The Cybernetic Relevance of Architecture:

An Essay on Gordon Pask's Evolving Discourse on Architecture

Ensar Temizel[1]
[1]Middle East Technical University
[1]temizel@metu.edu.tr

Gordon Pask, as one of the leading figures in the field of cybernetics, had an extensive impact on architecture through his lifelong connections with architectural circles in the UK and the USA from the early 1960s until his death in 1996. He is mostly known to architects by his collaboration with Cedric Price on a number of occasions; however, his affiliation with architecture include several other instances that involved designing architectural projects, teaching in architectural schools, writing on architectural issues and more. This paper aims to review these instances to scrutinize how his discourse on architecture unfolded in time by addressing his evolving understanding concerning the relationship between architecture and cybernetics. In doing so, the paper examines key aspects of his own work in relation to key instances of his relationship with architecture.

Keywords: *Cybernetics, Architecture, Design, Gordon Pask, Conversation Theory, Human-Machine Interaction*

Introduction

In two special double issues of Kybernetes journal in 2001, which comprised a memorial collection in honor of Gordon Pask (1928-1996), including those of Heinz von Foerster's and Stafford Beer's, a number of architects who had the chance to collaborate with him in various forms during his lifetime contemplated on his impact regarding both their own work and architecture in general. Cedric Price (2001, p.820), who directly cooperated with him on Fun Palace and JapNet projects, considered "his presence and inventions within life of the Architectural Association (AA)" as "both legendary and of day to day relevance". Peter Cook (2001, p.571), at whose architectural juries he was a frequent critic, called him "extraordinary" and argued that he was probably "more architect" than architects. Royston Landau (2001, p.752), who was the guest editor of two Architectural Design (AD) issues which he contributed to, wrote he was "always wishing to expand new architectural questions in which he played an important part with innovative projects". John Frazer (2001, p.641), who collaborated with him in his last years, argued that his contribution was crucial in the development of "an increasingly environmentally responsive architectural theory".

Pask has acted as a source of inspiration for many in architecture and he left a still evolving complex web of relations concerning architects mentioned above, along with several others including those who

are still promoting his ideas in architecture today. His legacy is still alive by virtue of this strong connection, 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 into architecture.

This vast influence is beyond the scope of this paper. Rather, I aim to provide here an account on Pask's discourse on architecture. In doing so, I will try to decode his evolving understanding concerning the relationship between architecture and cybernetics by focusing on two of his texts; the earlier, frequently cited "The Architectural Relevance of Cybernetics" (Pask 1969) and the later, unpublished "An Initial Essay: Towards a Unification of Architectural Theories" (Pask no date). I organized the paper in three main parts: In the first part, I will focus on his early encounters with architecture starting from the early 1960s until the early 1970s. In the second part, I will provide a brief overview of his own work, particularly his *magnum opus*, Conversation Theory (Pask 1975a;1976), its background and significance in the second-order cybernetics. In the final part, I will concentrate on his encounters with architecture in the later period starting from the early 1970s until his death in 1996.

Early Encounters: Architecture as a Field to Apply Cybernetics

Pask's first encounter with architecture was through Cedric Price. When Price was appointed the architect of the Fun Palace (Figure 1), he and Joan Littlewood invited him for an unpaid "cybernetician" position. He immediately accepted the post and formed a cybernetic working party (Price 2001, p.819), which was called "The Fun Palace Cybernetics Committee". He acted as the head of the committee which was the most powerful of the consultant groups in the project (Mathews 2006, p.44). The committee was very active and a document were produced in the form of a book after every meeting (Price 2001, p.819). The general goals of the cybernetics committee were established by Pask as the development of "new forms of envi-

