(RE)LATIONS OF COMPUTING: A CONJUNCTURAL ANALYSIS OF THE EMERGENCE OF THE HUMAN-COMPUTER INTERFACE

by

EZEQUIEL KORIN

(Under the Direction of James Hamilton)

ABSTRACT

Through a conjunctural analysis based on documentary sources, this investigation looks at the development of three forms of relationship between the computer and the human operator which emerged as the result of the processes by which the computer passed from wartime field devices used in the early 1940s to the distributed workflow of time-sharing computing of the early 1960s. The transit through these different processes allowed for the production of the computer as a cultural artifact, establishing the ways and means in which the operator and the computer became entangled in three distinct, yet deeply interrelated forms of relationship. The proxy relationship, which became produced through the usage of computerized apparatuses during WWII and posited the substitution of the human operator with the computer. The peer relationship, which required the digital general-purpose computer to become produced through its usage and posited the collaboration of the human and the computer, establishing each one as autonomous ontological entities, between who a dialogical relationship emerged. The partition relationship, which became effected through the incorporation of both, time-sharing computing and direct object manipulation, positing the existence of the operator and the computer not only as distinct ontological entities, but also residing in separate, irreconcilable worlds. The emergence, operation, and expansion of each of these relationships is studied and, in doing so, the conception of the human-computer interface is refocused as the result of the tensions and articulations of contradictory and coincident discursive and social practices. As such, the analysis posits that, although each of these three relationships developed within, through, and against specific contexts, they have not been abandoned in later computational developments but, instead, that they have become actualized and incorporated as facets of the human-computer interface.

INDEX WORDS: human-computer interface; interface; computer; media; cultural studies; United States; postwar; critique; conjunctural analysis; Stuart Hall; Raymond Williams

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DEDICATION

For Ana, who never stopped believing in me;

Emiliana, who never stopped dreaming with me;

and Lupita, who never stopped accompanying me.

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INTRODUCTION

Over the past seven decades, computerization of society has advanced rapidly in an apparently unstoppable manner, a dictum that seems to have grown out of the post-WWII techno-optimism and the accelerated changes brought about in the latter part of the 20th century by the transit from military-oriented computer systems to those oriented at the general public.[1] But does anything lie beyond this seeming constitution of society by computerized forms of communication? This question remains not only largely un-answered but largely un-asked, and the logic of the computerized society is that of a computerized totality: the seamless unique sign-on promised by Google, the use of one's Facebook profile as personal online identity/self, or the incorporation of Apple's unified interface as a continuum between mobile and desktop devices, among many others.

In the self-proclaimed age of computerized communication, the dominant social logic — whether espoused in academic discourses or everyday commentary — does not conceive a horizon beyond computerization. On the contrary, some panglossian perspectives suggest that the road inevitably leads to an extreme humanization of the computers.[2] Media historians and cultural analysts endlessly scrutinize the social, cultural, and political implications of computer mediation. Despite such efforts, the problematization of the computerized society itself, which had produced several important strands of thought prior to the turn of the millennium, seems to have been largely neglected. The naturalization of a computerized society, along with the effacement of any possible horizon beyond it, contributes to the self-fulfilling prophecy of technological essentialism.

One way this essentialism is manifest is in studies of what is conceptualized as the computer interface. Although the ways and means in which humans relate to computers constitute intertwined aspects of the same phenomenon, the dominant approaches to studying human-computer interaction seem to separate ways and means into independent instances, assuming a causal relationship between the means of the relation (human-computer interface) and the relations that are established (human-computer interaction). This conceptualization seems to have emerged from the way in which human-computer interaction as an area of knowledge developed, namely from cognitive psychology.[3] Under such a purview, the interface is conceptualized as a stimulus for interaction that as a result has been approached from a design perspective indebted to an engineering point of view.[4] Such an approach has spurred a view of the interface as a given fact, a fait accompli, to the point that its existence is ultimately accepted as inevitable, though not necessarily desirable.[5] As such, the interface is ultimately reified and its implications removed from critical examination.

In a general sense, user interfaces exist all around us, there to mediate the different ways in which humans operate and relate to machines of every type, both mechanical and electronic: from doorknobs in bathroom stalls to gauges in an airplane cockpit, from the recessed keypad in an ATM to the buttons and levers in a nuclear submarine, from the steering wheel in an SUV to the layout of the welcome screen in a smartphone. However, human-computer interfaces hold the particularity of mediating between the subject and the complex articulation of materiality and ether that is embodied by the digital computer, that 'meta-medium' that contains and collapses all other media into remediation, and which stands as a single gate of horn and ivory to the world of cyberspace.[6] The apparent abyss between human and machine, between sensible and electronic, then becomes the prime site of mediation in the computerized society, making its investigation for the fields of mass-communication research and media studies not only a legitimate endeavor, but a necessary one.

Subjecting the interface to a critical analysis is therefore of prime importance in producing new horizons of thought and action. The necessity of interrogating the interface beyond its reified conception or its inconspicuous treatment has been noted by an emerging body of literature that reconceptualizes this liminal space as a series of practices and relationships.[7] Such a view of the interface — not as a “thing” but rather as a space of performance — was further expanded through later works and has been recently given a second look.[8] Within this heterogeneous stream of research, the emergence and operation of the human-computer interface take a preponderant role in explaining the cultural and societal implications of human-computer interaction.

Despite the importance and advancement of this stream of research, the focus continues to purport the existence of the human-computer interface as an unquestionable fact. As such, any and all inquiries that depart from the constitution of the human-computer interface as an unquestionable fact risk a tangential approximation to the operations through which this acceptance had become normalized, even within critical approaches to it. This dissertation contributes to this emerging and developing stream of research, by questioning the emergence of the human-computer interface that provides support for a conception of computerized society as the inevitable outcome of human development. In doing so, this dissertation argues for the necessity and urgency of alternative and multiple social and political horizons.

Outline of the investigation

The first chapter establishes a series of important theoretical and conceptual points of anchorage, which will allow for the subsequent elaborations and analyses. As such, this initial chapter is centered on three aspects: first, a critical discussion of relevant literature that serve as the basis from which to approach the analyzed phenomena; second, the establishment of a theoretical common ground on which the different theoretical commitments of this investigation come to bear; third, the chapter exposes and explains the means of analysis employed, as well as the sources utilized in this analysis.

Chapters two, three, and four constitute the body of this investigation and have been structured following a simple recursive scheme, presenting three subsections each. The first subsection of each chapter addresses the emergence of the particular form of relationship and the mechanisms through which it was culturally produced. The second subsection notes the how the form of relationship in question worked in shaping resulting computer design and uses. The third subsection of these chapters deals with the ways in which the form of relationship served to articulate other processes, some of which lie outside the area of computation. The use of this recursive scheme within each of these three substantive chapters seeks to provide greater clarity to the trajectory of the arguments exposed.

The second chapter addresses the emergence of the computer after WWII via its conception compounding the massive laboratory calculators and the simpler task-specific computerized apparatuses used in wartime devices. As such, it explores two related issues: how did the relationship between the human and the computer become constituted positing the latter as a proxy of the former and how did the context and the technical developments emerging from WWII contribute to and become affected by this emerging form of relationship. By analyzing different materials from the end of WWII, the chapter suggests the emergence of a proxy form of relationship between the human operator and the computer. Given the confounding of electronic analog computers and electronic digital computers into a conceptually homogenized category of "computer," the characterization of the computer emerging from the war became extremely expansive and allowed for the establishment of a notion that the computer could – indeed – stand as a replacement for the human operator. The chapter argues that the lack of need to develop means of communication between the operator and the computer brought about by the incorporation of computational capabilities to previously existent devices, on one hand, and, on the other, the development of computers within laboratories and under a veil of secrecy brought about by the war avoided problematizing the means through which the operator instructed the computer to conduct a particular endeavor. Finally, the chapter circumscribes the operations of computers within this context to a gradual – yet continuous – process of transference of technical skills from the operator to the apparatus, which would reappear more forcefully in later iterations. Although this process of transference is similar to the degradation of skills Braverman identified in the destruction of craftsmanship attributable to monopoly capitalism, its application is more expansive, expanding its occurrence to the entire society.[9]

The third chapter deals with the inclusion of the computer in the civilian workspace during the 1950s, particularly after the development of the electronic digital computer. As such, it responds to two main objectives: first, to understand the peer form of relationship that became constituted as the result of the incorporation of the computer into the American workplace following the end of WWII, as well as the transformations that this inclusion effected in the workplace; second, to understand how this form of relationship constituted as much a product as an antecedent of the changing labor and societal conditions in 1950s America. In response to the first objective the investigation posits that the enactment of the peer status forced a dialogical relationship between operator and computer, while the physical means through which said dialogue became effected served as the material concretion which would eventually become conceptualized and known as the human-computer interface. In response to the second objective, the societal conditions surrounding the emergence of this form of relationship become the center of the analysis, which seeks to understand how it became articulated through and in response to said societal conditions at the time. Once again, the process of labor deskilling serves to explain – at least in part – the operations taking place around the human-computer interface.

The fourth chapter addresses the continuation of centralized control under the guise of individual empowerment. As such, the chapter focuses on the emergence of the partition form of relationship between the human operators and the computers in the transitional period surrounding the early 1960s, through the development of time-sharing computing and direct object manipulation. A second objective of this chapter is to posit the emergence of these technical developments as absconding vehicles that allowed for the continuation of centralized modes of power, despite their apparent promotion of individual empowerment. Finally, the process of deskilling which became analyzed in the prior two chapters is revisited, positing that the work by Sutherland regarding graphical manipulation supposed the emergence of one of its most advanced forms, which has only become exacerbated in later iterations.[10]

The fifth chapter summarizes the substantive chapters while also suggesting future avenues of research. Likewise, this fifth chapter argues the articulation of these three forms of relationship as facets of the human-computer interface through their iteration in later technical developments.

Notes to the Introduction

[1] For examples, see: Vannevar Bush, "As We May Think," *Atlantic Monthly*, July 1945; Peter J Denning, *The Invisible Future: The Seamless Integration of Technology in Everyday Life* (New York, NY: McGraw-Hill, 2002); Brenda Laurel, "When Computers Become Human," in *Talking Back to the Machine: Computers and Human Aspiration*, ed. Peter J Denning (New York, NY: Springer, 2012); David Silver, Adrienne Massanari, and Steve Jones, "How Digital Technology Found Utopian Ideology. Lessons from the First Hackers Conference," in *Critical Cyberculture Studies*, ed. David Silver and Adrienne Massanari (New York, NY: NYU Press, 2006).

[2] Raymond Kurzweil, *The Age of Intelligent Machines* (Cambridge, MA: MIT Press, 1992); *The Age of Spiritual Machines: When Computers Exceed Human Intelligence* (New York, NY: Viking, 1999); Laurel.

[3] John M Carroll, "Human-Computer Interaction: Psychology as a Science of Design," *Annual Review Of Psychology* 48, no. 1 (1997).

[4] Johanna Drucker, "Humanities Approaches to Interface Theory," *Culture Machine* 12 (2011).

[5] Donald A Norman, "Why Interfaces Don't Work?," in *The Art of Human-Computer Interface Design*, ed. B Laurel and S Mountford (Reading, MA: Addison-Wesley Publishers, 1990).

[6] The computer not only provides access to 'cyberspace' – that separate world to which the human can only gain access through – introduced by Gibson, but – as proposed by Bolter and Grusin – becomes a point of confluence of all previous media through a process of remediation, the prime mechanism through which new media operates, according to Manovich.

[7] Brenda Laurel, "Introduction," in *The Art of Human-Computer Interface Design*, ed. B Laurel and S Mountford (Reading, MA: Addison-Wesley Publishers, 1990); "Users and Contexts: Introduction," in *The Art of Human-Computer Interface Design* ed. B Laurel and S Mountford (Reading, MA: Addison-Wesley Publishers, 1990).

[8] Right around the turn of the century, both Johnson and Manovich expanded the views set by Laurel. Of more recent date, and taking on a more radical approach, Drucker, Galloway, and Hookway have built a robust scholarship around reconceptualizing the interface as a series of practices.

[9]Harry Braverman, *Labor and Monopoly Capital : The Degradation of Work in the Twentieth Century*, vol. 25th anniversary ed (New York: Monthly Review Press, 1998), Book.

[10]Ivan Sutherland, "Sketchpad: A Man-Machine Graphical Communication System" (Massachusetts Institute of Technology, 1963).

CHAPTER ONE: A critical approach to the human-computer interface

The objective of this first chapter is to establish the relevant theoretical and conceptual points of anchorage of this investigation, which allows for the subsequent elaborations and analyses. In response to this objective, the chapter first discusses relevant literatures of two significant approaches to the human-computer interface. A second portion of this chapter is devoted to the specific theoretical works which inform this investigation, as well as its methodological design, providing the necessary points of departure for the selection, treatment and analyses of the documentary materials that form a part of it and, in doing so, help situate both the analytical perspective and the commitments of the investigation.

Approaches to the human-computer interface

The ways through which humans operate, communicate with, relate to, or use computers have constituted an area of attention for various researchers since the emergence of the modern digital computer. Although literature on the human-computer interface abounds, two general approaches can be identified. One reifies human-computer interfaces and inevitably links its existence to the notion of human-computer interaction. A second reconceptualizes the human-computer interface as a series of practices and relationships through, against, and by which human-computer interaction takes place.

The human-computer interface as a reified instance

The human-computer interface has taken a central place in the development and research of modern computing since the adoption of commercially successful graphical user interfaces in personal computers. This importance of the human-computer interface has only become amplified by the emergence and adoption of later technical developments, such as the desktop metaphor used in personal computers, the tactile interfaces employed in smartphones and tablets, haptic interfaces of gaming and virtual-reality devices, and the aural interfaces of devices enhanced with elements of artificial intelligence.[1] As such, each new technical development seems to open the field to specific explorations of the means and ways of using computerized apparatuses, while the overarching basis of the relationship between operators and computers becomes further hidden under a veil of tacit acceptance.

Despite the technological changes marked by the development and adoption of graphic, tactile, haptic and aural forms, one basic conception of the human-computer interface as the combination of the hardware and software through which humans operate computers has remained largely unchanged. For example, Card, Moran, and Newell whose work emphasizes task analysis as a means of understanding human information processing. The perspective espoused by this work posits that human-computer interaction is ultimately shaped by the features of the computer system, thus resulting in an instrumental view of the human usage of computers and, in doing so, reinscribing the primacy of technological determinism.[2] A similar conception of the interface is provided by Ambler, who directly notes that human interaction is determined by the interface.[3] This reified notion of the interface persists, for example, in the works of MacKenzie, who notes that the interface is the place where interaction between the human and the computer actually takes place.[4] These three examples, among many others, identify the interface as the compendium of hardware and software that allows for the ways in which humans and computers interact and, in doing so, ultimately purport a reified notion of the interface.

Several important works, such as those of Hutchins, Hollan, and Norman, Nielsen or Shneiderman and Plaisant characterize the interface similarly, albeit as a nuanced or intermediate means in which the control of human-computer processes become exercised.[5] Even texts that seek to radically reconceptualize computer application design, such as the influential work of Bødker, share a notion of the interface as the combination of hardware and software elements that determines the ways in which humans and computers interact.[6] Although Bødker's work supposes a critique of the human factors and cognitive science approaches to the interface in favor of human activity theory, it nonetheless ratifies a conception in which it is purported as a part of the computational apparatus, thus, returning upon the reified basis of the approaches it sought to dismiss.[7]

From a critical perspective, the assumptions that underlie this characterization of the relation between humans and computers pose several problems. One is how elements through which people control the computer (such as the icons employed in the graphical user interface, the hardware used for control of computer processes, the software procedures through which a computer 'operates,' etc.) become objects separate and independent from users. Such a separation naturalizes the interface while it re-inscribes a Lockean conception of the isolated, Enlightenment individual.[8] A second is how claims of "human-computer interaction" anthropomorphize the computer, thus equating the subject's agency to that of the inanimate technological object. A third is how the interface as the sum of software and hardware reproduces a logic that supports the Kantian separation between the individual/internal and objectual/external world, thus negating the existence of discursive practices through which mediation operates.

The human-computer interface as a series of practices and relationships

Despite the preeminence of the conception of the human-computer interface identified in the previous section, a heterogeneous divergent conceptual stream has emerged, at least since the early 1990s. It has gradually diverged from the reified notion of the interface by privileging conceptions of the human-computer interface as relationships and spaces of their enactment. Although, as Teitelbaum notes, this reconceptualization has become espoused mostly by scholars in the areas of critical studies and media studies, the work undertaken by Laurel hints toward the recognition of this necessity and the consequent emergence of such a perspective within the area of human-computer interaction.[9]

Laurel's reinterpretation of the interface as a transformative shared/liminal space through which power relations become enacted calls into question the cognitivist basis of the design of human-computer interfaces.[10] This conception of the interface transcends its notion as the compendium of hardware and software and, in doing so, distances itself from the reification of the interface in three significant ways. First, the human-computer interface is recognized as the liminal place between the object [computer] and its user, thus recognizing that its existence is entirely contingent on the relation that becomes established between them.[11] Second, as a contact surface, the interface reflects the physicality of both entities involved and the functions they are to perform, as well as the relations of power and control implied by the relationship they establish.[12] Third, the transformations brought about by the relationship between the user and the interface are bidirectional, such that both the user transforms the interface and the interface transforms the user, thus situating the interface as a middle ground where tool and user intersect.[13] Reinterpreting the interface as a transformative shared/liminal space through which power relations are enacted implies a change in the theoretical approximation to the interface and, more significantly, to the entire conception of the relations between humans and computers.

Laurel's revolutionary reconceptualization of the interface as a site of concretion of power relations opened the door for further contributions in the critical approximation to the human-computer interface. Johnson, for example, would continue this line of thinking by resignifying the human-computer interface as a medium in itself, allowing for an understanding of the processes of interface design and execution not merely as technical acts, but rather as communicational ones.[14] Departing from a conception of the interface akin to those of its reification, Johnson pushed a reconceptualization of the interface as a practice carried out by the computer. In this sense, the notion of the interface as the means through which the computer communicates with the user compounds physical characteristics with functional aspects and, in doing so, purports a conception of the interface – simultaneously – as a series of digital objects (icons, metaphors, etc.) and an articulation of functional aspects that not only allow the computer user to exercise direct manipulation of said objects, but also the computer to communicate back with the user. In this sense, Johnson identifies the interface as a semantic code that makes such operations possible and, therefore, posits the interface as a medium, voiding it of the transparency that had sustained its reification.

