RECLAIMING MACHINE INTELLIGENCE: THE PASKIAN SCHOOL OF ARCHITECTURAL CYBERNETICS

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ABSTRACT

RECLAIMING MACHINE INTELLIGENCE: THE PASKIAN SCHOOL OF ARCHITECTURAL CYBERNETICS

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Doctor of Philosophy, Architecture
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This thesis brings together a series of attempts aimed at creating architectural machines or environments inspired by the field of cybernetics from the 1950s to the present. It particularly dwells on Gordon Pask's (1928-1996) diverse interactions with architecture and design communities and conceptualizes the research emerging from those interactions as the "Paskian school of architectural cybernetics." It examines how and why Paskian concepts and ideas have continuously been of interest to architects as a niche research tradition that has been producing novel approaches in modeling human-machine relationship in architectural contexts based on the idea of "conversation" as the quintessential form of interaction. In doing so, it explores different approaches in which Pask's theories and practices have been reinterpreted in or translated to architecture both by himself and his architect collaborators, students, and followers. The thesis aims to acknowledge and promote the Paskian school of architectural cybernetics as a research tradition that has been offering a distinct perspective for machine intelligence research in architecture by being continuously propagated and sustained via its precise research agenda and devoted community in the last sixty years.

Keywords: Machine Intelligence, Cybernetics, Gordon Pask, Human-Machine Interaction, Conversation

ÖZ

MAKİNE ZEKÂSINI YENİDEN SAHİPLENMEK: PASKÇI MİMARİ SİBERNETİK EKOLÜ

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Tez, 1950'lerden günümüze sibernetik alanından ilham alarak mimarlık bağlamında makine veya çevreler yaratmayı amaçlayan bir dizi girişimi bir araya getirir. Özellikle Gordon Pask'ın (1928-1996) mimarlık ve tasarım toplulukları ile olan çeşitli etkileşimleri üzerinde durur ve bu etkileşimlerden doğan araştırmayı "Paskçı mimari sibernetik ekolü" olarak kavramsallaştırır. Paskçı fikirlerin, etkileşimin özlü bir biçimi olan "söyleşi" fikrine dayalı olarak, mimari bağlamlarda insan-makine ilişkisini modellemede yeni yaklaşımlar üreten bir niş araştırma geleneği olarak mimarların ilgisini nasıl ve neden sürekli olarak çekmekte olduğunu inceler. Bunu yaparken, Pask'ın teori ve uygulamalarının hem kendisi hem de mimar işbirlikçileri, öğrencileri ve takipçileri tarafından mimarlığa tercüme edildiği farklı yaklaşımları araştırır. Tez, Paskçı mimari sibernetik ekolünü, son altmış yıl boyunca, iyi tanımlanmış araştırma gündemi ve adanmış topluluğu aracılığıyla sürekli olarak yayılarak ve sürdürülerek, mimaride makine zekâsı araştırmaları için farklı bir bakış açısı sunan bir araştırma geleneği olarak kabul etmeyi ve desteklemeyi amaçlar.

Anahtar Kelimeler: Makine Zekâsı, Sibernetik, Gordon Pask, İnsan-Makine Etkileşimi, Söyleşi

to Neris, who was there every step of the way

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This study would not be possible in its current form without the support of many other individuals. I am indebted to Chris Abel, John Frazer, and Paul Pangaro for having interviews with me. I would especially like to thank Chris Abel for opening his personal archive and providing several unpublished materials, which made it possible to write a significant portion of the thesis.

I am also grateful to the late director of the Gordon Pask Archive at the Department of Contemporary History of the University of Vienna, Albert Müller, who answered my request for a visit to the archive from his hospital bed just a week before he passed away from cancer. His selflessness opened a whole new avenue for this research. I am also grateful to Marianne Ertl for her support during my visit to the archive.

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CHAPTER 1

INTRODUCTION

At an address given in 1971 at the opening of the "Twenty-Fourth Annual Conference on World Affairs" at the University of Colorado,[1] Heinz von Foerster, who is widely considered to be one of the founding figures of the field of cybernetics, distinguished between two types of machines: The "trivial" and the "non-trivial." He argued that a trivial machine was "characterized by a one-to-one relationship between its 'input' (stimulus, cause) and its 'output' (response, effect)."[2] Since this relationship was fixed from the beginning, and, as such, an input given at different times would result in the same output, a trivial machine was a "deterministic" and "predictable" system.[3] Whereas, according to him, a non-trivial machine, whose input-output relationship was "determined by the machine's previous output," that is to say, "its previous steps [would] determine its present reactions," was "unpredictable," where "an output once observed for a given input [would] most likely be not the same for the same input given later."[4] In order to grasp the difference between these two types of machines, he defined the concept of "internal states," where he argued that, while the trivial machine had only one internal state, the non-

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[1] This talk was later published on two occasions: Heinz von Foerster, "Perception of the Future and the Future of Perception," *Instructional Science* 1, no. 1 (1972): 31–43; Heinz von Foerster, *Understanding Understanding: Essays on Cybernetics and Cognition* (New York: Springer, 2003), 199–210.

[2] von Foerster, *Understanding Understanding: Essays on Cybernetics and Cognition*, 208.

[3] von Foerster, 208.

[4] von Foerster, 208.

trivial machine could shift from one to another, which rendered it "so elusive."[5] Von Foerster claimed that we, as humans, directed all our efforts to the creation of trivial machines (i.e., toaster, washing machine, motorcar, etc.), whose behavior is predictable, or when possible, conversion of non-trivial machines to trivial ones, in a process he called "trivialization of our environment" (i.e., transforming nature through agriculture). He warned that, though it may be "useful" and "constructive" in certain domains, trivialization was a "dangerous panacea" when applied to humans themselves.[6]

On another occasion, arguing about the nature of recent technologies of artificial intelligence in a paper titled "Technologies of Engagement: Cybernetics and the Internet of Things,"[7] Andrew Pickering, a renowned historian of British cybernetics, distinguished between two types of technologies: Those of "engagement" and "disengagement." In this paper, Pickering argued that the philosophical tradition of dualism, "as a project and a practical achievement" with its goal of "making the world more dual" by splitting the human and the non-human in various ways, was creating technologies of disengagement.[8] To illustrate this point, he used, like von Foerster, the example of a car, already a product of the dualist vision as a passive machine under the command of a human agent, being transformed into an even sharper technology of disengagement with the development of driverless cars, the experience of being in one of which lacked "all the embodied activity of driving" and rather involved a state where "the human [is] almost completely split off from

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[5] von Foerster, 208.

[6] von Foerster, 208.

[7] Andrew Pickering, "Technologies of Engagement: Cybernetics and the Internet of Things," 2018, https://www.researchgate.net/publication/327941338_TECHNOLOGIES_OF_ENGAGEMENT_CYBERNETICS_AND_THE_INTERNET_OF_THINGS.

[8] Pickering, 1–2.

the machine."[9] In contrast to this view, he proposed envisioning technologies of engagement as a "class of technologies that somehow foreground and intensify our nondualist couplings to the world rather than trying to erase them."[10] Instead of the "tamed and obedient" environments of technologies of disengagement, he imagined the environments created by technologies of engagement to involve "human and nonhuman agency in which the nonhuman can always surprise us."[11] According to him, technologies of engagement would create "lively worlds that [could] resist us, or transform our inner being in unpredictable ways, […] or encourage rather than background creativity and novelty."[12]

This thesis is about those non-trivial machines or environments of technologies of engagement that are unpredictable and surprising in many ways and that open up new perspectives for both human and non-human agencies in the architectural domain. It centers on a set of initiatives aimed at envisioning and creating such machines or environments in architecture inspired by the field of cybernetics. It particularly concentrates on Gordon Pask's (1928-1996) various interactions with architecture and design communities and conceptualizes the research arising from those interactions as the "Paskian school of architectural cybernetics." It examines how and why Paskian concepts and ideas have continued to be of interest to architects in a niche research tradition that has been producing novel approaches in modeling human-machine relationship in architectural contexts throughout the last sixty years. In doing so, it investigates the different approaches in which Pask's theories and practices have been reinterpreted in or translated to architecture both by himself and his architect collaborators, students, and followers.

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[9] Pickering, 2.

[10] Pickering, 4.

[11] Pickering, 4.

[12] Pickering, 11.

As to why the intersections between architecture and cybernetics, or more precisely, the impact of Paskian concepts and ideas in architecture is chosen as the subject matter, one has to look at the current state of affairs in machine intelligence research in architecture, which has been transforming with the availability of relatively more data and new algorithms in the recent years. An ever-growing interest in this research area is maintained by diverse actors, including large design software companies, research groups in academia, architectural/design practices, etc. This state of affairs can be considered a part of a larger trend, in which the so-called "artificial intelligence" (AI) is ever more powerfully penetrating various other fields. In this process, the technological developments in data production, storage, and processing capabilities, and the new machine learning algorithms such as deep neural networks are creating a dual agency that renders a wider group of researchers able to conduct research in this area. In other words, the changing data economy is resulting in a new research sociology, where machine intelligence research in architecture, once a business for only a handful of groups and figures who had access to exclusive resources in the Anglo-American context, is now sprawling at an ever-increasing pace, transforming the research area from the project of the few to a field for many.

However, this process is also leading to a uniformity where machine intelligence is often recognized in a limited fashion in the contemporary techno-culture as well as in architecture. As the current mainstream AI practices, which generally involve the application of certain machine learning algorithms to certain problem-solving situations, are gaining dominance at a growing rate, machine intelligence research is also increasingly being identified with it. In other words, machine intelligence is being reduced to a narrow definition and a specific mode of practice, as opposed to its diverse interpretations throughout its history. In this connection, this thesis argues that there is a need to acknowledge those multiple dimensions. As an attempt towards that goal, it brings forward and renders more visible the role of cybernetics, especially of Pask's concepts and ideas, in machine intelligence research in architecture.

This thesis is constructed after the following line of reasoning:[13]

*-If machine intelligence research in architecture **today**; then machine intelligence research in architecture in **history**:*

As opposed to the uniformity caused by current AI practices, the thesis proposes to focus on the multiplicity of approaches that have been in place throughout the history of machine intelligence research in architecture to be able to offer a new frame of reference for the present moment.

*-If the history of **machine intelligence** research in architecture; then **cybernetics**:*

Although AI is considered to be the primary field of reference, cybernetics has been playing a significant role in the history of machine intelligence research in architecture by means of several concepts and ideas, which deserve wider recognition.

*-If **cybernetics**; then **Gordon Pask**:*

Pask enjoyed a fairly unorthodox relationship with architecture throughout his life as someone from outside the discipline and left a still evolving complex web of relations which has rendered him a source of inspiration for many architects, more so than any other figure from cybernetics.

*-If **Gordon Pask**; then **conversation:***

Paskian conversational approach to machine intelligence, which is chiefly concerned with a genuinely interactive relationship between two or more intelligent entities that

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[13] This line of reasoning was inspired by a similar structure proposed by Hugh Dubberly and Paul Pangaro in: Hugh Dubberly and Paul Pangaro, "Cybernetics and Design: Conversations for Action," in *Design Cybernetics: Navigating the New*, ed. Thomas Fischer and Christiane M. Herr (Switzerland: Springer, 2019), 89–94.

are able to learn from each other, has been offering a novel approach for machine intelligence research in architecture.

As to why the term machine intelligence is adopted in this thesis to refer to the specific area of computational design that studies intelligent behavior in architectural contexts, it is crucial to look at the origins of artificial intelligence. Although artificial intelligence is nowadays being widely used as an umbrella term to refer to virtually anything related to intelligence, it is in fact founded as a new field in the 1950s as a challenge to cybernetics with an agenda of simulating "every aspect of learning or any other feature of intelligence" in machines.[14] In this respect, artificial intelligence should be considered one of the fields, among others including cybernetics, that had an impact on machine intelligence research in architecture, rather than being used to refer to the whole field.

A similar confusion also exists regarding the term interaction, which is often used to refer to any system that involves responsive behavior. In the scope of this thesis, interaction is used in a very specific meaning based on Pask's notion of the term, which he conceptualized around the idea of "conversation." According to Pask, conversation, as the quintessential form of interaction, involves participants, whether humans or machines, that exchange understandings, rather than information, in such a manner that they learn from each other and arrive at novel situations that are not anticipated at the beginning. In this framework, interaction is not defined as a response of one agent to a stimulus caused by another. Instead, drawing on the fact that responsive capability does not necessarily lead to mutual exchange, it is defined as an indeterministic process where participants capable of learning from each other, communicate through their understandings to arrive at unexpected results.

Defined as such, Paskian conversation has been of interest to many in architecture

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[14] John McCarthy et al., "A Proposal for the Dartmouth Summer Project on Artificial Intelligence," 1955, http://jmc.stanford.edu/articles/dartmouth/dartmouth.pdf.

throughout the last sixty years. Several attempts have been made by different generations of architects to translate this framework in designing the human-machine relationship in architectural environments. By bringing those attempts together and conceptualizing them as the Paskian school of architectural cybernetics, this thesis promotes Pask's understanding of interaction as a research agenda that prioritizes process over goals and mutual effort over utility in machine intelligence research in architecture. Also, the thesis defines those attempts not just as individual historical case studies but as instances of an underlying research tradition conceptualized under the title of the Paskian school of architectural cybernetics, based on a research that investigates the complex web of relations that enabled their development. As the reader will follow in the subsequent chapters, this investigation provides two critical insights:

On the one hand, all the attempts discussed throughout the thesis imply that there is a precise research agenda, sustained with the goal of creating genuinely interactive environments regardless of radically different technological contexts, that has considered the interaction of the artifacts/spaces with their users/inhabitants a priority in architectural design. On the other hand, the relationships between all the figures discussed throughout the thesis suggest that there is a community that has involved multiple generations of eager architects/designers, especially in the Anglo-American context, who have greatly valued the Paskian ideas and utilized them in their research. Regarding these two insights, it is claimed that the research activity around translating Paskian concepts and ideas into architecture should be appropriately acknowledged as a niche research tradition that has been producing novel approaches in machine intelligence research in architecture. The Paskian school of architectural cybernetics, continuously propagated and sustained via its precise research agenda and devoted community, and as such, proven to be resilient to changes in the technological contexts, continues to offer a distinct perspective for machine intelligence research in architecture.

In bringing together those several attempts and dissecting those complex relations, this thesis heavily relies on a number of archival and oral history studies. First and foremost, the Gordon Pask Archive at the University of Vienna, Department of Contemporary History, constitutes the backbone of the study, the materials obtained from which are abundantly used in all chapters. The archive proved to be an indispensable source without which the thesis would not be possible in its current form. As yet another primary source, the Cedric Price Fonds of the Canadian Centre for Architecture (CCA) in Montreal is also crucial, as the whole fourth chapter and parts of the fifth chapter are based on materials acquired from there. Alongside these archival studies, the thesis also depends on a number of interviews conducted with Paul Pangaro, Chris Abel, and John Frazer, who collaborated with Pask during his lifetime. These interviews are essential as they provide insider's views on Pask's relationship with architecture and design communities.

By virtue of these efforts, the thesis argues for the relevance of the Paskian school of architectural cybernetics not only by discussing its merits based on its research agenda but also by culturally placing it in time and space from a historian's point of view. In this sense, it attributes equal significance to the features of artifacts created in this research tradition, alongside the research sociology that brought about their creation. Also, in proposing that the Paskian school of architectural cybernetics should be acknowledged as a distinct research tradition, the thesis points out a need to diverge from an all-encompassing discourse on machine intelligence research in architecture in favor of a new historiography that could appreciate the geographical and intellectual localities developed within it.

The main body of the thesis, which comprises four chapters, dwells on different aspects of the Paskian school of architectural cybernetics, ranging from its constructivist epistemology to its multidisciplinary nature, from its resilience to technological changes to its ability to attract interest from a multiplicity of actors. The structure of the thesis is as follows:

The second chapter, predominantly based on two articles produced by Pask in the late 1960s and the early 1980s, scrutinizes how Pask's discourse on architecture unfolded in time by addressing his evolving understanding of the relationship between architecture and cybernetics. With respect to this examination, the chapter identifies two distinct periods in Pask's discourse, from one that considered architecture as a field governed by cybernetics to another that acknowledged architecture and cybernetics as fields that coexist. In addition, the chapter also provides a brief history of cybernetics, alongside an introduction to Pask's conversation theory, which also renders it a preamble to the other chapters.

The third chapter brings forward the ARCHITRAINER project, designed by Chris Abel and built at the Architecture Machine Group at MIT in the early 1970s, as an extraordinary multidisciplinary endeavor situated at the intersection of architecture, cybernetics, psychology, and technology. It dwells on the period spanning from the 1960s through the 1970s concerning issues such as new pedagogical approaches in architectural design education, strong connections between architecture and technology, and the wide dissemination of constructivist epistemology across disciplines. The chapter presents the relationship between Chris Abel and Gordon Pask as a significant episode of Pask's unorthodox connection to the field of architecture, and it recognizes the ARCHITRAINER project as an overlooked attempt in the Paskian school of architectural cybernetics.

The fourth chapter offers a comparative history of Pask's role in conceptualizing the human-machine relationship in the Fun Palace and Kawasaki projects, which were developed by Cedric Price in collaboration with him in the 1960s and the 1980s, respectively. The chapter examines these two projects not only to provide a narrative concerning their particular features as individual artifacts but also to explore the reflections of the respective technological and cultural context in their design. Similar to the third chapter, this chapter justifies both projects as significant instances in the Paskian school of architectural cybernetics.

The fifth chapter focuses on a later period in the Paskian school of architectural cybernetics, based on a multitude of theoretical and practical attempts at translating Paskian concepts and ideas into architecture and design fields, which cover a span of more than thirty years starting from the late 1980s up to the present. It argues that this period is characterized by a multiplicity of approaches, alongside a multiplicity of actors from different generations, that include Pask himself, those who collaborated with him during his lifetime, and those who followed his ideas later. It brings forward the Paskian school of architectural cybernetics as a niche research tradition that has been attracting interest and producing novel outputs in machine intelligence research in architecture.

CHAPTER 2

FROM ARCHITECTURE GOVERNED BY CYBERNETICS TO ARCHITECTURE AND CYBERNETICS AS FIELDS THAT COEXIST[15]

> His presence and inventions within [the] life of the Architectural Association school are both legendary and of day to day relevance.[16]
>
> He was probably more architect than the rest of us, more able to understand, or at least parry with the various aspects of culture and phenomena, real, imagined, or somewhere out there if you could only grapple with them.[17]
>
> We were lucky that Gordon, with his unassuming determination, was so interested and involved in architecture. He was always wishing to expand new architectural questions, in which he played an important part […].[18]
>
> […] Systems thinking in architecture inevitably came to embrace cybernetics,

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[15] An earlier version of this chapter was presented online at The Education and Research in Computer Aided Architectural Design in Europe (ECAADE) Conference, "eCAADe 2020:Anthropologic" held between 16-17 September 2020 in Berlin and was published in the conference book: Ensar Temizel, "The Cybernetic Relevance of Architecture: An Essay on Gordon Pask's Evolving Discourse on Architecture", in *ECAADE 2020 Anthropologic: Architecture and Fabrication in the Cognitive Age* , ed. Liss C. Werner and Dietmar Koering (Hamburg: Tredition, 2020), 471–80.

[16] Cedric Price, "Gordon Pask," *Kybernetes* 30, no. 5/6 (2001): 820.

[17] Peter Cook, "The Extraordinary Gordon Pask," *Kybernetes* 30, no. 5/6 (2001): 571.

[18] Royston Landau, "For Gordon: Some Comments on Architecture and Its Context," *Kybernetes* 30, no. 5/6 (2001): 752.

and cybernetics in architecture inevitably came to embrace Gordon Pask.[19]

Above are quotes by Cedric Price, Peter Cook, Royston Landau, and John Frazer from a special double issue of Kybernetes journal published in 2001, which comprised a memorial collection in honor of Gordon Pask. In these remarks, those architects who collaborated with him in various forms during his lifetime recognized his unorthodox relationship with architecture, which has rendered him a source of inspiration for them and many others. He maintained a strong connection with architecture during his lifetime and left a complex web of relations with architects that is still evolving today.

Pask's enduring attachment to architecture, which manifested itself by several attempts, both by himself and by his architect collaborators, students, and followers, including those quoted above, at translating his cybernetic concepts and ideas into architectural contexts, is thoroughly discussed throughout the thesis. This chapter particularly focuses on two articles, "The Architectural Relevance of Cybernetics" and "An Initial Essay: Towards a Unification of Architectural Theories," produced by Pask in the 1960s and the 1980s, respectively.[20] Predominantly based on these two articles, which represent rare occasions as mainly theoretical discussions among the majority of practical applications in the Paskian school of architectural cybernetics, the chapter scrutinizes how Pask's discourse on architecture unfolded in time by addressing his evolving understanding of the relationship between architecture and cybernetics. Besides, the chapter also provides brief introductions to cybernetics and Pask's conversation theory, which also render it a preamble to

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[19] John Frazer, "The Cybernetics of Architecture: A Tribute to the Contribution of Gordon Pask," *Kybernetes* 30, no. 5/6 (2001): 642.

[20] Gordon Pask, "The Architectural Relevance of Cybernetics," *Architectural Design* 37, no. 6 (1969): 494–96; Gordon Pask, "An Initial Essay: Towards a Unification of Architectural Theories," ca 1983, Gordon Pask Archive, University of Vienna-Department of Contemporary History.

what follows in the upcoming chapters.

The chapter is organized into three parts. The first part provides a brief history of the field of cybernetics with a particular focus on its transformation from the "first-order" to "second-order" in the late 1960s and the early 1970s. The second part introduces Pask's conversation theory as a manifestation of second-order cybernetics, and looks into two earlier interactive machines produced by him as demonstrations of the fundamental aspects of the theory. And, the last part focuses on the two articles mentioned above to investigate how Pask's discourse transformed from a view that considered architecture as a field governed by cybernetics to another that acknowledged architecture and cybernetics as fields that coexist.

2.1 Between Orders: A Brief History of Cybernetics for Architects

Cybernetics is a vast transdisciplinary field; thus, its history is complex. The account provided here is not intended as a general history; rather, it offers a brief introduction for the reader who is not knowledgeable about the origins and the evolution of the field.

Cybernetics as a field formally emerged in 1948 when Norbert Wiener, in his seminal book *Cybernetics: or Control and Communication in the Animal and the Machine,*[21] named it so. As the title suggests, Wiener defined cybernetics as a new field that was interested in common mechanisms that govern behavior in both living and non-living organisms. In a book titled *The* Human *Use of Human Beings*, which was published in 1950 as a less technical, popular companion to the original book, Wiener discussed this point by describing the purpose of cybernetics as "to develop a language and techniques that will enable [scientists] indeed to attack the problem of control and

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[21] Norbert Wiener, *Cybernetics: Or Control and Communication in the Animal and the Machine* (Cambridge, MA: The MIT Press, 1948).

communication in general, but also to find the proper repertory ideas and techniques to classify their particular manifestations under certain concepts."[22] The reason for proposing cybernetics as a domain-independent field and the need for inventing such a word as its name was explained by Wiener as follows:

> Thus, as far back as four years ago, the group of scientists about Dr. Rosenblueth and myself had already become aware of the essential unity of the set of problems centering about communication, control and statistical mechanics, whether in the machine or living tissue. On the other hand, we were seriously hampered by the lack of unity of the literature concerning these problems, and by the absence of any common terminology, or even a single name for the field. After much consideration, we have come to the conclusion that all the existing terminology has too heavy a bias to one side or another to serve the future development of the field as well as it should; and as happens so often to scientists, we have been forced to coin at least one artificial neo-Greek expression to fill the gap. We have decided to call the entire field of control and communication theory, whether in the machine or in the animal, by the name *Cybernetics*, which we form from the Greek *κυβερνήτης* or *steersman*.[23]

Even though this book gave cybernetics its name, the birth of the field went back to earlier research efforts during World War II by several scientists, among whom Wiener was a leading figure with his research on the development of anti-aircraft

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[22] Norbert Wiener, *The Human Use Human Beings* (London: Free Association Books, 1950), 17.

[23] Wiener, *Cybernetics: Or Control and Communication in the Animal and the Machine*, 11.

fire-control systems.[24] A paper titled "Behavior, Purpose and Teleology,"[25] by Arturo Rosenblueth, Norbert Wiener, and Julian Bigelow, published in 1943, is widely considered to be one of the founding papers of the field. In this paper, Rosenblueth, Wiener, and Bigelow investigated the types of behavior and emphasized the role of "purpose" and "feedback" behind "predictive behavior," drawing on examples from both living organisms and machines.[26] In another paper titled "A Logical Calculus of the Ideas Immanent in Nervous Activity", published in 1943, Warren McCulloch and Walter Pitts developed the first artificial neuron model that could calculate basic logical functions based on the neural activity of the human brain.[27] In 1945, John von Neumann contributed to the development of the first general-purpose, electronic, digital computer, ENIAC, that was being developed by John Mauchly and Presper Eckert at the University of Pennsylvania, and proposed what is now commonly called the "von Neumann architecture," which enabled the creation of computers such as EDVAC, that could be programmed to carry out different tasks.[28]

Research efforts such as these, which spanned several disciplines, ranging from mathematics to physiology, from engineering to computing, led to a series of meetings organized by Josiah Macy, Jr. Foundation between 1946-1953.[29] There were other such meetings organized previously by Josiah Macy, Jr. Foundation that

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[24] Wiener, 5–6.

[25] Arturo Rosenblueth, Norbert Wiener, and Julian Bigelow, "Behavior, Purpose, Teleology," *Philosophy of Science* 10, no. 1 (1943): 18–24.

[26] Rosenblueth, Wiener, and Bigelow, 22.

[27] Warren McCulloch and Walter Pitts, "A Logical Calculus of the Ideas Immanent in Nervous Activity," *Bulletin of Mathematical Biophysics* 5 (1943): 115–33.

[28] John von Neumann, *Theory of Self-Reproducing Automata*, ed. Arthur Burks (Urbana: University of Illinois Press, 1966).

[29] Claus Pias, *Cybernetics: The Macy Conferences 1946-1953, The Complete Transactions* (Berlin: Diaphenes, 2016).

brought together researchers from various disciplines, such as "Cerebral Inhibition Meeting" in 1942.[30] However, the series of ten meetings organized between 1946-1953 are commonly referred to as the "Macy Conferences" and are considered to be the milestone in the establishment of cybernetics as a field. Organized by Frank Fremont-Smith and moderated by Warren McCulloch, the meetings were extremely interdisciplinary, a feature deliberately aimed for by McCulloch.[31] They were attended by figures from various disciplines, including those mentioned above, and others, such as Margaret Mead and Gregory Bateson from anthropology, Heinz von Foerster from physics/engineering, Claude Shannon from mathematics/engineering, Ross Ashby from psychiatry, and Grey Walter from neurophysiology.[32]

As cited by Pias, von Foerster, who was the co-editor of the proceedings of the meetings together with Mead, drew on their interdisciplinary character by arguing that "the thing that is shared [at the Macy Conferences] is *not* simply a belief that the different disciplines ought to understand each other better, *nor* a single problem towards the solution of which the members are bending their differentiated and united efforts, but rather, an experiment with a set of conceptual models which seem to be useful right across the board and which themselves provide a medium of communication also – when shared."[33] As cited by von Foerster, this idea was also echoed by Mead in a later remark, as she talked about the significance of cybernetics as "a cross-disciplinary thought which made it possible for members of many disciplines to communicate with each other easily in a language which all could

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[30] Steve Joshua Heims, *The Cybernetics Group 1946-1953: Constructing a Social Science for Postwar America* (Cambridge, MA: The MIT Press, 1991), 14–30.

[31] Pias, *Cybernetics: The Macy Conferences 1946-1953, The Complete Transactions*, 11–13.

[32] Pias, *Cybernetics: The Macy Conferences 1946-1953, The Complete Transactions*.

[33] Pias, 14–15.

understand."[34] Andrew Pickering, who wrote extensively about cybernetics, especially about its history in the British context, argues that cybernetics, as a strongly interdisciplinary field, was also an "antidisciplinary" one, as "it rode roughshod over disciplinary boundaries."[35] Bernard Scott, who collaborated with Pask in the development of the conversation theory and published a book recently on the relevance of cybernetics for the social sciences, claims that cybernetics is not only interdisciplinary by facilitating communication between different knowledge domains but also it is "transdisciplinary" by sharing knowledge across disciplines and "metadisciplinary" by commenting on forms and procedures that constitute particular disciplines as distinct knowledge domains.[36] These descriptions, all fitting in illustrating a different dimension of it, point out the fact that cybernetics was proposed by its founders as, and still continues to be, a broad field rather than an established discipline. As such, cybernetics found itself a significant place in several disciplines with its ideas centering around the use of circular feedback mechanisms in both understanding and designing systems by virtue of the efforts of several scholars.[37]

Cybernetics witnessed a new wave of theorization in the late 1960s and the early 1970s, which led to the rise of "second-order cybernetics" (also referred to as the "cybernetics of cybernetics"). According to Ranulph Glanville, who wrote the

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[34] von Foerster, *Understanding Understanding: Essays on Cybernetics and Cognition*, 288.

[35] Andrew Pickering, *The Cybernetic Brain: Sketches of Another Future* (Chicago: The University of Chicago Press, 2010), 9.

[36] Bernard C.E. Scott, *Cybernetics for the Social Sciences* (Leiden-Boston: Brill, 2021), 56–57.

[37] Ross Ashby, *Design for a Brain: The Origin of Adaptive Behaviour* (London: John Wiley & Sons, 1952); Ross Ashby, *An Introduction to Cybernetics* (London: Chapman & Hall Ltd, 1956); Gregory Bateson, *Steps to an Ecology of Mind* (New York: Ballantine Books, 1972); Stafford Beer, *Decision and Control: The Meaning of Operational Research and Management Cybernetics* (Chichester: John Wiley & Sons, 1966).

dictionary entry for the second-order cybernetics in UNESCO's Encyclopedia of Life Support Systems (EOLSS), this new approach was initiated by Mead in the First Annual Symposium of the American Society for Cybernetics (ASC) in 1967.[38] As cited by Glanville, Mead characterized "cybernetics as a way of looking at things and as a language for expressing what one sees," and called for the application of "cybernetic understandings" to the "embodiment of cybernetics itself."[39]

Mead's proposal, which involved the application of cybernetic principles to itself, led to the development of a new epistemology. Ranulph Glanville argues that although many played roles in developing second-order cybernetics, only Heinz von Foerster; Humberto Maturana and Francisca Varela; and Gordon Pask and his colleagues made it a primary aim to construct an approach and epistemology of it.[40] Among them, von Foerster's efforts, together with his colleagues and students at the Biological Computer Laboratory (BCL) at the University of Illinois, Urbana-Champaign, was published in a book titled *Cybernetics of Cybernetics: or the Control of Control and the Communication of Communication* in 1974.[41] It was a class project of a course of the same name offered by von Foerster from 1973 through 1974 and included articles from both established figures such as Wiener, McCulloch, Ashby, Maturana, Beer, and Pask and those from the students of the course. The book was particularly significant with its graphic design features and other content, which involved ample use of diagrams, drawings, and sketches.[42]

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[38] Ranulph Glanville, "Second Order Cybernetics," in *Systems Science and Cybernetics*, Encyclopedia of Life Support Systems(EOLSS) (UNESCO, 2008), 7, https://www.pangaro.com/glanville/Glanville-SECOND_ORDER_CYBERNETICS.pdf.

[39] Glanville, 7–8.

[40] Glanville, 10.

[41] Heinz von Foerster, ed., *Cybernetics of Cybernetics: Or the Control of Control and the Communication of Communication* (Minneapolis: Future Systems Inc., 1995).

[42] von Foerster.

On the very first page of the book, von Foerster, very concisely and eloquently, defined the second-order cybernetics as “the cybernetics of observing systems,” in contrast to the first-order cybernetics as “the cybernetics of observed systems.”[43] This distinction relied on a clear epistemological position. Von Foerster denounced “objectivity” as “a peculiar delusion in [the] Western tradition” and the objectivist proposition that argued “the properties of the observer shall not enter the description of his observations” as “nonsensical.”[44] Instead, from a constructivist point of view, he asserted that the “world is only in our imagination and the only reality is the imagining ‘I’.”[45], which was also illustrated with a sketch by Pask (Figure 2.1). In line with this view, he proposed second-order cybernetics as a field that appreciated the connection between the observer and the observed, and as such, produced systems that involved the interaction of both. In his course description, he elaborated on this issue as the following:

> “First-Order Cybernetics” developed the epistemology for comprehending and simulating biological processes as, e.g., homeostasis, habituation, adaptation, and other first-order regulatory processes. “Second-Order Cybernetics” provides a conceptual framework with sufficient richness to attack successfully second-order processes as, e.g., cognition, dialogue, socio-cultural interactions, etc.[46]

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[43] von Foerster, 1.

