Questions for Conversation Theory

or Conversation Theory in One Hour

Based on a presentation given at ASC 2016, Evergreen College, June 2016

Paul Pangaro, Ph.D.
Chair & Associate Professor, MFA Interaction Design
College for Creative Studies, Detroit USA
paul@pangaro.com

Presentation Abstract

In an ideal situation, I would like to answer each of the following questions: What is Conversation? What is Theory? What is Conversation Theory, anyhow? How did it arise? Who participated? How is it a theory? Where did it end up? Is it interesting? How might it be useful? Where has it been applied? Why should you care? What does it offer the practice of education? Of design? Of ethics? Where is it headed? (Sorry, steering joke, since Conversation Theory is situated in cybernetics, the art of steering.)

Design/methodology/approach

The seeds of Conversation Theory lie in Gordon Pask's instincts and in his "making". This paper begins by describing some of the machinery he constructed in order to explore human interaction. Next, a skeletal model of conversation is offered, and connections to Pask's own diagrams are drawn. Complementary to these models of the structure of conversations are their consequences, which are described in broad terms rather than given in detail. Lastly, Pask's approach to proposing a scientific theory, and his means of achieving it, are explained.

Originality/value

Conversation Theory is a thoroughly original body of work, unmatched by its range and specificity. It is also little known yet potentially profound, with a scope that has already influenced educational psychology, second-order cybernetics, knowledge modeling, and software design. By describing it's origins, models, and implications, I hope its value can be extended to new generations and to new domains.

Author's Note: This text was written at the kind invitation of the journal editors, and intended as a connector to the presentation at ASC 2016 of the same title and abstract. The presentation relied entirely on visuals to tell its story, and the reader is invited to refer to those visuals (Pangaro 2016) as accompaniment to this text. My thanks to Arun Chandra for asking for this contribution to ASC 2016 and to Michael Lissack for the support for me to attend.

Preamble
I love being asked to talk about conversation theory and I love being offered an hour to do it. To put it another way, I love being asked to do the impossible. Pask's primary sources on the subject, the books *Conversation, Cognition, and Learning* (Pask 1975) and *Conversation Theory* (Pask 1976a) are thick and prodigious, and too few people have read them. As a small aid to the journey I would like to offer a modest guide, an approach to Conversation Theory. The questions in the abstract are all important to answer, but only these can be answered within scope of this paper:

- What is Conversation?
- What is Theory?
- What is Conversation Theory, anyhow?
- How did it arise?
- How is it a theory?

I hope sometime you will ask me the questions that I won't have time to answer here.

Gordon Pask was a Maker
I think it's important to start by forefronting that Pask was a "maker" before we had that word. His theory came, not first from musings, but from making artifacts constructed to have interactions, often with human beings (though sometimes with other artifacts). He was well into his thinking and experimenting with systems of interaction when he encountered Norbert Wiener and cybernetics, thereby finding, as so many of us have, a grounding language in which to articulate our prior instincts. His instincts led him on a career-long journey from pragmatic experimentation to a profound, original, and all-encompassing theory of interaction and conversation.

In the mid-1950s, Musicolour (Pask 1971; Dreher 2015; Pangaro 2002) was one of the earliest devices that he made (at least for exploring human interaction, a focus that allows us to skip over the explosives he invented in his early teenage years). The immersive experience of Musicolour comprised someone playing an acoustical instrument (usually a piano), the sound of the instrument entering Musicolour via a microphone, and the apparatus producing a light show. The performer witnessed the light show and, by having a reaction to the lights and so changing what she was playing, in cybernetic terms she "closed the loop". But in addition to this inner feedback loop in direct connection with the performer, Musicolour possessed additional internal loops. For example, Musicolour would begin by responding to the performer's playing in a certain range of pitch by flashing lights in direct response. The connection was unmistakable and thereby engaged the performer, who would enter a "groove" of interaction, gaining the satisfaction of making the machine respond. However, if the performer played too long in the same pitch range (say, more than 10 or 15 seconds), 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 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.

Musicolour was only the first of a series of more than a dozen machines that he made, and in the process he evolved highly sophisticated conditions for studying human learning, all along exploring what it might mean to enable conversations between humans and machines or between humans through machines.

