Remaking Intelligence? Of Machines, Media, and Montage

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Abstract: Over the last decade, there has been a renewed interest in "artificial intelligence" (AI), notably in the form of "machine learning" (ML). This renewed interest may seem paradoxical, insofar as John McCarthy introduced the term "AI" in the mid-1950s to mark a distinction with ML, championing deductive reasoning over automated induction (e.g., Cardon et al. 2018). By contrast, the current reversal, towards ML-based forms of "AI," marks the statistical, if not spectacular, revival of automated induction. However, the terms used – revival, renewal, reversal – beg the question of the *common ground* of the involved alternatives. Taking its cue from recent historical (e.g., Penn 2020), relevant conceptual (e.g., Shanker 1998), and prior critical (e.g., Agre 1997) inquiries, this paper outlines a praxeological answer to the raised question. For the purpose, the paper develops a practice-based video analysis of a recent demonstration of "machine intelligence," the video demonstration of an "agent system" playing *Breakout* at "superhuman level," if not opening the gate for the advent of "general AI" (Hassabis 2017). In examining and engaging in "remaking intelligence" *in situ*, the paper dwells on the tricky interplay between machines, media, and montage, while making explicit and reflecting upon how particular configurations of "enchanted determinism" (Campolo and Crawford 2020) are staged and locally performed.

Keywords: artificial intelligence; breakout game; common ground; machine learning; practical reenactment(s); video demonstration.

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1. Introduction: The "Iceberg" Question – Is There a Common Ground to AI and ML?

In a recent talk on the intricate history of contemporary AI, a renowned sociologist elaborated on the paradoxical revival of "machine learning" (ML) as the currently dominant paradigm in the field, a field whose name – "artificial intelligence" (AI) – was precisely coined back in the mid-1950s to promote a deductive, rationalist paradigm to rule out prior empiricist efforts at inductive, example-based ML. Taking a historical stance, the sociologist paused on the argumentative pattern of the "perceptron controversy" from the late 1960s onwards, regarding the logical (im-)possibility of automated ML-based "image recognition" (e.g., Olazaran 1996), while interspersing his talk with epistemological considerations, among which the double meaning of "probability," statistical and psychological, as discussed in Hacking (2006[1975]). I hadn't read Hacking's book, *The Emergence of Probability*, but still needed to discuss the sociologist's argument, as the "discussant" of his talk[1].

Eventually, the talk I had listened to inspired me a question along the following lines:

> In his major work from 1983, *Representing and Intervening*, Hacking stages the controversy between Carnap and Popper in a long 30+ page introductory chapter only to conclude it, if I remember correctly, by the observation that their epistemological disagreement marks an Iceberg of common assumptions, notably their shared neglect of experimental practice, Hacking's topic. Hence my question: isn't there something similar going on in the history of AI? Doesn't the controversy between "deductive" AI, as pitched in 1955, and "inductive" ML, as pushed today, presuppose a common ground? What "common ground" is it? And how "deep" does it run?

In response to my question, I noticed a short silence, followed by a swift change in topic. The question, it seemed, had just triggered a "not now, not here" (Garfinkel 1975) phenomenon. In hindsight, the conspicuous silence may also be treated as constituting an inspiring starting point for multiple research directions, including the continuing challenge to write an encompassing history of AI/ML (e.g., Engemann and Sudmann 2018; Haigh 2021; Plasek 2016), the empirical interest of a "sociology of testing" in a field where the means of testing (e.g., data sets, algorithms, infrastructures) are often difficult to access, let alone replicate (Heaven 2020; Marres and Stark 2020), and a niche for "critical making" initiatives to tinker with, if not "rebuild" AI/ML-based systems (e.g., Bogers and Chiappini 2019; Lake et al. 2017; Sormani 2020). Rather than calling for a swift change in topic, the observed silence invites a sustained yet different line of inquiry, too[2].

This paper, accordingly, first pauses on the "Iceberg" question and two historical answers to it, material and conceptual, before explicating the alternative assumptions of its praxeological respecification (Section 2). On this basis, the paper then develops a practice-based video analysis of a recent demonstration of "machine intelligence," the video demonstration of an "agent system" playing the game *Breakout* at "superhuman level," if not opening the gate for "general AI" (Section 2). In probing this video demonstration, an episode of "remaking intelligence" *in situ*, the paper dwells on the tricky interplay between machines, media, and montage, while making explicit how particular configurations of "enchanted determinism" (Campolo and Crawford 2020) are staged and locally performed. In conclusion, the praxeological respecification of "enchanted determinism" as a *situated* production will be reflected upon, as part and parcel the examined "singularity moment" (i.e., when the newly developed *Breakout* program was shown to surpass human play)[3].

2. Background: Historical and Praxeological Answers to the "Iceberg" Question

If the literature that traces AI/ML in terms of controversially opposed positions is well established, if not redundant (e.g., Minsky and Papert 1969), historical studies that chart their *common ground* and, in that sense, offer a history of "machine intelligence" seem to be rarer. This section briefly presents two such studies. On the one hand, *Inventing Intelligence* (Penn 2020) offers a richly documented inquiry into the material aspects shared by the founding figures of AI/ML in the USA of the 1950s and 1960s. On the other hand, *Wittgenstein's Remarks on the Foundations of AI* (Shanker 1998) clarifies the formal assumptions of Turing's program of "machine intelligence," the program that underpins the mainstream of AI/ML research (from the 1950s onwards, if not to the present day)[4].

Inventing Intelligence (Penn 2020) bears on the following "material aspects" of the joint emergence of AI/ML in the USA of the 1950s and 1960s:

- First, the major lines of research by the founding figures of AI/ML in the USA (including H. Simon and A. Newell, J. McCarthy, M. Minsky, as well as F. Rosenblatt) all relied on *military funding* – substantial, sustained, and at times unconditional. In one case (Minsky), the stop of unconditional funding allegedly led to the end of AI research (Penn 2020, 184-185).
- Second, and along with crafting (computer) code, these lines of research all implied *political sociologies* (Penn 2020, introduction). For example, H. Simon and A. Newell's rules-based AI took inspiration from a model of "rationalized administration" (cf. Simon's *Administrative Behavior* originally published in 1947), while F. Rosenblatt's probabilistically operating ML saw, not only in the abstract neuron, but also in the "free market" an inspiring analogy (Penn, ibid., Chapters 2 and 3).

- Third, the promise of "machine intelligence" seemed all the more realistic as the research teams by the founding figures of AI/ML all set out working with the same *mainframe computer*, "IBM 704" (Penn, ibid., p. 129), the company's first commercial computer facility that allowed them to variably explore and exploit the "novelty of computing as a digital medium" (ibid., p. 204).