[44] von Foerster, *Understanding Understanding: Essays on Cybernetics and Cognition*, 285.

[45] von Foerster, *Cybernetics of Cybernetics: Or the Control of Control and the Communication of Communication*, 222.

[46] von Foerster, xiii.

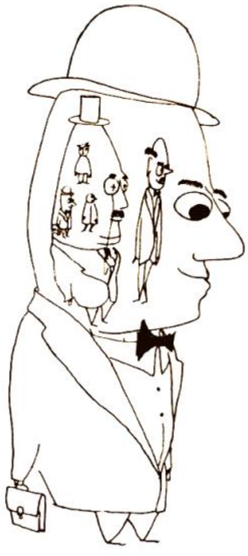

FIG. 2.

Figure 2.1. Pask's Illustration of von Foerster's Proposition, 1974. Source: Heinz von Foerster, Cybernetics of Cybernetics: or the Control of Control and the Communication of Communication (Minneapolis: Future Systems Inc., 1995), 222.

Maturana and Varela, who were also involved in research at von Foerster's Biological Computer Laboratory at the University of Illinois, Urbana-Champaign[47], followed the same epistemology in their work on the theory of autopoiesis, which was originally published in Spanish in 1972, and later in English under the name *Autopoiesis and Cognition: The Realization of Living* in 1980.[48] In this book, Maturana and Varela developed their theory of self-creation based on biological processes of living organisms with a constructivist epistemology that was embodied in their acclaimed statement regarding the role of the observer in cognition:

[47] Albert Müller, "A Brief History of the BCL: Heinz von Foerster and the Biological Computer Laboratory," in *An Unfinished Revolution? Heinz von Foerster and the Biological Computer Laboratory (BCL), 1958–1976*, ed. Albert Müller and Karl H. Müller (Vienna: Edition Echoraum, 2007), 288–89, https://web.archive.org/web/20130615072342/http://bcl.ece.illinois.edu/revolution/BriefHistBCL.pdf.

[48] Humberto Maturana and Francisco Varela, *Autopoiesis and Cognition: The Realization of Living* (Dordrecht: D. Reidel Publishing Company, 1980).

"Anything said is said by an observer."[49] According to them, by observing an entity who would also be itself, the observer created a description of it relative to its own interactions[50], which rendered their understanding of systems closely allied with von Foerster's.

2.2 Conversation as a Second-Order Cybernetic Theory

As yet another notable manifestation of second-order cybernetics, Pask's conversation theory was also built upon the same epistemology. Several aspects of the theory, which have been inspirations for many studies by architects discussed throughout the thesis, are examined in relevant parts. The following section provides a brief introduction to conversation theory by focusing on its epistemology and its position in second-order cybernetics. It also dwells on two early interactive machines produced by Pask, the Musicolour of the early 1950s and the Colloquy of Mobiles of 1968, which can be considered to have demonstrated fundamental aspects of the conversation theory though they were developed before it. These projects are also significant as they have acted as inspirations, like the theory itself, for several projects by architects discussed in the thesis.

Conversation theory was a large body of work, developed by Pask and his colleagues at Systems Research Ltd, a private research laboratory he founded in the 1950s. It was mainly published in two books, *Conversation, Cognition and Learning: A Cybernetic Theory and Methodology* and *Conversation Theory: Applications in Education and Epistemology*, in 1975 and 1976, respectively.[51] It was a continuation

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[49] Maturana and Varela, 8.

[50] Maturana and Varela, 8.

[51] Gordon Pask, *Conversation, Cognition and Learning: A Cybernetic Theory and Methodology* (Amsterdam: Elsevier, 1975); Gordon Pask, *Conversation Theory: Applications in Education and Epistemology* (Amsterdam: Elsevier, 1976).

of Pask's earlier studies starting from the 1950s up to the 1970s, which were brought together in an earlier two-book series, *An Approach to Cybernetics* and *The Cybernetics of Human Learning and Performance*, published in 1961 and 1975, respectively.[52] It was also the subject of a Social Science Research Council program titled "Learning Styles, Educational Strategies and Representation of Knowledge: Methods and Applications."[53] Conversation theory was originally conceived as "a new theory of learning and teaching" that resulted in applications in the field of education[54], but in fact, it was intended to be a more general second-order cybernetic theory that could be adopted in other fields. In Pask's own words, it was "an essay in [hu]man/[hu]man and [hu]man/machine symbiosis."[55] In essence, it was the culmination of Pask's more than twenty years of work on interaction and interactive systems.

Conversation theory involved several complex concepts and ideas such as P-/M-Individuals, levels of discourse in language, causal/inferential couplings, repertoires of procedures, etc., which were discussed in detail by Pask and his colleagues in various other instances.[56] In simple terms, conversation theory aimed to understand

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[52] Gordon Pask, *An Approach to Cybernetics* (London: Hutchinson, 1961); Gordon Pask, *The Cybernetics of Human Learning and Performance* (London: Hutchinson Educational, 1975).

[53] Pask, *Conversation, Cognition and Learning: A Cybernetic Theory and Methodology*, x.

[54] Gordon Pask, "Progress Report on Learning Styles, Educational Strategies and Representation of Knowledge: Methods and Applications," 1975, Gordon Pask Archive, University of Vienna-Department of Contemporary History.

[55] Pask, *Conversation Theory: Applications in Education and Epistemology*, ix.

[56] Gordon Pask, "Review of Conversation Theory and a Protologic (or Protolanguage), Lp," *Education Communication and Technology* 32, no. 1 (1984): 3–40; Bernard C.E. Scott, "Conversation Theory: A Constructivist, Dialogical Approach to Educational Technology," *Cybernetics and Human Knowing* 8, no. 4 (2001): 25–46; Bernard C.E. Scott, "Gordon Pask's Conversation Theory: A Domain Independent Constructivist Model of Human Knowing," *Foundations of Science* 6 (2001): 343–60; Bernard C.E. Scott, "The Cybernetics of Gordon Pask," in *Philosopher Mechanic: An Introduction to the*

and model exchanges between entities, whether they be humans, machines, or a combination of both, similar to those that would occur between two individuals conversing with each other. To this end, a model called a "strict conversation" was developed.[57] This model involved a "conversational language" (a natural or any other machine-readable language), whose rules were to be strictly obeyed by the participants; and a "conversational domain" which would typically come in the form of a representation of the topics to be dwelled upon on a subject matter.[58] In this model, "understanding" was given a specific connotation, where it was defined to have occurred if a participant learned or assimilated a topic from the conversational domain through the conversational language.[59]

The significance of this model as a second-order cybernetic framework came from its understanding of "understanding." In the scope of this specific model, understanding was defined as the basic unit of conversation that could be shared between the participants. In other words, the model was built upon the same epistemological position with von Foerster and Maturana discussed above, which considered direct information transfer between entities to be impossible, and, as such, it developed necessary methods and procedures to facilitate interaction based on understandings. The kind of exchanges that would spring from this model was described by Glanville as follows:

> Pask's conversational structures required at least two participants, the first of which presented some understanding (of some topic) to the second. The second took this presentation and built his/her own understanding of the first participant's understanding, presenting this understanding of an

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Cybernetician's Cybernetician, ed. Ranulph Glanville and Karl H. Müller (Vienna: Edition Echoraum, 2007).

[57] Pask, *Conversation Theory: Applications in Education and Epistemology*, 4.

[58] Pask, 4.

[59] Pask, 4.

> understanding in turn to the first participant. The first participant then makes an understanding of (the presentation of) the second participant's understanding of (the presentation of) the first participant's understanding, thus comparing his/her original understanding with the new understanding developed via the second participant's understanding. If these two understandings are close enough, the first participant can believe the second participant has made an understanding that is, at least operationally, similar to his/her original one.[60]

The model and the resulting complex exchange mechanism render the Paskian conversational approach a significant manifestation of second-order cybernetics. The model approaches participants of the conversation, whether humans or machines, equally, which elevates it to a genuine interactive framework. It eliminates the danger of creating a master-slave mechanism of fixed exchanges by establishing symmetry between the participants as conversational partners capable of learning, building, and exchanging understandings from what other has to offer.

Throughout his career, Pask always put a special emphasis on interaction even long before he wrote the conversation theory. He designed and built several artifacts, which were able to interact with humans or other artifacts based on the conversational mechanism discussed above. These artifacts were representative of his commitment to creating genuine interactive systems, and, as such, they can be considered precursors to the conversation theory.

The Musicolour (Figure 2.2) was one of the earliest artifacts Pask built together with Robin McKinnon-Wood in the early 1950s. It was described in detail in two papers by Pask: "The Conception of a Shape and the Evolution of Design," presented at the very first Conference on Design Methods in 1962, and "A Comment, a Case History

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[60] Ranulph Glanville, "Try Again. Fail Again. Fail Better: The Cybernetics in Design and the Design in Cybernetics," *Kybernetes* 36, no. 9/10 (2007): 1185.

and a Plan" published in the book *Cybernetics, Art and Ideas*, edited by Jasia Reichardt in 1971.[61]

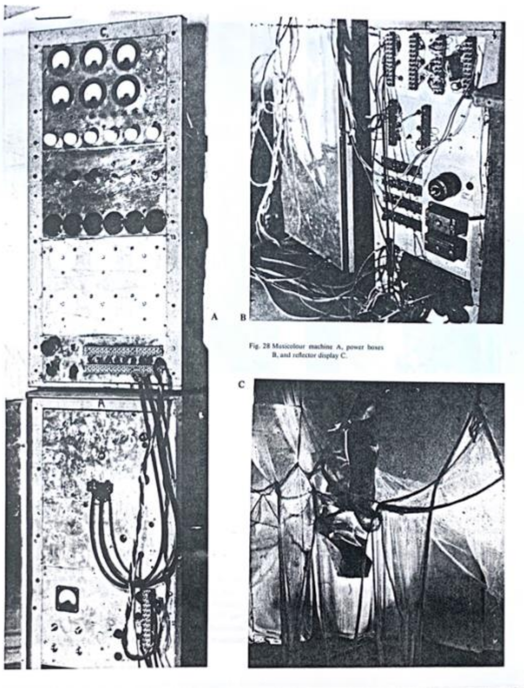

Figure 2.2. Different Components of the Musicolour Machine, ca. 1955. Source: Gordon Pask, "A Comment, a Case History and a Plan," in Cybernetics, Art and Ideas, ed. Jasia Reichardt (London: Studio Vista, 1971), 82.

The Musicolour was an adaptive light show machine with "spotlamps and a set of controlled optical filters, which [might] change the color of the lamp or the form of a projected image."[62] The machine was able to interact with a performer who played a musical instrument by interpreting their auditory input to create a changing visual display by the movement of the optical filters.[63] It had a "learning capability," which made it "able to modify the relation of the auditory vocabulary to the visual

[61] Gordon Pask, "A Comment, a Case History and a Plan," in *Cybernetics, Art and Ideas*, ed. Jasia Reichardt (London: Studio Vista, 1971), 76–99; Gordon Pask, "The Conception of a Shape and the Evolution of a Design," 1962, 153–67.

[62] Pask, "The Conception of a Shape and the Evolution of a Design," 164.

[63] Pask, 164.

vocabulary as the performance went on," which as a result made it able to become involved "in a close participant interaction" with the performer.[64] By virtue of this interaction, it could "co-operate" and "act as an extension of the performer" to achieve effects that could not be achieved otherwise."[65] This kind of a symbiotic relationship was achieved with the capability of the Musicolour to "get bored" through "adaptive threshold devices" (A.T.) (Figure 2.3), which made it "'direct its attention' to the potentially novel" if it was given a repetitive input.[66] This feature was described by Paul Pangaro as follows:

> If a performer played too long in the [same range of] pitch[es], Musicolour would "get bored" and drift its attention to a higher or lower range. The performer would notice its drifting attention from decreased responsiveness and seek to engage it again by changing his/her playing, thus engaging in a give-and-take with both human and machine reacting, each having multiple layers of action, learning, memory and goals. A key point here is that Musicolour explored a form of conversation with the human. And that was Pask's conscious intent. Beyond simple reactivity to the performer – presence of sound causing a light to flash, for example, quickly rather boring – Musicolour's intersecting loops of interaction and learning meant that each participant affected the other in a manner that was unexpected, evolving and persistent – all key elements of conversation.[67]

Although Musicolour was designed to be "an aid to a [musical] performer," Pask also argued that, with minimal alteration, it could be viewed as "an aid to a

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[64] Pask, "A Comment, a Case History and a Plan," 78.

[65] Pask, 78.

[66] Pask, 80.

[67] Paul Pangaro, "Questions for Conversation Theory or Conversation Theory in One Hour," *Kybernetes* 46, no. 9 (2017): 1579.

designer."[68] This proposition is particularly significant as it shows one of the earliest instances of Pask's persistent desire to promote his ideas in architecture and design fields. The Musicolour was indeed employed in architecture, although not the way Pask proposed it could be. Its ability to "get bored" inspired architects such as John and Julia Frazer, Stephen Gage, and Usman Haque, whose work is discussed in detail in the fifth chapter of the thesis.

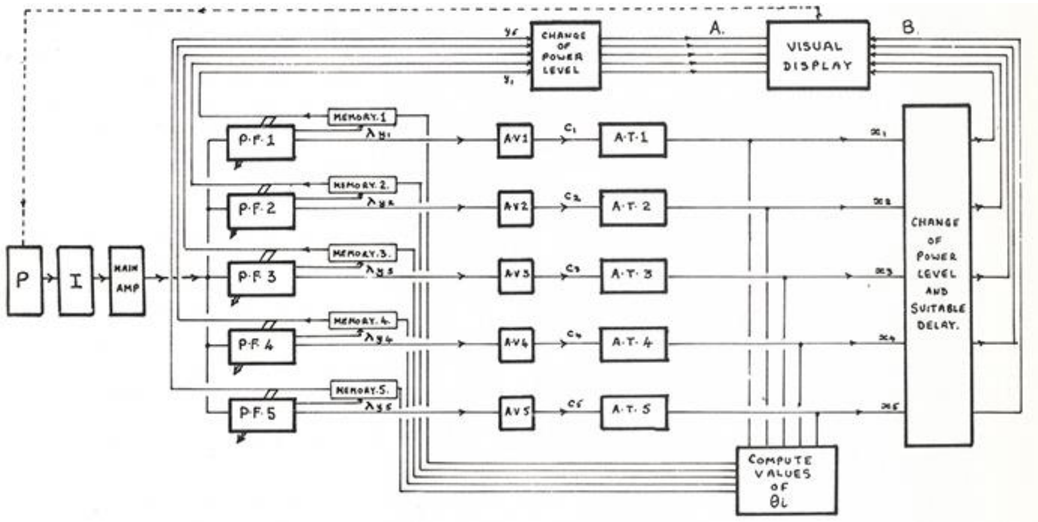

Figure 2.3. Internal Architecture of the Musicolour Machine, 1971. Source: Gordon Pask, "A Comment, a Case History and a Plan," in Cybernetics, Art and Ideas, ed. Jasia Reichardt (London: Studio Vista, 1971), 79.

Another notable machine designed and built by Pask before the conversation theory was called the Colloquy of Mobiles (Figure 2.4). This machine was in the form of a dynamic installation for the "Cybernetic Serendipity Exhibition" of the Institute of Contemporary Arts in London in 1968. The machine had quite complex exchange procedures, which were described in detail by Pask in "A Comment, a Case History and a Plan."[69] In simple terms, the machine functioned as follows: It had three female and two male figures (Figure 2.5), which could communicate with each other via

[68] Pask, "The Conception of a Shape and the Evolution of a Design," 166.

[69] Pask, "A Comment, a Case History and a Plan."

visual and audible signs.[70] Both the male and female figures had two kinds of drives. The goal of each male figure was to satisfy his drive by communicating with female figures via sending and receiving light beams and sound signals. But, to do so, they had to elicit the cooperation of a female figure which had a vertically positioned reflector capable of reflecting the light beam back to the male figure.[71] To satisfy their drives, male figures had to compete with each other as they were physically connected, which prevented them from acting independently. If a male and a female figure having the same drive could establish a connection, a further series of exchanges would take place, which would result in the satisfaction of their drives.[72] Humans too could enter the environment and participate if provided with means to produce visual signs.[73]

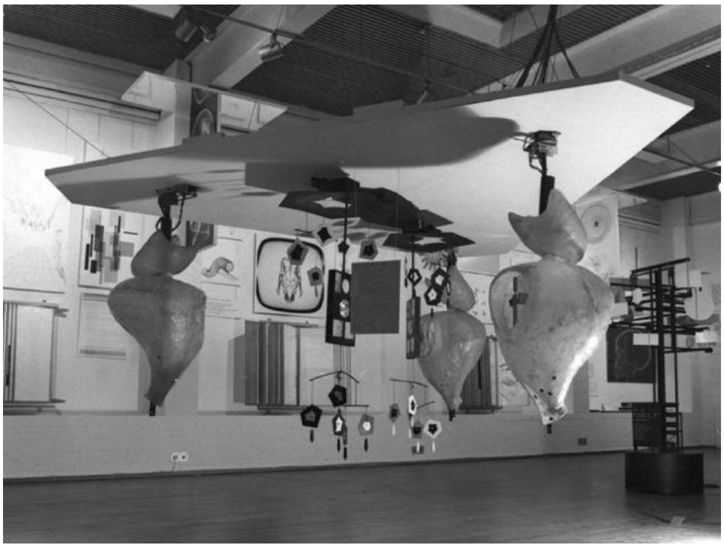

Figure 2.4. Photo of Colloquy of Mobiles at the Cybernetic Serendipity Exhibition, 1968. Source: http://www.medienkunstnetz.de/works/colloquy-of-mobiles/images/8

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[70] Pask, 89.

[71] Pask, 89.

[72] Pask, 90.

[73] Pask, 91.

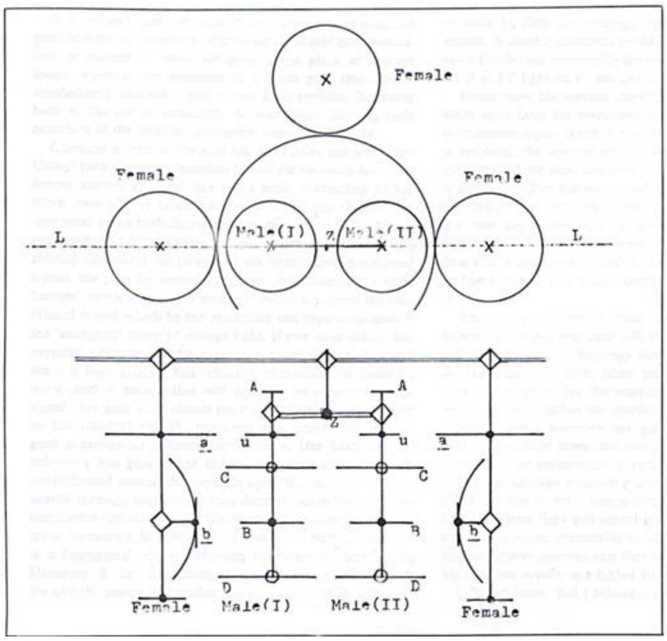

Figure 2.5. Plan and Elevation Diagrams of the Configuration of Colloquy of Mobiles. Source: Gordon Pask, "A Comment, a Case History and a Plan," in Cybernetics, Art and Ideas, ed. Jasia Reichardt (London: Studio Vista, 1971), 90.

The Colloquy of Mobiles, yet another manifestation of Pask's appreciation of interaction, was "a socially oriented, reactive and adaptive environment."[74] As discussed by Paul Pangaro and TJ McLeish, who built a replica of the installation in 2018 and exhibited it at the "Neurons: Simulated Intelligence" exhibition at the Pompidou Center in 2020 (Figure 2.6), the Colloquy of Mobiles "explored the nature of machine-to-machine and person-to-machine conversations in an interactive, immersive environment" (Pangaro and McLeish 2018, p.1)

[74] Pask, 88.

Figure 2.6. A Photo of Colloquy of Mobiles at the Pompidou Center, 2020. Source: Author.

2.3 Gordon Pask's Evolving Discourse on Architecture

Among many attempts at translating Paskian concepts and ideas into architecture, two papers produced by Pask bear a strong significance as general theoretical discussions among many practical applications discussed throughout the thesis: "The Architectural Relevance of Cybernetics," which was published in Architectural Design (AD) magazine in 1969 and widely celebrated by cybernetically inclined architects since then; and, "An Initial Essay: Towards a Unification of Architectural Theories," which was produced in the early 1980 and remained as an unpublished manuscript preserved at the Gordon Pask Archive.[75] This part focuses on these two articles with a particular interest in the ideas developed in them regarding the relationship between the fields of architecture and cybernetics to scrutinize Pask's

[75] Pask, "The Architectural Relevance of Cybernetics"; Pask, "An Initial Essay: Towards a Unification of Architectural Theories."

evolving discourse on architecture. In doing so, this section identifies a transformation in Pask's discourse from architecture as a field governed by cybernetics raised in the former article, to architecture and cybernetics as fields that coexist in the latter.

"The Architectural Relevance of Cybernetics" was published in the September issue of Architectural Design, titled "Despite Popular Demand, AD is Thinking about Architecture and Planning," guest-edited by Royston Landau in 1969. In addition to Pask's article, the issue presented an unusual mixture of contributions by leading figures from architecture, such as Stanford Anderson, Cedric Price, Nicholas Negroponte, and David Greene, alongside those from outside the discipline, such as Karl Popper, Imre Lakatos, and Warren Brodey. A sequel to this issue, also guest-edited by Landau, published in 1972, titled "Complexity," brought together, in a similar way to the previous issue, insights from a wide variety of fields, including those from figures such as Lancelot Law Whyte, Stafford Beer and Geoffrey Vickers alongside Pask, who contributed with his article, "Complexity and Limits."[76] These two issues exemplify a prevalent multidisciplinary attitude that aimed to draw insights from the then rising fields, such as cybernetics and general systems theory, to architecture in the UK at that period. A different reflection of this attitude in architectural education is discussed in the second chapter of the thesis with regard to the unorthodox curriculum deployed at the Architectural Association, School of Architecture (AA) in the 1960s and the 1970s.

In "The Architectural Relevance of Cybernetics," Pask proposed cybernetics as a unifying theory for architecture. He did so by providing an account of architecture from his own perspective. He argued that the way architecture was practiced "in or before the early 1800s" was dominated by "pure architecture rules," which were sort

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[76] Gordon Pask, "Complexity and Limits," *Architectural Design* 42, no. 10 (1972): 622–24.

of canons according to which the buildings were designed and evaluated by architects.[77] According to him, architects' brief was quite narrow, and all problems could be solved by applying those rules, which were largely determined by the ”quite rigid codes” and the ”conventions of society or the individual practitioner.”[78] According to this view, ”architects did not need to see themselves as system designers, even though they designed systems.”[79] However, Pask asserted that new techniques were assimilated, and new problems like designing a railway station or a great exhibition were posed in the course of the 1800s, which could not be solved by applying the pure architecture rules.[80] As a result of this process, he claimed, architects were forced ”to take an increasing interest in the organizational (i.e., non-tangible) system properties of development, communication and control.”[81] But, he also argued that architecture did not have a general theory to represent this understanding; instead, there were ”essentially cybernetic sub-theories” which were ”dealing with isolated facets of the field” throughout the whole process.[82] Thus, he proposed to collect ”the isolated sub-theories together by forming a generalization from their common constituents”, namely, ”the notions of control, communication and system,” and proposed cybernetics as a candidate for this undertaking. [83] He dwelled on this idea as the following:

> Cybernetics is a discipline which fills the bill insofar as the abstract concepts of cybernetics can be interpreted in architectural terms (and, where appropriate, identified with real architectural systems), to form a theory

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[77] Pask, “The Architectural Relevance of Cybernetics,” 494.

[78] Pask, 494.

[79] Pask, 494.

[80] Pask, 494.

[81] Pask, 494.

[82] Pask, 494.

[83] Pask, 496.

(architectural cybernetics, the cybernetic theory of architecture).[84]

According to Pask, the cybernetic theory of architecture had what he called the ”predictive power,” meaning that it could accommodate adaptive architectural systems that could evolve according to changes in the behavior of both the environment and the inhabitants, in contrast to pure architecture, which was ”descriptive (a taxonomy of buildings and methods) and prescriptive (as in the preparation of plans).”[85] And, he claimed, if the cybernetic theory of architecture was adopted, Le Corbusier’s famous proposition of the house as a “machine for living in” would be ”refined into the concept of an environment with which the inhabitant cooperates and in which he can externalize his mental processes.”[86]

This article represented a significant stage in Pask’s discourse on architecture, as it clearly demonstrated his understanding of the relationship between the fields of architecture and cybernetics as of 1969 with its bold assertions and propositions. In this particular and rather provoking view, Pask pictured the field of architecture, based on a coarse review of a number of architects and their projects predominantly from the British context in the 1800s, as having been governed by essentially cybernetic sub-theories, and urged for cybernetics as a general unifying theory. With an undertone that placed cybernetics in a superior position to architecture, he ascribed cybernetics the power to act as the theory of architecture, and regarded architecture as a field governed by cybernetics.

After nearly fifteen years, Pask indulged in another attempt at promoting cybernetics as a unifying theory for architecture in his unpublished draft manuscript, “An Initial Essay: Towards a Unification of Architectural Theories.” Although the manuscript

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[84] Pask, 494.

[85] Pask, 496.

[86] Pask, 496.

has no indication of date, it is thought that it was produced in the early 1980s, most likely in 1983, with regard to another document held in the Gordon Pask Archive in which it was mentioned: In a draft letter written to Alvin Boyarsky, then the chairperson of the AA, listing his plans for the 1983-1984 academic year as a part-time tutor, Pask talked about, amongst several other things, an essay he produced, titled "Towards a Theory of Theories of Architecture," to be published in a collection edited by Micha Bandini.[87] Considering the remarkable similarity between the two titles and the fact that neither such a collection nor such an essay under this title in some other publication could be identified, it is safe to assume that these two articles were the same. This implies "An Initial Essay" was produced, or at least existed in some form, in 1983.

In this article, Pask essentially argued that there was a need for "a unifying and synthetic approach which [might] tie together the very different theories of architecture" and proposed his conversation theory as a candidate for this task.[88] In doing so, he emphasized the constructivist epistemology of conversation theory, which he argued to be fitting as a theory of architecture.[89] In the first part of the article, he focused on what he considered to be peculiar features of architecture that made it difficult to theorize in, as opposed to the "standard tricks employed in constructing and testing a scientific theory."[90] With reference to Glanville, he argued that architectural design was "a different game from the game played by scientists, or even most philosophers of science, when they construct hypotheses and elect some of them to the status of theories."[91] He also claimed that an objectivist epistemology

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[87] Gordon Pask, "Letter to Alvin Boyarsky with Proposal for Work Year 1983-1984," ca 1983, Gordon Pask Archive, University of Vienna-Department of Contemporary History.

[88] Pask, "An Initial Essay: Towards a Unification of Architectural Theories," 2.

[89] Pask, 18.

[90] Pask, 2.

[91] Pask, 2.

("an orthodox theoretical stance"), which held that an observer or an experimenter was independent from their observations, and, as such, they might consider some statements factually true or false, was not characteristic of architecture.[92] He elaborated on this point as follows:

> The logic of architecture is seldom a logic of "true" and "false" or "probability" or "fuzzy evaluation". There are occasions when these truth values prove to be appropriate; for example, in the context of engineering or energetics, or to statements made in the formalisable part of the language used by architects, clients, students and teachers. In general, however, a piece of architecture, or a series of evolving designs is neither true or false. It is coherent or not.[93]

In the second part of the article, he argued for the merits of conversation theory which rendered it applicable as an interactionist theory in architecture with regard to its epistemological position. In doing so, he argued that the conversation theory belonged to the philosophical traditions of dialectics and hermeneutics.[94] Regarding dialectics, he referred to the origins of the term "dialectic" in the classical philosophy as a process of debate characterized by the stages of thesis, antithesis, and synthesis[95], which is compatible with his understanding of conversation as a process between two entities that involve coming to know agreements and disagreements between them. Regarding hermeneutics, on the other hand, he discussed the "hermeneutic circle" as "a non-viciously circular process," incorporated in the conversation theory through the interaction of participants in reaching common

[92] Pask, 2–3.

[93] Pask, 8.

[94] Pask, 19–20.

[95] Pask, 19.

understandings.[96] Here, Pask referred to an article by Charles Taylor, titled "Interpretation and the Sciences of Man" published in 1971 that discussed the possibility of "a science of interpretation," or "a hermeneutical science" that embraced hermeneutic circle as a viable process in conducting scientific activity, in contrast to the empiricist epistemological tradition of science that relied on verification.[97] Also of note here is the fact that, though Pask did not refer to Hans-Georg Gadamer's work on hermeneutics, which was first published as a book in German in 1960, and later translated to English under the title *Truth and Method* in 1975[98], his work conformed to Gadamer's to a great extent. Although it has not been possible to identify whether Pask was aware of Gadamer's work during either the development of the conversation theory or the writing of the "An Initial Essay," they shared a common position regarding the use of a literal conversation between two individuals as a model in developing their theories and epistemologies. Gadamer's discussion of conversation as equivalent to hermeneutics in the spoken realm[99], and his understanding of conversation as a process of reaching an understanding on a subject matter based on a common language[100], had strong parallels with Pask's approach.

This article is notable as one of the most significant theoretical attempts by Pask at promoting his concepts and ideas in architecture. But, it is also critical in the sense that it demonstrates the continuities and discontinuities in his discourse. Regarding the continuities, it is possible to argue that he essentially proposed the same idea with the former article, when he argued for the possibility of benefitting from the concepts

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[96] Pask, 20.

[97] Charles Taylor, "Interpretation and the Sciences of Man," *The Review of Metaphysics* 25, no. 1 (1971): 3–51.

[98] Hans-Georg Gadamer, *Truth and Method* (London: Continuum, 1975).

[99] Gadamer, 367–404.

[100] Gadamer, 371–73.

and ideas developed around the conversation theory to arrive at a unifying theory for architecture. In this sense, both articles promoted the relevance of cybernetics, whether in general terms or through its specific theories, for architecture, and, as such, they may be thought to have completed each other. However, the two texts differed considerably regarding Pask's understanding and representation of what architecture was as a field. In the former article, he boldly asserted that architecture did not have a qualified theory based on a limited historical review, and proposed cybernetics to remedy this defect. While, in the later article, he emphasized shared features of architecture and cybernetics, which rendered them in the domain of constructivist epistemology. In other words, in the former article, he put cybernetics in a hierarchically superior position to architecture, whereas, in the latter, he highlighted the similarities between the two. In this sense, it may be concluded that his discourse on architecture evolved from one that considered architecture as a field governed by cybernetics to another that acknowledged architecture and cybernetics as fields that coexist.

CHAPTER 3

ARCHITRAINER: A PASKIAN INTERACTIVE MACHINE AT THE INTERSECTION OF ARCHITECTURE, CYBERNETICS, PSYCHOLOGY AND TECHNOLOGY

> You have now successfully completed all those exercises required for the learning of a single construct. This pattern of exercises will be repeated for every construct in the client's construct system, until you are familiar with all of them. The presentations will differ only in that the text will be somewhat briefer than that necessitated in the introductory exercises.
>
> The next construct to be considered is construct B. The alternative descriptions given by the client for this construct are as follows:
>
> Likeness End: modern
>
> Contrast End: traditional
>
> We go on now to the first exercise in construct B.[101]

Above is a quote from a text output that could be read on the display of ARCHITRAINER, whose purpose was to make architects familiar with their client's views on some architectural topics. It was an interactive computer program inspired by theories and methods from cybernetics and psychology that was designed by Chris Abel at the Architecture Machine Group at MIT in the early 1970s. In its proper definition, ARCHITRAINER was "an interactive computer game" that used

[101] Chris Abel, "Instructional Simulation of Client Construct Systems" (Architectural Psychology Conference, Sheffield: University of Sheffield, 1975), 36.