A further step in this direction is advanced by Manovich, who identifies the interface as one of the privileged cultural forms of the present and characterizes its operation as the remediation of all previous cultural forms.[15] In doing so, the author centers the concept and relevance of the interface in its operation as a semiotic code through which all information presented by means of the computer becomes transcoded. As such, all operations involving computer interaction are necessarily subjected to the sieve of the computer interface, which "shapes how the computer user conceives of the computer itself […] (and) determines how users think of any media object accessed via a computer."[16] Seen in this way, the interface is not merely a space of contact or transformation between the user and the computerized medium, but an active site of resignification and propositional action. According to Manovich, this allows for the equation of leisurely and labor activities within the single aesthetic and political occurrence of the interface and, in doing so, it constitutes a "key semiotic code" that modifies the functioning of cultural objects within everyday life.[17]

Similar critical and humanistic approaches to the conception of the interface built on these grounds – such as those of Drucker, Galloway or Hookway – problematize not the interface qua object, but human subjectivity and agency in relation to the operations made viable through the use or constitution of the interface. In this sense, Drucker would purport the existence and emergence of the computer interface as the result of the human's performative action and, in doing so, further displace the discussion of the human-computer interface toward the practices by which it becomes enacted instead of circumscribing it solely to the technical characteristics of its design.[18] The notion of the interface as a liminal space produced through communicative practices is further expounded by Galloway, who pushes beyond the conception of the interface as a mere point of contact or window through which relationships are established between the different mediated layers of a system, thus implying parallel aesthetic events and, therefore, a series of active processes of signification.[19] A third perspective of the interface along these lines is developed by Hookway, who asserts the interface as a threshold condition that does not occur in the moment of contact between human and machine, but rather both precedes and proceeds it, limits and controls it and, in doing so, "defines its own interiority in exclusion of its bounding entities."[20]

The value of this work is in its unpacking of the human-computer interface not in terms of its formal or functional elements, but in the practices that take place in, around, and through it. By pushing back against a technological deterministic purview of society upheld by the reified conception of the human-computer interface, this work opens the door not only for a critical analysis of the interface per se, but of the forms of relationship that become established through it. Furthermore, the importance of this critical approximation lies in providing an understanding of the processes through which the human-computer interface has become developed through as a series of iterative processes and, as such, it bears great significance for future developments in the area of interface design, as they underscore the codependency between the agency of the human actor and the affordances of the computer.

Critical theory of the human-computer interface

The reconceptualization of the human-computer interface previously identified as an emergent stream within relatively recent investigations on the topic provides substantial resources for further work. Radically historicizing the practices and relationships of the interface further substantiates a critical theory for its analysis. This dissertation contributes to this literature by constructing a conjunctural analysis of the means and processes through which the human-computer interface emerged.

Given the need to examine the cultural production of the computer, its user, and the forms of relationship between them, this study relies on the analysis of the societal, cultural, and political processes from and through which said processes became effected. As such, its theoretical approach requires investigating beyond the manifest phenomena, articulating them to a larger and generative context of societal and historical processes. This need relies heavily on the mandate expressed by Jameson to always historicize, not as a practical recourse or rhetorical shorthand, but as part of the commitment to a purview of society as dynamically constituted by constant human action.[21] Thus construed, historical processes become the dynamic and organic outcome of the different, contradictory interrelations through, in, and against which human agency transforms its contexts while being transformed by it.

Such an endeavor demands a historical investigation that rests on the notions developed by Williams, in regards to re-inscribing the primacy of the historical as intrinsically constitutive of the processes of production and consumption of the phenomena under analysis.[22] By immersing phenomena in constitutive relations with their contexts, an investigation analyzes in and around the texts, entering into a dialogue where the historical is seen as past and present, as well as a set of possible futures. Such a conception of the historical derives from the implicit and constant changeability of reality, which demands the situation of the object of study within the historical moment when it was originally elaborated and the historical moment when it is being consumed. This multiple articulation of moments — far from implying temporal isolation or continual isomorphism — corresponds to the specific conditions under which the phenomenon is produced and re-produced. It is this last notion, that of re-production of culture through the phenomenon, that lies at the heart of the significance of this approach: the phenomenon not solely a material vestige, but rather an articulation of the conditions surrounding its coming of being, both in its original conformation and in its present consumption and usage.

Following Williams, the relationships and processes — both superstructural and among the real relations of production — should be anything but contained within two opposing categories such as base and superstructure.[23] As such, a richer model of articulation should consider not simply a dialectical relationship between two elements, as proposed by Grossberg and Hall, but rather accommodate the multiplicity of processes and relationships among these processes that occur and become effected, both as part of the superstructural relationships and as part of the concrete relations of production.[24] It would seem necessary, then, to transcend this limitation in favor of contemplating the simultaneous relationships that take place among the multiple processes, both at the superstructural level, as well as at the level of the relations of production. The emphasis on historical specificity avoids simplistic causal claims by emphasizing the contingent overdetermination of phenomena. Yet, at the same time it also avoids radical relativism by recovering the concrete and unique process by which specific phenomena congeal.

The problems posed by these limitations have been evidenced through various theoretical approximations, which sought to solvent the reductive dichotomy of an essentialized reading of dialectical relationships. In this sense, Hall himself would acknowledge such a necessity, by elaborating the concept of conjuncture, seeking to capture the development of historical periods in which "contradictions and problems and antagonisms, which are always present in different domains in a society, begin to come together."[25] As such, Hall describes the notion of conjuncture as "a period during which the different social, political, economic and ideological contradictions that are at work in society come together to give it a specific and distinctive shape."[26] As such, the intention of cultural studies in this vein is displaced and expanded from studying a particular instance ("the object" or "the phenomenon") to providing an analysis of the production of the forces that produce any particular articulation — an approach that Grossberg refers to as not a theory of things or of actions but of contexts, their effectivity and their constitution.[27]

Studying the forces by and through which cultural products become produced requires a dynamic notion of the processes that intervene, as well as that of the resulting articulations in which they become congealed. Following Hall, one can posit that such an approximation emerges from the constant negotiation of relations between the groups in dominance and those which are dominated, such that the resulting cultural products become constantly reconstituted by the shifts and changes in those relations of power.[28] Further elaborating on this notion, Hall notes that the meaning of cultural forms is not fixed nor inscribed to the forms themselves, but rather becomes actualized by the contingent positions of such forms under particular historical conditions.[29] Retaking Williams' notion of technical apparatuses as concretions of the corpus of knowledge of a technology as well as the conception of technical apparatuses as cultural products implied by their uses, it is possible to extend the prior assertion onto this area.[30] As such, one is confronted with a conception of technical devices – such as computers – which become constantly subjected to transformations in regards to their cultural form. Departing from these notions, this investigation analyzes three forms of relationship between human operators and computers yet, in doing so, it does not establish a temporal or epochal narrative beyond that determined by the development of specific technical apparatuses that serve as the congeal of the transformations and shifts in relations of power in the context of their occurrence.

Accordingly, this dissertation conducts a conjunctural analysis of three loosely-construed instances in which the computer, its user, and the constitutive forms of relationship between them came to be produced and, through which, the human-computer interface was developed. To investigate how the human-computer interface became constituted as a cultural artifact through which forms of relationship emerged, this study is guided by the following key questions:

1. How is the human-computer interface constituted as a cultural artifact?
2. What are the means through which the human-computer interface operates in establishing a relationship between the user and the computer?

3. How are the different forms made possible through the human-computer interface articulated within the broader, more expansive, social, cultural, political, and economic processes in, through, and against which they develop?
4. What are the implications of these forms and relationships for the subsequent emergence of the interface as a naturalized object?

Guided by the previously noted theoretical anchorages, this investigation interrogates the formation of the technical developments which would eventually become construed as the human-computer interface by analyzing the conditions under which their processes of production emerged. As such, it became necessary to conduct preliminary explorations of the source materials, resulting in the suggestion that the foundation for the cultural production of modern human-computer interface was laid from the late 1930s to the early 1960s, thus making this period crucial to understanding later developments. As a form is a social and cultural production and practice, significant sedimented evidence exists in printed popular press, advertising pieces, trade-press publications, corporate brochures and technical documents, and computer design and architecture articles. Due to its early technical and economic leadership, the United States was chosen as the geographic focus for this study. Preliminary research identified as key periods post-WWII decades of consumer-economy expansion and social change. This investigation uses primary sources such as corporate brochures, advertising pieces, and popular and trade press articles. It also incorporates secondary sources – most published within the timeframe studied – to provide contextualizing information that helps situate the processes under analysis. Likewise, some technical documents regarding specific developments become incorporated into the analysis, due to their relevance. However, given the focus of this research, it is important to note that it does not constitute an inquiry of technical nature, but rather posits the technical information as the congealment of the cultural processes (re)produced through media practice and, as such, circumscribes the technical materials within the scope of cultural practices.

Although the resulting mix of sources can only ever constitute a selection of the total, it incorporates a wide breath of concurrent points of view originating from different types of sources. As such, the selection of sources provides a panoptical approach consistent with the project at hand. The various types of sources required different approaches, in search for relevant instances for the analysis. Relying on preliminary, exploratory research, full-text searches were used delimited by three keywords ("computer," "brain," and "interface") within popular press sources and scholarly works produced a first selection of relevant materials. After noting the appearance of any of these keywords within an issue of the selected sources published during the specified time frame, the entire content of that issue was read (articles and advertisements), later retaining those instances deemed pertinent to the investigation, even if they did not contain one of the keywords. In the case of manufacturer's brochures, all the obtained sources of commercially-available computer equipment published during the specified time frame were subjected to analysis. In total, the investigation looked at more than 30,000 individual pages of magazine, newspaper, and journal articles, manufacturer's brochures and internal documents, and advertisement pieces.

In considering the popular press sources, several publications from the area of radio and television experimentation and amateur electronic enthusiasts (*73 Magazine, Radio and TV News, Radio TV Experimenter, Radio Age, Radio Craft, Radio Electronics*), played a central part, both given their importance as publications and that of their focus on the radio. Although few in numbers, three magazines about the broader area of electronics (*Popular Electronics, Elementary Electronics,* and *Electronics Illustrated*) provided richness to the investigation by incorporating the views of voices outside of radio, while still dealing with topics central to this investigation. One of them in particular, *Popular Electronics*, would go on later to represent a key influencer in the early development of personal computers, given the promotion of the Altair 8800 – the world's first microcomputer – on the cover of its January 1975 issue. Two additional publications of general character (*Time Magazine* and *Life Magazine*) contributed by providing an approach to contextual topics; however, one cannot overlook the importance of these magazines in underlining the relevance given to computing topics as they spilled over onto these mainstream lifestyle magazines.

Despite the lack of an organized and robust computing trade press during the period on which this investigation focuses, three periodic publications (*Computer and Automation, IBM's Applied Science Department Technical Newsletters,* and *RCA's Electronic Age)* as well as various manuals and technical brochures provided ample materials for the analyses conducted. Likewise, scholarly works at the time – such as the proceedings of national and regional conferences of the Association for Machine Computing – provided invaluable resources that allowed a more technical, yet crucial, understanding of the processes underlying the developments discussed in this investigation.

Advertisements carried out by manufacturers of computing hardware and services – both in the form of individual pieces and within entire campaigns – had great importance for this investigation, given the privileged position that commercial messages enjoyed in the cultural milieu of the period under study, and which still continues today. As such, the strategic messages and the characterization of the computer goods and connected services being advertised contributed to their insertion into the common parlance and, with this, as part of the general cultural backdrop of a consumer society.

These materials were subjected to a holistic, generative read that attends to the form of relationship produced against and through their contexts. The various elements presented in each one of the sources previously noted constitute a partial – yet complimentary – aspect of an entire web of significance articulated into the relationship forms identified in this investigation.[31] These forms of relationship constitute – in essence – elements of socialization that become construed and articulated both within and in response to specific sets of conditions, while also affecting and altering said conditions. Understanding that this investigation's point of departure lies well within a critique of technological determinism and that technical apparatuses – such as the computer – become constituted by and are constitutive of social relations, the proposed analysis follows the trajectory of the emergence and development of the forms of relationship that the different transformations of the human-computer interface adopted since its earliest iterations.[32]

Notes to Chapter 1

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CHAPTER TWO: The proxy form of relationship

This chapter responds to two interconnected objectives: first, understanding how the proxy relationship between the human and the computer became constituted; second, exploring how the context and the technical developments emerging from WWII contributed to and became affected by this emerging form of relationship. The chapter posits that the emergence of the proxy relationship between the computer and the operator was made possible through the incorporation of computational capabilities to pre-existent wartime apparatuses.

In response to these objectives, the investigation advances that the incorporation of computational capabilities to pre-existent apparatuses allowed for simple, yet intellectually-invested activities to become displaced from the human operator to the device. This process, akin to Braverman's notion of deskilling would find in the military actions of WWII and the immediate post-war American society the appropriate societal, economic, and labor conditions to fully develop.[1]

The vast technical advancements brought on by the war and the heightened valuation of the computer in the post-war techno-optimistic mentality emerging from WWII found a fertile ground for considering the possibility of reproducing human logical processes through the electronic means of the nascent modern computer. In this sense, the likening of computational processes and human reasoning allowed for the articulation of the role of the computer as an all-powerful and infallible proxy of its human operators.

To substantiate this argument, the chapter first addresses the cultural construction of the proxy relation, which was produced discursively through the computerized task-specific apparatuses employed in WWII and their substitution of the human operator. It then discusses how the proxy relationship affected and became evidenced in computer design and use. Finally, the chapter concludes by noting ways in which the proxy relationship articulated other diverse processes, suggesting its importance and effectivity beyond computing.

Emergence of the proxy relationship: from "thinking machines" to proxies

The replacement of human physical labor by machines (a defining characteristic of the Industrial Revolution) had, by the 20th century, started to be superseded by envisioning machines that could replace human creative thought. This substitution had emerged as a tangible realization through the application of the extreme forms of rationalization implied by Fordism and Taylorism, purporting the reduction of human actions to optimizable objective criteria.[2] Although machines and processes emerging from this purview sought to reproduce human physical actions through mechanical procedures, their human operator retained the exclusive capability of logical reasoning. The application of electricity and, later, electronics in machines presented for the first time the possibility of replacing human with machinic logical processes.

What made possible the replacement of not just human labor but human thinking was the production of a new relation between human and machine. Compared to primitive steam and electrical contraptions being mute and dumb servants for human desires, early computers came to be seen in a proxy relation with their operators, entailing their co-engagement in intellectually-invested processes. Produced within a progressivist paradigm that privileged optimization of procedures as the maximum goal of human actions, the computer's capacity to resolve sequences of binary expressions seemed to supersede their human operator's abilities. In doing so, it also allowed for a false equivalence between human thinking and the machinic concatenation of multiple simple processes into apparently complex calculations. This functional disparity, along with a generalized sense of mathematical calculations as tedious and laborious, bolstered the characterization of the "thinking machines" as efficient and infallible human proxies that freed humans from mathematical drudgery. [3]

One key area in which this re-envisioning of the relation between humans and machines occurred was that of early theoreticians of computation such as Turing and von Neumann.[4] Work such as this substantiated and expanded claims about the possibility of reproducing human logical processes through computer operation and architecture. Despite Turing suggesting the possibility of functional imitation and von Neumann positing the morphological and operational equivalence between computers and humans, positions such as these were grounded in the extreme forms of rationalism inherited and developed by Fordism and Taylorism that sought to break down human action – including reasoning – into discrete and identifiable steps.[5] Notions that electronic computers should develop human-like behaviors or possess anthropomorphic qualities not only represent the desideratum of the powerful mid-century technocracy, but reproduce and extend the central conceptual postulates of the Industrial Revolution by way of Fordism and Taylorism.

A second significant site for this re-envisioning was advertising. Claims about computers were prefigured by claims about the electron tube, advertising for which anthropomorphized the electronic apparatuses, thus laying important groundwork as well for the proxy relation. In its creative leeway compared to news stories and technical industry manuals, advertising was uniquely tailored to anthropomorphizing electronic devices, and by doing so providing a key means of producing active relationships between devices and people. During its development, RCA personifies the electron tube as a "magic brain" in popular-press advertising.[6] Although this characterization resounded with several of the brand's previous advertising pieces which identified devices such as aerial radiocompasses, home radio sets or vitrolas as magic brains during the late 1930s and early 1940s, using this denomination for what seemed to be no more than a fancy light bulb – and not an entire device – represented a significant change.[7]

Advertisers such as the Bell Telephone System further extended the centrality and characterization of the electron tube as a central neural organism by anthropomorphizing it to the point of attributing not only logical capacities to its functioning, but even heroic qualities due to its helping win WWII. For example, a full-page advertisement in the September 1943 issue of *Popular Mechanics* used the headline "It ought to get a war medal," calling for the electron tube to be recognized for its outstanding "work in many a device to find and destroy the enemy on land, in the air, and under the sea."[8] The vignette occupying the upper half of the page shows a single, apparently Caucasian, male hand holding an electron tube which, despite not being connected to any equipment, seems to irradiate rays of light, thus creating a visual focal point on the tube while also contributing to the attribution of a certain magical sense to it.[9] In doing so, both visually and narratively, the ad serves as a subtle – yet significant – representation of the underlying logic which substantiated the equivalence between human logical processes and machinic calculations, making thus possible the substitution of the former by the latter.

A third site of the re-envisioning of the relation between humans and machines was news stories within specialized publications, which in their technical-futurist approach further produced the proxy relation between people and computers. The incorporation of the electronic brain within a device produced thinking machines as viable equivalents of their human operators. The narrative constructed in the pages of these magazines posits that – via incorporation of electron tubes into machines – processes were granted speed and infallibility unattainable by human means. Within the context of WWII, the incorporation of "electronic brains" in various wartime devices characterized as thinking machines further facilitated establishing their similarity to human reasoning processes. Computer-controlled B-29 turret-mounted machine guns used their "brains" to conduct all the complicated calculations while the operator simply had to point and shoot. Anti-aircraft guns tracked and calculated the optimal shooting conditions by using their "brains" while the operator conducted other activities.[10] As such, discursively producing the electron tube as a brain and the computerized apparatuses as thinking machines reproduced – if not superseded – the intellectual capacities of its human operators. The notion of machinic brains that could perform or even outperform humans in gunnery came to be followed by praise for similar "electrical brains" that provided automated services such as opening doors, turning lights on or off, maintaining a desired room temperature or performing a variety of industrial mechanized tasks.[11] Beyond the theoretical constructs elicited by the nascent "electrical brains," the real possibilities opened by automation and the likelihood of machinic substitution of humans – something which had haunted workers since the Industrial Revolution – resurfaced with even greater force, this time aided by the apparatuses' seeming capacity to undertake intellectually-invested actions.