ronment capable of adapting to meet the possibly changeful needs of a human population and capable also of encouraging human participation in various activities" (Mathews 2006, p.44). With the contribution of the committee in line with these goals, the focus of the project changed from "a barrier-free venue for experimental theater" to "a more ephemeral mobility offered by new information media and mass communications" (Lobsinger 2000, p.123). In Price's words, Pask gradually shifted the focus of the Fun Palace "from Brechtian theatre towards cybernetics, interactivity and social control" (Mathews 2005, p.83).
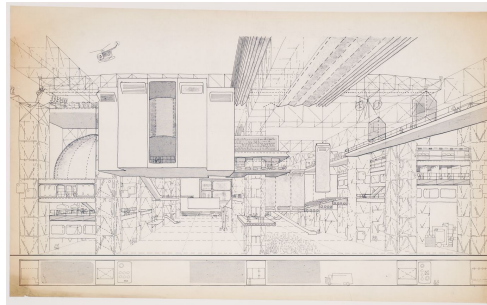
The Fun Palace project was never built, but acted as the foundation for a lifelong friendship between Pask and Price and became a stepping stone for Pask to engage in other activities within the AA circle. He was invited to several architectural juries by Peter Cook, Royston Landau, Alvin Boyarsky and George Balcombe throughout the 1960s and lectured in various occasions at the AA (Furtado 2007, pp.94-98). His lectures were so influential that several students, some of which turned out to be his own students in cybernetics in the later years, including Nicholas Grimshaw, Stephen Gage, Ranulph Glanville, Chris Abel, Isaac Haissman were visiting him in his office seeking advice for their projects (ibid, p.98).

Pask's promotion of cybernetic ideas in architecture culminated, when the guest editor Royston Landau invited him, along with several other famous figures such as Imre Lakatos, Karl Popper, Stanford Anderson, Nicholas Negroponte and Cedric Price, to

write an essay at the Architectural Design (AD) journal in 1969. Pask used this opportunity to propose "architectural cybernetics" as a unifying theory for architecture (Pask 1969). He argued that, architecture, the way it was practiced "in or before the early 1800s" were dominated by "pure architecture rules", which were sort of canons according to which the buildings were designed and evaluated by architects. According to him, architects' brief was quite narrow and all problems could be solved by the application of these rules which were largely determined by the "quite rigid codes of architecture" and by the "conventions of society or the individual practitioner" (ibid, p.494). As a result of this understanding, "architects did not need to see themselves as system designers, even though they designed systems" (ibid). However, in the course of the 1800s, new techniques were assimilated and new problems like designing a railway station or a great exhibition were posed which could not be solved by applying the pure architecture rules. As a result, architects were forced "to take an increasing interest in the organizational system properties of development, communication and control" (ibid). But, throughout this process, architecture did not have a general theory as to represent this understanding, instead there were "essentially cybernetic sub-theories" which were "dealing with isolated facets of the field" (ibid). 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 (ibid, p.496) and proposed cybernetics as a unifying theory:

"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* (architectural cybernetics, the cybernetic theory of architecture)." (ibid, p. 494)

According to Pask, the cybernetic theory of architecture had what he called "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)" (ibid). And, if the cybernetic theory of architecture was adopted, "the concept of a 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" (ibid, p.496).

This essay represents a significant point in Pask's relationship with architecture, as it clearly demonstrates Pask's understanding of architecture as of 1969. In this particular and rather provoking understanding, Pask pictures architecture as being governed by essentially cybernetic sub-theories since the second industrial revolution, but urges for cybernetics as a general unifying theory. With an undertone that places cybernetics in a superior position to architecture, he ascribes cybernetics the power to act as the theory of architecture and regards architecture as a field to apply cybernetics. A slightly different view was also adopted by Glanville (1997, 2007, 2009) regarding the relationship between cybernetics and design.

In the late 1960s and the early 1970s, another of Pask's strong connections to architecture was through his doctoral students in cybernetics at the Brunel University, who were architects. According to Glanville (2007), out of his 12 successful doctoral students at Brunel University, eight were architects and six came from the AA. In two reports on "Postgraduate Research in Cybernetics" (Brunel University 1970; no date) a list of postgraduate students and their research abstracts are provided, including Glanville himself along with Chris Abel, Michael Ben-Eli, Luis Pereira and Luis Monteiro. In this period, Pask and his architect-students produced research by which they tried to find solutions to architectural problems through cybernetics. For instance, Glanville's thesis (1975) aimed to relate architecture and language and consisted of a systems approach to solve problems in both of them. From Abel's research, born the Ar-

chitrainer (Figure 2), "an interactive computer game, that used techniques derived from interpersonal psychology and computer aided instruction to simulate dialogues between student architects and hypothetical clients" (Abel 1974; 2000, p.33; Negroponte 1975, p.112).

