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Autistic Mental Schema and the Graphical User Interface circa 1968

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Abstract

Evelyn Fox Keller calls the form of organisms a "devious" problem. How and why do such forms arise? Models, Keller argues, are necessary inroads to these questions. The speculative-propositional mode of computational and mathematical models permits scientists to question the physical and mental processes that shape matter into elegant form despite the "void" of certainty opened by the complexity of vitality. This article documents the use of the LOGO programming language in model-mind making as well as in experimental coding pedagogies for special needs students circa 1968. It provides a historical and philosophical background for interpreting clinical observations of two young autistic students, David and Joey. The article demonstrates that the designers of LOGO understood their design choices in terms of philosophical debates about the nature of purposive orientations in organisms. The author argues that cautious engagement with those debates—guided by Keller's philosophy of models and Catherine Malabou's understanding of Immanuel Kant's concept of schema—can open for humanists an interpretive project aimed at elucidating the historical meaning of the graphical user interface. Insights into the aesthetics of resistance from autistic rhetorician Remi Yergeau and philosopher-poet Fred Moten allow neuroqueer ephemera, lingering in the archives of LOGO, to illuminate a politicization of mental variety nascent in digital screens.

Keywords

philosophy of science, neuroqueer theory, screen cultures, history of programming

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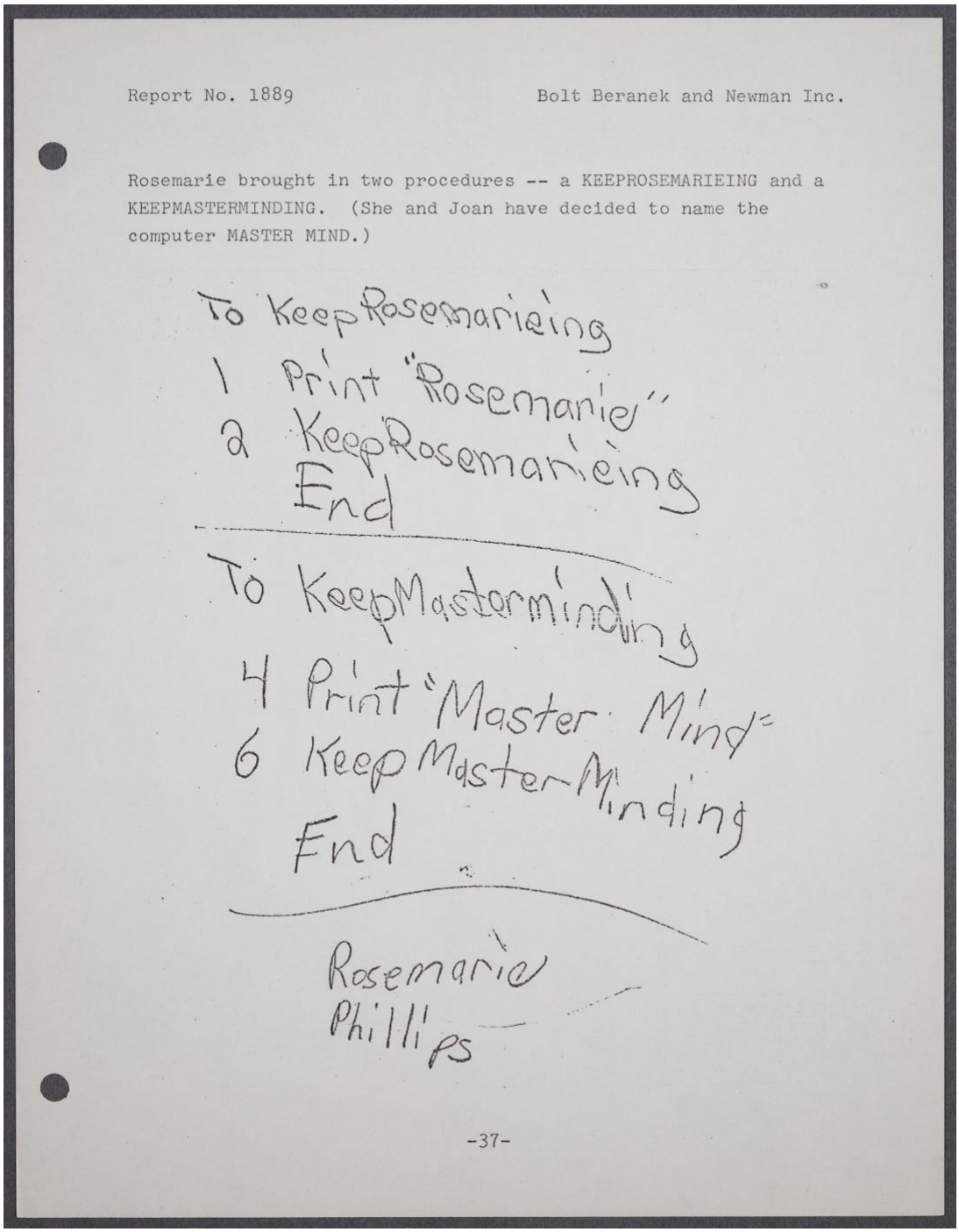
The Elegance of Naming in LOGO

In the summer of 1968, a second-grade student from the Emerson School in Massachusetts learnt a new way to write her name. Rosemarie Philips, with the help of Mrs. Marjorie Bloom, wrote what her teacher called a "procedure" (Feurzeig et al. 1969, 34–38). That procedure, interpreted and executed by a computer, typed out her name on a teletype machine (Figure 1). Philips programmed in a language called LOGO. That introductory exercise was part of an experimental summer school organized by members of MIT's newly founded Artificial Intelligence Laboratory (MIT AI Lab) and bankrolled by the defense contractor Bolt, Beranek, and Newman. Philips's work began as part of an experiment in teaching programming as a way into teaching "concepts" fundamental to "doing" mathematics: "Teaching Children Thinking," they said (Papert 1971, 3–4). The idea was to teach children "the art of setting up models" rather than memorizing formulas for the sake of test results (5).

What sort of model is a name? One power of programming is to facilitate the decomposition of a task into smaller parts that can then be named and reused as pre-written functional modules, like off-the-shelf parts in a library or repertoire of functions. Names encapsulate. One way to begin founding mathematics is to look for the most basic "operations"—order, addition, and metrics, for example—and then ask what sort of functions preserve "relations" generated by these operations across transformations in "structure" (Fong and Spivak 2019, 1–6). To think of a *property* as the preservation of a structural feature is to depart from substance into a "structural approach to modeling" that the AI Lab had inherited by myriad influences too numerous to document thoroughly in the present text (Fong and Spivak 2019; Papert 1967a; Papert 1967b; Piaget 1970). Learning her name was less a task in memorizing what to call herself or how to sign a proper name—a familial honorific, Rosemarie Philips—than an exercise in teaching the computer to store the string of characters, R-o-s-e-m-a-r-i-e, in a register and to then type out that string when certain conditionals are obtained. To store a word indicating "me" prompts pondering the "I think" via rethinking naming: thoughts on uses of I via rewritings of me (Longuenesse 2017, 53, 1-2). This is what the AI Lab team did; they asked students to use "himself [*sic*] as a model" for "thinking about thinking" (Papert and Solomon 1970, 3; Minsky and Papert 1972 33). That idea became the core constructivist philosophy of education that came out of the LOGO project—thinking about thinking through thinking about coding facilitates learning.



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Rosemarie brought in two procedures -- a KEEPROSEMARIEING and a KEEPMASTERMINDING. (She and Joan have decided to name the computer MASTER MIND.)

To KeepRosemarieing
1 Print "Rosemarie"
2 KeepRosemarieing
End

To KeepMastermind'ing
4 Print "Master Mind"
6 KeepMasterMinding
End

Rosemarie Phillips

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Figure 1. Rosemarie Philips, "KeepRosemarieing." Preparatory sketch for LOGO procedure executed on Digital Equipment Corporation's PDP-11 in summer of 1968 (Feurzeig et al. 1969, 34). Courtesy of MIT Libraries, Institute Archives and Special Collections. Seymour Papert Papers, Box 16, (17b-18a), MC693.
Alt text: Image of a page from an archival document. The document reproduces a portion of hand-written code by Rosemarie Philips. The lines of code pertinent to this article are described, word for word, and discussed in the next section of the article.

For scholars of autism—in its historical (Evans 2017), sociological (Eyal et al. 2010), and clinical (Nadesan 2005) existence as well as in its lived experience and philosophical or artistic form (Yergeau 2018; Manning 2017; Moten 2015)—the echo of thought in the mind (thinking about thinking), is a key concept. Some philosophers describe the feeling of thinking happening as a process that carries within its complex structure myriad unactualized variations of actual occurrences (Whitehead [1929] 1978; Manning 2017). Though not in contradiction with that description, others argue that humans need specific forms of mental reference to specific types of mental object to satisfy conditions for special kinds of thinking, such as moral reasoning (Kant [1787] 1998; Freud [1915] 1991; Longuenesse 2017). Clinical psychologists have proposed that autistics lack the ability to generate mental objects that model the minds of other beings (Baron-Cohen, Leslie, and Frith 1985). Programmers worked with autistic children in the 1960s because of the opportunity that the pedagogical situation provided for thinking about thinking through teaching programming. These programmers and their autistic students pursued and resisted thinking about thinking while making and interpreting computer-generated images. I argue that this recurrent archival pattern exists because of powerful intellectual tensions between philosophically entrenched ways of thinking about thinking; these tensions have had very real effects on both lived experiences and technological outcomes. The unfinished business of learning to talk about the varieties of mind lives on in our machines.