"techniques derived from interpersonal psychology and computer-aided instruction (CAI) to simulate 'dialogues' between student architects and hypothetical clients."[102] In the specific case above, having learned their client's first personal construct, the architect is prompted to the next one, which is described by the client to be characterized by the polarity between modern and traditional.

This chapter brings this ambitious yet overlooked project forward as an extraordinary multidisciplinary endeavor situated at the intersection of architecture, cybernetics, psychology, and technology. It provides an in-depth examination of the historical context it was developed in, the theoretical and methodological precedents it was established upon, and the fundamental principles and techniques it operated by, based on both archival and published materials. In doing so, it dwells on the period spanning from the 1960s to the 1970s with respect to issues such as new pedagogical approaches in architectural design education, strong connections between architecture and technology, and the wide dissemination of constructivist epistemology across disciplines. At the same time, the chapter presents the relationship between Chris Abel and Gordon Pask as a significant episode of Pask's unorthodox connection to the field of architecture by concentrating on their collaborations in detail. In general, the chapter recognizes the ARCHITRAINER as an instance of machine intelligence research in architecture inspired by Paskian concepts and ideas, and, raises this overlooked project as a significant exemplar of what is proposed to be the Paskian school of architectural cybernetics.

The chapter is organized into three main parts. The first part focuses on the relationship between Chris Abel, Gordon Pask, and Nicholas Negroponte, which was crucial to both the conception and the realization of the project. The second part provides a brief overview of the cybernetic and psychological precedents that acted

[102] Chris Abel, *Architecture & Identity: Responses to Cultural and Technological Change*, 2nd ed. (Oxford: Architectural Press, 2000), 33.

as inspirations for the project. And the final part dwells on the specifics of how the system worked with a focus on its significance.

3.1 A Fruitful Union: Abel, Pask, and Negroponte

The relations between Abel, Pask, and Negroponte played a significant role in developing the ARCHITRAINER project. Thus, this section offers a detailed account of their intermeshed stories in the late 1960s and the early 1970s, focusing on several of their academic and professional collaborations. In doing so, the section also brings forward the unorthodox pedagogies and transdisciplinary frameworks employed at the time at some architectural education institutions in the UK and the US as a significant and effective background that brought about the development of ARCHITRAINER.

In a personal interview, Abel stated that the first collaboration between Pask and him occurred at the beginning of the 1967-68 academic year when Pask was identified as what was called "an external tutor" for him in his final year at the Architectural Association (AA).[103] This opportunity was offered only to highly regarded students in their final years to allow them to be aided in their thesis work by leading figures from different disciplines.[104] A bounded manuscript of Abel's completed thesis, titled "Adaptive Urban Form: A Biological Model,"[105] preserved at the Gordon Pask

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[103] Chris Abel, Interview with Chris Abel, interview by Ensar Temizel, In-Person, February 25, 2020. Diaries of Systems Research Ltd (Pask's research laboratory) preserved at the Gordon Pask Archive show that the two knew each other before this instance. Abel, along with other students from the AA, such as Ranulph Glanville and Stephen Gage visited Pask at his office. But, Abel's thesis can be considered the first instance of a relationship that grew deeper in the coming years.

[104] Abel.

[105] Chris Abel, "Adaptive Urban Form: A Biological Model" (Diploma Thesis, London, The Architectural Association (AA), 1968), Gordon Pask Archive, University of Vienna-Department of Contemporary History.

Archive with hand-written notes and suggestions by Pask, demonstrates how systems theory and cybernetics were greatly influential on Abel's work. Contrary to the common practice at the AA at that period, where students were expected to produce a specific design project[106], Abel's thesis was more of a theoretical treatise. The study criticized the city planning practices of the time and proposed a model of what Abel called "a creative process" to analyze properties of urban environments, which he conceptualized as "self-organizing," "multiloop feedback systems" with reference to several leading figures from cybernetics such as Ross Ashby, Stafford Beer, Norbert Wiener, and Pask.[107] A later remark from an article he wrote in a special issue of Architectural Design (AD) magazine on selected thesis projects of students from the AA shows how he cherished the multidisciplinary approach he employed in his thesis and advocated its necessity for architectural education as follows:

> In coming to such an understanding we shall probably enlist the aid of cross-disciplinary sciences that up till now have been thought of as alien to planning and design. […] It is going to take interdisciplinary resources of a radical nature to foster this approach. The architectural school as we know it is too limited in its context to meet the demand; the appropriate resources will probably be found only within the full gamut of a university system. Even then it's not certain they will be made suitably available. If though, the right academic framework can be achieved, and the most is to be made of it, the schools could begin now by shedding the prejudices that still gear the architect to chiefly visual delights.[108]

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[106] Abel, Interview with Chris Abel.

[107] Abel, "Adaptive Urban Form: A Biological Model," 4–5.

[108] Chris Abel, "Mobile Learning Stations," *Architectural Design* 39, no. Special Issue (1969): 151.

Though Abel's thesis marked the first collaboration between Abel and Pask, it was not the first time Pask was involved with architecture. His first interaction with architecture took place a couple of years prior when Cedric Price and Joan Littlewood invited him to participate in the famous Fun Palace project.[109] As thoroughly discussed in the fourth chapter of the thesis, he established and chaired the Fun Palace "Cybernetics Committee" and produced several documents that gradually shifted the focus of the Fun Palace from an experimental theater venue to a cybernetic interactive machine. This successful initiation allowed him to further engage with architects within the AA circle. He was invited to several architectural reviews by Peter Cook, Royston Landau, Alvin Boyarsky, and George Balcombe; and lectured on various occasions at the AA throughout the 1960s.[110] His role as the external tutor for Abel's thesis, which Cook supervised, should be considered an extension of this long-term connection.

The relationship between Abel and Pask grew more profound in the following years after Abel graduated from the AA. Nonetheless, according to Abel, his introduction to systems theory and cybernetics was not through Pask, as he was already experimenting with biological and cybernetic concepts in his studies before the two started working closely together.[111] A project he designed in early 1967, called Mobile Learning Stations, was partly inspired by Price's work on Fun Palace and Potteries Thinkbelt projects.[112] In this project, Abel designed mobile learning units to be installable at both existing and future schools that would be programmed to

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[109] Price, "Gordon Pask," 819.

[110] Gonçalo Furtado, *Pask's Encounters: From a Childhood Curiosity to the Envisioning of an Evolving Environment* (Vienna: Edition Echoraum, 2009), 75–82.

[111] Abel, Interview with Chris Abel.

[112] Chris Abel, *Architecture & Identity: Responses to Cultural and Technological Change*, 3rd ed. (New York: Routledge, 2017), 65.

form variable spaces by means of an electro-magnetic grid on the floor.[113] The stations were designed in such a way that they could combine or split off like the biological organisms that inspired them, providing an evolving architectural environment that could be adapted based on users' needs.[114] Urban planning theorist Melvin Webber, whom Abel met in the summer of 1967, several months before Pask, was also influential in Abel's introduction to systems theory and cybernetics.[115] Webber recommended Abel read James Grier Miller's paper on "living systems,"[116] thus introducing him to general systems theory.[117] Following from there, Abel became exposed to "a whole new world of interdisciplinary thought," which acted as a core for his thesis.[118]

After graduating from the AA, Abel published two seminal articles based mainly on his thesis in Architectural Design (AD) magazine in 1968 and 1969. In the former, titled "Evolutionary Planning,"[119] he argued that "the fragmentation of urban form accurately reflects the fragmentation of modern urban societies, in contrast to the idealistic images of compact urban form then propagated by architects and urban designers."[120] In this article, he criticized the popular megastructure projects of the time as not being "capable of absorbing change" due to their compact, rigid form

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[113] Abel, "Mobile Learning Stations," 151.

[114] Abel, *Architecture & Identity: Responses to Cultural and Technological Change*, 2017, 66.

[115] Abel, Interview with Chris Abel.

[116] James Grier Miller, "Living Systems: Basic Concepts," *Behavioural Science* 10, no. 3 (1965): 193–237.

[117] Abel, *Architecture & Identity: Responses to Cultural and Technological Change*, 2017, 2.

[118] Abel, 2.

[119] Chris Abel, "Evolutionary Planning," *Architectural Design* 38, no. December (1968): 563–64.

[120] Abel, *Architecture & Identity: Responses to Cultural and Technological Change*, 2017, 3.

against "self-organizing model of urban dispersal" as a form of urban development that is more appropriate for an evolutionary approach to urban planning.[121] In the latter, titled "Ditching the Dinosaur Sanctuary,"[122] he dwelled upon "the potential consequences of the coming cybernetic revolution for architectural design and production" and argued that "architects' addiction to the idea of a standardized, mass-produced architecture was based more on ideological principles than any professional understanding of how things were actually made in conventional factories, let alone what emergent computer-based systems promised."[123] Based on his research in his thesis on "System 24 flexible manufacturing system" that was developed by a firm based in London by linking together a number of numerically controlled machines (commonly referred to as CNC machines), Abel provided the first coherent critique of architects' obsession with mass-production methods, declaring them redundant in the face of emergent systems of flexible, computer-based manufacturing.[124]

In the 1969-70 academic year, Abel enrolled in the Brunel University, Department of Cybernetics as a student of Pask.[125] This incident acted as a stepping stone for succeeding academic and professional collaborations between the two, eventually leading to the development of ARCHITRAINER. Their activity during this period can be followed by several letters and reports preserved at the Gordon Pask Archive.

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[121] Abel, 19–29.

[122] Chris Abel, "Ditching the Dinosaur Sanctuary," *Architectural Design* 39, no. August (1969): 419–24.

[123] Abel, *Architecture & Identity: Responses to Cultural and Technological Change*, 2017, 3.

[124] Abel, 30–44.

[125] "Postgraduate Research in Cybernetics" (Brunel University-Institute of Cybernetics, 1970), Gordon Pask Archive, University of Vienna-Department of Contemporary History.

In almost all of those exchanges, as in the instances mentioned above, one can see how systems theory and cybernetics were profoundly dominant in Abel's discourse.

To illustrate, a draft document from the Gordon Pask Archive titled "Design Yourself an Architect: A Proposal to Students of Architecture,"[126] produced by Abel upon a request from the AA for a possible one-day-a-week contract as a tutor in 1970, was brimming with ideas from cybernetics. In this document, Abel contemplated the relationship between architects and the environment in which they designed by referring to the "observed and observing systems," a conceptualization offered by Heinz von Foerster and the members of his Biological Computer Lab (BCL) at the University of Illinois, Urbana-Champaign around the same time to characterize the difference between the first-order and second-order cybernetics.[127] Translating this conceptualization into the realm of architecture, he proposed to consider architects a part of the environment in which they designed by arguing the following:

> The proposition is that a 'problem' exists not in some system separate from the problem-solver – in this case we might as well call him an architect – but in a system which <u>includes</u> him. The problem exists, in fact, in the system that describes the relationship between the two: some chosen set of attributes in the environment, <u>and</u> in the architect. The role of the architect, therefore, may only be specified by specifying the system: ARCHITECT/ENVIRONMENT. It is the appreciation of this intimate relationship that constitutes objective awareness on the part of the architect of his activities. In this sense, the

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[126] Chris Abel, "Design Yourself an Architect: A Proposal to Students of Architecture," 1970, Gordon Pask Archive, University of Vienna-Department of Contemporary History.

[127] von Foerster, *Cybernetics of Cybernetics: Or the Control of Control and the Communication of Communication*.

> architect 'steps out of himself' and observes himself as an internal part of a system.[128]

A research proposal from 1971, developed as part of Abel's doctoral studies, also deserves mention here as it may be considered a direct precursor to ARCHITRAINER. The proposal, also preserved at the Gordon Pask Archive, aimed at studying "the development of a design project within the Inner London Education Authority's (ILEA) programme of secondary school building" to illustrate "the principle features of decision processes involved and to identify any problems of communication that might arise between interested parties during the development work."[129] The final product of the project would be in the form of a simulation which could be used either "as a research tool designed to explain the nature of the process involved," or "as a training device for teaching particular members of the development team the decision making context in which they must operate."[130] In a similar way to ARCHITRAINER that succeeded it, the project was essentially aimed at developing a teaching machine that could be used as an aid in the execution of architectural operations. However, according to a letter from the Gordon Pask Archive, sent to Frank George, then the director of the Cybernetics Department at Brunel University, where Pask reported on the progress of his doctoral students, the project couldn't be completed due to the eventual decision of ILEA's executives not to allow the collection of certain data that was essential to its conduct, although they promised support initially.[131]

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[128] Abel, "Design Yourself an Architect: A Proposal to Students of Architecture," 1.

[129] Chris Abel, "Research Proposal to Inner London Education Authority," 1971, 1, Gordon Pask Archive, University of Vienna-Department of Contemporary History.

[130] Abel, 2.

[131] Gordon Pask, "Notes on Student Progress," 1971, Gordon Pask Archive, University of Vienna-Department of Contemporary History.

ARCHITRAINER, as yet another project in the form of a teaching machine, can be considered the culmination of Abel and Pask's joint efforts. Its developmental phases can be followed by several letters and draft documents exchanged between Abel, Negroponte, and Pask throughout 1972, available at the Gordon Pask Archive.[132] From those exchanges, it can be understood that Pask was greatly influential in both the conception and the realization of the project. Especially, his close contact with Negroponte, which is discussed in the following paragraphs, played a significant role as it made it possible for Abel to benefit from the state-of-the-art computational resources available to the Architecture Machine Group at MIT as a research affiliate for one semester to conduct the necessary project work there. Pask arranged the invitation and the funding for this visit and suggested Abel reading the works of George Kelly and Ronald David Laing from the field of psychology, which later turned out to be essential pillars that the project was built upon.[133]

Initially, the project was called "The Psychology of Architectural Style," and its definition did not involve a simulation of the relationship between the architect and the client.[134] Although the method was the same as the final version, the goal of the project was determined at this initial stage as the "identification of architects into

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[132] Gordon Pask, "Letter to Chris Abel," May 24, 1972, Gordon Pask Archive, University of Vienna-Department of Contemporary History; Chris Abel, "Letter to Gordon Pask," February 8, 1972, Gordon Pask Archive, University of Vienna-Department of Contemporary History; Chris Abel, "Letter to Gordon Pask," May 3, 1972, Gordon Pask Archive, University of Vienna-Department of Contemporary History; Chris Abel, "Letter to Nicholas Negroponte," October 19, 1972, Gordon Pask Archive, University of Vienna-Department of Contemporary History; Chris Abel, "Letter to Nicholas Negroponte," October 31, 1972, Gordon Pask Archive, University of Vienna-Department of Contemporary History; Gordon Pask, "Letter to Nicholas Negroponte," May 9, 1972, Gordon Pask Archive, University of Vienna-Department of Contemporary History.

[133] Abel, Interview with Chris Abel.

[134] Chris Abel, "The Physcology [Sic] of Architectural Style," 1972, Gordon Pask Archive, University of Vienna-Department of Contemporary History; Chris Abel, "The Psychology of Architectural Style-Note of Progress," 1973, Gordon Pask Archive, University of Vienna-Department of Contemporary History.

physcological [*sic*] types according to their response to architectural material presented to them."[135] Nevertheless, at a later stage, the project name changed to the more concise and powerful ARCHITRAINER, as did the content that took shape during Abel's visit to the US.

Some specifics of Pask's relationship with Negroponte also deserve mention here, considering its significance in the realization of ARCHITRAINER. Among several other collaborations throughout the 1970s, Pask's introduction[136] to Negroponte's book, *Soft Architecture Machines,*[137] can be considered the most significant example that explicitly shows the extent of their relationship. In this introduction, Pask wrote about the structure of conversations as envisaged in his conversation theory and argued for its ability to model the human-machine interaction in architecture. Through a total of ten hand-drawn diagrams (Figure 3.1), he proposed an "architecture machine" that can act as a partner to a human designer.[138]

HUNCH and Graphical Conversation Theory projects developed by the Architecture Machine Group were also significant instances of Pask and Negroponte's close relationship. HUNCH was a digital drawing system that attempted to recognize its users' sketches based on Pask's conversation theory.[139] Graphical Conversation Theory, on the other hand, was a five-year, ultimately unsuccessful grant proposal to the National Science Foundation (NSF) that included $1.42 million worth of

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135 Abel, "The Physcology [Sic] of Architectural Style."

136 Gordon Pask, "Introduction to Aspects of Machine Intelligence," in *Soft Architecture Machines*, by Nicholas Negroponte (Cambridge, MA: The MIT Press, 1975).

137 Nicholas Negroponte, *Soft Architecture Machines* (Cambridge, MA: The MIT Press, 1975).

138 Pask, "Introduction to Aspects of Machine Intelligence."

139 Liss C. Werner, "HUNCH 1972: A Second Experiment in Sketch Recognition or: 'I Know the Concept of Your Concept of Interpolation,'" in *Graphic Imprints: The Influence of Representation and Ideation Tools in Architecture*, ed. Carlos L. Marcos (Springer, 2019), 6.

projects aimed at uniting computer graphics, conversation theory, and a number of research projects under one umbrella.[140]

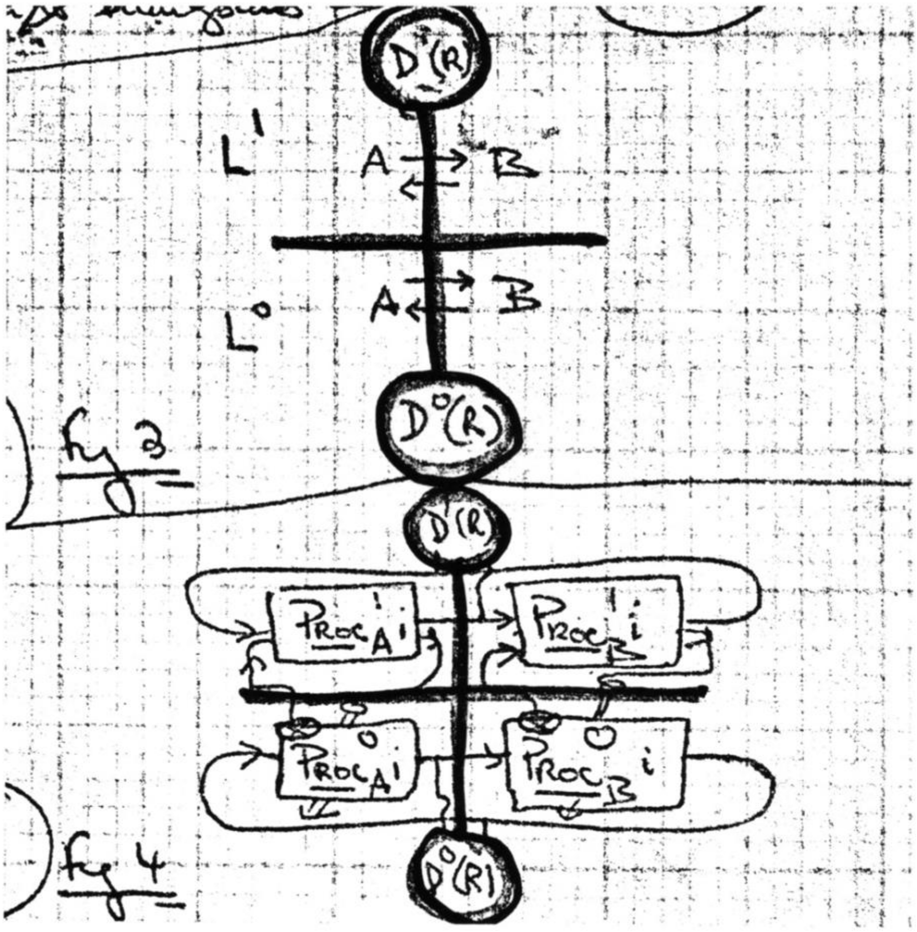

Figure 3.1. Diagrams (No:3-4) of Architecture Machine Drawn by Pask, ca. 1973. Source: Nicholas Negroponte, Soft Architecture Machines (Cambridge, MA: The MIT Press, 1975), 29.

Apart from those individual instances, the Architecture Machine Group played a significant role in architecture and technology research in the late 1960s and the 1970s, with its emphasis on transdisciplinarity. Established around the time when

[140] Molly Wright Steenson, *Architectural Intelligence: How Designers and Architects Created the Digital Landscape* (Cambridge, MA: The MIT Press, 2017), 193–94.

the School of Architecture and Planning at MIT were altering its curriculum and pursuing new research models, the group transformed architectural design research significantly with the development of a unique transdisciplinary framework that integrated architecture with engineering and computing, and, made it possible to acquire funding from military agencies such as Advanced Research Projects Agency (ARPA) and the Office of Naval Research (ONR).[141] With this model, the group brought architecture to the center stage of cutting-edge technological research and developed several projects that could be considered seeds of many technologies used today.[142] The group eventually transformed to the Media Lab in 1985 with a novel model of funding where the money would be received from private corporate sponsors[143] and, as such, still is a powerful hub for architectural and technological research.

The unorthodox pedagogy employed at the AA that made distinguished members of various disciplines take part in architectural design education and the transdisciplinary framework employed by the Architecture Machine Group at MIT that established strong connections between architecture and technology were strong reasons behind the development of a project like ARCHITRAINER. Alongside its innate qualities as an interactive teaching machine, ARCHITRAINER is also significant as an outcome of this exceptional context of the 1960s and the 1970s that diminished the boundaries between disciplines and bridged them in mutually benefitting directions.

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[141] Steenson, 165–69.

[142] Nicholas Negroponte, *The Architecture Machine* (Cambridge, MA: The MIT Press, 1970); Negroponte, *Soft Architecture Machines*.

[143] Stewart Brand, *The Media Lab: Inventing the Future at MIT* (New York: Viking, 1987), 137–54.

3.2 Cybernetic and Psychological Precedents

As noted earlier, ARCHITRAINER was inspired by theories from cybernetics and psychology, specifically Pask's conversation theory, Laing et al.'s interpersonal perception theory, and George Kelly's personal construct theory. This section provides a brief overview of those precedents and elaborates on inter-connections among them with a particular focus on their role in the development of ARCHITRAINER. In doing so, the section dwells on them as distinct but connected theories by virtue of their shared constructivist epistemology that was widely disseminated across disciplines in the 1960s and the 1970s. It presents the popularity of the constructivist epistemology among various fields as another strong reason behind the multidisciplinary approach that could be employed in ARCHITRAINER.

Of those precedents, conversation theory, particularly a teaching machine developed as a demonstration of it, called CASTE, is evident regarding the close relationship between Abel and Pask discussed above.

Conversation theory was discussed in the first chapter of the thesis with regard to several aspects. Here, the structure of conversations as envisaged by Pask is dealt upon via a practical application of the theory, called "Course Assembly System and Tutorial Environment" (Figure 3.2).[144] In short, CASTE, this system was considered to be "an essential tool for studying conversations" and "a clear embodiment of many parts of the theory" by Pask himself.[145] It was a direct precedent to

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[144] Pask, *Conversation, Cognition and Learning: A Cybernetic Theory and Methodology*, 71–140; Pask, *Conversation Theory: Applications in Education and Epistemology*, 19–49; Gordon Pask and Bernard C.E. Scott, "Learning Strategies and Individual Competence," *International Journal of Man-Machine Studies* 4, no. 3 (July 1972): 217–53; Gordon Pask and Bernard C.E. Scott, "Caste: A System for Exhibiting Learning Strategies and Regulating Uncertainties," *International Journal of Man-Machine Studies* 5, no. 1 (January 1973): 17–52.

[145] Pask, *Conversation, Cognition and Learning: A Cybernetic Theory and Methodology*, 78.

ARCHITRAINER on many levels due to the conversational structure aimed to be incorporated in both.

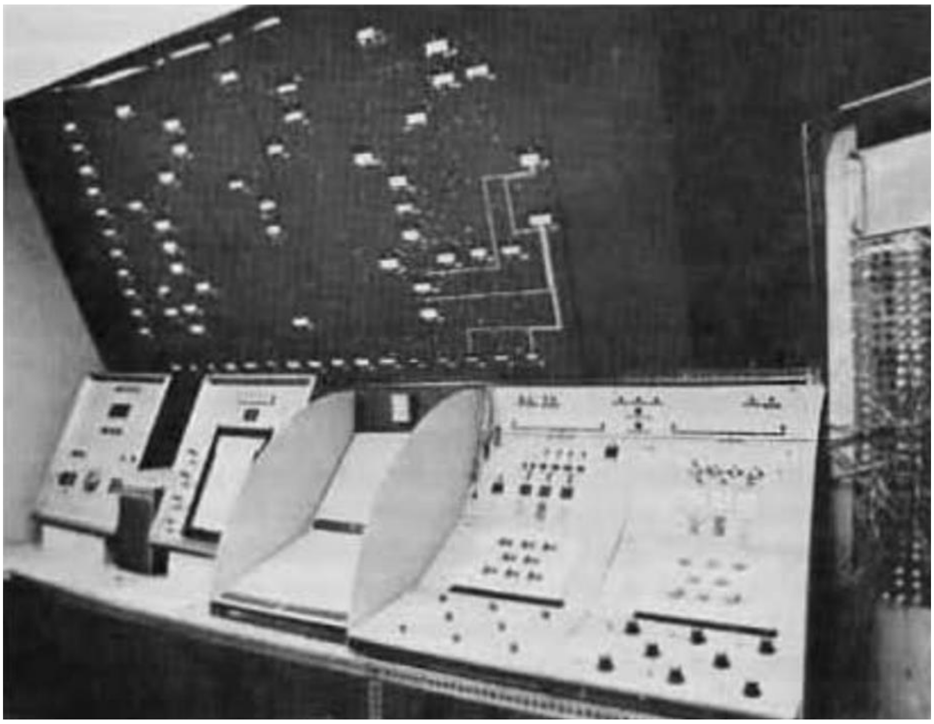

Figure 3.2. A Photo of Course Assembly System and Tutorial Environment (CASTE), ca. 1975. Source: Gordon Pask, *Conversation, Cognition and Learning: A Cybernetic Theory and Methodology* (Amsterdam: Elsevier, 1975), 80.

As discussed by Pask and Scott, CASTE was an interactive tutorial system designed to teach elementary probability theory to social science students.[146] It was a continuation of Pask and his colleagues' previous studies on teaching systems, which were aimed at solving discrepancies between different teaching strategies and learning styles.[147] The central hypothesis was that although many social science

[146] Pask, 79; Bernard C.E. Scott, "Working with Gordon Pask (1967-1978): Developing and Applying Conversation Theory" (2008), 6, https://www.researchgate.net/publication/288645432_Working_with_Gordon_Pask_1967-1978_Developing_and_applying_conversation_theory.

[147] Scott, "Working with Gordon Pask (1967-1978): Developing and Applying Conversation Theory," 6.

students had a "holist" learning style, textbooks and lectures on probability theory was based on a "serialist" teaching strategy making it hard for them to adapt to the learning material, which required the development of a system that would be capable of addressing this difference while ensuring effective learning.[148]

As described by Pask, the system had several components, which fulfilled different roles in the interactive learning process. It contained a large display that provided a mapping of the subject matter in the form of an "entailment structure."[149] The display showed distinct topics and their relationship to each other, which acted as an interface to facilitate the interaction between the student and the system. There was also a modelling and simulation facility, called "STATLAB," via which the students carried out modeling operations as explanatory answers to specific questions about each topic.[150] Students were free to choose a particular topic, as long as they demonstrated their understanding of other such topics indicated as pre-requisites to the current one on the entailment structure display.[151] Students' choices were monitored and recorded by "a suite of computer programs" called CET (Cooperative Externalisation Technique) heuristics," which assessed their current level of understanding of the subject matter to decide which further topics could be studied on that instance.[152]

Pask described the working procedures of CASTE with a heavy technical language

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[148] Scott, 6.

[149] Pask, *Conversation, Cognition and Learning: A Cybernetic Theory and Methodology*, 80.

[150] Pask, 81.

[151] Scott, "Working with Gordon Pask (1967-1978): Developing and Applying Conversation Theory," 7.

[152] Pask, *Conversation, Cognition and Learning: A Cybernetic Theory and Methodology*, 78–84.

in *Conversation, Cognition and Learning: A Cybernetic Theory and Methodology.*[153] In simpler terms, the system — the coupling of the student and CASTE — was designed in such a way that it incorporated genuine interaction between both by enabling exchange on two different “levels of discourse.” Following the same structure as the proposed architecture machine (Figure 3.1), on the lower level L_0, CASTE would select and offer a particular problem from a library of problems, to which the student could provide answers. The solution, which represented the student’s understanding of that topic, was fed back into CASTE to determine which other problems would be offered. On the upper-level L_1, students could choose from available topics on the entailment structure, which would be used by CASTE to develop a model of students’ learning style (either holist or serialist). In response, CASTE would adjust its teaching strategy and provide information back to students about their performance. These exchanges, both horizontal (between the student and CASTE) and vertical (between levels), would continue recursively until the student came to learn the subject matter.

The significance of the system arose from this two-level double-circular feedback mechanism, in which both the student and CASTE learned from each other by adjusting themselves according to the feedback provided to them by the other. The system eliminated the danger of creating a master-slave exchange mechanism by establishing symmetry between the conversational partners, whether humans or machines, enabling a truly interactive learning environment.

The conversational structure, which was elaborated throughout the conversation theory and brought to life via CASTE, had several similarities with the approach developed by Laing and his colleagues on interpersonal psychology in the 1960s.[154]

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[153] Pask, 71–78.

[154] R. D. Laing, H. Phillipson, and A. R. Lee, *Interpersonal Perception: A Theory and a Method of Research* (London: Tavistock Publications, 1966).

Indeed, both were complimentary to each other to such an extent that it can be argued that Pask's suggestion of Laing et al.'s work to Abel for the ARCHITRAINER project was not only because he was familiar with it in his capacity as a psychologist by training, but also because both studies incorporated very similar views on the issue of conversation.

Laing et al. developed their work to address "conjunctions and disjunctions" between two individuals (in their specific case, a married couple) concerning issues "in the context of their dyadic relationship."[155] Reminiscent of levels of discourse in Pask's conversation theory, they developed a model of a dyadic relationship, where they identified perspectives of different orders that were structurally tied together. They argued that participants of a dyadic relationship had three different perspectives on three different levels, which would be used to assess their communication.[156] According to this model, the first level was occupied by two participants' "direct perspectives" on a particular issue, whereas the second level involved the "metaperspectives" of the two, which denoted one's view of the other's view on the issue. And yet a third level, which belonged to "meta-metaperspectives," designated one's view of the other's view of one's view on the issue.[157] As Laing et al. explain, in this model, one could gather information about the effectiveness of communication in the relationship by comparing the perspectives of different levels. For example, comparing one's direct perspective and the other's direct perspective on the same issue would give clues about agreement or disagreement between the two participants. Whereas, a comparison between one's metaperspective and other's direct perspective on the same issue would indicate understanding or

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[155] Laing, Phillipson, and Lee, 38.

[156] Laing, Phillipson, and Lee, 55–59.

[157] Laing, Phillipson, and Lee, 55.

misunderstanding between them.[158]

Laing et al.'s work, a common structure characterized by distinct levels of interaction similar to Pask's conversation theory, was incorporated in ARCHITRAINER where the student (in the role of an architect) and the tutorial system (in the role of a client) would be able to interact on three distinct levels based on a real person's attributes on some architectural artifacts.[159]

To be able to obtain those personal attributes of the client, a specific method developed by Kelly in his personal construct theory published in a two-volume book, *The Psychology of Personal Constructs*[160] in 1955 was used in ARCHITRAINER. In this model, Kelly argued that individuals created their unique perspectives by formulating constructs through which they viewed the people or events surrounding them.[161] He developed a method called "repertory grid" to elicit an individual's personal constructs and identify the relationship between them.[162] The method was originally used on psychotherapy clients to evaluate their personal constructs about the people around them, through a procedure that involved several steps: The examiner would present some "role titles" (i.e., "a person of your own sex whom you would enjoy having as a companion on a trip") to the client and ask them to write the corresponding names on different cards. Following the completion of this

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158 Laing, Phillipson, and Lee, 60.

159 Abel, "Instructional Simulation of Client Construct Systems," 2–4; Abel, *Architecture & Identity: Responses to Cultural and Technological Change*, 2000, 33–34.