In particular, the semantic nuances that differentiate "electrical" from "electronic" allowed both terms to become confounded, thus assigning logical qualities – implied by "electronic" – onto the entire category of electrical apparatuses involved in industrial automation. In doing so, this process amplified both the fears that had become espoused since the Industrial Revolution and the production of the operator as indistinct from the electrical and electronic machinery within the industrial process. Whether the term brain was qualified as electrical or electronic, news stories on this topic associated new capabilities of machines with human thinking. Although the difference between electrical and electronic might seem small, it becomes significant as the former term merely implies the usage of electricity while the latter indicates the transference of information, and – as such – resembles human thinking.[12] Both concepts soon came to be intricately interwoven to the point of becoming interchangeable.

The merging of electrical/electronic and brain became effected by one of three ways: either by confounding electric with electronic, thus promoting their conceptual equivalence; by portraying electrical devices as possessing the information-processing capabilities of electronic devices; and by construing electronic devices as more-developed versions of electrical devices, making their difference one merely of degree. Some news stories use nearly identical descriptions – save for the qualification of electrical or electronic – when referring to the same device, as for example the computerized gunner's sight aboard American bombers.[13] Other stories note how electrical brains of photoelectric cells, thermostats or actuator switches process.[14] Finally, various stories established the passage from electrical brains to the electronic brains as a linear progression in the development of ever-more powerful thinking machines.[15]

Regardless of which way this was done, new electrical/electronic thinking machines elicited not only admiration and wonder, but fears originally attributed to the contraptions of the Industrial Revolution.[16] A 1949 article in *Radio Electronics* made perhaps one of the most poignant expositions of this lineage by linking wheelbarrows to the electron tube in a teleological progression:

> No mere machine, they said, could produce the remarkable features of the brain. In a sense, of course, they were right. When they thought of a machine they imagined objects like a wheelbarrow, a typewriter, or a steam-engine. […] But nowadays the word 'machine' has much richer meaning, the position of having been transformed by the electron tube. […] At last those who would build a brain have something comparable in functioning powers with the nerve cell.[17]

The personification of the electron tube as a brain legitimized the application of the term "computers" to all electronic equipment capable of executing complex mathematical calculations. An emerging category of electronic devices denominated as computers by the popular press and that were part of advanced wartime machines were also attributed with the ability to think due to the inclusion of the electron tube. As such, the cultural production of the computer was aided by the conceptual condensation of electronic and electrical brains previously discussed. A computer connoted not a specific machine, but a single, complex category of dissimilar devices, yet that shared the capability to think. An early reference in a 1941 magazine article naming "data computers" or simply computers applied an anthropomorphism by noting how they "are almost human in their operation, it only being necessary [for the human operator] to set the dials to know factors, with the computer doing all the work of calculating."[18]

Similarly, at the time the term "computer" began to appear in academic discourses in documents such as von Neumann, a computer was attributed with the ability to think like a human just as was claimed in earlier news stories.[19] This single term referred to high-end electronic assemblies operated by specialized scientists as well as much simpler electronic improvements of pre-existing devices that performed task-specific calculations and adjustments. Despite these differences, calling them all "computers" allowed the attribution of qualities of either one to become applied to the other. As a result, the computer became culturally produced under a halo of the heightened capacities perceived as a commonality between the different devices, each within its specific area of application.

Along with the heightened value of computerized devices comes a diminished valuation of its operator. This comparison in turn serves as a basis for the latter's effective substitution by the former, which is a key way the proxy relation between computer and human comes to be produced. Elevating the importance of computers in military endeavors, mathematics, and science also was a means of demoting both overtly and implicitly the human operator's actions.

Humans increasing were characterized as clumsy, flawed, fortuitous or – at best – inherently human and, therefore, insufficient compared to the computer.

Such claims took many forms in different venues. For example, references in news stories to how computers had "solved the difficult problem of compensating for the errors introduced by the human element" did not constitute an exception, but rather a norm of this dynamic.[20] Variants that discussed military uses supposed a direct displacement of the human operator from the intellectual labors, such that "[t]he electronic and mechanical brain inside the little black box goes to work on the information it has been given by other elements of the system."[21] And, outside the military world, the differential performance of computers and humans was underscored in allusions to physicists and mathematicians, whose work paled in comparison to that of the computers. "Modern types of electronics calculators are capable of solving in a single day problems which otherwise would take foremost mathematicians and physicists years to solve," an article mentioned.[22]

Given the discursive forms used in these characterizations, in which the centrality of the action falls back onto the computer while the human operator remains a passive element to be amended, one can identify a particular form of relationship between the computer and its user, which one can label as a proxy relationship. Beyond technical-utopian narratives, mentions in the popular press construe a human in opposition to the infallibility of the "brains" in the machines and, in doing so, constitute a discourse – and, thereafter, a social practice – that devalues the "human element" in the face of superior "thinking machine."

Furthermore, such claims were made in sites beyond the military and science, which not only paved the way to reconfigure human-machine relations. They provided a fertile field and organized means for the extension of this technocratic purview onto further technical developments within the temporal immediacy of WWII. Although this operation became originally articulated within the context of military operations circumscribed in WWII, it would also extend into other areas of human endeavor, further legitimizing the heightened valuation of the nascent computer and extending its applicability onto other realms of human action.

Extending from the pages of popular press magazines, the computer emerged from WWII as a differentiating element for the Allied forces and capable of improving the lives of civilians. These thinking machines, which possessed a “brain” and the resulting ability to think, to calculate, to improve the results of human actions to the point of infallibility could solve a wide range of problems of immense complexity. The cultural production of computers as proxies not only produced them as valuable instruments for facilitating human action, but — more importantly — as an extension of human intellectual capabilities or, in an extreme view, their direct and desirable viable substitute.[23]

However, this somewhat awe-inspiring description of what was seen as an imminent future had radically historical roots. The heightened valuation of the computer and their increasing relevance to other realms of human endeavors after WWII did not develop spontaneously or naturally, but due in great part to the extension and actualization of rationalist paradigms inherited from the Industrial Revolution of the previous century. As such, the extension of the computer onto areas other than the military implied the consolidation of an entire philosophical model of industrial production and human action, a model rooted in the positivist paradigm and brought to bear on early 20th century America through Taylorism, first, and Fordism, later, by the hand of a nascent technocracy. More broadly speaking, the nascent technocratic mentality of early 20th century America provided a receptive backdrop against which technology became characterized as the concretion of the West’s cultural superiority.[24]

The 20th century technocracy valued skills and technical knowledge rather than fealty to a cause or its leader as the source of legitimacy.[25] Cradled by the rationalist postulates of the Industrial Revolution and its later iterations, this technocratic mentality forcefully justified industrial mass production during the first decades of the century as a means to encourage and foster the development of consumer society as the ultimate goal of the modernist project.[26] As a result of this industrialist push, the United States experienced an apparent bonanza during the first decades of the century, substantiated by improved economic conditions of skilled labor amidst the birth of the consumer society.[27]

However, the erosion of the United States economy into the Great Depression and the eventual outbreak of WWII rearranged the focus of American industrialists toward the production of goods and machinery needed for the war.[28] Despite divesting their production toward the manufacture of wartime equipment and the vast changes in the workforce brought about by the armed conflict, the technocratic project would find in the accelerated pace of production and the vast financial resources committed to the war effort an invaluable push forward, coming out of WWII tremendously strengthened and with a technical development which would serve as its strongest support in the decades to come, the computer.

Emergence of the proxy relationship: an iteration of industrial automation

The computer as constituted through the proxy relationship was infused with a spirit of infallibility capable of satisfying the demand for factual information, thus enabling an enhanced degree of control over various processes, mainly within the areas of industrial manufacturing and management. Such a spirit underscored and supported American technocratic superiority while it also played a key role in generating and expanding consumer society. Emerging from the Industrial Revolution, early 20th century Fordism and Taylorism posited the advancement of manufacturing automation as the articulation of a techno-centric discourse of control as the basis of progress. By doing so, this discourse established the centrality of technical devices as key factors in the rationalistic model of optimization of relations of production and of consumption.

This spirit and ideals became constructed as a necessary and desirable constitutive element of modern life through media representations such as the print ads for IBM's electronic tabulating machines that ran from 1930 to 1934 on the pages of Time Magazine. By articulating a rationalist view of management and control, advertising discourses reinscribed a techno-centric purview of modernity, further justifying the importance of technological dependency. Ads asked potential clients to ask themselves "how consistently modern" they were, measured up against key elements of the corporation's core value proposition: modernity, adaptability, accuracy, speed, and economy.[29] Its faith in what became computerized knowledge was underscored in such truisms as "[o]nly facts […] can be trusted as a guide to profitable management" and claims that IBM products created "a source of dependable information […] with a speed and precision not otherwise obtainable."[30]

Additional advertising for the corporation more forcefully promoted use of its products by noting that they provided "absolute certainty behind the hand responsible for signing payroll checks."[31] Far from the dystopian portrayal of automation in Chaplin's "Modern Times," the technocracy that these proto-computers of IBM promised a new and appealing social order that congealed the 19th century aspirations for modernity into the fait accompli that consumer society represented.[32]

Yet, the ascendance of computers was hardly unproblematic. Discourses effected through wartime advertising and news stories articulated differential valuations of electronic devices and human operators. These diverging valuations were articulated through two distinct, but related, positions. The first was based on the assumption of the computer as an instrument ultimately used by human operators, thus producing the former as an extension of the latter's capabilities. The second was based on the difference between the enhanced value of the computer and that of its human operator, thus producing the former as an improvement, if not a replacement, for the latter.[33] Both of these positions, however, relied on rationalist discourses that reduced all activity – human or not – to objective and quantifiable discrete parts. As such, discourses that extolled computers as an improvement of the capacities exhibited by their human operators, also both valorized the computer while devaluing their human operators. This discursive formation, in turn, was the key cultural underpinning of the proxy relationship. The computer produced through this relationship represented an iteration of the push for industrial automation of the first decades of the 20th century.

Operation of the proxy relationship: rationalization and deskilling of humans

The cultural production of the proxy relationship between electronic thinking machines and human operators informed and guided subsequent technical innovations. In responding to needs required by a rationalistic approach, a self-fulfilling loop emerged in which needs and their answers became construed under the goal to reduce all action – human or otherwise – to objective and quantifiable facts.

Within the context of WWII, two concurrent positions indebted to rationalism allowed for the proxy relation between computer and operator to be put into practice. First was the preference for procedures that could be reduced to mathematical models. The feasibility of mathematically modeling certain procedures – such as calculating ballistic trajectories for directing anti-aircraft guns – encouraged the use of computerized devices to provide greater precision and reliability. Second was the tendency to anthropomorphize the (mechanical) means of making such mathematical models. The articulation of these positions produced computerized machines as equally important as their operators, yet capable of great improvements in their operator's efficacy. Additionally, the usage of anthropomorphized terms to explain these computerized devices — such as the inclusion of a "brain" and the connected capacity to "think" or "decide" — likened these devices to the servicemen who operated them. The combined result of these two positions produced these devices as proxies to their human operators: conceptually similar, yet operatively superior.

Not only did this cultural work distinguish computerized machines from those that lacked such features. It also divided human operators into more specific groups consisting of those operators with access to the new devices and those who used non-computerized predecessors. In so doing, the presence or not of a computer accounts for the performance of the human operators, while also making possible the collateral benefit for the operator who was now freed from tedious calculations. Doing so resignified the computer as both an enhancer of human performance and as a relief of the most tedious – yet crucial and intellectually intensive – part of the operator's job. This division in turn had great implications not only for the computer but also for the nature of work. By adding computers to equipment, the presence of an intermediate device — the computer — is rendered opaque and unperceivable. Second, the human operator relinquishes the most intellectually-invested portion of their job, transferring these competencies to the computerized apparatus in what is in effect deskilling.[34] Adding computers to machines that operators already knew how to use allowed the computerized equipment to blend in easier, thus allowing personnel with little or no additional training to successfully adapt to the new versions. However, in so doing, the presence of the computerized element receded into the background and, as such, the performance of the human operators could be perceived as comparable to those operating non-computerized versions of these devices. The performance of the equipment does not come into question (as it remains mostly unchanged), unlike the actions undertaken by its operators.

The process of deskilling implied by these moves enhances the importance of the computer. Given the centrality of the calculations in the evaluation of the operator's efficiency, it follows that the calculations entrusted to the computer not only represented the differential element in the ameliorated operator outcome, but also that such metrics largely reproduced the rationalist principles which had modelled the computer's initial conception. As such, the dual move of delegating onto the computer the processes of mathematical calculations, on one hand, and resignifying these processes as the definitive scale of performance, on the other, produced a self-fulfilling feedback loop. Through these moves, the computer became exalted – by performing exceptionally well in metrics derived precisely form the computer's capabilities – while the human operator became stripped of the defining technical skills implied by his job.

As a result of this process, two conclusions become apparent: first, the computer now has the ability to outperform the human in tasks previously reserved for human operators; second, human operators of computerized machines can be less skilled.

In combination, processes of rationalization of human actions and operator deskilling posit the computer as a viable proxy of the human operator, capable of performing the most critical tasks while relying on the operator solely as its eyes and hands. The demotion of the human operator to nothing more than the equivalent of the computer's afferent/efferent senses (until the computer acquires its own) becomes resignified as a side effect of progress and fully dismissed or, at most, assumed as a transitory stage through which society must traverse on its path to ultramodernity. In the case of the postwar United States, that pathway would become charted by a flourishing consumer society, contingent on elevated mass production and mass consumption.

Expansion of the proxy relationship: computerization of human actions

Although these processes occurred within the context of WWII, the resulting conceptualization of the computer as a proxy to the human operator would persist in America until the end of the decade and extend into the popular imaginary well after that. Fears elicited by the possibility of becoming replaced by a computer – reproducing those of the earlier push for automation at the beginning of the century – did not represent new concerns, but rather became dismissed by the technocratic and industrial elites as mere resistance to progress.[35] Posited by these elites as a clear sign of progress, the computer came to be culturally produced in post WWII as reducing the drudgery of laborious tasks. At the same time, workers' unions and other divergent voices would find in the prospect of computer proxies the Leviathan of a renewed – and seemingly unstoppable – rationalization of human life. Both condensed the articulation of several broader processes of transformation of the relationship between humans and technical apparatuses in a variety of mass-produced goods – a process and relationship that would become shaped and also help shape the social practices over the next decades.

The proxy relation produced between operators and computers came to inform a wide range of technical-consumerist needs, thus providing further evidence of its centrality. That America was no stranger to electronic machines is attributable to the increased penetration of the radio, the telephone and, later, the television. These three transforming technologies became not only means of communication but – in the case of the radio and, more increasingly at the time, the television – the center of family entertainment. Access to electrical power and a growing interest in novel inventions spurred the curiosity of amateur experimenters and enthusiasts. As such, not only had each of these inventions normalized, with increasing degree of success, the usage of electronic equipment within American households. They also spurred the development of a growing leisure market around electronics that was booming by the early 1950s.

One particular change evidenced in leading publications devoted to electronics and do-it-yourself projects at the time is a transformation in the conception of do-it-yourself hobbies from artisanal modes implying ad hoc production to industrial modes of serialized assembly. This transformation fit with an equally profound transformation in the value of these hobbies. By relocating technical skills from the user to the apparatus, a trend emerged that reproduced, in an uncanny manner, the operation identified through the example of computerized devices within the context of WWII, and that would underlie the development of consumer electronics — and, specially, computers — in years to come.

Specific examples of this transformation helps substantiate it. Fascinated by the possibilities of electronics, informal experimenters, enthusiasts, amateurs, and hobbyists of electronics and radio emerged in America since the first decades of the 20th century, prompting the development of popular press publications that overtly promoted experimentation within the field of electronics as early as 1908.[36] Common features of these magazines included instructional articles and schematic designs that required of its readers some specific skills, particularly in crafting ad hoc pieces for the largely artisanal setups depicted. During the first decades of the century, publications such as *Radio Amateur News*, *Modern Electrics* and *Radio Age* evidenced an increase in the availability of industrially manufactured electronic DIY kits, which gradually debased the artisanal character of earlier projects in favor of those requiring only the assembly of its premade parts.[37] By the latter part of the 1940s, articles and advertisements contained in these publications began to laud ease of assembly, which made it easier for more people to buy, assemble and enjoy these kits.

Although one could consider the increased availability of industrialized DIY kits as an indication of the improvement of mass-production techniques during the mid-20th century or the sudden increased availability of wartime surplus electronics materials, their widespread acceptance and growth was structured by the proxy relation pioneered in the development of computerized machines. In both, technical skills are transferred from the users to the apparatuses. Also like that of computerized machines, this transfer was produced not simply as a devaluing of human contributions and skills, but rather as a dual process of demoting the apparatus' mystical character into one more mundane and manageable, as well as of a heightening a sense of empowerment of the user, despite requiring of these users fewer skills and knowledge.

Other popular innovations that emerged or became popularized within this context present a similar logic of demanding less technical know-how by the users, such as paint-by-the-number kits or ready-to-eat meals such as TV dinners. These and similar industries that flourished in the 1950s in America share key characteristics. Participation in their consumption — whether DIY kits or TV dinners — becomes highly determined by the manufacturer, pre-packaged in a ready-to-consume method of delivery, in which the user has few choices to exercise. As such, this trend allowed for an increased level of control due to the homogenization of production and consumption, thus reinscribing the basic tenements of Fordism and Taylorism. In doing so, these characteristics and their embodiment displaced the technical skills required under previous modes of production, in which either artisanal or in-home elaboration processes played a more prevalent role. Thus construed, these booming industries of the mid-20th century America successfully articulated a gradual — yet constant — process of demotion of technical mastery from a quality attributable to the human users, to characteristics reified by the commercially available commodities, something that would seep into other areas of societal participation under the appeal of increased ease of use.

Users' lack of technical expertise became resignified. Where having a cooked meal or a radio set prior to these developments depended on user skill, with these changes they emerge as legitimized entryways into mass consumption. In a seeming contradiction to the technocratic values through which 20th century industrialism had emerged, the increased reliance on technical devices and the abandonment of the primacy of possession of technical skills became articulated as simpler paths to the enjoyment of modern comforts and pleasures.