Taken together, these aspects of emerging AI/ML research may be considered *material*, insofar as they facilitated such research "to get off the ground" in three respects at least: economical, ideological, and instrumental. Conversely, Shanker's book, cheekily entitled *Wittgenstein's Remarks on the Foundations of AI* (1998), clarifies the "formal assumptions" of AI/ML's common ground, Turing's program of "machine intelligence." For the purpose, Shanker leverages Wittgenstein's conceptual critique of Turing's program (as notably articulated in his 1937 essay). Each of Wittgenstein's critical points makes explicit one of Turing's assumptions, assumptions that may be listed accordingly:

- First, Turing's program of "machine intelligence" assumes the possibility of *mechanical reducibility* – that is, intentional conduct (such as "thinking," "calculating" or, say, "reading") is reducible to causal mechanisms, despite the normative terms (e.g., "rules," "norms," "reasons") that ordinarily characterize such conduct.
- Second, *computational complexity* is assumed to define intentional conduct as an emergent property – that is, there is a computable "learning continuum" from simple mechanisms to (human) everyday activities, "higher forms of learning [being] built up out of simpler components" (Shanker 1998, 65).
- Third, *mathematical formalism* is supposed to inform the mechanist reduction as well as the claimed emergence of intentional conduct, regardless both of the everyday use of mathematics ("in *mufti*", Wittgenstein 1956, Part 5, §2) and its normative character (i.e., in terms of "rules" or "subrules," not mechanisms or feedback loops).

Taken together, these *formal assumptions* of machine intelligence linger on in current forms of AI/ML as their common ground, at least as part of the common ground for their controversy narrative – for example, the idea of the "learning continuum" grounds both "ML" (as an inductive operation proceeding from "simpler components") and "AI" (as the deductively defined "higher form"). The same point holds with respect to the *material aspects* of AI/ML, insofar as current research continues to rely on substantial funding, ideological arguments, and/or instrumental infrastructure (for a recent study of continued military involvement, see Suchman 2022)[5].

Yet the regularly overlooked common ground does not tell us how it is drawn upon *in situ*, let alone how "enchanted determinism" (Campolo and Crawford 2020), as one variation or contingent imbroglio thereof, is performed via a technology demonstration. The open question points to the phenomenon studied in the next section. As a praxeological respecification, the study homes in on the demonstration of a *Breakout* program playing at "superhuman level," while proceeding from two alternative assumptions. First, the study assumes the *irreducible practicality* of its situated phenomenon in the following sense:

> invariant rules [e.g., formal assumptions] and material elements can only account for the fact that the possibility of concrete sense-making [e.g., a technology demonstration] is conditioned and subject to limiting conditions. However, formalities and materialities are thereby not sufficient conditions, but only necessary conditions [for sense-making to take place], which always presuppose specific ordering work but do not explain it (Waldenfels 1985, 26; our translation).

Second, and in describing how the technology demonstration is done *in situ*, the study nevertheless assumes that something can be learned from the demonstration's practical accomplishment (the "specific ordering work" alluded to in the above quote) with respect to the *historical contexts*, material and/or conceptual, that it presupposes – be it to have them changed, re-instantiated, or modulated in a particular way. Praxeological respecification, in that sense,

> [does] not deny the historical and social "contexts" in which social action and interaction take place; rather, [it] insist[s] that specifications of such contexts are invariably bound to a local contexture of relevancies (Lynch 1993, 125).

3. Example: A Praxeological Study of/as "Remaking Intelligence" *In Situ*

> Each technique [in AI] is *both* a method for designing artifacts and a thematics for narrating its operation (Agre 1997, 135; emphasis added).

This section presents a practice-based video analysis of a recent technology demonstration, the video demonstration of a computer program playing *Breakout* at "superhuman level" (see Hassabis 2017, and note 7, below). Drawing upon the analysis, reenactment, and reanalysis of the video demonstration, the praxeological study engages with "remaking intelligence" *in situ*, both as a topic *and* a resource. The video demonstration, through the reflexive analysis of its montage, will be probed *topically* – that is, the analysis will show how the news announcement conveyed by the demonstration of the *Breakout* program – "it did this amazing thing, it found the optimal strategy" (Hassabis 2017) – relies upon particular configurations of "enchanted determinism" (Campolo and Crawford 2020). In turn, the reenactment of the video demonstration, drawing upon "remaking intelligence" *in situ* as a methodological *resource*, will allow us to tease out the "myriad of contingences" (Maynard 1997, 98) whose tacit mastery the persuasive delivery of the news announcement relies upon. In so doing, the video analysis explicates how a particular genealogy of "machine intelligence" is folded into the video demonstration, while charting to what rhetorical effect its formal assumptions and material circumstances are deployed[6].

3.1 Analysis

In the video demonstration, Demis Hassabis, introduced as the "Co-Founder and CEO of *DeepMind*" (see shot 1), presents a computer program as an "agent system" and "AI" which, thanks to research and development (R&D) at the *DeepMind* company, has "succeeded in playing" *Breakout*, a video game from the late 1970s and early 1980s, at "superhuman level." How does Hassabis pitch his presentation? And how does his pitch appear convincing? *That* there might be a persuasion problem can already be gleaned from the vocabulary used to summarize the gist of the video demonstration. Indeed, the terms used – "agent system," "succeeded in playing," at "superhuman level" – all draw upon the questionable *formal assumptions* (i.e., mechanical reducibility, computational complexity, and mathematical formalism) and characteristic *material aspects* (e.g., a particular funding, organizational, and computing infrastructure) of "machine intelligence" – that is, as its necessary common, yet impossibly sufficient grounds. How then does the montage of the video demonstration solve (or dissolve) this persuasion problem? The transcript-assisted video analysis in this section offers a two-part answer to this empirical question. First, it examines how and what "ordinary circumstances" are configured for the news announcement to appear credible (3.1.1). Second, it takes a closer look at the "news announcement" itself by explicating its sequential organization (3.1.2)[7].

3.1.1 Configuring the ordinary circumstances of the news announcement

Breakout is at first sight a "highly straightforward video game" (Reeves et al. 2009, 207). Developed and marketed in the late 1970s and early 1980s by *Atari*, the video game has more recently become a test-bed for probing and improving ML algorithms, if not demonstrating "AI" as an emergent property of their successful testing. The video demonstration of present interest also relied upon this R&D strategy, a strategy whose (computer) scientific success had also been reported in a previous peer-reviewed publication (Mnih et al. 2015). Not all viewers of the video demonstration, let alone the documentary movie in which it figures, could and can be assumed to be computer scientists or regular readers of *Nature* though. Hence, the sole announcement of the *Breakout* computer program having "found the optimal strategy, which is to dig a tunnel" (see Excerpt 1, as indicated by white arrow) may fall short of its intended news value, as a convincing demonstration of cutting-edge AI, achieving "human-level control through deep reinforcement learning" (Mnih et al. 2015) or somehow even going beyond "human-level control" (as we shall see shortly).

