its originating field of ecological and perceptual psychology as well as its major applications in the field of design through a series of discursive projects and observations. Unlike most uses of an ABD approach however, I utilize affordance-based approaches through a reflective and descriptive model with the aim to provoke thought as opposed to be a deterministic model. This is done in order to hopefully incite meaningful reflections in the design process to create a particular sensitivity to designing interactive objects accounting for social and cultural assumptions in specific contexts of use.

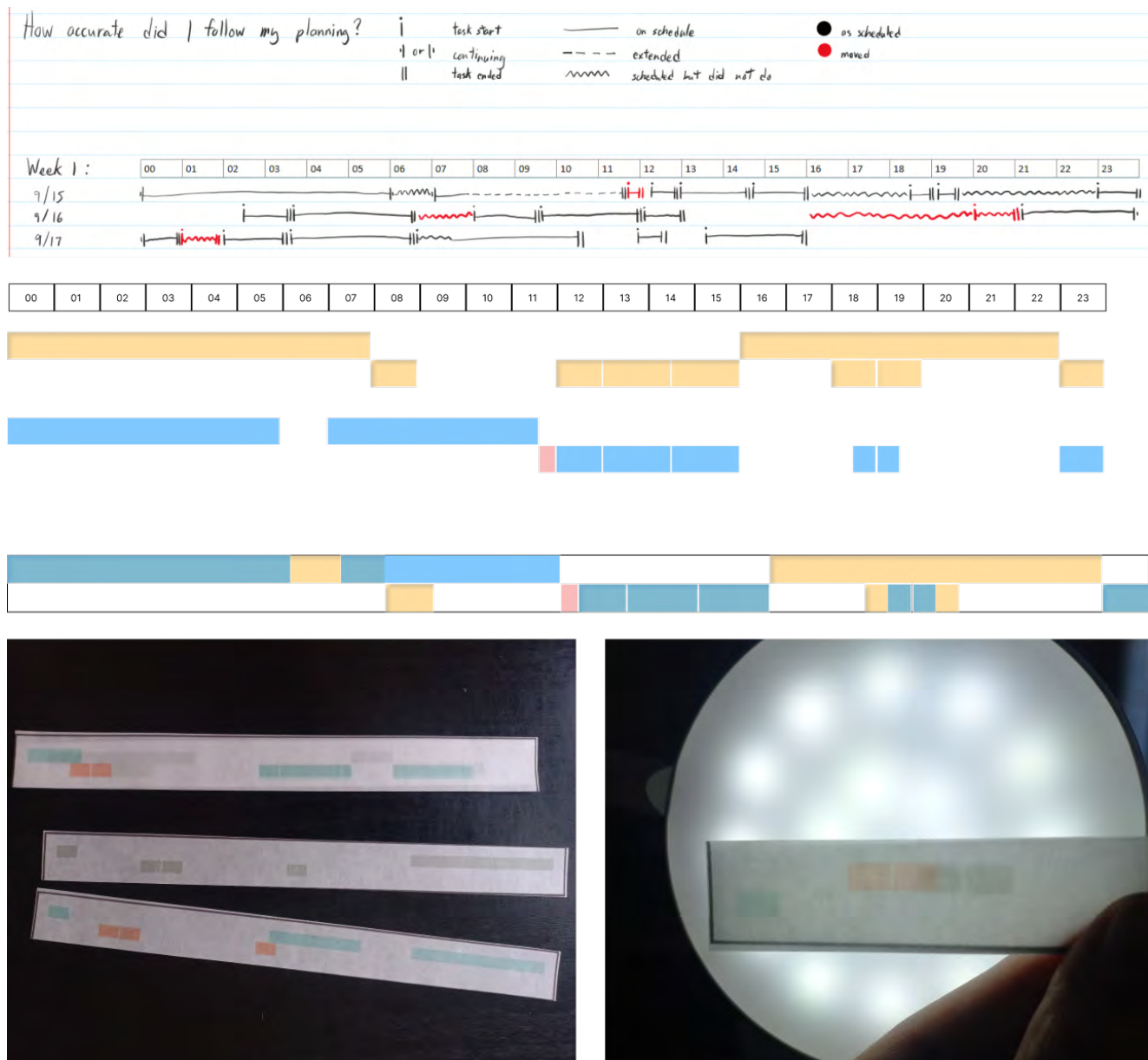
## CHAPTER 03:

# THE SPACE IN BETWEEN

As I have aforementioned, I look at the in-between spaces in the public domain. What does this entail? What constitutes these public in-between spaces? In this chapter, I explore the feeling of being in between a transition of states and how that might reflect in a space we traverse through in our daily lives.

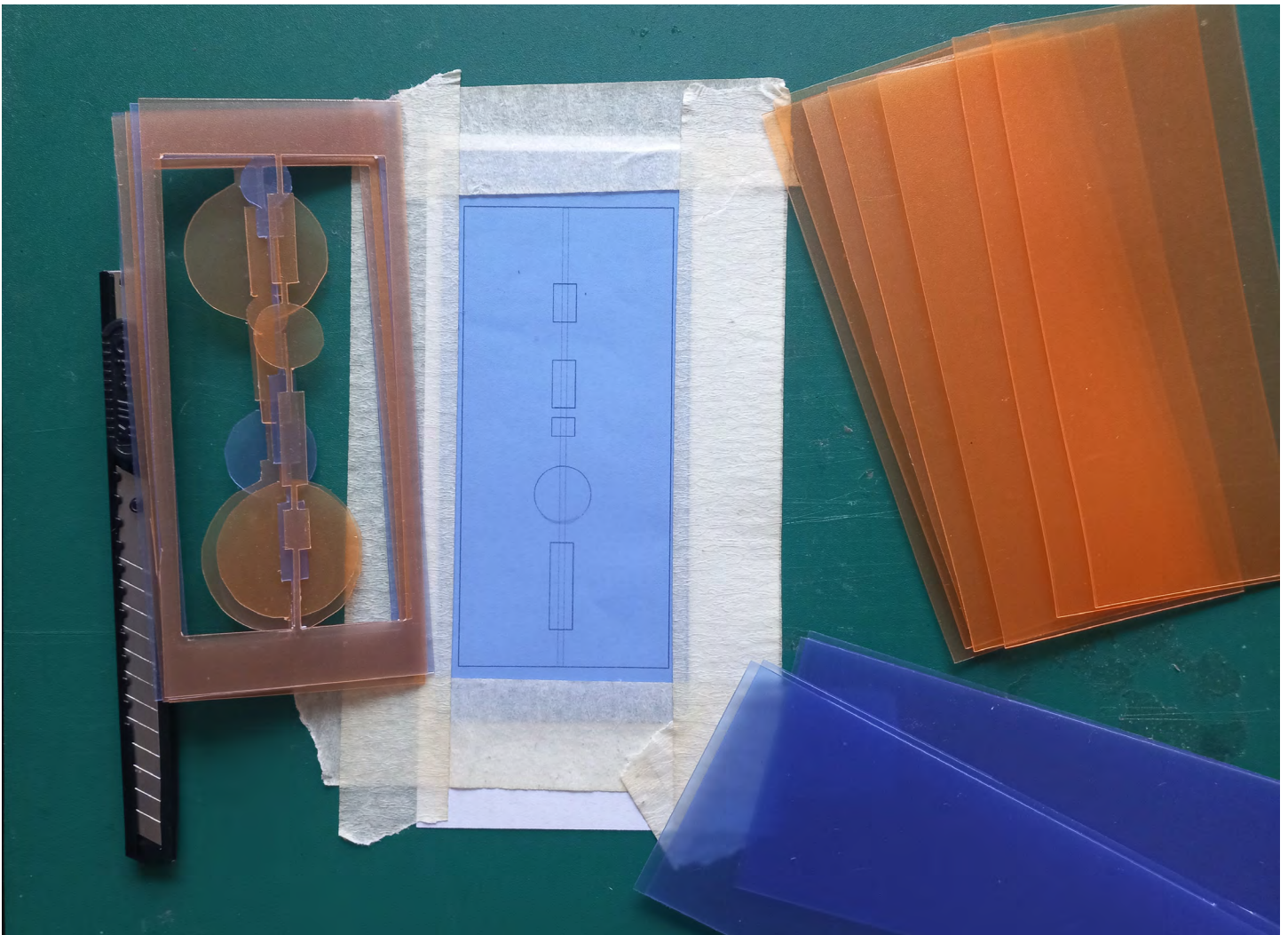
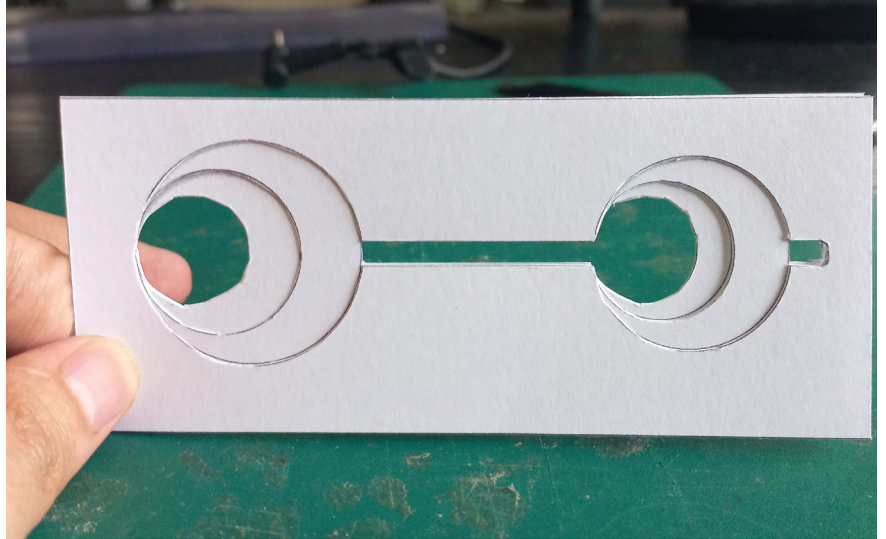
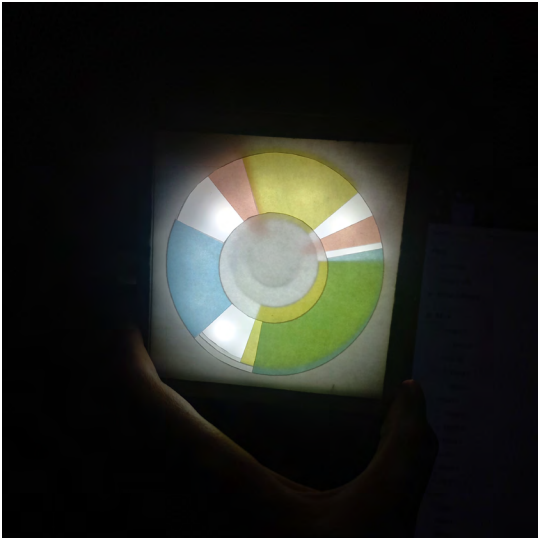
## STUCK IN THE MIDDLE

As an international student who started his graduate studies during the pandemic when VISA issuance delays were prominent, I spent my first month in the Fall term of 2022 entirely online with a 15-hour time zone difference. This meant having classes from 11 at night to six in the morning. In attempts of navigating being Stuck in the Middle, I recorded and compared my planned scheduled time against how I actually spent my lived time.



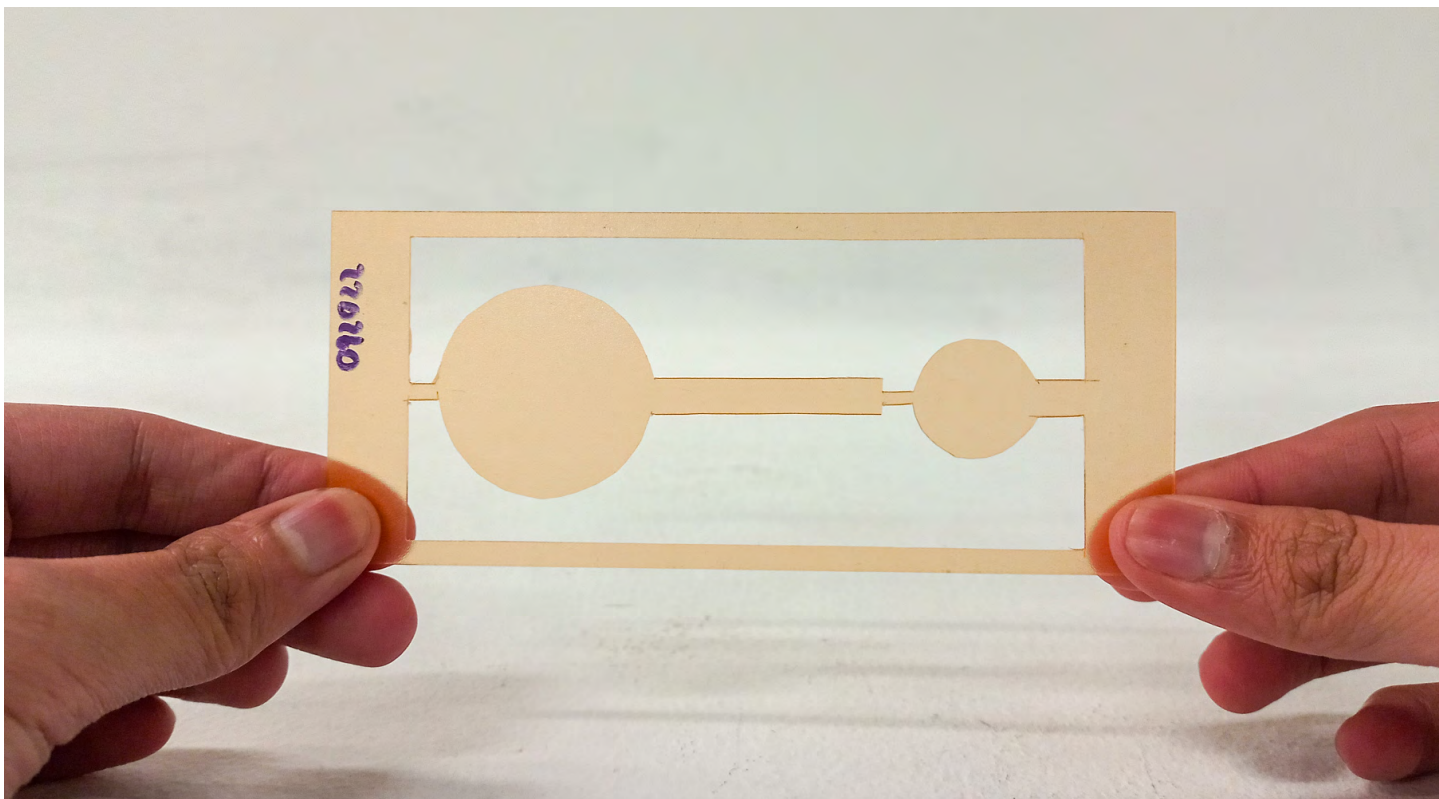
**Figure 3.** Visual recording of daily routine.