The casual misgendering of Rosemarie, quoted a moment ago, could also be read as an archival trace of Morgan Ames's argument that LOGO's acolytes culturally coded a "social imaginary" of programming as an occupation fit only for "the *technically precocious boy*" (Ames 2019, 28–29, 40–41). That imaginary, for Ames, is based in the implicit presumption that coders work alone, reliant only on this echo of themselves, rebounding in the mind, that facilitates their individual acts of hacker bravado. If that cultural imaginary is indeed pervasive and programming, culturally coded as an individualistic pursuit, excludes "girls and women, people of color and others who do not fit the gendered norms of these imaginaries," then the suggestion I support here, which is that there is an elusive and distinctly neuroqueer dimension to the archives of programming, will require conceptual tools that highlight that aspect of LOGO's history. I understand the goal of Ames's project to be detecting, in ethnographic fieldwork, the effects of that gendered imaginary on educational technologies that are rhetorically justified, by their advocates, as vehicles of liberation. I also see the need to conceptualize how ways of thinking about thinking (embedded in cultural imaginaries) shift. To understand how and when ways shift, I look for traces of a temporal rhythm wherein humans become bound by and released from patterns of judgment. KeepRosemarieing is an iteration of the rhythm that we will encounter in each subsequent code analyzed herein. Called *temporality* by philosophers, this rhythm inhabits life.

Through it, people thicken and vary the work of learning to form, share, resist, and let go of ideas and technologies that structure being together.

The phenomenology of temporality in its queer feminist modality has helped me perceive this rhythm of resistance and releasement at work in the archives (Ahmed 2006). I find Catherine Malabou's (2016) and Jacques Derrida's (1989) respective works on Kant's concept of the *transcendental* to be invaluable when identifying the effect of this temporalizing force on the course of computer history, as I explain below. For now, let us understand the transcendental as an implicit, constraining background guiding the formation of embodied minds and the mental objects they animate. In a biological register, we might wonder why and how organisms' growth attains and retains form in time: What guides their *morphogenesis*? In human worlds, we might also wonder not only how constraining social and technological conditions generate resistance (a psychodynamic phenomenon with political upshots) but also how and why minds under duress in difficult social interactions support unrealized variations of actual affairs.

By looking at the graphical appearance of the results of Philip's programs in the next section, and by performing a close reading of codes she and her classmates wrote in the summer of 1969, I show that a Kantian philosophical interpretation of the meaning of programming took shape as a motivating intellectual problematic at the AI Lab. I believe this period of unstable meaning production still structures possible, underrealized modes of interpretability that linger in a suppressed mental background of digital cultures. If our ways of handling and talking about computational things generates and suppresses an implicit "background"—and that background then becomes a "sedimentation" (joining implicit judgments into ways of speaking and thinking about minds, programming, and computers)—then refining "code-reading practices" in the humanities could be one way to build textual "orientation devices" that navigate the strings of reasoning that graphical things, called screens, encapsulate (Ahmed 2006, 32–34, 31, 3, 11, 41; Marino 2020, 17). The "textual apparatus" of media history, in this phenomenological mode, would aspire to raise machines out of their status of "object logics" with technologically facilitated surfaces and connections, which all "presuppose particular formations of infrastructure," and into a history of implicit structural models guiding the motion of thinking as it senses itself living (Stengers 2014, 24; Gaboury 2021, 17; Sterne 2012, 15).

In the archives of LOGO, model minds and graphical screens are entangled. That archive is a record of this dance between propositional sedimentation and temporalizing reorientation. Programmers bind functions into reusable objects. Release of that binding is both imperiled by the efficacy of the thing bound (it can be hard to give up what works) and ensured, as a possibility, by minds that withhold themselves from identity with the thing thought. That archive begins

with Rosemarie Philips being asked to rewrite her name and reread the meaning of naming as a way into remodeling her own thinking about being a thinking being.

In the half-decade before the MIT AI Lab, one of LOGO's designers, Seymour Papert, worked with evolutionary biologist Jean Piaget in Geneva. Piaget had spent a lifetime building a logical and experimental framework for modeling and observing learning processes across scales and domains of living phenomena. From speciation to variation in mental functions to cycles of scientific knowledge production, Piaget believed that "operations" governing the haphazard construction of meaningful forms operated in ways specific to the entities at play in each of these time frames and length scales yet generalizable, eventually, to the status of universal structures governing "development" in each domain (Piaget [1963] 1977, 345, 345–53). Piaget had enlisted Papert to assist him in "constructing a cybernetic model" of learning (Piaget 1970, 5). *Learning* was the word that many engineers, logicians, and psychologists who worked in the field of research known as *cybernetics* chose as a name for the incredibly arduous task of outlining what a rigorous search for the laws governing the attainment of form (in organs, thoughts, and cultures) might look like.

Philosopher of science and mathematical biologist Evelyn Fox Keller calls the problem of the origin and attainment of form a "devious" problem (2002, 301, 54–60, 89–95), observing that models, because they wrangle the rift between the model and the thing modeled, require an ongoing exchange and circulation of "epistemic values" (between scientists) to continually maintain and support the model's claim to "fill a conceptual void" (xi, 8, 13). That void is *not* the gap between mind and object, somehow filled by representation. Nor does this void gape merely for lack of evidence presented to the senses. What Keller names devious is a void of propositions that meaningfully bear on the question of how (and why!) complex organic forms can take and hold shape in time. That special ignorance opens a nothingness at the heart of thinking. Reflecting on models of cell growth built by cyberneticians, Keller discovers consistent forms of "explanatory satisfaction" that crop up to soothe this gnawing doubt about why and how life takes shape the way it does (7). She shows that observers are satisfied when witnessing a lifeform unfolding in time; that builders enjoy a mechanism working effectively; and that mathematicians are satisfied when a formula or a program generates results that exhibit the same beauty that life displays in its elegant machinations (70, 100–1). It will be helpful to keep in mind this idea of epistemic values circulating as a quality of intuitively satisfying appearance because it lends support to a genuinely temporal narration of how *media* take shape and are sustained by human actions and ideas, rather than being just another name for infrastructures and the representations or materials they carry.

I understand Keller's perspective as a reflection on the temporal dimension of the power of judgment. Code is a mental process "bound to time" (Marino 2020, 8). Languages fall in and out of use. But one must ship the code, so choices get made. That banality harbors great significance; it is a rhythm of work wherein time goes to work on thinking, forcing it to seek out communicable forms of satisfaction. Media history can teach us to reflect on the struggles introduced into human worlds by this rhythm of hard-won functionality and suffering caused by the failure to relinquish it. By observing (via the archive) the coeval design of a programming language (LOGO) and the rebuilding of models of autistic minds (via cybernetics), this paper identifies moments of resistance to the conflation of autistic interiority with those models. It does so by narrating how autistic students, David and Joey, negotiated their encounters with philosopher-scientists who were trying to model David's and Joey's minds. We meet these two students, in the final section, after a lengthy preparation. This preparatory discipline—by way of Mrs. Bloom and Rosemarie, Papert and Piaget, Kant and Malabou—will lead us to the rhythm of a neuroqueer residuum in the archives of LOGO. It may also ready us to listen for hidden temporalizing acts of neuroqueerness searching for a foothold within a misgendered imaginary, writ large. Autistic rhetorician Remi Yergeau (2018) and poet-philosopher Fred Moten (2015) assist me in that task of attunement—both authors have outlined the work of intertwining the science of the mind, phenomenology, and critical computer histories of cybernetics.

