SOCIAL SCIENCE AND THE SOCIAL IMPACTS OF COMPUTER TECHNOLOGY[1]

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This article argues that the impacts of computer technology on society are an extraordinarily important area for rigorous social scientific research. However, to this point there is only a modest amount of empirical research and a dearth of cumulative findings on this subject, and the conceptual and theoretical approaches informing the research are weak. After specifying the primary sources of our understandings about the social impacts of computing, the article suggests a taxonomy of impacts and a conceptual framework that might guide social scientific research on this subject. The final section summarizes eight broad generalizations that can be derived from the existing empirical research on the social impacts of computing.

Most people recognize that computer technology has a central role in the contemporary world. The concept of a "computer revolution" is widespread, and some take it quite literally. That is, the computer is identified as the key technological device producing the third great revolution in human history, as the plow was the key device for the agricultural revolution and the machine was the key device for the industrial revolution.

Yet people also believe that they do not have much understanding of the overall impacts of computer technology on their lives (Friedrich, 1983). There is widespread ambivalence in contemporary images regarding computing. On the one hand, the computer is presented as the great facilitator, loyal and tireless in its efforts to eliminate the drudgery of labor and to apply its genius to the service of rational life. On the other hand, the computer is ominous and threatening, the central artifact in a brave new world where human needs for individuality and privacy, for meaningful work, and for a sense of mastery over the environment are crushed by Dr. Frankenstein's most superhuman and uncontrollable creation. If the computer truly is a technology of immense and problematic consequence, its impacts on society merit the most extensive and thoughtful empirical study.

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most extensive and thoughtful empirical study.

Thus the purpose of this paper is to examine briefly the extent to which social scientists have been, as they arguably should be, leaders in the development of our knowledge about the social impacts of computing. In assessing the current status of empirical knowledge, this article attempts to be provocative rather than comprehensive. It raises, from a social scientist's perspective, a series of issues: What theory-based conceptions inform the social scientific research?; What are the dominant sources of knowledge regarding the impacts of computing?; What analytic concepts might assist in the expansion of our knowledge?; Can any tentative generalizations be derived from the recent empirical research?

Conceptions Informing the Assessment of Technology Impacts

Although there have always been a few scholars undertaking reflective and somewhat empirical analyses of the societal role of important technologies (see, for example, Mumford, 1934), social scientific analysis of the impacts of technologies has expanded greatly in the last 20 years. This has been due to both the dramatic explosion of high technologies and to the widespread recognition of their pervasive impacts on society. In the United States, for example, this period has been characterized by the formation of a federal Office of Technology Assessment and the creation of "technology and society" programs at about 150 universities.

Conceptual frameworks for studying the social impacts of technology have emerged from a variety of intellectual traditions, and remain, in general, unintegrated (Burke and Eakin, 1979; Layton, 1977). At present, there is a complex mix of normative and descriptive approaches, of empirical data and nonempirical observations, and of studies focusing on specific technologies and on "technology" as a generic category.

The most coherent body of empirical work that has emerged is the "technology and organization" literature. This research has established some interdependencies, primarily at the level of the single organization, between the type of technology (understood broadly as the system of production) it employs, its structural characteristics, and its performance, given its environmental milieu. Most relevant to our concerns, this research indicates that aspects of organizational structure (e.g., control relationships, patterns of authority and hierarchy, worker attitudes) tend to be contingent on the organization's "technology," defined broadly as a craft, mechanized, or automated system of production (see Blau and Schoenherr, 1971; Blauner, 1964; Burns and Stalker, 1961; Lawrence and Lorsch, 1969; Touraine, 1965; and Woodward, 1965).

When one considers the wider range of empirical work addressing technology-and-society issues, much of the work reflects three broad, normatively oriented perspectives, presented in a straightforward manner by Gendron (1977). From the "utopian" viewpoint, all or most social progress is due primarily to the growth and application of technologies, the use of which will ultimately eliminate scarcity, disease, exploitation, aggression, and so on. In contrast, the "dystopian" view holds that technological expansion creates or intensifies more social evils than it reduces, dehumanizing individuals, degrading the environment, and providing the means for devastating war and ecological catastrophe. Although recent written work often notes that these perspectives are too facile and that most technologies generate a mix of beneficial and detrimental impacts, many works still present arguments that can be classified in terms of these alternatives.