A Brief Overview of Conversation Theory

Conversation Theory was a body of work published in two books (Pask 1975a;1976), which essentially described the nature of interaction, no matter among what type of entities. It was a continuation of Pask's previous studies on "perceptual motor learning, group interaction and sequential choice" as well as on "learning, subject matter structuring and cognition" which were described in two previous books (Pask 1961;1975b) (Pask 1976, p.ix). It was also the subject of a "Social Science Research Council" research program titled "Learning Styles, Educational Strategies and Representation of Knowledge: Methods and Applications" (Pask 1975a, p.x). It was originally intended as "a new theory of learning and teaching" that resulted in applications in the field of education (i.e. CASTE, Course Assembly System and Tutorial Environment) (Pask 1975c), but it may as well be regarded as a second-order cybernetic paradigm that has been adopted in many fields. In Pask's words, it was "an essay in [hu]man / [hu]man and [hu]man / machine symbiosis" (Pask 1976, p.ix). In essence, it was the culmination of Pask's more than 20 years of work on interaction and interactive systems.

Conversation Theory involved quite complex concepts and ideas which were laid down in detail in chapter 4, 5 and 6 of (Pask 1975a). However, the earliest manifestation of the theory was included in an architecture book, "Soft Architecture Machines" by Nicholas Negroponte (1975), which represents another instance of Pask's interest in architecture. When asked to write an introduction to the first chapter of his book by Negroponte (1972), Pask accepted the request and wrote about his Conversation Theory, particularly the structure of conversations; and argued for its capability in modelling the human machine in-

teraction in architecture, proposing an "architecture machine" that is able to act as a conversational partner to a human designer (Pask 1975d). In doing so, he produced a total of ten hand-drawn diagrams (Figure 3), many likes of which can also be found in (Pask 1975a).
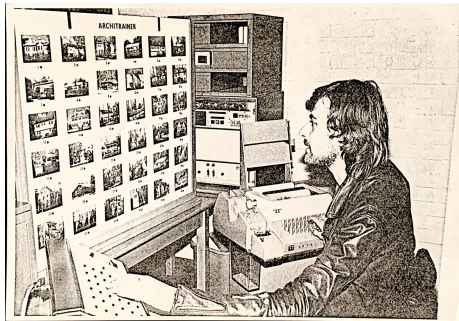

Figure 2
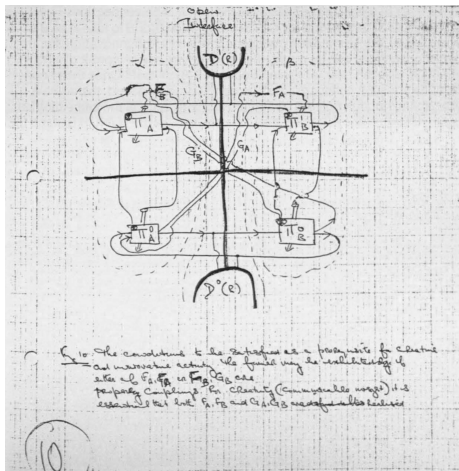A Photograph of the Architrainer, Source: Chris Abel

Figure 3
Diagram 10, Source: (Pask 1975d, p.29)

The specifics of the structure of conversations regarding concepts and ideas like P/M individuals, levels of discourse in language, causal/inferential couplings, repertoires of procedures, entailment structures and more are beyond the scope of this paper. However, the kind of exchanges to spring from this model is 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 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." (Glanville 2007, p.1185)

Naturally, this structure and the resulting complex exchange mechanism imply three outcomes. Firstly, this model approaches conversational partners, whether be it humans or machines, equally, which elevates it to a genuine interactive framework. By establishing a symmetry between the participants, it eliminates the danger of creating a master-slave exchange mechanism. Secondly, the model assumes that participants do not transmit or share meanings, instead they build understandings from what the other participant has to offer, which results in novelty to arise (ibid, p.1190). And thirdly, the model argues that intelligence is not in the individual, rather intelligence is in the interaction (Pangaro 2002, p.62).

Throughout his career, Pask always put a special emphasis on interaction even long before he wrote a theory about it. He designed and built several artifacts, which were able to interact with humans or other artifacts through circular feedback mechanisms. These artifacts were representative of his commitment to the creation of interactive systems and precursors to his Conversation Theory.