Although far from the mass-market commodity status that the computer apparatus would attain several decades later, advertisements of this period promoting computerization articulate the same values as industrially-manufactured DIY kits and ready-to-eat TV dinners. Together they invite unskilled workers to join the growing area of computerization, as either the corporation or the machines would be capable of supplying them with the missing knowledge. Thus construed, the deskilling of workers made possible by the atomization of the different industrial and operational processes into discrete units which computerization would make possible, put into practice the conceptual basis upon which Fordism had become structured. These changes that were organized by the proxy relation of humans to machines rendered the transfer of technical skills from people to machines as a normal and desirable process. It was a key way of increasing access to the benefits of "the modern," thus reiterating the values of the prewar discourses. As such, advertisements and commercial endeavors targeting the general population served as normalizing discourses, positing the technical developments as sure routes of access to modern pleasures and comforts and, in doing so, disguised the process of displacement under the argument of increased individual empowerment.

Chapter summary and conclusions

As a result of the interplay of the processes previously identified, two qualities attributed to computers seem to drive the characterization of computers and their human users during this period: first, the likening of computational processes and human reasoning, which allowed for the articulation of the role of the computer as a *proxy* to its human operators and which became further sustained on the absconding of the operation of computers through the addition of computational capabilities to pre-existent equipment; second, the displacement of technical skills of the users toward the technical advancements as an element empowering the user. Both of these qualities seem to operate in complementary directions — the former positing the viable replacement of the human operator by the computer, the latter furthering the possibility of human reliance on the technological apparatus — thus constituting a clear rationale upon which the relationship between humans and computers became initially established.

The characterization of the computer and of its user became produced through a complex process whereby the attributes assigned to one of them served as the basis for the attributes assigned to the other. This process of co-determination, however, does not stand in isolation from the context in which it takes place but, on the contrary, becomes deeply affected by it while contributing to its transformation.

As such, the initial moment of transformation from the instrumental view of technical apparatuses inherited from the Industrial Revolution to the quasi-deistic character attributed to the computer as the defining element in the Allied triumph of WWII became effected not only by the development of new affordances of computerized apparatuses, but more significantly by the context in which these developments took place. Thus construed, the production of the computer and of its user responded to the social processes articulated during WWII, in a certain sense reproducing the de-sensitized sentiment that emerges as a generalized defense mechanism in the face of prolonged armed conflicts. The resulting characterization of the human computer operator — replaceable by someone else with equal rank, replaceable in the operation of the computerized apparatus — seems to find a counterbalance in the characterization of the computer as its all-powerful and infallible *proxy*. However, whereby this conception might have seemed appropriate within the context of WWII, providing a sense of invincibility to the military operations in which computers were used, the conditions surrounding its eventual transference to the civilian world require a revision of the basic tenements of these characterizations.

Against a backdrop of changing relationships between users and technological apparatuses which became reproduced in areas as dissimilar as do-it-yourself leisure kits and ready-to-eat TV dinners, affording pre-existent equipment computational capabilities both absconded the presence of the computer and furthered the transference of technical skills from the human user to the computer. The growing trend toward the institutionalization of an increased reliance on technical developments as a widespread practice becomes evidenced in common, everyday segments, such as do-it-yourself kits and TV dinners. As such, it would suppose a continued and far-reaching trend, which would extend onto later technical developments.

Given the discussion of these transformations, it becomes possible to assert that the processes of co-determinate production of the computer and its user not only becomes transformed by the contexts in which they occur, but also effect transformations on said contexts. As such, the interplay between the specific processes of co-determinate production of the computer and its user and the general societal processes through, by, and against which they become transformed seem to constitute a continuous feedback loop, such that neither the specific nor the general processes in question could be conceived of in isolation. Beyond re-inscribing one of the basic theoretical commitments of this investigation, this assertion places the emphasis of inquiry in the resulting interplay between the specific and general processes through which these transformations become effected. However, as this interplay necessarily implies a series of continuous processes and transformations, positing the existence of a determinate point of stasis defined arbitrarily seems not only capricious, but entirely indefensible from a methodological perspective. A contrary approach, then, supposes that — precisely because of the ongoing nature of these processes and transformations — it becomes necessary to center their inquiry on a concrete vestige produced through said interplay. As advanced in a prior chapter, in the case of technology, the apparatus represents such a vestige and, therefore, stands as the congealment of the different processes of production — both specific and general — through which it has become articulated into a material reality.

The previous assertion, however, does not uphold the primacy of the apparatus as a reified and transhistorical congealment of its production processes, but rather posits its centrality as contingent on the context within which it becomes (re)produced. Thus construed, the apparatus simultaneously stands as both, the finalized point of arrival of antecedent processes of production and the inherently incomplete point of departure of posterior processes of production.

Notes to Chapter 2

[1] Braverman, 25th anniversary ed.

[2] James Beniger, *The Control Revolution: Technological and Economic Origins of the Information Society* (Harvard university press, 2009).

[3] "The Thinking Machine," *Time Magazine*, January 23 1950.

[4] Alan Turing, "Computer Machinery and Intelligence," *Mind* 59, no. 236 (1950); John von Neumann, "First Draft of a Report on the Edvac," *IEEE Annals of the History of Computing* 15, no. 4 (1993).

[5] Beniger; Turing; von Neumann.

[6] *What Is Electronics?*, (Radio News: RCA Victor, 1943), Advertisement.

[7] *An Amazing New Way to Play Records! Magic Brain Rca Vitrola*, (Life Magazine: RCA Victor Co., 1941), Advertisement; *A "Magic Brain" and "Magic Eye"... Yes!*, (Liberty Magazine: Radio Corporation of America, 1936), Advertisement; *Overseas Air Lines Rely on "Magic Brain" LISTEN - A 6 Page Advertisement of the Radio Corporation of America* (Life Magazine: Radio Corporation of America, 1937), Advertisement.

[8] *It Ought to Get a War Medal*, (Popular Mechanics: Bell Telephone System, 1943), Advertisement.

[9] Ibid.

[10] "B-29 Electronic Gunsight," *Radio Craft and Popular Electronics*, March 1945; "New Electronic Gun Director," *Radio Craft and Popular Electronics*, February 1944.

[11] "Electrical Brains Help Run the World," *Popular Mechanics*, July 1939.

[12] "Electrical," in *Oxford English Dictionary* (Oxford University Press); "Electronic," in *Oxford English Dictionary* (Oxford University Press).

[13] Russell H Lasche, "Electrical Computing Airborne Gunsight," *Radio News*, February 1945; "B-29 Electronic Gunsight."

[14] "Electrical Brains Help Run the World."

[15] "The Thinking Machine."

[16] Ibid.

[17] William Ross Ashby, "The Electronic Brain," *Radio Electronics*, March 1949, 77.

[18] "6th Corps Area Signal Battalion," *Radio News*, October 1941, 24.

[19] von Neumann.

[20] "New Electronic Gun Director," 270.

[21] "B-29 Electronic Gunsight," 369.

[22] David Fidelman, "Electronic Digital Computers - Part I," *Radio & Television News - Radio-Electronic engineering insert*, September 1948, 3.

[23] T Powell, "Electronics and Air Power," *Radio Craft and Popular Electronics*, September 1944; "Electronics and Air Power, Part Iii," *Radio Craft and Popular Electronics*, November 1944; "New Electronic Gun Director," ibid., February; "B-29 Electronic Gunsight."; T. E. Holland, "B-29 Electronic Gun Control Tests," ibid., October; Fred Shunaman, "Radar - Secret Weapon No. 1," ibid.

[24] Thorstein Veblen, *The Theory of the Leisure Class* (New Brunswick: Transaction Publishers, 1992).

[25] Max Weber, *Economy and Society: An Outline of Interpretive Sociology* (Berkeley, CA: University of California Press, 1978).

[26] Don Slater, "Looking Backwards," in *The Consumer Society Reader*, ed. M. J. Lee (Malden, MA: Blackwell Publishing, 2000).

[27] Frank Stricker, "Affluence for Whom?--Another Look at Prosperity and the Working Classes in the 1920s," *Labor History* 24, no. 1 (1983).

[28] The increases in wages of skilled workers and technocrats during the 1920s in the United States, which contrast with the slight decreases or meager increases in the wages of unskilled labor during the time, further underline the valorization of specialized knowledge at that time in America, as shown by Stricker.

[29] *Do You Ride to Business on a High Wheel Bicycle? Of Course Not!*, (Time Magazine: IBM, 1930), Advertisement.

[30] *Theories Nearly Ruined Their Business Now They Work with Facts,* vol. 19 (Time Magazine: IBM, 1932), Advertisement.

[31] *When You Sign the Payroll Check Don't Wonder Know!,* vol. 23 (Time Magazine: IBM, 1934), Advertisement, 13.

[32] Charles Chaplin, "Modern Times," (Chatsworth, CA: Image Entertainment, 1936); Slater.

[33] It becomes necessary to use the compounded sense in which both electronic digital computers and simpler electronic analog computers became bundled up into a unique category under the rubric of ‘computers.’ Although both types of apparatuses represent different uses and became developed through different processes, the usage of the label ‘computer’ to indistinctly indicate either type in the popular press of the time warrants their production as a cultural object merging both categories.

[34] Braverman, 25th anniversary ed.

[35] "The Thinking Machine."

[36] Hugo Gernsback, "To Our Friends," *Modern Electrics*, April 1908; "Why "Radio Amateur News" Is Here," *Radio Amateur News*, July 1919; Kristen Haring, *Ham Radio's Technical Culture*, Inside Technology (Cambridge, MA: MIT Press, 2007).

[37] For examples, see: *1950 Progressive Edu-Kit*, (Radio & Television News: Progressive Electronics Co., 1950), Advertisement; *Heathkit Service Instruments*, (Radio Craft: The Heath Company, 1948), Advertisement.

CHAPTER THREE: The peer form of relationship

The objective of this chapter is twofold: on one hand, to understand the peer form of relationship that became constituted as the result of the incorporation of the computer into the American workplace following the end of WWII; on the other, to understand how this relational form constituted significant changes to that of the proxy discussed in the prior chapter. The enactment of the *peer* relationship forced the establishment of a dialogue between operator and computer, while the physical means through which this became effected served as the material concretion which would eventually become conceptualized and known as the human-computer interface.

In response to these objectives, the investigation posits that proxy relations were transformed by the need to mass produce more useful and adequate computers to the managerial and commercial tasks that drove the post-WWII economy. As Campbell-Kelly, Yost, Ensmenger, and Aspray note, like other industrial or manufacturing areas, that of computation confronted the need to redirect its production following the end of WWII, thus fostering considerable attempts by computer manufacturers to redesign and reposition their apparatuses as general purpose computers for use in varied civilian endeavors.[1] These attempts came about due to two main considerations: first, the elevated costs associated with massive technical projects like the ones undertaken during the war made unsustainable the large-scale production of computers during times of peace, other than in the framework of defense industry 'contracts'; second — and partially brought on by the solution to the prior point — the incorporation of the computer within varied contexts of the civilian world forced computer scientists to consider the generation of less task-specific means through which more users could operate computers.

The departure from the correspondence between architectural design and functional operations implied by the emergence of the general purpose computer allowed computer manufacturers to target more potential clients within the civilian market, partially serving as a way to reduce the economic pressures imposed by their costly production processes.[2] In doing so, the application of improved mass production techniques developed during the war would play a crucial role in helping achieve more cost-effective production arrangements.

The processes through which the computer became reconceptualized and redesigned into a valuable device for commercial and managerial endeavors after abandoning the laboratories and war operations entailed its necessary transformation of the heightened characterization resulting from WWII that posited the computer as a *proxy* for its human operator. As a result of technical developments and commercial needs, the computer became transformed into a general-purpose machine thus allowing its seamless incorporation into the American workplace of the 1950s, while deeply transforming the relationship between the machine and its user.

To substantiate this argument, the chapter first addresses the cultural construction of the peer relation, which was produced discursively through the separation between the computer's form and its functions and the further addition of technical capabilities. It then discusses how the peer relationship became manifest in computer design and use. Finally, the chapter concludes by noting ways in which the peer relationship articulated other diverse processes, suggesting its importance and effectivity beyond computing.

Emergence of peer relationship: producing the computer through its uses

A peer relation (the computer as similar to its human operators, yet not substituting them) emerged through the separation between the computer's form and its functions and the further addition of technical capabilities. Along with enabling the general-purpose computer's "absorption" of functionalities previously restricted to task-specific apparatuses, this cleavage between form and functionality provided the usages given to the redesigned machine centrality in terms of its cultural construction.

The redesign of computers for managerial endeavors, industrial control, and other tasks as opposed to solely scientific or military purposes signaled profound changes in the relation between the human operator and the computer. The resulting peer relationship was produced through the active process of transformation in the characterizations of computers, increasingly coming to focus on what they were used for instead of what they were. This process placed the operator and intentions at the center of defining what the computer could do, instead of any intrinsic quality of the computer. In doing so, the peer relation became constituted, in that the computer "becomes" itself only through the use of a human operator.

Unlike the proxy relationship analyzed in the previous chapter that became produced through the use of task-specific computerized devices, the peer relationship established through the general purpose computer was not determined by what the machine was, but rather by what it could be made to do. Unlike gunners' sights or electronic gun directors, whose purposes and operations were determined by their design and functionality, the cleavage between the general-purpose computer's form and functions gave the operator a central role in determining how the computer could be used, and, as such, in what the machine was "made to be." As such, the relationship between the operator and the computer was what – in the last instance – produced the computer.

Given that, as mentioned in the previous chapter, the label "computer" had come to represent an entire category that included both the task-specific computerized devices used in military field operations and the "large calculators" employed in complex calculations within scientific, academic, and military research centers, the term became indistinctly applied to both types of equipment. As such, given that the term "computer" applied to a broad spectrum of devices, the concept of the operator has to be made equally expansive, serving to identify both individual operators and organizations.

A series of IBM advertisements from the early 1950s showed a device that could be useful within areas other than military planning and scientific research. However, unlike the task-specific devices on which the proxy relationship had become established, the general-purpose computer was portrayed as not having pre-defined functionalities. Instead, it had to become made only through the ways in which it was put to use in managerial, commercial or industrial applications, among many others.

Under the headline "Electronics at work," a 1950 advertisement for IBM gave three hypothetical situations in which computers were apparently being used other than for military ends: in business, in scientific research, and in engineering. While the copy of the ad noted that "these intricate requirements and countless others are being met at amazingly high speed through the use of IBM Electronic Business Machines," three images of elegantly-suited white men – each tending to different "intellectual tasks" – seem to orbit around "the IBM Electronic Counter, basic unit of IBM Electronic Machines."[3] The business manager, the scientific researcher, and the aeronautical engineer were – through their use of the computer – "making" it into a machine that controlled inventory and production schedules, a resource in atomic energy exploration, a way of testing airplane models. As the machine took on these different roles through the actions of the users, the relationship between the operator and the computer changed, transforming the incorporation of the computer within different human endeavors into an active process of production of the machine.

A later advertisement for the corporation would restate the central role played by the uses or applications of the computer in defining the working relationship with its operator. The ad inadvertently presents an opposition to the machine's intrinsic definition by first stating that "this momentous advance in electronic computing gives defense industries, for which this computer was especially designed," only to later mention that "[f]or peacetime uses, it will be applied to a wide variety of engineering, research, and scientific problems."[4] By opposing the original and intrinsic qualities of the computer to its possible future uses, the ad exposes the mechanism of transformation through which the computer is being made. This linguistic operation, although subtle, centered the computer's definition on the uses it could be given and, in doing so, established the relationship with its operator as both dynamic and generative of this definition. Graphically, the ad presents a large, nondescript, room whose walls are lined with a series of computers, while the only human presence is that of three white male operators – all wearing suits and ties – which could very well be engineers or business clerks. In doing so, the advertisement restates both the possibility of incorporating computers within any area of human action and the masculine nature attributed to handling computers at the time derived from the heteronormative roles sustained by mid-20th century advertisement.

A third ad for the company summed up both of these claims, noting that "IBM Electronic Business Machines are […] helping science and industry produce more good things for more people." A multiplicity of machines – from printers to electronic clocks – orbit around an electron tube, thus simultaneously underlining both its centrality in the world of electronics and the flexibility of applications its use allowed. In doing so, the advertisement once again stressed the process through which computers were being assigned to new roles, while also adding the notion that the computer constitutes an aide to science and industry.[5]

The changes in the way the computer became characterized did not only appear in advertisements, but also in news stories in the popular press, showing that the underlying mechanism of representation of the computer extended beyond the commercial claims made by the corporations manufacturing of these machines. As such, the perceived benefits of expansive computerization did not solely derive from or constitute commercial narratives, but became articulated as part of a broader and more generalized discourse spread through different means, including media outlets. In doing so, the seeming lack of vested interests of magazines and newspapers in the commercial success of computers served to validate the claims of the manufacturers, while providing their endeavors with a glimmer of disinterested social engagement.

The discourse articulated through these news sources would contribute to the construction of a positive portrayal of the expansive possibilities of computerization across different economic sectors. One early article published in 1949 in a popular magazine, for example, explained that the end goal of electronic computers was to provide answers to mathematical equations and that, therefore, "electronic computers have such applications in whatever field there are mathematical equations to be solved."[6] On one part, this claim reiterated the rationalistic assertions of the early 20th century; however, on another, it established the computer solely as an advanced calculator. Through this dual operation, the article differentiated between the computer's intrinsic definition as a mathematical machine from the definitions of it that emerged through the uses it might be given in any and all areas susceptible to mathematical modelling.

The purported computerization of both commercial and of non-commercial areas further contributed to constructing a narrative surrounding the new machines as highly malleable and, in doing so, allowed the articulation of different anthropomorphizing moves in regards to the nascent general-purpose computer. A news story featured in *Time Magazine*, narrating the various areas in which computers were being incorporated, noted that while one machine "has gone to work at the Weather Bureau, and will attempt to make weather forecasting an exact science," another one at the hands of airplane manufacturer Lockheed is "given all the characteristics of a plane [and it] tells what would happen in a real flight."[7] The article not only underlines the separation between the computer's intrinsic definition (what it is) and the emergent definition based on the uses it is given (what it does), but also amplifies the latitude of possible uses for the computer. The widened area of possible uses for the computer, then, amplifies the importance of the process through which the computer is made by its incorporation within different areas. Similarly, by anthropomorphizing the machine as someone who "has gone to work" or who "tells what would happen," the article reinserts the human – ostensibly absent from both mentions – by portraying the computer as a non-substitutive peer who goes to work (for/alongside them) or who tells (them) what would happen to a real plane.

Beyond representing the computer as a malleable and anthromorphized element, news stories would also contribute to establish a notion that the machines – in the last instance – represented an aide to the human worker, thus diminishing the anxiety and objections their incorporation in the workplace could produce. As an example, an article published in a highly influential magazine about electronics noted that, as of recently, computers had gained such a degree of versatility that "[i]n addition to doing all sorts of paper work, called 'data processing,' and performing control functions, they are now learning to 'lend a hand' in an increasing number of production jobs."[8] This story's mention of the computer's assistance, along with the increasing latitude of jobs in which they become included, not only underline the centrality of the computer's redefinition based on its usages, while also reinscribing the relationship with the human operator as one based on collaboration or, at least, of assistance.