	DH*	**it found the optimal strategy, which=**
18 (2:45)	DH*	**+is to dig a tunnel** +((close-up shot on "breakout" game, with ball bouncing up and down between walls)) +((computer music gets faster)) ♫♫♫… ♫♫♫… ♫♫♫ **#18**

#18 ((close-up shot on "breakout" game, with ball bouncing up and down between walls))

Excerpt 1. News item in video demonstration, as stated by Demis Hassabis (shots 17-18). (Transcript prepared by the author)

As other performative expressions, news announcements only work under "ordinary circumstances" (Austin 1962, 52) as convincing communicative moves. The video demonstration may first be examined for *what* circumstances it (re-)configures and *how* it does so to convey its core message. In the transcribed fragment (see Appendix I), these circumstances are configured in familiar terms, as the autobiographical reflections of a successful entrepreneur, where the image of the latter (identified as "Demis Hassabis, Co-Founder & CEO [of] DeepMind," shot 1, video column) and the expression of the former (in the first person singular, "when I was a kid, I loved playing games", ibid., audio column) elaborate each other. Accordingly, Hassabis' arrival at the conference venue (at "Oxford University, UK," shot 2) is not only shown and told as the culminating part of his extraordinary career as a child prodigy (starting "off with board games like chess," having become the "Co-Founder & CEO [of] DeepMind"), but this culmination is also suggested to have been informed by a major insight all along: "computers were this sort of magical device that could extend the power of your mind" (shots 3-4). Taken together, these material aspects of "enchanted determinism" (i.e., regarding the male child prodigy turned successful contemplative entrepreneur) set the stage for the video demonstration of "machine intelligence" in the form of a particular news announcement: the *Breakout* program's "optimal strategy," if not its "potential for general AI" (shots 17-19)[8].

3.1.2 Drawing upon the sequential organization of the news announcement

To whom was the "news announcement" made, the announcement of the new *Breakout* program's performance at play? On the basis of the transcribed fragment (in Appendix I), two audiences can be identified: the intended audience of the documentary movie as part of which the video demonstration is shown (i.e., *AlphaGo. The Movie*, Krieg and Kohs 2017), the audience present at Hassabis' Oxford University lecture which included the video demonstration of the new *Breakout* program to begin with (as shown in shots 7, 9, 10, etc.). A singular achievement of the movie's montage, then, is the production of a seamless articulation of scenes and sounds for these two publics to be addressed or at least shown to be addressed (a point we shall return to, see our reenactment and reanalysis sections below). In any case, the video demonstration addresses a broader audience (be it at home, in and/or via the lecture hall) than a specialist readership in science or computer science (e.g., as addressed by Mnih et al. 2015). How, then, does the documentary video's montage allow us, as a projected community, to:

> see through [our] cultural knowledge [and to] understand the filmic image and sequence […] in much the same way, and by reliance on the selfsame resources that we use to understand the perceptual world around us, a perceptual world of activity and interaction (Jayyusi 1988, 272)?

In answer to this question, the present section examines how the news announcement of the stunning performance of the new *Breakout* program – "it did this amazing thing, it found the optimal strategy" (Hassabis 2017) – was delivered. As we have seen, the entrepreneur's autobiography, if setting the stage for the news announcement, wouldn't be sufficient to convey it. In turn, the transcribed fragment (in Appendix I) allows us to examine how the news announcement of the program's "optimal strategy" is actually delivered, with particular reference to the interactional resources that the "sequential organization" of its delivery relies upon[9].

Notice that the news announcement in question is not only progressively delivered (audio column, from shot 9 onwards), but also shown as it is being fulfilled (video column, from shot 11 onwards). Moreover, the successive shots, organized in terms of as many "say-shows" (Garfinkel 2002, 177), articulate a particular "news delivery sequence" (Maynard 1997). From ordinary conversation, the sequence borrows its constitutive parts: an announcement, followed by its response, an elaboration, and a final assessment (ibid., p. 97). Yet the parts are not distributed as reciprocating turns at talk, as in conversation, but across the successive "say-shows" that compose the video episode.

Accordingly, the "announcement" is first stated ("so I'm gonna show you a few videos of the agent system, the AI," shots 9-10, audio column), for the viewer then to be enabled to reach a first "response," at home or in the local audience (as a male public member is shown to pay close attention (shot 10, video column)). The subsequent "elaboration," then, suggests that not only the "agent system has to learn everything for itself" (shot 12, audio and video column), but also that its performance, after having become "after three hundred games […] about as good as any human can play this" (shot 15), eventually surpasses human play by doing an "amazing thing" (shot 17) – that is, finding the "optimal strategy, which is to dig a tunnel" (shots 17-18, including a close-up, as shown in Excerpt 1 above).

Finally, and after having drawn laughter from the audience (shot 18, audio column), the "assessment" of the performance is left to the speaker (Demis Hassabis, as shown in shots 19-20) for contrasting qualifications – that is, as an expression of the limited *Breakout* skills of his "AI developers," on the one hand (shot 18, audio column), and the instructive "potential for general AI," on the other (shot 19, audio column).

Taken together, these interactive moves and their audiovisual montage foster "commitment evaluation routines" (Lampel 2001, 304), rather than a questioning stance or critical inquiry, regarding the presented technology and its discursive framing. In a nutshell, a second configuration of "enchanted determinism" is the manifest result (i.e., regarding the *Breakout* program's "potential for general AI," shot 19, calling for a "next step now," shot 20)[10].

3.2 Reenactment(s)

In the "perceptual world of activity and interaction," to use Jayyusi's felicitous phrase (1988, 272), conversationalists "shape each component [of a news delivery sequence] according to a *myriad of contingences*," as Maynard points out (1997, 98; emphasis added). The tentative reenactment of the video demonstration of the "singularity moment" – the moment at which the newly developed *Breakout* program was shown to surpass human play – allows us to tease out (some of) its critical contingencies – that is, contingencies which proved critical to articulating that news item in the first place (i.e., by Demis Hassabis, as shown in the Oxford University lecture hall, as staged and seen in the documentary movie). Yet different reenactments allow one to tease out different kinds of contingencies. This section presents three sets of them (see "reenactments A, B, C" below), before considering them as an ensemble of "tutorial problems" (Garfinkel 2002) for *reanalyzing* the initial transcript in the next section, including the "critical" or "incidental" character of the contingencies identified (i.e., as constitutive of the "ordinary circumstances" of the news announcement)[11].