The Musicolour (Pask 1962; 1971) (Figure 4) was one of the earliest artifacts he built in the early 1950s. It was an adaptive light show machine that had "spot-lamps and a set of controlled optical filters, which may change the color of the lamp or the form of a projected image" (Pask 1962, p.164). The machine was able to interact with a performer who played on a musical instrument, by interpreting his/her auditory input to create a changing visual display by the movement of the optical filters (ibid, p.164). It had a "learning capability" which made it "able to modify the relation of the auditory vocabulary to the visual vocabulary as the performance went on", which as a result made it able to become involved "in a close participant interaction" with the performer (Pask 1971, p.78). 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" (ibid, p.78). This kind of a symbiotic relationship was achieved with the capability of the Musicolour to "get bored" (ibid), which made him able interact with the performer in an "unexpected, evolving and persistent" manner (Pangaro 2017, p.1579). This feature was described by 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." (ibid)

Although Musicolour was designed to be "an aid to a [musical] performer", Pask also argued that, with minimal alteration, it can be viewed as "an aid to a designer" (Pask 1962, p.166). 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 even before the Fun Palace project.

The Musicolour was indeed employed in architecture, although not the way Pask proposed it could be. Its ability to "get bored" inspired John and Julia Frazer when they were designing the computer programs that control the behavior of individual com-

ponents of Cedric Price's Generator project in the late 1970s. They designed a "boredom program" by which Generator would "get tired of its users" when its components were not shuffled frequently enough; and "generate unsolicited plans and improvements" (Steenson 2017, p.157).

Another notable machine built by Pask before the Conversation Theory, was called the Colloquy of Mobiles (Pask 1971) (Figure 5). 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 (Pask 1971). However, simply told, the machine functioned as follows: It had three female and two male figures which could communicate with each other via visual and audible signs. 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 be able to do so, they had to elicit the cooperation of a female figure which had a vertically positioned reflector that is capable of reflecting the light beam back to the male figure. To be able 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. Humans too could enter the environment and participate, if provided with means to produce visual signs. (ibid)

The Colloquy of Mobiles, yet another manifestation of Pask's appreciation of interaction, was "a socially oriented, reactive and adaptive environment" (ibid, p.88) that "explored the nature of machine-to-machine and person-to-machine conversations" (Pangaro and McLeish 2018, p.1) The mobiles and humans could engage in interactions through circular feedback routines.
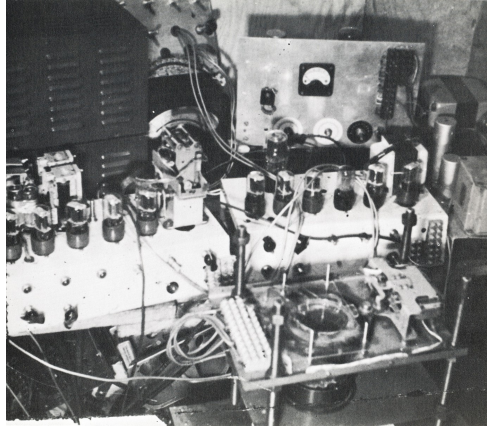
Later Encounters: Architecture and Cybernetics as Fields That Coexist

Pask continued to promote his ideas in architecture in various forms after the Conversation Theory. He became involved in two projects, Hunch and Graphical Conversation Theory, which were developed by the Architecture Machine Group of MIT in the mid 1970s. Hunch was a digital drawing system that attempted to recognize the sketches of its user (Steeenson 2017, p.188). It was programmed based on Conversation Theory and operated in three levels, where it was able to create its model of the user, its model of user's model of it and its model of user's model of its model of the user (Werner 2019, p.6), reminiscent of

the structure of conversations. Graphical Conversation Theory, on the other hand, was a five-year grand proposal to the National Science Foundation (NSF) that included $1.42 million worth of projects (Steenson 2017, p.193). It aimed at uniting computer graphics, conversation theory and a number of research projects under one umbrella (ibid, p.194). However, the proposal couldn't be realized as NSF rejected it (ibid, p.195).