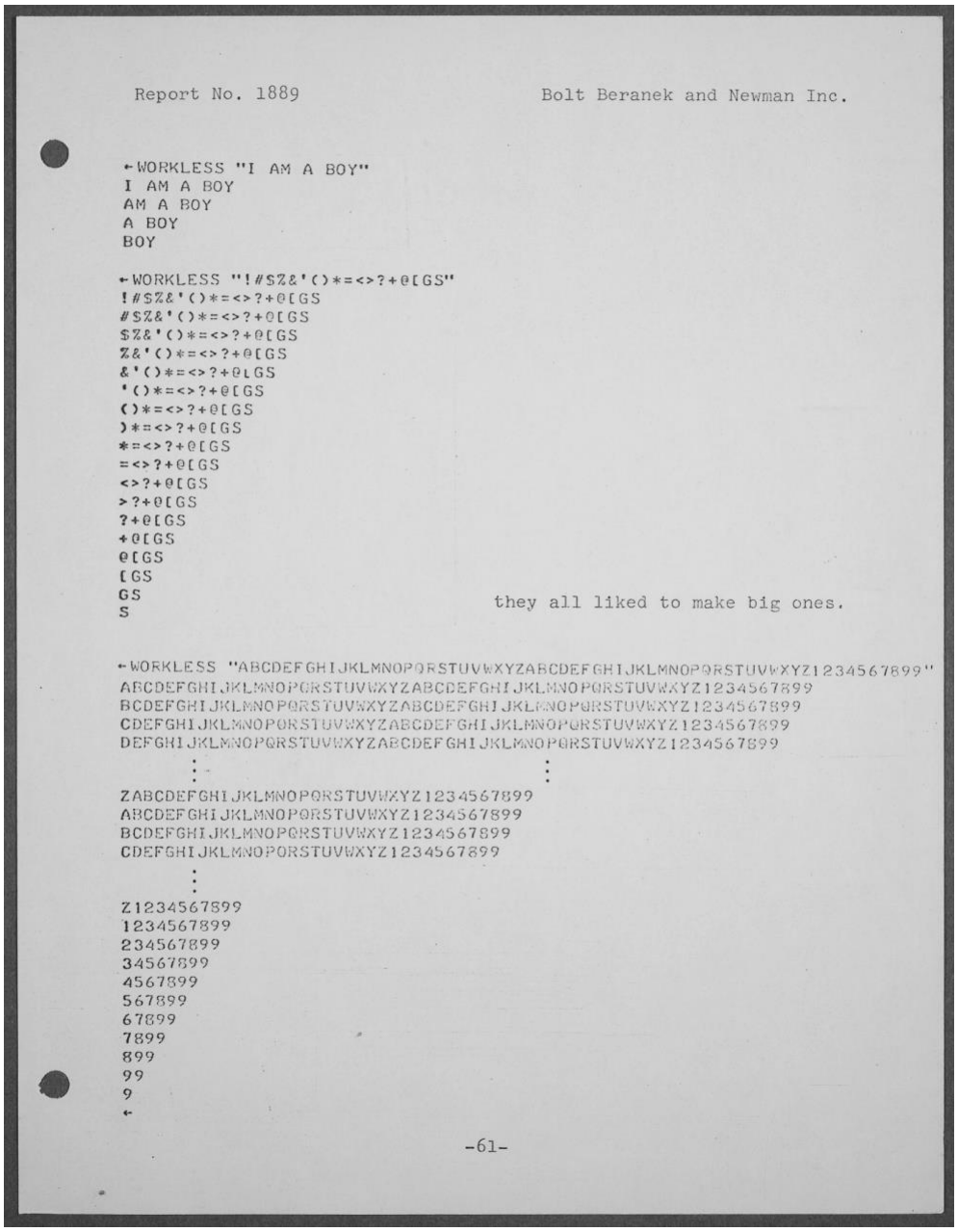
Poly / Side / Angle

Seymour Papert read code by Rosemarie Philips as a basis for reflection on what Sigmund Freud once called the "psychophysiological parallelism" (Freud [1915] 1963, 111, 110–46; Papert 1963, 138–39). The idea was *not* that code is an "explanation" of mental function (Craik 1952, 84, 59, 59–65; Newell, Shaw, and Simon 1958, 151, 151–66; Simon and Newell 1971, 147, 145–59). Papert understood the parallel of mental function to neurons in terms of Jean Piaget's inquiry into the "schemata" of "autistic thought" (Piaget 1918, 165; Piaget [1937] 1977, 275). *Schema* was the word Piaget used to describe the finite logical form of mental phenomena he hypothesized to be operating in the nonconscious background of ordered speech and action (Piaget [1937] 1977, 275). The LOGO designers believed that intuitions of transcendentals had a historical dimension because finitude introduces contingencies of individual and technological mediation into the process of priming and refining intuitions. In 1969 those same designers were also building code libraries for graphical screens using the structural approach to modeling.

The first line of Philip's code declares a new function, called "KeepRosemarieing." The string of characters "T" and then "O" tell the computer that whatever comes next is the name of what LOGO's designers termed a "procedure," which many programmers in 2023 would simply call a *function* (Feurzeig et al. 1969, 276;

Schiffman 2008, x; Monfort 2016, 268; McCarthy, Reas, and Fry 2016, xi). The next word, "Print," rather than being a function defined by a programmer in LOGO, is a function defined by the programmers of LOGO. Print is available off the shelf; it is part of LOGO's library of functions. Writing Print tells the computer that whatever character comes next ought to be given in the specific form (an argument) valid as input specific to Print's parameters. By placing Rosemarie in quotation marks, young Philips was telling the computer to read each letter of her name as content meant for storage in memory. In the next line Philips calls the function she has just declared with T and O and then defines it by using the letters Rosemarie as input to Print. KeepRosmarieing will keep on printing Rosemarie—over and over, reeling off the teletype, sheet after sheet of pinwheel paper, layering in accordion folds on the floor until the paper runs out, the plug is pulled, or she must add the command End. There is no "*state*" that defines the end of the loop, so just KeepRosemarieing (Buswell 2018). How does nature know when to stop? What value, or count, could limit function, binding it to the state of the finite system while guiding its form to an end? One riddle of morphogenesis is already here, ingrained in this choice of beginning a history of graphics with learning to code: What binds a set of operations into a stable form-content, argument-input relation that unfolds and stops at the right times? The form of time remapped not to code, alone, but to an echo of a riddle as it finds a new human medium in which to take hold.

Another "normal" student from the Emerson school appears next in the Bolt, Beranek, and Newman report from the '68 AI Lab summer school. Jay's "Workless" function returned a value and was therefore dubbed a "LOGO thing"; it hacked off one "Word" each time using an "operation" which meant an end state could be defined by the emptying of a register (Figure 2) (Feurzeig et al. 1969, 274, 277, 321). A meaning of function is carried by the name of Jay's function. "Workless" was the name Mrs. Bloom chose for an exercise working with the stock LOGO functions "First," "Last," "ButFirst" (reading: the first word or character in a set), and "ButLast" (275). All these functions identified items in a string stored in memory. Jay started by storing a string, "I am a boy" (61). Then, he used First to have the computer remove the first word from the string: then the next, then the next. This simple function made Workless into a letter-animating toy (274–77). Mrs. Bloom may have chosen the name for its "fun" resonance with the disappearance of the diminishing stock of characters, for which the computer and printer worked less and less each time it executed the code (53). For each Wordless the computer would Workless. It was an orthographic drift, a glide atop proper form, nonetheless eminently programmable, executable, valid: proper nonsense.



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```
←WORKLESS "I AM A BOY"
I AM A BOY
AM A BOY
A BOY
BOY

←WORKLESS "!#$%&'()*=<>?+@[GS"
!#$%&'()*=<>?+@[GS
#$%&'()*=<>?+@[GS
$%&'()*=<>?+@[GS
%&'()*=<>?+@[GS
&'()*=<>?+@[GS
'()*=<>?+@[GS
()*=<>?+@[GS
)*=<>?+@[GS
*=<>?+@[GS
=<>?+@[GS
<>?+@[GS
>?+@[GS
?+@[GS
+@[GS
@[GS
[GS
GS
S                                   they all liked to make big ones.

←WORKLESS "ABCDEFGHIJKLMNOPQRSTUVWXYZABCDEFGHIJKLMNOPQRSTUVWXYZ1234567899"
ABCDEFGHIJKLMNOPQRSTUVWXYZABCDEFGHIJKLMNOPQRSTUVWXYZ1234567899
BCDEFGHIJKLMNOPQRSTUVWXYZABCDEFGHIJKLMNOPQRSTUVWXYZ1234567899
CDEFGHIJKLMNOPQRSTUVWXYZABCDEFGHIJKLMNOPQRSTUVWXYZ1234567899
DEFGHIJKLMNOPQRSTUVWXYZABCDEFGHIJKLMNOPQRSTUVWXYZ1234567899
      :                                 :
ZABCDEFGHIJKLMNOPQRSTUVWXYZ1234567899
ABCDEFGHIJKLMNOPQRSTUVWXYZ1234567899
BCDEFGHIJKLMNOPQRSTUVWXYZ1234567899
CDEFGHIJKLMNOPQRSTUVWXYZ1234567899
      :
Z1234567899
1234567899
234567899
34567899
4567899
567899
67899
7899
899
99
9
←
```

-61-

Figure 2. Jay, "Workless." Printout of LOGO code executed on PDP-11, 1968. (Feurzeig et al. 1969, 61). Courtesy of MIT Libraries, Institute Archives and Special Collections. Seymour Papert Papers, Box 16, (17b-18a), MC693.

Alt text: Image of a page from an archival document. The document reproduces the results of a procedure, named Workless, written by Marjorie Bloom's student Jay. The procedure takes a string of characters, removes the last word or the last character from the string, and then prints out the string minus that word or character. Three different inputs to the program are shown. The string "I am a boy" becomes "am a boy" then "a boy" then "boy" and then the program stops. The next two input examples are composed of (1) all the non-alphanumeric symbols on the keyboard and (2) all the letters and numbers on the keyboard, in order. The character-removal procedure creates an image of wedge shape by slowly chipping away at the length of the string.

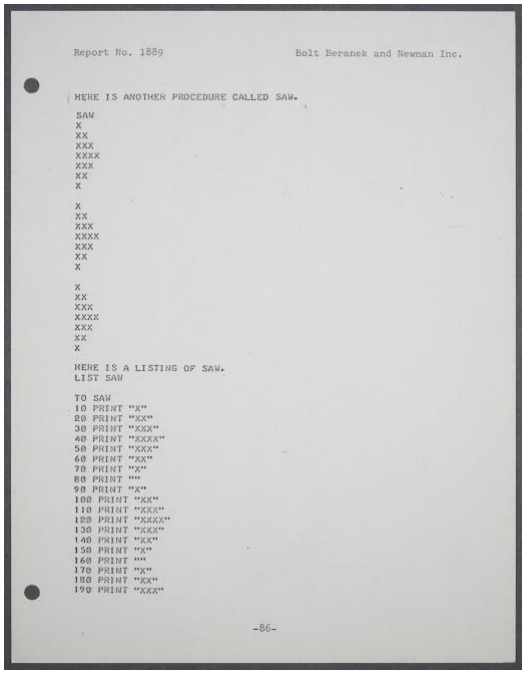
Some philosophers believe that proper functioning defines morphogenesis: the feeling of what it is like to undergo a malfunction (i.e., pain) is evidence, in perception, that meaning arises to guide organic form toward functional, goal-oriented assemblies of matter (Neander 2017). If so, then what is the meaning of this proper nonsense? If meaning arises during the assessment (immanent to feeling) of (dys)functional form, guiding beings towards purposeful proper functioning, then why do minds make a guile song of nonsense glee from improper use (Deleuze 1990; Tomlinson 2023)? We could functionalize play, saying that proper functioning requires that minds glimpse the terms of interactions, at a distance, via make believe (Bateson [1954] 1972). We could also see—without negating that function of play—the variation of ways as rooted in a time before such a meta-assessment of function has taken hold of thought, dancing instead in the delight of meaningful impropriety. Let us see this wavering unfolding in graphical appearance.

The usefulness of proper names in indulging this glee seems quickly to have expired, displaced as letters became graphical tokens used to stock registers with moveable bits: "they all liked to make big ones" (Feurzeig et al. 1969, 61). In the descending and ascending edge generated by the program, "Saw," LOGO fills and empties registers with letters deployed by Jay as graphical tokens (86). Motion appears in the instant that words predicating me (I am a boy) are loosed from the grips of linguistic community, departing to instead bind logic, word, and storage into a "pattern-making procedure" by which the appearance of a rhythmic pulse, both organic and mechanical, takes hold of the work of computation (Figure 3) (186). What was the meaning of this paper-screen appearance of the unfolding of a form? It meant that the elemental form of recursive circling to nullity and back, open and shut with each return to debugging and building up bigger and bigger models—departing from coding into thinking, for a moment—had entered the interpretive field opened by programming and screens, children and computers, and ideas about what event in the mind was dignified by that word, *fun*.

Code "as a 'black box,'" a prominent group of LOGO coders explained, is never absolutely closed: "We are not at that moment concerned with *how* the procedure computes its results, only with the fact *that* it computes" and so "how" can be "suppressed": boxed, for now (Abelson, Sussman, and Sussman 1996, 26). The authors of that statement, Harold Abelson and his colleagues, built up from basic geometric "primitives" a library of functions for drawing two-dimensional polygons to the vector screen of the PDP-11 computer or via the movements of a floor roaming "turtle" robot carrying a pen in its undercarriage (Papert 1973, 108). They elucidated the concept of a program that invokes itself using the example of a function that approaches an ideal circle with only incremental steps of angle and movement: "A particularly important way to make new procedures and vary old ones is to employ a program control structure called *recursion*; that is, to have a procedure use itself as a sub procedure, as in:

```
TO POLY SIDE ANGLE
      FORWARD SIDE
      RIGHT ANGLE
      POLY SIDE ANGLE
```

The final line keeps the process going over and over by including 'do POLY again' as part of the definition of POLY" (Abelson and diSessa 1981, 17) (Figure 4). If the programmer were to input the number 1 to the LOGO variables Side and Angle, then that number (as side length) and that same number (as angle degree) would conspire with the recursion line to form a minimal introduction to the origin of geometric transcendental ideas in LOGO: a perfect circle. In Papert's words, Poly was a programmable pathway to the Idea of the circle: a "direct aesthetic experience" of a "symbiotic relationship…of mutual exploitation" between "the aesthetic and the functional" that he claimed "opens mathematics to 'remembering' its genetic roots" (1978, 113, 118). Papert believed that these genetic roots run deep. He conceived of them as foundational operations used to define mathematical systems (as in the structural approach to modeling advocated by logicians), as items that could be selected as starting points for the design of libraries of functions (e.g., LOGO), and as models for operations that construct functions in actively conscious minds (i.e., models of himself).



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HERE IS ANOTHER PROCEDURE CALLED SAW.

```
SAW
X
XX
XXX
XXXX
XXX
XX
X

X
XX
XXX
XXXX
XXX
XX
X

X
XX
XXX
XXXX
XXX
XX
X
```

HERE IS A LISTING OF SAW.