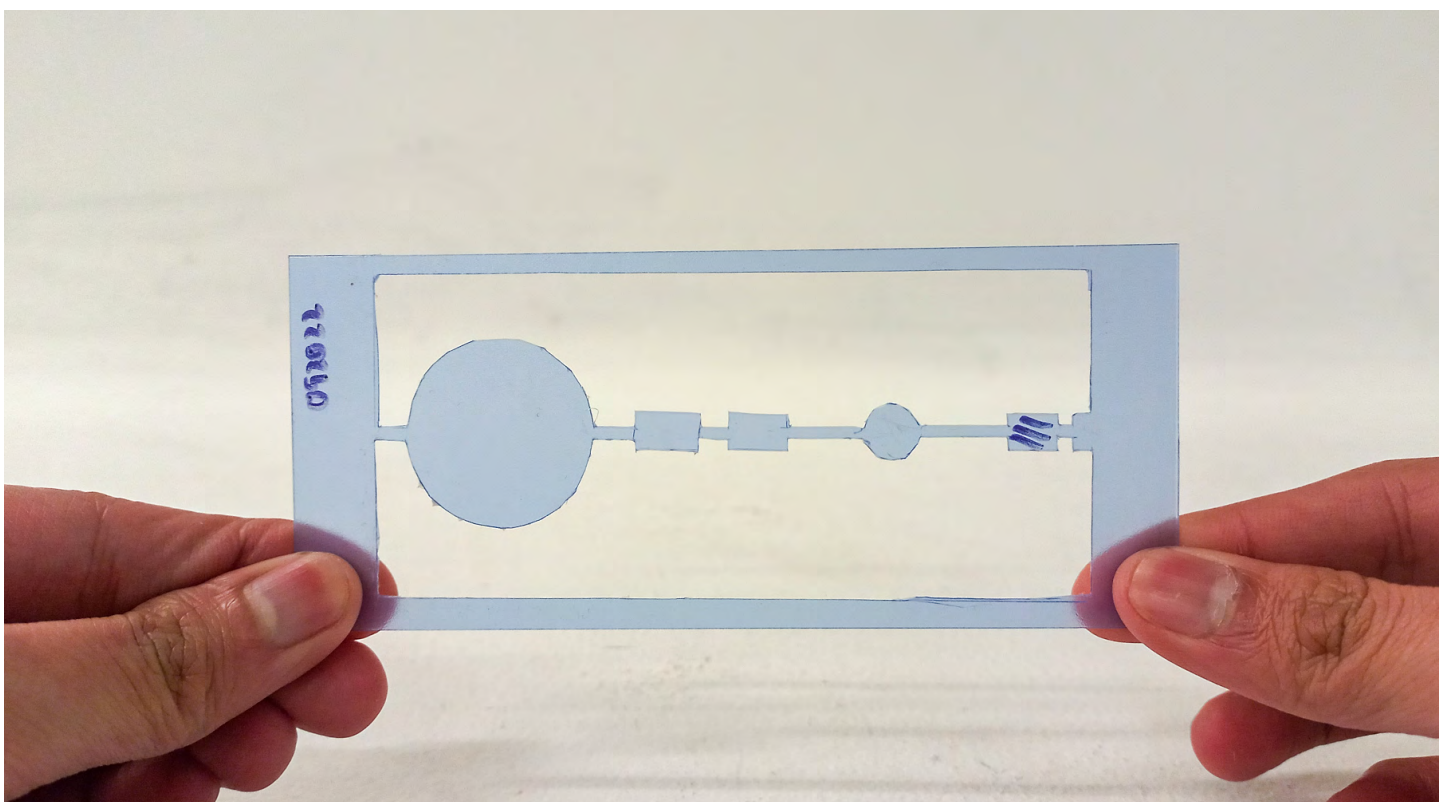


**Figure 4.** Visualization of layered data using transparency, shadows, and lighting.

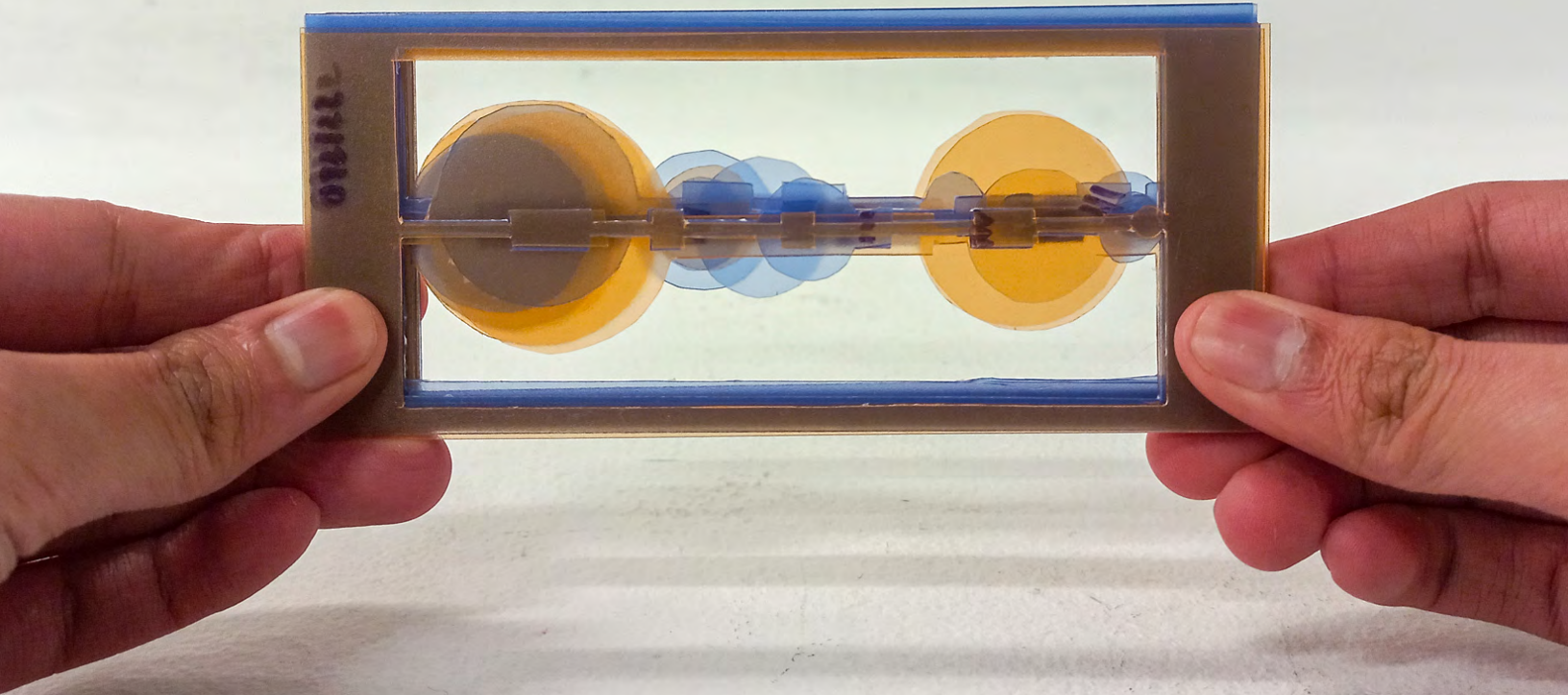




**Figure 5.** Orange card denoting planned schedule.



**Figure 6.** Blue card denoting lived time.



**Figure 7.** Data visualization of stacked daily routines for a week in between two time zones.

Collecting data about one's life becomes a ritual which allows for in-depth awareness and reflection. Through visualization of this information, it further allows a deeper level of connecting with everyday activities (Lupi & Posavec, 2016). This data visualization allowed me to reflect on how I spent my time amidst living in between two worlds, but also made me aware of how taxing adapting to two modes of living felt. Each pair of blue and orange cards reflected a day in the week I recorded. And despite being the same day, with the same tasks, same time, same routine, the unexpectedness of user behaviour due to uncalled for circumstances that would potentially delay schedules was prominent by the erratic sleep and work times recorded.

The feeling of not having any control as to what would be considered appropriate behaviour in contrast to what you are used to is a difficult space to navigate in. In combining all cards into a single stack, I was able to see patterns emerge for the whole week... a rhythm as to how I thought I would act and how I actually did—the contrasting ideas of expected behaviour and those of uncertainty in user responses to various stimuli factors perceived and responded to.

## MOVING IN AND OUT

*“Spaces are produced and reproduced on a daily basis”*

(Moran, 2012)

Public spaces in urban studies are usually discussed through the lens of the diversity of experiences and encounters in the city. There is a prominent focus, however, on public spaces being an appropriation of fixed spaces rather than mobile ones, limiting its scope to the likes of parks, squares, and streets among others. While I may not work in fields such as urban design and urban planning, I have for all of my life taken public transportation, even back home in the Philippines. This caused me to question whether public modes of transportation, the space in which people become a part of an amalgamation of diverse experiences and encounters while transitioning from one place to another, may be considered as a public space. Tuvikene and others claim that public transportation spaces draw people together in physically close encounters in dense populations (2023), becoming a site for everyday multiculturalism (Lobo, 2014) and thereby be considered as a public space.

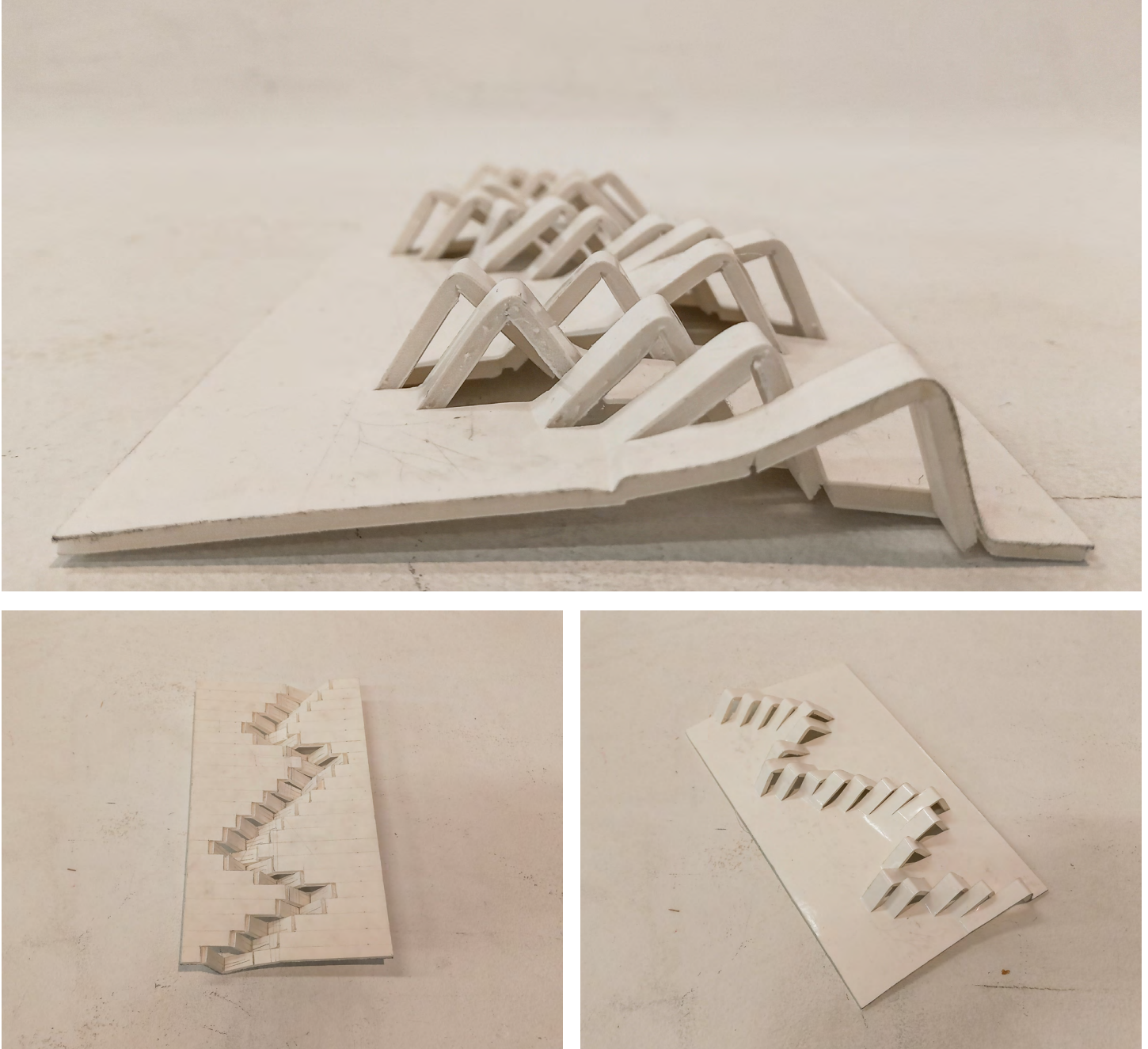
I view public transportation as a public in-between space, a space that one situates in during a transition from one location to another. The act of commuting using public transportation causes one to pass by familiar structures both under the same and different conditions during travel (Edensor, 2012). While public transportation such as trains and buses may quite literally move a person as a means of translation from one space to another, simple passageways such as doors that separate a room from another may also be considered among these public in-between spaces. It is that shifting from one state to another that I would consider as in-between spaces as it describes a movement that becomes second nature in the transition from context to context in the built environment.

To illustrate this transition point, I responded to Lefebvre's concept of *rhythmanalysis* (2013) as a way to view structures as transformative. Through this form study, I visualize Lefebvre's theory of moments (2013) where every moment helps shape who we become, not diluting the meaning of each moment to small granular instances, but rather considering them as part of a greater whole that make up an experience. I visualize this by creating a breaking point, a transition from the foamboard in its flattened state to a three-dimensional one that consists of individual segments that when viewed collectively gives rise to a dynamic form and perception of movement.



*“Everywhere where there is interaction between a place,  
a time, and an expenditure of energy, there is rhythm”*

(Lefebvre, 2013)



**Figure 8.** Form study on rhythmanalysis and moments of transition.

# CHAPTER 04:

## AFFORDANCE IN PRACTICE

In this chapter, I look at the presence of affordances in everyday interactions and investigate how we may use affordances in evaluating cognitive ergonomics of interactive objects. I explore different research-through-design projects supported by literature on affordances to develop a cultural-affordance-based approach to evaluating cognitive ergonomics.

Seeing as there is a difference in the original intention of use of the concept of affordances contrasted with how it is used contemporarily in design, I will look at affordances through analyzing existing objects and the creation of provocation through discursive artefact-making. Affordances can help designers understand unintentional and unexpected responses and behaviour of users when interacting with our designs (Agirachman & Shinozaki, 2021). To make it even better, the concept of affordances has already been embedded in design frameworks since its introduction to the field, thereby simply working with an already established concept will not be too abrupt of a transition in how we might look at the world around us. Through an evaluation of these affordances, designers would be able to better pull out intended affordances and hopefully avoid confusion in users' responses in the interaction with their designs.

I offer a typology of affordances to clarify my approach:

**Affordance as Invitation**

**Affordance as Identity**

**Affordance as Information**



## AFFORDANCE AS INVITATION

Affordances are often used to describe what actions can be done to an object when users interact with them. In doing so, it is highly intertwined with an object's function. With this in mind, I became curious as to how the concept of affordances would relate to the ever prominent phrase of "form follows function" coined by American architect Louise Sullivan (1896). This phrase is a widely discussed and controversial saying in design fields which I believe may have lost its original context and meaning through the years. I would argue that form does not in fact follow function nor does function follow form as they are not dependent to one another. Affordances, however, are form dependent and in this section I look at how the form of objects influences our actions.





**Figure 9.** Traces: Invisible Imprints 3D prints under normal room lighting conditions.

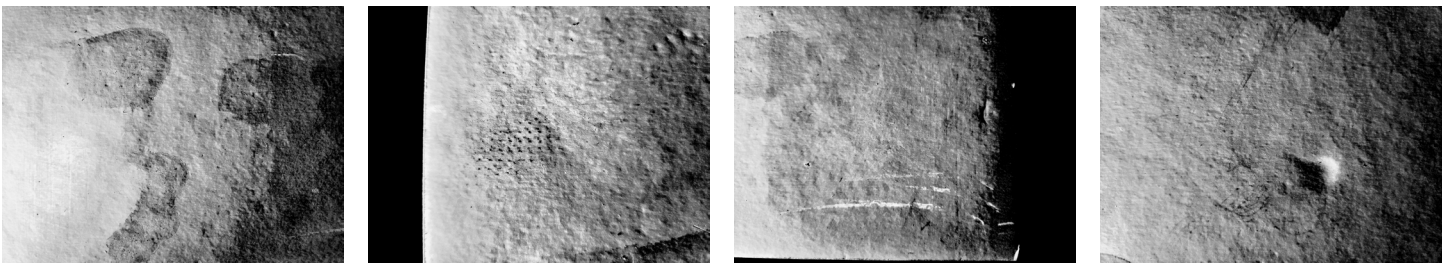
## TRACES: INVISIBLE IMPRINTS

This project sought to investigate whether we are directed to handle objects in ways dictated by how they are structured. As someone who lived in a country where household dishwashers usually meant fellow family members assigned to washing dishes after every meal, the concept of loading dirty dishes in a dishwasher felt foreign to me. I would always hand wash dishes and utensils, and the single-serve blender I got over the summer was no different. I initially observed I was scrubbing and washing the single-serve blender cup differently from how I would usually scrub a normal drinking cup. This was because of the constraints placed by the ridges on the walls of the inside alluding to its nature as a blender. Despite my understanding of why this was important in its structure, it annoyed me a lot as my flow kept on breaking as I engaged with the act of scrubbing and washing it.

With this, I wanted to see how much of actions we actually perform based on subtle influences from an object's form. I 3D printed six cups with different transitioning structures—some with



ridges going from horizontal to vertical, some being long slots with the adjacent side having a grid perforation of circular holes instead, and the like. Having used dishwashing as an activity for research, I made swatch tests to identify what scrubber I would be using to record my actions. I settled on using a silicone scrubber together with the invisible ink to scrub the 3D printed cups to see the direction of my strokes. At first, I was self-conscious about how I would conduct the scrubbing, but after a while I simply let my hands move without thinking hard about the actions being performed.



**Figure 10.** Swatch tests of sponge, paper napkin, steel wool scrubber, and silicone scrubber (from left to right)



**Figure 11.** Traces: Invisible Imprints 3D prints under UV light.



**Figure 12.** Invisible ink scrubbing imprints left on 3D prints under UV light.

In my findings, I saw that in certain instances of transition such as one side having horizontal ridges and the adjacent side having vertical ridges running along its wall, I had switched the direction of my scrubbing to meet the direction of the ridges of each respective side. In doing so, however, I had noticed diagonal strokes near the corner where the two sides meet. This signaled to me that without thinking about it, I was subtly influenced to move according to what my sense of sight the touch could perceive which was the change in direction of the ridges on the cup being scrubbed.

After this project, I was more conscious of how I responded to objects' forms as prompts for action, gaining a heightened observational mindset in all that I encounter as I deconstruct my movements and behavioural patterns in my interactions with objects. I started observing everything my hands would touch and manipulate, be it my phone, washing dishes and utensils, taking out cards from my wallet, and opening doors. Being well informed and observant of the actions we might passively and unconsciously commit will be a valuable asset in designing for interactions, especially with physical objects, seeing as the function of an object might be independent of form, but its affordance is not. As King and Chang describe, it would serve well for designers to be better attuned to their senses especially in the interaction with tangible materials (2016). Deconstructing interactions with objects would allow this heightened awareness through one's senses and develop a sensibility to the nuanced actions we are directed to do based on object affordances.





