

# THE QUESTION OF THEORY: A COEVOLUTIONARY APPROACH TO DESIGN THESES

Barry WYLANT

Faculty of Environmental Design, The University of Calgary

## ABSTRACT

This paper addresses the use of theory within student efforts to complete design theses. Background sections outlining features of problem space and solution space are provided to contextualize and offer insights into the design thinking surrounding the consideration of information, research and theory within a given thesis or design process. The inherent pitfalls associated with the a priori framing of problems, or methodological approaches, are discussed as means of illustrating where the use of theory can benefit in circumventing these risks. To exemplify such insights, a series of student projects are presented. These are unique in that each uses a theoretical interest as a departure point to engage thesis research. At the outset, students do not know what thing/object/product they will eventually design. Rather the design response emerges from a considered understanding of the theoretical topic pursued, contextualized within a specific application or use situation, and identified as part of the process. As such these exercises demonstrate aspects of a discursive or dialogic approach to design, which in turn seems to foster a coevolutionary understanding of the design problem and design solution as the design effort unfolds.

*Keywords: Design theory, problem space, solution space, coevolutionary design, design innovation*

## 1 OCCUPYING PROBLEM SPACE

A fundamental question at the beginning of any design exercise is simply ‘what to design?’ This question, arguably, is as true for problems seemingly self-evident, or well defined as it is for the oft-cited ‘wicked’ problem [1]. It is also something eminently true for design thesis students embarking upon their research. This paper explores the realms of problem space, solution space and the role of theory in generally addressing design problems, and in undertaking design theses specifically. Of particular note is the potential role of reflection as part of an essential sense-making step in understanding the design problem.

For practitioners, the design brief offers an initial introduction to the design problem, and it can be readily assessed regarding its clarity, that is as well-defined, ill-defined or wicked. For thesis students (as with senior designers and design managers), they are typically in the position of composing their own brief as a means of framing the intended design exercise. Design briefs can outline a variety of characteristics and parameters pertaining to the design problem, listing dimensional, performance, aesthetic, and a variety of use aspects among many issues to consider in developing a potential design. Effectively, they can be seen as an initial foray in addressing the question of ‘what to design’. Yet do they fully convey the nature of the design problem?

A notion well established in the literature on design thinking is that of ‘problem space,’ as proposed by Newell and Simon [2]. This can be seen as an inarticulate bubble or cloud of many bits of information surrounding the ‘thing’ to be designed. To arrive at a solution, the cloud must be sifted through and these bits identified and considered. Seen in this way, Newell and Simon describe the problem solving endeavour as a search exercise through this cloud, where different solutions may be identified, and among them, a potentially optimal solution found. The idea of a problem space gives a context to better understand the role of the design brief as an initial effort in identifying many of the bits of information necessary to arrive at a design solution. A criticism of problem space though, is that it would seem to suggest that once the bits of information have been identified, then solving the problem becomes a relatively deterministic exercise to develop a design response.

Yet design problems are wicked. As noted by Buchanan, wickedness in the design problem arises from its “indeterminate” nature [3]. Indeterminacy does not mean that parameters, constraints, and criteria for a given design cannot be determined, rather indeterminacy means that parameters are not predetermined, in an a priori manner, at the outset. Effectively, parametric constraints are established as part of the process undertaken in addressing the design. Two questions arise from this view: first off is the typically well defined problem, well defined? And secondly, what is the nature of consideration necessary to assess those bits of information? Consider the design exercise Cross describes regarding an effort by automotive designer Gordon Murray [4]. Murray was given the task of addressing a Formula One (FISA) regulation which stipulated that cars could not use ‘sliding’ skirts to obtain ‘ground effect’ and that further, vehicle designs had to maintain a 6 cm ground clearance to the undercarriage of the car. Ground effect is a phenomenon where, at high speed, the closer a smooth bellied car body can be to the road surface, the more the aerodynamics increase the downforce on the car’s body and its grip on the surface. However, in the early 80’s when ground effect was first acted upon, its implementation led to crashes in the track corners where the ground effect led to handling instabilities. The FISA regulation arose in response to this.

Two particular bits of information become salient in this example: one that there can be no driver operated moving parts to manipulate the relationship of the car body to the ground and that a 6 cm ground clearance to the underbelly of the car is to be maintained. At first glance, two seemingly straightforward constraints which might lead us to describe the problem as well defined. Yet Murray questioned the nature of the 6 cm clearance knowing that the car’s relationship to the road surface is dynamic, and that as a car brakes or corners, the suspension will allow the car body to drop into the 6 cm clearance space. Ultimately this manner of understanding the constraint led to Murray’s development of the hydro-pneumatic suspension, which allows a car to hug the road more closely in straightaways and relax in turns effectively meeting both the regulation requirement and allowing the safe use of the ground effect phenomenon.