Increasingly, the analytic work takes a position more akin to Gendron's third, "socialist," perspective, which holds that the critical issue is control—that the impacts of a technology are fundamentally determined by the actions of those groups who control its development and use. Among their alternative answers to the question "who controls?" are (1) the key group(s) who dominate the exercise of power and the establishment of values for the socio-political system in which the technology is implemented; (2) the technical experts who hold a relative monopoly of specialist knowledge; (3) a multiplicity of groups who interact in a pluralistic market system; and (4) no one at all, since the totality of technological systems produces a dynamic that is relatively autonomous from any structure of human control.

The question of control is clearly an important one; but it cannot be assumed a priori that the identification of those who seem to control a technology also provides a precise specification of its social impacts. Clearly, such a causal chain is a major hypothesis, requiring empirical testing. Even if "the controllers" can be specified, an analysis of impacts must consider such additional factors as unintended consequences, spillover effects, interactions among technologies, and so on. A basic assumption in this article is that our current knowledge of the social impacts of a complex technology like computing is so limited that it is appropriate to undertake empirical analyses that address independently the intriguing issues of control and of social impacts, as well as exploring their linkages.

Sources of Knowledge Regarding the Impacts of Computing

Given the uncertainty and ambivalence characterizing most people's understandings about the impacts of computing, what are the major sources from which these understandings are developed? While such a question has its roots in complex epistemological issues regarding the social construction of knowledge (see, for example, Berger and Luckmann, 1967), this discussion can at least identify four major sources of these "understandings": (1) personal experience; (2) those with economic stakes in computing; (3) the producers of culture; and (4) social scientists.

As the uses of computers become pervasive in everyday life, a growing source of individuals' cognitive, affective, and evaluative orientations toward computing will be their own experiences with the technology. It seems likely that there will be considerable variation in people's orientations. The individual who takes advantage of an automated bank teller comes to appreciate the convenience and versatility of computing; the individual who finds that the system is inoperative when needed or who has the machine confiscate his/her banking card is likely to feel the anxiety, helplessness, or anger that can be provoked by involvement with computing. Similarly, the teller who is laid off due to automation is not likely to share the bank manager's enthusiasm for the cost efficiency of computing.

Those with an economic stake in the expansion of computing tend to provide self-serving representations of its social impacts. Although some groups whose values are threatened (e.g., unions) warn of the negative impacts of extensive computerization, this source of knowledge is dominated by information from hardware and software vendors, who tend to be unabashedly utopian in their descriptions of the impacts of computing use. Much of the information about computing impacts from those with economic stakes is disseminated through the media by means of advertisements which more or less overtly celebrate computing.

Representations of the social impacts of computing by the producers of culture are quite varied. The most explicit cultural portrayals are often dystopian, as in the dismal, dehumanized computer-based worlds of Vonnegut's *Player Piano* and the film *THX 1138*, and the rebellious and dangerous computers in Clarke's *2001: A Space Odyssey* and the film *WarGames*. The positive images of the impacts of computing are usually embedded in less explicit cultural constructs, with the computer serving as the remarkable and unproblematic tool in the background, whether serving a contemporary TV doctor or a twenty-fifth century space cowboy.

While these types of knowledge claims can be extraordinarily influential in what Charles Sanders Peirce called "fixing belief," social scientists must be uneasy with their veracity. They tend to be unsystematic, based on individual assessments or limited cases that are not necessarily representative of the distribution of actual impacts. They tend to be unsupported by the kinds of evidence required by the scientific method, relying instead on highly selective and/or subjective observations or on assertions that have no precise empirical referents. In many cases, the claims are more imaginary than real, based on hopes or fears about computing. In short, many such claims are best understood as advocacies, which attempt to persuade by manipulating information or symbols.

In contrast, the social scientist's role should be (in the jargon of positivism) to undertake empirical research in an effort to develop precise, verified general theory about the social impacts of computing. Although social scientists should have a major role, and perhaps the essential role, in creating and diffusing such knowledge about computing, the contribution of social scientific research has, to this point, been modest.

The emergence of research on computers in society has been slow at least in part because of the absence of a well-defined scholarly community undertaking the research. Social scientific research on the social impacts of computing emerges from a variety of disciplines, including sociology, political science, administrative and management science, and economics, and a significant proportion of the work is being done by those trained (and located institutionally) in other disciplines, such as computer science, history, philosophy, and law. Among the consequences of this dispersion of researchers is the absence of a clear disciplinary home within which the research is viewed as a valid subfield worthy of peer support; and this, in turn, affects such matters as the acceptance of written work by major journals, the formation of panels at conferences, and even professional standing within a discipline.