A third, and more prominent, area in which the uses of the general-purpose computer would become determinant of its characterization are the promotional materials directly published by computer manufacturers. Given that the publication of these materials constituted – simultaneously – a commercial practice akin to advertisements and an informative endeavor close to a factsheet, the resulting discourse provides an unfettered view of the valuation computer manufacturers made of the technical developments they were promoting.

The claim that computers had "flexibility," "adaptability," "versatility," or any other similar variant, became a commonplace practice since the first commercial general-purpose computer, Eckert-Mauchly's Univac. In its brochure, the corporation argued that the computer system had been developed for use in "applications as diverse as air traffic control, census tabulations, market research studies, insurance records, aerodynamic design, oil prospecting, searching chemical literature and economic planning."[9] Later variations of this argument would consist, simply, of a generalized argument of flexibility or versatility, suggesting the computer could become incorporated – and, hence, recharacterized – within an increasing range of human endeavors. Through this operation, computer manufacturers not only increased their potential target market, but in doing so completely eliminated the notion that computers were anything other than that which the users made them to be.

A particular example, due to the clarity of the operation, is the 1954 brochure for IBM's 705, which – under the very appropriately heading "Flexibility" – would explicitly lay out the transformation of a general-purpose computer into a specific apparatus through its use. "A simple change of the stored program from one application to another turns the IBM 705 into a very specific, highly efficient, special purpose machine," mentions the brochure.[10] Underlining the separation between the computer's form and its functions, the brochure openly posits the how the machine becomes transformed through the uses its operator gives it. In doing so, the brochure achieves two goals: first, it implies the operator garners a generative centrality in redefining the computer through its uses; second, it establishes that the transformation of the computer is temporary and subjected to change again, if the operator introduces another "simple change of the stored program."[11]

The combined effect of these discourses allowed for the characterization of the computer to become established primarily on the uses given to it. As a result, references to the computer in different forms of printed media would gradually shift from considering "what the machine was" to "in what was it being used." The computer then "adopted" — or, for more precision, became attributed with — characteristics inherent to the tasks it undertook, yet remained determined by the usage given to it by its operator and made possible through the abandonment of an inherent notion of task specificity.

A key operation of this transformation – which subtly denotes the formation of the peer relationship between the operator and the computer – is the reincorporation of the human operator as the main actor in the usage of computers. As such, the emergence of this form of relationship would become evidenced in two changes in the syntax of the discursive formations: First, the appearance of syntactic formations in which the operator was the linguistic agent and the computer its patient, such as in the following example: "Air Force personnel will make tactical decisions which, in turn, will be carried out automatically by the computer. From this location, the operator can request additional information from the computer […]."[12] Second, the inclusion of verbs implying collaboration, such as "aid," "help," and "assist," as in some of the materials previously noted or in the following example: "It is believed that these computers when given the necessary weather data, together with certain information about the bomb, will assist in predicting what the distribution and intensity of radio activity will be on the ground […]." [13] These changes in the syntax of materials about general purpose computers imply conceptual transformations in the relationship between the machine and the operator which place the operator at the center of the process. This occurs in one of two ways: either through the use of specific grammatical arrangements or through the use of denotative verbs implying the operator's central role. However, these linguistic operations do not appear in isolation, but instead become intertwined with the narratives that note the emergence of the computer's characterization based on its uses. As such, they function as amplifiers – albeit subtle and, sometimes, unperceivable – of the general discursive production of the peer relationship.

Operation of the peer relationship: generation of an ontological entity through a collaborative dialogue

The peer relation responded to the proxy relation in three key ways. It established the computer as an equal to the human operator, thus reducing the anxiety produced by the computer's prior characterization as a human proxy. It produced the computer ontologically as an entity distinct from its human counterpart. It solidified a dialogical relationship between the computer and the user.

The first way in which the peer relationship responded to the proxy relationship was through a dynamic process of production of the computer, based on the uses it was given. This allowed two opposing approaches to emerge in relation to the characterization of the machine: one which saw in the lack of specificity of the general purpose computer nothing more than an instrument to that the human operator could make use of and another which reinscribed the heightened valuation of the computer emerging from WWII and which had served as the basis for the articulation of the proxy relationship.

The first approach to the lack of prefiguration of the computer espoused an entirely instrumentalist view of the machine. In doing so, it constructed the relationship between operator and computer in direct opposition to the proxy relationship analyzed in the prior chapter. "The machine, incidentally, cannot think entirely by itself," reads one news story of the time, dismissing the logical processes assumed of the computer as a proxy. As such, this argument denies all possibility of the machine becoming a substitute for the human.[14] Another article would underline the absence of logical processes while reinscribing an anthropocentric purview, noting that "[t]he electronic 'brain' cannot actually think for itself. Technicians must tell it exactly what to do […] The 'brain' is actually a mindless robot depending entirely on human guidance."[15] Other news stories, with similar articulations, would appear in the popular press at the time, pushing back against the heightened vision of computers implied by the proxy relationship and demoting the computer to the status of a mere instrument.

The second approach to the incorporation of the computer into civilian endeavors upheld the proxy character of the machine, preserving the its heightened valuation from WWII. As such, from this perspective, the superior logical capabilities of the computer represented its main element of differentiation from prior electronic machinery. This characterization articulated an entire discursive form that eliminated the human, both visually and narratively, and, in doing so, underscored the conception of the computer as an autonomous element with absolute independence from all human volition or action. For example, a 1954 ad for IBM's new 702 Data Processing Machine titled "A 'Giant Brain' that's Strictly Business" shows a detailed view of the two magnetic tape spools and the machine's tape-carrying mechanism in an anthropomorphized arrangement that resembles a close-up frontal image of a human head.[16] Another variant of actualized portrayals of the proxy relationship, this time present in an advertisement piece for Remington Rand, shows an outstretched index finger from a single decontextualized human hand in the instant before making contact with the computer's ON button against the vast emptiness of space, pictorially reproducing Michelangelo's *The Creation of Adam*.[17] The continuation of this established view, as well as its preponderance in advertisements and news stories at the time, served as the base construction from or against which new and divergent characterizations of the computer could develop.

These two approaches constituted antithetical discourses, which would come to be resolved in the popular press of the time in one of three ways. First, through their direct coexistence, such that both approaches were upheld through separate claims or arguments. Second, through negotiation, such that a middle position emerged in claims partially accepting portions of each approach while rejecting others. Third, as their synthesis, through the articulation of a dynamically-produced characterization continuously and solely remade through the uses given to the computer by the operator. This latter position situated the computer on a different plane than that of a "mindless robot" or a "Wellsian brain," providing centrality to the process of production of the computer through its relationship with the operator. In doing so, this approach ascribed the relationship with a generative quality while allowing the computer to become both, an extension of the operators and a product of their actions.

The process through which both computer and operator became negotiated and produced not only altered the characterization of the computer but, most importantly, transformed the terms in which the peer relationship with the human operator became conceptually constituted and discursively articulated. As such, the gradual abandonment of the opposing approaches to the computer produced the machine and its operator as non-competitive collaborators, thus dispelling the ominous prospects implied by the proxy relationship while avoiding the demotion of the computer to a mere hyped-up calculator. Several advertisements and news stories of the time articulate the presence of the computer in the workplace not under the menacing prospect of the replacement of the human worker or as a mere piece of bureaucratic office equipment but, instead, as a human peer that could contribute by maintaining — and perhaps improving — the labor conditions of those workers directly involved in areas becoming computerized.

The negotiation of the different approaches to the relationship between the human and the machine would serve to articulate several discourses around computerization and, in doing so, contribute to the cultural production of both operator and computer through widely accepted means. As a prime vehicle facilitating this formation within a capitalist system, advertising would play a key role in establishing the narrative around the computer-human peer relationship.

Evidence of the formation of these discourses can be seen, for example, in a 1956 advertising piece for Autonetics, which sought to rationalize the arguments of the proxy relationship by expounding the limitations of the human intellect. As such, the piece explained that "because of the complexity and number of his problems – when the speed needed to solve them is beyond human limitations – he has to create electronic servants that can compute, decide and act for him faster than his brain can think."[18] Although the advertising implied some degree of substitution of the human operator, it justified this move based on human limitations, while expressly demoting the computer to the role of a servant.

A different articulation of these discourses would be centered on the benefits perceived through the inclusion of computers in everyday endeavors. An example of this can be found in another advertisement, published by Bendix Computers the following year, which used the title

"Bendix computers are lifting the burden from busy engineers" while its copy stated that the "computer is a priceless 'assistant' to the overburdened engineer."[19] In articulating the peer relationship, this advertisement directly characterized the computer as an "assistant" to the human, thus applying one of the linguistic mechanisms noted in the previous section regarding the emergence of this form of relationship. If the overburdened engineer needed an assistant, he now had it in the form of metal cabinets, transistors, and cables; an assistant that would lift the burden, but that did not compete with the engineer. Two superimposed images illustrate the piece: in the background, the image of an white "older" male engineer tiredly looking at a sliding ruler fades into the white magazine paper while – in the foreground – a younger, yet also white male, engineer sits comfortably at his desk, merrily glancing over his teletype-style keyboard at the two vertical metallic cabinets, his new "assistant."[20]

As well as these two pieces, various others would help produce the computer as a human peer, thus steering away from the ominous prospect of the proxy relationship by attributing to the computer a role that purported support for the operator instead of substitution. Although the emergence of the peer relationship seemed to push back against the proxy form of relationship discussed in the previous chapter, characterizing the computer as a non-competitive equal to the operator resignified the process of deskilling. Under the computer's characterization as an aide to the human operator, the notion of the machine freeing humans from the drudgery of laborious and tedious tasks becomes a potent articulation of the peer relationship, serving both to appease resistance to the underlying process of deskilling and to provide concretion via tangible benefits to an otherwise ethereal argument.

By characterizing the computer as a non-competitive aide for the human operator, the articulation of a peer form of relationship allowed the displacement of the laborious or tedious tasks from the operator to the computer to become resignified as a positive outcome inherent to this form of relationship. Similarly, unlike the claims espoused within the formation of the proxy relationship, the "laborious and tedious tasks" subjected to transference within the peer form of relationship were not identified as intellectually-intensive activities (such as mathematical calculations) but rather remained undefined as "tasks." In doing so, this narrative downplayed the process of deskilling, which could have otherwise elicited greater resistance from workers and labor unions. In its place, this discourse articulated a portrayal of the computer as a peer willing to absorb the most negative aspects entailed by the job at hand.

Within the techno-optimistic discourses displayed by news stories portraying this transference as a benefit for the operator, the claim served as a concentrated and colloquial argument in favor of the ideals that upheld the prospects of widespread computerization. *The New York Times*, for example, featured an article in 1955 discussing automation in general – and "electronic brains" in particular – arguing that "[i]t promises a vast expansion in goods and services, sharp reductions in prices and increased opportunity for the enjoyment of leisure. It makes the three-day week-end a realizable goal; it offers emancipation from the drudgery of routine, repetitive tasks."[21] That same year, in a *Time Magazine* article, IBM's board president at the time, Thomas J. Watson Jr., would be quoted as saying "[o]ur job is to make automatic a lot of things now done by slow and laborious human drudgery."[22] News stories in *Electronics Illustrated*, *Computers and Automation*, *Radio & TV News*, *Popular Electronics* – among many other publications – would utilize the same claim, thus constituting a common dominant narrative in favor of computerization.[23]

This first way in which the peer relationship responded to the proxy relationship emerged from the dominant discourses which encapsulated this nascent form of relationship into a palatable and marketable shorthand, such as that endlessly reproduced in the previously mentioned magazines and newspapers. In this sense, although the arguments and the wording of the claims regarding the perceived benefits of computerization seemed to constitute a concerted advertising campaign, their repetition is a sign of a growingly hegemonic purview on the benefits and possibilities of technological development. The seeming homogeneity in the claims espoused by these publications not only indicates the pervasiveness of American mid-century techno-optimism, but also provides evidence of the popular press as one of the main mechanisms through which the dominant purview on technology became reproduced in the 1950s.

A second way in which the peer relationship responded to the proxy relationship was through the production of the computer as an ontological entity distinct from its human operator. As mentioned in a previous section, the cleavage between the general-purpose computer's form and its functions both allowed and required the production of the computer through two different, although interrelated, processes. First, through the relationship established between the operator and the computer, which resulted in the dynamic process of making the computer through its usage. Second, through a dialectic operation, which resulted in a device distinct from both the mere instrument and the heightened computer of WWII.

The dynamic and continuous nature of these two processes, which hinged on the computer's constant production "through its usage," made it impossible to consider the machine – even once produced through a specific set of usages – as a permanent arrangement. This continual possibility of transformation (made salient in materials such as IBM's 705 brochure referenced above) produced the computer on a level more similar to that of the operator, yet constantly changing as the operator's usage of it changed.[24] Conversely, since the operator's activities were also transformed through the use of the computer, in a certain sense, the relationship also produced the operator who changed as the computer she used changed. As a result of these processes, the peer relationship rendered both the computer and its operator equal yet distinct, autonomous yet co-determined, ontological entities. As such, the computer became subjected to a process of individuation that completed its transformation into a human peer.

The coexistence of the computer and the operator as distinct ontological entities made it conceptually impossible for them to become collapsed into a single ontological entity, such as that supposed by the previous characterization of the computer as a human proxy. Once the possibility of substitution of the human by the computer as its peer became negated on an ontological plane, the establishment of a relationship between both entities could become established — at most — on egalitarian terms.

Several printed materials of the time articulate this egalitarian relationship through the portrayal of the computer in the civilian workplace as a non-competitive partner to the human, aiding in the achievement of better results. In doing so, these discursive resources re-inscribed both the computer as an ontological entity and its role as a non-competitive peer.

The brochure for IBM's 1401 system announcing the new product line, for example, articulated these two topics in a very salient manner, providing relevance and intent to the enactment of a peer relationship between the computer and its operator. "What is Balanced Data Processing?" the brochure interrogates, only to immediately answer, "[i]t is systems and services… machines and men."[25] Under the rubric of "balanced data processing" IBM's brochure underscored the collaboration between computer and operator as a factual relationship and, as such, articulated the notion of ontological equivalence between computer and operator implied by the peer relationship. In doing so, this move dispelled the ominous threats of substitution by computers that had predominated in the proxy form of relationship, partially resolving the fears expressed by labor unions and the general public.

As equal partners in a relationship, it would also become necessary for the operator and the computer to exchange information in an egalitarian manner, such that the information provided by either one of the partners in the relationship could affect the actions and responses of the other. In the case of the proxy relationship, this was not necessary, due to two considerations: first, that the proxy form of relationship did not seek to establish the computer and the operator as egalitarian partners and, second, that the means through which the operator and the computer shared information corresponded to those of the pre-existent devices used. Within the peer form of relationship, however, the urgency of establishing means of exchange of information between the computer and the operator not only sought to enact this relationship on egalitarian terms, but were also produced by the cleavage between the computer's form and functions.

One important technical development that influenced this process was the inclusion of an internal (core) memory in the architecture of the computer, which allowed the storage of intermediate calculations or program sequences, in substitution for the magnetic drum.[26] However, unlike the magnetic drum, the computer's memory and the processes it entailed remained hidden from the user, providing the computer with an "internal" world directly inaccessible to humans and that could only become available via representations perceivable by the human operator.

This characteristic would require the development or adaptation of ways in which to allow these representations and the human actions they elicited to take place, thus bridging the internal processes of the computer with the external world of the operator and vice-versa.[27] From this perspective, the development and incorporation of general and standardized means of control

– visual displays, keyboards, printers, scanners, and light pens, among other – sought to bridge the internal/computer-external/operator divide. In doing so, the existence of an internal world of the computer and an external world of the operator as well as the means for traversing this divide established a dialogical basis for the peer relationship to become enacted.

A third way in which the peer relationship acted as a response to the proxy relationship was by solidifying a dialogical relationship between the computer and its operator. It did so through two distinct ways: first, through the incorporation of naturalized higher-level computer programming languages and, second, through the elaboration of particular apparatuses through which to effect the dialogical relationship.

As mentioned previously, the cleavage between the computer's form and functions which made possible its constant production through the uses it was given also made possible a separation between the computer's internal word and the operator's external world. To bridge this internal/external divide and carry out the constant process of production of the computer, would require a fluid exchange of information between the computer and the operator. To become enacted on egalitarian terms and allow the fluid exchange of information between the computer and the operator, the peer relationship required the establishment of a certain "dialogue" between the entities that formed this relationship. As such, the establishment of a dialogical relationship between the operator and the computer served as a means to bridge the internal/external divide of the computer, allowing for the enactment of the computer's ontological character and, as such, the peer relationship with its user.

Two significant technical developments would allow this dialogical relationship to become concretized and expanded, providing responses to the previously identified purposes: first, the development of naturalized higher-level computer programing languages, which would serve as the shared code between the human operator and the computer; second, the concretion of particular apparatuses through which the operator and the computer could exchange information. The development of the means through which the dialogical relationship became concretized prefigured the human-computer interface and, as such, reified the dynamic processes implied by the dialogical relationship.

Unlike prior lower-level programing languages in which the operator used of binary or decimal codes, the development of semantically-complete higher-level languages (such as COBOL) allowed the operator to use natural language elements to provide instructions to and extract information from the computer. In launching a computer system in 1959 General Electric, for example, articulated the purpose of using naturalized computer languages by noting that "[t]o utilize most effectively the automatic techniques inherent in computing systems, a language, common to both man and machine, is needed for the processing of business documents."[28]

Although the manifest intention of using naturalized languages corresponded to the commercial interests of computer manufacturers, as noted in the above example, the importance of this move can only be weighed against the context of the effective enactment of the peer relationship between the computer and the operator. In this sense, the use of "a language, common to both man and machine" allowed the computer to become reinscribed as both a peer and an ontological entity who shared the operator's symbolic means of communication, thus concretizing the dialogical nature of the peer relationship by providing common linguistic means through which to enact the computer-human exchange of information.

Along with the naturalization of computer languages, a second technical development that solidified the dialogical relationship was the development of means by which to exchange information between the operator and the computer, thus bridging the gap between the computer's internal world and the operator's external world.

Unlike its wartime predecessors that mostly depended on the addition of computational capabilities to already-existent devices, general-purpose computers were defined by the cleavage between their architecture and operation, thus requiring the development of particular apparatuses which allowed the exchange of information between the operator and the computer within the different areas of usage of these machines. However, producing the computer through its applications required that the particular apparatuses employed in their usage remained specialized in regards to the operation of the computer, yet general and standardized in regards to the use being given to the computer.