3.2.1 The classic "home console" reenactment (A)

In 1983, the book *Pilgrim in the Microworld* was published, D. Sudnow's reflexive ethnography of playing *Breakout* at arcade halls and with home consoles (see Appendix II). As a later review puts it,

> Sudnow becomes his phenomenon: he hangs around arcades, plays the game with his children, and for long, long hours immerses himself in playing game after game of *Breakout*. His focus is on how an array of moves develop and build on one another through long-term play. (Reeves et al. 2009, 209).

Long-term play? In this respect, Sudnow's ethnography makes three interesting observations, as its author develops and deepens his "video skill" at and with his home console (as a "re-enactment" of the video game as first observed to be engaged in by his children, friends, or other aficionados at play).

First, Sudnow's reflexive ethnography offers a succinct characterization of the *overall goal* of *Breakout*: "The overall goal, fat chance, is to eliminate the entire barricade until paddle and ball are all alone in empty court, victors" (Sudnow 1983, 35). Second, the book indicates the best *opening move* to reach that overall goal:

> the immediate object is to chip through to the open space on the other side, and once you've made this Breakout the ball rebounds like crazy between the far wall and the band [of bricks] […]. (Sudnow 1983, 34; see Fig. 1)

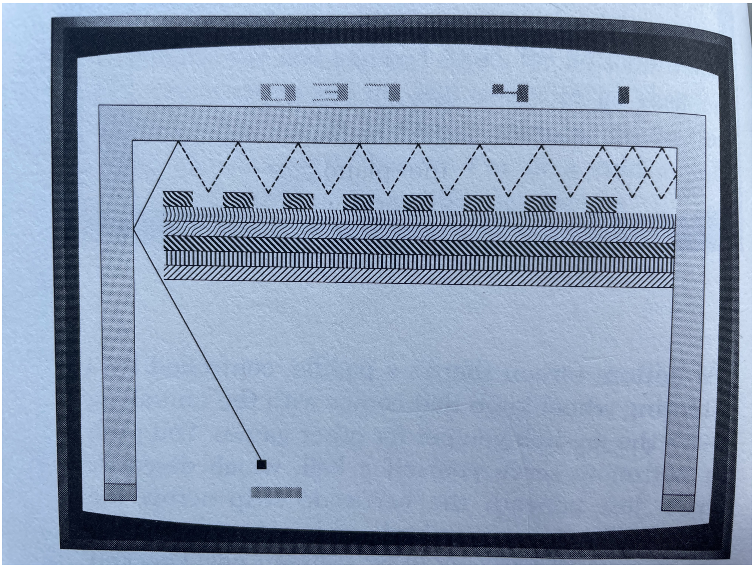

Figure 1. The best opening move in and for playing *Breakout*. (Photograph taken by the author)

Third, the book explains that the overall goal, despite or precisely because of sustained and skillful play, is often *not* reachable. "Lockups" are the result, which Sudnow describes as follows:

> With nearly nothing on the screen, the ball gets into a triangular pattern [sic] so immobile and regular you could take your hand off the knob [i.e., joystick], walk away for a week, and come back to find it just where it was. (1983, 85; see Fig. 2, ibid.)

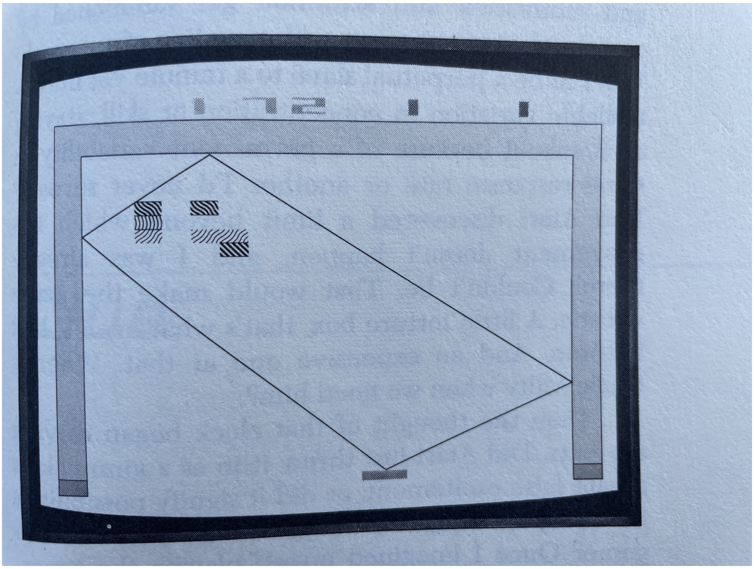

Figure 2. The unreachable overall goal in and of playing Breakout. (Photograph taken by the author)

Taken together, these three observations invite us to re-examine the video demonstration, its initial transcription (as to be found in Appendix I), as well as its transcript-assisted video analysis. Before doing so, let us consider two more recent reenactments of the video demonstration, however[12].

3.2.2 A contemporary "Zoom lecture" reenactment (B)

In a recent "Zoom lecture," I decided to reenact Hassabis' video demonstration by misreading its initial transcript as a roleplay script, while presenting the *Breakout* program to the remote audience by holding my laptop computer in front of the camera. The result: a deliberately "poor image" (see Fig. 3). Any lecturer with similar equipment could have done the reenactment, a possibility highlighted by the black-barred eyes (ibid.).

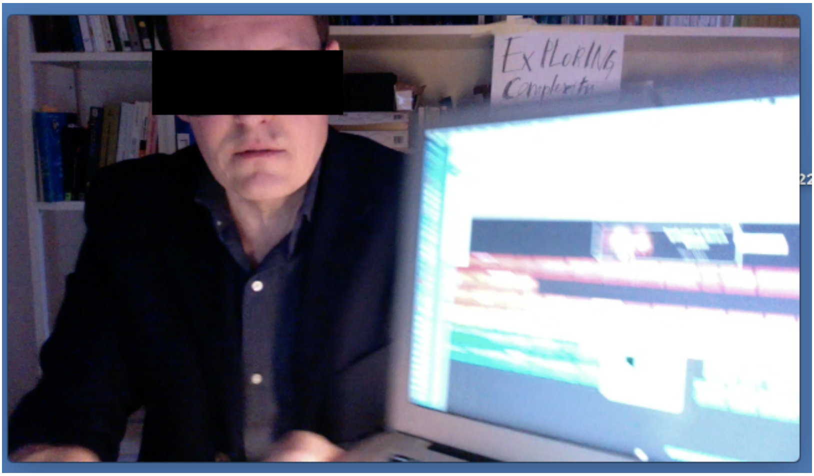

Figure 2. The "Zoom lecture" reenactment in and as its "poor image" (Steyerl 2010). (Screenshot taken by the author)

The laptop screen showed the *Breakout* program. I also had put up and redrawn the conference poster, entitled "Exploring Complexity," which was to be seen next to Hassabis during his video demonstration at Oxford. Some classic music found on the internet rounded off my "Zoom lecture" reenactment of Hassabis' demonstration. Both despite of and due to these practical efforts, my reenactment encountered innumerable problems of "say/show" coordination, some of which we shall draw upon in the reanalysis of the initial transcript, too (hence the allusion to the *deliberately* "poor image").