Pask also participated with Cedric Price on an entry for an architectural competition, called JapNet for the city of Kawasaki in the late 1980s (Figure 6). It was the first direct engagement between Pask and Price after more than twenty years. Pask's role in this project was larger compared to the Fun Palace as he personally designed and drafted a significant portion of the project. The project was based on the idea of "techno-trees", which were supposed to be used as intelligent post-boxes by the citizens of Kawasaki (Price and (Hardingham, 2016, p.659). Both Price and Pask designed their versions of techno-trees and Pask's version was "a mathematical model, denoting a continuous feedback of unlimited information storage" (ibid). The entry had a panel that was solely devoted to Pask's entailment structure diagrams (Pask and Price no date).
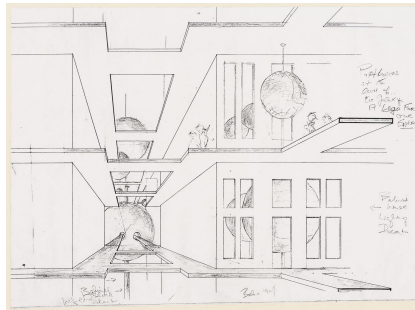
Figure 6
A Perspective Drawing from the JapNet, Source: Cedric Price Fonds, Canadian Centre for Architecture

Apart from these individual instances, another means for Pask to interact with architecture was his affiliation with the AA throughout the 1980s and the early 1990s. Pask worked there at a part time basis and organized lecture series, gave lectures of his own, attended diploma units' classes and more during this period. The letters he exchanged with figures, including chairpersons, Alvin Boyarsky and Alan Balfour; fellow instructors and lecture series partners Royston Landau, John-Julia Frazer, Raoul Bunschoten, Pete Silver and Sam Stevens constitute valuable sources regarding his activity in this period.

In one of those letters, Pask described his plans for 1983-1984 work year to Alvin Boyarsky, then the chairperson of the AA, and offered him giving lectures/seminars and producing tangible models on six topics; "The Computers in Architecture", "The Architecture of Knowledge", "The Information Environment", "Odd Structures", "The Lifespan of Restaurants" and "Pleasure Gardens and Music Halls" (Pask 1983). Under the title, "The Architecture of Knowledge", which was also the topic of (Pask 1984), he offered to use "a proto logic, Lp, and a computer supported system THOUGHTSTICKER" to interpret architectural theories (Pask 1983). He argued that he already had an interpretation of "Le Corbusier's first manifesto and the thesis of Venturi" and stated his desire to tutor the production of other such interpretations at the AA. He also mentioned an essay, titled "Towards a Theory of Theories of Architecture" which was soon to be published, as a source for further detail.

No such essay under this title was published by Pask, however it is highly likely that an unpublished draft manuscript, titled "An Initial Essay: Towards A Unification of Architectural Theories" (Pask no date), was in fact the essay Pask mentioned in his letter. The title of the essay may have changed for some reason, but, both the letter and the essay discuss the same issue, namely the possible role of a conversational framework as a unifying theory in architecture.

In this essay, Pask essentially argued that there was a need for "a unifying and synthetic approach which may tie together the very different theories of architecture" and proposed his Conversation Theory and the proto logic Lp,; a language which may be used to represent and/or manipulate topics/concepts in a conversational framework, as viable can-

didates for this task. In the first section of the essay, he focused on what he considered to be peculiar features of architecture which make it difficult to theorize in, by providing discussions on issues like the "special ontology of architecture", its "dominantly participatory aspect" and the distinction between the "language of architecture" and "language used by architects" (ibid). He then referred to his idea of "Information Environment" (Pask and Curran, 1982), a term he used to describe the consequences of the developing microprocessor technologies of the time, and argued that architects should take more responsibility in the fashioning of it (Pask no date). In the second section, he discussed the specifics of Conversation Theory and the Lp by way of an example where he explained the structure of conversations and specifics about conversational exchanges such as "collective/distributive/analogy coherences". Then he argued the merits of Conversation Theory which render it applicable as an interactionist theory in architecture referring to its epistemological structure (ibid).