More broadly, a coherent network among these researchers has not yet developed (Kling, 1980; Szyperski et al., 1983). Rather, individuals and small groups have forged their own informal systems for communication and interaction. It is only in the past several years, for example, that social scientists have become editors of journals, although marginal ones, that emphasize research on the social impacts of computing. Even the major source in the United States for research funding on the social impacts of computing is a program within the Division of Mathematical and Computer Science, not the Division of Social Science, at the National Science Foundation.

Despite the absence of a research tradition, a considerable amount of written work on computing has now been produced by social scientists. Some of this work emphasizes the design, implementation, and/or management of the computer package rather than its impacts. Some of it offers advice, although in a scholarly tone, and a surprising proportion of it is future-oriented, discussing what should be or what could be or what will be, rather than what is. For example, Urban (1974) reported that only 3 percent (5 of 150) of the articles on computing systems in *Management Science* during an 18-month period dealt with operational systems in real organizations where they had been implemented.

Building on the pioneering empirical work of Whisler (1970) and others, there are now several dozen scholars whose continuing research activities emphasize empirical analyses of the social impacts of computing (see Kling, 1980), and there are several hundred scholars who have contributed one or a few analyses to this topic. While proper reference is usually made to the "seminal" existing studies, few undertake research that refines the theoretical premises of others' work or replicates others' work in an effort to verify and expand the empirical base from which to formulate generalizations. Moreover, the theoretical element and concepts informing much of the research are limited.

Our understanding of the social impacts of computing, as well as the development of theory and generalizations, are likely to be best served by the production of a body of rich empirical studies. The development of such "grounded theory" (Glaser and Strauss, 1967) will be facilitated by agreement upon a conceptual element—that is, a set of basic concepts that inform the research. Given the current absence of widely accepted concepts, it seems useful to suggest briefly the kinds of analytical concepts that might structure the research.

Concepts for the Study of Computing Impacts. An initial problem is that the object of study, "computing," is difficult to define. The computer can be defined narrowly as a machine whose function is the electronic processing of data. But its protean forms range from a large CPU (central processing unit) to a tiny microprocessor that can rest on a fingertip, and computers now guide the operations of an enormous diversity of products and processes, from electronic games to microwave ovens to factory robots to nuclear weapons. Thus, computing is best understood as a general process through which data are manipulated and tasks are performed, not as a machine. And, an adequate formulation requires a broadened concept, "the computer package," which includes not only the hardware but also the software and the skilled personnel involved in the provision of computing (see Danziger et al., 1982: chap. 2). Moreover, even the notion of a social "impact" of computing is somewhat deceptive, since it implies a direct and explicit linkage between cause and effect. In fact, computing often has effects on individuals and groups that emerge in a varied, subtle, and evolutionary manner.

Object Units of Analysis. A pivotal conceptual task is the specification of the "object units of analysis" regarding the social impacts of computing—that is, the units whose behavior is to be explained (Eulau, 1969). Computing can have an impact on individuals or on groups/collectivities. Thus one level of analysis is the impacts on the *individual*; but it is less clear how many levels one might specify for collectivities. Ultimately, the decision regarding the nature of the object units of analysis above the individual level will depend upon the theoretical framework and the empirical findings, since these will indicate which analytic units provide meaningful distinctions. As a suggestion, the kinds of collectivities that could be distinguished include: (1) the *organizational* level, referring to a single organization and its subunits; (2) the *institutional* level, composed of a network of relevant organizations, such as "the banking industry" or "the educational system"; (3) the *societal subsystem*, composed of a major subsystem of the total society, such as "the political system" or "the cultural system"; (4) the *societal system*, composed of a collectivity defined either as a "state" (a territorially bounded sovereign entity) or as a "nation" (a group sharing collective identity); and (5) the *international system* or its major subsystems. It seems clear that the most tractable empirical analyses of the impacts of computing are likely to emerge from research at the individual, organizational, and institutional levels, although extremely interesting research issues can be explored at the higher levels of analysis.