160 George A. Kelly, *The Psychology of Personal Constructs-Volume One: Theory and Personality*, vol. 1, 2 vols. (London: Routledge, 1991); George A. Kelly, *The Psychology of Personal Constructs-Volume Two: Clinical Diagnosis and Psychotherapy*, vol. 2, 2 vols. (London: Routledge, 1991).

161 Kelly, *The Psychology of Personal Constructs-Volume One: Theory and Personality*, 1:3.

162 Kelly, *The Psychology of Personal Constructs-Volume One: Theory and Personality*; Kelly, *The Psychology of Personal Constructs-Volume Two: Clinical Diagnosis and Psychotherapy*.

step for all the role titles, the examiner would show three cards to the client and ask whether there was an “important way” that made the two of them alike but different from the third. The response would constitute what was called the “likeness end” of the construct (i.e., “have high morals”). In the second step, the examiner would show the odd card and ask the client how that person was different from the other two, and the response would be recorded as what was called the “contrast end” of the construct (i.e., “low morals”). This procedure would be repeated with other combinations of three cards to obtain other constructs in bi-polar form. In the third step, the elicited constructs would be placed on one axis of a grid and the role titles on the other, and the client would be asked to fill out the grid by considering each role title’s relationship to each construct. Some qualitative and quantitative analysis would then be conducted on the grid to obtain insights into the client’s construct system.[163]

Abel utilized the method in ARCHITRAINER in almost the same form to elicit the personal constructs of the client.[164] However, some alterations had to be made to adapt the method for the purposes of the project. In doing so, Abel used a set of architectural examples (photographs of 36 houses), which corresponded to the original test's role titles.[165] The client would be presented with those pictures, and the procedure described above would be followed. The repertory grid produced out of this process would then be used as a basis for other phases.[166]

Kelly’s theory and model shared several aspects with those of Pask’s and Laing’s. An unpublished paper by Pask, titled “Some Relations Between Personal Construct Theory and Conversation Theory: Between Grids and Meshes” presents a valuable

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[163] Kelly, *The Psychology of Personal Constructs-Volume One: Theory and Personality*, 1:152–238.

[164] Abel, *Architecture & Identity: Responses to Cultural and Technological Change*, 2000, 34.

[165] Abel, 34.

[166] Abel, 34–36.

source on the complementarity of those models.[167] But above all, the most significant feature of all three theories was that they were based on the constructivist epistemology, which constitutes the essence behind many projects and ideas discussed throughout the thesis. They all would accept the impossibility of direct knowledge transfer and that only the understandings of what was offered to them could be communicated between entities, whether they be a student and a tutorial system in Pask's case, a married couple in Laing's, or a psychologist and a client in Kelly's. And as such, they all had to develop ways to overcome the difficulties arising from their adoption of this epistemology by devising complex structures that modeled and facilitated genuine interaction between entities. In this sense, all three were sibling theories fuelled by the same source, although the contexts for which they were developed differed significantly. The common constructivist epistemology behind all three theories can be considered a strong reason why Abel was able to incorporate them in ARCHITRAINER, a project intended for yet another realm, architecture.

3.3 The Architecture of ARCHITRAINER

This section takes a closer look at ARCHITRAINER by focusing on some fundamental aspects concerning how it worked. As published texts on ARCHITRAINER[168] are only in the form of short notes or summaries, the account

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[167] Gordon Pask, "Some Relations Between Personal Construct Theory and Conversation Theory; Between Grids and Meshes," 1981, Gordon Pask Archive, University of Vienna-Department of Contemporary History.

[168] Chris Abel, *The Self-Field: Mind, Body and Environment* (Routledge, 2021), 160–63; Chris Abel, "Analogical Models in Architecture and Urban Design," *METU Journal of Faculty of Architecture* 8, no. 2 (1988): 175–76; Chris Abel, *Architecture and Identity: Towards a Global Eco-Culture*, 1st ed. (Oxford: Architectural Press, 1997), 33–36; Abel, *Architecture & Identity: Responses to Cultural and Technological Change*, 2000, 33–36; Chris Abel, *The Extended Self: Architecture, Memes and Minds* (Manchester: Manchester University Press, 2015), 272; Negroponte, *Soft Architecture Machines*, 112–13.

provided here is largely based on two unpublished sources by Abel, a report titled "ARCHITRAINER: An Instructional Game for Architects" available at the Gordon Pask Archive, and a conference paper, titled "Instructional Simulation of Client Construct Systems" from the personal archive of Abel, produced in 1974 and 1975 respectively.[169]

As noted earlier, ARCHITRAINER incorporated a structure where the student (in the role of an architect) and the tutorial system (in the role of a client) would interact at three distinct levels. At the first level, an actual client's architectural attributes on some artifacts or classes of artifacts were acquired, and a model of it was developed in the tutorial system. At the second level, the student would learn about those personal attributes by interacting with the model. And in the third level, an assessment of the student's understanding of those personal attributes would be performed by the tutorial system.[170]

ARCHITRAINER was composed of a display of 36 house photographs and a teletypewriter through which the student would interact with the system (Figure 3.3).[171] The program was written in TICS (Teacher-Interactive Computer System) programming language, which was itself designed to produce instructional software in which students would be able to take different paths in learning a subject matter.[172] ARCHITRAINER was in the form of an interactive tutorial that simulated a client in conversation with an architect.[173] It aimed to provide the architecture students with

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[169] Chris Abel, "Report on ARCHITRAINER," 1974, Gordon Pask Archive, University of Vienna-Department of Contemporary History; Abel, "Instructional Simulation of Client Construct Systems."

[170] Abel, "Instructional Simulation of Client Construct Systems," 2–4; Abel, *Architecture & Identity: Responses to Cultural and Technological Change*, 2000, 33–34.

[171] Abel, "Report on ARCHITRAINER," 3.

[172] Abel, "Instructional Simulation of Client Construct Systems," 16.

[173] Abel, 15.

the kind of experience they could gain through the actual practice while still at the school.[174]

Figure 3.3. ARCHITRAINER in Use at MIT, ca.1973. Source: Chris Abel, "Report on ARCHITRAINER," 1974, Gordon Pask Archive, University of Vienna-Department of Contemporary History, 7.

ARCHITRAINER presented three sets of exercises for the student, each designed for a specific purpose based on the repertory grid obtained by interviewing real persons with the procedure described above.[175] These repertory grids would contain 36 columns representing the detached, one-family houses and 12 rows of construct descriptions (i.e., simple-complex, modern-traditional, confined-spacious, new-old), which were denoted in the usual bi-polar form.[176] Each house would be rated on a

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[174] Abel, "Report on ARCHITRAINER," 5.

[175] Abel, "Instructional Simulation of Client Construct Systems," 15–16.

[176] Abel, "Report on ARCHITRAINER," 8.

five-point scale (likeness end: 1, contrast end: 5) for each construct (Figure 3.4).[177]

Name: Sam Desch
Date: Dec. 14, 1973

Construct Descriptions

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	Likeness End	Contrast End
A	4	5	2	2	2	2	3	3	2	4	3	3	2	3	3	2	3	4	3	3	3	4	3	4	4	2	4	2	2	3	4	3	3	2	1	3	SIMPLE	COMPLEX
B	4	1	2	2	5	2	2	2	1	1	2	4	3	5	3	2	4	1	3	5	3	1	5	4	4	2	4	2	2	3	1	3	1	5	5	3	MODERN	TRADITIONAL
C	4	1	2	1	1	1	1	2	1	1	1	3	2	5	2	2	4	1	3	4	2	1	2	4	4	1	4	2	2	3	1	2	1	4	2	3	NEW	OLD
D	4	3	2	2	2	2	2	3	2	5	3	3	2	4	3	2	3	3	3	4	3	3	3	4	4	3	4	2	5	2	2	2	3	3	1	3	CONFINED	SPACIOUS
E	1	4	1	1	1	4	3	1	4	5	3	1	1	1	1	4	1	5	1	1	1	5	3	1	1	4	1	1	1	1	5	1	1	1	1	1	STANDARD	ORIGINAL
F	2	1	1	1	1	1	1	1	1	1	1	2	1	3	1	1	3	1	1	1	1	1	1	2	1	1	3	1	1	1	1	1	1	4	2	4	SUBURBAN	RURAL
G	4	2	1	1	1	2	3	2	2	2	2	3	1	3	2	1	5	2	2	5	1	3	3	4	4	2	5	2	1	5	2	2	3	4	1	2	BLAND	RICH
H	2	2	3	3	5	2	2	3	3	5	2	2	3	5	3	3	2	2	2	2	4	2	2	2	3	2	1	2	4	3	3	3	2	5	4	5	CLOSED LANDSCAPING	OPEN LANDSCAPING
I	1	3	3	3	3	3	2	4	3	1	3	5	4	5	2	2	5	1	4	5	5	4	4	5	2	4	1	4	3	2	2	4	2	2	5	5	A SYMETRICAL	SYMETRICAL
J	5	4	3	2	5	5	2	2	1	2	1	5	4	5	4	1	5	3	3	4	3	2	2	5	5	1	5	3	2	3	3	3	3	4	2	4	LOW	HIGH
K	5	5	5	4	4	4	3	1	2	2	1	5	5	4	5	1	5	2	5	5	3	2	1	5	5	4	1	4	4	4	5	5	3	3	5	5	DIFFUSE	COMPACT
L	1	2	5	5	5	3	2	5	5	-	5	1	2	2	5	5	1	4	3	3	5	4	5	1	1	4	1	4	4	3	4	5	2	1	4	2	I WOULD LIKE TO LIVE THERE	I WOULD NOT LIKE TO LIVE THERE

Figure 3.4. An Example of a Repertory Grid, ca. 1973 Source: Chris Abel, "Report on ARCHITRAINER," 1974, Gordon Pask Archive, University of Vienna-Department of Contemporary History, 8.

The first set of exercises aimed to make the student familiar with concepts regarding the personal construct theory and repertory grid method.[178] To this end, the student would be presented with three house pictures and asked to differentiate amongst them in the same way as the client.[179] Then, the student would be asked to rate those three houses on a five-point scale, and the results of their selection would be displayed in the form of a table, the format of which would consistently be used throughout the later stages of the tutorial.[180] This exercise aimed to enable the student to understand how the information from the client was obtained and how it would be

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177 Abel, 8.

178 Abel, "Instructional Simulation of Client Construct Systems," 15–16.

179 Abel, 17.

180 Abel, 17.

presented in the program.[181]

The second set of exercises aimed to make the student understand the nature of the client's individual constructs.[182] For each one of those, the student would be asked to solve four exercises, which were organized in such a manner that they would provide fewer clues as the student advanced through them (i.e., In the first exercise, the students would be provided with the client's ratings of two pictures and asked to predict the third one, whereas, in the fourth exercise they would be asked to predict all three ratings without any clue).[183] Students would be deemed successful when they correctly predicted which end of the construct the example lies (i.e., for a client rating of 1, a student rating of 1 or 2 would be considered a correct response).[184] If the students failed in one exercise, they would be diverted to a remedial one, where the same exercise would be presented with different houses. If a further error occurred, they would be redirected back to a simpler exercise.[185] A student would be considered to have achieved sufficient understanding of the client's every construct with the completion of all necessary exercises, the exact number of which would be dependent on their success. Throughout the whole process, the student would be informed about the actual ratings of the client after each exercise.[186]

Building on the student's understanding of individual constructs, the third set of exercises aimed to make students acquainted with the client's construct system.[187] For this purpose, a particular cluster analysis method was applied to the original

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[181] Abel, 17.

[182] Abel, "Report on ARCHITRAINER," 3.

[183] Abel, "Instructional Simulation of Client Construct Systems," 18–19.

[184] Abel, 20.

[185] Abel, 20.

[186] Abel, 20.

[187] Abel, 20.

repertory grid data, which would classify houses into certain groups based on the relationship between individual constructs.[188] The student would be presented with one example from a group and asked to name the other three examples that they think the client would regard as similar.[189] If the student's responses matched with those already determined via the cluster analysis, they would be directed to another group of houses.[190] Otherwise, another cluster analysis would be performed to check whether the correlation of student's responses to the group was within acceptable limits. If the student's responses still did not match, they would be presented with another example of the group to provide additional information.[191] This process would go on until a sufficient understanding of the relationship between the client's individual constructs is achieved on the student's side.

ARCHITRAINER was a teaching machine that aimed to incorporate genuine interaction through double-circular feedback mechanisms at distinct levels.[192] However, it was short of such a model for a couple of reasons. Firstly, it lacked "sufficient freedom of manoeuvre," which prevented the "monitoring and investigation of alternative learning strategies of the student."[193] In other words, ARCHITRAINER neither monitored student's learning style nor had a teaching strategy that could be modified according to the input provided by them. Instead, it incorporated a simpler linear learning routine, where the students were allowed to take an alternative path only when they had to solve additional exercises due to their failure in forming a sufficient understanding of a specific construct.[194] Secondly, the

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[188] Abel, "Report on ARCHITRAINER," 3.

[189] Abel, 4.

[190] Abel, 4.

[191] Abel, 4.

[192] Abel, "Instructional Simulation of Client Construct Systems," 14.

[193] Abel, 23.

[194] Abel, 20.

project did not involve modeling students' individual constructs and the construct system. ARCHITRAINER could model that of client's and the student was supposed to learn them in consecutive levels, regardless of their own understanding of those constructs.

However, although ARCHITRAINER lacked the more advanced feedback and model-building routines embodied in Paskian cybernetic machines, it fulfilled its purpose as a multi-level simulation of the psychological processes involved in interpersonal communication. ARCHITRAINER was successfully tested at MIT and Portsmouth Polytechnic, where it was rebuilt in 1975 after Abel returned to the UK.[195] Some goals for further experimentation were anticipated to improve some of the issues mentioned above.[196] A more advanced MK-2 version[197] with colored video screens was also proposed, yet, was not ever realized.

Abel continued to work on problems concerning interpersonal communication in architectural contexts in the late 1970s. Although ARCHITRAINER could not be further developed in terms of hardware or software, Abel's subsequent studies on "cognitive profiles" can be considered to be an extension to the project, where he applied a similar approach to real-life problems.

In one such study that he developed at Portsmouth Polytechnic, School of Architecture in 1975-76[198], Abel aimed to address communication problems among members of the "Interdepartmental Landscape Working Party" of Hampshire County Council in the UK, which was established to improve the standard of the landscaping

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[195] Abel, Interview with Chris Abel.

[196] Abel, "Instructional Simulation of Client Construct Systems," 22.

[197] Abel, 35.

[198] Chris Abel, "A Note on the Direct Elicitation of Construct Links: Research Monograph," 1975, Personal Archive of Chris Abel; Chris Abel, "Landscape Studies Project," 1976, Personal Archive of Chris Abel.

of educational buildings designed within the council's architecture department, but unable to fulfill its task due to different views held by its individual members. The project aimed to identify the reasons behind those problems and make appropriate recommendations.[199]

In doing so, Abel used Kelly's theory and method in a similar fashion he did in ARCHITRAINER with the hypothesis that the difficulties the group was experiencing could be explained "as a failure of members of the group in construing each other's construct systems."[200] Thus, the project involved the use of the repertory grid test to identify the personal constructs of individual members of the group. The data gathered would be used to identify each individual's construct system to investigate the correlations between the structural organization of their construct system and their ability to predict the behavior of others.[201] To this end, a graphical representation method called "cognitive profiles," which demonstrated the "hierarchical structure of relations between personal constructs," was developed.[202] The cognitive profiles would demonstrate different qualities of construct systems (i.e., hierarchical vs. heterarchical) according to the number and distribution of links among the individual constructs.[203] Conceived as relational structures, they were developed by Abel to test the relationship between personal resistance to change and cognitive complexity, which acted as major themes he went on to develop in his later work.

Though Abel pursued the project no further, ARCHITRAINER deserves recognition

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[199] Abel, "Landscape Studies Project," 1–2.

[200] Abel, 2.

[201] Abel, *The Self-Field: Mind, Body and Environment*, 10.

[202] Abel, *Architecture & Identity: Responses to Cultural and Technological Change*, 2000, 35.

[203] Abel, 34.

as an extraordinary research effort that spread across disciplines due to the particular multidisciplinary academic and professional research landscape of the late 1960s and the early 1970s in the Anglo-American context.

In this connection, the chapter brought this overlooked project forward with an emphasis on three concurrent circumstances that made its development possible: The multidisciplinary pedagogical approach employed at the AA that initiated the deep connection established between Abel and Pask in the coming years as a peculiar instance of many other connections built between architecture and cybernetics over the years; the central position of architecture in the cutting-edge technological research at MIT that permitted Abel to conceive and develop his project there; and, the wide dissemination of constructivist epistemology across disciplines that rendered the formulation of such a multidisciplinary research effort possible. The chapter also disclosed a significant episode of Pask's unorthodox relationship with architecture by focusing on his collaborations with Abel in detail.

CHAPTER 4

REVISITING PASK AND PRICE: A COMPARATIVE HISTORY OF THE CONCEPTUALIZATION OF HUMAN-MACHINE RELATIONSHIP IN FUN PALACE AND KAWASAKI PROJECTS[204]

> How does a Fun Palace differ from an arbitrary collection of entertainments, educational facilities, modern amenities and covered enclosures? We appeared to agree that the distinction rested upon a couple of features, namely (1) The organic and developing character of the system itself and (2) Its organic relation to the external environment.[205]

> It is taken for granted that the flow and storage of information are virtually unlimited and this point is retained as a physical and economic reality in the allocation of communication channels and local to habitation-module storage [in the Kawasaki project]. Given this realistic assumption, it makes sense to see the neighborhood of an inhabitant as governed by geographical proximity and sensory-perceptual proximity.[206]

Above are two quotes about the frequently cited and extensively studied Fun Palace project of the 1960s and the little-known and remotely appreciated Kawasaki project

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[204] An earlier version of this chapter was presented online at the European Architectural History Network (EAHN) Thematic Conference, "Architecture and Endurance" held between 30 September-02 October 2021 in Ankara.

[205] Gordon Pask, "Fun Palace Cybernetics Committee Minutes of the Meeting of 27th January, 1965," 1965, 16, Cedric Price Fonds, Canadian Centre for Architecture (CCA).

[206] Gordon Pask and Cedric Price, "Campus City Competition Explanatory Summary Text," 1986, 1, Cedric Price Fonds, Canadian Centre for Architecture (CCA).

of the 1980s. Gordon Pask, who played a pivotal role in their design alongside Cedric Price, describes his conceptions of both projects here, which mainly spring from his belief in the use of technology as a means of interaction between the buildings and their inhabitants.

This chapter juxtaposes these two projects to offer a comparative history of Pask's role in conceptualizing the human-machine (inhabitant-building) relationship in both. It examines them not only to provide a narrative concerning their particular features as individual artifacts set apart by twenty years but also to explore the reflections of the respective technological and cultural contexts in their design. The chapter dwells on Pask's role in both projects through an archival research at the Cedric Price Fonds of the Canadian Centre for Architecture (CCA), where the project documents are held.[207] In doing so, the chapter provides three main insights: Firstly, it acknowledges both projects as historical cases that exhibit continuities and discontinuities in terms of their model of human-machine relationship. Secondly, it brings the little-known Kawasaki project forward as a significant instance of interactions between the fields of architecture and cybernetics alongside the most recognized Fun Palace project. Lastly, it appreciates the true extent of Pask's contribution to both projects by delving into the technical language he uses while describing his models, which has remained mostly opaque to an architectural audience. Overall, the chapter acknowledges the Fun Palace and the Kawasaki projects as instances of machine intelligence research in architecture inspired by Paskian concepts and ideas and presents them as key exemplars of what is proposed to be the Paskian school of architectural cybernetics.

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[207] The archival research was carried out remotely as a fellow of the Doctoral Research Residency Program (DRRP) of the Canadian Centre For Architecture (CCA) in 2020, with the project titled "Revisiting Pask and Price: A Comparative Study on the Conceptualization of Human-Machine Relationship in Fun Palace and Japan Net Projects".

The chapter is organized into three main parts. The first part focuses on the Fun Palace project covering both its initial conception by Joan Littlewood and Cedric Price and its following transformation with the involvement of Pask. The second part concentrates on the Kawasaki project as a second attempt at collaboration between Pask and Price. The final part compares the similar and contrasting features of the models of human-machine relationship in both projects.

4.1 Fun Palace: A Machine that Both Controls and Is Controlled

This section decodes specific features of the model of human-machine relationship in the Fun Palace project by looking at its complex system of interaction proposed by Pask, mainly based on a number of archival materials. Through this analysis, it scrutinizes the meaning of the word control used in this context and challenges the idea of the Fun Palace as a social control mechanism. Instead, it proposes the Fun Palace as a machine capable of learning from its users and interacting with them in creating novel arrangements of itself.

The idea of the Fun Palace originated from a desire by the famous theater director and producer Joan Littlewood to create experimental techniques through which "people could experience the transcendence and the transformation of the theater not as audience but as players."[208] This idea was a continuation of Littlewood's efforts in trying to facilitate new ways of audience participation with her company, the Theater Workshop.[209] The project turned into a much larger effort that was intended not only serve this purpose but also to incorporate many other ways of participation of users with the involvement of several actors from different fields, a process

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[208] Stanley Mathews, "The Fun Palace as Virtual Architecture: Cedric Price and the Practices of Indeterminacy," *Journal of Architectural Education* 59, no. 3 (2006): 40.

[209] Mathews, 39–40.

discussed in detail in the following part.

Littlewood met Cedric Price in 1960, which led to a long-term collaboration on the Fun Palace in the coming years.[210] Littlewood's "desire for a new theatrical venue […] became the inspiration for Price's architectural imagination"[211], where he saw a "potential to investigate the ability of users to control their own physical environment and to make an architecture with a responsive internal and external organization."[212] Achieving such a goal would require expertise from other fields; thus, they recruited new figures, among whom Pask became highly influential as the project developed. Owing to his contributions and of other such figures from the fields of cybernetics, psychology, engineering, sociology, history, art, politics, etc., the project transformed into an interdisciplinary endeavor that went far beyond the original intentions. The focus gradually shifted from an experimental theater venue that allowed audience participation to a cybernetic interactive machine that both served its users and controlled their behavior at the same time.

In an early article written to publicize the project at the New Scientist in 1964, Fun Palace was described by Littlewood as "a laboratory of pleasure, providing room for many kinds of action" with "informality" and "flexibility" as its two essential features.[213] The same features were also emphasized by Price in the same article with

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[210] Samantha Hardingham, ed., *Cedric Price Works 1952-2003 A Froward Minded Retrospective*, vol. Volume 1 Projects (London-Montreal: The Architectural Association (AA)-Canadian Centre for Architecture (CCA), 2016), 47.

[211] Mary Louise Lobsinger, "Cybernetic Theory and the Architecture of Performance: Cedric Price's Fun Palace," in *Anxious Modernisms: Experimentation in Postwar Architectural Culture*, ed. Sarah Williams Goldhagen and Réjean Legault (Cambridge, MA: The MIT Press, 2000), 119.

[212] Hardingham, *Cedric Price Works 1952-2003 A Froward Minded Retrospective*, Volume 1 Projects:47.

[213] Joan Littlewood, "A Laboratory of Fun," *New Scientist*, no. 391 (1964): 432.

further reference to the transient/impermanent character of the place.[214] They gave examples as to what kind of activities were to take place, which ranged from a "fun arcade" of games and tests devised by "psychologists and electronics engineers" to a "science playground" where visitors could attend lectures and demonstrations supported by teaching films, closed-circuit television and working models. There would be no "permanent structures" and "segregated enclosures," the activities would be "experimental," and the building would be "expandable and changeable."[215]

Without doubt, the technological context and the cultural landscape of the UK at the time were significantly influential in the adoption of this kind of framework. During the early 1960s, forthcoming automation and its possible consequences had already become a broader concern in the country. By 1963, in a famous speech, Harold Wilson, then the leader of the opposition and later the prime minister, was already identifying the change the country was going through as a "scientific revolution" and famously envisaging that Britain was going to be "forged in the white heat of this revolution."[216] In the same speech, Wilson was talking about the possibility of a "conscious, planned, purposive use of scientific [and technological] progress to provide undreamed of living standards and the possibility of leisure ultimately on an unbelievable scale."[217] Automation and its consequences, especially on the leisure activities of citizens, were a primary concern for Littlewood and Price too. However, they were positioning themselves against the idea of "increased leisure" and were rather anticipating that the distinction between work and leisure would become

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[214] Littlewood, 433.

[215] Littlewood, 433.

[216] Harold Wilson, "Labour's Plan for Science: Reprint of Speech at the Annual Conference at Scarborough," 1963, 7, https://nottspolitics.org/wp-content/uploads/2013/06/Labours-Plan-for-science.pdf.

[217] Wilson, 3.

obsolete.[218] Fun Palace was a response to this kind of a change where entertainment would take place through a multitude of other activities, especially with educational ones, a reason why the project is also referred to as "a university of streets" by its creators.[219] In an undated project booklet available at the Cedric Price Fonds, Littlewood and Price argued on this issue as the following:

> The division between work and leisure has never been more than a convenient generalisation used to summarise conscious human activity – voluntary and imposed. Both the nature and scale of conditions causing or requiring imposed activity have changed to such an extent over the past 20 years that the convenience of such a division is no longer valid. The current socio/political talk of increased leisure makes the assumption that people are sufficiently numb or servile to accept that the period during which they earn money can be made little more than hygienically bearable, while a new mentality is awakened during periods of leisure. The new mentality is dependent on a new approach to education and the abolition of obsolete forms of labour.[220]

Although Littlewood and Price had obvious differences with Wilson in their views regarding automation and its consequences on citizens' lives, their attitude reflected a common desire to utilize new capabilities offered by automation. This attitude can be considered a particular reflection of a broader current, prevalent in the UK in the 1960s as demonstrated in Wilson's speech, that put confidence in science and technology in transforming citizens' living standards for good. This context is particularly significant in understanding the involvement of Pask and several other

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[218] Stanley Mathews, "The Fun Palace: Cedric Price's Experiment in Architecture and Technology," *Technoetic Arts: A Journal of Speculative Research* 3, no. 2 (2005): 79.

[219] Littlewood, "A Laboratory of Fun," 432.

[220] Cedric Price and Joan Littlewood, "Fun Palace Project Booklet," ca 1964, 1, Cedric Price Fonds, Canadian Centre for Architecture (CCA).

figures from various disciplines in the Fun Palace project.

Littlewood met Pask through mathematician Maurice Goldsmith in 1963.[221] Price's acquaintance with him, on the other hand, went back to the early 1950s when the two were studying at Cambridge University.[222] They recruited Pask for the Fun Palace project in 1963[223], and in turn, he established the "Cybernetics Committee," which acted as a platform to recruit other such people from several disciplines mentioned above. The committee had a number of meetings, minutes of which were produced by Pask as extensive reports. These reports, which are likened to books rather than minutes by Price[224], are preserved at the Cedric Price Fonds of the Canadian Centre for Architecture in Montreal, and they constitute the primary sources about the committee's activity.

In an early document produced as a preparation for the committee's first meeting, Pask described the Fun Palace "as an attempt to provide a form of environment that is capable of adapting to meet the possibly changeful needs of a human population and capable, also, of encouraging human participation in various activities."[225] To be able to satisfy this goal, he defined the role of the cybernetics committee as "to determine an attitude, a philosophy, and a manner of control for the Fun Palace organization"[226] and sketched out ten problem areas for the committee to work on. These problem areas would require a number of systems, each responding to a

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[221] Mathews, "The Fun Palace: Cedric Price's Experiment in Architecture and Technology," 83.

[222] Price, "Gordon Pask," 819.

[223] Hardingham, *Cedric Price Works 1952-2003 A Froward Minded Retrospective*, Volume 1 Projects:50.

[224] Price, "Gordon Pask," 819.

[225] Gordon Pask, "Fun Palace Cybernetics Committee Introductory Document, Circulation List and Basic Plans," ca 1964, 1, Cedric Price Fonds, Canadian Centre for Architecture (CCA).

[226] Pask, 5.

specific need in developing the project into a cybernetic machine that could interact with its users on many levels. These systems would perform tasks such as determining the expected visiting patterns and loads, recommending available capacities and procedures for the structural arrangements, enabling activities that involve feedback from an audience, controlling communication and information systems such as sound and television channels, and combining conventional entertainment media and facilities with less conventional ones. In addition, there would also be adaptive teaching machines and cybernetic art forms, the likes of both of which were already being developed by Pask and his colleagues.[227]

In the same document, Pask also raised two critical points that presented a broader perspective for the committee. On the one hand, he offered a reflection on Littlewood and Price's approach described above regarding automation and its consequences on citizens' lives by pointing out the necessity of determining "what role the organisation should play in relation to the leisure of an automated society," and on the other, he attempted to provide a direction for the project based on the popular cybernetic agenda of the period by bringing forward the idea of the Fun Palace "as a self-organising system wherein a set of facilities […] develop in a fashion that is inherently regulated."[228]

Pask provided a model of this framework in the form of an "organizational plan" at the minutes of the first meeting of the committee (Figure 4.1 and Figure 4.2). [229] He produced two diagrams to develop the basic terminology and procedure for such a system. As will be discussed in the next section, in this model, inhabitants would be able to provide feedback for a set of complex electronic devices that organize the

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[227] Pask, 5–10.

[228] Pask, 10.

[229] Pask, "Fun Palace Cybernetics Committee Minutes of the Meeting of 27th January, 1965," 3–8.

Fun Palace by dynamically matching activities to be held with the available facilities at a particular moment. The diagrams and the accompanying text were conceived in a technical language that is mostly unfamiliar to an architectural audience, which can be understood by the lack of emphasis on the specifics of the model while it has been referred to as a fundamental feature of the project on several occasions. Thus, understanding the details of the system is of great importance when the dynamics of the proposed relationship of the Fun Palace to its inhabitants is concerned. A fairly simplified description of the model is provided below.

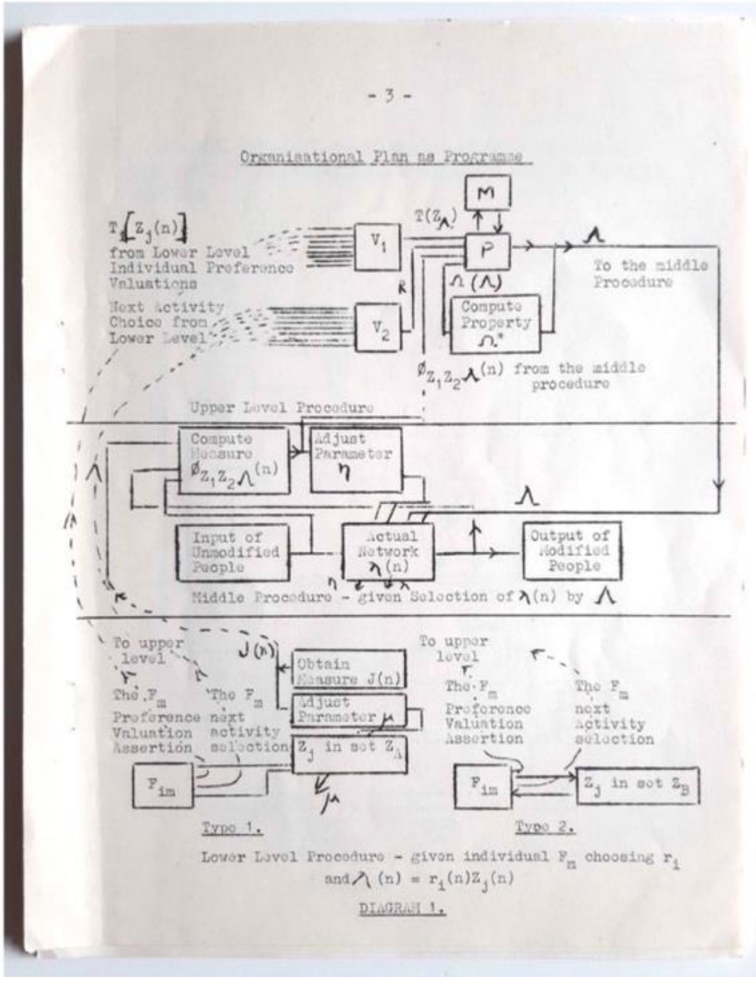

Figure 4.1. Pask’s Organizational Plan for the Fun Palace, 1965. Source: Cedric Price Fonds, Canadian Centre for Architecture, © CCA.