The transit from task-specific devices to general-purpose computers transformed the correspondence between the actions of the operator and the results obtained from the usage of the computer and, in doing so, allowed two significant and deeply interrelated processes to take place: on one hand, the reduction of all human processes of production which required specific actions and means to machine-dependent processes which used standardized actions and means; on the other, the initial displacement and later reification of the human processes carried out through the particular apparatuses used in operating the computer. Both of these processes, however, remained closely tied to the production of the computer and the particular apparatuses employed in its operation through their usages and, as such, creating their capacity to "be made into" whatever the operator required them to be.

The reduction of human activity into standardized computer-dependent processes came about through a dual operation. First, the correspondence between operating task-specific devices and the results obtained through those operations became ruptured through the substitution of these task-specific devices in favor of the standardized apparatuses required by the general-purpose computer. Second, enabled by this rupture, a new correspondence was established through the use of the computer. This allowed the use of the standardized apparatuses in substitution of the task-specific apparatuses and, in doing so, produced them as specific means of operation. For this process to expand onto other areas of human actions, all that would be required – it seemed – was those areas to become subjected to mathematical modeling. Given the constant emergence of new areas in which computers were being incorporated, the expansion of mathematical modeling seemed more a factual reality than a theoretical possibility.

By enabling the constitution of a new correspondence between the operator's actions and the results obtained through the general-purpose computer, the dialogical relationship between operator and computer acquired a generative character, allowing the usage of the computer – first – and the standardized apparatuses it employed – second – to become produced in substitution of any and all processes previously carried out through task-specific apparatuses. In doing so, this dual process carried forward the rationalistic ideals of the early 20th century, purporting the control and optimization of all human processes in resemblance to processes of industrial automation.

This displacement of the human processes onto computer-dependent processes would also allow for the dialogical relationship between the operator and the computer to become a site of reification of the actions previously conducted through task-specific devices. As such, the standardized apparatuses could be turned into specific apparatuses through their usage, further allowing the lack of a predefined correspondence between the apparatus and the action to become concretized as inherent to the "intermediate" role played by the computer. For example, if a teletype keyboard turned into a typewriter when composing a letter, this redefinition occurred through the action of the computer; if it turned into a switchboard when controlling an industrial process, it was due to the action of the computer.

Much like the production of the computer through its uses, the multiplicity of possibilities of production of these apparatuses allowed them to “become what they were being used for.” However, this move did not consider the standardized apparatuses functioning as controllers of the computer processes, but rather as embodying the specialized means implied by the processes being conducted through the computer. The capacity of the standardized apparatuses in their factual operation (with the computer) to remain hidden behind their “ultimate” operation (through the computer) opened the possibility for the reification of the entire process through which these apparatuses became re-produced through their usage.

Expansion of the peer relationship: its articulation within 1950s America

Although the peer relationship emerged during the initial steps of the digital general-purpose computer, it continued to exert influence as one of the principal forms under which computerization would become construed over the following decades as the human-computer interface. The societal processes facilitated through the peer relationship would have a profound influence in the 1950s computer operator in America and, to a certain degree, on the entirety of society, due to the reliance on technology that the peer relationship professed and made available through the active and dynamic process of production of the computer.

The peer relationship reproduced some of the significant transformation in the American work ethos of the 1950s. The opposing views that had developed surrounding the computer after WWII – some assuming the heightened valuation of the proxy relationship, others demoting the computer to the role of an instrument – would become resolved by the emergence of the complex characterization of the computer as the malleable and contingent result of the operator’s activity.

The dynamic process through which the computer became made-in-use by the peer relationship had two implications. On one hand, it divested the responsibility of the production of the machine from the manufacturer to the operator and, as such, avoided the notion of an external element trying to exert control over the human operator. On the other, it portrayed the machine positively as an assistant to the human worker who could improve – yet not overtake – the worker’s job. The combination of these two elements reduced the threat supposed by the computer of the proxy relationship, while providing a concrete argument in favor of an extension of computerization, transforming the prospects of computation from an exercise of dominance to one of presumed liberation of the human operator.

One particular argument which concretized the presumed liberation of the operator derived from the computer’s capacity to reduce the burden imposed on the human by the repetitive or laborious tasks entailed by her job. Although this argument recalls that espoused in connection to the proxy relationship, two significant differences emerge. First, the dynamic process of production and the dialogue implied by the peer relationship repositioned the computer as a self-produced solution to the problems the operator envisioned in her own work. Second, the techno-optimistic narrative constructed by manufacturers and columnists around the production of the computer did not characterize the tasks being transferred from the human operator to the computer as intellectually-intensive or as a process of deskilling of the worker, but rather maintained these tasks hidden and undefined under the label of “tasks.” Both of these processes culturally produced an individual that was not necessarily incapable of matching the capacities of the computer – even more considering that these remained unmentioned – but rather one invested in seeking ways to reduce the drudgery of work they could yet refused to do and, therefore, dismissive of the inherent value attributed to labor.

As innocuous as this assertion might seem, it contradicts a characteristic purported as the cornerstone of the American ethos at the time and a key aspect of what Weber had identified as the felicitous coincidence of the Protestant ethic and the spirit of capitalism and, in doing so, underlined the far-reaching possibilities of the computer as an agent used to modify deep-seated societal patterns.[29] Through the enactment of the peer relationship, the search for simpler or less laborious ways of performing tasks considered tedious or menial became articulated in a complex arrangement, being purported as a direct, tangible, and liberating benefit for the operator and – simultaneously – operating through the extension of the process of deskilling of the human operator.

One area in which this contradictory duality became concretized was that of the development of programming languages. Although, as noted previously, the usage of semantically complete higher-level programming languages had incorporated the operator's natural language to simplify the exchange of information between operator and computer, later developments toward the end of the 1950s would seek to further facilitate programming by structuring a series of computer-specific instructions. Through this operation, computer manufacturers had traversed an entire ellipsis from computer-specific languages, through naturalized languages, to computer-specific arrangements using naturalized languages and, in doing so, had reinscribed the principles of the proxy relationship that constrained the operator's presumed freedom.

A clear example of this mechanism was IBM's 1959 launch of its proprietary Report Program Generator (RPG) and an accompanying library of common reports. Under the claim that the RPG represented a simplified form to obtain reports from an IBM computer, the system required the operator to introduce of a minimum amount of arguments while the computer took care of translating them into the entire set of instructions needed for the production of the report.[30] Through this operation, the RPG entirely bypassed the programming knowledge needed, and elevated the degree of operator deskilling while purporting the benefit of increased ease of use and, in doing so, underscored the codependence of the liberating benefit of a simplified operation and the limiting constraints of a deskilling process.

The continued use of this dual articulation by computer manufacturers during the second half of the 1950s underscores the relevance of this claim for its target audience, thus suggesting that the enactment of the peer form of relationship was successful in reducing the negative implications of the process of deskilling. Under the conditions of the peer relationship, proposals such as that of IBM's RPG or Bendix's move to provide its clients with access to more than 1000 pre-tested programs did not represent attempts by computer manufacturers to exercise control over the operators (as would have been portrayed under the proxy relationship) but rather more and easier ways in which the operator could engage in an egalitarian and generative relationship with and through the computer.[31] In doing so, this dual articulation of deskilling and facility of use furthered the rationalistic principles through which automation had flourished in the earlier part of the century, yet found little opposition given the peer relationship's capacity to reframe the operator-computer relationship as one based on collaboration and mutual benefit.

However, within the context of the Cold War, the relinquishment of intellectually-invested tasks implied by the process of deskilling in favor of increased ease of use could hardly be outweighed by the possible costs it implied, as would become evidenced in the lagging state of American technical education in the latter part of the decade. If "progress in the fields of radio, electronics, television, etc. in peacetime can give us the necessary experience and training so essential to our security," as an editorial for a magazine about radio and electronics had proclaimed a decade earlier, the 1957 successful launch of Sputnik showed that the technological project seemed to have failed America in what constitutes, perhaps, one of the most tangible effect of the process of profound deskilling made possible through the peer relationship. [32] As a response to this failure, concerted and institutionalized efforts to promote widespread access to formal technical education would be enacted, somehow recognizing the underlying problem caused by the sustained process of deskilling of the American workforce in the 1950s,.[33] The opening provisions of the National Defense Education Act of 1958, citing the "insufficient proportion of our population educated in science, mathematics, and […] trained in technology" seem to echo these concerns as a matter of national security. [34]

Despite the warning signs evidenced in the enactment of such an important piece of legislation, the implied process of operator deskilling would continue to expand alongside the expansion of the peer relationship. The unquestionable reliance on technology which the peer relationship made available by reducing the negative aspects it could entail would become amply espoused by several manufacturers, both through their industrial design and advertisement strategies. In doing so, the imaginable future of comfort, stability, security, and wellbeing expressed through this narrative stood as a tangible reality contingent on the complete expansion of computerization to society as a whole and, as such, the concretion of an even higher level of dependence on technology through the enactment of the peer relationship on a large scale. As such, the process of operator deskilling implicit in the dynamic of the peer relationship seems to have represented as much the solution as the problem to this mid-century quandary.

A second implication brought about by the characterization of the 1950s American computer operator as invested in seeking means to reduce the laboriousness of work implicitly underscores the idealization of the equilibrium between the responsibilities of work and the pleasures of leisure. As such, it transforms the computer's characterization from a mere human peer to an aide who would sacrifice itself for the worker to successfully achieve the treasured work/life balance. This, in turn, expanded and deepened the positive portrayal of the computer implied by the peer relationship beyond the mere sphere of the workplace and onto the social benefits it could provide the operator.

If taken at face value, this operation would seem to reproduce the correspondence between methods of work and modes of living in advanced capitalism as foreseen by Gramsci and, therefore, posit the situation of the mid-century American worker as being on due course to fulfill the maxim set by Marx to end exploitation through the erasure of the division between labor and leisure.[35] However, in a capitalist society as that from which this analysis emerges, leisure time cannot be considered devoid of labor but, on the contrary, as a unique moment in which workers become unknowingly transformed into commodities for advertisers, as suggested by Smythe.[36] The operation of purporting the greater enjoyment of leisurely activities through the computerization of the workplace represents a deeply ideological operation grounded, simultaneously, on the negation of the possibility of the worker's liberation through her labor and on her production as a commodity within the market for leisurely activities. As such, the previous argument uncovers a major trend exhibited in advertising of mass consumption goods during the period which sought to provide a rational incentive to consumerism and foster the institutionalization of employment as the only means to fully reap the benefits of the booming 1950s economy and, therefore, it represents an ideological move to further the system through the presumed benefits produced by computerization.

However, beyond this articulation, its occurrence within the context of 1950s America also produces a secondary — and much more problematic — reading, positing the transformation of the computer's characterization as an attempt to re-inscribe the dominant male role within American society at the time. Against the 1950s backdrop of complex and shifting televisual representations of gender roles and division of domestic labor such as that identified by Spigel, the implications of the transformation in the computer's characterization seem to liken the computer's role as an aide in the office – a role commonly portrayed as female in advertisements at the time – to that of the stereotyped housewife of the early 1950s, who waits on her overpowering husband hand and foot.[37] The complexities implied by this parallelism abound, as the portrayal of the workflow generated by the computer and evidenced in computer manufacturers' literature of the time largely re-inscribed the strong heteronormative divide of the period, attributing clerical roles to female employees and analytic tasks to their male counterparts, thus serving to further consolidate the dominant social norms of the time.[38] Likewise, the diminishing importance of the clerical role in computation — due largely to eventual changes in the human-computer interface which would gradually allow for their complete disappearance — render the feminization of the computer as a powerful argument that points to an obliteration of the subordinate female/clerical role through substitution by the computer, thus fulfilling its role as a peer to the male, dominant, role. As such, if the computerized apparatuses of WWII had served as *proxies* for the male servicemen, the digital general-purpose computer served as his office assistant and, in so doing, not only took on the role of the female employee, but even that of the submissive wife constructed through various of the period's advertisements.

Chapter summary and conclusions

The previous transformations came about in the context of the profound changes in American society following the end of WWII and, as such, served as both their point of departure and their fruition. Adjusting industrial production to the peacetime economy became a challenge for manufacturers, who in many instances would have to modify their products in order to reap the advantages of improved mass production techniques perfected through the war effort within a booming economy. Perhaps no commercial sector felt the need to introduce vast changes in the production as that of the nascent area of commercial computation. Given the economic need to increase their production through economies of scale and offset the costs of computer manufacturing, it became a priority to increase sales of computers within the American workplace. However, the propagandistic portrayal of the computer as a proxy for its human operator — that computer that confounded computerized apparatuses and cryptic massive high-end computers into a technical marvel that had represented an invaluable asset in the victorious outcome of WWII — became confronted with the need to mass produce more useful and adequate computers to the managerial and commercial tasks that drove the market.

Given such pressures, American computer manufacturers after the end of WWII faced the conundrum of constructing a characterization of the computer that struck a compromise between its seemingly supra-human capacities — which represented its primary point of differentiation versus previous machines — and its nature as a mass produced device. As made possible by the separation between the computer's form and its functions, this characterization arose by adding technical characteristics that provided the computer with similarities to its human operators, yet posited not their substitution, but rather as their peer.

The development of the general purpose computer capable of taking on such a role and the pressure on computer manufacturers to transform the computer into a mass-market product had three significant and interconnected implications. First, it established the character of the computer as an equal to the human operator, thus reducing the anxiety produced by the computer's prior characterization as a human proxy. Second, it generated an internal world of the computer distinct from the external world of its user, thus providing for the reconceptualization for the computer as an ontological entity distinct from its human counterpart. Third, the need to establish a dialogical relationship between the computer and the user became concretized, which necessarily took the form of generalized mediating devices, given the abandonment of computerized apparatuses in favor of general purpose computers capable of taking on any role within any industry, and the development of a common code of communication between computer and user. All of these elements constituted the bases for the subsequent emergence of the human-computer interface.

The improved economic conditions of the market, however, put a strain on the American worker who — by then — enjoyed the bounties of a booming consumption economy through inexpensive credit and increased spending. The changing relationship between workers and employment resignified work as a way of maintaining the standard of living and posited the computer as one of the many threats endangering the viability of the household's financial stability. However, the characterization of the computer as an aide capable of ridding the human operator of tedious or menial tasks redefined its role within the workspace. As such, the computer — converted into a valuable aide — became entrusted with the tedious, yet more intellectually invested tasks that had previously fallen on the human operator. However, in doing so, operators were relying more on computers, divesting part of their intellectual endeavors to the latter. The trend observed in leisurely areas such as the DIY ready-to-assemble kits explained in the previous chapter serves to explain this process.

The occurrence of this process within the American workspace of the 1950s and in the context of the Cold War serve to note as well two important implications. First, the social impact created by this underlying process of transference of technical skills from operators to computers had eroded mathematical and technical education to the point that the enactment of educational policies to somehow revert its results emerged as a concerted response from the political echelons of society.[39] Second, the transformation of the inherent value attributed to work changed from a constitutive part of the American ethos to a means through which to access and make viable the worker's leisure. As a result of the latter and against a background of heteronormative and gendered portrayals of feminine and masculine social roles, the computer occupied a particular place as the "man's aide" in the workspace, occupying the place of the female employee.

As such, the computer would become characterized as the female working companion, which did not enter into competition with its male user, but rather became submissive to him.

Notes to Chapter 3

[1] Martin Campbell-Kelly et al., *Computer: A History of the Information Machine* (New York, NY: Westview Press, 2013).

[2] ibid.

[3] *Electronics at Work*, (Time Magazine: IBM, 1950), Advertisement.

[4] *The New Ibm Electronic Data Processing Machines*, (Time Magazine: IBM, 1953), Advertisement.

[5] *Speeding Business through Electronics...* (Time Magazine: IBM, 1950), Advertisement.

[6] David Fidelman, "Electronic Computer Applications," *Radio News*, March 1949.

[7] "The Brain Builders," *Time Magazine*, March 28 1955.

[8] Herbert Reid, "Are the Brains Taking Over?," *Popular Electronics*, July 1956.

[9] *The Univac System*, (Philadelphia, PA: Eckert-Mauchly Computer Corporation, 1948), Brochure.

[10] *Ibm 705 Magnetic Cores for Memory in Microseconds in a Great New Ibm Electronic Data Processing Machine for Business*, (White Plains, NY1954), Brochure.

[11] Ibid.

[12] "Giant Computer - "Brain" of the Sage System," *Radio & Television News*, September 1956.

[13] "Electronic Digital Computers," *Radio & Television News*, June 1956.

[14] "Components Assembled Automatically," *Popular electronics*, October 1954, 52.

[15] Reid, "Are the Brains Taking Over?," 44.

[16] *A "Giant Brain" That's Strictly Business*, (Time Magazine: IBM, 1954), Advertisement.

[17] *Q: Who Profits from Push-Button Accounting?*, (Time Magazine: Remington Rand Inc), Advertisement.

[18] *Why Man Needs an Electronic Intellect to Act Faster Than His Brain Can Think*, (Time Magazine: Autonetics, 1956), Advertisement.

[19] *Bendix Computers Are Lifting the Burden from Busy Engineers*, (Time Magazine: Bendix Aviation Corporation, 1957), Advertisement.

[20] ibid.

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CHAPTER FOUR: The partition form of relationship

This chapter has two objectives: first, to explore the emergence of the partition form of relationship between operators and computers as a result of the development in the transition from the 1950s to the 1960s of time-sharing computing and direct object manipulation; second, to understand how these technical developments functioned through the partition relationship in order to maintain hidden the continuation of centralized forms of control, under the guise of individual empowerment. The concretion of the partition form of relationship in the graphical manipulation of computer-generated objects posited by Sutherland allowed the process of deskilling to become not only more advanced, but also to remain hidden, thus allowing for its permanence in time.[1]

In response to these objectives, the analysis suggests that while the peer form of relationship separated the human operator from the computer by constructing each of them as distinct ontological entities only to attempt reuniting them later through the process of active production of the computer through its uses, the partition relationship made no such attempt. By contrast, it articulated the operator and the computer not only as distinct ontological entities, but as inhabitants of distinct and irreconcilable worlds.