Conversation and human interaction

Pask was the subject of an episode of the BBC documentary series "The Experimenters" in 1974. On camera Pask says about his research firm, "Conversations are the things we study", there specifically in the context of education and "learning to learn."[1] In logical elaborations of his conversational machines from the 1950s, including Musicolour, in the 1960s he and others at his UK research firm, Systems Research, Ltd. (Scott 2011), built the Course Assembly System and Tutorial Environment (CASTE), whose name is self-explanatory. In the 1970s came THOUGHTSTICKER, continuing a tradition of making and of creating unique and surprising experimental conversations. More so, these systems demonstrated that the primary way of overcoming limitations of a given technological era was by a steady gaze on a key focusing question—and thus he was able to use whatever kit was available at the time, no matter how apparently crude, to construct a means for asking it.[2]

In closest parallel to Musicolour in that it was also an immersive interactive experience, Pask's Colloquy of Mobiles[3] enabled a form of conversation between male and female figures that moved in response to each other and in response to the interventions of a gallery goer (Pask 1971).

Elements of Conversation

All this begs the question, what is Pask's model of conversation? This can be answered in terms of its elements (this section) and its architecture (next section).

While any short paraphrase of Conversation Theory is entirely inadequate to express its range and depth, the following simplification is a useful rule-of-thumb for understanding the gist (Figure 1).

Conversations begin with a participant having some sort of goal, whether specific or general, articulated or unformed.

---

[1] For an excerpt from that episode, see http://cyberneticians.com/video/pask-from-bbc-1974.mov.

[2] Unfettered by the limitations of Pask's own era, a series of prototypes and a commercial product by the author and his collaborators have applied Pask's models of conversation to the most modern context. For example, see Streamful.ly for an instance of conversation theory in operation, here mediating a conversation between a human browsing web pages and a surrogate software participant that selects a snippet from the full text at the other end of a browser hyperlink, using user context and history to prioritize its selections, as another person might. Bridging the 1950s and the 2010s, Pask's models of regulating novelty in an interaction are operating all through.

[3] To hear Pask's own commentary on his Colloquy of Mobiles, see http://cyberneticians.com/video/pask-on-conv-and-beauty2.mov. See also Dreher 2015 for photographs, diagrams, and commentary.

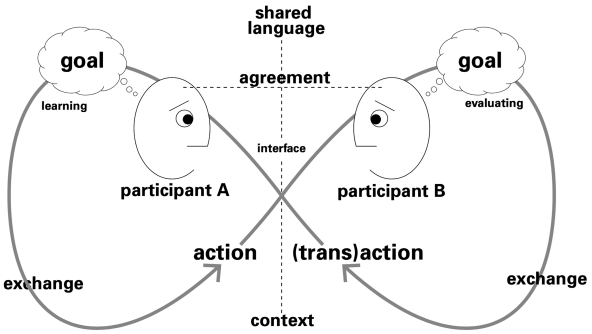

Figure 1: Simplified view of Pask's view of conversation. After Dubberly Design Office.

The consequences of pursuing that goal in conversation can be characterized as the following elements:

- context—a moment, situation, place, and/or shared history sets the stage for…
- language—at least an initial shared means for conveying meaning, in order to begin an…
- exchange—engagement in back-and-forth, language-based interactions that may build to…
- agreement—(sufficiently) shared understanding of concepts, intent, values, that may lead to…
- action or (trans)action—a coordinated interaction in domains other than language, for example, commerce, contracts, dance, games, etc.

The difference between communication (including the technical, information-theory sense of Shannon) and Pask's conversation is that for conversation to have occurred, something must have changed for one or more of the participants—understandings, concepts, intent, values. That is, something has evolved. Otherwise it is merely the exchange of messages (Pask 1981).