Cross describes Murray’s design thinking in this as returning to first principles [5], yet arguably it is more than that. I would propose that Murray’s design thinking in this represents an effort to understand the implications of these nominal bits of information in the brief. In other words, it is not enough to identify (or give cursory thought to) aspects of the problem but to effectively engage and question their implications. What does this 6 cm clearance mean? What does that look like when driving? How is this achieved? What is the suspension doing, etc.? Thus the specific bit of information in the design brief subsequently leads to a line of inquiry, not about a design solution, rather about the very nature of that piece of information. The designer does not simply undertake a ‘search’ in problem space, rather the designer occupies problem space more as a part of an inquiry to both identify bits of pertinent information, and further, to make sense of that information as part of a more holistic understanding of the problem. Navigating problem space is thus a sense-making exercise, an exercise that is thoughtful and indeed creative, aimed at understanding as much as identification.

## **2 THE MOVE TO SOLUTION SPACE**

Design problems certainly can be fuzzy to navigate. At times it can be easier to just jump in and start designing. Sometimes just diving in is beneficial where, in arriving at an early design idea, the designer can use this to further an understanding of the design problem. For instance, in examining early sketches the designer may ask, why does this feature seem to work, how would a user manipulate it in a particular setting? Is it even necessary? Such queries can act as an illustrative tool and shed further light on the nature of the design problem and potentially lead to other promising directions. Another outcome though occurs when one pursues a design that readily meets requirements yet seems to miss a useful understanding of the issue. An example in the FISA problem above would be to simply adjust the car’s chassis design to ensure it allows the required 6 cm ground clearance and forego any benefits of ground effect.

Such lines of inquiry reflect the indeterminate nature of design, and the emerging nature of one’s understanding of the problem. Dorst proposes that design is situated problem solving, that is the design problem is “seen through the eyes of the designer” [6] and thus in the situation of the designer confronting the problem in a localized setting. Effectively it lies in how the designer thinks about the problem, a notion evident in Murray’s consideration above. In identifying a specific issue, one weighs various aspects in a determination of their importance given the aims of the design exercise. How

important is a given concern, should it be included at all, is it overwhelmingly dominant or is it a subset of some other aspect? To get at this requires an understanding of the issue, initially independent of its potential role in a design solution. It requires a “discursive” [7] understanding of the issue before arriving at a prescriptive understanding of it and its role in the design exercise.

The prescriptive understanding represents the ultimate design question of ‘should’, or as Simon notes, design is a pursuit fundamentally concerned with what “ought” to be made [8]. Indeed, given the burden of legitimation, Coyne and Snodgrass argue that one should not approach the design problem with “fixed and predefined problem statements,” [9] rather that one is open to the dialogue and reflection necessary to create effective new understandings (also reflected in Dorst’s use of discourse) [10]. In other words, as designers move from an understanding of the design problem into solution space, they carry with them a requirement of legitimacy in their decision making. Though as noted above, one can enter solution space as a means to better understand the problem. That is, designers can toy with solutions as a learning device, an idea reflected in Buchanan’s notion of placement [11]. In this solutions are temporarily entertained and contextualized within the design problem, but not committed to. Only with commitment to a particular design decision, or course of action, does the obligation of legitimacy come into effect.

Following on the notion of an a priori sense of the problem, designers can also move quickly to a proposed solution, at times becoming unduly attached to it (a situation design educators are likely quite familiar with). In this, a cursory understanding of the problem can lead to the question of legitimacy in the design response, evident in the comment “well, what problem are you solving?” One way to mitigate this is to foster the designer’s awareness that they are thinking in ‘solution space’ and have bypassed a useful understanding of the problem. In other words, to allow the designer to become aware of not only the issue under consideration but also the very manner of their consideration. Given the dialogic mandate above, consideration of a topic can also include a certain cognitive situational awareness: am I thinking in solution space or problem space?

### **3 THEORY**

Over the last century, design has evolved significantly through the incorporation of many theoretical areas of inquiry. As these have emerged they’ve played a large role in informing design, design techniques and methodologies. Today, everything from the obvious realms of art and engineering, through to psychology, anthropology, cultural studies, etc., can be purposefully applied in design. Many of these theoretical arenas have become embedded in professional design methodologies, such as human factors research and analysis. Indeed many of these theoretical tools have come into practice as a result of trying to bring a greater scientific certainty to the design exercise.