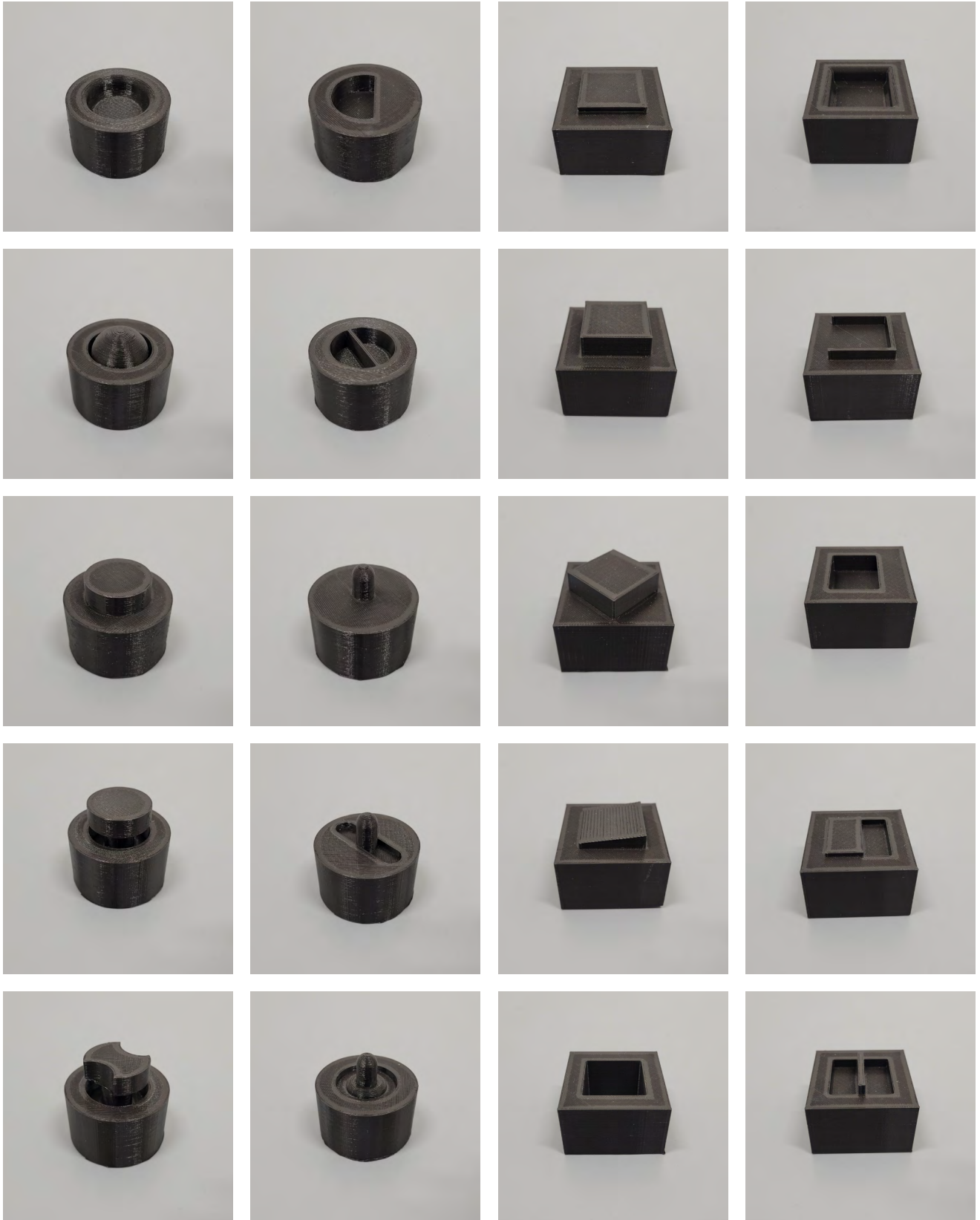
In the Fall of 2023, I was teaching an industrial design studio class and as I gave an introduction lecture on affordances, I wanted to do an in-class exercise to gauge the students' understanding of the topic through the observation of a physical object that they can tangibly hold instead of mere images projected on a screen in front of the classroom. For this reason, I 3D printed a series of switches that are static in nature as I wanted to simply capture their perception of the affordances involved in the objects' forms. My intention was to look at the associated action they would do based on how they would know some familiar structural signifiers commonly found in objects.

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associate it with what they are used to based on personal and individual prior experiences. It was a surprise to me, however, to see that some responded quite differently with the prompt. Instead of simply focusing on the different user interface touchpoints on the surface, some students actually literally took the entire object and manipulated it that way. Some turned a toggle switch upside down and spun it like a top. Some tried fitting pieces together as if they were parts of a set when they weren't meant to do that. Different creative ways of manipulating the objects were seen all throughout the room, taking me aback with how I had intended the objects to be used in the exercise in contrast to how these creative design students had explored virtually all possibilities with these objects.

A system may be capable of possessing a multitude of affordances, but there is still a level of quality that describes how well the system affords the specific use and behaviour (Maier & Fadel, 2009) that would be revealed by an individual's collected knowledge and experiences associated with the object they are interacting with. This observation in the classroom pointed to how much uncertainty there is in the behaviour of end-users that might become unexpected responses towards a designer's intention. In this case, the students were in a social context where they were expected to have grasped a lecture on object affordances about an hour before the activity and may have felt a heightened awareness to coming up with a variety of actions to be performed on the objects to show their newly learned knowledge. They may want to be different from the rest of their peers in their outcomes as the classroom is of a competitive and focused setting where expectations may push some students to think what the instructor may want them to grasp and understand from the activity.

We might be able to design such obvious affordances, and most of the time we might achieve the expected results whenever users would interact with our designs, but there is still the off chance that our designs will be used in different ways compared to how we have envisioned them, especially in densely populated spaces with a diverse range of cultures and mental models of preconceived notions of how things work as one's engagement with objects is shaped by their respective relation to the social context of where the interaction resides. It is dependent on the end-goal of the user that directs their attention to the affordance existing in the interaction to be the most appealing for their use case, otherwise affordance competition may arise to compete for the user's attention.



**Figure 14.** Switch it Up 3D prints.





## AFFORDANCE AS INFORMATION

Information resolves uncertainty as to what actions to perform (Baber, 2022). Assigning meaning to symbols taken from the environment's features become second nature to humans as we store these meaning-making and association from our experiences in our environment. The perception and interpretation of these symbols that aid in informing us of how to go about using and interacting with objects depends on our individual mental models shaped by our experiences. One thing to us may be something else to another despite being the same thing. It is through this familiarity developed through association over time that dictates how we acknowledge certain semantic cues, interpret them, and act according to what we know of them.



**Figure 15.** My brother and I opening a *balikbayan* box.

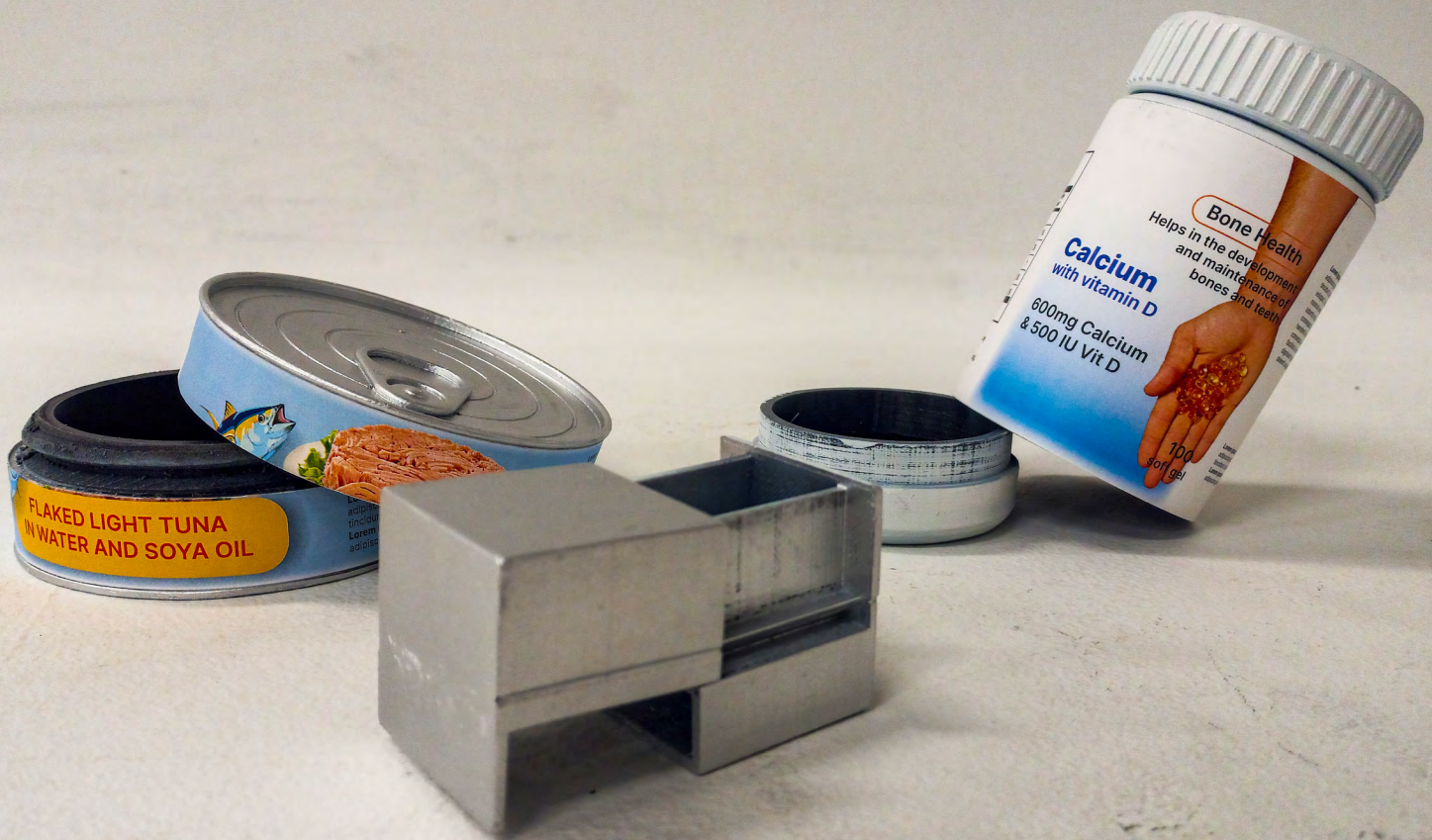
## STRANGE FAMILIARITY

Filipinos have a strong sense of looking back at their homeland and those that they have left behind in the process of searching elsewhere for financial stability to support their families (Basa et al., 2012; Hall & Shelby, 2000). We call them *Overseas Filipino Workers* (OFWs). A prominent gesture OFWs do, aside from helping their families financially, is to ship back home a cardboard box wrapped in packaging tape over and over again filled with consumer goods for their families called a *balikbayan* box. These would usually contain chocolates, clothes, soaps, and gifts that OFWs would slowly collect over the course of months, usually items on sales, and wait for a chance to send them all at once to their loved ones in the Philippines. The feeling of anticipation when expecting a box coming in a few months and of opening it to enjoy new imported goods and items is always a delight for Filipinos, especially young children. This has always been my sentiment whenever my father, who for most of our childhood was an OFW in Dubai, would tell us over a videocall on Skype that we should expect a *balikbayan* box coming



in about two to three months. And while these goods are a part of our culture and show the love OFW parents have for their children, it is still very sad to not have your father physically with you growing up.

Children have their own views regarding a migrant parent's absence due to working abroad (Asis, 2006) and upon sharing our respective experiences and recollections of our childhood, my brother told me that since we grew up with my father already working abroad and only staying in the Philippines for about a month or two a year on vacation, he felt as though it was familiar to him and was not saddened by our father's departure every time as that was perceived to be the norm. I, on the other hand, would feel very excited for his annual arrival but then saddened during his departure. Whenever he'd come back home for a month or two, however, I found myself a bit distanced for the initial few days as I do not know how to interact with him again before easing up to show my comfortability. This exemplifies the feelings of a strange and awkward interaction—a strange familiarity—between migrant parents and their children whenever they would reunite (Arguillas & Williams, 2010) as well as the viewpoint of the parent-child relationship despite the geographic and temporal distance simply being the usual routine and norm.



**Figure 16.** Strange Familiarity 3D prints opened

People not only perceive geometry, but also try to embody feelings, images, and thoughts in tangible materials (Tuan, 1977) embedding them with their own meaning and interpretations. I wanted to capture this feeling and translate it into my explorations of how prior knowledge and experiences influence the ways we process perceivable affordances through design probes informed by discursive design principles (Tharp & Tharp, 2019). I 3D printed three items that may be found in *balikbayan* boxes: a tuna can, a medicine bottle, and a ring box. I wanted to see how people would react to these familiar objects based on initial perception in contrast to when they finally get to hold and attempt to open them.





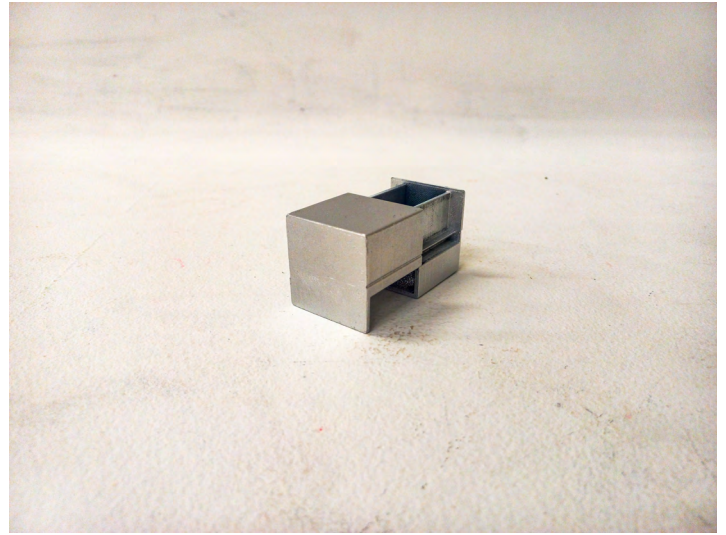
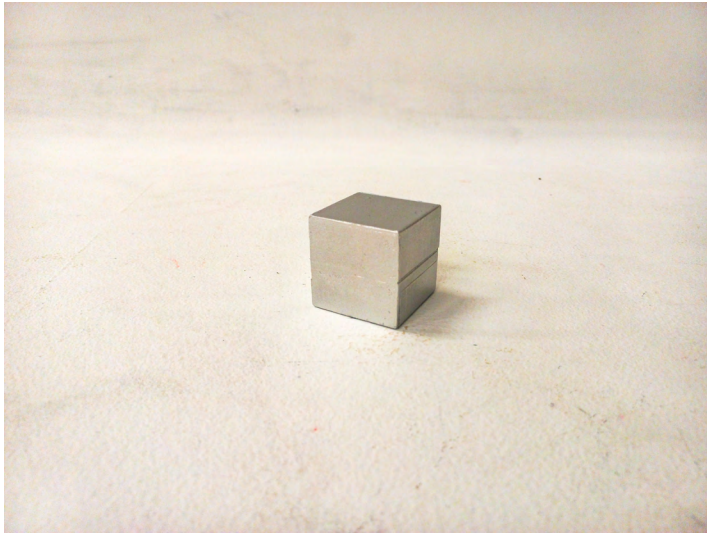
**Figure 17.** Strange Familiarity 3D prints closed.



**Figure 18.** Participants attempting to open Strange Familiarity 3D prints.

For some items such as the tuna can which split right in the middle, it was easier for people to identify how it worked. For the other two, however, it was more challenging due to the fact that the ring box had no signifier at all while the medicine bottle had common signifiers that point to the associated recognized response for people to act. There was initial shock and amazement from participants who tested the artefacts, but they soon voiced the activity to be a weird sensation due to the unfamiliar interaction with familiar objects. Even when they already knew that the three objects wouldn't open the way they are accustomed to, participants still found it frustrating that it wasn't functioning as expected, as what they have associated with the forms before them.





**Figure 19.** Strange Familiarity 3D prints closed (left) and opened (right).

Products affect users and convey necessary information through the interaction with said products (You & Chen, 2007). How we perceive information is dependent on what we are capable of looking for in the search and understanding of elements in the objects we interact with. Gestalt theory (Wertheimer, 1938) looks at how information is perceived through objects, shapes, and forms as wholes rather than separate parts that act independent from one another. The same principle could be applied to the perception of affordances where we perceive the actions that we perform from the collective context of properties objects would convey that corresponds to an associated whole rather than an inspection of the granular. The way one would grip a handle and perform a movement with it would depend on context if they were to be lifting a dumbbell off the ground, swing a tennis racket with a single arm, or if one's arm is perpendicular to the handle at around chest level while pulling a door open. The appropriate action would be based on the context of use that is not only embedded in the singular part (the handle) but its position in relation to the user and other parts of the object as well as the object's other properties that convey a perception and feeling of what can be and can't be done by the user. Looking at communication models and how information is transmitted (Hubel & Lussow, 1984), I likened this to the transmission process of one's interpretation of these signs in objects where a source gives off a stimulus that is received and perceived which then gets interpreted and responded to by means of action, especially in user-interface-object interactions (Sato & Youn-Kyung Lim, 2000).