Conversation for Design

Pask became a consultant to MIT's Architecture Machine Group, hired by Nicholas Negroponte in the 1970s to collaborate on the direction of his first research lab. This was more than a decade before his more famous successor, the MIT Media Lab, would be established. Negroponte invited Pask to write an introduction to the chapter on machine intelligence in the book he edited, *Soft Architecture Machines* (Negroponte 1976b). In his chapter, Pask wrote out the complete logical structure of his theory, conversation theory.[4]

The significance of Pask's contribution to the Architecture Machine Group is somewhat lost to the history of interaction design. Under Negroponte, who trained as an architect but who possessed an interpretation of "the built environment" as embracing technology, ArchMach was focused on enhancing the process of design, and specifically architectural design, through computation. Pask contributed his formalism on the nature of conversation, based on his experiments of the prior two decades, and proposed a strategy for how a computer could

[4] There is no doubt that a series of researchers employed by Pask's research firm, Systems Research, influenced him greatly, though it remains for a skilled researcher to write about the originators of Conversation Theory aside from Pask himself. To name only the two that I am sure of, B.C.E. Scott at minimum was instrumental in setting up the learning experiments including CASTE (see Scott 2011 for his own thorough and reliable accounting). Dionysius Kallikourdis at minimum influenced, and perhaps was a critical collaborator, in the formalization of the theory (Pask, Kallikourdis and Scott 1975).

partner with a human designer in conversations-for-design (Dubberly and Pangaro 2016). This was in sharp contrast to pre-existing frames of interaction between human and machine. For example, computers were already known to be great at calculation and even simulation (Englebart 1968); beyond that obvious application, Douglas Englebart had described the role of computers to be for “augmenting human intellect” (Englebart 1962). JCR Licklider wrote of “Man-Computer Symbiosis”, “to let computers facilitate formulative [sic] thinking” and create a “partnership” (Licklider 1964). Alan Kay and Seymour Papert had elaborated the role of computers for helping children and perhaps the rest of us to “learn how to think” (Kestenbaum 2005).

But none were as audacious as to propose that the computer be a *design partner* in a conversation-for-design. Pask provided a series of hand-drawn figures to illustrate the complete theory of conversation, expecting them to be re-rendered during the process of publication, yet Negroponte had the great idea to simply photographically reproduce them (Figure 2 is one example from Pask’s paper).

Figure 2 shows the structural relationships in a conversation between human designer (to the left of the vertical line) and the computer-as-design-partner (right side). Pask’s handwritten scrawl labels the left as “Designer as physically localised processor” and the right as “Architecture Machine as physically localised processor” (note the cybernetic equivalence given to human/animal and machine, per Wiener 1948). In the upper-right quadrant, the computer executes “Inductive/Learning/Routines”, where inferences are made, goals are developed and exchanged, and learning occurs by the Architecture Machine during conversation with the human designer. In the lower-right, “Operating Routines” perform more mundane tasks expressed as “Relations in architecture, geometry, mechanics” (lower circle) that enables it to attempt making objects in the environment (area in dotted bubble along the bottom).