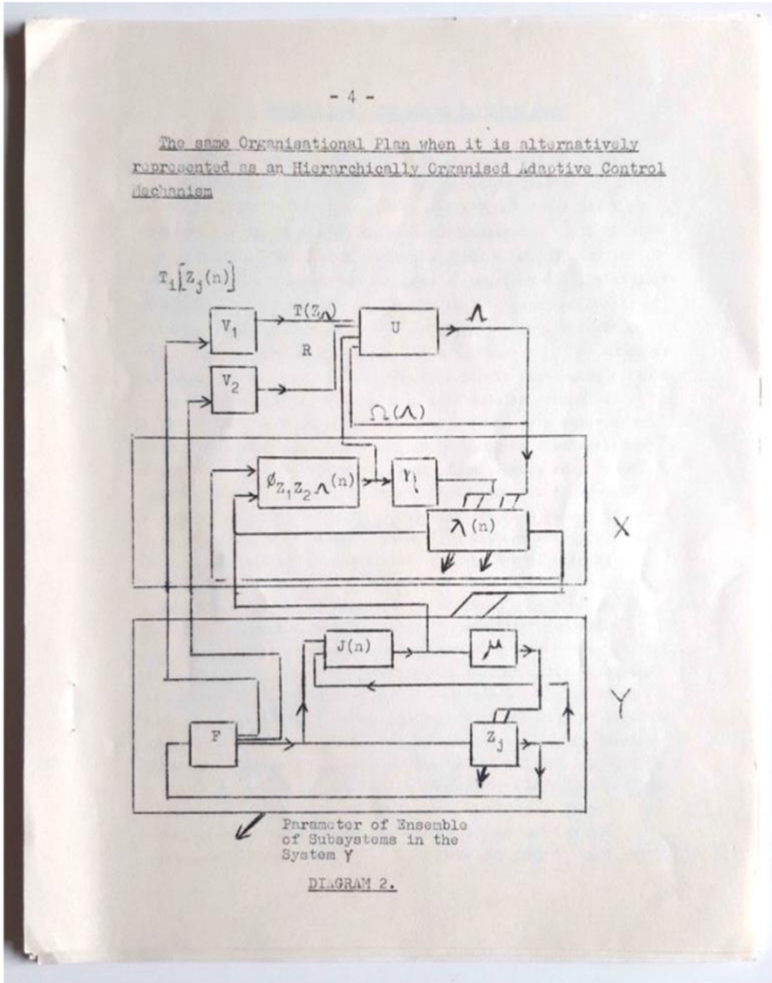

Figure 4.2. The Same Organizational Plan Represented as a Hierarchically Controlled Adaptive Mechanism, 1965. Source: Cedric Price Fonds, Canadian Centre for Architecture, © CCA.

There would be a collection of facilities (Z) and a collection of possible activities (R). Facilities would be categorized into two sub-sets as “input or accepting facilities” (z_1) (e.g., a television studio) and “output or transmitting facilities” (z_2) (e.g., a viewing screen). There would also be groups of facilities labeled as “adaptively controlled facilities” (z_A), an example of which was the “The Cybernetic Theatre” developed by Pask as an outcome of another collaboration with

Littlewood[230], and "fixed facilities" (z_B) which contain conventional entertainment media such as cinemas, theaters, and restaurants. The system would automatically decide which individual activity should be assigned to which individual facility for a certain period of time, based on the data gathered from the inhabitants.[231]

The system would involve three different levels of complex procedures (Figure 4.1 and Figure 4.2). On the lower level, the inhabitants (F) would provide two different types of feedback: At a certain instance (n), they would rate a certain activity that they performed in a certain facility ($T_i[z_j(n)]$), and they would indicate their next activity choice ($r_i(n)$). On the upper level, the data of individual ratings and choices coming from the lower level would be fed into two pattern recognition devices (V_1 and V_2), respectively. V_1 would produce a valuation ($T(Z_\Lambda)$) for certain individual activities performed in certain facilities based on individual activity ratings, whereas V_2 would determine the activities (R) to be held at the coming cycle based on individual next activity choices. Then, a program (P) would assign certain facilities to those activities determined by V_2 by comparing the valuations provided by V_1 for different activity-facility pairs with the help of its memory unit (M). Its output (Λ), which was in the form of a sequence of certain activity-facility pairs, would be disclosed to the inhabitants, and the process would repeat recursively.[232]

In deciding the activity-facility pairs, P would also take two constraints as input that are produced based on the usage patterns of sub-groups of facilities according to the assigned sequence. "A measure of utilization" ($\Phi_{z1z2\Lambda}(n)$) would be obtained in the middle procedure, which would be high valued if the use of any input facility (z_1) at a certain instance was correlated with the use of any output facility (z_2) at a later

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[230] Gordon Pask, "Proposals for a Cybernetic Theatre," ca 1964, https://www.pangaro.com/pask/ProposalCyberneticTheatrePask1964r.pdf.

[231] Pask, "Fun Palace Cybernetics Committee Minutes of the Meeting of 27th January, 1965," 3–8.

[232] Pask, 3–8.

instance. And, a further measure, ($\mathbf{\Omega}(\Lambda)$), would be generated, which would be high valued if the assigned sequence separated any two fixed facilities (z_B) by placing an adaptively controlled one (z_A) in between. The goal of the system would be to maintain the values of these two measures high while organizing/reorganizing itself. In addition, there would also be another constraint called "variety measure" (J(n)), which could be used to keep the environment of the inhabitants "varied or novel enough to sustain [their] interest and attention but not so varied that it is unintelligible" while they interact with adaptively controlled facilities (z_A).[233]

In essence, the system would facilitate interaction between its human and machine components through circular feedback mechanisms. Users could regulate the organization of the Fun Palace by providing their choices, while the Fun Palace could adjust the experience of its users by offering different options. In this system, the feedback from the users would not be used to merely trigger an already-determined response on the Fun Palace's end. Instead, the Fun Palace and its users could effectively modify their behavior by learning from each other. To a certain extent, the users could control the behavior of the Fun Palace, and the Fun Palace could control the behavior of its users at the same time, a feature common to all other projects discussed in the thesis that are inspired by Paskian concepts and ideas, and as such considered to be exemplars of Paskian school of architectural cybernetics.

This model was criticized as reflecting "a vast social control system" where "human beings were treated as data."[234] Indeed, Pask talked about the idea of control over people — not only the inhabitants but also the society in general — several times in the documents of the Cybernetics Committee, as, for instance, when he discussed the possibility of using communication channels and data displays in controlling the Fun

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[233] Pask, 3–8.

[234] Mathews, "The Fun Palace: Cedric Price's Experiment in Architecture and Technology," 85.

Palace users alongside entertaining them.[235] Or, he talked about the "degree of control that can be and should be exerted upon local population" when discussing the relationship of the Fun Palace with society.[236] He even used the terms "modified people" and "unmodified people" in the middle procedure of his organizational plan (Figure 4.1). Considering statements such as these, one can conclude that Pask envisioned the Fun Palace as a device for social engineering, where a superior control mechanism takes decisions on behalf of people. However, the term control used in the context of the system described above should not be confused with the common usage of the word that implies authoritative power of one over another. Rather, control refers here to the ability of an environment to learn from its users and interact with them in creating novel arrangements of itself.

This particular system reflects Pask's broader understanding of what architectural design should be concerned with when it is informed by system-oriented thinking. According to him, architects ought to consider themselves as designers of systems where the building and the users are recognized as interacting components of a whole. A full manifestation of this view was provided by him a couple of years after the Fun Palace in 1969 in his article, "The Architectural Relevance of Cybernetics," which is also thoroughly discussed from a different point of view in the second chapter of the thesis. There, he argued that "a responsible architect […] cannot merely stand back and observe evolution as something that happens to his structures,"[237] and he further articulated his position as such:

> It follows that a building cannot be viewed simply in isolation. It is only meaningful as a human environment. It perpetually interacts with its inhabitants, on the one hand serving them and on the other hand controlling

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[235] Pask, "Fun Palace Cybernetics Committee Introductory Document, Circulation List and Basic Plans," 9.

[236] Pask, 11.

[237] Pask, "The Architectural Relevance of Cybernetics," 495.

> their behavior. In other words, structures make sense as parts of larger systems that include human components and the architect is primarily concerned with these larger systems; *they* (not just the bricks and mortar part) are what architects design. I shall dub this notion architectural 'mutualism' meaning mutualism between structures and men or societies.[238]

If this argument, which attributed equal significance to the design of organizational relations and the built form in order to achieve a dialogue between the architectural environments and their inhabitants, was to be accepted, having designed the relationship between the Fun Palace and its users through his organizational plan, Pask can be considered an architect of the project in his own right.

4.2 Kawasaki: Another Attempt at Architecting for Pask

Another of Pask's attempts at promoting his concepts and ideas in architectural design, which also involved the design of concrete architectural forms alongside the organizational relations, came after approximately twenty years in 1986 when Pask and Price indulged in a competition project for the city of Kawasaki in Japan. This section dwells on various aspects of this little-known project, which has been recognized in only a few studies[239], touching upon issues such as the competition context, the nature of collaborations between Pask and Price, and the distinct approaches adopted by them based on the archival material held at the Cedric Price Fonds of the Canadian Centre for Architecture in Montreal. With a particular interest in its model of human-machine relationship, the chapter presents the project as yet another exemplar of the Paskian school of architectural cybernetics.

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[238] Pask, 494.

[239] Furtado, *Pask's Encounters: From a Childhood Curiosity to the Envisioning of an Evolving Environment*, 157–78; Hardingham, *Cedric Price Works 1952-2003 A Froward Minded Retrospective*, Volume 1 Projects:658–63.

The competition, titled "The International Concept Design Competition for an Advanced Information City," was organized by the Japan Association for Planning Administration (JAPA) and Mainichi Newspapers around the "Campus City" concept.[240] According to the brief, it aimed to solicit proposals for the revitalization of Kawasaki from "a long term major industrial city" to "an information-intensive and humanistic city."[241] Kawasaki was chosen as the subject of the competition due to its qualities common to established industrial cities around the world. The participants were asked to use the city of Kawasaki as a model so that their proposals could be applied to other such redevelopment efforts for similar cities.[242] In other words, the organizers were looking for generic solutions rather than site-specific ones, which could be applied generously to other contexts. The jury of the competition was comprised of several members of JAPA alongside the chief architect of the French Government Joseph Belmont, architect Arata Isozaki, fashion designer Hanae Mori, the director of the National Museum of American History Roger Kennedy and the chancellor of the United Nations University Soedjatomoko.[243]

The competition was built around the concept of "campus city" that would be made technologically possible through the implementation of advanced information systems. It aimed to develop a plan for the rebuilding of Kawasaki through the use

[240] "Competition Brief of the International Concept Design Competition for an Advanced Information City," ca 1986, Cedric Price Fonds, Canadian Centre for Architecture (CCA).

[241] "Competition Brief of the International Concept Design Competition for an Advanced Information City," 1.

[242] "Competition Brief of the International Concept Design Competition for an Advanced Information City," 1.

[243] "Competition Brief of the International Concept Design Competition for an Advanced Information City," 3.

of high technology as a tool of revitalization.[244] The participants were asked to develop proposals for at least one of the following four themes defined by the competition organizers: Intelligent Plazas, The Kawasaki Institute of Technology (KIT), The Campus City Festival, and The Intelligent Network.[245] Considered together, the first three themes would be a part of a scenario where the Intelligent Plazas would act as both the units of the Kawasaki Institute of Technology and the sites for the events of the Campus City Festival. The Intelligent Plazas would be imagined as existing or newly created individual public or private buildings/spaces that can serve as urban facilities for a variety of activities.[246] The Intelligent Network, on the other hand, would be conceived as a connector of urban facilities, which would be made possible by the effective utilization of information systems and telecommunication technologies.[247] Online, real-time interaction among the Intelligent Plazas provided by the Intelligent Network would distinguish the KIT from a "centralized university."[248] As opposed to a traditional university campus where a portion of urban land would be allocated to some specific educational activity, this model aimed to take advantage of new technologies in creating a decentralized university whose components were distributed around the city in the form of mixed-use nodes, hence turning the whole city into a campus.

The competition was, in fact, proposed as a small-scale urban reflection of a country-

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[244] "Competition Brief of the International Concept Design Competition for an Advanced Information City," 4.

[245] "Competition Brief of the International Concept Design Competition for an Advanced Information City," 6.

[246] "Competition Brief of the International Concept Design Competition for an Advanced Information City," 16–20.

[247] "Competition Brief of the International Concept Design Competition for an Advanced Information City," 18–20.

[248] "Competition Brief of the International Concept Design Competition for an Advanced Information City," 22–23.

wide effort of furnishing Japan with a new information and communication infrastructure that would be used in various sectors such as tourism, education, agriculture, forestry, health, and management.[249] This effort was acknowledged in the brief as the following;

> Japan has begun to install an infrastructure which will generate and carry vast amounts of information. Fiber optic cables are being laid across the nation; high-powered direct broadcasting satellites are being launched; and the development of super-computers and fifth-generation computing systems, a matter of high national priority is moving ahead. Many small scale CATV [cable television] systems are operating in regional areas and cities, while two-way multichannel CATV projects are being developed in urban areas. Videotex [a similar technology with teletext and a precedent to the internet] is commercially available throughout the country. Recent legislation, which lessened regulatory controls over telecommunications in Japan, is allowing accelerated growth in the business community.[250]

Characterized by an extremely positive sentiment towards technology, the competition brief proves that the organizers, amongst other things, were primarily driven by an optimism towards technology and its transformative power on Japanese society.

According to the jury report, the competition attracted a total of 213 proposals, 93 of which were from overseas.[251] The "grand prix" award winner was Peter Droege and

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[249] "Competition Brief of the International Concept Design Competition for an Advanced Information City," 10–11.

[250] "Competition Brief of the International Concept Design Competition for an Advanced Information City," 10.

[251] "Jury Report of the International Concept Design Competition for an Advanced Information City," 1987, 15–16, Cedric Price Fonds, Canadian Centre for Architecture (CCA).

his team from the USA with their proposal titled "Technology for People: A campus City Guide," which was based on the notion of "'purposeful transparency' of city networks and facilities" for the citizens of Kawasaki to collaborate in planning the introduction and evolution of technological innovations.[252] Pask and Price's entry, if it was really submitted[253], was not among the fourteen award-winning projects.

Pask and Price's competition entry consisted of five A1-size presentation panels (Figure 4.3) and an explanatory summary text[254], which are preserved at the Canadian Centre for Architecture in Montreal. Far less in number when compared to Fun Palace, the archive also includes some draft drawings and notes that provide information about the project itself but fail to disclose the relationship of the two figures during the design process. Thus, it is hard to draw insights into the details of the nature of their collaboration. However, the content of the posters offers enough evidence to surmise that Pask and Price split the design work and developed their portions of the project rather independently, likely not in the presence of each other, without aiming to integrate their individual designs. Pask came up with design solutions for the Intelligent Plaza and the Intelligent Network themes, whereas Price offered a different version of the latter, which he called an "anti-matter network."[255] In doing so, they gave little to no reference to each other, nor did they depict in any way each other's ideas/proposals in their own drawings. The organization of the poster contents reflects this sharp distinction too. Photocopies of previously and most likely individually produced drawings and text were stuck later to the presentation

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[252] Peter Droege, "Technology for People," *Places* 5, no. 3 (1989): 50; "Jury Report of the International Concept Design Competition for an Advanced Information City," 29–34.

[253] There is no definite answer to as to whether they submitted their entry or not. The presence of the jury report among other project materials at the archive suggest that they did, however, there is no mention of their entry in this document, nor there is, to my best knowledge, any other document in the archive confirming this.

[254] Pask and Price, "Campus City Competition Explanatory Summary Text."

[255] Pask and Price, 2.

panels. The materials produced by Pask were placed on the first four posters, while the remaining poster was allocated to Price's sketches and collages (Figure 4.3). Among those, Pask's diagrams and drawings (perspectives, plans, sections, façades, and details) drafted all by himself are especially significant as peculiar architectural representations from someone without any formal architectural education. His interactions with architecture communities already spanning more than two decades by then must have helped him in accomplishing such a task.

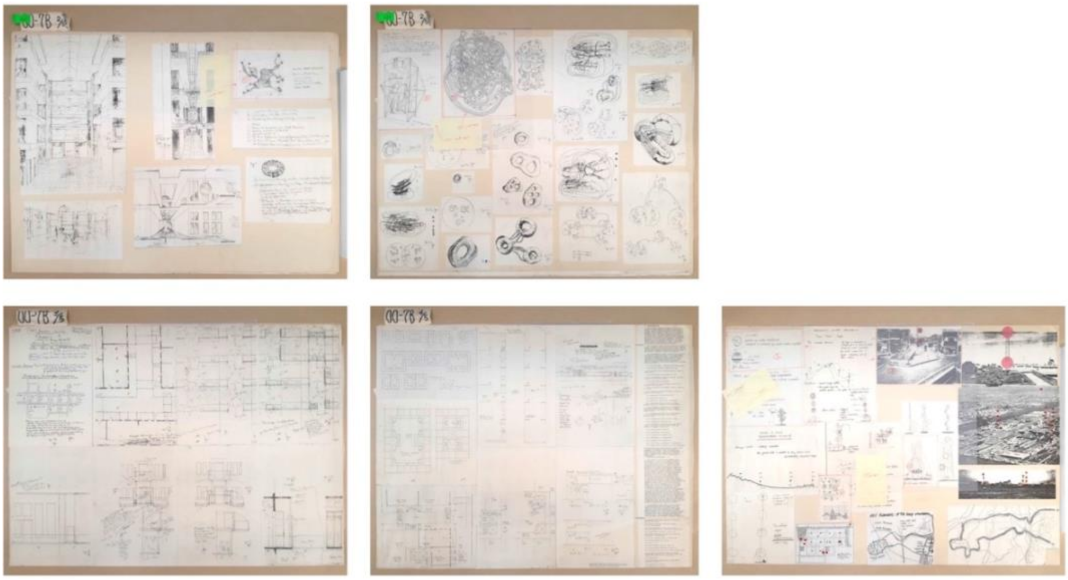

Figure 4.3. Presentation Panels of Pask and Price's Competition Entry, 1986.
Source: Cedric Price Fonds, Canadian Centre for Architecture, © CCA.

For the Intelligent Plaza, Pask proposed an installation that would be both the venue and the object of an exhibition called "The Architecture of Knowledge" (Figure 4.4).[256] Judging from the information provided by him about the scale of the drawings and the size of the presentation posters, this structure would sit on an approximately 12mx24m base and would have a height of almost 65 meters. It would be composed of an intricate suspended mesh whose form would be achieved by

[256] Pask and Price, 1.

connecting a series of toroidal shapes with each other at different angles (Figure 4.5) along with a supporting tensile structure built from slender masts and connecting cables. It would be a tensile integrity (tensegrity) structure where the compression elements (masts) were isolated from each other with the arrangement of tension elements (cables) in such a way that they would provide continuous tension. The design would also incorporate a number of viewing platforms at different levels, access to which were not depicted in the drawing (Figure 4.4).

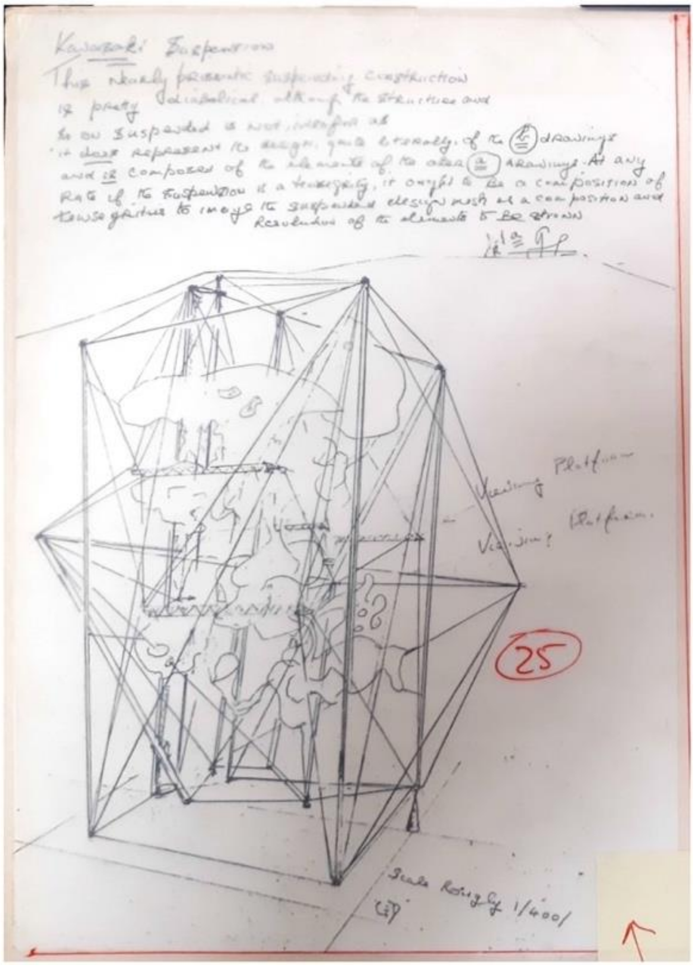

Figure 4.4. A Depiction of the Architecture of Knowledge Installation, 1986.
Source: Cedric Price Fonds, Canadian Centre for Architecture, © CCA.

Figure 4.5. An Impression of the Suspended Mesh, 1986. Source: Cedric Price Fonds, Canadian Centre for Architecture, © CCA.

It is very likely that Pask was inspired by Buckminster Fuller's work on tensegrity in proposing such a design. In an unpublished paper produced around the same time as the Kawasaki project, titled "An Initial Essay: Towards a Unification of Architectural Theories," which is discussed in detail in the second chapter of the thesis, he dwelled on Fuller's tensegrity structures with regard to their capacity in exemplifying a kinetic architecture[257], a feature he tried to incorporate in the design

[257] Pask, "An Initial Essay: Towards a Unification of Architectural Theories," 10–11.

of his own structure. Moreover, Pask was associated with Fuller through Michael Ben-Eli, who worked with Fuller as a close associate on a number of projects in the 1960s, and later became a doctoral student of Pask at the Institute of Cybernetics at Brunel University in the early 1970s.[258] In a letter to the director of the institute about the progress of his doctoral students, Pask praised Ben-Eli's research as "generating information theoretic ideas" related to "Fuller's concept of inherent stability."[259] Ben-Eli acknowledged Fuller and Pask's influence on him as particularly significant in his thesis.[260] Thus, even though Fuller was not mentioned in the documents of the Kawasaki Project, it would be fair to argue that his work was a great influence on the design of Pask's installation. It should also be said that Price's London (Snowdon) Aviary, as a highly successful example of a tensegrity structure with its striking lightweight image, may have acted as an inspiration for Pask.

The intricate suspended mesh whose form was to be produced out of connected tori would represent "the design and the existing habitation of Kawasaki."[261] A computer animation of the structure would also be built, the form of which was supposed to dynamically change as the city evolved.[262] This intricate structure, both in its physical and digital form, was, in fact, proposed as a materialization of an "entailment mesh," a product of a specific knowledge representation model developed by Pask for his conversation theory in the 1970s, which was discussed with regard to its various aspects in the second chapter of the thesis. The entailment meshes were used as a medium for interactive exchanges among different entities,

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[258] "Postgraduate Research in Cybernetics."

[259] Pask, "Notes on Student Progress," 1.

[260] Michael Ben-Eli, "Comments on the Cybernetics of Stability and Regulation in Social Systems" (Ph.D Thesis, London, Brunel University, 1976), https://bura.brunel.ac.uk/handle/2438/5167.

[261] Gordon Pask, "Description of the Intelligent Plaza and the Intelligent Network," 1986, 1, Cedric Price Fonds, Canadian Centre for Architecture (CCA).

[262] Pask, 1.

whether they be humans, machines, or a combination of both. They would act as an interface in allowing the individuals who take part in the conversation to negotiate their own network of cognitive concepts with that of their counterparts. In the original conversation theory books[263], the idea of conversation through entailment meshes was exemplified with a machine called "Course Assembly System and Tutorial Environment" (CASTE), several features of which were discussed in the third chapter of the thesis. CASTE, an interactive tutorial environment designed to teach elementary probability theory, used a large display in the form of an "entailment structure" (a pruned version of an entailment mesh) that showed distinct topics of the subject matter and their relationship to each other to facilitate the interaction between the student and the machine.[264] In the specific case of Kawasaki, the entailment mesh Pask proposed was, in fact, a machine-readable knowledge representation diagram of the city, hence the name "The Architecture of Knowledge." In this diagram, nodes (or in Pask's own terms, "concepts") would be defined and distinguished from others by toroidal skins, which would form a continuous structure when brought together.[265] Pask explained the process behind the coming together of those toroidal skins as relational structures between concepts in the second presentation poster with a total of 25 diagrams, starting from the simplest and leading up to the more complex configurations (Figure 4.3).

Although it is pretty doubtful that an individual without any prior knowledge of conversation theory and entailment meshes would even understand the idea behind the proposal, the appealing image of the intricate mesh and the lightweight tensegrity structure must have been considered by Pask as fitting for an architectural audience.

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[263] Pask, *Conversation, Cognition and Learning: A Cybernetic Theory and Methodology*; Pask, *Conversation Theory: Applications in Education and Epistemology*.

[264] Pask, *Conversation, Cognition and Learning: A Cybernetic Theory and Methodology*, 79; Scott, "Working with Gordon Pask (1967-1978): Developing and Applying Conversation Theory," 6.

[265] Pask, "Description of the Intelligent Plaza and the Intelligent Network," 1.

It is probably also this image that led Pask to the simplistic approach of converting a supposedly scale-free dynamic representation into a fixed-scale static architectural object. However, to compensate for this drawback, Pask also proposed a computer-animated version of the installation that would evolve in time as the city changed. Although not specified anywhere in the competition documents, considering other various instances Pask used entailment meshes such as CASTE, this dynamic digital copy would likely be used as a facilitator of interaction for the citizens in sharing and understanding each other's cognitive concepts on the city.

Pask developed a whole other approach for the Intelligent Network theme where he proposed a series of four to six-floor-high buildings which are tightly packed together with 8-meter streets in-between (Figure 4.6). The buildings were classified into types according to their dimensions, but they had the same architectural organization throughout: They had atriums of various sizes in the center surrounded by balconies on all sides. The individual spaces were designed in two modules (6mx7m and 6mx11m) and located around atriums. There was also another layer of balconies surrounding the individual spaces from outside, which were further furnished with some bridges to provide access to the other buildings from upper levels (Figure 4.3).

Pask ironically likened his blocks to computers and declared that the whole design was conceived as a "monumental joke."[266] In a conference proceeding produced a couple of years later, Pask referred to his design as the following;

> […] a block looks like a computer, maybe smells like one. But it isn't a computer, if only because the competition brief insists that the city, itself, is intelligent…

[266] Pask, 3.

[…] A city *should* have intellect. So it *isn't* a computer.

On the other hand, it is a habitable artifact … a machine.[267]

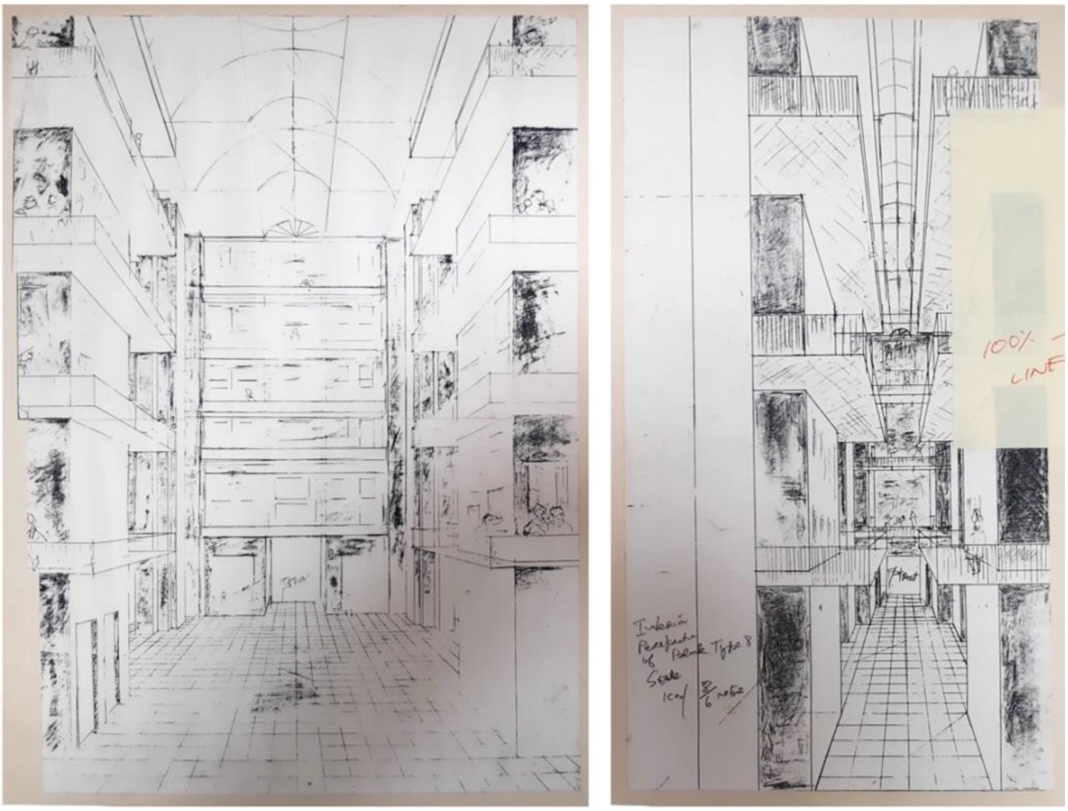

Figure 4.6. An Interior Perspectives from Intelligent Network Blocks, 1986.
Source: Cedric Price Fonds, Canadian Centre for Architecture, © CCA.

It is hard to decide whether the blocks looked like a computer, but architecturally speaking, they were certainly quite ordinary in appearance and conventional in spatial organization both on the architectural and the urban scale. However, as ordinary and conventional as they architecturally were, these buildings were, in fact, designed for a high-tech future based on a supposition that dominated Pask's

[267] Gordon Pask, "The Two-Fold Price of Intellect," in *Proceedings of the Tenth European Meeting on Cybernetics and Systems Research*, ed. Robert Trappl (Cybernetics and Systems '90, Vienna: World Scientific Publishing, 1990), 312.

discourse in the 1980s, through which he argued that there would be no limit to communication bandwidth and information storage in the near future. In an earlier paper from 1980, which he mentioned in the competition documents, titled "Limits of Togetherness," Pask explained this presumption as the following:

> In the past, conversation has often been hampered by lack of communication. In the future, the familiar barriers, such as geographical distance, are unlikely to be obtrusive; conversation will be more endangered by excessive togetherness; the possibility of communication can be safely assumed to exist. The matter is especially significant in the context of well known developments in communication, data storage, and (classical) computation, which are rapidly creating an 'information environment'. […] These developments, combined with the technical advances and the pressures to implement them, lend substance to the claim that communication/computation proximity is no longer just a matter of geography. Rather, the natural environment of mankind becomes increasingly an information environment, chiefly determined by these communication/computation systems. This claim is not confined to dense conurbations (as it might have been a few years ago), nor is it a claim about the unforseeable (sic) future. It is a simple extrapolation from currently available facts and figures.[268]

As a response to this transformation process, which was also elaborated in a book published by Pask in 1982, titled *Micro Man: Computers and the Evolution of*

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[268] Gordon Pask, "The Limits of Togetherness," in *Proceedings of the Information Processing 80*, ed. Simon Lavington (Information Processing 80, North-Holland Publishing Company, 1980), 1000, https://www.pangaro.com/pask/pask%20limits%20of%20togetherness.pdf.

Consciousness[269], he proposed an infrastructure to be built into the Intelligent Network buildings that would be equipped with a minimum of 60 gigabytes of RAM and CD-ROM storage along with four fiber optic and coaxial channels and twelve telephone lines[270], a generous estimate for its time. However, to counter the effects of this highly connected information environment, he also provided some architectural elements, specifically "drawbridges" (Figure 4.7) and "sensory perceptual adaptable interior walling" (Figure 4.8), that would render the geographical and perceptual neighborhood relations of the inhabitants flexible. As the flow and storage of information would be virtually unlimited owing to the proposed infrastructure, by adjusting the position of the drawbridges or rotating the moving slats and louvers of the special walls, it would be possible for an inhabitant or a group of inhabitants to achieve visual and auditory privacy and be nearer to someone else in another city than they are to their neighbors in the same block.[271] In other words, the building would provide the inhabitants with not only the socialization but also the isolation they may need for specific activities.