## PRODUCT SEMANTICS

Intuitive use of objects is always a great objective for every designer. In some cases, however, it may be more crucial than others. When a user may not know how to switch a lamp on in their home, they would have ample time to figure things out based on trial and error through physical inspection and manipulation of the object (Baber, 2022; Wilson, 1999). In some cases, however, we do not have this luxury. In the case of public spaces, especially those of public in-between spaces where people only occupy the space in short amounts of time during their transition from one context to another and where the space is densely populated with unexpected encounters and interactions, concise and clear information in how one might operate an interactive object would be crucial so as to not delay a queue, not be late for scheduled departures, or even just to simply not feel embarrassed in public. One way of relaying clear information of object operations is through the use of product semantics.

While affordances are concerned with the reciprocal nature between user and object which is reflected in the use of physical constraints to limit and facilitate the actions and behaviours one

partakes in through the use of ergonomic and anthropometric data to modify product features, product semantics emphasizes the correct interpretation of signs in the product that leads to the expected and designed way of interacting with it. Designers translate meaning to form through this for the purpose of relating objects to the intended signs the user is to perceive. Product semantics highlight the value of meaning and meaning making. The appearance of objects directly correlates to the user's cognitive responses, emphasizing a back-and-forth communication between object and user.

Product semantics assume users are able to accurately interpret objects' meanings (Baber, 2003). However, what does 'meaning' in this context entail? Humans respond according to their interpretations (Marras & Hancock, 2014) of the conditions being perceived and semantics (Krippendorff & Butter, 1984) helps one interpret meaning that is cognitively constructed mentally in the user's mind based on the information our senses perceive. But despite having a clearer understanding of how to engage with an object through the use of semantics, what would we consider a correct or appropriate way of interpreting these messages?

Seeing as culture influences how we perceive things (Henrich et al., 2010), culture would also therefore influence how we interpret affordances and semantics alike. We would respond differently to a prompt based on how we would have mentally collected our experiences (Lefebvre, 2013) individually and socially which would contribute to building how we perceive and interpret the built environment in our own respective ways.





## AFFORDANCE AS IDENTITY

Identities are said to address and respond to specific social practices they become a part of (“The Role of Objects,” 2021). We play many roles, thus have many identities. The same could be said for objects as well. There are various functional, cultural, social, and symbolic roles objects may take on, depending on the situation that calls for them. And this specificity in culture and social norms of function and use would influence greatly how we might interact with objects. Should something be associated with its use in a specific context, once the context shifts, it may not be applicable to respond the way we are accustomed to.

Lee and others (2017) talk about system properties and human characteristics involved, describing the system, cognitive, physical, and social factors involved. I framed this in the interaction with objects in a given environment to the human factors acting on them that turn into social and culture-specific norms for how to engage with them. Social and cultural affordances (de Carvalho, 2020; Ramstead et al., 2016; Rietveld et al., 2019) are formed through the association of a certain behaviour and action to a stimuli that is recognized by a specific locale of context. While the former focuses on influencing how individuals interact in a space with each other, the latter helps shape how individuals would come to interpret and make meaning from signs within their cultural context. These affordances become prominent especially in the public domain. A space is appropriated into a place, a social context, when endowed with human interactions at a certain time (Sulzmann, 2014). Collective knowledge and familiarity of a locale is made up of repeated experiences by people in that environment (Merleau-Ponty, 1996; Tuan, 1977).

## FILIPINO TIME

In the Philippines, we have an expression called “Filipino Time” which refers to the culture of not being on time and simply accepting it as such. While other cultures may have their own variations of this concept in their own regions, the generalization that Filipinos don’t ever come on time to gatherings and events may be traced back to the Spanish colonization centuries ago that attributed the tardiness of the upper class to evoke a sense of priority to an event. While accounts for this may or may not be justified so as to say that the concept of Filipino Time is true, Filipinos nowadays are more and more becoming tardy, not by choice, but rather due to heavy traffic congestion and inefficient public transportation.

Public transportation is a crucial part of the country’s activities and heavy traffic congestion is already associated by Filipinos to describe the everyday environment we live in, needing to allocate extra lead times to arrive at their destinations ‘just in time’. Metro Manila topped the 2023 TomTom Traffic Index among metro areas across 55 countries with the slowest travel time in traffic (TomTom Traffic Index, 2024; Yu, 2024). With this in mind, the culture formed by the social and cultural practice of tardiness due to heavy traffic congestion—the in-between space that Filipinos dread lingering too long in—develops into cultural and social affordances, becoming the norm.







**Figure 20.** Bus 84 stop at VCC-Clark station.

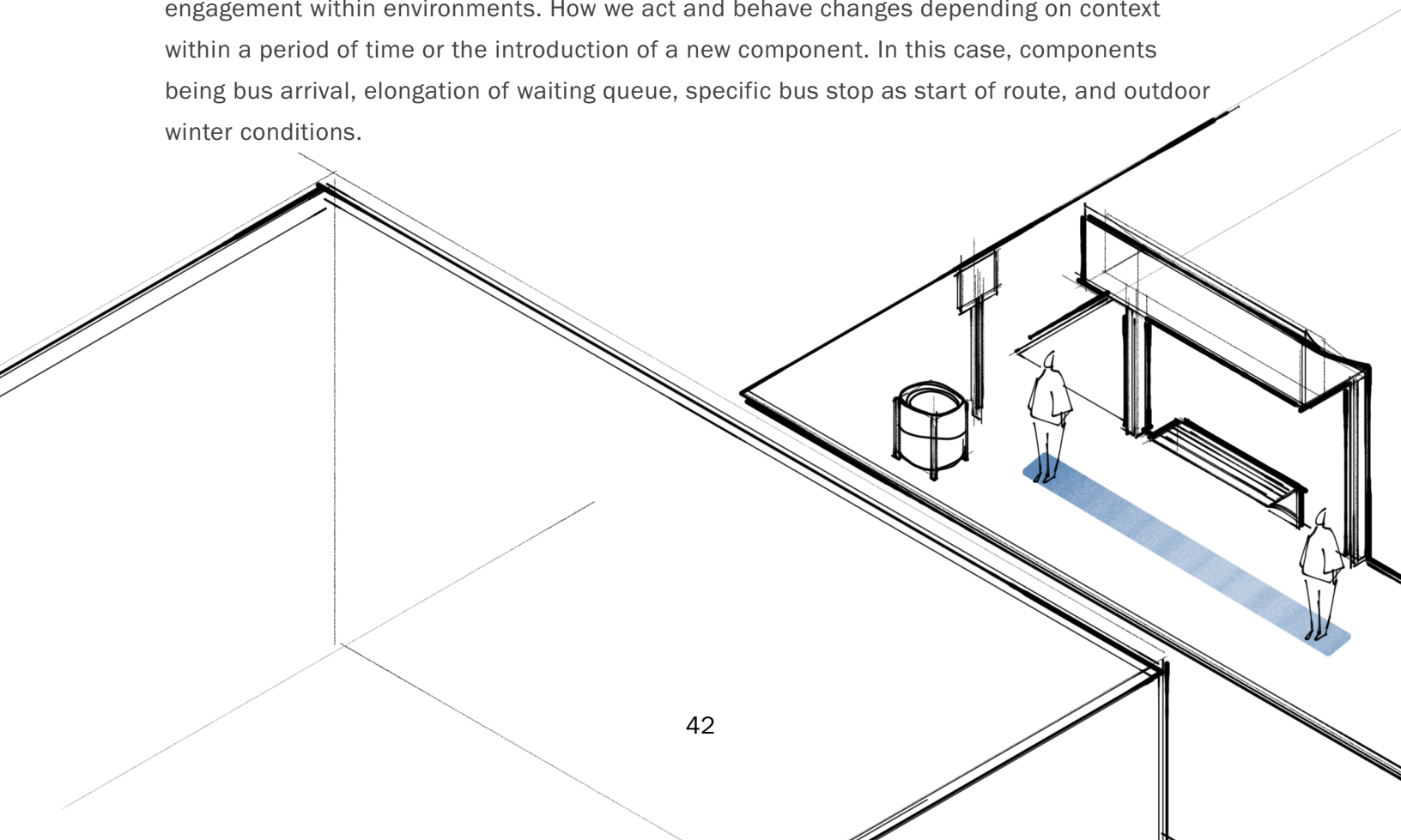
## SOCIAL COORDINATION

In contrasting public transportation in the Philippines that generally would take one an average of 25 minutes and 30 seconds to travel ten kilometers (TomTom Traffic Index, 2024), a prominent observation of difference I noticed upon coming to Vancouver is that public transportation can actually be measured based on set schedules for departure and arrival. This is unlike the erratic time of waiting for a bus or jeepney under the scorching heat back in the Philippines. With this in mind, I looked at how people behaved and interacted in this in-between space in the context of Vancouver.

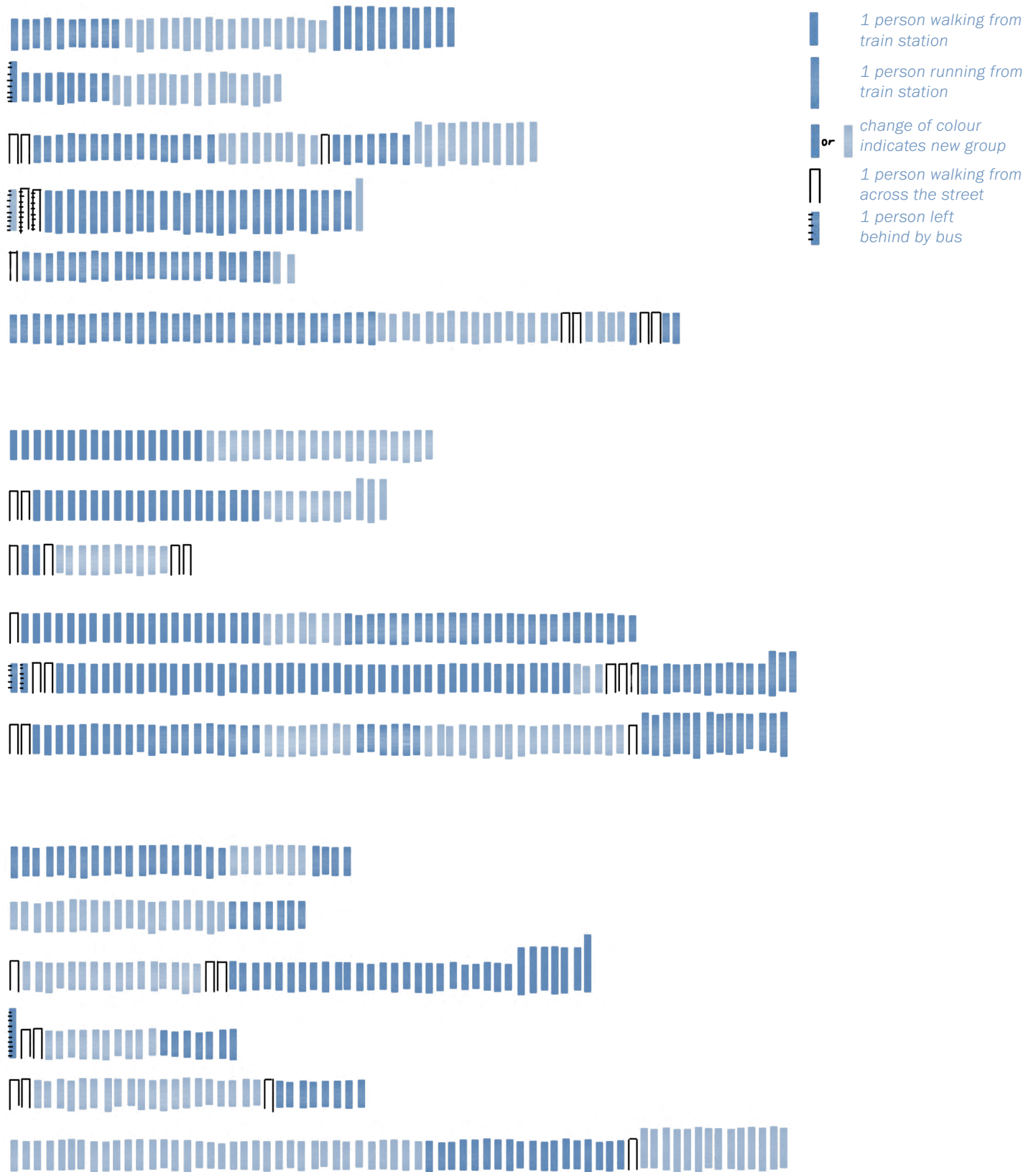
Amidst the snowy winter, I stood in front of the bus 84 stop in front of the VCC-Clark train station which I pass by almost everyday in my transit from home to school for three days, an hour each. I observed the interaction and behaviour of people in that particular space—with respect to the length of the queue of people, distance from the bus number post, exit gates of the train station, and the bus itself—focusing on the transitioning of people from exiting the train station to getting on the bus 84. I paid great attention to the number of people that extended physically the queue at the stop and the presence of the bus, accounting for the scheduled bus arrival time interval.

Physicalizing the data gave a better understanding of situating the pattern of foot traffic to bus interval estimation through people's behaviour in context to the space, perceivable and understood as a form of agreed social coordination. People stayed calm and collected in a slow pace when the bus isn't there yet. They would casually still pace their walking when the bus wasn't there but would take shortcuts in the route to the queue whenever the line had already exceeded a certain distance from the start of the queue. And lastly, people were of great emotions trying to catch the bus whenever they see the bus in place to board in fear of being left behind. For those who had ran but were left behind by a hair of a second, they were evidently upset as they would need to wait for the next bus in the morning winter cold.