```
LIST SAW

TO SAW
10 PRINT "X"
20 PRINT "XX"
30 PRINT "XXX"
40 PRINT "XXXX"
50 PRINT "XXX"
60 PRINT "XX"
70 PRINT "X"
80 PRINT ""
90 PRINT "X"
100 PRINT "XX"
110 PRINT "XXX"
120 PRINT "XXXX"
130 PRINT "XXX"
140 PRINT "XX"
150 PRINT "X"
160 PRINT ""
170 PRINT "X"
180 PRINT "XX"
190 PRINT "XXX"
```

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Figure 3. "Saw." Coding exercise from the classroom of Marjorie Bloom. Printout of LOGO code executed on PDP-11, 1968 (Feurzeig et al. 1969, 86). Courtesy of MIT Libraries, Institute Archives and Special Collections. Seymour Papert Papers, Box 16, (17b-18a), MC693.
Alt text: Image of a page from an archival document. The document reproduces the results of a procedure, named Saw, written by Marjorie Bloom's students. The Saw procedure uses the letter X

as input to a procedure much like Workless. Instead of diminishing to zero letters then stopping, saw stars from one letter X, adds another X, then another, until there are four X's. Then the procedure removes one X at a time. This loop, back and forth from one to four X's, creates an undulating line of triangular teeth, like the edge of a hand saw.

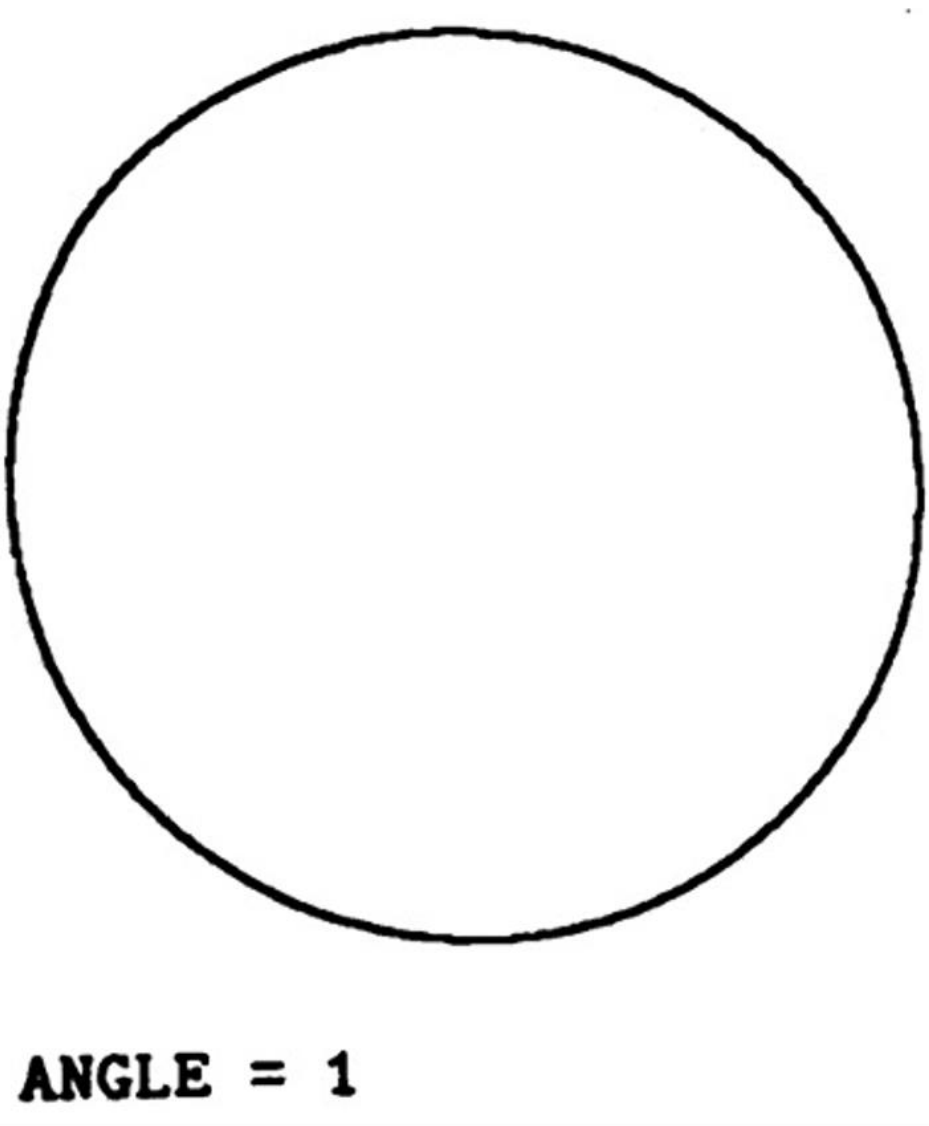

Figure 4. Harold Abelson and Andrea diSessa. Output of Poly with input 1 for Side and Angle. (Abelson and diSessa 1981, 17). Fair use.
Alt text: Image of a page from a LOGO textbook. A circle drawn by the Poly procedure is shown. The text "Angle = 1" appears below the circle. The author describes how the procedure draws the circle in the body of the text.

Let us now further recover LOGO's embeddedness in cybernetics for the sake of cultivating our sense that personal computers are bearers of a latent historicity of judgment's temporalizing power to bind ideas about formal variation into normative horizons hitched to specific functions. It is helpful to notice that Poly has already forced the storied philosophical questioning of time to shine through

screens as programmable geometricized light. Philosopher Catherine Malabou reminds us that the questioning of time is reoriented in every interpretation of the meaning of the "fundamental structure of before and after" (2016, 134). Code breaks up this problem by demanding that time be imported into thinking in the form of a dualism. Phrased philosophically, "the numbering of time"—its counting of steps within the loop of a recursion—"reveals the non-mathematicity of number" (134). Phrased computationally, in code, it is noticeable that operations and numbers stand apart: the operations are more purely math because they can be freed to work beyond the plugging and chugging of counted tokens.

The rendering of a graphical appearance is always limited by storage while that appearance can also be altered with a formalism that generates results in ways that conscious reflection, mensuration, and paper tools would not have allowed. But functionality is not guaranteed; it is limited by storage and validity while departing from linearity and consciousness as nested black boxes stack up in the background, guaranteed (if valid) and resisted (if not) by computability. The stuttering of graphical appearance bears functions' knotting of time.

In the case of Poly, the "omnitemporality" of the pure circle—that intuited form that supposedly exists beyond input to Side and Angle, though the function does not work without that input—is for minds only and is traditionally called *transcendental* (Derrida 1989, 39). Phenomenology asks whether this sense of beyond has truth by trying to discover the form of the genesis of that sense. As Derrida reminds us, paraphrasing Edmund Husserl, the phenomenologist asks: What "essential form becomes recognizable through a method of variation" (Derrida 1989, 123)? That question opens the pursuit of thinking without asking for conditions of the possibility of appearances (38–39). All searches for secure conditions run up against organic impairment and interference from the structure of time (Sterne 2022; Derrida 2011). Instead, phenomenological questioning claims that it is possible to await the form of the genesis of appearances by way of variation in reflection (Derrida 1989, 47). That task is fundamentally different from asking what mechanism makes an observed function possible. It generates observations of forms. Any formalized essence could (in principle) be unboxed into observable mechanisms, but understanding does not require that. For instance, in terms of the structural approach to modeling, there is not a unified, stable "internal essence" in question for any model—only "relationships" between elements grouped into "sets" defined by structures that persist under transformation (Fong and Spivak 2019, 24, 8). Those structures do not necessarily have material correlates. Reflection can resist the fall into the resolution of thinking by the satisfaction of mechanism. Refection can reorient toward the play of structure and essence. The circle is never perfect; its form of appearance is vague. Its edges must appear in time, refined as worn down, or be penetrated by an imagination of a microcosmic interiority sparkling on its surface (Bachelard [1948] 2011, [1958] 2014). So, I ask, what "vague essences" appeared, on screen,

by way of a coded circle that Derrida may well have said was "*essentially and not accidentally inexact*, and *therefore* also unmathematical," even irreverently "anexact" before pronounced "defect" in the passage to the limit of pure-then-blurred ideality partially freed of number but bound to voltages animating a phosphorescent screen (Derrida 1989, 122)?

Papert and Piaget both argued that there are different pathways to the realization of intuitions of the transcendent forms that govern the appearance of truths. The stakes of that claim cut to the heart of an eighteenth-century debate over a proposed link between the source of variation governing the formation of species and what Kant called "the mere self-development of reason" (Lenoir 1980, 98; Kant [1787] 1998, 629). Kant's view on the nature of the transcendental set the terms. Kant used the term *schema* to indicate the process by which transcendental regulators of thinking maintain themselves as "garbled" presences in organic matter ([1787] 1998, 629, quoted in Malabou 2016, 164, 164-65). He claimed that the transcendental is a set of guidelines for thinking, embedded in organisms, that nonetheless are "complete in time, although they all had their schema, as the original germ, in the mere self-development of reason, and on that account are not merely each articulated for themselves in accordance with an idea but are all in turn purposively united with each other as members of a whole in a system of human cognition" (Kant [1787] 1998, 629). Malabou explains that Kant used the term *purposiveness* as an organic analogy to purposeful, goal-orientated functioning in animals. Kant likens the assembly of functions in the mind to teleologically oriented organic growth and claims the regulation of that assembly process (by the invariant original germ of systematicity) as both universal and subject to contingent realization (Malabou 2016, 165). Michel Foucault tried to establish a difference between an "historical *a priori*" and "formal *a priori*" categories by showing that humans seek out contact with the latter by exteriorizing logic into material operations performed using instruments and words (Foucault 1972, 127, quoted in Malabou 2016, 107). However, thought, in time, makes of itself an object; it can shift orientation by way of acts of reflection—it has no inner essence, after cybernetics, only varieties of primitive function reigniting the unfolding of structure down a priori pathways. Externalization became a mental function. Interiority moved outside, into the cybernetic wild. While it is certainly possible to constrain computation to the functions of prediction, optimization, and automation—nesting it in preexisting technological pathways and data structures—the passage of time's enigmatic relation to form into a new medium may forestall any hasty resolution of the meaning of both mind and computation by human purpose; if we learn to sense its opening of time for shifting ways.

Autism had been important to Papert's early efforts to assert the scientific and philosophical significance of programming because autistic students were evidence that this hypothetical variety of ways exists not only as a variety of

formal systems (as Kurt Gödel established) but also in the variation of biological and social processes that build and rebuild minds (as Kurt Goldstein had argued) (Papert 1963, 137). Autism was evidence that the transcendental regulation of mental form is a genuine historical process, operating both in the mind, on screen, and in the school system.

By synthesizing Papert's interest in Kant with the search for a definition of the historical a priori in continental philosophy, my point is that, for Papert, there was more at play here than simply redefining the nature of the garbled *a priori* as a new model for autistic minds. Before the mental process of programming came to provide an experiential analog for the haphazard biological assembly of functions, inside the head, the word *autism* meant something quite different. Historian of medicine Bonnie Evans (2017) provides a detailed account of this shifting meaning of autism in her analysis of British child psychology case histories. Her focus is mainly on the inter- and post-war years. Piaget plays a strong role in the narrative. Piaget hypothesized that overactive mental image production prevented children from "orienting" their minds by consciously differentiating between two kinds of mental process: mental processes provoked by things in themselves and mental processes generated by the autonomous activity of the psyche. For Piaget, the discoveries he made in the experimental classroom (substantiating his assertion of the reality of these two processes) could only be summarized by him in terms of a peculiar "diversity of form of equilibrium between the two processes" ([1937] 1977, 275, 274). While autism still bore the weight of a definition by way of the negation of a capacity to gain such powers of orientation, for Piaget and LOGO's designers there was, nonetheless, an epic void opened by the question of what epistemic values could tame these cyber-metaphorical renderings of the process of mind formation. Filling that void began by proposing meanings via readings of codes that generated elementary graphical animations—not by refining a model for deficient attainment of a necessary condition.