As mentioned before, Price also developed his own ideas on the Intelligent Network theme, which he called an "anti-matter" network.[272] He proposed "Techno-Trees" or "People-Poles" (Figure 4.9) as large-scale urban structures to "establish familiarity with both the geographic and demographic texture of the whole city."[273] As the explanatory summary text and the poster reveal, Techno-Trees would carry as many as four "spherical pods" depending on their height. The facilities within the pods would be decided according to the location (industrial/residential). Nonetheless, they

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[269] Gordon Pask and Susan Curran, *Micro Man: Computers and the Evolution of Consciousness* (New York: Macmillan, 1982).

[270] Pask, "Description of the Intelligent Plaza and the Intelligent Network," 3.

[271] Pask and Price, "Campus City Competition Explanatory Summary Text," 1.

[272] Pask and Price, 2.

[273] Pask and Price, 2.

would generally include “electronic data exchange facilities” at the highest level, “local environmental conditioners” at the middle, and “publicly accessible resources including the equivalent of the ‘local postman’ and bookstall” at the lowest level.[274] Several hundreds of Techno-Trees would be scattered across the whole municipal area of the city, the exact positions of which would be determined by user demand. The entire network was proposed as a temporary “socio-civic learning toy” intended to be “always visible-always available.”[275]

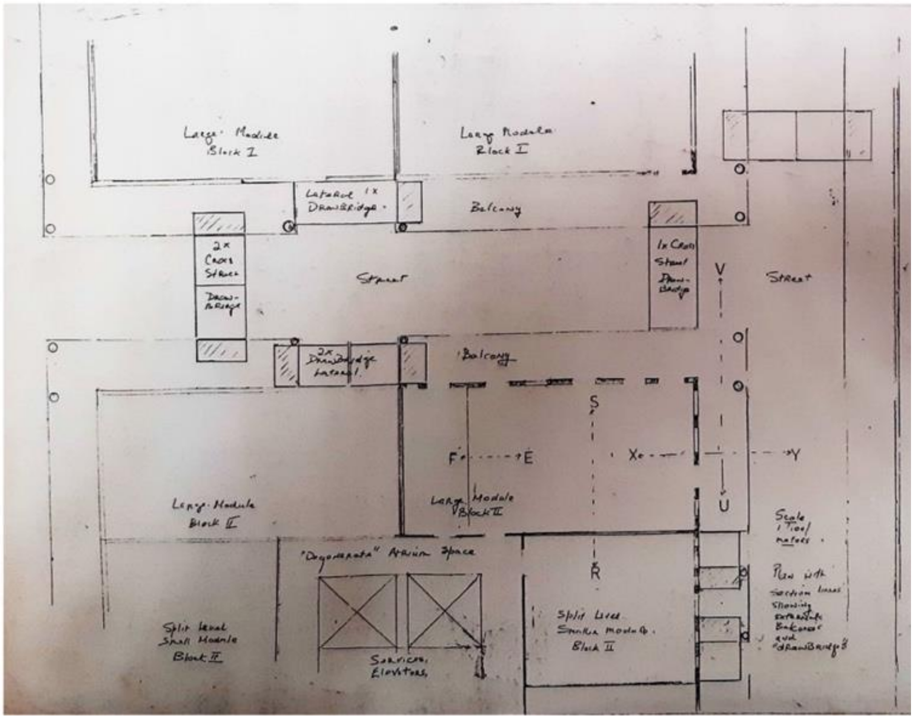

Figure 4.7. A Plan Showing the Locations of Drawbridges, 1986. Source: Cedric Price Fonds, Canadian Centre for Architecture, © CCA.

[274] Pask and Price, 2.

[275] Pask and Price, 2.

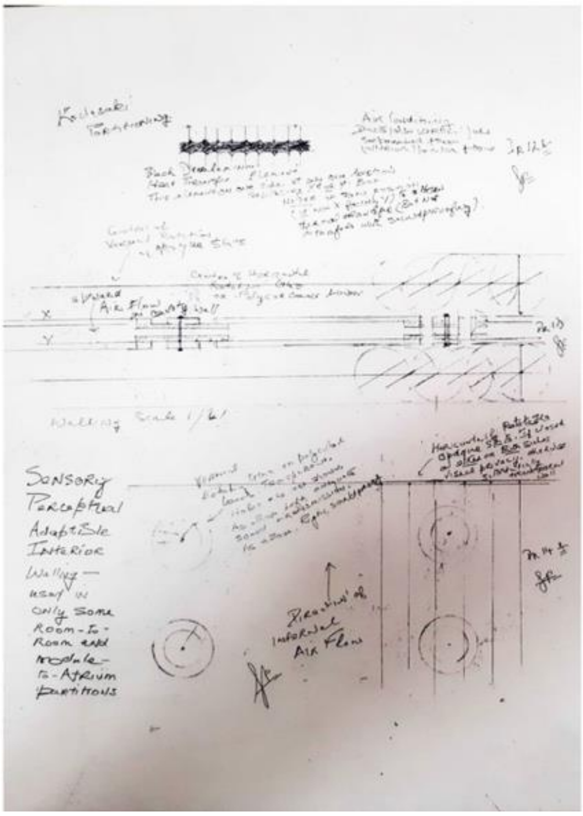

Figure 4.8. Plan and Section Detail of Sensory Perceptual Adaptive Walling, 1986.
Source: Cedric Price Fonds, Canadian Centre for Architecture, © CCA.

Using large spherical elements for civic purposes was an idea Price experimented with earlier. The Olympia project, developed for a pedestrian plaza at the village of the 1972 Olympic Games in Munich also involved a sizeable spherical element with multi-media facilities for public use (Figure 4.10). However, the trees of the Kawasaki project were different in the sense that they would also be able to perform on another scale as they could communicate among themselves and with other such facilities. The network would act as an "invisible postman" and individual techno-trees as high-tech postboxes "available for random access and use."[276]

Considering both solutions to the Intelligent Network theme, it is interesting to

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[276] Pask and Price, 2.

observe how Pask and Price differed in their understanding of architectural manifestations of technology. Although both dealt with spaces/artifacts that would house the latest technology, they ended up with two very different images: Pask's conventional buildings against Price's high-tech towers. This raises the question of whether spaces or artifacts designed for showcasing the latest technology should themselves be high-tech in their appearance. Nonetheless, in either approach, Kawasaki was imagined as "an evolving system with a matrix of feedbacks and participatory engagements,"[277] and this renders both approaches similar to each other despite their apparent differences.

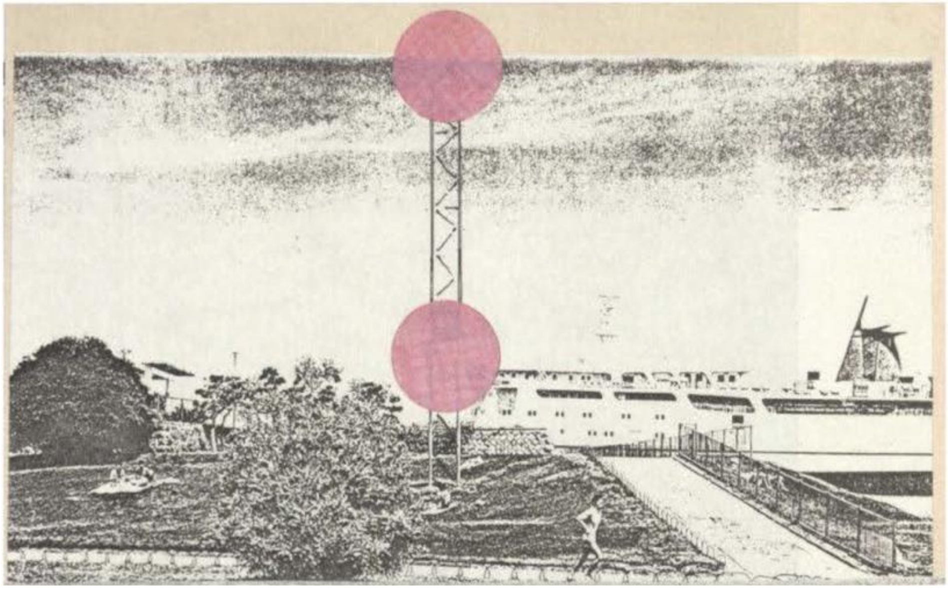

Figure 4.9. A Collage Depicting a Techno-Tree in the Kawasaki Project, 1986. Source: Cedric Price Fonds, Canadian Centre for Architecture, © CCA.

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[277] Furtado, *Pask's Encounters: From a Childhood Curiosity to the Envisioning of an Evolving Environment*, 171.

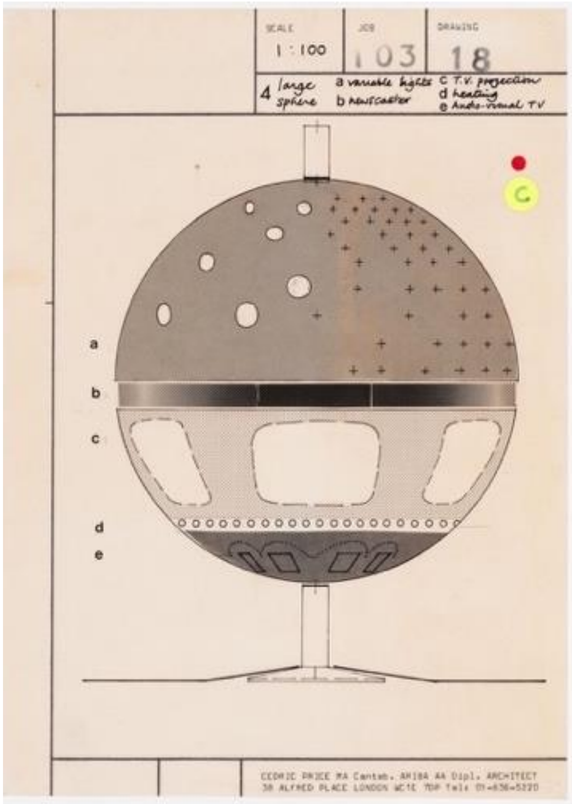

Figure 4.10. Elevation of Large Sphere in the Olympia Project, 1971. Source: Cedric Price Fonds, Canadian Centre for Architecture, © CCA.

4.3 Interactive Architectures of Obsolete Technologies

Based on the detailed investigation provided above, this section focuses on the reasons behind the continuities and discontinuities between the models of human-machine relationship in both projects. In doing so, it is claimed that, from the 1960s to the 1980s, though changes in the computer hardware technologies and communication infrastructure significantly contributed to the difference between the models of human-machine interaction in both projects, Pask's persistent agenda, which was based on the idea of interaction of buildings and their inhabitants, rendered them homologous to each other. This section also argues for the relevance of Pask's agenda as one that is generalizable enough to be employed in different technological contexts, and as such, one that is resilient to technological changes.

As both the Fun Palace and the Kawasaki projects were designed to take advantage of the latest technological developments of their time, they were inevitably constrained by them. Thus, set apart by approximately twenty years, the models of human-machine relationship in these projects differed in many respects, mostly due to the changes in the computer hardware technologies and communication infrastructure.

An IBM System/360 Model 30 computer was to be used in the Fun Place.[278] This mainframe computer was the lowest-end member of a highly successful family of new generation computers announced by IBM in 1964, which transformed the computer industry with the idea of "compatibility" across products. System/360 offered a number of computers with small to large processing and storage capabilities incorporating the same microelectronics and programming instructions that allowed them to work with each other.[279]

Although these computers were state-of-the-art and brought several innovations to the computer industry, they were haunted by some problems common to all computer systems in the 1960s. Firstly, they were still quite expensive, which made them affordable for only big companies and institutions. According to an IBM Data Processing Division press fact sheet, a System/360 Model 25 was rented for $5,330 a month or sold at a price of $253,000 in 1968.[280] More extensive systems such as Model 75 were even more expensive with a monthly rental range of $50,000 to

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278 Mathews, "The Fun Palace as Virtual Architecture: Cedric Price and the Practices of Indeterminacy," 44.

279 "IBM100 - System 360," CTB14 (IBM Corporation, March 7, 2012), http://www-03.ibm.com/ibm/history/ibm100/us/en/icons/system360/.

280 "IBM Archives: System/360 Model 25," TS200, January 23, 2003, http://www.ibm.com/ibm/history/exhibits/mainframe/mainframe_PP2025.html.

$80,000 and a purchase price range of $2.2 million to $3.5 million.[281] Secondly, the computers could only be operated by trained staff and needed high maintenance due to their sheer scale. Although they offered significant advantages in terms of size when compared to first-generation vacuum tube computers, System/360 computers would fill in a sizeable room with its "peripherals" such as magnetic storage devices, visual display units, communication equipment, punched card readers, printers and so on.[282] Under these circumstances, the Fun Palace project was conceived as a centrally organized system that aimed to put expensive computational resources to the service of the people with an overemphasis on the role technology could play in increasing the socialization of individuals.

Whereas in the 1980s, the technological landscape was quite different. The microprocessor technology, representing the third generation in the evolution of computers, was thriving by virtue of its steady development since it first became available in 1971.[283] Based on this technology, personal computers, having already become a reality with several models from several brands in the late 1970s and the early 1980s, were starting to proliferate.

The communication infrastructure was also flourishing at the time. "A worldwide wave of deregulation, privatization and liberalization" was resulting in "a thorough restructuring of telecommunications operators, and the total number of telephone subscribers, which after 100 years of telephony had reached 350 million, increased to almost 1 billion by the end of the century."[284] As a result of this process, the

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[281] "IBM Archives: System/360 Model 75," TS200, January 23, 2003, 75, http://www.ibm.com/ibm/history/exhibits/mainframe/mainframe_PP2075.html.

[282] "IBM100 - System 360."

[283] "The Story of the Intel® 4004," Intel, accessed November 7, 2021, https://www.intel.com/content/www/us/en/history/museum-story-of-intel-4004.html.

[284] Anton Huurdeman, *The Worldwide History of Telecommunications* (New Jersey: John Wiley & Sons, 2003), 363–64.

telecommunications networks were evolving from "narrowband, circuit-switched, state-owned" networks to "broadband, packet-switched, private" networks.[285]

The transition from radio-relay to coaxial to optical fiber transmission was also providing significant increases in transmission capacities around the same period.[286] Although the "internet" was not commercially available until the early 1990s, services such as "teletex"[287] and "videotex"[288] were already in use. "Cable TV" systems that worked through coaxial and optical fiber cables as opposed to traditional TV that relied on radio signals were flourishing.[289] Given all these developments, the Kawasaki project was proposed as a distributed unlimited communication infrastructure that emphasized the information environment and its consequences on the socialization as well as isolation of individuals.

Nonetheless, apart from these differences, both projects shared fragments of Pask's personal research agenda in cybernetics, which was primarily focused on the interaction of humans, machines, or a combination of both, and as such, their model of human-machine interaction was similar to each other. Around the time Fun Palace was designed, self-organization was a dominant research agenda in cybernetics which was spearheaded by Heinz Von Foerster and his colleagues at the Biological Computer Laboratory (BCL) at the University of Illinois Urbana-Champaign.[290] As

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[285] Huurdeman, 364.

[286] Huurdeman, 445.

[287] Huurdeman, 512.

[288] Huurdeman, 580–81.

[289] Huurdeman, 580–89.

[290] Heinz von Foerster, "On Self-Organizing Systems and Their Environments," in *Cybernetics of Cybernetics: Or the Control of Control and the Communication of Communication*, ed. Heinz von Foerster (Minneapolis: Future Systems Inc., 1995), 220–30; Ross Ashby, "Principles of the Self Organizing System," in *Cybernetics of Cybernetics: Or the Control of Control and the Communication of Communication*, ed. Heinz von Foerster (Minneapolis: Future Systems Inc., 1993), 232–43.

an eminent member of the cybernetics community, Pask was also conducting research on self-organizing systems there.[291] Thus, he reformulated Littlewood and Price's Fun Palace in such a way that the building and its inhabitants would constitute a self-organizing system that can sustain itself via the feedback provided by each. In the 1980s, Pask was pursuing a similar agenda through his conversation theory, for which he considered Von Foerster's self-organization as its "progenitor,"[292] based on the constructivist epistemology widely referred to as the "cybernetics of cybernetics" or "second-order cybernetics."[293] Hence, Pask proposed the Kawasaki project as a materialization of ideas he developed around interaction in conversation theory. In that respect, both projects shared the same understanding that the architectural environments should be considered as part of systems that involve both human and non-human entities; and they should be designed in such ways that they would be capable of learning from their inhabitants and interacting with them in creating novel situations.

Since both projects were intended to be architectural manifestations of the latest computer technologies of their time, they were destined to become obsolete as the technology changed, a view also shared by their creators. From a technological point of view, the Fun Palace project was already outdated when the Kawasaki project was designed, as would be the case with the Kawasaki project if it was viewed from the 2000s. In this sense, it would be fair to say that they do not signify much as architectural manifestations of the latest technologies of their time; rather, they endure as two very prominent cases through their model of human-machine relationship based on interaction, which renders them still of interest to us today. The

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[291] Pask, *An Approach to Cybernetics*, 100–108.

[292] Gordon Pask, "Heinz von Foerster's Self-Organization, the Progenitor of Conversation and Interaction Theories," *Systems Research* 13, no. 3 (1996): 349–62.

[293] von Foerster, *Cybernetics of Cybernetics: Or the Control of Control and the Communication of Communication*.

comparative history provided here demonstrated that they, though naturally quite distinct from each other when viewed from a perspective concerned with their respective technological contexts, embody essentially the same model of human-machine relationship as a result of the contributions of Pask.

CHAPTER 5

STUDENTS AND FOLLOWERS TAKE COMMAND: EXPERIMENTS/APPROACHES WITHIN THE PASKIAN SCHOOL OF ARCHITECTURAL CYBERNETICS

> Our purpose in making the show is to show a way forward, as I argue in my study. Pask's contribution, and indeed the value of cybernetics itself, is not as historical curiosity, no matter how much we may gain from looking at it in the historian's light.[294]
>
> […] The architectural and artistic insights of Gordon Pask and those around and following him are both examples and inspirations. They give us a springboard from which to launch ourselves towards new worlds and new possibilities. This is an exciting time to look forwards rather than drifting back nostalgically into the past.[295]

Above are two quotes from Ranulph Glanville and Steven Gage, the co-curators of the "Pask Present" exhibition, organized in 2008 in Vienna, bringing together several figures from art, architecture, and design who considered Gordon Pask's work inspirational for their own.[296] These remarks give strong clues about the way they

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[294] Ranulph Glanville, "Introduction," in *Pask Present: An Exhibition of Art and Design Inspired by the Work of Gordon Pask, Cybernetician, Artist*, ed. Ranulph Glanville and Albert Müller (Vienna: Edition Echoraum, 2008), 11.

[295] Stephen Gage, "The Bartlett Interactive Architecture Workshop," in *Pask Present: An Exhibition of Art and Design Inspired by the Work of Gordon Pask, Cybernetician, Artist*, ed. Ranulph Glanville and Albert Müller (Vienna: Edition Echoraum, 2008), 69.

[296] Ranulph Glanville and Albert Müller, eds., *Pask Present: An Exhibition of Art and Design Inspired by the Work of Gordon Pask, Cybernetician and Artist* (Vienna: Edition

approached the issue of making sense of cybernetic ideas in architectural and design contexts. According to them, cybernetics, particularly Paskian cybernetics, should be seen not just as a matter of the past but as a valuable source that can be adopted to discern and evolve the present.

Based on works presented in this exhibition and a multitude of other theoretical and practical attempts at translating Paskian concepts and ideas into architecture and design fields, which cover a span of more than thirty years starting from the late 1980s up to the present, the chapter focuses on a later period in what is called the Paskian school of architectural cybernetics. It argues that this period is characterized by a multiplicity of approaches that involve theoretical, educational, and practical realms, alongside a multiplicity of actors from different generations, including Pask himself, those who collaborated with him during his lifetime, and those who followed his ideas later. It establishes the Paskian school of architectural cybernetics as a niche research tradition that has been producing novel outputs regarding human-machine relationship in machine intelligence research in architecture, based on its strength in creating a devoted community and a precise agenda that have been continuously propagated and sustained through generations.

The chapter is organized into four parts. The first part emphasizes Pask's presence at the UK architectural education scene in the 1990s by focusing on a number of efforts in translating his concepts and ideas into architecture. The second part dwells on two other attempts by his students that aimed to promote the relevance of Paskian cybernetics not only in architecture but also in the larger design field. The third part concentrates on the Pask Present exhibition as a significant event with a particular interest in a number of design works proposed by a new generation of architects. The final part dwells on current approaches in the Paskian school of architectural

Echoraum, 2008); "Pask Present » Exhibition," accessed December 7, 2021, http://paskpresent.com/exhibition/.

cybernetics based on a number of recent studies.

5.1 Pask at the UK Architectural Education Scene in the 1990s

This part focuses on the multiple appearances of Paskian concepts and ideas in leading architectural education institutions in the UK in the 1990s and demonstrates that they found themselves a substantial place in architectural design education.

The seeds of the strong presence of Paskian ideas in the UK architectural education scene in the 1990s were sown through Pask's earlier interactions with architecture in the 1960s. His involvement in Fun Palace by Joan Littlewood and Cedric Price, which was discussed in detail in the previous chapter, led to him being invited to the AA on several occasions to give lectures and attend architectural reviews throughout the 1960s.[297] This was an opportunity for Pask to reach out to architecture, which he seized by establishing relations with some of the students there, such as Ranulph Glanville, John Frazer, Stephen Gage, Chris Abel, and Michael Ben-Eli, with whom he collaborated in various forms in the following years.

Following these early interactions, Pask's presence in the UK architectural education scene became more reinforced when he was appointed a tutor at the AA in the 1980s. Although the exact date of this appointment could not be specified, the Gordon Pask Archive consists of several letters going back as early as 1988 that included contracts of employment with the AA, exchanged with Alvin Boyarsky, then the chairperson of the AA. According to these documents, Pask was employed as a tutor on a part-time basis (one day per week), and his salary would be paid from the "chairman's

[297] Gonçalo Furtado, "Envisioning an Evolving Environment- The Encounters of Gordon Pask, Cedric Price and John Frazer" (Ph.D Thesis, London, University College London, 2007), 94–98, https://discovery.ucl.ac.uk/id/eprint/1444949/.

salary reserve."[298] These yearly contracts were continued to be offered to Pask by Alan Balfour, who followed Boyarsky as the chairperson of the AA from 1991 to 1995.[299] The archive also includes other documents which suggest that Pask's tutorship at the AA might have started earlier. For example, a letter from Pask to Boyarsky listing Pask's proposals for the 1983-84 academic year as a part-time tutor[300], or a series of leaflets, produced by the "AA Computing Staff," which was formed of Ranulph Glanville, Robin McKinnon Wood and Gordon Pask, for the AA Projects Review 1986-87[301] (Figure 5.1) proves this point.

Pask's activities at the AA were threefold. First, he offered lecture series in the General Studies Program. Among those, the one titled "Architecture of Past and Future Worlds," whose series descriptions and individual lecture abstracts have been preserved at the Gordon Pask Archive, was dealing with his conception of the so-called "information environment" and "too much togetherness."[302] These were issues Pask had been involved in since the early 1980s that also acted as inspirations for his proposal for the Kawasaki project, which is discussed in detail in the previous chapter. In a fax letter to the General Studies program coordinator, Pask described

[298] Alvin Boyarsky, "Letter to Gordon Pask with Contract of Employment for 1988-1989 with the AA," August 1, 1988, Gordon Pask Archive, University of Vienna-Department of Contemporary History; Alvin Boyarsky, "Letter to Gordon Pask with Contract of Employment for 1989-1990 with the AA," August 1, 1989, Gordon Pask Archive, University of Vienna-Department of Contemporary History; Alvin Boyarsky, "Letter to Gordon Pask with Contract of Employment for 1990-1991 with the AA," August 1, 1990, Gordon Pask Archive, University of Vienna-Department of Contemporary History.

[299] Alan Balfour, "Letter to Gordon Pask with Contract of Employment for 1993-1994 with the AA," August 1, 1993, Gordon Pask Archive, University of Vienna-Department of Contemporary History.

[300] Pask, "Letter to Alvin Boyarsky with Proposal for Work Year 1983-1984."

[301] Ranulph Glanville, Robin McKinnon-Wood, and Gordon Pask, "All Drawings and Text Here Were Computer Generated at the AA," ca 1986, Gordon Pask Archive, University of Vienna-Department of Contemporary History.

[302] Pask, "The Limits of Togetherness"; Pask and Curran, *Micro Man: Computers and the Evolution of Consciousness*.

the series as follows:

> For a long while, most noticeably perhaps during the last few decades, there has been a fundamental change in the environment. We now rely upon and live in an environment which is dominated by information and organisation, computation of all kinds being a part of it. […] This aesthetic and this ethos permeates [sic] life, construction space, habitation proximity and privacy, giving all of these commonsensical words a deeper, in some ways, different, in all ways more profound meaning. […] In the course of the series we shall examine many facets of this novel and necessary perspective, a paradigm shift.[303]

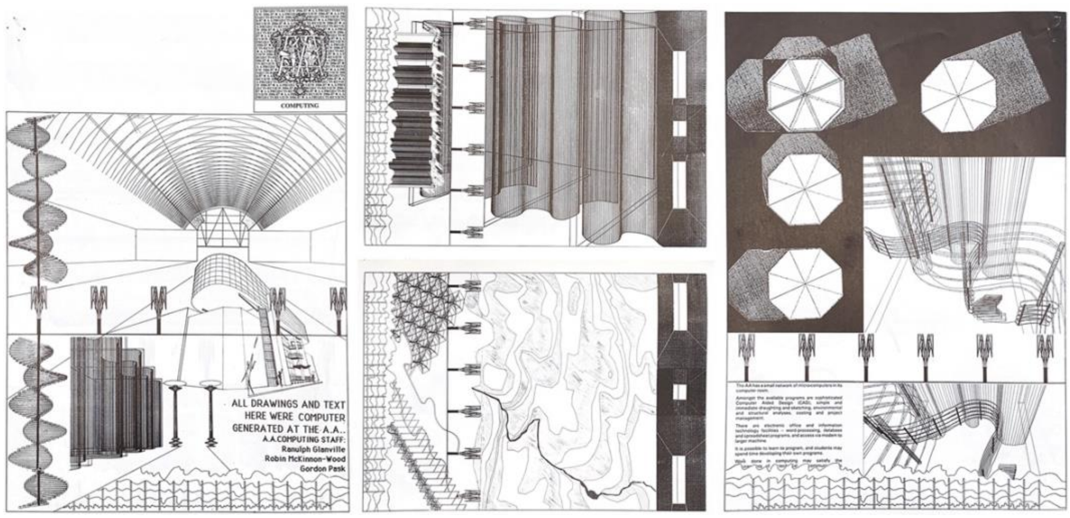

Figure 5.1. A Leaflet Produced by AA Computing Staff, ca.1986, Source: Gordon Pask Archive.

Apart from this series description, the individual lectures also reflected his emphasis on the information environment and its possible effects on the design and the experience of architectural spaces. In these lectures, Pask characterized the

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[303] Gordon Pask, "Architecture of Past and Future Worlds Series Description," 1991, 1–2, Gordon Pask Archive, University of Vienna-Department of Contemporary History.

information environment as a revolution that was gone largely unnoticed though it had the potential to "dominate the social and architectural scene."[304] He dealt with the issues of "informational transfer" and "organisational closure," and argued that "connectivity," with its effect on "geographical proximity," was a significant factor regarding the "habitability" of a space.[305] He particularly dwelled on the interactions between architects and inhabitants on how the former, by creating a tangible architectural piece, would invoke a complementary architecture in the latter's mind.[306] He argued that this "architecture of mind and thought," as he called it, was also buildable as an architectural piece[307], just as he had done earlier at the Kawasaki project, discussed in the previous chapter, by proposing the Architecture of Knowledge installation as a cognitive representation of the city.

Pask was also offering, jointly with Raoul Bunschoten, another lecture series called "Chaos and Order" and later "Risk and Transgression."[308] These series were significant insofar as they offered lectures by speakers who came from a wide variety of disciplines (i.e., cybernetics, physics, mathematics, computer science, psychology, etc.) for architecture students (Figure 5.2).[309]

Apart from these lecture series, Pask was also involved in two other activities at the AA. On the one hand, he was supervising general studies theses of diploma students. Among those who became Pask's student in this capacity was Samantha

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[304] Pask, 3.

[305] Pask, 2.

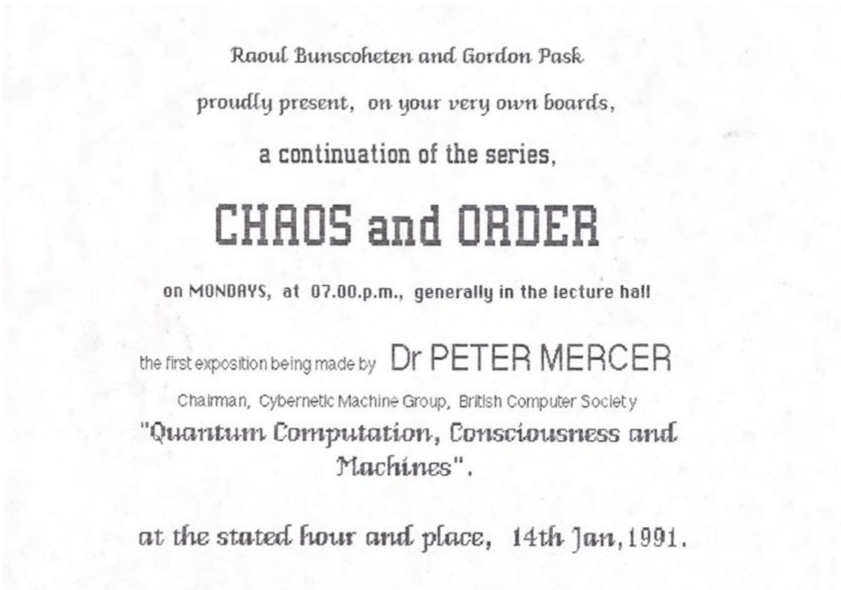
[306] Pask, 4.

[307] Pask, 2.

[308] Raoul Bunschoten, "Preface," in *Cybernetics: State of the Art*, ed. Liss C. Werner, vol. 1, Conversations (Berlin: Universitätsverlag der TU Berlin, 2017), xi.

[309] Gordon Pask, "Letter to Raoul Bunschoten About Risk and Transgression Series," December 22, 1990, Gordon Pask Archive, University of Vienna-Department of Contemporary History.

Hardingham, who later went on to publish about the Fun Palace and the Kawasaki projects[310], with her thesis proposal titled "The Human Use of Computer Beings: Cooperation, Conflict and Coalition."[311] On the other hand, Pask was acting as an instructor at the design studios, notably at the Diploma Unit 11 of John and Julia Frazer, the specifics of which are discussed in the following section.


Raoul Bunscoheten and Gordon Pask

proudly present, on your very own boards,

a continuation of the series,

CHAOS and ORDER

on MONDAYS, at 07.00.p.m., generally in the lecture hall

the first exposition being made by Dr PETER MERCER

Chairman, Cybernetic Machine Group, British Computer Society

"Quantum Computation, Consciousness and Machines".

at the stated hour and place, 14th Jan, 1991.

Figure 5.2. A Flier for the Risk and Transgression Lecture Series, 1991. Source: Gordon Pask Archive.

As stated by him in a personal interview, Frazer was a student at the AA between 1963-68.[312] He attended a lecture given by Pask at the AA upon invitation from Peter Cook, which greatly impressed him.[313] After his graduation, he started working at

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310 Hardingham, *Cedric Price Works 1952-2003 A Froward Minded Retrospective*, Volume 1 Projects:46-85 658-663.

311 Samantha Hardingham, "The Human Use of Computer Beings: Cooperation, Conflict and Coalition," 1992, Gordon Pask Archive, University of Vienna-Department of Contemporary History.