Taxonomy of Impacts. The core of the conceptual element is the development of concepts (that is, taxonomic categories) for classifying and measuring different types of impacts of computing on a given set of object units of analysis. While a reasonable case can be made for using existing categories (Parsons's pattern variables, for example), it might be more helpful at this stage to posit a taxonomy directly related to the social impacts of computing. If one attempts to generate a set of analytic categories that might be employed for such impacts across the entire range of levels of analysis, the existing research suggests at least four categories. These categories of impacts might be further elaborated, and any given use of computing might have both direct and indirect impacts for the unit of analysis and might result in impacts on any combination of the categories. Table 1 provides some illustrative examples of the types of effects from computing that might be measured in each of the four categories at the individual and collective (es-

TABLE 1

Social Impacts of Computing: Illustrative Examples

Impacts of Computing on the	Orientations	Interactions	Capabilities	Value Distribution
of an individual	Attitudes of self-worth, self-actualization Sense of competence in dealing with artifacts Feeling of control of environment Definition of personal values	Frequency, nature, and duration of interpersonal involvements at work Time spent in social interactions at home and leisure Extent of interpersonal contacts as a client	Productivity in workplace Information to support responsibilities in work and home life Capacity to complete work and home tasks	Influence in decisions of collectivities Privacy Material well-being
of a collectivity	Importance of technical/instrumental/quantitative criteria for decision and action Emphasis on efficiency and rationality in operations Attitudes toward sociotechnical (people-technology) interface	Relations with workers and unions Subunit autonomy Centralization of authority Superordinate-subordinate relationships Replacement of humans with machines Coordination among subunits Relations with clients	Capacity to achieve key goals Efficient use of available resources Access to relevant data Dependence on external skills Manipulation of symbols and data Mastery of environmental conditions Adaptation of resources to needs	Status of computer elite Power versus relevant other collectivities Expansion of domain Level of autonomy from public agencies Accumulation of material values National/international influence

pecially the organizational and institutional) levels of analysis.

One category of impacts might be termed *orientations*. This refers to the effects of computing on the object unit's cognitive, affective, and evaluative perspectives. This is most easily understood at the individual level, since it suggests that computing can alter the knowledge, feelings, and attitudes that the individual has toward the self, other people, and the array of objects, processes, and structures in social life. At the level of a collectivity, the concept of orientation can indicate either the configuration of its individual members' perspectives or the broad perspectives that tend to guide the actions of the collectivity. For example, some suggest that computing increases the reliance on quantifiable criteria in both individual and collective judgments, a hypothesized social impact of computing that could be subjected to a variety of rigorous empirical analyses.

A second category of impacts is designated *interactions*, and refers to the effects of computing on relationships between the object unit and other individuals and collectivities. Here the central issue is whether and how computer technology mediates social interactions and, as a consequence, alters their character, frequency, variety, and so on. There are, for example, intriguing issues regarding whether the expanding applications of computing will increase person-machine involvement at the cost of time spent in interpersonal activities. At the level of the collectivity, one might examine such issues as the effects (if any) of computing on centralization/decentralization of authority and control or on intra- or inter-institutional coordination of functions.

A third category, *capabilities*, refers to the role of computing in the object unit's relationships to the physical environment. The central question is whether computing affects the capacity of the unit to produce valued goods, services, or conditions from the manipulation of natural and artifactual objects. Here one might address such issues as the creation and use of knowledge, individual and collective utilization of resources, or mastery of such environmental conditions as disease and natural catastrophe.

The fourth suggested category, *value distribution*, refers to the effects of computing on the actual configuration of values, whether material, symbolic, behavioral, or of some other form. Since any object unit has defined an array of values, both positive and negative, the question here is whether computer technology affects the set of valued phenomena experienced by that unit. Perhaps the most interesting questions regarding the social impacts of computing concern whether and in what ways the technology might alter the distribution of such values as wealth, power, welfare, privacy, autonomy, and survival among affected units. Some values affected by computing are likely to be zero-sum, while others might increase or decrease across all object units.

Explaining Impacts. These kinds of taxonomic dimensions serve one basic goal of social scientific research, the classification of phenomena. With more complete specification, they also facilitate a related goal, measurement of these impacts. Achieving the further basic goal, the explanation of how and why these impacts occur, is far more complex and difficult. Explanation entails theoretical formulations of how concepts are interrelated and then empirical analyses to validate those relationships. As we have noted above, there is little theory with which to structure analyses regarding the social impacts of computing.

Perhaps the main bit of theory that informs much of the recent empirical research is that the social impacts of computing are highly contingent upon *the context of use*. That is, the impacts are quite varied in their nature and their levels, not only across different types of settings, but also across different computing contexts within comparable settings, and even across different individuals within comparable settings and computing contexts. This variability, along with the diversity of contexts of computing use, means that the path to empirically validated analytic generalizations about the social impacts of computing is likely to be a long and tortuous one.