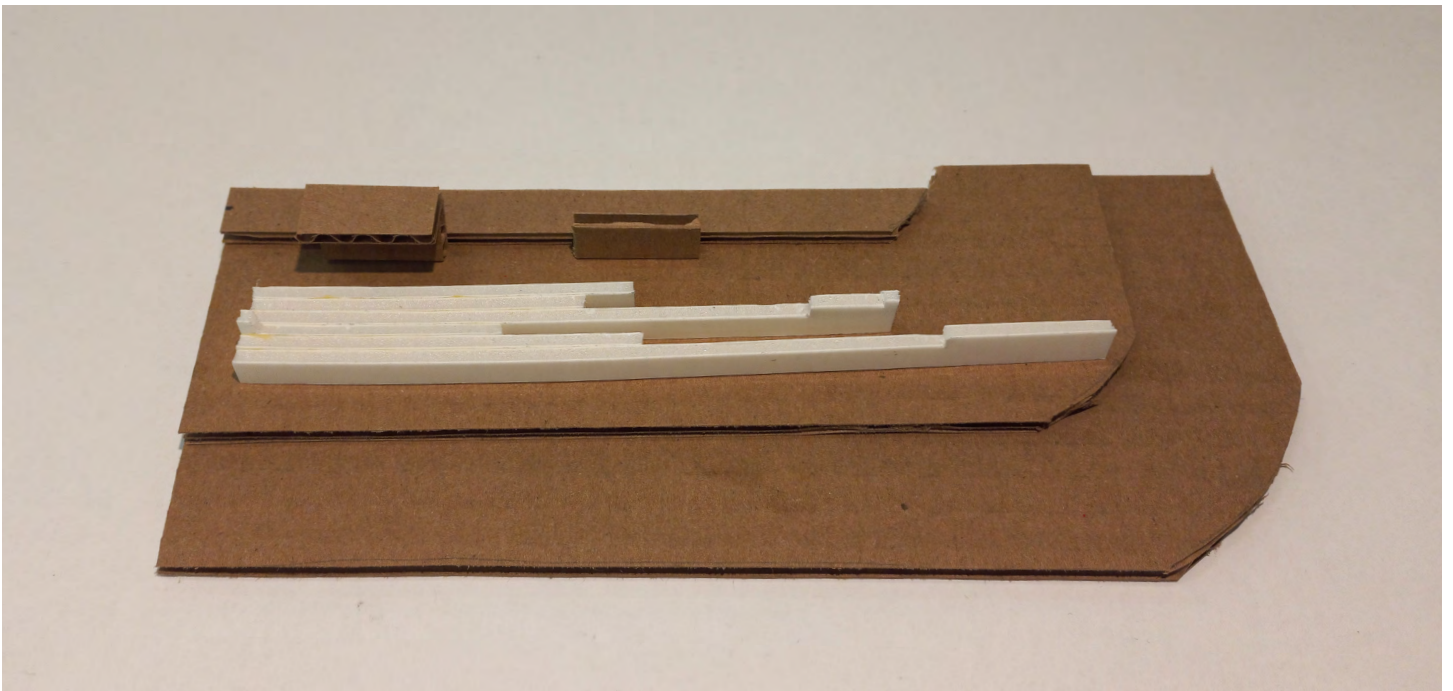
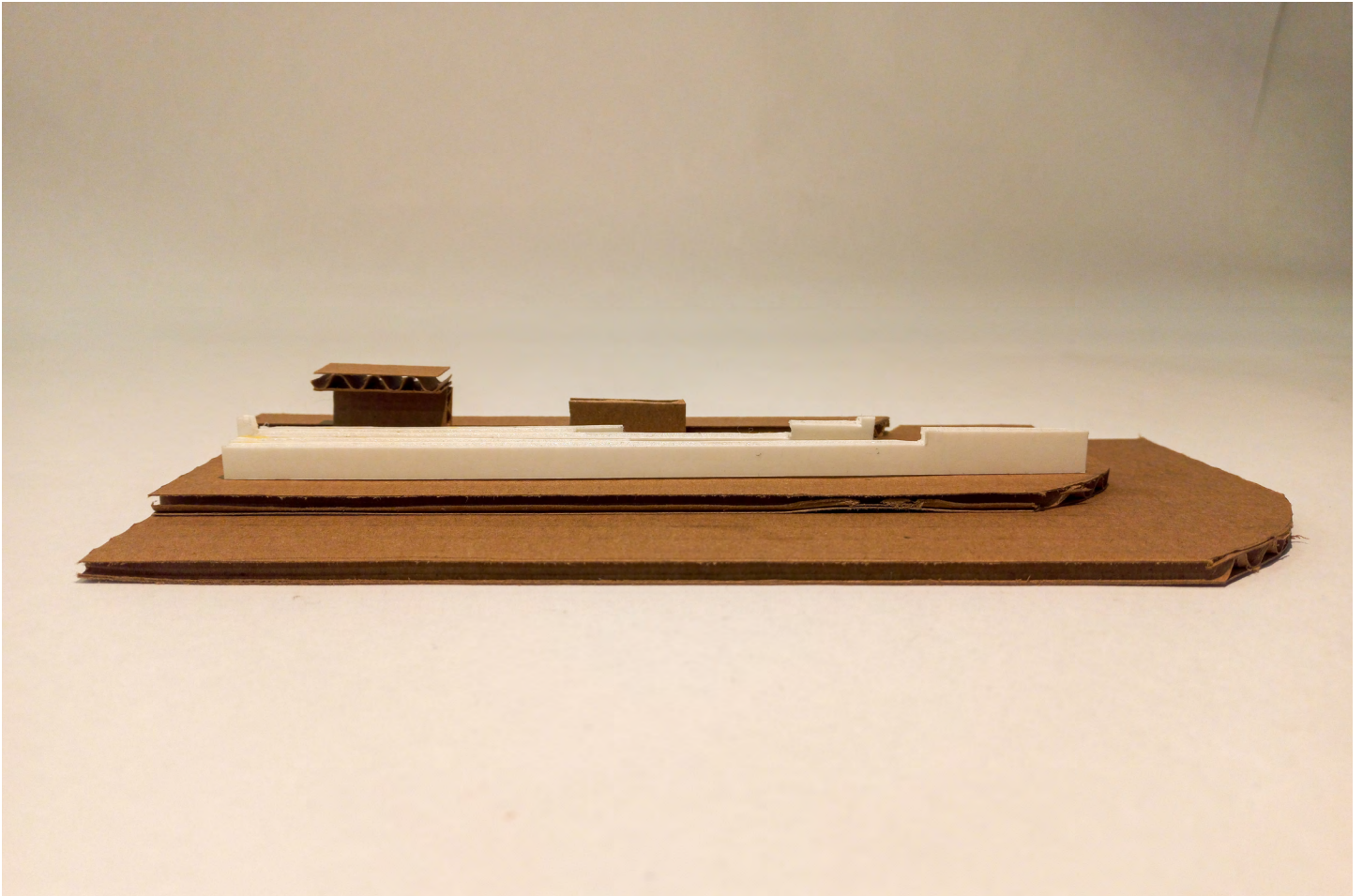
This case illustrates how social coordination and understanding become the norm in our engagement within environments. How we act and behave changes depending on context within a period of time or the introduction of a new component. In this case, components being bus arrival, elongation of waiting queue, specific bus stop as start of route, and outdoor winter conditions.





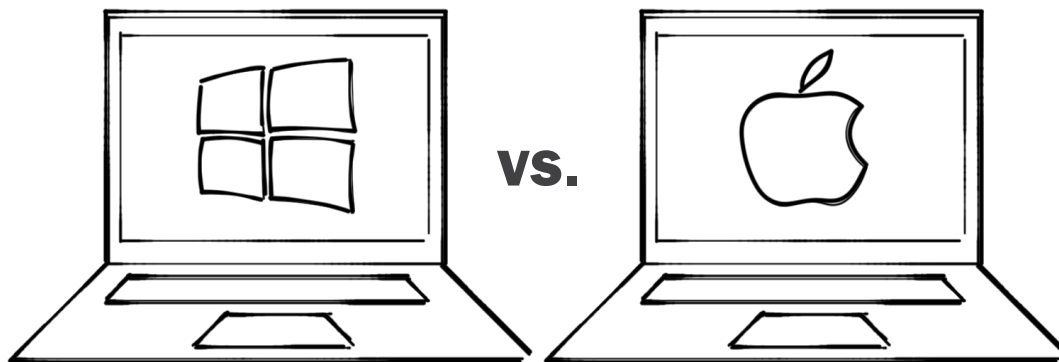


**Figure 21.** Bus interval recordings for three days.



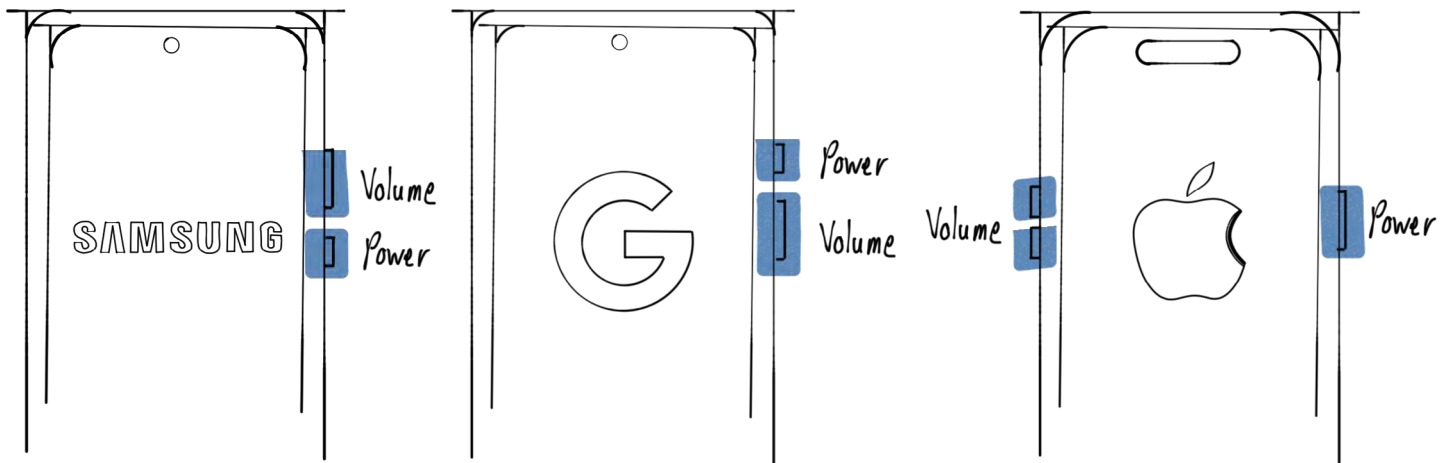
**Figure 22.** 3D Data Physicalization of passenger foot traffic in different bus intervals.

This context-driven behavioural response is particularly evident in product ecosystems that run the world of consumer electronics. The limiting of accessibility and the designing for exclusivity results in an association of behaviour and action to a specific tool and an imminent confusion when utilizing the same tool but for a different product ecosystem—a different culture altogether.



**Figure 23.** Illustration of Windows (left) and Apple (right) computers.

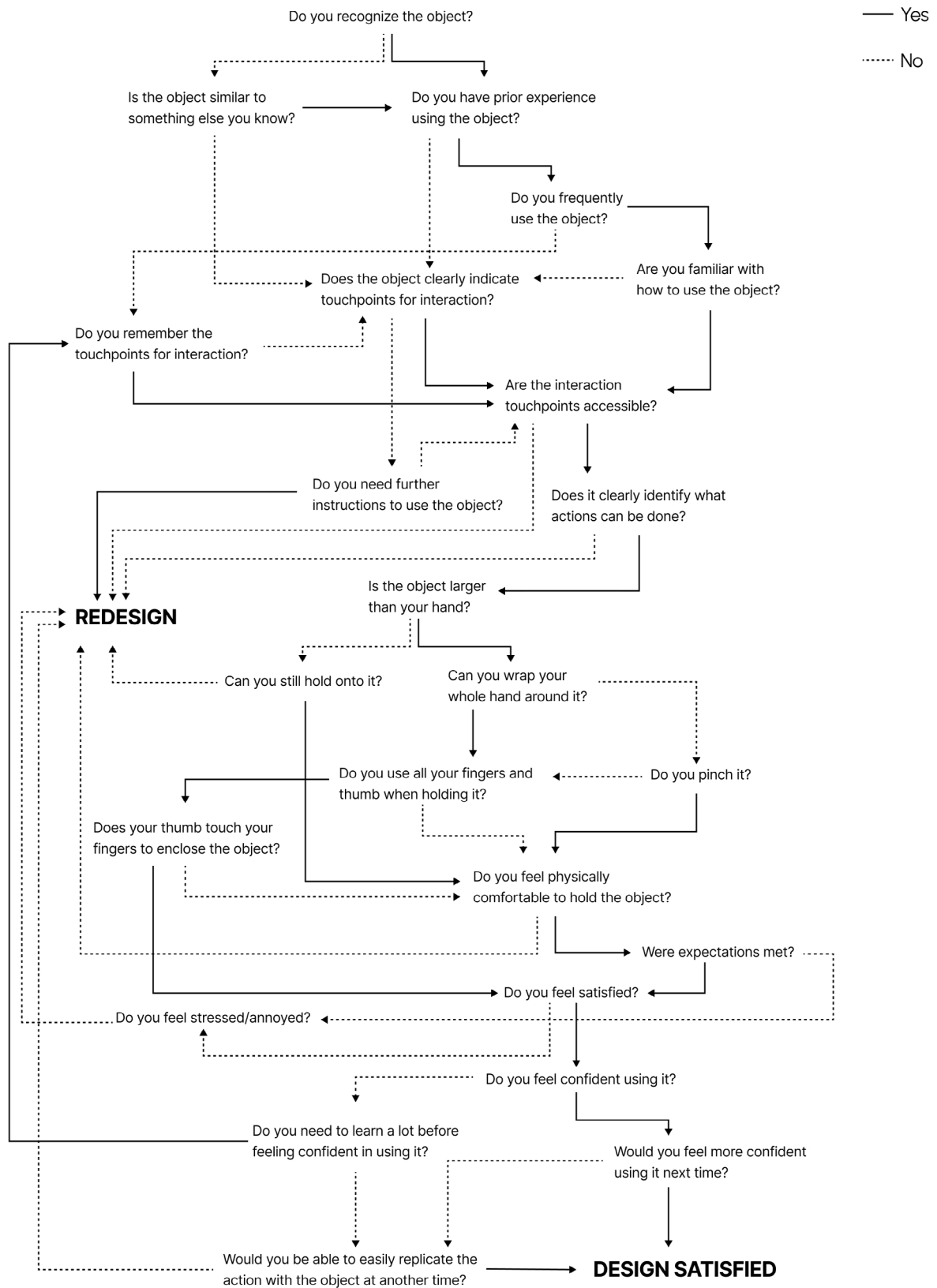
Take for example the difference in the keyboard and trackpad interface of a Windows laptop and an Apple Macbook. I, as a Windows user all my life, found it challenging at first to make use of Mac computers in the library at school. Upon asking some of my peers who are avid Apple users to try and conduct tasks on my Windows computer, they were able to accomplish the task goals I had asked of them to do, albeit not through the use of common shortcuts. They took a long time trying to manually find the tools in the toolbar and significantly took a longer time than they would on a Mac, evidencing a real-life application of the findings in *Strange Familiarity* that was aforementioned in the previous section.



**Figure 24.** Illustration of Samsung, Google Pixel, and iPhone side buttons.

In comparing a Samsung, Google Pixel, and iPhone to one another, the simple placement of buttons on their sides would result in some confusion and annoyance whenever users would press a different button from the action they were trying to accomplish due to their recognized response in their respective product ecosystems.

With these in mind, I devised a binary flow of yesses or noes to act as a reflective tool for evaluation (see Figure 23). It was informed by Baber's Recognition-Primed Decision Making (2022) and exploits the sense of familiarity (Dourish, 2004) to assume how it works and how to interact with it. In mapping out this flow of questions, I found that it would be difficult to create a binary evaluation for very nuanced scenarios of interactions. Instead of developing an approach to standardize actions based on affordances due to the numerous possibilities of interactions especially in varying social contexts, I move to looking at how we might evaluate understanding based on what affordances emerge from our perception and cognition.



**Figure 25.** Binary reflective framework.



# CHAPTER 05:

## ROLE OF DESIGNERS

Now I ask, what the role of designers would be in the facilitation of this communication between users and objects? In this chapter, I seek to create a designer's approach in evaluating the cognitive ergonomics of interactive objects to better understand potential problems that users may face when interacting with one's designs.

With the shifting roles of Industrial Designers nowadays, I view our roles as not being people who dictate how users should use designed objects and systems, but rather as facilitators of the communication between users and objects in their interaction. The same way as how we behave differently when around different people in our lives, the same could be said true for objects. Unexpected responses and exploration of various actions possible to be done will be out of the scope of a designer's work as it will be heavily based on everyone's unique personal experiences and background. However, as designers—as facilitators and mediators—we have the responsibility to present our intention while not limiting how users are to build meaningful relationships with the things they use and interact with.



# TAXONOMY OF AFFORDANCES

Several scholars have tried to create a taxonomy of affordances, looking at several similar and different factors involving the interaction of user and object.

SCHOLARS	TYPES OF AFFORDANCES
(Norman, 2013)	Perceptible Affordances Hidden Affordances
(Gaver, 1991)	Sequential Affordances Nested Affordances
(Raubal & Moratz, 2008)	Physical Affordances Mental Affordances
(Scarantino, 2003)	Goal Affordances Happening Affordances
(Maier & Fadel, 2009)	Artefact-User Affordances Artefact-Artefact Affordances

**Table 1.** Taxonomy of affordances by different scholars.

The most common categorization comes from Norman (2013) who categorizes affordances as those *perceptible* and *hidden* from users. Gaver (1991) introduces *sequential* affordances which allow for affordances to be revealed over time and *nested* affordances that group affordances in a space.

Direct interactions between users and objects are categorized as *physical* affordances while *mental* affordances are described as internal operations such as deciding, remembering, calculating, and thinking (Hu & Fadel, 2012; Raubal & Moratz, 2008).

Scarantino (2003) describes affordances as *goal* affordances which represent what the organism does and *happening* affordances which entail what happens to the organism. This way of categorization creates directionality of subject and object in the interaction and the entailing affordances present in said interaction.

Hu and Fadel (2012) redefined Scarantino's *goal* affordances to *doing* affordances as the change in terminology would clearly define the actual manifestation of the affordance rather than the mental process of users to enact the affordance.

Lastly, Maier and Fadel had differentiated two distinct types of affordances based on the bodies interacting in the context of use (2009). *Artefact-User Affordances* (AUAs) express the interactive relationship between artefact and user where the resulting behaviour and use could not manifest for one without the presence of the other. The affordance in this case is a kind of interaction, and not the act itself. In *Artefact-Artifact Affordances* (AAAs), the affordances present describe the interaction of artefacts among other artefacts without being dependent on human intervention and manipulation. Artefact-artefact affordances are usually designed in such a way to fulfill artefact-user affordances as the end goal.

With these, I asked two participants to interpret what they think an object is and what its use is based on their sensory perception aside from sight. While they voiced out their tactile exploration of different objects, a spray bottle, USB flash drive, and rubbing ointment, four people were tasked to be notetakers. Two of which were carefully observing the users' actions, while the other two were observing the objects' actions. This provided insights onto the communication between user and object as separate interactive entities.

I then tried to break up these interactions with the three objects by dissecting the affordances present in them using Maier and Fadel's as well as Scarantino's categorizations. I have also made use of the subject + verb phrase + object structure in identifying the affordance statements of each entry. This helps to articulate the directionality and relationality mentioned in Scarantino's categories. In these cases of analyses, I found that deconstructing the different interactions between interactive entities and the respective affordances they are conducting or being conducted on themselves allowed one to think more about the components that are involved in the design parameters of the objects as there is a relationship between affordances and the design parameters of an objects' overall structure that are mitigated by the designer through constraints used in orienting and refining actionable possibilities in an interaction (Chen et al., 2022).