The Poly procedure became the new KeepRosemarieing during LOGO's tenure as a prominent introductory programming language (throughout the 1970s and 1980s), starting with Papert and engineer Cynthia Solomon's 1971 memo "Twenty Things to Do with a Computer." That text still bears strong traces of Papert's preoccupation with philosophical psychology. He included a section suggesting that programmers start by coding up their own versions of the Müller-Lyer illusions, as he had done in Geneva (Papert 1961; Piaget and Papert 1963; Papert and Solomon 1971). Piaget and Papert had imagined that new ways to control and present these diagrams on screens, as squares of varying position and size, would assist in the narrative characterization of the "schema" underlying the nonconscious synthesis of the visual field (1963, 353). Another group of LOGO coders, from the Bionics Laboratory at the University of Edinburgh—who would initiate the first experiments with teaching LOGO to autistic students—suggested a simple model of the physics of bounce as an introductory LOGO thing

(Goldstein and Goldstein 1972). The Bionics Lab's bouncing ball also fits this same narrative of screens designed to meet the background of thought halfway. They ported a classic oscilloscope training exercise—immortalized by the video game *Tennis for Two*—into LOGO because physics models and mental models were meant to be mutually reinforcing instances of this interplay of reciprocally corrective internal and external logics (Papert 1973, 80; Lowood 2009, 13). Paul Goldenberg, of Bolt, Beranek, and Newman, translated Poly for the special needs classroom and presented photos of LOGO geometries as evidence of learning facilitation for a nonverbal student (also named Jay) with cerebral palsy. Jay encapsulated his feelings for "Moms" and "Dads" in Poly (1979) (Figure 5). In the glide from philosophical speculation on functional form to functional programming imported into clinical contexts, Papert's theorization of LOGO as a new contact point with the mathematical unconscious tantalized the corporate executives at Xerox Corporation.

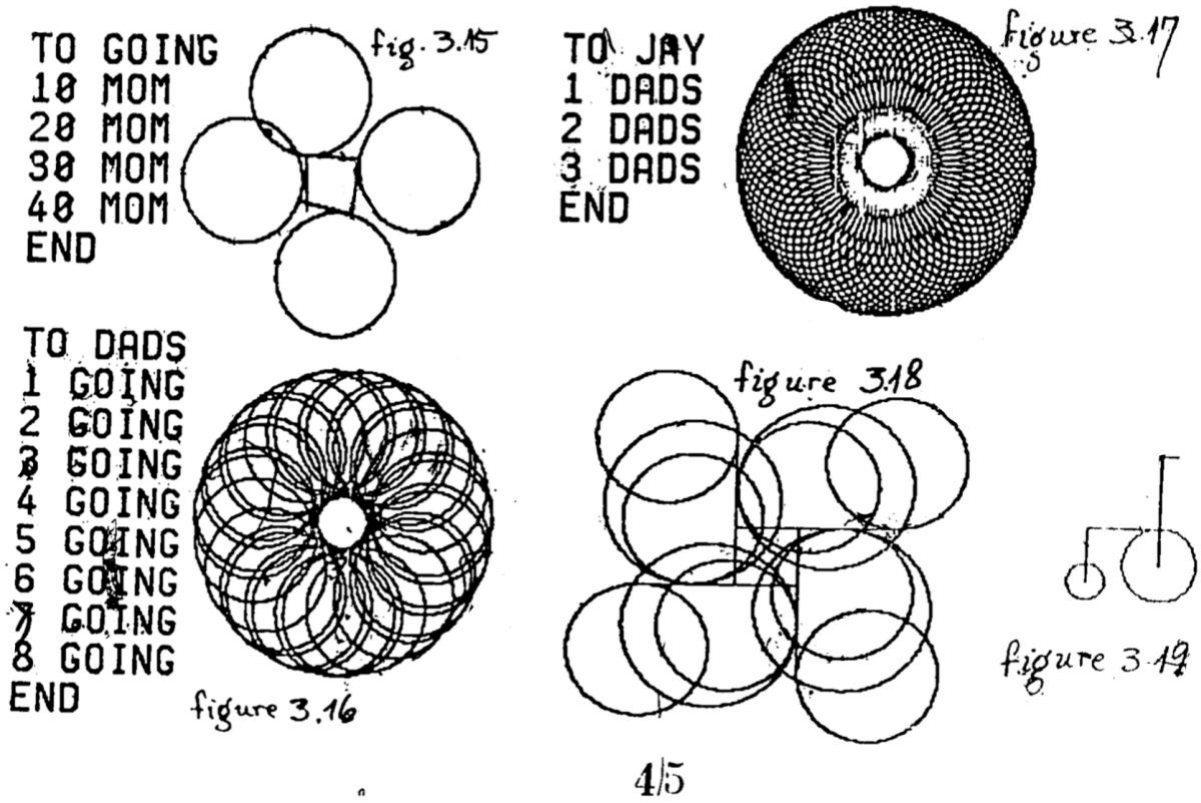

Figure 5. Jay's naming conventions for Poly, 1977. Fair use.
Alt text: Image from an academic book about teaching LOGO to special needs students. The image reproduces LOGO geometry figure made using the Poly procedure. Four abstract geometric patterns are shown, all of which are composed rings made of circles. One ring is only composed of only four circles while two others are composed of many more, creating a pattern of arcs formed by the overlapping shapes. The author of the procedures (a student also coincidently named Jay) used the words "Dads" and "Mom" and "Jay" to name the functions that generate the circles.

Xerox executives gave programmer Alan Kay—a close associate of Papert's—freedom to build a prototype personal computer: the famous Alto workstation. Programmer Adele Goldberg designed the Smalltalk '72 language, with Kay, for the Alto. The sine qua non of personal computing, for Kay and Goldberg, was a graphical surface on which any term could be highlighted and interpreted. Menus popped out from any bar of highlighted text, revealing the code underwriting that textual appearance in an editor. In Smalltalk, a programmer could call a "turtle" function with a "Smiley" icon command (Goldberg and Kay 1976, 3, 16). To enter the smiley icon into an executable Smalltalk command, "hold 'SHIFT' and the '2' key" (16). That symbolic shortcut generated a geometric origin. Encapsulated in the iconic smile, overwriting or revising menus and windows (willingly or not) unfurling lines issued from this generative point (Goldberg and Kay 1976, 16; Ingalls 2020, 7). With the smiley turtle command in play, the functional surface would be layered over with each new whim to sketch out a different set of inputs to a variation on the Poly function, from random walk tracks to Hilbert's space-filling curves (Figure 6). Kay gave explicitly media historical reasons for this strong design choice to foreground a tension between functional rectilinearity and the elegance of geometries driven by modern logic: "They [computers] are clearly more than a tool also, though in typical McLuhanesque fashion, much of their content has been adopted from previous media, and their own attributes are just beginning to be discovered" (1972, n.p. [3]). Without the forced association of iconic happiness with layered modifiability and unfurling polygons, new beginnings (without the burden of past infrastructures of formatting and ontologies of objecthood) would be compromised—written out of history at the inception of a devious form of questioning that would have demanded a rethinking of the nature of computation before it became a receptor for investment in textual and audio-visual functionality. Kay seemed to have been touched by the need to protect a kernel of nonsense from a future that already did not respect it: "It may seem almost sinful to discuss the simulation of nonsense" names, shapes, and screens, but "it is just this realm of apparent nonsense that must be kept open for the developing minds of the future" (1977, 244).

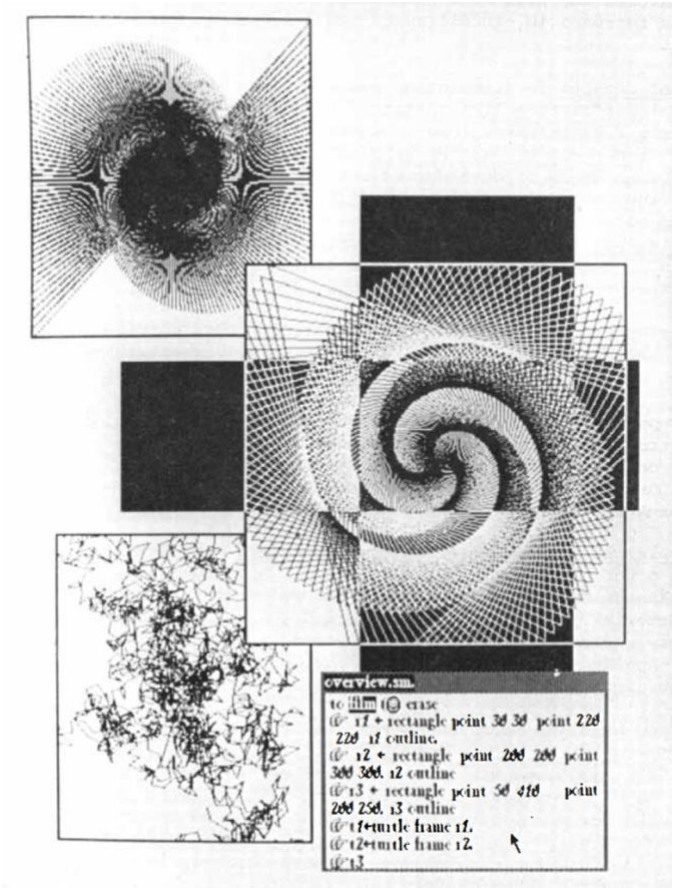

Figure 6. A screen photo by Kay used to demonstrate layers of code, boxes, and turtle geometry (Kay 1977, 244). Fair use.
Alt text: Image from a magazine article showing a screen photo of a graphical user interface written in Smalltalk '72 and running on a Xerox Alto. Visible are the tangled, wandering lines of a random walk program and geometric designs based on the Poly procedure. Also visible is a coding environment at the Smiley command. There are boxes bordering the designs as well as a layering of black and white rectilinear forms.

By 1975 photos of almost blank screens from Kay's lab circulated in *Creative Computing* magazine. One article showed screen photos of programs by Marian Goldeen—eighth grade, Jordan Junior High School, Palo Alto, California—that display functionality common to illustration software of the 1980s (Figure 7). In a series of process shots, leading up to a polygon drawing tool, a motionless square appears at the center of a graphical programming environment. The smiley command was a clone of the LOGO geometry drawing system for the PDP-11. Now, a rectangle function, named "square," had replaced the freedom of the frameless point in LOGO: "I don't know what the boys in the class did, but Colleen and I created a painting program" (Goldeen 1975, 42). LOGO's story suspends such functional boxes in the moment before their becoming interfaces. In that moment, screens remain contestable receptors of possible functionality, soon to be caught in the series of hylomorphic palpitations called coding. Sustaining that moment of release, reticence toward cybernetic model work appears in the

archive. "Every computer program is a model," Abelson and company explained, "hatched in the mind, of a real or mental process" (1998, xi). The search for reasons to want to make computing productively unfriendly pushed LOGO researchers into the special needs classrooms to find, there, evidence that their model-making exercises made models in minds flourish, like an unfurling polygon. Let us withhold assent to the "charismatic promises" lurking in this moment of hypnotization by the constructivist's big idea: LOGO opens a new, more accessible way to link your mind to transcendental form by way of coding recursive geometry graphics (Ames 2019, 9). Instead, we now read only those passages that give us glimmers of what autistic students brought to the stage during their encounters with graphical screens and mind modelers.

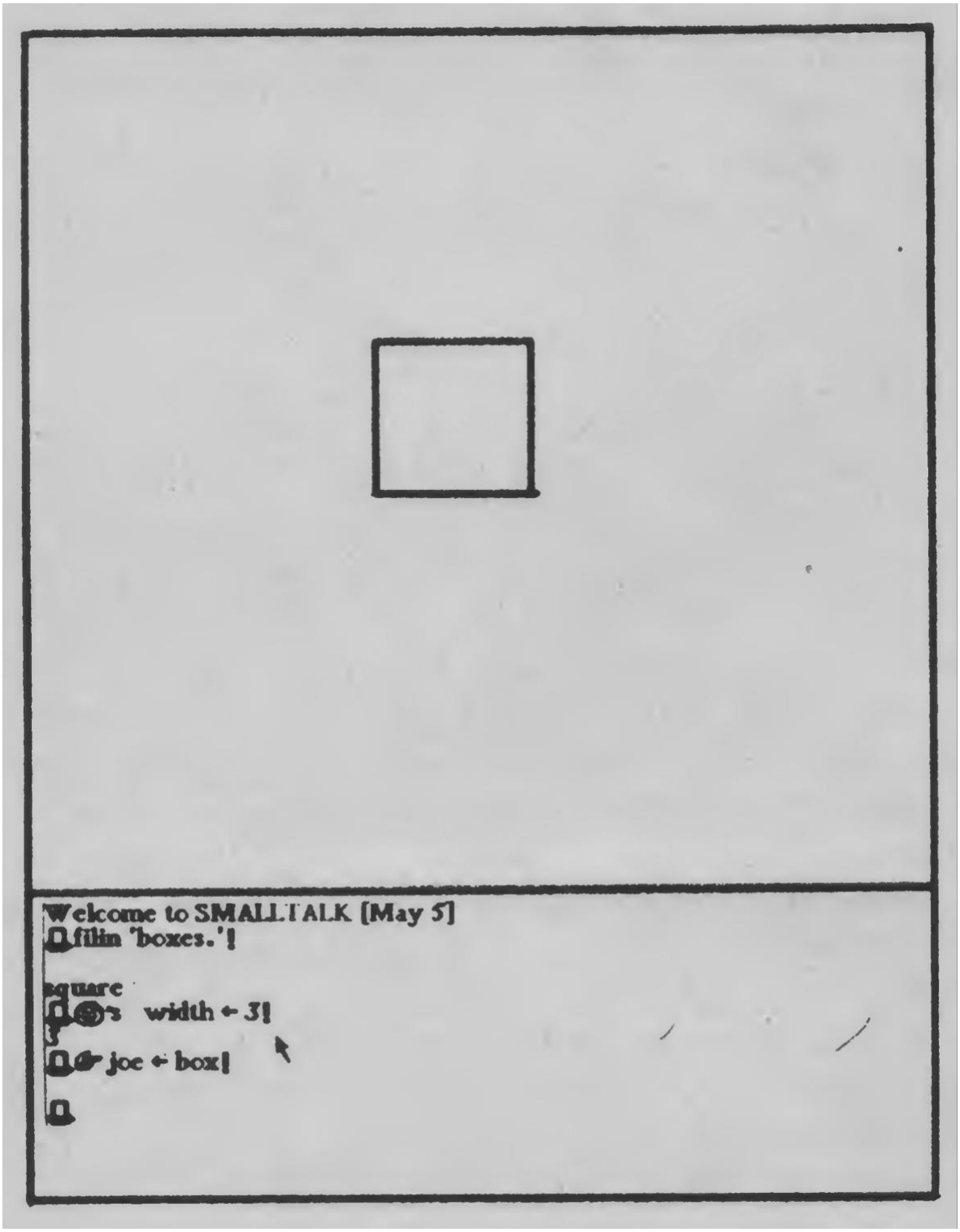

Figure 7. Marian Goldeen. Square drawn in Smalltalk '72. Smiley icon is visible on line four. (Goldeen 1975). Fair use.
Alt text: Detail of a page from a computer magazine. The image is described thoroughly in the preceding paragraph.

David's "Laigian Proportions," Joey's "Thank You"

Autistic students presented to Papert and his colleagues a way into a terrain of modeling and observation on which it was not only impossible to decide on the true model of mind but on which it also became imperative to further articulate the extent of the limitations of then-current approaches to the questioning of mind. Bionics Lab researcher Sylvia Weir would come to MIT in the early 1980s, having caught the LOGO team's attention in 1976 with an article titled "Catalysing Communication in an Autistic Child in a LOGO-Like Learning Environment" (Emanuel and Weir 1976). Documenting their work with seven-year-old David, Weir and her co-author cited British radical anti-psychiatrist R.D. Laing's book *Self and Others* when defining David's autism as "an evocation of models" operating "at several different levels" (Emanuel and Weir 1976, 126). At the time, Weir and her colleagues were working with students to code simple drawing functions. The primary datum of analysis that they derived from the experience was the incommensurability of their way of interpreting David and his way of interpreting them: "David's perception of the situation he was in, including objects and our behaviors towards him, our view of the situation and of David's behavior in it and our view of our perceptions and his perceptions – an interpersonal situation of truly Laingian proportions" (126).