This essay is notable as it is one of the most significant attempts of Pask to promote his cybernetic ideas in architecture. But, it is also critical in the sense that it clearly demonstrates both the continuities and the discontinuities in his discourse. In this essay, Pask essentially proposes the same thing as (Pask 1969): to benefit from cybernetics in order to arrive at a unifying theory in architecture. In the former essay, he discusses the relevancy of the cybernetics as a unifying theory in general terms. And, in the latter, he argues Conversation Theory and Lp as two concrete candidates referring to several aspects of them including method of application in fine detail. In this manner, two essays complete each other.

However, two texts differ considerably regarding Pask's understanding of the relationship between architecture and cybernetics as described in them. In the former essay, Pask puts cybernetics in a hierarchically superior position to architecture. Whereas, in the latter, he especially emphasizes the features of both architecture and cybernetics which renders

them in the domain of constructivist epistemology. In this sense, he does not consider architecture as a field to apply cybernetics to any more. Instead, he argues that architecture and cybernetics are compatible with each other as fields that share the same epistemology.

The theme of The Architecture of Knowledge and the idea of architecture and cybernetics as two compatible fields recurred in a number of other times in Pask's correspondence with the AA figures (Pask 1990; 1991; 1992). He pointed out to the similarities between architecture and cybernetics and pictured them as coexisting disciplines in these letters.

Conclusion
Pask enjoyed a fairly unorthodox relationship with architecture throughout his life. And, by means of this relationship, he won the interest of several architects, only a few of whom could be included in this paper. He became highly influential thanks to those collaborators, students and followers who adopted and promoted his interactionist approach in modeling human-human and human-machine relationship in architecture. However, this paper can hardly be considered as a study that scrutinizes the extent of this influence. On the contrary, it examines how architecture influenced Pask and his understanding concerning the relationship between architecture and cybernetics. In doing so, it focuses on some of his significant encounters with architecture and some significant features of his own work, dwelling in more detail on the arguments presented in his two essays: the earlier, frequently cited (Pask 1969) and the later, unpublished (Pask no date). From this inquiry, it identifies two distinct periods characterized by two distinct understandings in Pask's evolving discourse on architecture: The former time period, starting from the early 1960s until the early 1970s defined by the view that considers architecture as a field to apply cybernetics to; and the latter time period, starting from the early 1970s until his death in 1996, defined by the view that acknowledges architecture and cybernetics as fields that coexist by virtue of their similarities.

REFERENCES

Abel, C 1974 'Report on Architrainer: An Instructional Game for Architects', *Gordon Pask Archive*, Vienna

Abel, C 2000, *Architecture & Identity: Responses to Cultural and Technological Change*, Architectural Press, Oxford

Cook, P 2001, 'The Extraordinary Gordon Pask', *Kybernetes*, 30-5/6, pp. 571-572

Frazer, J 2001, 'The Cybernetics of Architecture: A Tribute to the Contribution of Gordon Pask', *Kybernetes*, 30-5/6, pp. 641-651

Furtado, G M 2007, *Envisioning an Evolving Environment-The Encounters of Gordon Pask, Cedric Price and John Frazer*, Ph.D. Thesis, UCL

Glanville, R 1975, *A Cybernetic Development of Epistemology and Observation, Applied to Objects in Space and Time (As Seen in Architecture)*, Ph.D. Thesis, Brunel University

Glanville, R 1997 'The Value When Cybernetics Is Added to CAAD', *Proceedings of AVOCAAD First International Conference*, Belgium, pp. 39-56

Glanville, R 2007, 'Try Again. Fail Again. Fail Better: The Cybernetics in Design and the Design in Cybernetics', *Kybernetes*, 36-9/10, pp. 1173-1206

Glanville, R 2009, 'A (Cybernetic) Musing: Design and Cybernetics', *Cybernetics and Human Knowing*, 16-3, pp. 175-186

Hardingham, S (eds) 2016, *Cedric Price - Works 1952-2003. A Forward Minded Retrospective*, Architectural Association Publications, London

Landau, R 2001, 'For Gordon: Some Comments on Architecture and Its Context', *Kybernetes*, 30-5/6, pp. 752-755

Lobsinger, M L 2000, 'Cybernetic Theory and The Architecture of Performance: Cedric Price', in Williams Goldhagen, S and Legault, R (eds) 2000, *Anxious Modernisms: Experimentation in Postwar Architectural Culture*, MIT Press, Cambridge, MA, pp. 113-137