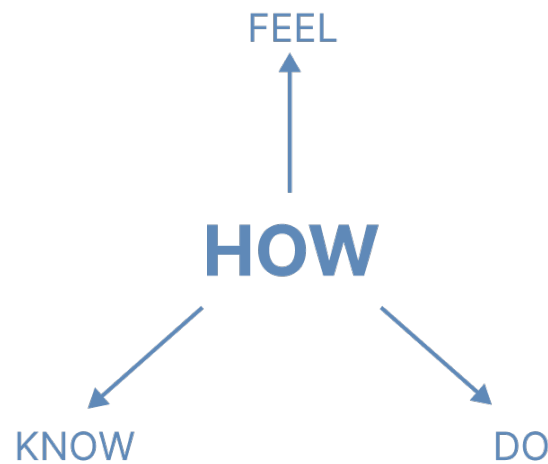
Interactive entities	Maier & Fadel's categorization	Scarantino's (modified) categorization	Affordances (subject + [verb] + object)
bottle → liquid	AAA	Doing	Bottle holds liquid
liquid → bottle	AAA	Happening	Liquid is held in bottle
user → bottle	UAA	Doing	User picks up bottle
user → bottle	UAA	Doing	User grips bottle
user → spray head	UAA	Doing	User positions finger on spray head
user → spray head	UAA	Doing	User presses down on spray head
spray head → bottle	AAA	Happening	Spray head is pressed down on bottle
spray head → spring	AAA	Doing	Spray head compresses spring
liquid → tube	AAA	Doing	Liquid travels through tube
liquid → spray head	AAA	Happening	Liquid is released from spray head
user → spray head	UAA	Doing	User lifts finger from spray head
spray head → user	UAA	Happening	Spray head is released by user
spring → spray head	AAA	Doing	Spring pushes spray head upward

Interactive entities	Maier & Fadel's categorization	Scarantino's (modified) categorization	Affordances (subject + [verb] + object)
user → case	UAA	Doing	User picks up case
lid → case	AAA	Happening	Lid is held in place by case
user → lid	UAA	Doing	User rotates lid
lid → case	AAA	Happening	Lid is rotated on case
lid → case	AAA	Happening	Lid is removed from case
user → ointment	UAA	Doing	User smells ointment
user → ointment	UAA	Doing	User sees ointment
user → ointment	UAA	Doing	User scoops ointment
ointment → user	UAA	Happening	Ointment is scooped by user
user → ointment	UAA	Doing	User rubs ointment on skin
ointment → user	UAA	Happening	Ointment is spread on skin by user

Interactive entities	Maier & Fadel's categorization	Scarantino's (modified) categorization	Affordances (subject + [verb] + object)
user → case	UAA	Doing	User grasps case
case → user	UAA	Happening	Case is enveloped by user's hand
user → case	UAA	Doing	User pinches (holds) case
keyring → case	AAA	Happening	Keyring is attached to case
user → keyring	UAA	Doing	User flicks keyring back and forth
user → keyring	UAA	Doing	User pinches (holds) keyring
cap → case	AAA	Happening	Cap is held in place by case
user → cap	UAA	Doing	User pulls off cap
cap → flashdrive head	AAA	Doing	Cap covers flashdrive head
flashdrive head → cap	AAA	Happening	Flashdrive head fits inside cap
flashdrive head → case	AAA	Happening	Flashdrive head is attached to case
user → cap	UAA	Doing	User pushes cap in place

**Figure 26.** Three cases of breaking down an interaction based on affordances.

## EVALUATION CRITERIA



**Figure 27.** Interaction design framework by (Verplank, 2009).

Bill Verplank diagrams interaction designers' train of thought when designing for people's physical and emotional needs together with their ever-increasing intellect through asking "How do you DO?", "How do you FEEL?", and "How do you KNOW?" (2009) seeing as even the simplest of appliances require an understanding of the three points of consideration in design. Through this framework, I identify the physical, mental, and affective responses of an individual to be crucial points of consideration in interaction design.

I annotated the System Usability Scale (SUS) and the NASA Task Load Index (NTLI) (Li-Wang et al., 2023), a usability metric scale and assessment tool used in measuring perceived mental workload respectively, having been informed by Verplank's framework of doing, feeling, and knowing. I contrasted the criteria identified from my annotations of the test metrics as well as an outlined list of affordance properties (Hsiao et al., 2012) with cognitive ergonomic criteria established by prior studies (Zhang et al., 2019). With this, I devise my own set of criteria to evaluate the cognitive ergonomics of interactive objects through the use of a sliding scale.

Name	Task	Date
------	------	------

**Mental Demand**  
*KNOW*

**Physical Demand**  
*DO*

**Temporal Demand**  
*FEEL/DO*

**Performance**  
*DO*

**Effort**  
*DO*

**Frustration**  
*FEEL*

How mentally demanding was the task?  
*understanding what to do*

How physically demanding was the task?  
*associated action (motor engagement)*

How hurried or rushed was the pace of the task?  
*temporal conditions of task to completion*

How successful were you in accomplishing what you were asked to do?  
*succession of a task*

How hard did you have to work to accomplish your level of performance?  
*amount of physical/mental workload*

How insecure, discouraged, irritated, stressed, and annoyed were you?  
*(satisfaction) resulting affect after the task*

Very Low
Very High

Figure 28. Annotations of the NASA Task Load Index.

### System Usability Scale

© Digital Equipment Corporation, 1986.

1. I think that I would like to use this system frequently  
*Potential frequency of use*
2. I found the system unnecessarily complex  
*Complexity*
3. I thought the system was easy to use  
*Ease of use*
4. I think that I would need the support of a technical person to be able to use this system  
*Complexity*
5. I found the various functions in this system were well integrated  
*Ease of use*
6. I thought there was too much inconsistency in this system  
*Complexity*
7. I would imagine that most people would learn to use this system very quickly  
*Ease of use*
8. I found the system very cumbersome to use  
*Complexity*
9. I felt very confident using the system  
*Complexity*
10. I needed to learn a lot of things before I could get going with this system  
*Complexity*

*S - satisfaction  
EF - effectiveness  
EX - efficiency* ] *usability*

Strongly disagree      Strongly agree

1 2 3 4 5

1 2 3 4 5

1 2 3 4 5

1 2 3 4 5

1 2 3 4 5

1 2 3 4 5

1 2 3 4 5

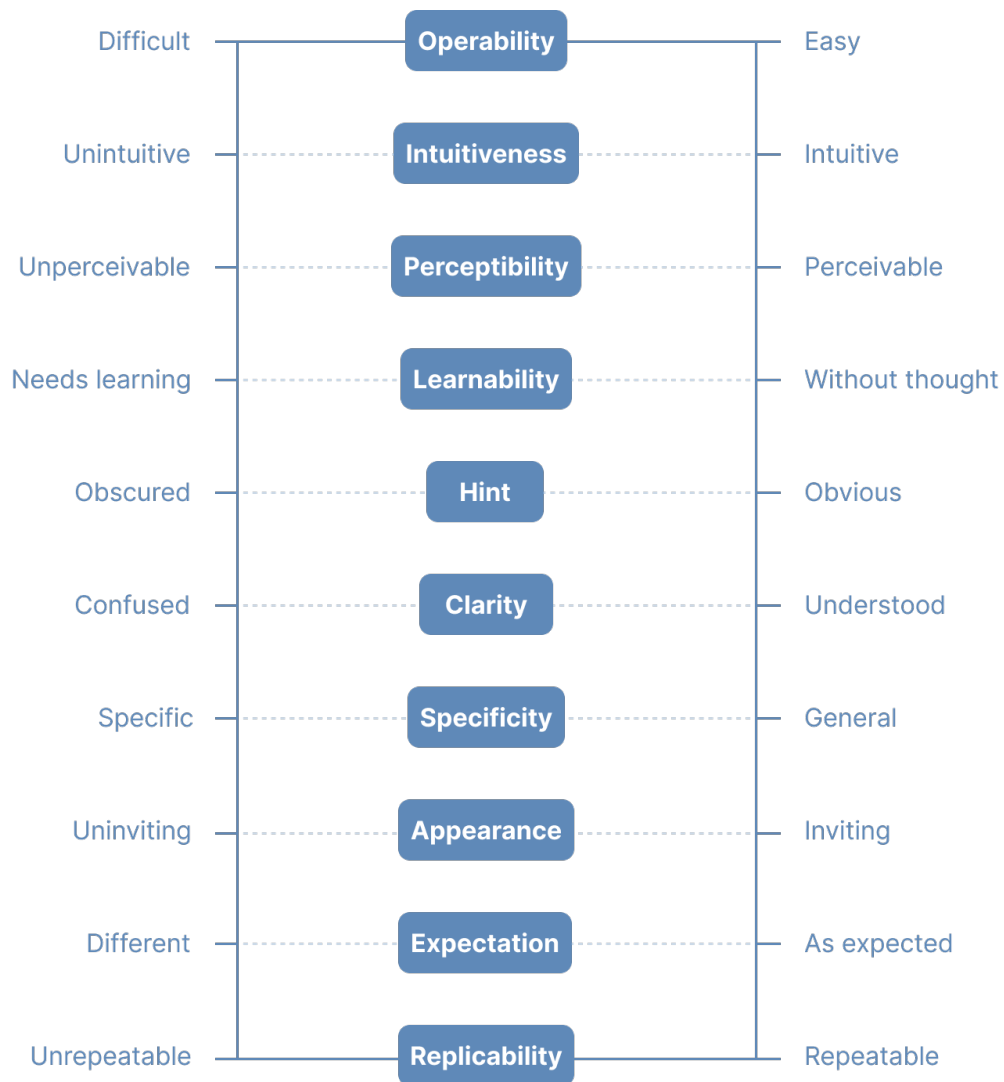
1 2 3 4 5

1 2 3 4 5

1 2 3 4 5

Figure 29. Annotations of the System Usability Scale.





**Figure 30.** Cognitive ergonomics evaluation scale.

This scale consists of ten criteria for evaluation, informed by usability metrics, affordance properties, and cognitive ergonomics criteria from other studies. The listed ten criteria for evaluation are as follows:

**Operability.** How easy is it to operate?

**Intuitiveness.** How intuitive is it?

**Perceptibility.** How perceivable are the possible actions to be performed on it?

**Learnability.** How much prior knowledge is needed to operate it?

**Hint.** How much of the operational actions are hinted solely based on the function of the object?

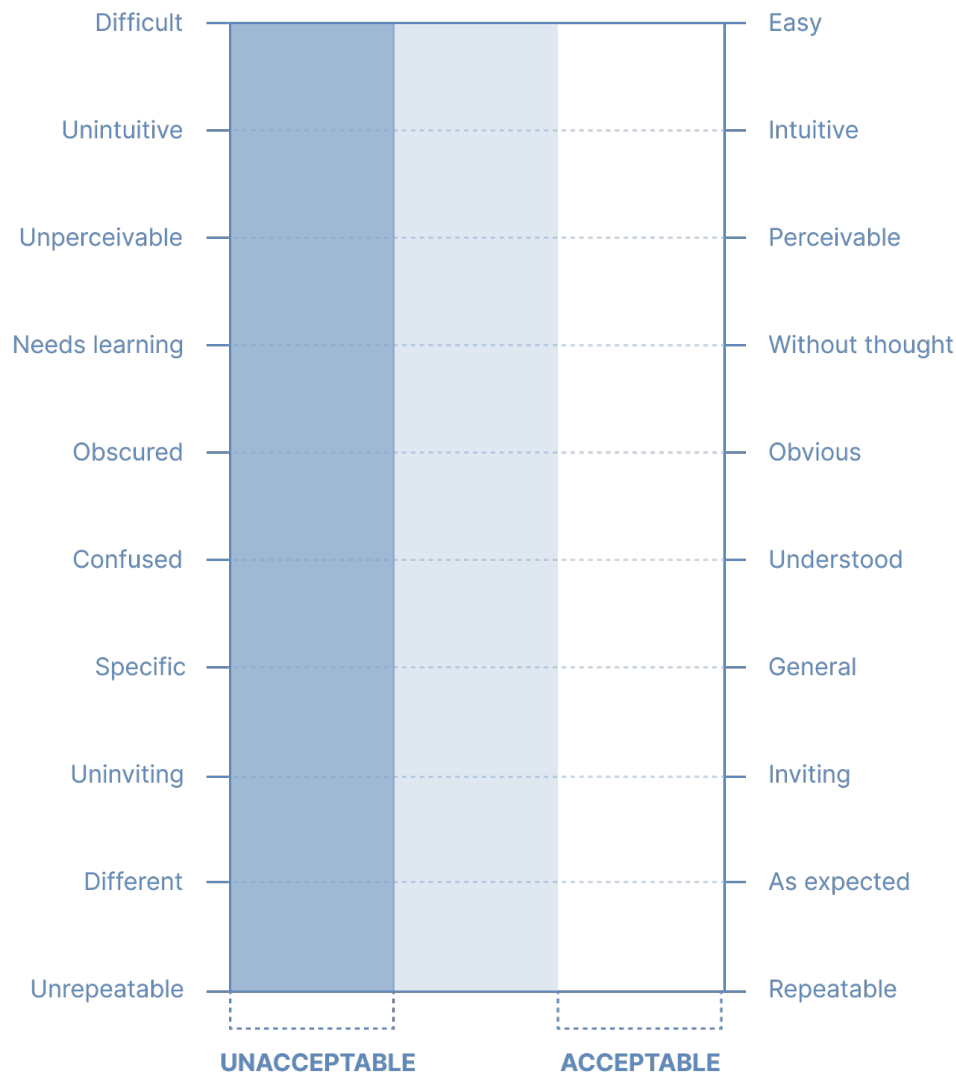
**Clarity.** How clear is the information on its operation?

**Specificity.** How specific is the operation to this particular object?

**Appearance.** How much influence does the appearance of the object affect knowing what actions to perform?

**Expectations.** How much of a match is the operation of the object to that of one's mental model?

**Replicability.** How confident is one to repeat the operational tasks to be performed on the object without additional assistance?



**Figure 31.** Interpretation of the cognitive ergonomic evaluation scale.

Looking at the scale as a visual representation of a decision matrix, which consists of possible responses being a 1, 0, or -1 depending on the affirmation or negation of the criteria defined, allows one to divide the evaluation scale into three equal parts to represent the three outcomes—unacceptable, acceptable, and a middle ground that is undefined. As the purpose of the evaluation is primarily a thinking tool with which designers may evaluate an interactive object system using the listed ten criteria as a way of rethinking potential design recommendations for improvement, benchmarking them with other products, or as a positioning tool for the design and creation of an interactive object system with the defined levels based on the criteria, it is worth noting that not all criteria on the scale may be appropriate and needed to be met in certain scenarios such as when a designer is deliberately trying to disrupt or change behaviour through provocation to challenge users' expectations.

# CHAPTER 06:

## DESIGN APPROACH

With all the explorations conducted in order to understand the role of affordances in the evaluation of cognitive ergonomics, I now propose a Cultural-Affordance-Based Approach to Cognitive Ergonomics Evaluation, which I appropriately dub as D.O.O.R. This would allow Industrial Designers to assess cognitive ergonomics across broad applications, however, I will be using it in this research to evaluate interactive objects in public in-between spaces. The approach is divided into the following stages:

**DECONSTRUCT**

**OBSERVE**

**ORIENT**

**REFINE**

# D.O.O.R. EVALUATION

The evaluation approach I propose is appropriately named as D.O.O.R. as a reference to the common use of door handles as examples in affordance studies. The term *Norman Door* (Morgan, 2019) describes a door that incites cognitive friction (Cooper, 2004) regarding understanding if a door is to be pushed or pulled due to the ambiguity of the affordance perceived.

In this evaluation approach, I use affordances as a basis of assessment in order to provide a way of thinking about physical interactions in public in-between spaces to designers who may evaluate existing interactive objects and systems for a redesign or evaluate their own work during the design process.

I will be illustrating each step of the approach in a case study evaluating Translink bus rear doors in Vancouver by means of D.O.O.R. However, I do acknowledge that the four stages of the approach may be used interchangeably in order and would come to inform one another depending on the type of case being evaluated.

## A NOTE ON TRANSLINK BUSES



**Figure 32.** Bus A rear door.



**Figure 33.** Bus B rear door.

There are two different mechanisms for older and newer Translink buses respectively to open the rear doors. These will be dubbed as Bus A and B respectively. The doors of Bus A (left) are opened by pushing on “bars” while the doors of Bus B (right), on the other hand, are opened by being prompted to “touch” the yellow strip on the doors themselves.