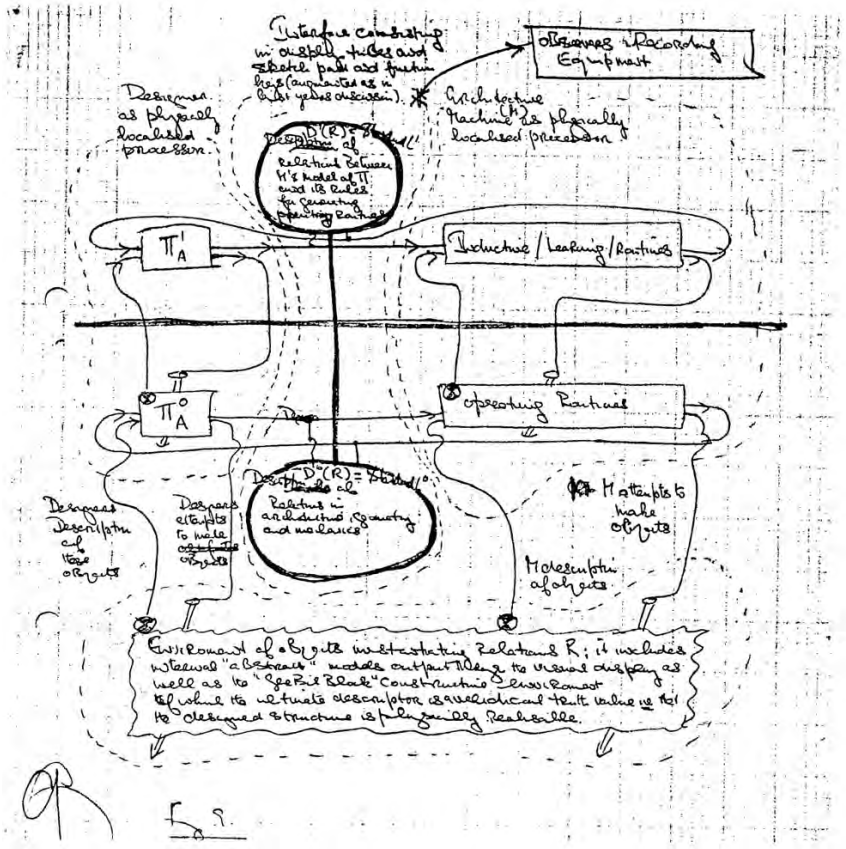

Figure 2: Pask’s hand-drawn model of a conversation between a human Designer and an Architecture Machine (Pask 1976b).

In general there is symmetry between the designer and machine, and both operate in the environment where they make objects and bring descriptions of those objects to higher levels in the conversation.

Only Negroponte can answer whether Pask was the source of inspiration for imagining computers as design partners in conversation. Only Pask could have offered then, or even in the present day, a formal model for how that would work. His article in *Soft Architecture Machines* is hardly a production blueprint for an Architecture Machine but, given the depth and breadth of Pask's conversation theory even at that point in 1976, it's a jump-start to building a computer-based design partner. Pask had a great deal more to offer right then, especially in regard to the representation scheme to be used to encompass "relations" and "descriptions" (next section).

Outcomes of Conversation

While Figure 2 shows the structural relationships in a conversation, it begs the question, what goes on inside the boxes? Put another way, how does the human being process incoming signals and on what basis does it respond? (Similarly, how does the machine?)

Not unexpectedly, Pask had a highly detailed answer (Figure 3). Incoming signals become triggers[5] to pre-existing processes (our knowledge, what we already know; or, as Pask preferred, our "knowing", a form which forefronts its dynamic and on-going nature). These triggers cause changes in those processes (i.e., "learning"). In order to model the processes and their changes, Pask developed *entailment meshes* to express the processes and an accompanying calculus or proto-logic to express their transformations (Pask, Kallikourdis and Scott 1975; Pask and Pangaro 1980; Pask 1980).

While not intended to be read in detail here, Figure 3 provides a necessary summary of a key outcome of (some) conversations, that is, what Pask termed an *agreement over an understanding*. My intention is to give a sense of the specificity of his model of conversation, and to invite more detailed enquiry into its strengths and weaknesses, neither sufficiently explored in the research community after Pask.

The lower left block (labeled Fig 1.2) shows the process interrelationships involved in a *concept,* here represented in a calculus of relationships where the letters T, P, and Q represent distinctions, or topics, such as circle, compass, and plane, possessed by a participant named A. The 6 equations and their folding onto each other—the product of each becoming input to others—indicates that the entire structure is self-making and organizationally closed (specifically, it is autopoietic).

[5] Here I consciously use Humberto Maturana's concept of "trigger" in regard to signals impinging on the nervous system. The alternative terminology of "input" suggests an incorrect relationship between the conversational participant and what comes in "from the outside." Pask and Maturana (and von Foerster, for that matter) all had compatible and resonant views of human interactions, and this use of trigger is completely consistent with Pask's intent (Pangaro 2007).