312 John Frazer, Interview with John Frazer, interview by Ensar Temizel, Online, March 3, 2021.

313 Frazer.

Cambridge University, and later at the AA and the Ulster Polytechnic, where he invited Pask to give lectures and conduct workshops.[314] Their relationship continued in a more comprehensive manner when John and Julia Frazer invited Pask to join their graduate studio, Diploma Unit 11, at the AA in the late 1980s. During the time the Diploma Unit 11 (also referred to as Unit 14 in 1989/1990 academic year) existed from 1989 to 1996, Pask acted as a tutor,[315] and was especially influential on the works of a number of students.[316] The unit's work was presented to the public with a major exhibition titled "An Evolutionary Architecture" in 1995 and published in a seminal book of the same name[317], the foreword of which was written by Pask.

The book covered Frazer's activities in the last thirty years, including his student years at the AA and his subsequent research efforts at the University of Cambridge, Ulster Polytechnic and Autographics Software Ltd, a private company he established with Julia Frazer, where they pioneered the use of computers in design education. In Pask's words, the fundamental thesis of the works presented in the book was that of "architecture as a living and evolving thing."[318] This assessment was supported by Frazer's own remarks on architecture as "a form of artificial life, subject, like the natural world, to principles of morphogenesis, genetic coding, replication and selection."[319] The book was intended to generate tools and methods to accommodate this kind of understanding in architectural design.

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[314] Frazer.

[315] Frazer, "The Cybernetics of Architecture: A Tribute to the Contribution of Gordon Pask," 641.

[316] Frazer, Interview with John Frazer.

[317] John Frazer, *An Evolutionary Architecture* (London: The Architectural Association (AA), 1995).

[318] Gordon Pask, "Foreword," in *An Evolutionary Architecture*, by John Frazer (London: The Architectural Association (AA), 1995), 6.

[319] Frazer, *An Evolutionary Architecture*, 9.

Cybernetics was quite central to the whole agenda of the studio,[320] and several individual projects incorporated cybernetic ideas in their design. Of these, the Universal Constructor project is particularly significant as it was based on the idea of self-organization, which was a longstanding principal research agenda in cybernetics that Pask had also passionately pursued throughout his career. The project was produced by the whole studio group and presented at the end-of-year exhibition at the AA in 1990 (Figure 5.3).[321] Its name was given in reference to John von Neumann's universal constructor machine proposed as part of his theory of self-reproducing automata.[322] The idea was that this model could be used by each student as a base for their own specific problem definitions. It was basically an installation that was composed of a three-dimensional array of identical cubes that could be arranged by the visitors. It had a 12x12 base-board, on each cell of which could be stacked a maximum of 12 cubes. Each cell had eight light-emitting diodes (LEDs) that represented one of 256 states. Massages could be passed vertically between the cubes on each stack and horizontally on the baseboard, which made each cube able to communicate with any other. At any time, the configuration of the whole structure would be deduced by a controlling processor and mapped as a more abstract virtual model on a display screen. Cubes could also communicate with the visitors via two red LEDs, where one flashing light meant "take me away" and two flashing lights meant "add a cube on top." In a typical scenario, the system would "request an interactor to configure an environment." The model would then indicate its proposed response by "asking the interactor's assistance in adding or removing units," and the participator could in turn "modify the environment."[323] This process, when applied

[320] Frazer, "The Cybernetics of Architecture: A Tribute to the Contribution of Gordon Pask," 641.

[321] Frazer, *An Evolutionary Architecture*, 44.

[322] Frazer, 44.

[323] Frazer, 44–49.

recursively, would facilitate interaction between the model and visitor, where both would learn from each other's response and act accordingly.

Figure 5.3. A Photo of Universal Constructor with Gordon Pask, ca. 1990. Source: John Frazer, "Computing Without Computers," Architectural Design 75, no.2 (2005): 41.

As "a self-organizing interactive environment,"[324] this project had some common features with another project from 1970 produced by Nicholas Negroponte's Architecture Machine Group at MIT. SEEK was a system composed of five hundred metal-plated cubes, a colony of gerbils, and a robotic arm (Figure 5.4).[325] The activity of the gerbils would constantly disturb the rectilinear arrangement of the cubes called for by the robotic arm. If a cube were "slightly askew," the robotic arm would realign it. However, if it were "substantially dislocated," the arm would place it in a new position, on the assumption that "the gerbils wanted it there." The outcome

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[324] Frazer, 49.

[325] Negroponte, *The Architecture Machine*, 105; Negroponte, *Soft Architecture Machines*, 47; Steenson, *Architectural Intelligence: How Designers and Architects Created the Digital Landscape*, 184–87.

would be "a constantly changing architecture that reflected the way the little animals used the place."[326] The gerbils and the robotic arm, though having conflicting interests, would come up with novel configurations through the circular feedback mechanism between them.

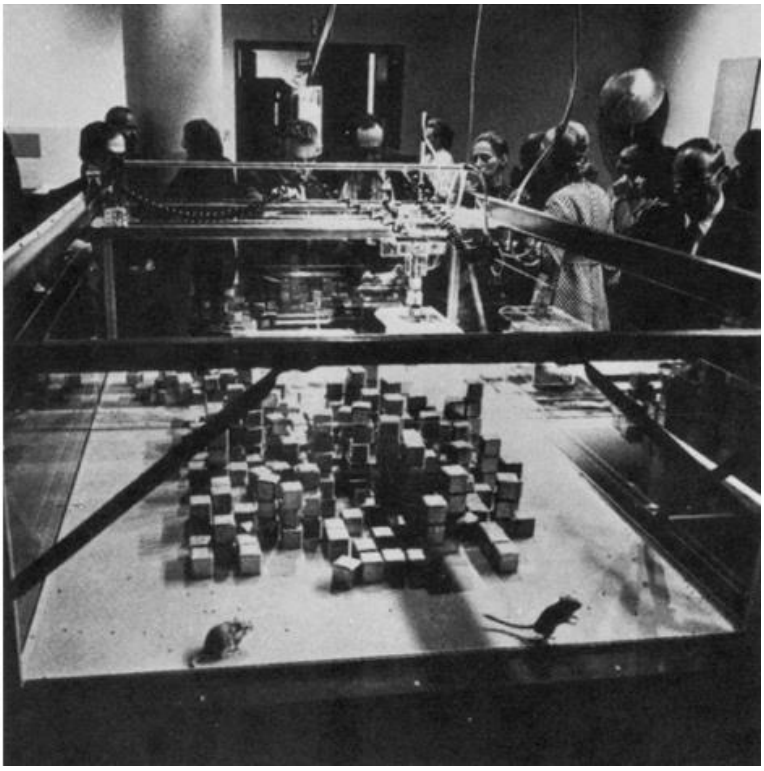

Figure 5.4. A Photo of SEEK. Source: Nicholas Negroponte, Soft Architecture Machines (Cambridge, MA: The MIT Press, 1975), 47.

Though SEEK can be considered an inspiration for the Universal Constructor, the project was much more a reflection of the Frazers' work in the late 1970s and early 1980s on a system called "intelligent physical modeling" (Figure 5.5).[327] The idea behind this system was to furnish physical model parts with integrated circuits to make it possible for a computer to read the changing configuration of the model and

[326] Negroponte, *Soft Architecture Machines*, 47.

[327] Pask, "Foreword," 119.

automatically create its virtual twin. This virtual model would then be used to plot architectural drawings (i.e., interior/exterior perspectives) that could provide information for the further modification of the model (Figure 5.6). In other words, the information derived from the drawings about the spatial outcome of a version of the model could be used as an input for further iterations. In their capacity as the "computer consultants," the Frazers used this system in building a model of Cedric Price's Generator project. The system was disseminated through a number of conference papers[328], the copies of which are preserved at the Generator project folder of the Cedric Price Fonds of the Canadian Centre for Architecture in Montreal. In the earlier paper, titled "Intelligent Physical Three-Dimensional Modelling Systems," the Frazers described the system as the following:

> Intelligent physical three-dimensional modelling systems imply physically incorporating local intelligence or logic circuits into the kit of parts for building a physical model. The model can be viewed by a human observer as a physical representation and simultaneously understood by the computer as a logical electronic model. The computer is able to interrogate the physical model and deduce its organizational configuration. The data derived from this interrogation can be used to provide immediate feedback during the construction of the model or the data can be stored for later use. Feedback might take the form of additional projections of the model under construction (such as displaying internal plans) or might be instructions about the rules of further extending the model (such as building regulations or structural constraints). [...] In many applications it also represents a convenient method

[328] John Frazer, Julia Frazer, and Peter Frazer, "Intelligent Physical Three-Dimensional Modelling Systems" (Computer Graphics 80, Birmingham, 1980); John Frazer, Julia Frazer, and Peter Frazer, "New Developments in Intelligent Modelling," in *Proceedings of Computer Graphics 81* (Computer Graphics 81, London, 1981); John Frazer, Julia Frazer, and Peter Frazer, "The Use of Simplified Three-Dimensional Computer Input Devices to Encourage Public Participation in Design," in *Proceedings of CAD 82* (CAD 82, Brighton, 1982).

> of data input and avoids the tedium of two-dimensional digitizing let alone the problems of three-dimensional digitizing employed in the automotive and chemical engineering industries. The simplicity of the technique and the immediacy of the feedback should facilitate better interaction between designer and client.[329]

The paper also described five working models of this system, the final one of which was the Generator project. In this section, the Frazers postulated the idea of extending the intelligent physical modeling system to the real world through Generator[330], a project proposal developed by Cedric Price for the Gilman Paper Company on a site in Jacksonville Florida. They proposed to embed logic circuits into the individual site components, which would enable a computer to read the current configuration of the site and suggest new arrangements which would be implemented with the help of a crane.[331] They developed a computing package, which comprised "a suite of four programs."[332] Of these four programs, the last one, referred to as "the most powerful" one, would "take suggested activities and arrange the site [..] in accordance with simple rules of crane lift, structural spans and circulation."[333] To be able to do so, it was provided with "a concept of boredom," a direct reference to a machine designed and produced by Pask almost thirty years before in the 1950s, called Musicolour,[334] which is thoroughly discussed in the second chapter of the thesis. The program, following what the Musicolour machine did in the context of a musical performance, would get bored and "generate

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[329] Frazer, Frazer, and Frazer, "Intelligent Physical Three-Dimensional Modelling Systems," 1.

[330] Frazer, Frazer, and Frazer, 10.

[331] Frazer, Frazer, and Frazer, 10.

[332] Frazer, Frazer, and Frazer, 10.

[333] Frazer, Frazer, and Frazer, 11.

[334] Frazer, Interview with John Frazer.

unsolicited plans" if the site was not being "re-organized or changed for some time."[335] The concept of boredom ensured that the Generator was not a passive environment that depended entirely on users' preferences; instead, it was designed in such a way that it would also have a capacity to affect them.

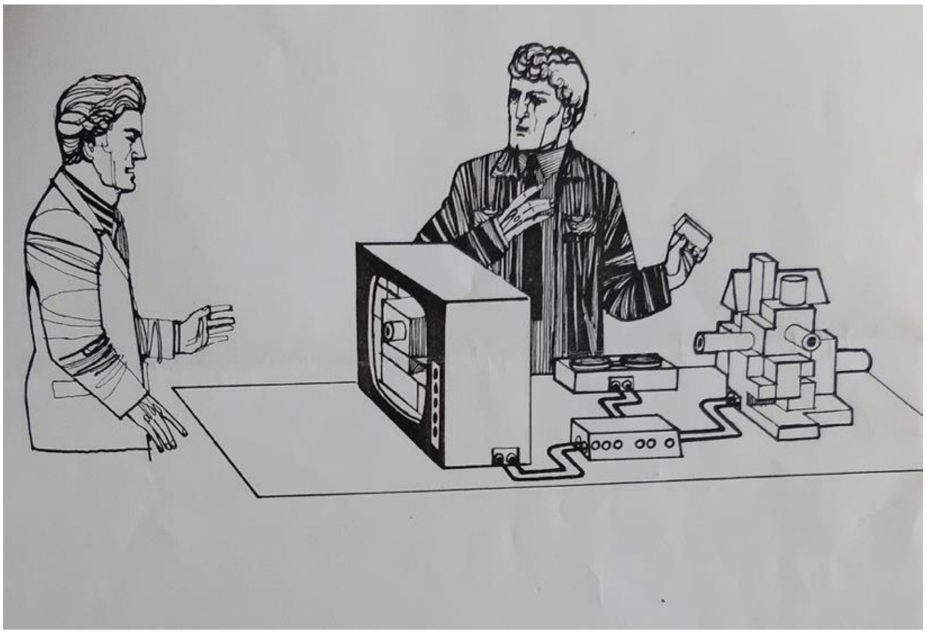

Figure 5.5. A Diagram of Intelligent Modelling System, 1980. Source: Cedric Price Fonds, Canadian Centre for Architecture, © CCA.

335 Frazer, Frazer, and Frazer, "Intelligent Physical Three-Dimensional Modelling Systems," 11.

Figure 5.6. A Photo of Intelligent Modelling System, ca. 1980. Source: Cedric Price Fonds, Canadian Centre for Architecture, © CCA.

Besides the Universal Constructor and the Generator, cybernetic ideas were central to the Frazers' other projects too, notably the Universal Interactor in 1992[336], the Interactivator in 1995,[337] and the Groningen project that followed in the late 1990s.[338] In a paper titled "The Architectural Relevance of Cyberspace," whose title was proposed as a tribute to Pask's essay from 1969, "The Architectural Relevance of Cybernetics," which was also discussed in detail in the second chapter of the thesis, Frazer characterized architecture as "an essential organ of interaction with the environment" and argued that the emphasis in design moved "from forms, to the

[336] Frazer, *An Evolutionary Architecture*, 75–78.

[337] Frazer, "The Cybernetics of Architecture: A Tribute to the Contribution of Gordon Pask," 645–47; John Frazer, Manit Rasstogi, and Peter Graham, "The Interactivator," *Architectural Design* 65, no. 11/12 (1995): 80–81.

[338] John Frazer, "The Groningen Experiment," in *Proceedings of the Second Conference on Computer Aided Architectural Design Research in Asia* (CAADRIA '97, Hsinchu, 1997).

relationship between forms, to forms in their environment, to the relationship between forms and their users."[339] In line with this view, interaction made possible through mutual learning between environments and their users/inhabitants was common to the Frazers' activities.

Another involvement of Pask with the UK architectural education scene in the 1990s was through Stephen Gage, who was also a student at the AA in the 1960s.[340] Gage, who also acted as a unit tutor at the AA between 1974-1993, started teaching at the Bartlett School of Architecture in 1993, where he led the Diploma Unit 14 and the Bartlett Interactive Architecture Workshop (BIAW).[341] Like the Frazers, he invited Pask to his studio as a tutor, a role he played until his death in 1996.

As with every other figure discussed in this thesis who was a student at the AA in the 1960s, Gage was greatly influenced by the cybernetic ideas having been translated into architecture with the Fun Palace project.[342] This influence led to his subsequent interest in cybernetics, which, alongside systems theory, behavioral analysis, and performative design, were defined by him as the primary influences behind the work at the BIAW.[343] Some of his students, such as Usman Haque and Ruairi Glynn, still continue to promote cybernetic ideas, particularly Paskian ideas

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339 John Frazer, "The Architectural Relevance of Cyberspace," *Architectural Design* 65, no. 11/12 (1995): 77.

340 Stephen Gage, "The Sixties and the Seventies (and Ranulph)," in *Ranulph Glanville: Architecture, Art, Cybernetics, Design: London and the 1960s*, ed. Marianne Ertl, Werner Korn, and Albert Müller (Vienna: Edition Echoraum, 2016), 11.

341 UCL, "Prof Stephen Gage," The Bartlett School of Architecture, December 21, 2016, https://www.ucl.ac.uk/bartlett/architecture/people/prof-stephen-gage.

342 Gage, "The Sixties and the Seventies (and Ranulph)," 15.

343 UCL, "Bartlett Interactive Architecture Workshop (BIAW)," The Bartlett School of Architecture, December 6, 2016, https://www.ucl.ac.uk/bartlett/architecture/research/bartlett-interactive-architecture-workshop-biaw.

in architecture through their teaching and practice, which will be discussed later in the chapter.

Gage's own attempts at trying to translate cybernetic ideas into architecture appeared in different forms involving both theory,[344] teaching[345] and practice[346]. In those attempts, Gage aimed to show "how concepts from cybernetics [could] help to illuminate and possibly resolve some central, linked questions in architecture."[347] In doing so, he benefitted from Heinz von Foerster's concept of "trivial" and the "non-trivial machines"[348] and Pask's idea of "aesthetically potent environments."[349]

By dwelling on the distinction between a trivial and a non-trivial machine, which was described as being a machine's capability in delivering "unpredictable" outputs for the same input at different instances, Gage asked whether such machines could be constructed in architecture, whose output is "continually surprising and new."[350] He used Pask's Musicolour machine and Colloquy of Mobiles installation as examples of such non-trivial machines, whose interactions with observers/participants were based on the same principle.[351] As discussed in detail in the second chapter of the thesis, these machines could learn from their participants

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[344] Stephen Gage, "The Wonder of Trivial Machines," *Systems Research and Behavioral Science* 23, no. 6 (2006): 771–78; Stephen Gage, "How to Design a Black Box and a White Box," *Kybernetes* 36, no. 9/10 (2007): 1329–39; Stephen Gage, "Constructing the User" (ACADIA 2009: reForm(): Building a Better Tomorrow, Chicago, 2009), 44–51.

[345] Stephen Gage, "Heinz Von Foerster Is a Member of the Viennese Magic Circle," *Architectural Design* 72, no. 3 (2002): 80–88.

[346] Stephen Gage and Chris Leung, "The Mechanical Homunculus" (19th European Meeting on Cybernetics and Systems Research (EMCSR 2008), Vienna, 2008).

[347] Gage, "Constructing the User," 44.

[348] von Foerster, *Understanding Understanding: Essays on Cybernetics and Cognition*, 199–210.

[349] Pask, "A Comment, a Case History and a Plan."

[350] Gage, "The Wonder of Trivial Machines," 771.

[351] Gage, "Constructing the User," 47.

and tune their responses accordingly, which would result in novelty. As such, they were exemplifying aesthetically potent environments, which offered sufficient variety to provide novelty in its interactions with observers but avoid too much variety not to be unintelligible.[352] According to Gage, these machines "had the observer in mind and held the observer in a conversation," which made them relevant for "today's Architects."[353]

Regarding all these instances of Paskian framework being translated into architecture as a result of both Pask's and his architect colleagues' efforts, it can be said that his ideas found themselves a substantial place in cutting-edge design research in architectural education institutions in the UK in the 1990s. As discussed earlier, his successful initiation into architecture by virtue of the warm relations he established within the AA and the strong presence of his ideas in architectural circles in the 1960s had a great impact on this consequence. Similarly, his presence at the UK architectural education scene in the 1990s gave way to a third wave of adaptation of Paskian ideas by architects in the 2000s and 2010s, which will be discussed later in the chapter.

5.2 Design as Paskian Conversation

Two other attempts at translating Paskian ideas into not only architecture but also the larger design field came from two former Ph.D. students of Pask, Ranulph Glanville, and Paul Pangaro, who had a relatively closer relationship with him when compared to other figures discussed above. This part aims to disclose those attempts, which were more ambitious in their scope, more enduring in their span, and more

352 Pask, "A Comment, a Case History and a Plan," 76.

353 Gage, "The Bartlett Interactive Architecture Workshop," 66–67.

substantial in their content involving theoretical, educational, and practical dimensions.

Of the two figures, Ranulph Glanville was also a student at the AA in the late 1960s and the early 1970s, and his early acquaintance with cybernetics was also due to the interdisciplinary atmosphere prevalent at the AA that made it possible for figures such as Pask to get involved in architectural education at that period. He developed a close relationship with Pask and valued Paskian ideas throughout his life. After his graduation from the AA, Glanville went on to conduct, like some other students of the AA, his Ph.D. studies at Brunel University, Department of Cybernetics under the supervision of Pask. His Ph.D., which was awarded in 1975, aimed to relate the fields of "architecture" and "language" with the application of a "Systems Approach to problems in both."[354] The thesis dwelled on the perception of some architectural topic (e.g., the locational structure of a city) and aimed to develop a non-hierarchical system in which a number of observers could communicate their own perceptions to others.[355] In Glanville's own words, this effort echoed "the dominant architectural philosophy of the 1960's" that was based on the ideas of "highly serviced environment," "plug-in," "do-it-yourself," and "flexibility," which were manifested in the work of Cedric Price.[356] The thesis involved the execution of a number of experiments (London Knowledge Test, London Structure Test, Conceptual Space) aiming to assess perceptual differences on the urban structure of London, whose subjects were architecture students from the AA.[357] In this sense, the thesis was an attempt to benefit from concepts and methods from cybernetics and psychology in

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[354] Ranulph Glanville, "A Cybernetic Development of Epistemology and Observation, Applied to Objects in Space and Time (As Seen in Architecture)" (Ph.D Thesis, London, Brunel University, 1975), 1.

[355] Glanville, 2.

[356] Glanville, 2.

[357] Glanville, 115–62.

architectural contexts, and as such, it was one of the first attempts by Glanville to transcribe knowledge from those fields to architecture. An undated syllabus of a seminar course titled "Cybernetics and Architecture," to be given by Glanville at the Technical Studies Service Unit (TSSU) of the AA probably around the same time, also proves this point. In this document, the aim of the course was defined as "to concentrate on areas to which Cybernetics addresses itself" and "to show how [architects] could benefit from and use these approaches," which might help them in their analyses of their own work.[358] Of note regarding those early attempts is also Glanville's second Ph.D. thesis[359] at the Centre for the Study of Human Learning at Brunel University under the supervision of Laurie Thomas, in which he investigated "the description of human experience" of architecture by using the repertory grid method of George Kelly's Personal Construct Theory, a method also employed in the ARCHITRAINER project, which was discussed in detail in the third chapter of this thesis.

Apart from those early instances, Glanville's principal argument regarding the relationship between design and cybernetics was developed in a series of papers published in the late 1990s and the early 2000s[360], which culminated in his seminal essay titled "Try Again, Fail Again. Fail Better: The Cybernetics in Design and the Design in Cybernetics."[361] This essay was published as the leading paper in a special

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[358] Ranulph Glanville, "Seminar Course No.6: Cybernetics and Architecture," ca 1971, Gordon Pask Archive, University of Vienna-Department of Contemporary History.

[359] Ranulph Glanville, "Architecture and Space for Thought" (Ph.D Thesis, London, Brunel University, 1988).

[360] Ranulph Glanville, "Researching Design and Designing Research," *Design Issues* 15, no. 2 (1999): 80–91; Ranulph Glanville, "A (Cybernetic) Musing: Design and Cybernetics," *Cybernetics and Human Knowing* 16, no. 3/4 (2009): 175–86; Ranulph Glanville, "The Value When Cybernetics Is Added to CAAD," in *Proceedings of AVOCAAD 1997* (AVOCAAD 1997, Brussels, 1997), 37–50.

[361] Glanville, "Try Again. Fail Again. Fail Better: The Cybernetics in Design and the Design in Cybernetics."

double issue of the journal Kybernetes in 2007, dedicated to "Cybernetics and Design" and guest-edited by himself. In this paper, Glanville argued that cybernetics and architecture were "complementary arms of each other," and presented "cybernetics as theory for design" and "design as cybernetics in practice."[362] He attempted to demonstrate the connections between the two fields based on the second-order cybernetic thinking and its materialization in Pask's conversation theory.[363] He considered the design process to be essentially a cybernetic activity, particularly a "Paskian cybernetic conversation."[364] In doing so, he argued the following:

> [Design] can be thought of as a conversation held mostly (but not exclusively) with the self. In the most common traditional version, the conversation consists of making a mark with a pencil on paper (equivalent to talking, in a verbal conversation), and then looking at it to see what the mark suggests (equivalent to listening) and, consequently, modifying the drawing. The process goes on and on in a potentially endless circle. […] It is this process of conversation, primarily held with the self (but also with others in, for instance, an office), that indicates a cybernetic process at work: for conversation is perhaps the epitome of second order cybernetic systems. And, like any conversation, it is open and can take us to places we did not expect to be, thus introducing novelty. […] In this manner, sketching, the central source of creative design action, can be described and explained as and by means of a primary second order cybernetic system – the circle of conversation. And, although this is not all of design, it is a, if not the, key activity at the heart of design: so cybernetics supports design and design

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362 Glanville, 1173.

363 Glanville, 1178.

364 Glanville, 1189.

> supports cybernetics, in a further second order, conversational, cybernetic circle![365]

Akin to Glanville, at least similar to the first part of his argument that deliberates cybernetics as the theory of design, Pask also adopted an approach where he argued for the relevance of cybernetics as a theory for architecture in two earlier papers, "The Architectural Relevance of Cybernetics" and "An Initial Essay: Towards a Unification of Architectural Theories," which are thoroughly discussed in the second chapter of the thesis.[366] In this regard, Glanville's attempt can be seen as a continuation of Pask's earlier attempts at promoting cybernetics as a theory in architecture and design fields.

A multiplicity of other attempts to promote Paskian ideas in design came from Paul Pangaro, who was, like Glanville, a Ph.D. student of Pask at Brunel University, Department of Cybernetics. Unlike figures discussed above who had architectural backgrounds, Pangaro was graduated from MIT with degrees in humanities and computer science. As he stated in a personal interview, he continued his graduate studies between 1976-77 at the Architecture Machine Group (AMG) of Nicholas Negroponte[367], who had multiple collaborations with Pask around that time, which are discussed in the third chapter of the thesis. As a member of the Architecture Machine Group, Pangaro was involved in an unsuccessful grant proposal called "Graphical Conversation Theory" that aimed to merge the group's interest in computer graphics with the Paskian framework."[368] After having been strongly

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[365] Glanville, 1178–79.

[366] Pask, "The Architectural Relevance of Cybernetics"; Pask, "An Initial Essay: Towards a Unification of Architectural Theories."

[367] Paul Pangaro, Interview with Paul Pangaro, interview by Ensar Temizel, In-Person, February 24, 2020.

[368] Paul Pangaro, "THOUGHTSTICKER 1986: A Personal History of Conversation Theory in Software, and Its Progenitor, Gordon Pask," *Kybernetes* 30, no. 5/6 (2001): 793.

impressed by Pask's work, Pangaro dropped out of Negroponte's Ph.D. program and started working with Pask at his private laboratory, Systems Research Ltd.[369] There, he developed a version of an existing application of conversation theory, called THOUGHTSTICKER, which was also the subject matter of his Ph.D. thesis.[370] THOUGHTSTICKER was a specific system that used entailment meshes as a knowledge representation method. It was a general-purpose version of CASTE, which was discussed in the third chapter of this thesis as the first practical application of conversation theory in the form of a teaching machine that also used entailment meshes for knowledge representation. By virtue of the entailment mesh idea, THOUGHTSTICKER could understand the relations between different topics of a subject matter that made it able to provide the user, upon choosing an individual topic, with other relevant topics that were determined to be related to their initial choice. However, more importantly, it could build a model of the user based on their navigation in the search space that would enable it to offer bespoke suggestions for each user.[371] As such, THOUGHTSTICKER, like its predecessor CASTE, could learn from its user and adjust its response according to the feedback provided to it.

Pangaro, in a variety of roles throughout his career as business executive, corporate consultant, software designer, entrepreneur, and professor, has argued for the merits of conversation theory on many occasions and promoted Paskian ideas in various ways.[372] These efforts also included two articles he produced in collaboration with

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369 Paul Pangaro, "Winky Dink and Me: Origins," *World Futures* 75, no. 1/2 (2019): 44.

370 Paul Pangaro, "An Examination and Confirmation of a Macro Theory of Conversations through a Realization of the Protologic Lp by Microscopic Simulation" (Ph.D Thesis, London, Brunel University, 1987), http://bura.brunel.ac.uk/handle/2438/5320.

371 Pangaro, "THOUGHTSTICKER 1986: A Personal History of Conversation Theory in Software, and Its Progenitor, Gordon Pask," 797.

372 Paul Pangaro, "Conversations for Design - Design for Conversations - Du Pont," accessed December 7, 2021, https://www.pangaro.com/DuP-Sem/DuP-Sem.html; Paul Pangaro, "PANGARO Incorporated - Brief History - Contents," accessed December 7, 2021, https://www.pangaro.com/PI-Brochure/PI-Brochure.html; Paul Pangaro, "The Architecture of Conversation Theory," 2002,

Hugh Dubberly, particularly centered around the idea of "design as conversation for action," or in its shorter form, "design as cybernetics."[373] Dubberly and Pangaro, complementary to Glanville's approach, pointed out the connections between design and cybernetics and argued that "[second order] cybernetics is a necessary foundation for twenty-first century design practice" with its ability to frame "*both* the process of designing *and* the things being designed."[374] They elaborated on this idea as the following;

> We see design-for-conversation as the emergent space of design for the twenty-first century and aim for it as our goal. Whether designing interactive environments as computational extensions of human agency or new social discourses for governing social change, the goal of second-order design is to facilitate the emergence of conditions in which others can design – to create

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https://www.pangaro.com/L1L0/ArchCTBriefly2b.htm; Paul Pangaro, "New Order from Old: The Rise of Second-Order Cybernetics and Implications for Machine Intelligence," 2002, https://www.pangaro.com/NOFO/NOFO2002r-v8d.pdf; Paul Pangaro, "The Past-Future of Cybernetics: Conversations, Von Foerster, and the BCL," 2003, https://www.pangaro.com/Past-Future-of-Cybernetics-von-Foerster-BCL.pdf; Paul Pangaro, "Brief History of the North American Gordon Pask Archive," ca 2008, https://www.pangaro.com/Heinz-von-Foerster/Pangaro-Pask-NorthAmericanArchive-ViennaPaper.pdf4; Pangaro, "Questions for Conversation Theory or Conversation Theory in One Hour"; Paul Pangaro, "Cybernetics as Phoenix: Why Ashes, What New Life?," in *Cybernetics: State of the Art*, ed. Liss C. Werner, vol. 1, Conversations (Berlin: Universitätsverlag der TU Berlin, 2017), 16–33; Paul Pangaro and TJ McLeish, "Colloquy of Mobiles 2018 Project" (2018 Convention of the Society for the Study of Artificial Intelligence and Simulation of Behaviour (AISB 2018), Liverpool, 2018).

373 Hugh Dubberly and Paul Pangaro, "How Cybernetics Connects Computing, Counterculture, and Design," in *Exhibit Catalog-Hippie Modernism:The Struggle for Utopia* (Minneapolis: Walker Art Center, 2015), http://www.dubberly.com/wp-content/uploads/2015/10/Cybernetics_and_Counterculture.pdf; Hugh Dubberly and Paul Pangaro, "Cybernetics and Design: Conversations for Action," in *Design Cybernetics: Navigating the New*, ed. Thomas Fischer and Christiane M. Herr (Switzerland: Springer, 2019), 85–100.

374 Dubberly and Pangaro, "Cybernetics and Design: Conversations for Action," 85.

conditions in which conversations can emerge – and thus to increase the number of choices for all.[375]

Even though not particularly focused on Paskian conversation, also of note regarding Dubberly and Pangaro's promotion of cybernetics in design is a course offered at Stanford University, Human-Computer Interaction Program between 2002-2007; titled "Introduction to Cybernetics and Systems for Design."[376] This course aimed to apply "cybernetic frameworks to the design of complex, interactive systems" through "readings, lectures, discussions and project work,"[377] and as such, it was not only a theoretical effort but also a practical one.

5.3 Pask Present: A New Generation of Paskian Artifacts by a New Generation of Architects

This section concentrates on the Pask Present exhibition[378] as a significant instance of efforts that promoted Paskian ideas in architecture. In doing so, it dwells on the context it was produced in, and the actors involved in its organization with a particular interest in the works presented there by a number of architects who were students and collaborators of figures discussed above. In this sense, this part focuses on a new generation of Paskian artifacts produced by a new generation of architects. In doing so, it follows and renders more visible another chapter regarding the impact of the Paskian school of architectural cybernetics.

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[375] Dubberly and Pangaro, 97.

[376] "CS 377A: Introduction to Cybernetics and the Design of Systems Course Homepage," accessed December 7, 2021, https://web.stanford.edu/class/cs377a/.