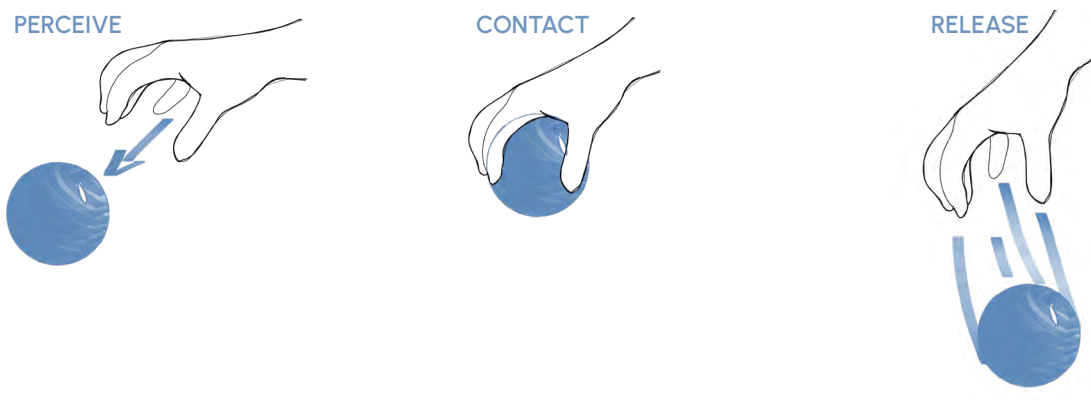


# 1. DECONSTRUCT

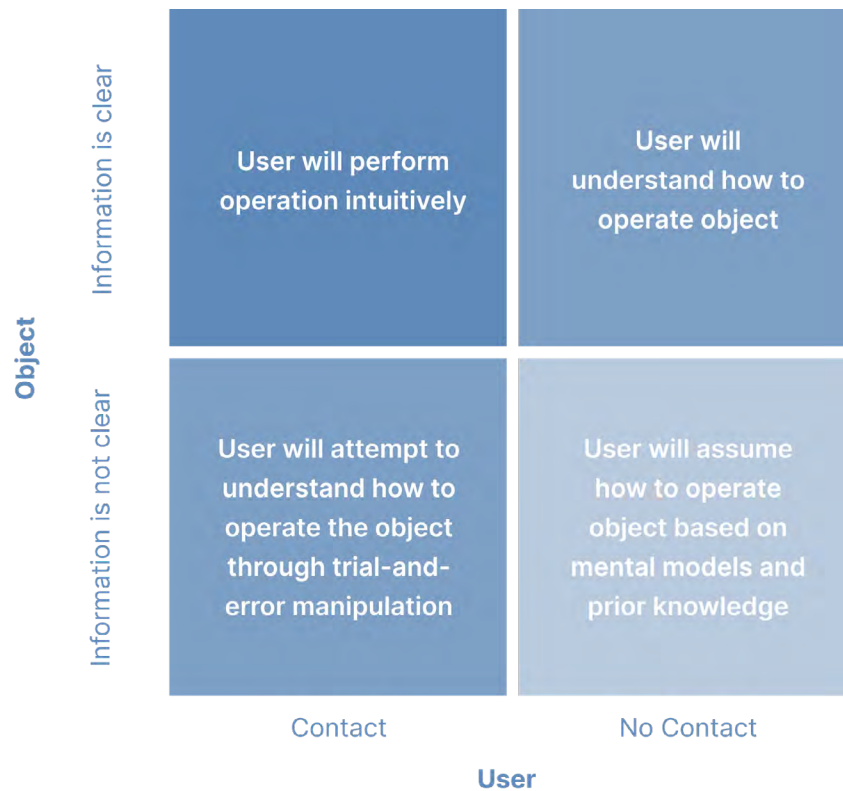
## 1.1 OVERVIEW

Upon referencing Falco and others' structure in describing the pick-and-place task segmentation and transitions of the hand (2018), I offer deconstructing the interaction being evaluated as the first stage of the approach and as an opportunity to segment the overall experience into one contact and two non-contact phases in order to heighten the designer's awareness to nuanced actions and behaviours in an interaction as evidenced in *Traces: Invisible Imprints* where upon reflecting on the invisible lasting effects of my actions on the artefacts, I developed an observational awareness which may be used in the succeeding stage.

- The first phase called **Perceive** is a non-contact phase of the interaction which encompasses perceiving the object. This entails using other sense apart from touch to perceive touchpoints of the interaction. No direct contact or manipulation of the object is performed in this phase;
- the second phase is the **Contact** phase which depicts the direct touch and manipulation of the object;
- and lastly, the second non-contact phase called **Release** is when the user lets go of contact with the object.



**Figure 34.** Illustration on Perceive, Contact, and Release phases of interactions.



**Figure 35.** User responses in the relationship of information clarity and direct contact with object.

I highlight this step of deconstruction as I see the following user responses illustrated by the relationship of object information clarity and users having direct physical contact to better understand how an object operates (Baber, 2022).

## 1.2 CASE STUDY

I mapped out the experience of exiting through the type A bus rear doors. Defining the activities with corresponding interactive components as well as detailing what senses are used (V-visual, A-auditory, O-olfactory, T-tactile, G-gustatory), potential user deciding conditions, friction points they may encounter that hinders their achievement of their interaction goal, what the emotional and physical status of the user might be, and then condensing what the problems are with the interaction on all the three phases of Perceive, Contact, and Release phases. Through this, I was able to define the affordances present in each phase and what the corresponding problems found in each interactive component were that we may look into improving. These were thanks to the heightened awareness provided in Traces: Invisible Imprints by conducting the dishwashing with invisible ink project to reflect on the invited actions one is directed to based on an object's form and respective affordances.

STAGES	PERCEIVE	CONTACT	RELEASE
<b>ACTIVITIES</b>	Hold on while bus is moving (T) Read signages (V) Wait for light (V) Hear hydraulics of bus stopping (A)	Grip poles (T) Push poles (T) Wait for bus doors to open (V) Hear hydraulics of bus doors opening (A)	Step out (T)
<b>INTERACTIVE ENTITIES</b>	Signages (V) Overhead light (V) Pole (V) Doors (V)	Poles (T) Doors (V)	Doors (V)
<b>UNDERSTANDING/DECIDING CONDITIONS</b>	What do I do? Can I push the poles now? Will the doors open when I push the poles now?	Do I push or pull the poles? How long does it take to open?	How long after it opens does it close?
<b>FRICTION POINTS</b>	Where else to hold on to aside from the poles? Uncertainty with how and when to trigger the doors to open	Doors not opening after activation	Doors closing in on someone getting off
<b>EMOTIONAL/PHYSICAL STATUS</b>	Anticipation to get off at stop User awaiting in front of doors	User interacts with poles to trigger doors opening Frustration when doors do not open immediately	Delighted to get off bus (say thank you)
<b>PROBLEMS WITH THE SYSTEM</b>	Lack of holding support for standing aside from poles Low visibility and readability of signages due to positioning in relation to standing height Lack of visible information on waiting for light before acting on poles	Poles incite pulling gesture Sometimes one pole is malfunctioning	Lack of feedback to signal proper activation of door trigger

**Table 2.** Experience map segmenting the interactions in opening bus A rear doors.

USER NEEDS	AFFORDANCES	DESIGN CONSIDERATIONS	INTERACTIVE ENTITY
Something to hold onto while bus is in motion	Afford to hold	Separate support to hold must be provided	Support pole
Better visibility of informative signages	Afford to see Afford to read Afford to inform	Signage must be informative and always visible	Signage
Feedback for user input	Afford to respond Afford to inform	Feedback must inform door activation trigger	Feedback indicator
More intuitive trigger interface	Afford to push	Pole must invite pushing action	Push bar

**Table 3.** Design considerations and interactive entities based on user needs and affordances.

## 2. OBSERVE

### 2.1 OVERVIEW

Conducting field observations has always been a method I employ in my research approach. Upon deconstructing the phases of an interaction from the previous stage, observations allow the designer's assumptions to be validated. In now understanding the different phases of Perceive, Contact, and Release one is to be looking at, better clarity in observational insights will be enacted as there is already a mental structure on organizing and recording the observations.

Of course, allowing the designer's observations some freedom of randomness and unexpectedness must be allotted for, seeing as public in-between spaces are fast-paced and dense with multicultural encounters. Being open-minded in the observation process will garner a more fruitful data collection process in the field. With these public spaces also being too wide of a scope to account for all possible encounters, immersing in the field through observations is also a useful approach to accounting for different interactions that may not be reflected in usability tests or surveys as they may come from the most unexpected sources.

### 2.2 CASE STUDY

I had observed a man possibly in his 20s trying to get off the bus through the back doors. This bus we were on was a type A bus which had the cylindrical bars one would need to push to open the doors. The man, however, kept pushing on the door itself, in between the two bars. A ringing sound kept going off while the doors stayed shut and everyone looked in confusion. By the end, the young man had simply gone out through the front door opened by the bus driver.

Upon taking the train one day, I noticed an old man waiting in front of the doors as the train approaches the next station. As the train slowly gets to a stop, he pushes on the black bars on the doors as one would with the newer bus type B models. This made me realize that people had associated bus and train modes of transit with one another but this association had caused confusion as to how simple doors opened.





**Figure 36.** “Push bar to open” signage on Bus A.



**Figure 37.** “Touch here to open” signage on Bus B.



**Figure 38.** “Touch here to open” signage wrapped around Bus A bars.



**Figure 39.** “Push bar to open” signage pointing to yellow strips on Bus B.

These encounters made me wonder how much information is actually being transmitted to passengers regarding the operational actions involved in opening doors in transit. Conducting more field observations, I looked at product semantics on the doors themselves, noting how there is an ample amount of signages and instructions attached to the doors. These signages, however, I found were very ineffective in communicating exactly what actions to take.

Figure 36 shows what one would usually find in bus A doors. I do find, however, that the placement of this signage is relatively below eye level and would not be visible for most people. With it also being mostly text instructing passengers to push on bars to open the door with an arrow pointing at the direction of the bars, it does not exactly show the action apart from telling it, in only English nonetheless. The arrow also communicates the general direction of the bars to be pushed but anywhere within that general area may be interpreted as the area to be pushed (similar to the context of the man pushing in between the bars aforementioned).

Figure 37 is usually the only signage found on bus B doors, which is a yellow strip that only instructs one to touch the strip to open the door, with an icon of a hand with its palms open, indicating the operation of touching, pushing, or similar actions. I find this ineffective, however, as it asks to touch the strip when the activation is actually wider than the strip itself due to being an overhead sensor. In this case, even if people don't touch the strip itself, the doors suddenly open abruptly, hitting whoever is standing a bit too close to them in the process.

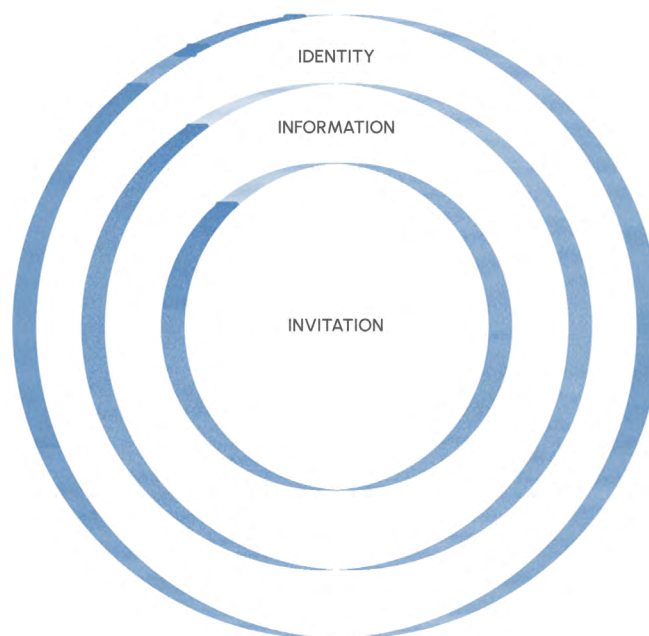
Figures 38 and 39 are cases I've observed where wrong signages and instructions are given to the two types of rear doors. The former has a strip wrapped around the bars themselves that asks passengers to "touch" even going to have the same icon used in bus B's yellow strips. The latter, on the other hand, has the same signage of bus A but for the bus B doors. I find this may prove to be confusing not only as instructions become unclear and mixed between types of actions to be performed, but also becomes confusing to passengers who may associate an action with a particular mode of transportation, not knowing there are different ways of approaching the same mode of transportation, just because they have different types of mechanisms involved.

## 3. ORIENT

### 3.1 OVERVIEW

Once ample amount of information has been collected and reflected on, the third stage entails orienting the interaction being considered and accounted for. This entails two parts:

- Orienting the direction of the interaction by pointing at the unintuitive and unnatural (forced) affordances built in with the system and
- orienting the user as to how to interact with the object through the use of proper product semantics and affordances that match the operational actions to be asked of the user.



**Figure 40.** Affordance typologies.

This step involves considering and accounting for the correct affordances in the design of objects with users' potential actions. Remember that affordances could be viewed as three typologies: as invitation to action, information to response tuning, and identity forged by social practice. The affordance becomes an **Invitation** to action based on the interaction between the object and user. It becomes **Information** for response tuning when in an environment built around the user's mental models and prior experiences which have built associations with certain objects, forms, and functions. And lastly, it becomes an **Identity** if it is in a social context of use that the particular context in question is within the bounds of a social understanding in that place.

## 3.2 CASE STUDY

In the case of public in-between spaces, the third, Affordance as Identity, is a bit trickier to account for as passersby may not be local to the place and won't have ample time to fully grasp the cultural context of use and interaction. For people having a familiarity to specific mental models of interactions with objects in their respective cultural contexts, it would prove challenging to adapt quickly once faced with a change to their environment. Therefore, a deeper consideration for affordances as both Invitation and Information must be highlighted in order to minimize cognitive friction and confusion.

I started by surveying common door handles. I categorized my observations based on the following factors: actions done on the door handles, how the hand grasps the object, and the forearm movement when interacting with the door handle. Through this analysis, different forms are associated with certain movements based on what the handles could afford the user. Observations relating the form language of the various handles and levers to the type of motion and gesture acted upon to open the various observed everyday objects were then analyzed as the following:

**Length.** Objects that tended to be longer in length mostly resulted in using a full gripping gesture.

**Extended Appendage.** Objects having an extended appendage from the rest of its body most likely resulted in a particular direction of movement, such as in the case of having a pivot point that results in a rotation of the lever or a positioning for where to grip. These usually resulted in a pulling motion.

**Broad/Wide.** Objects with a broad/wide surface usually resulted in a pushing motion.

**Flat.** Flat objects, usually a few millimeters protruding from the initial surface of the door, initiated a pushing motion.

**Hollow.** Objects with a hollowed opening usually resulted in hooking a finger or two, displaying a pulling gesture.



## ACTION TYPES

### Grip



### Pinch



### Push



### Hook



## OPPOSITION TYPES OF THE GRASPING HAND

### Pad Opposition



### Palm Opposition



### Side Opposition

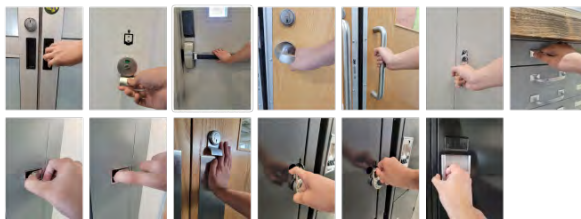


### Non-grasp



## FOREARM PRONATION-SUPINATION MOVEMENT

### Pronation



### Supination

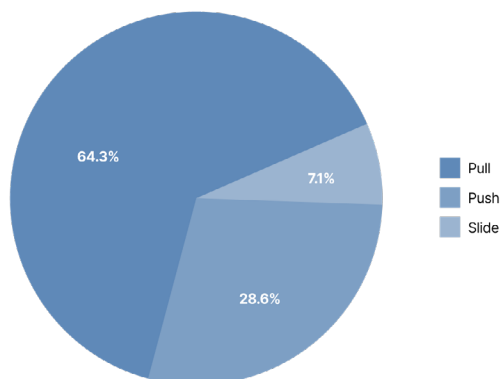


**Figure 41.** Sorting of different grasps and door handles.

In doing so, a mental model associates the cylindrical bars on the bus A rear doors to that of a normal door handle that invites the action of pulling. Of course, these were no ordinary doors in a building, so I had originally thought the reason behind such a form choice of having poles for the back door mechanism was to also act as handle bars to hold on to. However, upon looking at the transitioning of Translink buses from the type A rear doors to the type B ones that use Ultrasonic Door Actuation sensors, it was interesting to note how in a 2009 forum in Translink's online blog, Buzzer, their Communications Advisor listed reasons for transitioning away from the poles included the fact that people tended to use said poles as something to grab and hang onto while the bus was in motion, which was noted to be dangerous as the back door mechanism might malfunction and open abruptly while in-service (Pabillano, 2009).

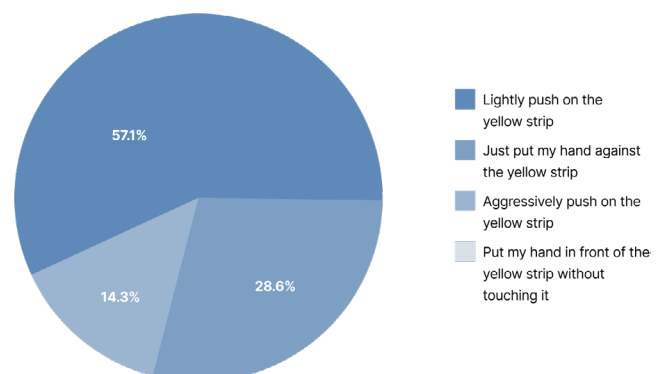
The persistent use of this form of bars is a misleading notion, however, for the type of form used for the back door mechanism of bus A, is to intuitively grip and pull on it. In comparison, bus B, on the other hand, seeing as it is a contact-less sensory door actuation system, the action of "touch", and such a vague one at that, does not connect the functional action to the intended and invited affordance being asked of. A majority of fourteen survey respondents also emphasized that their associated actions with what they perceive for both types of bus rear doors are not exactly what the signages instruct. And as evidenced in *Strange Familiarity*, this challenge of going against preconceived notions of interaction with objects such as opening cans and bottles in unexpected and different ways may cause confusion and annoyance in times of criticality where efficiency in public spaces may be a priority in the action being performed.