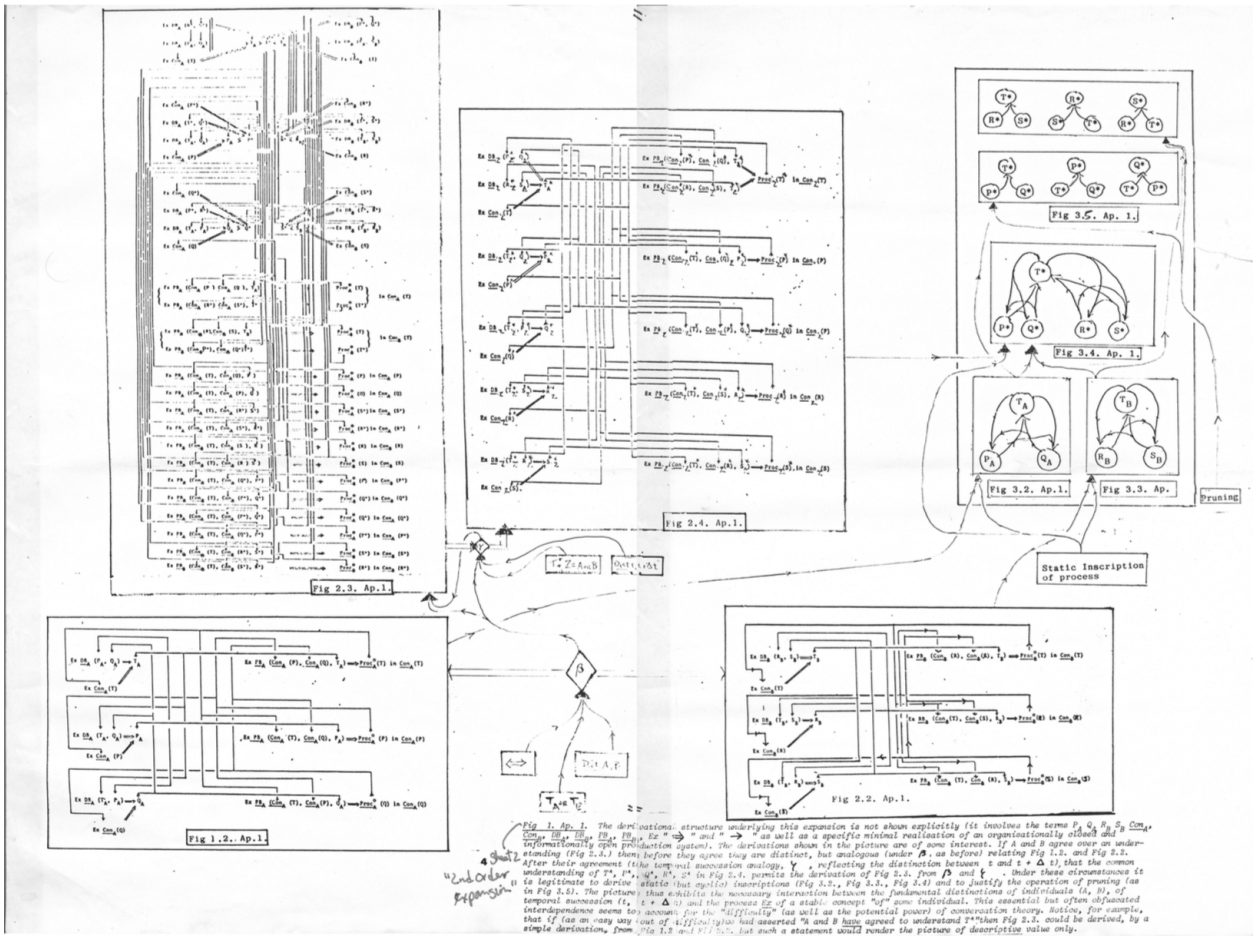

Figure 3: Summary of the processes and outcomes in "agreement over an understanding". Source: Paul Pangaro's Pask Collection, part of the Pask Archive at the University of Vienna.

The parallel block on the lower right (sub-labeled Fig 2.2) shows the equivalent interrelationship for a different participant, B, who composes the same topic T from different topics than A, namely, R and S. In order for A and B to understand the other's concept of T, and to confirm that each of them mean the (sufficiently) same thing by T, each of them must process the large set of relationships modeled by the equations in the upper left (sub-labeled Fig 2.3). The consequence of each of those processes being performed by A and by B is the set of interrelationships in the upper-middle box (sub-labeled Fig 2.4), which says in essence that T* can be reproduced either by combining P* and Q* *or* R* and S*. (The remainder of the relations necessarily show how P*, Q*, R*, and S* are reproduced, also.) The addition of the asterisk to qualify each of the topic names is necessary to make the point that A's T is not identical to the topic T that is shared by A and B—participant A would have experiences not shared by B, and *vice versa.* The overlap of what they share—the agreement over an understanding—is therefore indicated by an asterisk.