Yergeau has elucidated that such situations force autistic people into confrontations with those who would justify their disqualification from possession of "purposive" and "symbolic" mental life by way of reference to their lack of "internal models or schema" of other people's minds (2018, 58, 42, 4–51). Though the theory of mind disqualification was proposed in 1985, Weir's work with LOGO presages these developments by suggesting that David did not "project" ideas of other minds into a social wold: he held back, held in, only switched between a "'passive pupil' role" and "'emotionally committed' role," paused before the symbolic event of "see-as" (Baron-Cohen, Leslie, and Frith 1985; Emanuel and Weir 1976, 120, 126). Weir repeats the phrase "*models of himself*" as a reading of David catching himself not quite seeing himself being seen while coding, never fully seeing others as people with minds of their own (Weir 1981a; 1981b; Emanuel and Weir 1976, 126). Her point of reference for the model of mind as the noninteraction of incompatible mental models is a 1973 AI Lab report by Papert.

In the AI Lab memos, Papert and Solomon hypothesize that student programmers work by "using himself as a model" (1970, 3). Their thinking worked like this: to learn how to write and fix programs, students could use flowchart bubble diagrams of linked functions to externalize and spatialize functions otherwise listed in strings of linearly organized code. Kay too picked up on this idea when he suggested that children would be able to use a "personal computer" to build up a "private cosmos" and compartmentalize, on screen, different aspects of their mental lives—including "reflexive communication of the owner with himself [*sic*]" and menus that organize repositories of small coding exercises

alongside messaging and word processing functions (1973, n.p. [2]). Modeling one's own thought through programming became a minor reading of the meaning of coding. That reading preceded a shift from the enigma of mind's form of historical being to the design of public meanings, hovering on screens, that, once assimilated to daily action, would eschew the question of the interpretability of anxiety in the face of inherently an exact purposiveness and the incommensurability of crisscrossed mental worlds opening a void of meanings latent in an unfathomed variety.

Another moment from the LOGO classroom can help elucidate the nature of the challenge to thinking posed by computation as a medium structuring reflection on the historical plasticity of finite mental growth and form. The context here is a Cambridge, Massachusetts, special needs classroom set up by a Bolt, Beranek, and Newman researcher, Paul Goldenberg, during the half-decade postdating the founding of the AI Lab in 1967–68. In a group ranging in age from four to fourteen, Goldenberg experimented with teaching autistic children to draw with a floor roaming turtle robot. Joey "an autistic adolescent…observed to be mute and assumed to be deaf, spoke his first words to a robot turtle" (1979, 75–76). Working on a LOGO geometry drawing, the words came when expressing his frustration at the behavior of a teacher operating a LOGO command needed to activate the lever that lowered an erasable marker to the linoleum floor beneath the robot turtle's undercarriage, allowing the creature to draw: "Down!" said Joey (Goldenberg 1979, 75). After returning the pen to the floor, the "words were muddier this time, but there was no question but that he had said 'Thank you.' Joey spoke his first words on videotape and then went silently back to pushing the turtle" (75–76). A reluctant thank you, a decisive command; perhaps even, in a glance, an archival residue of neuroqueer ephemera in the form of a well-muddled geometric primitive bearing forth the appearance in which "only a communal subjectivity can produce the historical system of truth" (Derrida 1989, 60). Is there a difference in kind between these difficulties and those of a normal student? How would that difference be claimed? Could you observe the neural network in question? Do you know its exact form, marred from elegance in the case at hand? Can you build a working model of it? No. Well, maybe. What is certain, I believe, is that to deliver this admixture of insistent negation and hesitant engagement with force and compassion, as I hear Joey doing, is a particular kind of historical act. Yergeau has theorized the nature of this form of difficulty, opening the possibility of encapsulating with the term *neuroqueer* an epochal fracture between the philosophy of mind and the unrealized historicity of anexact purposiveness embedded in screens and the cultural imaginary of coding.

Learning to dance avoidantly in the experimental theater created to verify models not grounded in listening to the subject of analysis, but rather oriented only by the desire for empirical validation of a technoscientific project, is an artform that I understand Yergeau to elucidate with their term *neuroqueer rhetoric* (2018, 56, 43–

51). Yergeau is concerned specifically with how the philosophy of mind has created the stage within which neuroqueer performers generate these truth abeyant procedures (68–72). And so, I describe the resistance of autistic children to theories of mind developed in LOGO coding classrooms *neuroqueer* without wishing to predicate David's or Joey's gender. As psychoanalyst and media historian Hannah Zeavin has shown, "queer" and "neurodivergent" children came into existence as a category of gendered subject position when cybernetic psychologists of family life proposed models of pathological psyche development, such as Piaget's theory of the failure to assemble orientation functions (2021, 54). Coder and media theorist D. Fox Harrell (2013) suggests the word *phantasm* to denote imaginative worldviews by which users and personal computers, software developers and coding environments, could form networks of relations not currently accessible by way of our interfaces, networks, and their quotidian presence as imaginary mental representations. If Tobin Siebers is right to say that disability theory is concerned fundamentally with the modes of aesthetic and ethical engagement that shape the politicization of "disability as a form of human variation" (2008, 25), my overarching aim can now be clarified: to show how the media history of computing can act as a "philosophical laboratory" where fundamental ontology and critical thinking work in tandem to construct the social, historical, and scientific base upon which such politicization could take shape (Sterne 2003, 27). Specifically, media history can contribute to the ongoing process of building "difficult, perhaps counterintuitive, coalitions across disciplines and sectors"—but how, exactly (Chun 2021, 27)? Take the term *construction*, for example. While Ames carefully brackets constructivist philosophy from her work (after explaining how Papert's and Kay's formulation of that concept contributed to the boy coder imaginary), it is also significant to note here that philosopher of science Isabelle Stengers has asserted that rethinking "constructivism" ought to be considered a core objective of the humanities (2014, 19). Stengers's contention is that rediscovering the substance of constructivism could modify the meaning of critique for humanists, dispelling the popular notion that humanists have become entrenched institutionally in a "polemical network" founded on the critical consensus that concepts and institutions that mediate social life are "merely" constructed (11–21). Queer feminist philosophers of science have pointed toward the life sciences as one way to substantiate talk of construction, modifying that function by identifying how physical constraints on biological and mental life generate non-gender-aligned psyche and sociobiological forms that resist the subsumption of binary sex categories to any single kinship structure or division of reproductive labor (Haraway 1991; Butler 1993; Kirby 2011; Wilson 2015). Ethnographers and theorists of digital culture have discovered that suffering induced by digital-cultural phenomena calls for emancipation from extractive encroachment on neurological and mental worlds (Schüll 2012; Chun 2016). Even if Alexander Galloway (2012) is right to assert that software overrides the necessity of questioning the truth of what an object truly is—simply replacing that urge to regulate a fit between categories and things with

the satisfying success of operationalized data—vital forms would still resist these impositions, making organisms signal stations calling out for the regulation of informatic ontologies. Does life really resist the burden of ontological claims made in software? It can. I think. But there is an elusive coalitional we that must learn to listen for the appearance of formative resistance in a contestable quotidian of malleable models of mental morphogenesis.

The autistic children that Papert and his team engaged with left traces of such formative resistance. Under pressure from cybernetic model work, their mental life had become almost thinkable and remained unimaginable in the same situations. Moten might call these neuroqueer performances the rhythm of a "repercussive revision," operating within "socioaestehtic activity," that calls upon a particular "sound and movement or, more precisely, a kind of audiotheatricality that is the essence of political consciousness" (2018, 168–69). Philosopher of science Gaston Bachelard thematized this oscillation in the powers of judgment, caught up in the flow of their synthesizing objectivations, using the word "*recursion*." With that term he defined a "permanent process of rectification and reorientation," "unfolding within scientific activity" a sense that "an ongoing tribunal of rectification" is always precariously underway (Bachelard 1987, 298, quoted in Rheinberger 2010, 29). Resistance to preemptively resolved models sustains something: a persistent questioning of the urge to maintain the unresolved for the sake of the already-established form of functioning. What is the nature of the form in time of an a priori guided by something as changeable as purposiveness, embedded in a network of observers tinkering with modifiable functions, temporalized by recursive layers of reflection oriented now by perception, now by reason, now by a resistance that touches the present from a void?