The analysis notes that, given the profound changes surrounding the passage from the 1950s to the 1960s, societal shifts during this period are key to understanding the significance of the partition relationship as it emerged. As Halliwell notes, understanding the complexities of ‘the fifties’ requires leaving behind a notion of this decade as “a site of dualities, tensions and contradictions.”[2] As such, complex negotiations of power between groups in dominance and subaltern groups would gradually evolve into countercultural responses of the 1950s and 1960s with varying degrees of organization and speed of development.[3]

Within, through, and against this context, the emergence of the partition relationship posited a way in which centralized control was maintained – although in a covert manner – while distributed forms of control became presumably enacted. In the 1950s, the contestation of centralized forms of exercising power took hold to the point of becoming institutionalized through government policies. Eisenhower's displacement of the railroad in favor of the individual automobile through the construction of the Interstate Highway System and the expansion of covert direct intervention in the affairs of foreign countries through CIA-led operations represent just two ways in which government policies at the time articulated the transformation of centralized means of control.[4] Furthermore, as Melanson and Mayers note, Eisenhower brought about important shifts in the ways in which political control was exercised in and by America, departing from centralized arrangements of the past in favor of more opaque and distributed forms.[5]

To substantiate this argument, the chapter first addresses the cultural construction of the partition relation, which was produced discursively through the incorporation of computers into self-sufficient arrangements, identified as "systems." It then discusses how the partition relationship became manifest in computer design and use through the development and operation of time-sharing computing. Finally, the chapter concludes by noting ways in which the partition relationship articulated the process of direct object manipulation, suggesting its importance for future developments within computing.

Emergence of the partition relationship: the separate worlds of humans and computers

By the late 1950s, the vast changes in computing technology and in American society would transform the computer and, as a result, also the relationship established with its operator. These transformations would initiate different uses not of isolated computers anymore, but of computers connected to each other, thus preconfiguring what would develop as the partition form of relationship.

Although communication between computers with limited or no human intervention did not constitute a new development, the discourses built around the transfer of data between these computers – almost entirely bypassing the human operator – gave an account of the emergence of the partition form of relationship between the operator and the computer. An example of this is a news story in 1960 published in *Electronics Illustrated*, which mentioned that "[i]n addition to processing information and deciding payment for services rendered, computers now talk to each other via regular toll telephone calls."[6] Although this exchange seems to completely isolate the computer from the human, the article explains further that "the operator places the data-filled tape reel on the 7701 and then dials the telephone number of the receiving location […] the receiving location operator verifies that the receiving terminal is prepared to record the transmitted data."[7] Through these rudimentary operations, the transfer of data from one computer to another took place through the user, yet – much like in the proxy relationship – only required the human capacities that the computer was unable to fulfill and, in doing so, proposed a particular form of collaboration between the operator and the computer. If the peer relationship had allowed for the computer and the operator to become made through the usage of the computer, the partition relationship involved both computer and operator in a relationship that neither transformed nor produced either one.

Conceptually, the interconnection of computers would allow for a deepening of the autonomy of machines from its human operators. An example of this can be seen in a news story published in *Radio & Television News*, which referenced the interconnection between two computers designed by the Bureau of Standards. In the article, it notes that "[i]t should therefore be possible to inter connect two or more general-purpose machines so that they can cooperate on a common task."[8] The article in question not only expounded the basic conception of machinic interconnection, but also underlined the complete dispensation of human intervention, such that "[t]he two computers […] worked cooperatively on a common task to demonstrate program-controlled machine intercommunication."[9] Both of these instances completely ignored the human element. But, unlike the proxy relationship which sought to replace the operator through the computer, in this computer-computer interconnection there is no operator to substitute and, as such, the "actions" of these computers seem to take place on a plane different than that where its operators are located.

Although these two examples serve to note some of the first indications of the emergence of the partition relationship, a definitive turning point occurred with the configuration of entire systems of computers. Given economic and technical considerations, computer manufacturers began producing smaller, leaner, computers that could satisfy the needs of mid-size clients and, in doing so, applied a modular and scalable design to their product lineup.[10] Due to the limitations established by the constraints of mass producing more limited units, the capacity to "produce" the computer through its usage – such as in the peer relationship – became reduced to "configuring" the adequately-sized system.

Producing the computer as an element within a modular system, however, entailed the related moves of eliminating their individual ontological quality and yet, simultaneously, reinscribing its occurrence to the computer's incorporation within an arrangement of similar devices which shared a common sense of "belongingness." "You pick and choose from the broadest array of input and output devices and processing power […] Select those units you need right now. Then, add to them later or change them as your problems change," mentioned one manufacturer in their brochure, doing away with any lingering notion of an ontological totality as that of the peer relationship by underscoring the modularity of the machine.[11] The abandonment of an egalitarian and cooperative nature of the computer as a human peer in favor of this seemingly instrumental arrangement produces a stark contrast which can only be understood against the constitution of individual computers within an entire system of "similar" computers.

The modularity of these smaller computers and their interconnection into systems allowed the partition relationship to develop. Although the label "system" had become incorporated by various computer manufacturers previously, the launch of IBM's system/360 would articulate the concept into a technical reality, given the unified processor instruction set under which it was developed, transforming the need for large computers into the need to incorporate more interconnected specific modules. In doing so, it also reinscribed an instrumental notion to the computer and the possibility of interaction between the different computers that composed the system.

As such, the computer of the partition relationship was not a standalone unit, but rather formed part of a group described to have some variant of belongingness. SDS's Sigma Computers formed part of "a family" while those of Packard-Bell, Electronic Associates, or Control Data also formed a part of the manufacturer's "system." Positing the computer as a part of an entire technological ecosystem implied a dual move. It de-personalized the computer and re-inscribed it within a group of other, similar, interconnecting computers. As such, it posited not an individual, standalone computer — as had become articulated within the peer relationship — but rather an element which had ties and belongingness within a world distinct from that of its operators. In doing so, computer manufacturers provided a new depth to the characterization of the computer, no longer as an isolated individual, but as a social being capable of interrelating with others like it, yet completely separated from the world of its operator. Although the operator would have access to the computers that composed the system, she could never join it and, as such, the relationship between the operator and the computer became constituted on the basis of two distinct and irreconcilable worlds.

Operation of the partition relationship: time-sharing computing and workspace dynamics

Separating the operator and the computer into different and irreconcilable worlds did not emerge as an institutionalized mandate or as part of a concerted effort by manufacturers, but rather emerged as the result of the societal needs of the time and the responses provided by some of the technical developments that they spurred. In this sense, the development of time-sharing computing inscribed the separation between the operators and the computational processes that took place exclusively within the world of computation and, in doing so, seemingly resolved some of the operational issues present in prior ways of working with the computer.

The different transformations which the computer underwent during the 1950s, changing the compounded notion that had produced the "thinking machine"' which emerged from WWII, first, into human proxies and, later, into human peers, had successfully positioned the computer as a valuable asset for its inclusion within the workspace. The growth of the computer segment throughout this period — increasing from 100 installed computers in 1951 to 22.500 units by 1965 — provides a clear indication of the alignment of computers to the tasks at hand and vice versa.[12] Despite the seemingly linear progression implied by such an assertion, the growth of the segment responded as much to the changing computer market offer as to transformations in the American social, economic, political and cultural contexts.

Despite the significance of the vast transformation in the characterization of the computer brought about by these articulations, the inclusion of these interconnected systems in the workplace did not immediately transform of the dynamics implied by its operation. On the contrary, the initial promotional literature reiterated — both textually and graphically — the centralized operation which had become established during the 1950s.[13] As explained previously, the inclusion of the computer in the American workplace during the 1950s had reproduced — via the creation of clerical and analytical roles and their inscription in the discursive means of representation — the dominant social stratification of the time. Even the operation of 'smaller' computers (such as the IBM 650 or the IBM 705) became represented through the centralized process known as batch processing. An interested business unit expressed the need for a particular report or calculation, transcribers generated perforated cards or tape with said request, the tape or cards would be fed into the computer, which would then process the data and eventually provide the sought-after results. If — unlike prior apparatuses — the emergence of the digital computer had implied a separation between human actions and desired results, the cumbersome workplace dynamic that developed around it made this distance seemingly insurmountable.

The batch processing model employed by business across America reproduced that applied at large computation centers such as MIT's Computer Lab emerged as a means of optimizing costs. This model rested on two significant presumptions. On one hand, the computer's capability to undertake faster, more efficient, logical processes, therefore implicitly accepting the inferiority of the user's mental processes to the computer's processes of calculation. Second, computer time came to be more valued than human time, which posited computer down time as unacceptable, while its human users could wait — for hours, days, weeks, or months — for their projects to progress through the computer's processing cue.[14] Large computers (like the IBM 704 housed at MIT) or smaller computers (such as the business-oriented IBM 650) could plow through several hundred jobs in a single day, save for the user intervention which necessarily implied down time of the computer while the user was thinking.[15]As such, based on economic considerations, the solution implemented contemplated the centralization of the workflow, so as to guarantee a continuous feed of computation jobs to the computer, thus optimizing computer processing time.[16] The problem of cost, from the perspective of this approach, emerged as a result of the inefficient allocation of computational resources available, attributable to the 'slowness' of the human operator in opposition to the computer. As such, the workflow around large computers — such as those housed at MIT's Computer Lab — and which had become a common practice in large corporations throughout the 1950s, had not resolved the issue of elevated costs and excessive computational power inherent to the smaller computer units developed by manufacturers.

Based on the same notions that justified the establishment of the centralized workflow within MIT's computer laboratory, the proposed solution contemplated a system that applied economies of scale to high-speed central computation by suggesting that a more expensive — yet more powerful — central computer could serve to feed various simpler and inexpensive terminals.[17] Each of these terminals would use up only a portion of the central computer's processing power, thus eliminating its downtime due to human lag and, in so doing, harness only the required amount of computational power by each user. The notion of time-sharing computing seemed to contest the model of overt centralized control exhibited by the widely adopted MIT arrangement.

Although the concept of time-share computing apparently criticized centralized control prevalent at the time of its emergence, it retained and obscured a highly centralized architecture, as the underlying system centralized all the computation power while users would obtain access to it through various autonomous terminals. One additional element, however, has great significance for the way in which time-sharing computing became conceptualized and the relationships that it established between its users and the computers involved. Its proponents purported that the user could remain unaware of the centralization of the system, given its automatic organization and allocation of the central processing computer's capacity.[18]

Given its operational arrangements, three different relationships became established through the conception of time-sharing computing. Where the first was between the user and the terminal, a second was between the user and the central computing unit, with a third between the terminal and the central processing unit.

The first of these relationships — that between the user and the terminal — would constitute the most proximal of the three for the human operator. It became the model for the eventual development of the workstation, first, and subsequently the desktop computer. Having direct access to a computer terminal allowed the user to bypass the clerical step of transcribing the program into an intermediate medium and, as such, rendered the workers assigned to such role unnecessary. If the computer posited as the worker's aide in some way implied a substitution of the feminine role, its complete obliteration became possible through the direct access to a terminal. However, this move also supposed that the operator engaged in an intimal relationship with a mere lessened surrogate which stood in place for both, the female worker formerly entrusted with the clerical duties and the central computing unit now entrusted with the computational processes. Through access to the terminal, the user became empowered, being donned with the computational power of the terminal and, in doing so, reproduced the reliance on technical apparatuses which stood as a social maxim developed since the early 1950s.

The second relationship that time-sharing computing established — that of the user and the central computing unit — remained hidden from the user and, as such, operated autonomously. In this sense, although one cannot posit the articulation of a relationship between the operator and the central computing unit, its existence determined the various processes that the operator could engage in, their turnaround time, as well as the parameters the user would have to employ. As such, the central computing unit acted through the terminal to determine and model the interaction the operator could have with it and, in doing so, would allow those with access to the central computing unit to redefine it. This notion would posit the human-computer interface as an obscuring means that would not allow the user to know the processes through which the data became manipulated.

The third relationship implicitly established by time-sharing computing — that between the terminal and the central computing unit — has a great importance, as it not only implied the interconnection between two computers and, as such, necessitated the development of a series of protocols and mediating elements that would allow it to take place. It also re-inscribed a certain autonomy of the computational processes from the human operator. This interconnection, in turn, would serve as the basis for a secondary conception of the interface, which equates the processes of information transmission between computers or between computers and other apparatuses with that of the operator and the computer. The central computing unit and the terminal negotiate the terms of the operator's processing job through the transfer of data and, in doing so, establish a relationship distinct from that between the operator and the terminal. This process, however, is unique in that it exists only within the world of computers and does not produce any external manifestation which could be perceived by the operator. A process of this sort – for example, determining the priority of a requested job – is carried out through the use of "automatic" negotiations entirely between the terminal and the central computing unit, without the operator's intervention. Yet neither is the operator made cognizant of said "dialogue" between the terminal and the central computing unit, nor does it ultimately modify the results made available to the operator once the process has concluded. As such, data transfer between the terminal and the central computing unit exists only within the realm of the computer, except for those in direct response to the operator's commands and only after the terminal provides information through an external channel, such as a display unit or a printer.

The notion that certain logical instances only exist in/among computers has great significance. It supposes the existence of an entire world unbeknownst and unknowable to the human operator. If the inclusion of an internal memory had allowed the computer to become posited as an ontological entity, providing it with the possibility of generating logical occurrences distinct from the operator inserted it within an entire environment to which the human-computer interface is but a semi-translucent window.

The conceptual solidity of time-sharing computing and the success of its commercial application in computer systems such as the IBM system 360, effectively reducing costs and increasing penetration of computers and connected computer services, provided grounds for its continued use until the present. However, the operation that it had most masterfully allowed — obscuring the persistence of centralized control mechanisms — would become the paragon through which dominant groups in America attempted to navigate the tumultuous era that laid ahead, the 1960s.

Expansion of the partition relationship: direct object manipulation as a form of control

One additional event in the area of computation would emerge as a significant transformation in the relationship between the human operator and the computer: direct object manipulation. Operating the computer via graphical representations further isolated the underlying processes from the computer operator while positing a radical transference of technical skills from the user to the computer.

Posited by Sutherland's development of the Sketchpad system as the possibility of employing line drawings as a means of communication between the computer and its operator, direct object manipulation not only implied a graphical basis for this interaction, but also — more importantly — imprinted the computer's internal world with a sense of materiality, a condition that would render it complete.[19] In essence, Sketchpad utilized a series of graphical representations of mathematical formulations — known as ring structures — to portray, via the generation of a computer display, objects which only existed in the computer's rendering of them.[20] By recalling previously prepared blocks from the computer's storage, users without any experience could successfully generate line drawings and, in so doing, obtaining a graphical representation of the actions they had done.[21]

Although one could consider the graphical results generated by the Sketchpad system nothing more than rudimentary sketches, three principles emerge which merit further attention. First, the utilization of the system and the technical knowledge of the user became contingent solely on the operator's basic visual-motor skills. Second, the operation of the system through visual representations become contingent on the backdoor operations of its programmer. Third, the objects generated through the system constituted material existences without a correlate in the operator's physical world.

The first principle which emerged from the development of Sketchpad posits the substitution of the operator's technical knowledge for mere visual-motor skills. In doing so, this process reinscribes not only the deskilling of the computer operator (something that can be traced back to the emergence of the digital general-purpose computer), but also the displacement of technical skills from the user to the mass-market technical apparatus (something evidenced in the DIY electronics kits of the 1950s). As such, the process of prefigured this operation. The emergence of naturalized higher-level programming languages furthered this process, making it possible for an operator with little technical knowledge, but with sufficient linguistic ability, to instruct the computer to undertake particular actions. However, Sketchpad's operation relied merely on the visual-motor skills of the user, completely dispensing with the need to share a linguistic commonality with the computer.[22] The fact that the system relied on a basic ability common to any animal donned with sight and the capacity to move implied an extreme process of transference of technical skills onto the computer. In this sense, all a user would require for the operation of the computer became reduced to the capacity to effectively move in coordination with the visual information available. As such, the intellectual capacities of the user were greatly devaluated, given the computer's capability both to represent information in a visual manner that the operator can act upon and to recognize the user's actions and convert them into equivalent computer instructions.

Despite the previous assertions, the operation of the system through visual representations implied by Sketchpad requires the existence of a library of equivalences between the operator's actions and the computer representations.[23] As such, the "translation" involves a search for the correspondent representation within a repository of pre-loaded display possibilities, and the conversion of said pre-loaded response onto a visual representation that the operator perceives. The operation undertaken by the computer, which recalls the possible response to the operator's action from a pre-loaded library of objects, reinserts the programmer into the communicational relationship that becomes established. As such, the computer does not respond to the operator's actions so much as it mediates between the operator's action and the response previously provided by the programmer. In this sense, the graphical interface that becomes used in the operation of Sketchpad represents a site of mediation — albeit subjected to temporary displacement — between the operator and the programmer. Nonetheless, by obscuring the presence of the programmer through the direct response seemingly provided by the computer, Sketchpad re-inscribed the logical capacities of the computer and, in so doing, provided a new iteration of the characterization of the computer as a thinking machine. At the same time, however, by absenting the programmer from the communicational relationship, the system portrayed the operator as the ultimate instance of control of the computer's representations, although this control remained — ultimately — centralized in the programmer's pre-loading of possible responses onto the library.

As such, the Sketchpad system, which constitutes a primary exemplar of what would become the graphical user interface, serves as a mediating instance which underlines a false sense of empowerment for the operator, as the responses available to the computer remain, ultimately, contingent on the previous actions of the programmer. Thus construed, the human-computer interface came to represent a site of mediation between two human actors — operator and programmer — whose actions necessitate the existence of the interface solely due to the temporal displacement that separates their occurrence.

The existence of virtual objects solely as computer representations enabled by the Sketchpad system provided the possibility of generating and manipulating these objects whose materiality remained contingent on the computer's representation. This characteristic re-inscribes not only the conception of the computer as having generative capabilities, but also that of its existence within a completely distinct and seemingly inaccessible world to the operator. This notion, along with the conception of the computer as forming a part of a distinct ecosystem posited by IBM's system 360 and articulated by the operation of time-sharing computing, provides a sense of materiality to this ecosystem. As such, it completes the articulation of the computer as an ontologically-complete entity which occupies a separate world to which the human operator has access solely through the operations made possible by the human-computer interface.

Beyond the previously noted implications of the Sketchpad system developed by Sutherland, the reasoning that sustained its emergence becomes an important element in understanding the operations it sought to enable.[24] As such, the main argument in support of the development of Sketchpad seems to fall back on the presumed limitations that the reduced speed of the human operator imposed on the computer.[25] Suggesting that Sketchpad, with its elimination of text as a communicative medium between operator and computer, stands as the solution to this problem implies a radical change in the conception of the relation between the operator's capacities and those of the computer. If the naturalization of computer languages had brought about a leveling of the human and the computer, positing that the computer possesses the ability to interpret the physical commands of the operator and then convert them into objects — despite their existence exclusively within the computer medium — produced two divergent, yet simultaneous, characterizations. On the surface, the computer seemingly functioned as the push-button rudimentary machines of the early days of computation. Below the surface, they enabled the operator to undertake processes with a reasoning interlocutor. This dual articulation became possible through the development of the mediating elements that 'translated' back-and-forth between the human and the computer, the human-computer interface.