Lastly, the box in the upper right (containing sub-labeled Fig 3.2 through Fig 3.5) holds alternative short-hand expressions of the other boxes. (sub-labeled Fig 3.2 is shorthand for Fig 1.2; Fig 3.3 is shorthand for Fig 2.2; Fig 3.4 is shorthand for Fig 2.4).[6]

What's a "Theory of Conversation"?

When Pask claimed to be making a theory, he didn't mean it in a light-weight sense.[7] Pask took seriously a strict, scientific meaning for theory, which he asserted must comprise principles of *duality*, *complementarity*, and *conservation*. Again the context of this paper only allows for the briefest outline of his intentions.

For complementarity, conversation theory compares the *descriptive* and the *prescriptive* components of processes that embody our knowing. For example, to convey or embody an understanding of the relationship between pencil, writing, and paper, it is not enough to say that "A pencil can be used for writing on paper." That's the descriptive component which only begs the question of how it all works together. This requires something like, "Place the graphite end of the pencil against the surface of the paper and push with sufficient pressure to leave a mark on the paper." That's the prescriptive component. (Later Pask eschewed those terms and moved to the more abstract "Con+" and "Con–", to express the complementary components of any concept more abstractly).

For duality, conversation theory contrasts the interactions that take place along the loops in Figure 2 with the consequences of those loops, that is, the evolution of the processes that result, and as may modeled by the evolution of entailment meshes (the briefest taste of which is contained in Figure 3; the relationships in the upper right are one way to diagram meshes, which are shorthand for the interrelationships expressed more fully in the remainder of the figure). Thus, interactions and their consequences are "two sides of the same coin" of conversation, going together inextricably—they are duals of each other.

For conservation, conversation theory asserts that, just as in physics where mass and energy are conserved despite any transformations of them, it is *consciousness* that is conserved from conversation, including any transformations that follow. Pask used this term in a specific way, derived from McCulloch's pairing of it with *awareness.* On my own I may be *aware* of the concept pencil as an implement for writing on paper. If I am aware and I know that you are aware and I believe you have a similar concept to mine, and *vice versa* such that we have an agreement over that understanding, than we are *conscious* of the concept of a pencil. (Put more simply but less specifically, consciousness comprises shared awareness of an agreement.)

As in everything he did, Pask was very serious about all this. He wanted to be understood as offering a strict scientific theory of conversation, and in my experience he never let a lecture go without emphasizing the point about consciousness being conserved.[8] He meant that our shared awareness is persistent, in that it carries forward in time, even when our current

---

[6] The curious reader may wish to refer to presentation slides and a video of the original presentation (Pangaro 2016).

[7] For example, many have attributed the term "theory" to Minsky's *Society of Mind*, a book comprising hundreds of individual pages of relatively disjointed musings on the possible nature(s) of thinking and mind.

[8] He also never missed an opportunity to say that human brains are merely the medium through which concepts live and evolve a life of their own, much as human digestive tracts exist for the sake of *E. coli* .

exchange is over. We retain the experience of the conversation in that our mental processes have been changed as a result of the conversation, and we carry those changes with us. While each of us may carry forward somewhat different concepts, they are grounded in our agreements. So, consciousness is conserved. Put another way, and as Pask loved to say: Once begun, conversations never end. I think of this as a wavefront of consequences emerging from our last exchange that goes forward even when we are not talking. I replay our conversation on my own, and speculate on how to take it further, based on my understanding of what you think and who you are. Even when we are apart, the conversation is there, albeit in a more limited way than if we are together. Even if I forget what we said, my mental repertoire is forever changed, in the small or in the large, as a result of our conversation. Even when I die, you continue without me.

And so, our conversation never ends.

———————————————————————————————————————

References

Dubberly, H. and Pangaro, P. (2015). How cybernetics connects computing, counterculture, and design. In *Hippie Modernism: The struggle for utopia* (pp. 126-141). Minneapolis, MN: Walker Art Center. Available at http://www.dubberly.com/articles/cybernetics-and-counterculture.html.