What action do you associate with the bars on the rear doors?



**Figure 42.** Association with Bus A bars.

How do you open this type of door when you see it?



**Figure 43.** Actions for opening Bus B doors.

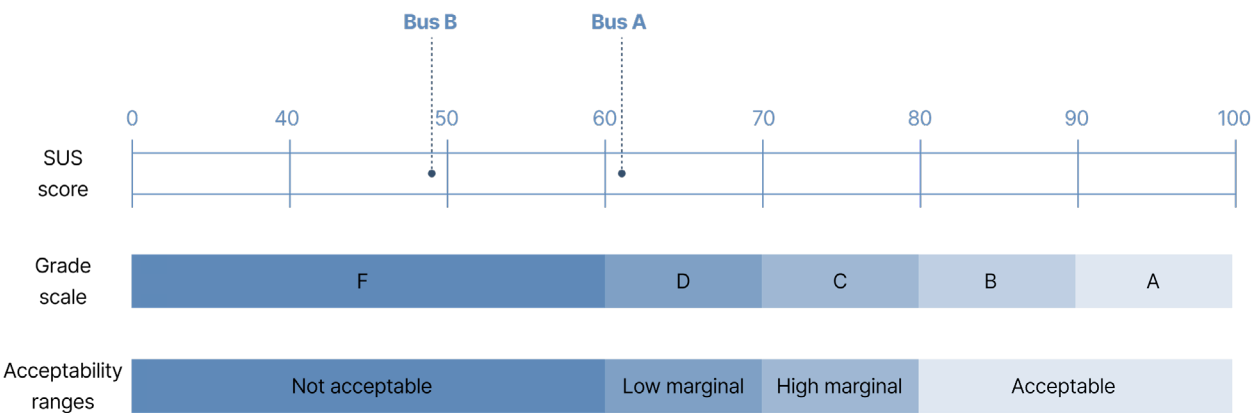
# 4. REFINE

## 4.1 OVERVIEW

In this last stage of the evaluation, we look at refining the design of the object through a set of considerations and recommendations based on the analyzed information from the previous stages as well as any metric tests used.

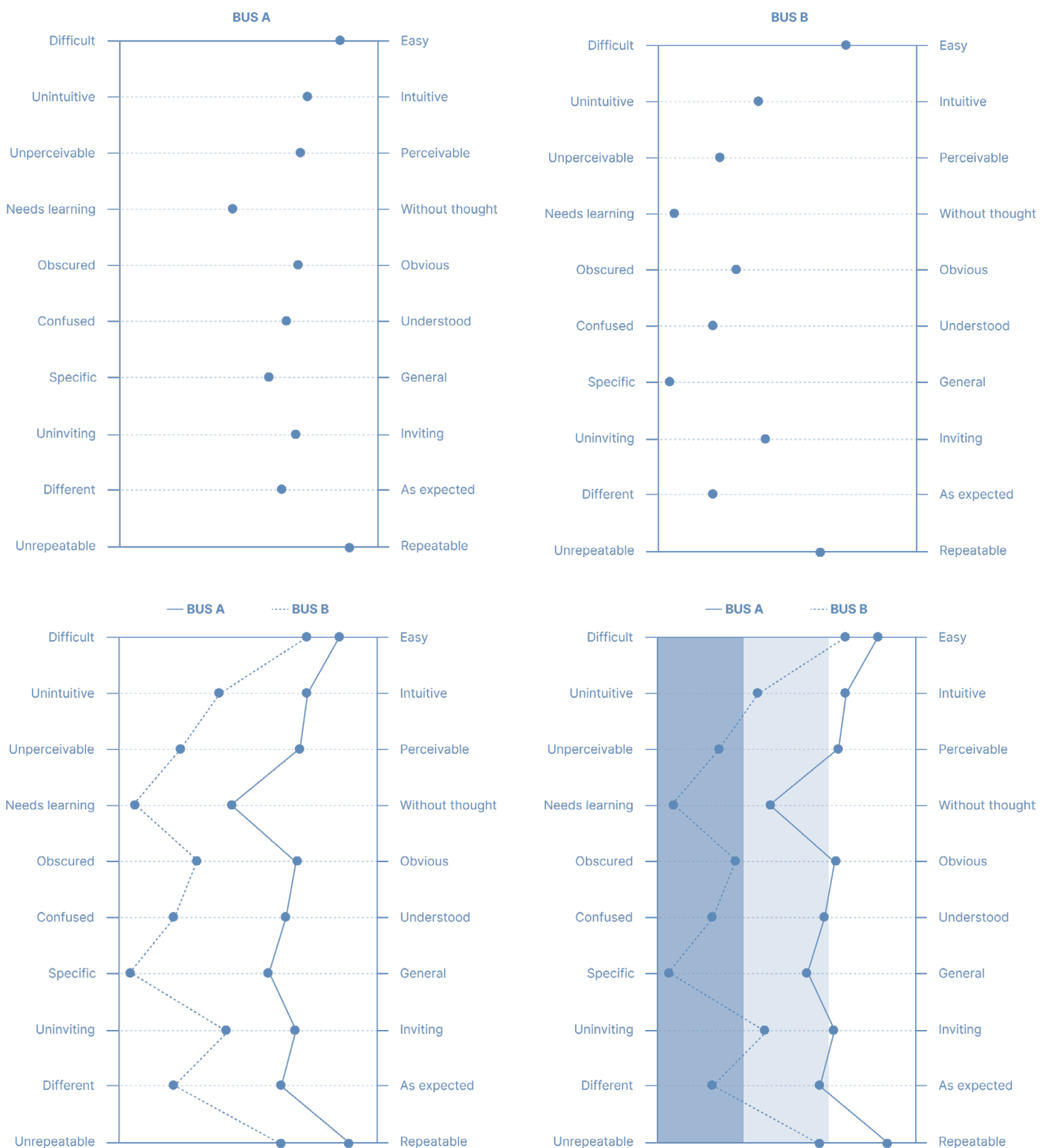
## 4.2 CASE STUDY

Using the System Usability Scale (SUS), I evaluated the existing bus rear door opening systems. I conducted this for both types of bus rear doors. After evaluation from fourteen users, Bus A had garnered a final SUS score of 62.32 with a low marginal acceptability while Bus B had gotten a final SUS score of 48.75 which was not acceptable. Seeing as both types of rear door systems were below average in terms of usability, it prompted an evaluation of why this is and what redesign recommendations might be made.



**Figure 44.** System Usability Scale for bus A and B rear doors.

With this, I wanted to evaluate their respective cognitive ergonomics using the devised cognitive ergonomics scale, accounting for the ten criteria of operability, intuitiveness, perceptibility, learnability, hint, clarity, specificity, appearance, expectations, and replicability.



**Figure 45.** Cognitive ergonomics evaluation of bus A and B rear doors.



**Figure 46.** Data physicalization of Bus B Cognitive Ergonomics Evaluation Scale benchmarking.



In using the cognitive ergonomics evaluation scale devised, I was able to parallel the results from the SUS and pinpoint what aspects of the system may need improving. While these data points on the scale for both bus rear door types are of a single person, being able to conduct this evaluation scale on a great sample size would enable patterns to emerge that would highlight a more accurate user experience evaluation of interacting with these interactive objects in the dynamic and multicultural public in-between spaces such as those of bus interiors.

While this scale may be used for evaluation of cognitive ergonomics, it is not quantitative, but rather, descriptive. Being able to describe what may be points for improvement or reconsideration in the design of interactive objects will be beneficial for designers as a way of gauging existing designs or even assessing their own while in the midst of the design process altogether. Being able to visualize this evaluation as well helps a designer in having a clearer picture as to how big of an impact this design actually makes in the interaction of users in the public domain as evidenced in the physicalization of data in benchmarking Bus B (see Figure 46).

Through synthesizing the insights from the different stages of Deconstruct, Observe, Orient, and Refine, one is able to create design considerations based on the affordances that present themselves in the interaction with passengers.

# CHAPTER 07: REFLECTIONS

In this chapter, I seek to reflect on my practice and the outcomes of this research. I present two artefacts that represent a non-fictional narrative of cultural differences and a fictional metaphor of the manipulation of interactive components in a system affecting the resulting outcomes in an interaction.

Throughout the conduct of this research, as well as in my own design practice, artefact-making has always been a critical part of my process in not only trying to understand concepts but also communicating them to other people. The tangible experience of holding an artefact in one's hands and being able to explore it and immerse oneself in the narrative told through said artefact is what I always aspire in my designs, grasping the abstract and intangible through an embodied learning.

The whole research talks about public in-between spaces and as a stranger in a strange land, all I could do in this new social context is to act as an outsider learning new conventions and becoming more and more accustomed to the social norms of this foreign land I now reside in.



**Figure 47.** Tales of Moments showing Canadian and Filipino everyday situations.

## TALES OF MOMENTS

This modular lithophane lamp shows the cultural differences of how people behave and the challenges that may arise in transitioning from one context to another and the constant learning, unlearning, and relearning of various modalities of interactions shaped by sociocultural contexts of the environments we reside in. It is a physicalization of the narrative storytelling of the seen and the unseen, the covered and uncovered, and the combining of moments through its modularity. It compares my experiences and observations of interactions back in the Philippines to here in Vancouver.

Upon coming to Vancouver, the very first time I have been exposed to a culture outside of my own, I was needed to unlearn some social practices and learn new ways of doing things, covering my Filipino mental models in favour of Canadian ones. The cover shade in each layer

of the lamp represents this choosing of what moments from our experiences we cover and uncover depending on where we are, who we are with, and what we are doing that is driven by social context of the environment we reside in. This was evidence in my learning of how to interact with Translink bus rear doors and its interfaces that vastly differ from those back in the Philippines.

Yet, despite constantly trying to unlearn and cover these mental models and associated behaviours of interaction, we are able to uncover and reveal them whenever met with contexts where they are deemed appropriate. Sometimes, in multicultural environments, we may even mix these cultural mental models to enrich our experiences by drawing from different perspectives and social practices.

Henri Lefebvre describes in the theory of moments that when granular moments are combined, they would form a greater whole and become experiences (2013). I wanted to show this through the lamp's modularity where different moments from my lived experience in both cultural contexts are stacked on top of one another that would continue to be built up as a totality of my experience, regardless of where I am.

Objects that live in the mundane of the everyday life are embedded with culture that we might not even be aware of. The everyday objects we interact with passively and unnoticed represent the culture of a specific niche. This was the case with looking at and comparing the mechanisms used on door hooks at the very beginning of the research that represent how in Vancouver there is a temporary housing culture where people do not stay in a household for a very long time unlike in the Philippines where it becomes a permanent fixture not only in the immediate family but also for extended and atomic families' next of kin as well. It isn't until we view our own practices through an outsider's lens that we truly notice and appreciate this ingrained cultural specificity in our interactions both with other people as well as the objects around us.



**Figure 48.** Tales of Moments assembled by stacking one module consisting of four moments on top of another with a shade cover sandwiched in between.





**Figure 49.** Form studies for Shifting Patterns 3D printed zoetropes.

## SHIFTING PATTERNS

This project is an exploration of 3D printed zoetropes inspired by *Blooms* (Edmark, n.d.) that puts emphasis to the varying factors in a system affecting one's perception. With the variation in form, pattern arrangement, rotation speed, camera shutter speed, and environment lighting, a different pattern emerges from the zoetrope. This creates a discourse on how unexpected behaviours arise from a multiplicity of perspectives and lived experiences. It acts as a reminder for us to consider a sensitivity to differences in perception, understanding, interpretation, and response to whatever we might design.

It was at first challenging to get things to work, to have all the factors in sync with one another in order to evoke the illusion desired to be shown which is a growing spiral based on the golden angle. Through the various trials and tribulations, however, I reflected on how a slight change in any of the factors that comprised the zoetrope system had a significant effect on whether

it showed what I as the designer wanted to happen. This parallels how designers may have an ideal interaction in mind, but due to the variety and unexpectedness in individuals' behavioural responses, varying perceptions and reactions may arise outside that of the designer's original intention. Even when things became in sync and the pattern emerged was what I had expected, after a few minutes, the motor started to give out which resulted in the rotation speed of the turntable slowing down. This was a change in one of the factors in the system that affected the overall result of the interaction even without human intervention.

Slight nuanced shifts in pattern emerge from a variety of potential reasons ranging from human or object interventions to even a difference in perception, understanding, and interpretation of certain object affordances. As designers, we may consider developing a heightened awareness at observing these slight nuances in user interactions with the things we create seeing as personal, social, and cultural mental models and contexts of use would differ how one would interact with an object despite said object being the same for a variety of cultures.



**Figure 50.** Shifting Patterns 3D zoetrope attached to a turntable and spun.

## A DESIGNER'S REFLECTIONS

As an industrial designer, I have always investigated systems of thought through physical material exploration. This artefact-making practice of mine has allowed me to represent data, theories, and stories both visually and tangibly. I see this as always having been a key component in my design practice but not being fully realized and recognized until my master's studies.

I have had some challenges throughout this journey in perhaps being a bit too deterministic in my approach. However, through conducting this research, I am able to be more creative with how I artefact information and experiences, unrestricted from conventional usability and feasibility considerations I used to obsess over. I have learned to embrace the unexpectedness and variability of responses to one's design outcomes and the process involved in getting to them. My own practice has developed significantly through the engagement with this research and will continue to develop even after, as I have developed this new-found sensibility to the less determined and spontaneous conduct of interactions that I hope to have shared with other designers as well.

As a stranger in a strange land, both geographically as well as culturally, I have mentioned that we notice the culture embedded in the objects we interact with upon inspecting them through the lens of an outsider. This parallels my practice as a designer in that this introspection into my own culture and the personal and social relations that help built that culture in me becomes a prompt to look at my own design practice free from preconceived notions and biases of what type of designer I thought I would become and embracing this rich individuality presented in my practice.

# CHAPTER 08: CONCLUSION

In this chapter, I aim to summarize my research and elaborate more on the impact of looking at cognitive ergonomics through the lens of cultural affordances in public in-between spaces will have.



This research has explored cultural influences on the practice of industrial design through the lens of interaction design principles that simplify and break down our engagements with objects, especially in public spaces with diverse users. Culture influences perception and thereby influences how and which object affordances are perceived and understood. It also impacts not only people's interpretations and understanding of contextual semantics and behavioural responses of how we might use and interact with objects, but also of the differing perspectives on how these interactive objects might be designed in the first place. Objects live in the mundane of the everyday life and have become embedded with culture that one might not even be aware of. It is not until we take a step outside of our own cultures and act as observers and outsiders do we realize how ingrained our culture is in our own practices and objects that we passively interact with daily.

Through this research, I hope to have shown the object as a cultural artefact that reflects social behaviour in a given cultural context through its affordances. While affordances are not something new to the field of design, I hope I have shed some insights on being able to look at affordances not only as a mere property of the object that is usually used through deterministic and prescriptive approaches, but rather as an ever evolving, growing, dynamic concept of insight into an individual or a culture's behaviour, action, perspectives, intent, encounters, values, and practices.

I argue that cultural perspectives impact how one perceives and uses objects, making a "one-size-fits-all" design approach ineffective. By understanding cultural affordances through viewing them as invitations to action, information as response triggers, and identity forged through social practices, designers can create more user-friendly and culturally sensitive experiences for diverse populations in fleeting environments.

With this research, I hope to have encouraged designers to move beyond solely physical utilitarian considerations of traditional industrial design and draw focus on the application and consideration of both physical and cognitive ergonomics in one's work. Through this consideration, unpredictable user behaviour and cultural differences in perception and interpretation of semantic meaning may no longer lead to cognitive friction and overload. Instead, I hope it would result in more intuitive and meaningful interactions in the fleeting encounters we have in public spaces.

It should be acknowledged that the study is coming from the perspective of a young educated Filipino male in his early twenties looking back at the culture he grew up in and looking forward

to this new culture that would make-up this new chapter of his life, observing both currently as an outsider still residing in between the two worlds. My comparisons of Filipino to Canadian cultures have stemmed solely from my direct experiences and those I have directly interacted and encountered with. It does not claim to fully encompass what it means to be a Filipino and how it is to live in Canada as I come from a position, while not of great privilege, privileged, nonetheless.

Further research into how other non-Filipino cultures and perspectives would influence other user-object interactions and social contexts would be a great way to expand the insights from this research to other communities and sociocultural contexts. And while this research situates itself in between industrial and interaction design fields, it mostly is positioned through the lens of industrial design informed by interaction design practices. As interaction design had been informed by industrial design since its conception, and now it returns to inform the latter, it will be interesting to see how the implications of this research which deals with physical interactions alone would impact the digital space especially with extended reality technologies now changing how we view the world.

*The brief encounters we have with people or objects may sometimes be our last without us knowing. These lost hours and spaces may hold meaningful interactions that we fail to recognize. Cherish these fleeting everyday moments in between yesterday and tomorrow.*

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