One of the research questions which seems to hold promise for cumulative findings and generalizations is whether variation in the impacts of computing is systematically associated with variations in the context of use. Danziger and Kraemer (forthcoming-b) suggest three elements of the context of use that might have theoretical and/or empirical merit. Perhaps the most obvious element of the context of use is the nature of the relevant *computer package*. That is, computing impacts depend on the technology-in-use. Here one might measure such aspects of the available technology as its hardware and software sophistication, the tasks performed by the automated applications, the extensiveness and routinization of computing in the setting, the responsiveness to users of those providing computing services, the distribution of control over the uses of computing, and so on.

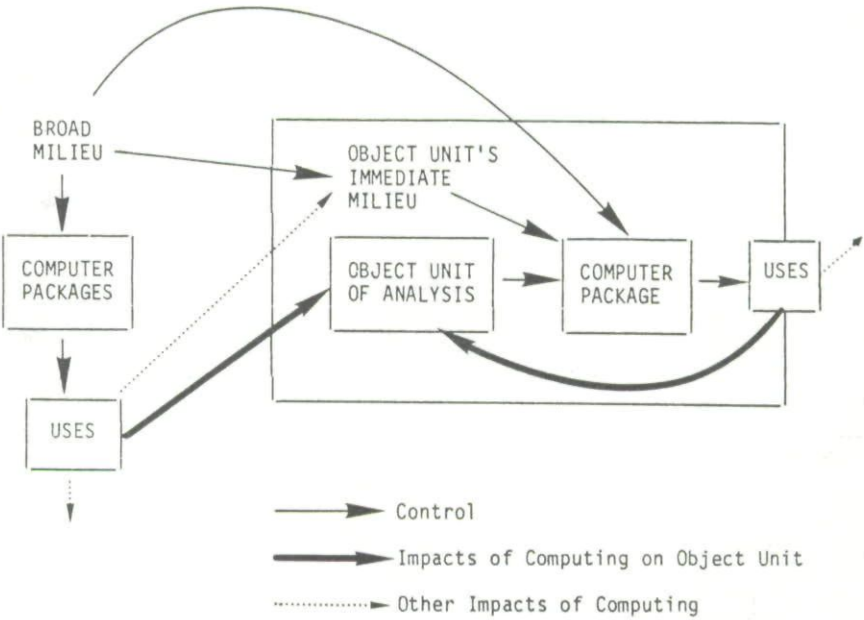
The second contextual element is the broader *milieu*. Computing impacts occur within a setting that has opportunities, constraints, and demands which might condition the effects of computing on the object unit of analysis. Appropriate milieu variables must be identified in relation to the specific phenomena being analyzed. For example, the impacts of robotics on employment in a given industry might be contingent upon such milieu variables as the actions of trade union organizations and the structure of the national and international market in the industry.

The third element in the context of use is the *characteristics of the unit* that is impacted by computing. If the units being analyzed are individuals, for example, the relevant variables might include age, education level, personality style, computer literacy, and so on. If the unit is an organization, the relevant variables might include organizational functions, scale, centralization of control, complexity, and slack resources. As in the case of the milieu element, the crucial concern is to identify those features which might have a significant effect on the level and nature of computing impacts.

Figure 1 suggests that the patterns of relationships among the contextual elements might involve linkages both within and across levels of analysis. The object unit of analysis, which might be either an individual or a collectivity, can be affected by the computer package within its own milieu or by computer packages in the external environment. For example, a manufacturing firm's production decisions could be influenced both by marketing simulations from its own computer package and also by an innova-

FIGURE 1

Relationships among Contextual Elements Determining the Impacts of Computing



tive computer-aided manufacturing process of its rival. While the object unit has general control over its own computer package, the nature of this package can also be affected by characteristics of either the internal or the external milieu (Danziger and Dutton, 1977). And, most broadly, both the internal and external milieus can be signficant as the setting of use, which can condition the linkage between the object unit and computing impacts (Ein-Dor and Segev, 1982; Kling and Scacchi, 1982).