3.2.3 The museum "game station" reenactment (C)

At a local museum of cultural anthropology, I noticed that a *Breakout* "game station" had been installed (see Fig. 4 below) as part of its current AI exhibition. What for? The installation served two purposes at least. First, it offered a stepwise explanation of "reinforcement learning" by using the *Breakout* program as a paradigm case to illustrate the progressive improvement of such machine learning (that is, "from one day to another," rather than in terms of "hundreds of games"). Second, the installation invited its user to press "start" and use the "joystick" to play *Breakout*, if only to eventually contrast his or her expectably "slow play" with the rapid moves of the program (as shown during the "reinforcement learning" explanation).

Figure 3. The *Breakout* "game station" as installed at the museum. (Photograph taken by the author)

On both counts, the installation not only took its cue from Hassabis' video demonstration, but it also turned his persuasive argument into a lived experience, the lived experience of *failing* against the seeming superiority of the machine – that is, the *Breakout* program which was shown to master the game on-screen (as in Hassabis' demonstration) in contrast to the somewhat clumsy moves that were only possible to be played with the joystick due to its slow "reaction time" (as part of the museum installation). However, this and other handicaps proved heuristic, when it came to reanalyzing the initial transcript of the video demonstration.

3.3 Reanalysis

The news announcement of the computer *Breakout* achievement drew upon a sequential organization from ordinary conversation, while building upon the prior depiction of its "ordinary circumstances" (including the male child prodigy turned contemplative *DeepMind* CEO, his interested audience, the spectacular lecture hall, and so on). The ensuing reenactments of the *Breakout* achievement and/or its video demonstration had me pause on (some of) its/their critical contingencies. In what sense do they afford us with "tutorial problems" for reanalyzing the video demonstration? In answer to this question, it is worth revisiting the demonstration's initial transcript in the light of the encountered contingencies, if only to assess the manifest contribution of their practical mastery to the video demonstration (e.g., "critical" or "incidental")[13].

What more is to be learned from Sudnow's reflexive ethnography of *Breakout* (A) on Hassabis' video demonstration? In a nutshell, Sudnow's classic "home console" reenactment challenges Hassabis' video demonstration both in its premises and conclusion. To begin with, Hassabis not only characterized "games [as] very convenient in that [many of them] have scores" (shot 7, audio column), enabling the "easy […] measure[ment] [of] incremental progress" (shot 8, audio), but also identified *Breakout* as an exemplar of this type of game. In turn, Sudnow's reenactment calls into question this twofold premise. First, Sudnow does not report his playing experience in terms of "incremental progress" (e.g., reaching an average player's skill after "three hundred games," shot 15), but as part of a uniquely qualifying situation (setting out with "one evening," Sundow 1983, 35). Second, if the "overall goal" (Sudnow, ibid.) of *Breakout* could be expressed by an optimal "score" (Hassabis, shot 7), that doesn't mean that this optimum can or could be "easily" measured, let alone reached. To the contrary, Sudnow's eventual mastery of *Breakout* led to "lockups," the repeated production of ball trajectories around remaining ceiling or wall parts still to be removed. A never-ending game was the result[14].

Returning to amateur play may then challenge the video demonstration's conclusion, the presentation of the new *Breakout* program as demonstrating a "potential for general AI" (shot 19). In turn, the presentation may be re-inspected for how it was delivered to make that conclusion plausible. This seems to have been done in three ways at least. Crucially, the opening move in *Breakout* as ordinarily played – the game's "immediate object" (Sudnow 1983, 34) – was cast as the program's *final* discovery – this "amazing thing […] it found the optimal strategy" (shots 17-18). Retrospectively, this discovery was suggested to be the result of "very easy to measure incremental progress" (shot 8): not only was the overall goal of the program simplified – from "eliminat[ing] the entire barricade" (Sudnow 1983, 35) to "break[ing] through this rainbow-colored wall" (shot 11) – but the pursuit of this simplified goal was shown to be "easy to measure" (in swiftly stated numbers of games played, shots 15a and 17a, and corresponding progress, shots 15b and 17b). Prospectively, the demonstrated discovery was suggested to have taught the "optimal strategy" of *Breakout* not only to the broader audience (via a close-up shot, see shot 18, video column, and Excerpt 1), but also to "amazing AI developers" themselves (shot 18), thus suggesting "potential for general AI" (shot 19)[15].

What more is to be learned from the "Zoom lecture" re-enactment of *Breakout* (B) and its "game station" installation at the museum (C), respectively? These two reenactments highlight two complementary sets of "ordinary circumstances" that the news delivery of the *Breakout* program and its "potential for general AI" hinges upon.

On the one hand, the misreading of the transcript as a script – to reenact the scene and setting of the *Breakout* program demonstration via a "poor image" (Steyerl 2010) strategy – cast into sharp relief not only that scene and setting as the background of this demonstration as its figure (including the "taxi ride" to the prestigious location, "Oxford University, UK," and the spectacular lecture hall), but also how the "figure-background" pair is assembled through its audio-visual montage: through a quick alternation of wide-angle and close-up shots (1-17), diversely accentuating the oral presentation, via multiple camera shots, and culminating in the close-up shot of said "optimal strategy" (shots 17-18). The montage, in a nutshell, both shows and dramatizes "the way things work from the inside" (Wieder et al. 2007, 249). Upon re-inspection, however, the quick alternation of shots also becomes of critical interest, insofar as it makes disappear the lack of diversity of the lecture audience (indeed, the audience seems to be composed of male members only, an arguably select "computer science" audience)[16].

On the other hand, the installation of the "game station" at the museum required its visitors and potential players to use the joystick to play *Breakout*. As I engaged in playing, the installation seemed to operate like a "one-way mirror." While it progressively produced the appearance of the *Breakout* program's transparent operation (as I was shown its improved play on the screen, similarly to Hassabis' video demonstration), the installation left in the dark how it entailed simultaneous player incapacitation (as my *Breakout* moves were made difficult due to the slowly reacting joystick). The latter provided an embodied, material condition for the former operation to become visible, if not credible. The initial video demonstration may be reexamined accordingly. While it draws upon the formal assumptions of "machine intelligence" (mechanical reducibility, computational complexity, mathematical formalism), the demonstration conspicuously leaves in the dark the material conditions for them to operate so transparently (i.e., as shown via the short video, demonstrating the excelling "agent system" via the simple *Breakout* interface, yet passing over the technical details of its operation)[17].