Dubberly, H. and Pangaro, P. (2016). Cybernetics and Design: Conversations for Action. In Cybernetics & Human Knowing, Volume 22, nos. 2-3 (pp. 73-82).

Dreher, T. (2015). History of Computer Art, IASLonline NetArt: Theory. Available from http://iasl.uni-muenchen.de/links/GCA_Indexe.html.

Englebart, D. (1962). “Augmenting Human Intellect: A Conceptual Framework”, SRI Summary Report AFOSR-3223, prepared for: Director of Information Sciences, Air Force Office of Scientific Research, Washington DC, Contract AF 49(638)-1024 , SRI Project No. 3578. Available at http://www.dougengelbart.org/pubs/augment-3906.html.

Englebart, D. (1968). “Mother of all Demos”, see http://www.dougengelbart.org/firsts/dougs-1968-demo.html.

Kestenbaum, D. (2005). “A conversation with with Seymour Papert, Marvin Minsky, and Alan Kay”, Communications of the ACM, Volume 48, Number 1 (2005), pp. 35-38. Available at http://www.benslade.com/tech/TalkWithPapertMinskyKay.html.

Licklider, J.C.R. (1960). “Man-Computer Symbiosis,” Transactions on Human Factors in Electronics, (March, 1960), 4.

Negroponte, N. (ed.) (1976). *Soft Architecture Machines.* Cambridge, MA: MIT Press.

Pangaro, P. (2007). “The Past-Future of Cybernetics”, in Müller, A. and Müller, K. (eds.), *An Unfinished Revolution?, Heinz von Foerster and the BiologicalComputer Laboratory 1958 – 76*, echoraum, Vienna, 2007. Available from http://www.pangaro.com/heinz-von-foerster-biological-computer-lab.html.

Pask, G. (1971). “A comment, a case history, and a plan”, in *Cybernetics, Art and Ideas*, ed. Reichardt, J., Greenwich, CT, NewYork Graphics Society.

Pask, G. (1975). *Conversation, Cognition and Learning: A Cybernetic Theory and Methodology*. Elsevier Publishing Company, New York, NY, USA.

Pask, G. (1976a). *Conversation Theory: Applications in Education and Epistemology*. Elsevier Publishing Company, New York, NY, USA.

Pask, G. (1976b). Introduction to Chapter 2 on Machine Intelligence, in *Soft Architecture Machines*, Negroponte, N. (ed.), MIT Press, Cambridge, Massachusetts.

Pask, G. (1980). "An essay on the Kinetics of Language as illustrated by a Protologic Lp". Proceedings of 2nd Congress of the International Association for Semiotic Studies, Vienna, 2-6 1979, workshop on "Fuzzy Formal Semiotics and Cognitive Processes". Reprinted in Ars Semiotica, Amsterdam: John Benjamins, pp. 93-127.

Pask, G. (1981). "Limits of Togetherness", in Lavington, S. H., (ed.), Information Processing. Proceedings of IFIP '80, Invited Keynote Paper. North Holland Publishing Company.

Pask, G., Kallikourdis, D. and Scott, B. (1975). "The representation of knowables", International Journal of Man-Machine Studies, 7, pp. 15-134.

Pask, G. and Pangaro, P. (1980). "Entailment Meshes as Representations of Knowledge and Learning", Conference on Computers in Education, Cardiff, Wales.

Pangaro, Paul (2002). "New Order from Old: The Rise of Second-Order Cybernetics and Implications for Machine Intelligence", unpublished manuscript p31. Available at http://www.pangaro.com/NOFO/NOFO2002r-v8d.pdf

Pangaro, Paul (2016). Slidedeck for presentation at Annual Meeting of the American Society for Cybernetics 2016, Evergreen College, Olympia, Washington. Available at http://pangaro.com/conversation-theory-in-one-hour.html.

Scott, B. (2011). Explorations in Second-Order Cybernetics: Reflections on Cybernetics, Psychology and Education, edition echoraum, Vienna.

Wiener, N. (1948) *Cybernetics: Or Control and Communication in the Animal and the Machine,* Cambridge, MA: MIT Press.

###