In sum, there are different causal "routes" through Figure 1, and the appropriate path for a given analysis of the impacts of computing will depend upon the particular unit-impact nexus that is being examined. This very brief explication is intended to suggest how the three contextual elements might serve as an organizing framework for research, enabling the analyst to identify and test hypothesized relationships among key variables in the context of computing use, to determine the extent to which the social impacts of computing are contingent upon any specifiable configuration of variables, and, ultimately, to explain the processes underlying such impacts. A variety of research styles ranging from detailed case studies to large-scale quantitative analyses could contribute to a knowledge base developed in terms of this basic conceptual framework.

Some Tentative Generalizations

This article has argued that social scientific research on the social impacts of computing is a young area of inquiry, and, as a consequence, is still short on theory and on empirical findings that are systematic and consistent. These shortcomings are exacerbated by other factors, particularly the absence of both a research tradition and an institutionalized network of scholars. Moreover, the impacts of computing have penetrated so many areas of social life that the domain of inquiry has grown to nearly unmanageable proportions. And the technology has been characterized by such extraordinarily rapid and dramatic changes that there is little time to gain a precise measure of impacts before both the technology and the milieu of use have been substantially transformed.

Given these difficulties, has social scientific research contributed any illuminating findings about the social impacts of computing? While the empirical findings remain fragmented and somewhat contradictory, eight broad generalizations, suggestive of the kinds of insights that are emerging from the empirical research, can be noted briefly. These are "tendency statements," particularly given my earlier argument that the social impacts of computing are often highly contingent upon the characteristics of the milieu, the computer package, and the affected object unit(s). In addition, they are tentative, framed in the short-run period during which actual rather than predicted impacts have been analyzed, and they stress the levels of analysis where the most rigorous empirical research has been conducted.

1. In most settings, the short-run social impacts of computing have been far less pervasive and dramatic than were forecast by many sources. The introduction of computing into a home, an office, an organizational function, typically alters orientations, interactions, and so on; but most affected individuals perceive short-term changes to be modest, and organizational analyses indicate that alterations in standard operating procedures and functions are usually limited. Thus, as a qualifying generalization to those that follow, in most settings the computing system is made to conform to existing behavior and practice in the short run, and immediate, major transformations rarely follow the introduction of computing. The current empirical research offers little insight about the cumulative impacts of the totality of computing uses and has not yet addressed the longer-term impacts (see for example, Colton, 1978; Dery, 1981; Eason, 1980; Frantzich, 1982; Kling and Scacchi, 1982; Kraemer and Danziger, forthcoming-b; Laudon, 1974; and Olson, 1983).

2. Orientations: individuals. *Most individuals perceive the direct impacts of computing to have been mildly benign, to the extent that any impact is perceived.* Despite the imagery of the computer as a threatening and anxiety-producing technology, these attributes are quickly replaced in most individuals by a sense that computing can be controlled and that its use will generate net benefits for the individual. Once the basic skills of use are mastered, most people are oriented positively toward the convenience and increased capabilities afforded them by automated tellers, word processing systems, automated record-keeping and record-searching activities, and so on. The strongest positive responses are among a limited number of the people who have immersed themselves in the uses of computing—primarily computer experts and some users of personal computers, especially children (see, for example, Danziger and Kraemer, forthcoming-a, forthcoming-

b; Edwards, 1978; Engleberger, 1980; Kling, 1978b; Krois and Benson, 1980; Mertens, 1983; Papert, 1980; Simon, 1981; and Turkle, 1984). The major exceptions have been among some of those affected by robotics and in certain other unskilled and semi-skilled jobs—situations where individuals' orientations have been quite negatively affected by "de-skilling" and elimination of jobs. To this point, the negative effects of computing on individual workers have been evident mainly in the industrial workplace (see, for example, Forslin et al., 1979; Gilchrist and Shenkin, 1982; Office of Technology Assessment, 1982; Robinson, 1981; Rothwell and Zegueld, 1979; and Wilkins, 1981).

3. Orientations: collectivities. *Computing tends to increase the importance for decision and action of quantitative, technical criteria.* The most evident initial impact of computing on the orientations of collectivities has been the increased reliance on the kinds of data and analyses that are generated by computerized systems, in comparison to alternative modes of information that are not amenable to storage and manipulation in automated systems. While this might be viewed as a salutary evolution toward more analytical and efficient modes of decision, evaluation, and action, many of the empirical analyses provide persuasive arguments that there are tendencies toward overestimation of the reliability, validity, and significance of quantifiable data and toward what Weizenbaum (1976) termed "instrumental reason." From this perspective, narrow, technical considerations tend to override a richer assessment of crucial goals and the most appropriate means for achieving them (see, for example, Alter, 1980; Brewer, 1974; Collins, 1981; Dutton and Kraemer, forthcoming; Keen and Morton, 1978; Kling, 1978a; Malvey, 1981; Mowshowitz, 1978; Nora and Minc, 1981; and Stabell, 1974).