4. Conclusion: Beyond "Enchanted Determinism" – Yet Another Ambivalent Hybrid

This paper first reminded readers of the *common ground*, both conceptual and material, of AI and ML, a common ground that may be traced to Turing's program of "machine intelligence," on the one hand, and to the shared efforts of AI/ML research in the USA to engage in "(re-)inventing intelligence" via computer programming in the 1950s and 1960s, on the other. How is this common ground brought to play in a *current situation*? In answer to this question, the paper developed a practice-based video analysis of a recent demonstration of an "agent system" excelling at *Breakout*, the *Atari* video game from the 1970s/1980s, and thereby potentiating "general AI" (Hassabis 2017). In addition to a detailed transcript, three *contrasting reenactments* of the video demonstration were drawn upon to explicate how its scenic plausibility was achieved. In the process, I described successive configurations of "enchanted determinism" (e.g., a child prodigy turned contemplative CEO, the agent system's "general AI" potential), while embedding the analyzed sequence of news delivery in its "ordinary circumstances" (e.g., an Oxford lecture hall, a simplified game, a select audience, mostly male). The praxeological description, then, suggested how the video demonstration of the new *Breakout* program framed its "deep learning" (or "reinforcement learning") achievement in the terms of lingering 1950s AI convention, both formal and material (e.g., a game-based "human-machine" comparison, in addition to the initially mentioned terms)[18].

However, the latter suggestion may be discussed further. Therefore, we shall reflect on "enchanted determinism" as a *situated* production – that is, as part and parcel of the peculiar "singularity moment" that this paper just described.

On the face of it, the presently analyzed, reenacted, and reanalyzed video demonstration of the *Breakout* program appears as a telling instance of "enchanted determinism," as indeed "magical mystery and technical mastery curiously work together" (Campolo and Crawford 2020, 4). Not only the initial allusion to computers as a "magical device [extending] the power of your mind" (shots 3-4) already nurtures this impression, but also the careful montage of the video demonstration suggests this conclusion, where the expression "careful montage" alludes to the persuasive demonstration of having the *Breakout* program appear as an "agent system" (shot 9), excelling at *Breakout* (shots 17-18), and showcasing the "potential for general AI" (shot 19). Indeed, the video demonstration borrows a longstanding framing of AI (i.e., the game-based "human-machine" comparison), while gesturing at its particular operation in terms of "machine learning" (ML, measuring the "incremental progress" from training session to training session, shots 12-18) with the help of a simple interface (i.e., the game interface of *Breakout*). Hence also the possibility of identifying multiple configurations of "enchanted determinism"[19].

Yet the observed multiplicity also hints at a more intricate genealogy of "machine intelligence" than its dualist AI/ML controversy narrative suggested, a dualist narrative which the notion of "enchanted determinism" seems to echo (if only insofar as "enchantment" presupposes its disenchanted opposite). Interestingly, this more intricate genealogy is to be found across STS and computer science. Indeed, not only the history of STS approaches to AI is full of ambivalent hybrids, *aka* "human/machine mixings" or "sociomaterial assemblages" (e.g., Suchman 2008), but so is the history written by AI researchers themselves – canonical (e.g., McCarthy et al. 2006[1955]) or critical (e.g., Agre 1997). The canonical project grouped diverse approaches to "machine intelligence" under the contested label ("AI"), while the critical approach teased out the philosophical rhetoric folded into technical practice(s).

Against this backdrop, the "singularity moment" described in this paper appears as the contingent introduction of yet another ambivalent hybrid – that is to say:

> the *general* intelligence that is put to test is modelled after a very *specific* and singular understanding of what human intelligence involves. It universalizes the idea of a player programmed into [a] 1980s Atari video [game] and restricts the task of an agent to outperforming this benchmark. (Bruder 2021, 80; emphasis added).

However, this peculiar hybrid not only confronts us with "a radically provincial idea of human creativity, intelligence, and ability," an idea borrowed from Western "video game design" (ibid.), but it also rehearses an older trajectory, trope, and trick:

> not one of rupture but of *remaking* – a [yet again] recalibrated "origin" of AI that re-contextualizes research fashions [e.g., "neuroscience"] in relation to local contingencies [e.g., video gaming]. (Penn 2020, 199; emphasis added)

– at least for now.

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Notes

[1] Empirically, the sociologist's talk was firmly rooted in digital data, reminding me of A. Rouvroy's nostalgic observation: "knowledge is not produced *about* the world anymore, but *from* the digital world. […]" (2013, 147).

[2] In the vein of recent IT developments, it has become common currency to pitch new types of ML (in particular "deep learning") against older forms of AI (prioritizing "intelligence simulation"), be it in terms of "human-aided" or "beyond human" types of ML (e.g., Fazi 2021; Mühlhoff 2020). For a longitudinal bibliometric study of the AI/ML controversy, see Cardon et al. (2018).

[3] In their recent paper, Campolo and Crawford (2020) introduce "enchanted determinism" as a sociological gloss to discuss the paradoxical rhetorical "enchantment" of ML (i.e., in terms of "magical powers" or otherwise unexplainable forces) *at the very moment* of its successful statistical operation (i.e., via determinate, if not deterministic, procedures of mathematical optimization). In turn, this paper examines the suggested paradox in and through the mentioned "singularity moment," while drawing upon prior work on technology demonstration (e.g., Lampel 2001; Reeves et al. 2016) and computer advertising (e.g., Aspray and deB. Beaver 1986). For a recent "state of the art," see Rosental (2021), and from a media historical perspective, Natale (2021).

[4] On the emerging domain, with a particular focus on the UK, see already Fleck (1982).

[5] In turn, Fazi's conceptual discussion of the "paradoxical condition of logico-mathematical abstraction" (2021, 70) in current ML systems, the condition of both relying on and going beyond human abilities of computation, echoes Wittgenstein's critique of Turing's program (see, again, Shanker 1998). Hence, "enchanted determinism" (Campolo and Crawford 2020), and "deceptive media" (Natale 2021) more specifically, may be understood as part of, and pragmatic responses to, that paradoxical condition.

[6] The video analysis, in addition to its transcript-mediated character, will draw upon reenactments of the analyzed demonstration below (in Section 3.2). This additional move defines the video analysis as a *practice-based* one, while making possible a reanalysis (see also Sormani 2016, 2019), if not a critique (e.g., McHoul 1994). Excerpts in this section are taken from and refer to the transcript of the video demonstration (in Appendix I). The video demonstration is included in *AlphaGo. The Movie* (Krieg and Kohs 2017), a documentary movie which showcases the development of *AlphaGo*, a successor program to the presently examined *Breakout* playing program (e.g., Binder 2021; Mair et al. 2021). Both programs were developed by Google-owned *DeepMind*, a London-based company specializing in "neuroscience-inspired AI" (Hassabis et al. 2017).