Yet, if there is a danger in approaching the design exercise with an a priori sense of the design problem, is there not also a similar danger in approaching it with a fixed set of theoretical tools? If design is to be seen truly as an area of genuine inquiry, then can one undertake any analysis as simply a matter of course? In embracing the inherent indeterminacy of the design problem, one is in the position to incorporate the use of theoretical tools as it becomes evident that they’re necessary to navigate the problem space. It may be a subtle distinction, yet it is important to note that the need to undertake any analysis is the result of critical choice. Consider that when confronted with a given design exercise, the designer is put in the position of first raising the fundamental question, “what am I designing?” followed by the query “what do I need to know or do to design this thing?” The decision then to use any theoretical area, research techniques, methodologies, etc. arises in response to this basic question, operational in the specific instance of application.

### **4 DESIGN THESIS**

Typically in undertaking a design thesis, a student may identify a particular type of product (or thing) to be designed or the student may identify a particular user experience or use situation that is problematic. Once chosen, the student can then undertake background research, a literature search, investigate precedents, or perhaps set up a particular research project such as ethnographic research, ergonomic analysis, and ultimately compile information to effectively equip themselves to then develop a design response. Seen in this way, the thesis exercise can easily be described as inhabiting both problem space and solution space as described above. Indeed students tend to spend a great deal of time and effort in establishing a rigorous sense of the problem and there is often an amplified focus on problem space within a design thesis.

Yet the design response can still be somewhat (or substantially) pedantic. Sometimes the research becomes pivotal in the student's work, while the design response gets added on, almost as an afterthought, failing to truly address aspects of the problem. In other instances, and as noted above, the student may harbour an a priori attachment to a particular design solution or to an a priori compulsion to use a particular methodology or theoretical paradigm.

The difficult area seems to be in making the transition from problem space to solution space, and, using the wealth of information generated, to then usefully embark on a design response. In particular, I would argue that a necessary sense-making exercise is lacking. In compiling an overview of a specific problem space, even with exhaustive research and analysis, one may still arrive at a quality of information more akin to the nominal 6 cm clearance height above than to Murray's exceptional insight into the dynamic behaviour of the car vis a vis this 6 cm clearance. It seems to be this necessary pondering of information, in the vein of Dorst's discussion, Coyne and Snodgrass' dialogue, and Schön's reflection, that must be allowed for within the thesis process, and indeed within the design process, if we're to see more innovation on a level comparable to Murray's insight. Further, such reflection appears ongoing, iteratively throughout the thesis/design process, so that one's understanding of the design problem and the proposed solution seem to coevolve, exemplifying Dorst and Cross' notion of coevolution [12].

## **5 PROJECT EXAMPLES**

A question thus emerges: is there a way to structure a thesis that emphasizes sense-making in the manner described above? One possible way is to avoid focus on an object (or product) as the subject of the thesis at the outset. Rather, that one establishes a theoretical focus first before determining what is to be designed. That is, to initially forego any determination of what should be designed until an effective synthesis of a theoretical question is well underway. Removing the object/product focus eliminates potential for an a priori or fixed understanding of the problem space, and allows for an emergent or coevolutionary result. The design response can become something that inherently arises out of the inquiry and the designer's sense-making efforts. The following series of student projects (all supervised by the author) provides examples of the possibilities found in this approach.

### **5.1 Alien Objects**

In this project the thesis student was interested in the way in which innovations result when users creatively misuse existing products. A number of examples exist, things like the development of "scratching" used by rap DJ's, or the use of silly string by US Marines to find trip wires in Iraq. Websites and magazines, like Ikea Hacker and Make, abound offering ideas of what others have done misusing existing products to make new things.

The student examined various theoretical perspectives: Gibson's notion of affordance [13], aspects of creativity theory, object meaning and Krippendorf's notion of sense making [14], Sander's elaborations on scaffolding user experience [15], bisociation and humour [16], the democratization of creativity and the flattening of traditional professional creativity hierarchies. The student even conducted a short studio exercise with a group of first year students to see what ideas they arrived at when challenged with a problem of creative misuse. The results of this proved noteworthy, in allowing the student researcher to determine how other students honed in on the affordances evident in the objects provided and matched those to the problem context the researcher demanded.

The student in this instance though was confounded by a critical problem, how does one design for creative misuse if the misuse is completely beyond the designer's control? Anticipating any specific misuse would ultimately make that misuse contrived. In the end he arrived at the understanding that one cannot design for creative misuse, however one can create conditions which foster creative misuse. The design response proposed a series of objects with no intended use, yet stood as a challenge for users to determine, or create, uses. Offered as a set of collectibles, they were designed around the affordances evident in the studio exercise. The student then proposed a blog where users could post their results and share in other's creative findings.

### **5.2 Critical Wayfinding**

This was a project where the student sought to merge the seemingly disparate theories of wayfinding and critical theory. He completed a comprehensive literature review investigating modernity and the

history of modernism, postmodernism, wayfinding theory, theories on cultural production, the philosophy of technology, Hertzian space [17], and cognitive mapping (to name the main ones). Throughout the literature review and even after arriving at a cohesive theoretical stance, a design project seemed elusive. One characteristic was however noted: that many critical design projects seem better suited to an art gallery rather than something for everyday life and so a major design ambition was to propose a product that could facilitate a greater critical awareness in users of a mass produced item. A number of avenues were explored, including games, aspects of social media, yet few seemed promising.