4. Interactions: individuals. *Computing use tends to isolate individuals, reducing their interaction with other people in both work and leisure settings.* While this seems merely to state the obvious fact that there is a zero-sum relationship between time spent with a machine and time spent with humans, the issue is somewhat more complex. One claim regarding computer technology was that its speed and efficiency at performing tasks would "liberate" people from routine and shorten work periods, providing more time for discretionary activities. However, for most workers, regardless of function, an increasing amount of work time is spent with computer technology, and there has been no reduction in total work time. Even more significantly, in many settings where computing systems are available, individuals increasingly opt to interact with them rather than with other humans, whether the choice is computer games versus other recreational activities in the home, automated tellers versus human tellers at the bank, computer-based messaging versus the telephone at the office, and so on. The current preference toward isolation via computing is not total, as studies of telecommuting, for example, have revealed. But, on balance, the broadest social impacts of computing on the individual might be characterized as "antisocial" (see, for example, Kraemer, 1982; Leduc, 1979; Martin, 1978; Nilles et al., 1976; Olson, 1983; Uhlig et al., 1979; and Venkatesh and Vitalari, 1983).

5. Interactions: collectivities. *Computing increases organizational control available to central authorities.* The automated applications that are

adopted early and are dominant in most organizations are those that facilitate the control over resoruces, especially funds and personnel. There is general support for the expectation that computing centralizes (or maintains central) control, even while it might facilitate decentralization of functions or operations. While such systems fall short of total efficiency and most seem to have resulted in only modest increases in direct control of personnel, they have substantially increased the capacity of central managers and resource controllers to monitor how resources are allocated and used and to measure performance. Some computer-based workload monitoring systems reduce the discretion of subordinates, particularly among those who previously enjoyed relative freedom from supervision because they worked in field environments or did tasks where manual collection of performance data was not feasible. In a comparable manner, institutional actors employ activity data and action protocols in computerized networks to insure interorganizational adherence to standards of decision and action that are established by the central authority (see, for example, Alter, 1980; Danziger et al., 1982; Danziger and Kraemer, 1984; Fairclough, 1982; King, forthcoming; Kling, 1978a; Laudon, 1974; Markus, 1979; Noble, 1979; Office of Technology Assessment, 1982; Quinn, 1976; and Robey, 1981).

6. Capabilities: individuals and collectivities. *Computing has become a major source of productivity gains for individuals and organizations.* Most relevant empirical research confirms that computing has resulted in notable productivity gains, from robotics to word processing to detective work. While some dispute the validity of the productivity measures or argue that the costs of the total computer package are greatly underestimated, in most domains of economic activity the value ratio of outputs to inputs has been improved through the introduction of computing. In general, the empirical data suggest that the productivity benefits from the current applications of computer technology are greatest on more structured and repetitive tasks and that they tend to be most problematic on less structured tasks involving large-scale, complex integrated information systems. Also, benefits tend to be more clear in terms of efficiency criteria than effectiveness criteria. Computing has particularly increased the information processing capabilities and the level of throughput/output for knowledge workers, while automation-based productivity increases causing job displacement have primarily occurred among workers in the manufacturing sector. In a direct or an indirect way, computer technology has become the *sine qua non* of much economic growth in post-industrial societies (see, for example, U.S. Bureau of Labor Statistics, 1980; Danziger and Kraemer, forthcoming-a, forthcoming-b; Forslin, Sarapata, and Whitehall, 1979; King and Kraemer, 1981; Matteis, 1979; Menzies, 1981; Office of Technology Assessment, 1982; and Rothwell and Zegueld, 1979).