[7] The video analysis focuses on the *Breakout* demonstration as it is shown in the documentary movie (Krieg and Kohs 2017). For its initial presentation, as part of a *Nature* journal article and an invited lecture at Oxford University, see Mnih et al. (2015) and Hassabis (2016), respectively.

[8] As Hassabis is still shown to be arriving at the conference venue (shots 5-6, video column), his lecture is already to be heard (ibid., audio column). Why? Note that the initially audible part of the lecture follows his audible reflections in the first person singular. A smooth transition is thereby suggested between his autobiographical reflections on "board games," "computers," and so on (shots 1-4, audio column), and the R&D activities of the company that he has been shown (in shot 1) and will be heard to represent: "virtual environments and games […] we [at DeepMind] think they are the perfect platform for developing and testing AI algorithms" (shots 5-6, audio column). For further analysis along these lines, see Wieder et al. (2007, 254-255).

[9] This sequential organization appears to be a regularly used conversational resource in technology demonstrations – hence the possibility for the present analysis to draw upon prior analysis (e.g., Sormani 2019). Perhaps because of its mundane character, the sequential organization of news delivery has largely escaped the rich literature in STS on technology demonstrations (e.g., Rosental 2021).

[10] Instead of "focus[ing] attention on problems and limitations [or elaborating on factual information], *commitment evaluation routines* […] focus on the achievements and future potential of the new technology" (Lampel 2001, 304; emphasis in original). Conversely, one may ask: "But what form of intelligence is this" (Bruder 2021, 79)?

[11] Garfinkel's rationale for attempting to (re-)enact Galileo's "*inclined plane demonstration*" is worth quoting in this respect: "The experiment on which we report was set

up, not to figure out how Galileo's experiment did work but rather to discover what would make it *not* work, what contingencies would lose the phenomena. Because these would then be *[critical] contingencies* that Galileo would have to have taken into account. And indeed when you find out what they are, you can see that certain features of the design of his experiment are designed to take those contingencies into account" (Garfinkel 2002, 264, note 2; emphasis added).

[12] For a reedition of Sudnow's 1983 *Pilgrim*, see Sudnow's 2020 *Breakout*.

[13] In *Ethnomethodology's Program*, Garfinkel (2002) characterized its studies' "results," empirical and pedagogical, as "tutorial problems" (p. 145) – that is, as problems which disclose "members' discipline-specific procedures," on the one hand, and lend themselves to be discussed with practitioners (*aka* "members") "tell[ing] me [the analyst] what I'm talking about" (ibid.), on the other.

[14] Technically, the "optimal strategy […] to dig a tunnel around the sides" (shots 17-18) may constitute a further case of "specification gaming" (Krakovna et al. 2020), insofar as that *Breakout* strategy allows a player to maximize the score, yet without finishing the game. For further discussion of this "flipside of AI ingenuity," see Krakovna et al. (2020) and Bruder (2020:78-81). I shall return to this argument in the conclusion.

[15] This suggestion, again, was made without showing how the *Breakout* program reaches its overall goal to "eliminate the entire barricade" (Sudnow 1983, 35), assuming that it is able to reach that overall goal. Nota bene: the reenactment-based reanalysis bears on how the *video demonstration* disables "critical evaluation" (Lampel 2021, 305), not on the evidence and analysis by the supporting paper in computer science (Mnih et al. 2015).

[16] To have this lack of diversity disappear seems important from a producer's standpoint, if only to pitch the video demonstration to a broader audience, the intended audience of *AlphaGo. The Movie* (Krieg and Kohs 2017).

[17] The qualifier "conspicuously" alludes to how the "ordinary circumstances" told and shown (e.g., the male child prodigy turned *DeepMind* CEO arriving at Oxford) manifestly omit how the *Breakout* program was set up to achieve its demonstrated performance (i.e., culminating in discovering "this amazing thing […] the optimal strategy," shots 17-18). Its material "set-up" includes various training rounds in "reinforcement learning" and many other technical details (see Mnih et al. 2015). "Specification gaming," from that perspective, may not be a problem, but the aim (see, again, Krakovna et al. 2020).

[18] If early AI envisaged to "reduce epistemology to code" (Penn 2020, 199), then the examined demonstration offered a recurring version of that project, namely to "reduce play to performance" (see Section 3).

[19] To the "child prodigy" (1) and "general AI" (2) configuration, we may add that of the "obscure(d) backstage" (3), insofar as the video demonstration appeared to mobilize the former (1) to account for the latter (2), instead of dwelling on its technical explanation (see Mnih et al. 2015) or self-critical qualification (Krakovna et al. 2020).

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Appendix I

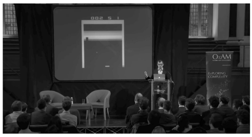
Transcript of "Breakout" Demo – *AlphaGo. The Movie* (Krieg & Kohs 2017, 1:24 – 3:05)

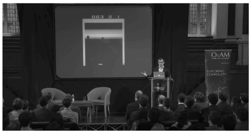
Movie available at: https://www.youtube.com/watch?v=WXuK6gekU1Y (accessed 1 November 2022)
(Transcript prepared by the author in accordance with conventions below)

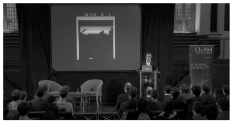
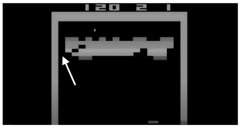
```
DH*   Demis Hassabis
      (the asterisk marks his categorial identification in the video,
       as "Co-Founder & CEO, DeepMind")
WP    Welcome person
```

Shot	*Voice*	*Audio*	*Video*
1 (1:24)	 (DH*) (DH*)	♬… ((young man shown in taxi..)) …♬… ((.. identified as Demis Hassabis, Co-Founder & CEO, DeepMind)) **when I was a ❘kid,** ❘((DH* shown in taxi)) ***#1a*** **I loved, °uh°=>playing games.<** …♬…	 ***#1*** ((DH* shown in taxi))
2	 (DH*) (DH*)	…♬… **I ❘started off with,** ❘((DH*, accompanied, is shown to walk in the street, from right to left)) **❘board ga:mes, like chess** ❘*tac, tac, tac* ❘((DH*'steps in street)) ***#2*** …♬…	 ***#2*** ((DH* shown accompanied, walking towards University of Oxford))
3	 (DH*) (DH*) (DH*)	…♬… **and then I bought my first computer=>when I was eight.<** **with ❘winnings from a** ❘*tac, tac, tac* ❘((DH*'steps in street)) ***#3*** **chess tournament.** ❘*tac, tac, tac* ❘((DH*'steps in street)) **ever since then, I felt that, computers were this** …♬… **sort of magical device.** …♬…	 ***#3*** ((DH* shown accompanied, walking towards University of Oxford))