Crucially, he undertook a cognitive mapping exercise of the Apple iPhone, and developed two large maps illustrating various meanings and attributes of the iPhone. This exercise allowed the student to focus in on people's relationship to the Hertzian space to which an iPhone is central and in which we live out our everyday lives. The final design response sought to allow users to navigate and map Hertzian space. The student proposed a beefed up antenna and radio receiver embedded into a flexible iPhone sleeve. This was coupled with an app, which would allow users to map, visualize and track the Hertzian space in which they pursued daily activities.

### **5.3 Graffiti**

In this instance, the thesis student was curious about the phenomenon of graffiti. Certainly he held no initial ideas regarding a potential design intervention, but sought to understand the various dimensions of graffiti as a prevalent activity in modern cities. To this end he contrasted aspects of the criminality with urban theories pertaining to the role of public space and citizen voice within that. He investigated graffiti as a cultural product and as an independent area of study, and he surveyed the various technologies of 'surface' to understand where there might be potential for design intervention. Again this student struggled to determine a design exercise. The impasse lay in the student's desire to foster public engagement in the urban realm but without the damage to property graffiti entails. A survey of emerging technologies which can affect built surfaces provided a framework to resolve the impasse. The final design was embodied as a piece of urban street furniture, which could become a focus within a square or plaza. The device used electronics to interpret user gestures, translating these gestural strokes into control inputs for a laser projector, which could then temporarily project a resulting image onto a neighbouring building facade. Further the devices could be networked, and supported by a website, facilitating an urban dialogue between sites and even cities.

### **5.4 ...and Others**

Some other notable projects include one student's commentary on consumer choice and the food industry, resulting in a proposal for restaurant dinnerware designed around a fixed menu which negates choice. Another student project had a fairly well defined product idea, namely a digital pinhole camera, that served as a discussion piece to investigate the slow movement and develop a 'slow' approach to technology. Still another project delved into consumers' compelling fascination with beauty products and the beauty industry. Noting the surgical lengths people now go to in pursuit of beauty, this student used the theories of fictional product design to develop a concept for diagnostic footwear. These would be used temporarily in a shoe store, allowing shoppers to see what procedures might be necessary to ensure an optimal fit with their favourite designer shoes.

## **6 COEVOLUTIONARY REFLECTION**

With one exception, these projects all began with an inquiry based on theoretical interest and not with a product or object focus for an ultimate design exercise (in the exception theory played a significant role in allowing the student to better frame the project). Overall students found it risky to undertake a project without really knowing what will be designed at the end of the day. All were aware of one potential pitfall, that is the "so what?" question, where having investigated all manner of theory, one still has no idea how to act on it. Students were thus put in the position of understanding theoretical importance from a broad perspective, and then how such insights could work operationally in a specific application. It is the effort to circumvent the "so what?" question that seems to force reflection upon theory to understand and identify a potential application in practice. To do this seems to require an insight cognitively comparable to Murray's above. Yet achieving this was never straightforward or easy. Students tackled this in various ways, from pure reflection on the theory, to sketching and raw designing, to some combination of approaches. Effectively it became an act of

creative synthesis to make useful sense of a wide spectrum of information, and in the end, all of these students were able to achieve innovative results.

It is worth noting that the sense-making endeavour is continuous throughout the thesis and design processes. Students, from early in their respective literature reviews, through to framing a problem, establishing design intent, and in completing a design, were constantly making sense of information uncovered. The focus was less about finding answers and more about habitually raising good questions throughout. Even in detailing design responses, students were encouraged to understand how the resolution of one facet of the design still continued to operate within the theoretical realms of the project. An interesting example of this lies in the graffiti exercise, where the student in early design studies, proposed a minimalistic box as a design response. In this the student seemed to adhere, in an a priori manner, to a modernist idea of the design as a background piece. Upon further consideration, the student realized that it operated more in the manner of street theatre and could therefore have a more prominent street presence, engendering a completely different approach to the product's overall form. Similarly, in the critical wayfinding thesis, this student found that one technological feature of his design, the antenna, required a certain fractal geometric configuration. This insight changed his understanding of what his proposed iPhone sleeve design was about, and in turn he gave prominence to this as a visual feature in his design, as a means of semantically flagging its ability to monitor hertzian space. Such insights exemplify the dialogic ambition, where one's understanding of the problem, the theory or research used to make sense of it, and ongoing design work continuously evolve, one informing the other. Indeed, sometimes one only fully understands what to design, once it has been designed.

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