[377] "CS 377A: Introduction to Cybernetics and the Design of Systems Course Homepage."

[378] Glanville and Müller, *Pask Present: An Exhibition of Art and Design Inspired by the Work of Gordon Pask, Cybernetician and Artist*; "Pask Present » Exhibition."

In its full name, “Pask Present: An Exhibition of Art and Design Inspired by the Work of Gordon Pask, Cybernetician and Artist” was on display in March-April 2008 at a modest gallery space (Atelier Färbergasse) in Vienna (Figure 5.7). The exhibition was held there as a tribute to Pask’s strong connection to the city. By the time the exhibition was organized, Pask’s archive was already transferred to the University of Vienna, next to Heinz von Foerster’s.[379] Also, the exhibition was associated with the 19th European Meeting on Cybernetics and Systems Research (EMCSR 2008), an event of a conference series organized biannually from 1972 onwards by the Austrian Society for Cybernetic Studies (ÖSGK), to which Pask was a regular attendee.[380] The exhibition was curated by Richard Brown, Ranulph Glanville, and Stephen Gage and built by the students of the Bartlett Interactive Architecture Workshop. It included eighteen art/design pieces, some of which were presented in physical form while others in video format.[381]

Among the participants with non-architectural backgrounds were Richard Brown and ArtStation (Anne Hayes and Glenn Davidson). Brown’s work was mainly based on the idea of chemical computers, an area of interest for Pask early in his career. The Pask Present exhibition grew out of the Maverick Machines exhibition organized and curated by Brown a year before in Edinburg that also brought together art and design works inspired by Paskian ideas.[382] The ArtStation’s work, on the other hand, presented in video, documented the artists’ experiments with Pask around building both physical and digital models of his entailment meshes. The

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[379] Glanville, “Introduction,” 9.

[380] Glanville, 10.

[381] Glanville and Müller, *Pask Present: An Exhibition of Art and Design Inspired by the Work of Gordon Pask, Cybernetician and Artist*.

[382] Richard Brown, “Pask Parallels,” in *Pask Present: An Exhibition of Art and Design Inspired by the Work of Gordon Pask, Cybernetician, Artist*, ed. Ranulph Glanville and Albert Müller (Vienna: Edition Echoraum, 2008), 111–30; “Maverick Machines,” accessed December 7, 2021, http://maverickmachines.com/WordPress/.

“BiTori” installation created for a conference by the American Society for Cybernetics (ASC) in 1989 was an example of such an effort, where a paper structure created with two orthogonally intersecting tori was inflated with air (Figure 5.8).[383] Due to its scale, someone could walk into this structure and experience it from inside, an act performed by Hayes, Davidson, and Pask himself on that occasion.[384] As a built structure representing a very simple entailment mesh, BiTori can be considered a demonstration of Pask’s earlier Architecture of Knowledge installation for the Kawasaki project, discussed in the previous chapter. Several other versions of these paper structures were built and exhibited in various places by Hayes and Davidson in the coming years.[385]

Figure 5.7. A Photo of the Pask Present Exhibition, 2008. Source: http://www.paskpresent.com/gallery/gallery2/main.php

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[383] Anne E. Hayes and Glenn Davidson, “Paper & Air Installations,” Artstation, accessed December 7, 2021, https://www.artstation.org.uk/installation-collection.

[384] Glenn Davidson and Anne E. Hayes, “Artstations Practice and a Cybernetic Canon,” ed. Nicholas Tresilian (19th European Meeting on Cybernetics and Systems Research (EMCSR 2008), Vienna, 2008).

[385] Hayes and Davidson, “Paper & Air Installations.”

The works presented by the architect participants of the exhibition included those by the co-curators Glanville and Gage (Slow and the Mechanical Homunculus, respectively).[386] However, more significantly, the show also included works by a new generation of architects who took the Paskian cybernetics of conversation as an inspiration for their own work.

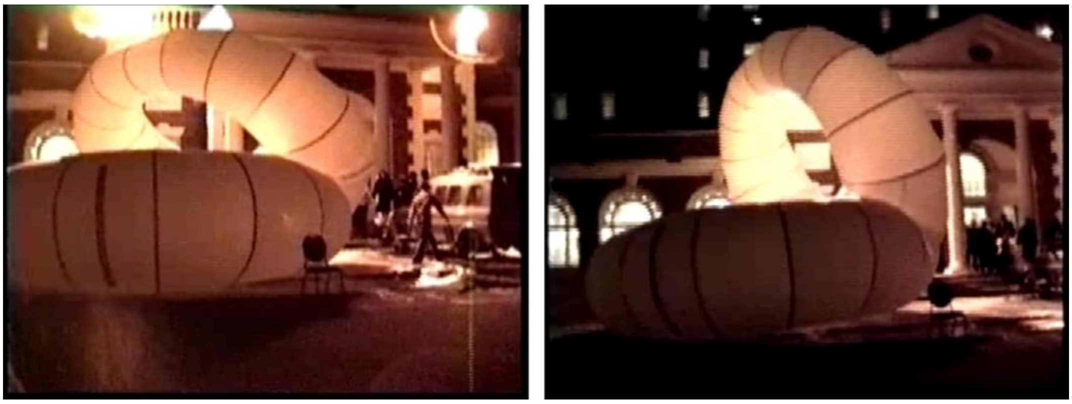

Figure 5.8. Stills from a Video Showing BiTori, 1989 Source: https://vimeo.com/353551183

Usman Haque, a former student and later an associate at Gage's BIAW, participated in the exhibition with the installation, Evolving Sonic Environment IV, produced in collaboration with Rob Davis (Figure 5.9 and Figure 5.10).[387] This installation consisted of a number of floating sonic devices[388] whose "behaviour collectively changed in response to the pitch ascendancy or descendancy that each one detected."[389] Each device could produce a rising and/or descending tone according to the sounds it gathered from the human participants in the environment. However,

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[386] Glanville and Müller, *Pask Present: An Exhibition of Art and Design Inspired by the Work of Gordon Pask, Cybernetician and Artist*, 43–51.

[387] Glanville and Müller, 40–42.

[388] In the Pask Present exhibition, only two sonic devices were used. But, at other events, the installation was composed of several of those devices.

[389] Glanville and Müller, *Pask Present: An Exhibition of Art and Design Inspired by the Work of Gordon Pask, Cybernetician and Artist*, 40.

if a device heard too much of one type of tone, it would get “bored” and slowly modify its behavior. This installation, as yet another artifact inspired from the “boredom factor” idea developed by Pask in his Musicolour machine in the 1950s, was aimed at creating an interactive environment where the devices and the human participants could exchange information in a non-deterministic and emergent way.

Figure 5.9. A Photo of Evolving Sonic Environment IV at the Pask Present Exhibition, 2008 Source: http://www.paskpresent.com/gallery/gallery2/main.php

The impact of the Paskian conversational framework on Haque’s discourse and practice was not limited to this example. Haque argued for Pask’s relevance in architecture in a number of publications[390] and designed other such installations, notably the Moody Mushroom Floor (1996) and Open Burble (2006).[391] In

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[390] Usman Haque, “The Architectural Relevance of Gordon Pask,” *Architectural Design* 77, no. 4 (2007): 54–61; Usman Haque, “Architecture, Interaction, Systems,” in *Pask Present: An Exhibition of Art and Design Inspired by the Work of Gordon Pask, Cybernetician, Artist*, ed. Ranulph Glanville and Albert Müller (Vienna: Edition Echoraum, 2008), 99–110.

[391] Usman Haque, “Usman Haque – Work,” accessed December 7, 2021, https://haque.co.uk/.

collaboration with Paul Pangaro, he also became engaged in an unfinished project called Paskian Environments, which aimed to apply algorithms from Pask's past projects to the construction of a dynamic large-scale environment.[392]

Figure 5.10. A Complete version of Evolving Sonic Environment, 2006. From: https://haque.co.uk/work/evolving-sonic-environment/

Ruairi Glynn, also a former student at the BIAW, participated in the exhibition with his installation, Performative Ecologies (Figure 5.11 and Figure 5.12).[393] This was a "kinetic 'conversational' environment, where "a community of autonomous but very sociable robotic sculptures"[394] would perform a "dance" for the inhabitants.[395] The dance of the robotic arms would evolve by the use of a genetic algorithm that used facial recognition to assess the attention levels of the inhabitants and assigned a

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392 Haque, "Architecture, Interaction, Systems," 109.

393 Glanville and Müller, *Pask Present: An Exhibition of Art and Design Inspired by the Work of Gordon Pask, Cybernetician and Artist*, 52–54.

394 Only one of the three robotic arms were displayed in the Pask Present exhibition.

395 Ruairi Glynn, "Ruairi Glynn," Ruairi Glynn, accessed December 7, 2021, http://www.ruairiglynn.co.uk/.

fitness value to each new choreography. This would allow the robotic arms to keep and recombine successful maneuvers to produce new performances while discarding less effective ones.[396] In Glynn's own words, "as an ecology together with human inhabitants, the installation [constructed] an intertwining of networks, rich in circularities of reciprocal communication and adaptation" where "individual participants both human and synthetic" [operated] as part of the conversational environment, each performing independently, but continually negotiating their actions with each other."[397] Glynn was inspired by Pask's conversation theory and his own interactive environments, particularly the Colloquy of Mobiles, in the design of his installation, and argued for Pask's conversational model of interaction in architecture for the future.[398] Glynn's more recent work, notably the Fearful Symmetry (2017),[399] can be considered a continuation of this approach. Also, as the founding director of the Interactive Architecture Lab at the Bartlett School of Architecture[400], which can in many ways be considered as a successor to the BIAW, Glynn continues to promote Paskian ideas in an educational context.

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[396] Ruairi Glynn, "Conversational Environments Revisited" (19th European Meeting on Cybernetics and Systems Research (EMCSR 2008), Vienna, 2008), 4, http://www.ruairiglynn.co.uk/wp-content/uploads/2016/10/0802_PUB_CON_Conversational-Environments-Revisted-Cybernetic-Conference-Paper.pdf.

[397] Glynn, 5.

[398] Glynn, 5–6.

[399] Glynn, "Ruairi Glynn."

[400] "Interactive Architecture Lab | : Design for Performance and Interaction," accessed December 7, 2021, http://www.interactivearchitecture.org/.

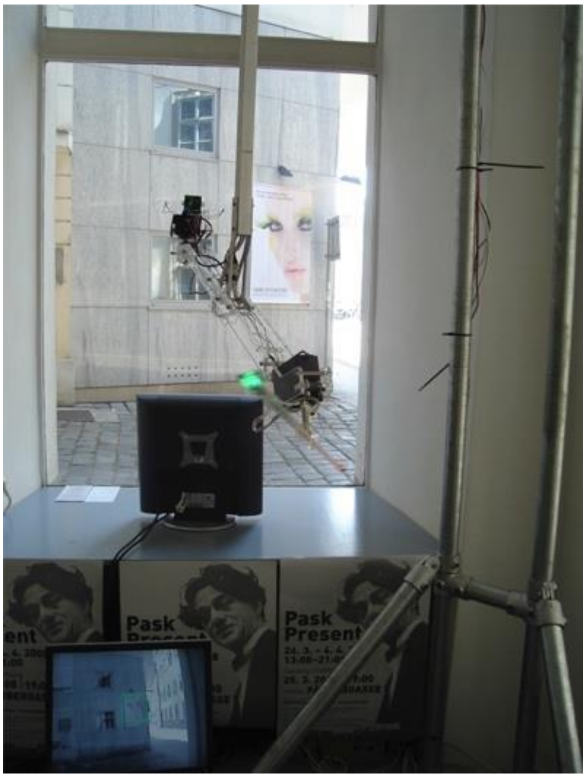

Figure 5.11. A Photo of Performative Ecologies at the Pask Present Exhibition, 2008. Source: http://www.paskpresent.com/gallery/gallery2/main.php

Figure 5.12. A Later Version of Performative Ecologies, 2012. Source: http://www.ruairiglynn.co.uk/portfolio/performative-ecologies/

Omar Khan, who studied with Pask at the AA in 1990-1991 at Raoul Bunschoten's Diploma Unit 2, also participated in the exhibition with his piece, Open Columns Homeostat (Figure 5.13 and Figure 5.14).[401] This was a working model of a long-term project that involved a system of "nonstructural columns" that could reconfigure the space beneath them through their deployment.[402] Like Glynn's, the project was inspired by Pask's Colloquy of Mobiles and imagined "as a space of interaction between people and their environment where the architecture [had] subjectivity and [could] adapt to changing condition[s]."[403] It involved an array of column-like structures made out of composite urethane that would deploy from the ceiling as a response to the carbon dioxide (CO2) levels of an enclosed space. They would come up or down according to the measured CO2 levels of the space, either encouraging people to come together or disperse respectively. However, apart from deterministically responding to the CO2 levels, the columns would also store and analyze the impact of their different configurations on the CO2 levels and use this information for future instances. In this way, the columns would "learn about their space based on their own actions within it," which would turn the environment into one that "[acted] on particular goals but [had] no determinate goal to which it is driven."[404] And, as such, it would create a truly Paskian interactive environment.

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[401] Glanville and Müller, *Pask Present: An Exhibition of Art and Design Inspired by the Work of Gordon Pask, Cybernetician and Artist*, 55–57.

[402] Omar Khan, "Open Columns: A CO2 Actuated Redponsive Architecture," accessed December 7, 2021, http://cast.b-ap.net/opencolumns/.

[403] Omar Khan, "Open Columns: A Carbon Dioxide (CO2) Responsive Architecture" (CHI 2010, Atlanta, 2010), 4791–92.

[404] Khan, 4791.

Figure 5.13. A Photo of Working Model of Open Columns at the Pask Present Exhibition, 2008. Source: http://www.paskpresent.com/gallery/gallery2/main.php

Figure 5.14. A Full-Scale Version of Open Columns, 2009. Source: http://cast.b-ap.net/opencolumns/

The art and design work at the Pask Present exhibition, including those that were not discussed here, were inspired from historical environments produced by Pask, which went back as early as sixty years; however, they were proposed for a future that involved new possibilities in the design of interactive environments in architecture.

In this sense, as the co-curators Glanville and Gage argued, the exhibition was a beginning of a way forward that continued to bear fruit by the efforts of those senior and junior architects, who, by involving in both theory, teaching and practice, have brought in new recruits, maintained interest and sustained the Paskian school of architectural cybernetics.

5.4 Paskian School of Architectural Cybernetics Today

More recently, Paskian concepts and ideas are still being promoted in architecture in various ways by those figures discussed above and a number of others who find them inspirational for their work. Here, a number of most up-to-date examples developed around Paskian concepts and ideas are provided. This selection, though not covering the whole extent of the Paskian school of architectural cybernetics today, represents the breadth of approaches developed within it, which involves both theory, teaching, and practice.

Among those more recent attempts, a book titled *Design Cybernetics: Navigating the New*[405], published in 2019, is particularly significant. As the editors Thomas Fischer and Christian Herr state, inspired by Glanville's idea of design and cybernetics as complementary arms of each other, the book brings together a number of "cybernetically inclined designers and design researchers" around the idea of design cybernetics, which is proposed as a multi-disciplinary research area that consisted contributions from "architecture, interior lighting studies, product design, embedded systems, design pedagogy, design theory, social transformation design, enquiry theory, art and poetics as well as theatre and acting."[406] The book includes articles from several researchers with architectural backgrounds, including those

[405] Thomas Fischer and Christiane M. Herr, eds., *Design Cybernetics: Navigating the New* (Switzerland: Springer, 2019).

[406] Fischer and Herr, xi–xv.

from the editors, Fischer and Herr, alongside those others from Liss Werner, Ben Sweeting, Timothy Jachna, and Claudia Westermann. These contributions discuss various aspects of design cybernetics by drawing on Glanville's approach and its origin, Pask's conversation theory.

Other than these more theoretical pursuits, some recent studies that can be considered a part of the Paskian school of architectural cybernetics involve designing actual artifacts and systems. Among those, the work by the Living Architecture Systems Group (LAS)[407], a multidisciplinary research cluster initiated and administered by Philip Beesley, a practicing visual artist, architect, and professor at the University of Waterloo and European Graduate School, who is also affiliated with Pangaro, is particularly significant, as the group puts a special emphasis on the design of "kinetic, living architecture that engages with visitors during extended interactions and enhances human experience in an immersive environment,"[408] a research framework perfectly in line with the Paskian understanding of the relationship between spaces and their inhabitants. The group aims to develop "built environments with qualities that come close to life – environments that can move, respond and learn, with metabolisms that can exchange and renew their environments, and which are adaptive and emphatic towards their inhabitants."[409] In achieving this goal, the group has designed several projects, one of the most recent ones of which is discussed here.

The Meander project, developed as an environment that can exhibit such qualities, is constructed within a historic warehouse building (Tapestry Hall) in Cambridge,

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[407] "Living Architecture Systems Group," accessed December 23, 2021, https://livingarchitecturesystems.com/.

[408] "Living Architecture Systems Group."

[409] "Living Architecture Systems Group."

Ontario in Canada (Figure 5.15).[410] It consists of a series of intricate structures with skeletal forms produced out of “hundreds of thousands of laser-cut, thermally-formed transparent polymer and mylar, glass and expanded sheet steel components.”[411] These interwoven structures may respond to their visitors in concert with each other. In doing so, the environment makes use of two layers of feedback, those provided by the visitors and those derived from its own local structure, which makes it able to change its responses for different situations as opposed to a simple deterministic system where a certain response would be generated for a certain stimulus. According to the project description, the environment behaves as the following:

> Sensors embedded within the environment signal the presence of occupants, and send ripples of light, motion and sound through the system in response. Software is organized in clusters of interconnected groups that can communicate with neighboring groups resulting in global behavior connections throughout the system. A second layer of sensors provides ‘proprioception’ – internal sensing. Like the human body’s ability to know its own actions, this layer of information provides each cluster of mechanisms with information about action happening within its local structure. By using this constantly-cycling information, the systems can adapt their behavior and form new responses.[412]

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[410] “Meander,” Meander, accessed December 23, 2021, https://meandercambridge.ca; “Meander – Living Architecture Systems Group,” accessed December 23, 2021, https://livingarchitecturesystems.com/project/meander/.

[411] Philip Beesley, “Diagrams of Entropic Forces: Design for New Dissipative Fabrication,” in *Fabricate 2020: Making Resilient Architecture* (London: UCL Press, 2020), 260.

[412] “Meander – Living Architecture Systems Group.”

As such, the Meander project can be considered a Paskian environment where genuine interactivity is achieved with layers of circular feedback mechanisms, which facilitate learning between the environment and its inhabitants.

Figure 5.15. Meander at Tapestry Hall, Cambridge, Canada, 2020, © PBSI. Source: https://livingarchitecturesystems.com/project/meander/

Considering the recent approaches within the Paskian school of architectural cybernetics, one may also look into the work of Cyber-Physical and Intelligent Systems in Architecture and Urban Design (CyPhyLab), an interdisciplinary research lab founded by Liss Werner at TU Berlin in 2018, based on an agenda called "humanification of technology" through the use of cybernetic principles and methods.[413] The lab aims to bring together "biological computing, material behaviour and sensor technology" to be able to create architectural and urban environments as "cyber-physical systems" that may become familiar with human behavior and act accordingly.[414] The projects of the lab are diverse in scale, ranging from developing solutions for digital workflow in the architecture and construction industry to improving acoustic comfort in open-plan workspaces.[415]

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413 "CyPhyLab," accessed December 23, 2021, https://cyphylab.chora.tu-berlin.de/.

414 "CyPhyLab."

415 "CyPhyLab."

Currently, Paskian concepts and ideas find themselves a place in architectural education too. For example, a student project from the Interactive Architecture Lab at the Bartlett School of Architecture, designed by Scarlett Chen and Shiyu Wang in 2021, called "Hyper Familiar"[416] (Figure 5.16), is inspired by Pask's idea of offering "sufficient variety to provide the potentially controllable novelty," which was proposed as the first attribute of his conception of "aesthetically potent environments" in his seminal essay, "A Comment, a Case History and a Plan."[417] In this project, Chen and Shiyu offer an experience that amplifies people's sensory perception by defamiliarizing them from their environment with the use of augmented reality techniques that involve both visual and sound effects so that the visitors are offered a variety that enables them to experience the environment they would normally take for granted, in a different way.[418]

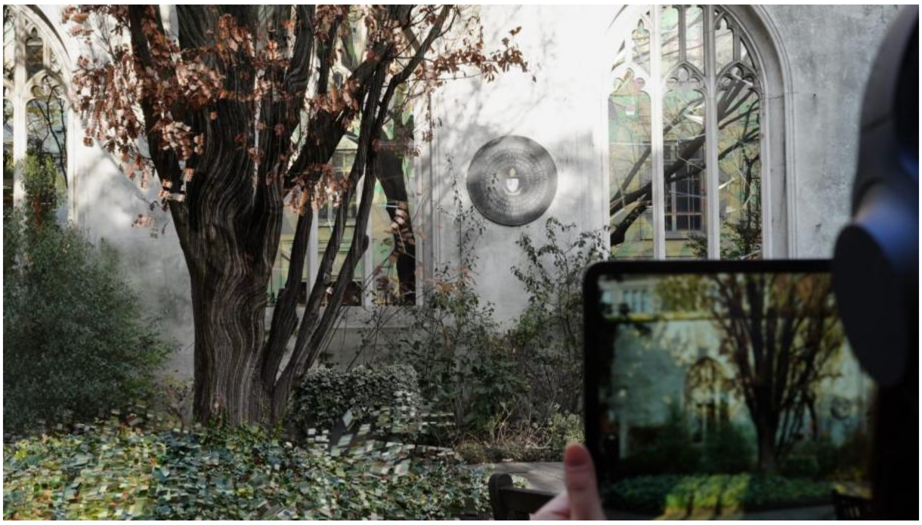

Figure 5.16. Hyper Familiar, 2020. Source: http://www.interactivearchitecture.org/lab-projects/hyper-familiar

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416 "Hyper Familiar | Interactive Architecture Lab," accessed December 23, 2021, http://www.interactivearchitecture.org/lab-projects/hyper-familiar.

417 Pask, "A Comment, a Case History and a Plan," 76.

418 "Hyper Familiar | Interactive Architecture Lab."

Pask has been acting as a source of inspiration for architects and designers mentioned above, along with others that could not be covered here. His legacy is alive by virtue of a still-evolving complex web of relations, which is due to a combination of his interest and involvement in architecture; and the openness of a few but devoted architects willing to incorporate his ideas. This chapter dwelt on a later period in this reciprocal relationship and demonstrated how a research agenda for achieving genuine interactivity between architectural environments and their inhabitants through a conversational framework has been deliberately pursued by a devoted community of architects.

CHAPTER 6

CONCLUSION

This thesis conceptualized and designated the research activity centering around translating Pask's concepts and ideas into architecture as the Paskian school of architectural cybernetics with the aim of acknowledging its role in machine intelligence research in architecture. In doing so, it covered a period of approximately sixty years starting from the early 1960s up until the present by dwelling on several research efforts by Pask himself and his architect collaborators, students, and followers.

These research efforts have been argued to be instances of an underlying school of thought based on two main observations. On the one hand, the thesis demonstrated that they all share a precise research agenda aimed at creating genuinely interactive environments inspired by Pask's understanding of conversation as the quintessential form of interaction. On the other hand, it showed that they are all developed by a devoted community of architects and designers who valued Paskian ideas and found them relevant for their work. Thus, these efforts are conceptualized as a research tradition that has been continuously propagated and sustained via its precise research agenda and devoted community throughout the last sixty years.

The need for acknowledging the Paskian school of architectural cybernetics as a research tradition emerged from an observation about the current machine intelligence research landscape in architecture. It was argued that, though the availability of relatively more data and new machine learning algorithms for a broader audience in recent years has been transforming machine intelligence research in architecture from a project of the few to a field for many, the growing dominance of current mainstream AI practices is resulting in a uniformity where machine intelligence is being reduced to a narrow definition and a specific mode of practice, as opposed to its diverse interpretations throughout its history. The thesis aimed to acknowledge the Paskian school of architectural cybernetics as a research tradition that provided one of those diverse interpretations.

In accordance with this aim, the thesis brought together several studies that involved theory, education, and practice. In doing so, it focused not only on their individual features as interactive artifacts but also on the relations between their creators, since the longevity of the Paskian school of architectural cybernetics as a research tradition for the last sixty years is thought to be owing not only to its original and relevant research agenda but also to a complex web of relations that has grown out of Pask's initial interactions with architecture.

In this sense, the thesis deliberately dwelled on the inner workings of those artifacts and the specifics of those relations, and offered detailed descriptions about them, which provided key insights that are central to its main argument. In doing so, the study also emphasized the context, the wider cultural, sociological, and technological landscapes in which those artifacts were produced and those relations were established. In this respect, it aimed to propose the Paskian school of architectural cybernetics as an outcome of the interplay of those local/global and micro/macro scale interactions.

By providing a history that culturally placed the Paskian school of architectural cybernetics in time and space as a peculiar approach to machine intelligence research in architecture, the thesis also exercised a geographically and intellectually situated historiography. It is, therefore, argued that there has been no single, universal lineage to machine intelligence, and nor could be written an across-the-board narrative that encompasses it as a whole. Instead, there should be multiple narratives that can appreciate distinct local approaches, such as the Paskian school of architectural cybernetics, practiced within the research area.

Each chapter, though in different intensities, aimed to reveal the following four aspects of the Paskian school of architectural cybernetics.

*Its **constructivist epistemology**:*

Pask's conversation theory, and his other efforts of producing interactive artifacts, which have been sources of inspiration for many ideas discussed throughout the thesis, were all raised upon a constructivist epistemology. Also shared by others such as Heinz von Foerster and Humberto Maturana in the second-order cybernetics, this epistemological position would embrace the view that direct knowledge transfer is impossible and that it is only understandings that can be communicated between entities. The difficulties arising from the adoption of this epistemological position have been compensated by devising complex systems that could facilitate genuine interaction.

*Its **multidisciplinary nature**:*

As a research tradition born out of close interactions between two fields, it is natural that the Paskian school of architectural cybernetics is multidisciplinary. Also, partly due to Pask's prolific character as a researcher who had connections in various other fields, the Paskian school of architectural cybernetics has drawn insights from fields such as psychology and education; and has found a place in art and larger design fields.

*Its **resilience to technological changes**:*

Artifacts developed within this research tradition have been manifestations of the latest technologies of their time, and as such, they have been prone to becoming obsolete as the technologies they were constructed upon changed. However, the Paskian school of architectural cybernetics has endured by virtue of its conversational framework, which proved to be sufficiently generalizable by being amply tested in radically different technological contexts in the last sixty years.

Its ***ability to attract interest from a multiplicity of actors****:*

Pask's initial interactions with architecture and design communities in the 1960s led to a series of strong connections where his ideas found themselves a significant place in theory, education, and practice, especially in the Anglo-American architectural scene. These connections involved multiple generations of architects who appreciated those ideas and used them in their studies, making the Paskian school of architectural cybernetics able to maintain a critical community for the last sixty years.

Regarding why this research tradition has not been appreciated by a wider audience and has not been properly acknowledged in machine intelligence research in architecture, one could point out a number of factors. First, though Pask was very much willing and elaborate in trying to convey his ideas to others, he was extremely technical in his descriptions. His books and articles, alongside other written documents produced by him, were conceived in a language that is mostly unintelligible to a wider architectural audience. Only those who went beyond this opaque technical language could truly appreciate the relevance of his concepts and ideas. Second, though a particular lineage established between Pask, his architect students, his students' students, and so on, has been having a pivotal role in sustaining the Paskian school of architectural cybernetics as the primary channel of recruitment, it has lacked the capacity to attract large numbers of people. Third, the Paskian school of architectural cybernetics has not been able to produce, in a strictly architectural sense, an easily discernible series of architectural products. Though offering a coherent body of work with their shared goals, studies produced within this research tradition are diverse in terms of their nature and scale, ranging from theoretical discussions to concrete artifacts and from large-scale urban projects to small-scale installations. This may have acted as a factor in the lack of their appreciation as constituents of a research tradition.

Nonetheless, despite its limitations, the Paskian school of architectural cybernetics has endured, not because it has offered a toolkit that can be applied in certain problem-solving situations, but rather because it has introduced an interactionist theory that is capable of modeling human-machine relationship in a genuine way, based on its origins in the constructivist epistemology. As such, the Paskian school of architectural cybernetics has produced a powerful ethos that has been faithfully followed by those who could appreciate its value. It is hoped that this thesis will enable others to do so.

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CURRICULUM VITAE

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EDUCATION

Degree	Institution	Year of Graduation
Ph.D.	METU Department of Architecture	2022
M.Arch	METU Department of Architecture	2014
B.Arch	METU Department of Architecture	2011
High School	Rize Anadolu Öğretmen Lisesi	2006

PROFESSIONAL EXPERIENCE

Position	Institution	Year
Research/Teaching Assistant	METU Department of Architecture	2012-2021
Part-Time Architect	Baobab Mimarlık	2011-2012
Intern Architect	Özer-Ürger Architects	2010

SYMPOSIA & PUBLICATIONS

2021 Temizel E., "Revisiting Pask and Price: A Comparative Reading on the Conceptualization of Human-Machine Relationship in Fun Palace and Kawasaki Projects", Architecture and Endurance: The European Architectural History Network (EAHN) Thematic Conference, Ankara (paper presentation)

2020 Temizel E., "The Cybernetic Relevance of Architecture: An Essay on Gordon Pask's Discourse on Architecture", *Proceedings of the 38th eCAADe Conference on Education and Research in Computer Aided Architectural Design in Europe*, vol.1, Tredition, Hamburg, 471-480 (paper presentation, full paper published)

2016 Çetin H. O., Parlak N., Temizel E., "Kayabaşı, Çamlıca Camii ve 7 İklim 7 Bölge Yarışmaları Üzerinden Yarışma Meşruiyeti

Kavramının Sorgulanması Üzerine Bir Deneme", *Yarışmalar ve Mimarlık Sempozyumu*, Arkitera Mimarlık Merkezi, İstanbul, 124-140 (paper presentation, full paper published)

2016 Zelef M. H., Çetin H. O., Temizel E., Yıldırım C., Dörtlük M., Şanlı S., "Ankara Atatürk High School Building by Bruno Taut", Do.Co.Mo.Mo_TR Poster Presentation, Samsun (poster presentation)

2014 Temizel, E., "A City Is Not A Tree, Nor It Is a Semi-Lattice", 7th International Deleuze Studies Conference: Models, Machines and Memories, İstanbul Technical University, İstanbul (paper presentation, abstract published)

2012 Dörtdivanlıoğlu, H., Karakaya, U., Temizel, E., "Eko-Morfoloji", *Ankara Kent Atlası (Urban Atlas of Ankara)*, Güven Arif Sargın (ed.), The Chamber of Architects of Turkey, Ankara, 87-97 (chapter in a book)

GRANTS & SCHOLARSHIPS

2020 Canadian Centre for Architecture (CCA), Doctoral Research Residency Program (DRRP).

2014-2018 TÜBİTAK (The Scientific and Technological Research Council of Turkey), National Scholarship Program for PhD Students.

2012-2013 TÜBİTAK (The Scientific and Technological Research Council of Turkey), National Scholarship Program for Master's Students.

HONORS & AWARDS

2017 Purchase Prize, Conceptual Neighborhood Design Competition, Ministry of Environment and Urbanization of Turkey. Project Team: Neris Parlak, Ayça Sapaz, Ensar Temizel

2014 Honorable Mention, High School Campus Competition in Eskişehir, Ministry of Education of Turkey. Project Team: Utku Karakaya, Cânâ Dai, Ensar Temizel, Erkut Sancar

2013 2^{nd} Prize, 90th Anniversary Polygon Complex Competition, Turkish Shooting and Hunting Federation. Project Team: Yiğit Acar, Cânâ Dai, Ensar Temizel, Erkut Sancar, Utku Karakaya

MEMBERSHIPS

2022 American Society for Cybernetics (ASC)

2019	European Architectural History Network (EAHN)
2016	Architects' Association 1927
2011	Chamber of Architects of Turkey

RESEARCH INTERESTS

Architecture and technology, History of machine intelligence research in architecture, Human-machine interaction, Cybernetics, Gordon Pask

LANGUAGES

Turkish (native), English (advanced skills), German (beginner skills)