Thus construed, the birth of the graphical user interface allowed — perhaps in a more effective and radical manner than its predecessors — upholding the notion of empowerment of the individual through the technological apparatus while covertly making possible the establishment of vast constraints to the operator. This operation, much like those enabled by the IBMs homologation of processor instruction sets and the conception of time-sharing computing, absconded a high degree of centralized control under the guise of individual empowerment.

Chapter summary and conclusions

The transit from the 1950s to the 1960s represented a series of significant transformations that shattered the seemingly homogenous social context of America and, in doing so, provided the ideal context for the emergence of contestations to centralized forms of exercising power, to the point of becoming institutionalized through government policies. The societal, political, cultural, and economic changes of the period would force a redefinition of the computer. In this sense, given economical motivations, computer manufacturers were compelled to redesign the computer, providing smaller, leaner, machines targeting medium-sized clients, thus developing machines that could – under a modular scheme – become incorporated within larger "groups" of similar computers, if the needs of the client organization changed or differed from the presumed basic standard. This allowed the computer to become construed as part of a group in which it shared "belongingness" such as a "family" or a "system," being both of these terms utilized for describing and conceptualizing – through advertisements, manufacturers' literature, and news stories – a changing characterization of the computer from an isolated human peer to a distinct element which interconnected with others like it, within a separate world than that of its human operator. This change would be brought on, in part, as the result of IBM's decision to rationalize and optimize its product lineup, unifying its processor instruction set.

Unifying computers within a different world than that of humans would be furthered by the development of time-sharing computing. Developed as a way to optimize computer usage and offset the costs of large computational units, time-sharing allowed operators to access less powerful and more basic terminals, while the heft of the computational power remained centralized by a large computing unit with which the individual terminals negotiated on behalf of the operator, thus making it impossible for the operator to establish a direct relationship with the central computing unit. Although time-sharing seemingly represented a contestation of the dominant and centralized workflow of batch processing, in essence it furthered centralized control while allowing the central operation to remain obscured from the user. In doing so, it resolved the need for distributed forms of computation while maintaining, in the last instance, a high degree of control over the computational processes, yet displaced this control from the dynamics of the workplace and the organizational arrangements that enabled it to the automatic operation of protocols between computers. In doing so, time-sharing computing reinscribed the separation between the world of humans and that of computers.

One more development, the possibility of operating the computer without the need of language, but through mere graphical representations, provided a final means of obscuring the underlying processes from the computer operator, while positing a radical transference of technical skills from the user to the computer. The principles entailed by Sutherland's development of the Sketchpad system provided the means for the operator to rely solely on her visual-motor coordination, thus eliminating not only the need for specialized technical knowledge in operating the computer, but even doing away with the basic requirement of a shared or common symbolic system, such as that of the naturalized higher-level programing languages. In doing so, the computer became an interpreter of the human operator, enabling the translation of basic movements into computer processes or instructions, thus prefiguring what would later become the graphical user interface.

Notes to Chapter 4

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CHAPTER FIVE: Summary and conclusions

This chapter seeks to summarize the study. It addresses in overview the analyses of relationships developed between the computer and its human operator throughout the moments of transformation previously described. It then assesses the contributions of the study by addressing the key research questions posed at the beginning, as well as by providing a valuation of these findings in regards to the current usage of computers. This chapter then addresses future avenues of research enabled by this investigation.

Three forms of relationships, three facets of the human-computer interface

Discourses that coalesced around the early development of the electronic general-purpose computer were sites of key transformations and articulations of forms of relationship between the computer and its operator. Taking each of these forms of relationship as the result of the interplay of different cultural practices, this study of the computer and operator from the end of WWII to the early 1960s argues that the computer and its posited operator emerged through the production of their relationship, which is at once a discursive, procedural and physical process with equally discursive, procedural and physical manifestations.

The first form of relationship is that of a proxy, which refers to an all-powerful and infallible substitute for, in this case, a human operator. The addition of computational capabilities to pre-existent wartime devices during WWII facilitated the likening of the processes of calculation of the machine to the logical processes of its operator. This process was further helped by emerging technological purviews, such as that of Turing or von Neumann, which posited the similarities and possible reproduction of the human logical processes and capabilities through the use of electronic devices.

Based on the continuation of the rationalist principles that had guided the passage from the Industrial Revolution to the early 20th century industrialism in America and through a heightened characterization due to its better efficiency in conducting fast and accurate mathematical calculations during the war, computerized devices became portrayed as all-powerful and infallible substitutes for their human operators, thus becoming construed as their proxies. By compounding the task-specific devices used in the war field with the large, complex, calculators used for military and scientific research, the discursive construction of "computers" further helped construe a characterization of the machine under a gloss of superiority to its human counterpart, therefore adding a more substantial argument to the possibility of serving as a replacement for the human operator.

During this period, it became assumed that computers were ideal for undertaking the tedious and laborious calculations which represented critical tasks during the armed conflict, such as the calculation of optimal conditions for firing air-air ordinance and, in doing so, this allowed the displacement of technical skills from the operator to the computer. This process, akin to the deskilling of the human operator, hinged on the assumed superiority of the computer to conduct the intellectually-intensive and critical tasks.

The proxy relationship came to inform a wide range of technical-consumerist needs, becoming evidenced – for example – in the changes to the DIY electronics projects during the 1950s. Under the argument of increased ease-of-use, these projects substituted artisanal modes of production for assemblage and, in doing so, underscored the reliance not on the apprehended skills of the user, but rather on the inherent qualities of the technical apparatus. As such, the process of operator deskilling – which would continue and deepen throughout the development of later forms of relations between the operator and the computer – would become resignified into a desirable sign of modernity and, as such, represent the main logical argument for increased and voluntary acceptance of it.

The second form of relationship is that of a peer as a non-competitive and collaborative partner. As the general-purpose computer began making its way into the American workplace during the first half of the 1950s, the separation of its form from its functions was key to redefining the relationship between the machine and its operator. Unlike the pre-determined functionality of the computerized task-specific devices that worked through the proxy relationship, the general-purpose computer's capacity to take on a seemingly endless array of tasks and thus become a seemingly endless variety of machines produced the computer through its usage. As such, the relationship between the operator and the computer enabled the practice not only of the use of an apparatus, but rather one of the constant and dynamic production of the computer itself.

Because the resulting computer came to be subjected to a process of individuation, with its resulting internal world remaining hidden – and arguably inaccessible – to the operator, the computer was produced as an ontological entity, distinct from its operator. This separation required a means of bridging by using particular apparatuses of control and exchange of information – such as keyboards, visual displays, and lightpens, among others –to exchange information between the operator and the computer. Along with the development of naturalized computer languages, recognizing these interlocking developments reveals how a dialogical relationship between the computer and the operator was produced and, through this process, concretizes the notion of the computer as the human's non-competitive and assistive collaborator.

As the third form of relationship between operator and computer, the partition form developed as the result of changes enabled by the technical developments of time-sharing computing and direct object manipulation. Unlike the peer relationship (which separated operator and computer as distinct ontological entities reunited through the active process of producing the computer in its use), the partition relationship made no such attempt, instead articulating the operator and the computer as inhabitants of distinct but irreconcilable worlds. As such, developments such as the unification of the processor instruction set served to construct a notion of belongingness of computers within group arrangements of "families" or "systems" rather than as isolated standalone units.

Furthermore, although the profound contradictions of the 1950s and the shifting power relations of the period fostered the contestation of centralized means of control, these contradictions and relations provided a fertile ground for their covert continuation, which became more overt with the emergence of countercultural movements by the 1960s. Within this context, two key technical developments resulted from as well as guided the production of a partition relationship. As the first development, time-sharing computing estranged the relationship between the computer and the operator, in which the user had a close relationship with a terminal, but the terminal with the central computing unit. Through the dialogue and negotiation of the operator's commands as mediated by the terminal, three different relationships were established: between the operator and the terminal, between the terminal and the central computing unit, and between the operator and the central computing unit. In its mediating role between the operator and the central computing unit, the terminal became a surrogate for both the operator and the central computing unit. In doing so, it maintained and furthered the separation between the computer and the human operator into completely distinct worlds.

As the second key technical development, the graphical form of interaction with the computer through the direct manipulation of virtual objects made possible through Sketchpad consolidated the existence of objects that only existed within the world of computers.[1] In doing so, this capability made possible a greater degree of operator deskilling, as it supposed the computer had the capacity to translate common movements of the operator into commands that the computer could act upon.

Responding to the inquiries of this investigation

The research questions posed at the beginning of this study provide a means of evaluating the usefulness of the approach taken here. In doing so, the value of this investigation in regards to the present state of computerization is made salient.

Question 1: How is the human-computer interface constituted as a cultural artifact?

The development and articulation of the three forms of relationship between the operator and the computer noted throughout this study posit the human-computer interface not as a reified and separate object, but as the congealment of various processes of production (equally discursive, physical, and organizational, among others) carried out with and through the computer. In this sense, the human-computer interface emerges as a multi-faceted cultural construct in the broadest sense, which simultaneously contains and produces the changing relationship between the operator and the computer. As such, the production of the human-computer interface is the result of various shifting correlations of power between different aspects of social life, coming together into a particular form of arrangement, a process illuminated by Hall's notion of conjuncture.[2] The processes through which the human-computer interface becomes constituted as a cultural artifact entail both the technical developments that make possible the emergence of these forms of relationship, as well as the discursive and social practices through which these relationships enter the popular discourse.

In distinction from the reified notion of the human-computer interface as the combination of hardware and software used in computer operation, the cultural production of the human-computer interface denotes the result of complex signifying/social practices which enable the development of specific forms of relationship enacted through particular and changing technical arrangements. Understanding these dynamic processes as central to the development and operations of the human uses of computers, then, constitutes a reading of its widespread acceptance as the intersection of economic, cultural, political, and social conditions and practices. In doing so, two conclusions can be drawn. First, the current state of naturalization of computerization must become reconceptualized not as the result of an increasing adequacy of computerized processes to resolve human endeavors, but as the result of an iterative process of transformation of the relations of production that tend to model human endeavors as a series of tasks and procedures capable of being subjected to mathematical modelling and, hence, apt for computerized manipulation. Second, he discussion around the current conceptions of the human-computer interface reemphasizes the intentionality implied by the development of the conditions through and by which the human-computer interface has become developed and actualized.

Uncovering the historical development of the three forms of relationship identified between humans and computers allows for these processes – as well as those produced through their articulation – to be further studied as mechanisms of societal control and domination. Such a reconceptualization posits the human-computer interface as a series of practices which emerge from the relationships identified in this investigation and, in doing so, not only bring to question the current state of uncritical acceptance and naturalization of computation, but – more importantly – allow for the contestation of the conditions of production of these relations, as well as their mechanisms of actualization, thus providing a route for present and future avenues of resistance in regards to these operations and their uncritical acceptance.

Question 2: What are the means through which the human-computer interface operates in establishing a relationship between the user and the computer?

Given the prior conception of the human-computer interface and its cultural production, one can suggest that the means through which it operates, both in a narrow technical sense and in a broader cultural sense, are as much the apparatuses used in the operation of the computer as the practices enabled by those apparatuses. Thus construed, the three previously discussed forms of relationship between the operator and the computer constitute an articulation of the specific means of operation (the computerized gunner's sight, the shared linguistic code, the distributed access to computational processes) and the practices they enable (abandonment of critical calculations, standardization of operational processes, automation of operations). This dual articulation is maintained, however, through the elaboration of positive characterizations of the processes, which allows for the generation of a highly appealing conception in which the computer relieves the human operator of the negative aspects entailed by her work.

Furthermore, each of the forms of relationship studied in this analysis indicate the development and operation of particular mechanisms through which the human-computer interface becomes constituted by a relationship between the operator and the machine. In the case of the proxy relationship, this mechanism takes the form of displacement of the human operator in favor of the computer. In the peer relationship, the mechanism present is one of collaboration between the operator and the computer, without substitution of one for the other. The partition relationship functions through a mechanism not only of separation of the operator and the computer as distinct ontological entities, but also of their realms of action into distinct and irreconcilable parallel realities. Despite these particularities, an element common to all of these forms of relationship and – arguably – inherent to the human-computer interface is a process of operator deskilling, whose saliency seems to diminish as the degree of transfer of technical skills from the operator to the machine increases.

Question 3: How are the different forms of relationship articulated within the broader, more expansive, social, cultural, political, and economic processes in, through, and against which they develop?

Each one of the forms of relationship between the operator and the computer was in turn reproduced through other, seemingly unrelated practices.

Given the WWII context, the inclusion of computerized devices such as gunner's sights or surface-air gun directors extended the proxy relationship. While much of its mechanic corresponded to broader aspects of mid-century automation that had been developed as a progression on early 20th century industrialism, the circumscription of the proxy relationship within the context of the war accepted the machine's superior calculation abilities as a definitive strategic advantage. This in turn helped make the computer more valuable, which substantiated the possible substitution of the human operator by the infallible machine.

The end of WWII and the economic pressures on computer manufacturers prompted the search for more efficient production techniques. The corresponding general-purpose computer came to be a product that could satisfy and attract a greater client base, therefore offsetting the elevated R&D costs of computation. However, the lack of specificity of the computer – its greatest asset in appealing to a broader public – also required the computer to maintain a certain degree of malleability, causing it to remain “undefined” a prioi, definable only through its usage. As a result of this condition and against a background of contrasting and contradicting societal processes, the general-purpose computer required the negotiation of its own identity and, in doing so, also forced the operator to become constituted against its potentialities.

However, the presumed normalcy of the 1950s would also be the site of contestations to centralized forms of power, forcing technocratic, financial, and political elites to find ways in which to preserve this centralization, while also purportedly responding to the growing voices of opposition that demanded more distributed forms of power, and which would culminate with the various countercultural movements of the 1960s. In response to and through these shifting and dynamic renegotiations of power, the development of means to obscure and distance the relationship between the operator and the computer would serve to maintain and – to a certain extent – even further enact centralized forms of power. Despite these mechanisms, the presumably distributed forms of power enabled by the development of the partition relationship would maintain its centralized nature obscured behind a gloss of operator empowerment.

Question 4: What are the implications of these forms and relationships for the subsequent emergence of the interface as a naturalized object?

Each of these forms of relationship contributed to the naturalization of the interface. They posited the computer, first, as a substitute for and, later, as a partner of the human operator. Throughout the development of each form of relationship, dominant societal values – such as sacrifice during WWII or social acceptance during the 1950s – helped shape the discourses surrounding the production of the relationship between the computer and the operator and, in this sense, their naturalization. As such, the three forms of relationship analyzed throughout this investigation reproduced and prefigured broader social processes and, in doing so, incorporated the development of the computer alongside these processes, naturalizing the presence of the computer as part of an effort to become "modern," an effort that continued and extended the goals of early 20th century push for automation in America.

On a secondary level, the increasing extent of operator deskilling allowed for the computer interface to become resignified as a mechanism that augmented operator empowerment. In this sense, although technical skills were being divested from the operator to the machine in an incremental manner, the existence of more complex and distanced means of direct action between the operator and the computer allowed for the relationship between them to remain "hidden in plain sight" and, by doing so, reducing the possible resistance to it.

Implications and paths that lie ahead

Studying the emergence of the human-computer interface in the period of 1940-1960 provides an antecedent view with respect to already established notions of the computer, the operator, and the interface. Although the relationships identified in this analysis emerged and developed within, through, and against specific processes and conditions, their permanence and actualization in subsequent technical developments need to be more broadly recognized.

Developments in computation post-1960s show a remarkable persistence and reformation of these forms of relationship. Although more recent technical developments, such as the personal computer or the graphical user interface, may seem to represent new forms of relationship, it is more accurate to see them as developing through a variable amalgamation of the relationships explored in this study. For example, the development of the computer mouse represents variants of the proxy relationship (by substituting the human hand for the electronic pointing device), the peer relationship (by "becoming" through its usage within a specific application), and the partition relationship (by translating operator movements into traces only existent within the computerized medium). A similar analysis could help inform studies of software products, such as a calendar application or a suite of productivity tools, where each of these relationships becomes salient in varying, yet differing degrees.

Additional example of how the analysis in this study illuminates more recent developments can be selected from some of the most successful developments in computation of the past 30 years. For instance, the 1984 16-page advertisement insert launching Apple's Macintosh presented claims that resonate with each of these forms of relationship. Part of the ad's copy mentions "[t]he real genius is that you don't have to be a genius to use a Macintosh. You just have to be smart enough to buy one."[3] Because the computer can solve and operate on the most complex problems the user might have, the advertisement works through and reproduces the proxy relationship.[4] A later segment in the same ad promotes the availability of different peripherals for the Macintosh. Its question of "[w]hat do you give a computer that has everything?" resonates not only with the seemingly ontological quality of the peer relationship, but even reproducing the intimate relationship with an emotional companion.[5] Yet another part of the ad articulates the logic of the partition relationship by mentions that "if you work for a company big enough to have its own mainframe or minicomputer, Macintosh can fit right in […] it can talk to IBM® mainframes in their very own 3278 protocols."[6]

In ways similar to this Macintosh advertisement, other manufacturers and products reproduce some of the forms of relationship evidenced since the 1940s-1950s, thus evidencing the mechanism through which these previously construed relationships become actualized in more recent products. Their continued presence suggests various paths in which the present analyses could – and should – become expanded in the future.

Through similar analyses of more recent developments, such as the mouse, the graphical user interface or the personal computer, it would become possible to validate and expand the notions set forth in this study and, in doing so, enriching an understanding of the human-computer interface in its more current articulations. Similarly, the expansion of these analyses through the incorporation of a vast corpus of internal documents from computer manufacturers – such as memos, letters, and publications – could provide further indications of the internal processes surrounding the development of the technical apparatuses herein discussed and, in doing so, allow an understanding of their antecedent conditions, as well as the politics and poetics of their conception and production. This would enable the expansion of the analyses not only in terms of the broader societal context, but also in regards to the specific internal conditions of their production. Expanding this investigation in these directions would not only enrich its reach, but probably uncover other elements which, at present, remain unknown.

Notes to Chapter 5

[1] "Sketchpad: A Man-Machine Graphical Communication System."

[2] Hall and Massey; Hay, Hall, and Grossberg.

[3] *Introducing Macintosh*, (Newsweek Magazine: Apple Computers, 1984), Advertisement.

[4] Ibid.

[5] Ibid.

[6] Ibid.

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