In answering these questions, scientists, philosophers, and coders will need to inhabit the temporal form of a danger structured by the devious question: How and why do minds form in time? Black studies scholar Therí Alyce Pickens describes the model of "linear progressive history" that dominates the definition of Blackness and autism (2019, 96). Humans influenced by this implicit temporal schema will tend to posit an "end of time" wherein, after having raised the value of Blackness and neuroatypicality (through technological intervention), those categories will cease to exist (112). In theory, within this framing by "ableist assumptions of 'mind,'" possession of coding skill would open the naming of autism as disability to critique only by way of valuing autism as productive of a natural affinity for computation (7). Autism, if subsumed by an imaginary of white boy coding, would encapsulate the meaning of computation in the economic value of that specific ability. Pickens elucidates how resisting schematization by the meaning of progressive time takes form, in Black speculative fiction, as an aesthetic tension between "psychosocial definitions" and "biomedical definitions" of madness (4). David and Joey, in the moments of broken silence and silent

dissent, contribute to academic reflection on the conceptual elbowroom that their sustaining of these tensions created. Their presence in the archives opens the possibility of cybernetic "folktales" that refuse "overcoming narratives" and "reconciliation narratives" (71). We must learn to refuse the cognitive rationalization of involvement in computation in terms of a temptation to reconcile with or liberate others and ourselves by way of computation. That refusal, I suggest, could help the us of this article understand our resistance to that temptation "as a systematic structure of meaning-making that is always unfinished or in process" undergoing a change of ways (Pickens 2019, 71, quoting Smith 2012, 55). The we this article constructs might also learn, from the modification of temporal rhythm created by such moments, how to sustain caution in all allisions to resistance. Naming resistance deposits responsibility for radical action on the shoulders of those whose lives show us the variable meaning of time (Pickens 2019, 58). In other words, to claim that neuroqueer rhetoric is a form of resistance is to risk demanding of autists "radicality"; furthermore, to discover in the structure of the form of time a resistance not from a thing-in-itself but from epistemically significant affects arising from the formal structure of temporalization is to forge intellectually (from the lived reality of duress) a certain "creative purpose" (Pickens 2019, 64; Whitehead [1929] 1978, 248, quoted in Manning 2017, 110). A deeper understanding of the force of recursive rectification to reorient could attune us towards difficulty understood as path-finding reticence that uncouples function coming-into-being from assessment equipment that forecloses the "elliptically open" pathway to the construction of new forms (Pickens 2019, 63). Let us now channel through the archive our understanding of difficulty's unfolding.

Yergeau partially conceptualizes "*neuroqueer*" motion through Malabou's notion of "plasticity" (Yergeau 2018, 71, 74–76, quoting Malabou 2008). Specifically, Yergeau narrates how autistic performances have at work in them an expansive notion of "entelechy" that "explodes" the questioning of "purposiveness" (Yergeau 2018, 71, 74–76, 211). In the moment that denizens of the parallelism encounter autistics, the noncommunication of mental interiority forces the theory of "intentionality" (as the inner essence of mental acts) to confront the meaning of intersecting finitudes incapable of fully capturing any intention for inspection (Yergeau 2018, 32, 35-43). The finitude of mind (a fragile form on the edge of the impairment of its unfolding schema) meets the finitude of understanding (thinking caught up in an open chain of elegance, operation, witnessing) in situations where defiance of the preemptive resolution of the psychophysiological parallelism rebounds to Laingian proportions, both within and between minds. With specific reference to the situation of being observed by thinkers of the parallelism, Yergeau repeats, "to be clear," their concepts and movements are rhetorical resistance to the structure of theory of mind, the search for autism's "etiology," and the disqualification from symbolism (2018, 15, 52, 70). *Authoring Autism* posits no absolute negation of the possibility of an etiology for autism but

rather formulates how neuroqueer performance is "resistantly elliptic" to the danger posed thereto by necessarily dualistic questioning of the parallelism (173). "I cannot stop Melanie-ing in the same way that I cannot stop breathing" (211). KeepRosemarieing. By simulating Weir's gaze into David's glare (which Weir cannot see as not lacking in the very moment she is awestruck at the depth and complexity of what Moten might call a "rapt countenance"), could this narration of that situation help media historians of computing rediscover "ephemera of neuroqueer histories" that index a formative reticence, before tomorrow—before preemptive predication of a vague essence by "*functional assessment*" of atypical students and model users, alike, recycles for another generation (Yergeau 2018, 211, citing Muñoz 2009, 65; Moten 2003, 32–34; see also Pow 2019)?

Casual readings of the meaning of purpose and model, just after the cybernetic moment, are precisely what overwrote the neuroqueer, defining it as a "failure to arrive" at a cogently grounded orientation: a "cognitively purposive standard that even neurotypicals don't stand up to" (Yergeau 2018, 42, 58). While early cognitivists admitted that "nobody has had any idea" what mechanisms underlie autism, they still took the displacement of how from questioning (as afforded scientific legitimacy by elegant cybernetic models) as license to disallow such models in the minds of autistic children (Baron-Cohen, Leslie, and Frith 1985, 38). Papert saw this happening in the misapplication of Piaget to education. Papert had stated, in a 1973 National Science Foundation grant, that "we"—the AI Lab's LOGO Group—"see much of the 'Piaget and Education' community as standing him on his head by emphasizing the negative aspect of his work, namely his demonstration that children of certain ages have surprising 'deficiencies' (which some say should be 'remedied' by the schools)" (1973, 51). Papert understood his work on LOGO as a venture propelled forward by a context of technical inquiry in which screens and new programming languages promised a new future for computing, like that prophesied in Goldeen's paint program. The context of intellectual inquiry he had inherited (the debate over the relation of mind to brain that demanded immediate revisions to the diagnosis and treatment of autism) forced him to conceptualize screens as interventions into the neurophysiological ordering of an item of staggering philosophical complexity: the inherent ambiguity of purpose. The anexact meaning of the appearance of purposiveness is a phenomenological clue. The secret of morphogenesis is constantly preemptively resolved by the normativity that arises from the form of thought for humans: the lapse into generative dualism and the recovery into historicizing reflection called forth by diffusive resistance.

These are cybernetic situations worth remembering as specific instances of the appearance of a neuroqueer resistance of the object, even as the lure of charisma still lurks in the background of my presentation of these moments. It is all too easy to circulate Papert's reading of LOGO as a generator of signs of promised correction or coding as gateway to social justice via experimental digital

pedagogy, as Christo Sims (2017) has documented. Whether a promise of communicative gains in autistic students, or improved test score and college admissions rates, LOGO could still be used to define normative spectra—now with coding and not-coding at its poles—that mark out any elliptic refusal with a presumption that the story of noncommunication, or nonengagement with computation, requires evaluation and special placement. What about the narration of the temporalizing form of satisfaction that obtains in those "desirously queer" insistences that a "residuum" that "resists" announces that it will always remain unexplored in any medium (Yergeau 2018, 57; Malabou 2016, 109)? The variational primordium embedded in that radical doubt—the new meaning of transcendental, for Malabou (2016), is residuum that resists—is part of the phenomena to be more fully elaborated in reflection; its under-thematization having already structured the tensions in a plastic media-historical a priori that governed the form of this origin story, shaping its time into a now-necessitated resistance to the untruth carried by the already-here graphical user interface. David and Joey reluctantly sustained their nonfit in what for Papert became a master reading of coding: a support structure that presumes its efficacy as a mode of accommodation while also leaving the form of its conditions of historicity lingering in need of troubling. Yet LOGO's prehistory has introduced a garble of workable reticence into the media history of computation: may cybernetic model work get stuck in ambi-valent oscillations whilst our recursive rectification of the concepts of purpose and function learns to sing code neuroqueer. Abhor best fit between data, network, interface, and object before their phantasmal medium has been raised to the status of a reflection on their manifestation of layered histories. A narrative lesson issues from rhythmically riven mind: rectify learn.

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