4	 (DH*) WP (DH*)	…♬… **that could** **ext'end the** '((turns towards DH*)) ***#4*** **power of your mind.**	 ***#4*** ((DH*, accompanied, approaches university building))
5 (1:48)	 (DH*)	…♬… **|"virtual environments and games.** …♬… …♬… …♬. |((DH*, accompanied, approaches Oxford univ. building)) ***#5*** **we=**	 ***#5*** ((DH*, accompanied, approaches university building))
6 (1:51)	(DH*)	**=th|ink, they are the perfect platform for** |((DH* walks through dark entrance corridor)) ***#6*** **developing and testing** **'AI algorithms.** '((person accompanying DH* enters lecture hall, DH* follows him))	 ***#6*** ((DH* walks through dark entrance corridor))
7 (1:55)	( ) (DH*) (DH*) (DH*)	**(.)** |((top rows of lecture hall are shown…)) **|games. are very conve:nient,** **in +tha:t** +((…camera turns to lower floor…)) **a lot of them have sco|:res.** |((…showing packed lecture hall and (DH*) as speaker)) ***#7*** **so, it's=**	 ***#7*** ((camera shows packed lecture hall and speaker (DH*)))

8 (1:59)	DH* DH*	**=>very<=ea|:sy,** |((emphasizing gesture)) ***#8*** **to measure incremental progress.(.)**	 ***#8*** ((DH* emphasizes “easy”))
9 (2:01)	 DH*	((camera shot on entire lecture hall)) **so,>I’m gonna show you.<** **a few videos of the** **a:gent sy|stem,** |((emphasizing gesture)) ***#9***	 ***#9*** ((DH*emphasizes “system”))
10 (2:05)	DH*	**the +AI.** +((male public member in top row on the right-hand side is shown to pay close attention)) +((computer music starts)) ♬… ♬… ♬… ***#10*** **so, let’s start off with breakout.**	 ***#10*** ((male public member is shown to pay close attention))
11 (2:07)	DH* DH*	**so, here you co|ntrol the** ♬… ♬… ♬… |((hints at “breakout” game shown in presentation)) ***#11*** **bat and ball, and you=>are trying to break through this rainbow-colored wall.<**	 ***#11*** ((hints at “breakout” game shown in presentation))
12 (2:12)	DH*	**the +agent system has to** +((close-up shot on “breakout” game)) ♬… ♬… ♬… ***#12*** **learn everything for itself, just from the raw pixels.** ♬… ♬… ♬… **it doesn’t know=>what it’s controlling.<**	 ***#12*** ((close-up shot on “breakout” game))

13 (2:19)	DH* DH*	**it doesn’t** **e|ven kno:w,** |((emphasizing gesture)) ***#13*** **what=** ♬… ♬… ♬… **=>the object of the game<=is.**	 ***#13*** ((emphasizes “it doesn’t even know”))
14 (2:22)	DH* DH* DH*	**now (at) the=>beginning<=** **=after a |hundred games.** |((hints at initial “breakout” play)) ***#14*** ♬… ♬… ♬… **you can see the agent is not very good.** ♬… ♬… ♬… **it is=>missing the ball<=most of the time.**	 ***#14*** ((hints at initial “breakout” play))
15 (2:28)	DH* DH* DH* DH* DH*	**but it is starting to get** ♬… ♬… ♬… **the |hang of the idea** |((turns around at “After 300 Games” slide)) ***#15a*** **that the bat(.)** ♬… ♬… ♬… **should go towards the ba|ll. (.)** |((looks into the audience)) ***#15b*** ♬… ♬… ♬… **now after three hundred games, it’s about as good as a|ny human** |((looks into the audience)) **can play this.** ♬… ♬… ♬…	 ***#15a*** ((turns around at “After 300 Games” slide))  ***#15b*** ((looks into the audience))
16 (2:37)	DH* DH*	**+and it (pretty much)** +((top-down shot on packed lecture hall and speaker DH*)) ***#16*** **gets the ball back every time.** ♬… ♬… ♬…	 ***#16*** ((top-down shot on packed lecture hall and speaker DH*))

17 (2:41)	DH* DH* DH* DH*	**+(and) we thought=>well,** +((frontal shot on "After 500 Games" slide and speaker DH*)) ***#17a*** ♬… ♬… ♬… **that's pretty<=cool.** **but we left the system playing for another two hundred games.** ♬… ♬… ♬… **and it did this ama+zing thing.** +((frontal shot shows game ball "breaking through")) ***#17b*** ♬… ♬… ♬… **it found the optimal strategy, which=**	 ***#17a*** ((frontal shot on "After 500 Games" slide and speaker DH*))  ***#17b*** ((frontal shot shows game ball "breaking through"))
18 (2:45)	DH* DH* Aud. DH*	**+is to dig a tunnel** +((close-up shot on "breakout" game, with ball bouncing up and down between walls)) +((computer music gets faster)) ♬♬♬… ♬♬♬… ♬♬♬ ***#18*** **around the "si:des.** **"ha,ha,ha.** **and put the ball round the back of the wall.** **the researchers working on this, (they are) amazing AI developers so, they are not so good at "breakout" and they=**	 ***#18*** ((close-up shot on "breakout" game, with ball bouncing up and down between walls))
19	DH* DH* DH* DH*	**=didn't know about that strategy.** **so they learned something from their own system,** **which is pretty funny and quite instructive I think about the potential for** |((emphasizing gesture)) ***#19*** **general AI.**	 ***#19*** ((DH* emphasizing 'AI potential'))

20	DH*	**So for us what's the next step now?"** ***#20***	 ***#20*** ((shot towards the audience))

Transcription conventions:

[ ]	onset and end of overlap
=	latching, no discernible interval between adjacent utterances, or activities
(1s)	pause
(.)	micro-pause
he-	cut-off
so	emphasized stretch of talk
>so<	faster stretch of talk
°so°	quieter stretch of talk
?	rising intonation
.	falling intonation
,	"continuing" intonation
" "	start and end of transcribed lecture
()	incomprehensible passage
(go ahead)	uncertain hearing
((does))	description, comment
tac, tac	noise (e.g., steps in the street)

If there is a verbal line, the onset of activity is marked on the verbal line and again on the comment line, as in the following example:

T: **here |I let you have a look.**
|((hands the magnifier to the student))

Film stills / screenshots are numbered (***#1, #2, #3***, etc.) and positioned where taken.

Appendix II: *Pilgrim in the Microworld* Book Cover (1983)