7. Value distribution: individuals. *Computing increases social control and monitoring, reducing the privacy of individuals and small groups.* Computer technology has revolutionized the scale and flexibility of data bases containing personal information, and hence the "surveillance potential" (Rule, 1974) of those with access to the data. The empirical research indicates that early concerns about the potential of computing to compromise the

privacy and confidentiality of personal information seem well founded. Already, computerized systems like the electronic funds transfer system (EFTS) have powerfully extended the capacity of collectivities to monitor the activities and even the real-time location of individuals and groups. And France, for example, is experimenting with a "smart card" to be carried by each individual and to include a considerable array of personal information regarding health, finances, and behavioral history. Among the most active collectors and extensive users of personal data banks are those public agencies responsible for order maintenance and social control. In addition to "legitimate" uses of such personal data (with legitimate use defined by those with political power), a number of individuals inside such systems can gain inappropriate access to confidential information, and current cryptography techniques cannot prevent security breaks into these systems by outsiders. Empirical studies have not identified widespread violations of individual rights through the use of computer-based systems; but there are isolated examples of such abuses in both totalitarian and democratic societies, and most research forecasts that these will become more widespread over time (see, for example, Colton and Kraemer, 1980; Hoffman, 1971; Kling 1978a; Mowshowitz, 1978; "Computers, Spies," 1981; OECD, 1976; Rule et al., 1980; and Stabell, 1974).

8. Value distribution: collectivities. *The current impacts of computing tend primarily to serve the interests of the more dominant groups in a given setting, thus reinforcing existing power distributions.* The growing power of technocratic elites dominated by computer specialists has often been posited, since those groups have essential skills regarding computer systems, an increasingly decisive resource in the competition within and between organized groups. There is also contrasting imagery of the computer as a democratizing tool, since it can distribute information-as-power more widely. In fact, most key decisions about the uses of computing in a particular domain are directly made by those with power and control in that domain, or they are made by those who are subordinate to, and generally serve the interests of, the powerful. While there have been some "power shifts" to the groups with technical expertise in either the operation of the computer package or the use of information in automated systems, these have been quite limited. The empirical evidence generally indicates that computing is likely to cause a redistribution of power and control *within* an elite rather than to result in a net reduction in the power of dominant groups in favor of subordinate groups (see, for example, Danziger et al., 1982; Dery, 1981; Dutton and Kraemer, 1977, forthcoming; Frantzich, 1982; Hoffman, 1971; Kraemer and Danziger, 1984; Laudon, 1974; and Nora and Minc, 1981).

Concluding Observations

The computer is the essential symbol of modern society, a technology that already does the work of five trillion individuals. Few would question that computers have the capacity to transform contemporary life. Most of the uncertainty centers in questions regarding how dramatic and how fast the transformation will be, the extent to which the changes will be life-enhancing or destructive, and whether society has the will and capacity to make wise choices and control the changes.

This article has argued that the impacts of computing on society constitute an extraordinarily important area for rigorous social scientific research. It has further noted the modest amount of empirical research, the dearth of cumulative findings, and the underdeveloped state of conceptual and theoretical approaches. A few broad and tentative generalizations that might be derived from the limited and somewhat contradictory empirical research have been summarized. Our knowledge is minimal, not only due to the absence of extensive research but also because the subject is changing more rapidly than we are capable of studying it. Thus generalizations about computing tend to be both time- and context-bound.

A dramatic example of this problem is the sudden explosion of microcomputer use. Of necessity, most of the existing empirical research has focused on the impacts of mainframe computers, although use has often involved "hands-on," interactive computing. In a thoughtful essay, Calhoun (1981) observed that the microcomputer "revolution" constitutes "a point where quantitative changes in technological capacity may, if they are fully exploited, have a qualitative impact on social life" (p. 398).

In theory, at least, microcomputers will significantly personalize the computing activities of users, freeing them from rigid information processing routines and also from the locational, scheduling, and surveillance constraints embedded in the use of mainframes. *If* microcomputers are widely used as independent, unmonitored systems, some of the generalizations in the previous section could be undercut, especially by reducing the impacts of computing on organizational and social control and on power concentration. However, networks of microcomputers might also reinforce most current impacts of computing in organizational and institutional settings. Both routinization of microcomputer technology and empirical studies of its impacts are at such an early stage that plausible rival hypotheses abound. It is such constant and major evolution in computing technology that makes empirical research both fascinating and frustrating.

While there does seem to be some acceleration in the level and quality of empirical research on the social impacts of computing, our knowledge remains seriously inadequate in relation to the significance of the subject. There are important research questions regarding the social impacts of computing that are germane to central theoretical concerns within every social science discipline. Yet such research receives minimal infrastructure support within the academic social sciences. One must wonder at the conditions that will nurture, rather than tolerate, the emergence of a strong field of social scientific research on the social impacts of computing. **SSQ**

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