Mathews, S 2005, 'The Fun Palace: Cedric Price's Experiment in Architecture and Technology', *Technoetic Arts: A Journal of Speculative Research*, 3-2, pp. 73-91

Mathews, S 2006, 'The Fun Palace as Virtual Architecture: Cedric Price and the Practices of Indeterminacy', *Journal of Architectural Education*, 59-3, pp. 39-48

Negroponte, N 1972 'Letter to Gordon Pask', *Gordon Pask Archive*, Vienna

Negroponte, N 1975, *Soft Architecture Machines*, MIT Press, Cambridge, MA

Pangaro, P 2002 'New Order from Old: The Rise of Second-Order Cybernetics and Implications for Machine Intelligence', *Unpublished Manuscript*, pp. 1-63

Pangaro, P 2017, 'Questions for Conversation Theory or Conversation Theory in One Hour', *Kybernetes*, 46-9, pp. 1578-1587

Pangaro, P and McLeish, TJ 2018 'Colloquy of Mobiles 2018 Project', *Symposium on Cybernetic Serendipity Reimagined*, Liverpool

Pask, G 1961, *An Approach to Cybernetics*, Hutchinson, London

Pask, G 1962 'The Conception of a Shape and the Evolution of a Design', *Conference on Design Methods*, London, pp. 153-167

Pask, G 1969, 'The Architectural Relevance of Cybernetics', *Architectural Design*, 37-6, pp. 494-496

Pask, G 1975a, *Conversation, Cognition and Learning: A Cybernetic Theory and Methodology*, Elsevier, Amsterdam

Pask, G 1975b, *The Cybernetics of Human Learning and Performance*, Hutchinson Educational, London

Pask, G 1975c 'Progress Report on Learning Styles, Educational Strategies and Representation of Knowledge: Methods and Applications', *Gordon Pask Archive*, Vienna

Pask, G 1976, *Conversation Theory: Applications in Education and Epistemology*, Elsevier, Amsterdam

Pask, G 1983 'Letter to Alvin Boyarsky', *Gordon Pask Archive*, Vienna

Pask, G 1984 'The Architecture of Knowledge and The Knowledge of Architecture', *Proceedings of 7th European Meeting in Cybernetics and Systems Research*, Vienna

Pask, G 1990 'Letter to Alvin Boyarsky et. al.', *Gordon Pask Archive*, Vienna

Pask, G 1991 'Letter to Royston Landau', *Grodon Pask Archive*, Vienna

Pask, G 1992 'Letter to Alan Balfour', *GordonPask Archive*, Vienna

Pask, G and Curran, S 1982, *Micro Man-Living and Growing with Computers*, Century Publishing, London

Pask, G 1975d, 'Introduction to Aspects of Machine Intelligence', in Nicholas, N (eds) 1975d, *Soft Architecture Machines*, MIT Press, Cambridge, MA, pp. 7-31

Pask, G no date 'An Initial Essay: Towards a Unification of Architectural Theories', *Gordon Pask Archive*, Vienna

Pask, G and Price, C no date 'Collage of Sketches for Kawasaki Project', *Cedric Price Fonds-Centre for Canadian Architecture*, Montreal

Pask, G 1971, 'A Comment, A Case History and A Plan', in Raichardt, J and Greenwich, CT (eds) 1971, *Cybernetics, Art and Ideas*, Graphics Society, New York, pp. 76-99

Price, C 2001, 'Gordon Pask', *Kybernetes*, 30-5/6, pp. 819-820

Steenson, MW 2017, *Architectural Intelligence: How Designers and Architects Created the Digital Landscape*, MIT Press, Cambridge, MA

Brunel University, Institute of Cybernetics 1970 'Scientific Report on Postgraduate Research in Cybernetics', *Gordon Pask Archive*, Vienna

Brunel University, Institute of Cybernetics no date 'Scientific Report on Postgraduate Research in Cybernetics', *Gordon Pask Archive*, Vienna

Werner, L 2019, 'HUNCH 1972: A Second Experiment in Sketch Recognition or: 'I Know the Concept of Your Concept of Interpolation'', in Marcos, CL (eds) 2019, *Graphic Imprints: The Influence of Representation and Ideation Tools in Architecture*, Springer, Cham, pp. 3-11