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The Effect of Technology on Alienation from Work : Testing Blauner's Inverted U-Curve Hypothesis for 110 Industrial Organizations and 245 Retrained Printers

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This article presents new evidence on the effect of technology on alienation from work that is pertinent to Blauner's inverted U-curve hypothesis. One data set permits comparative analysis at the organizational level and addresses a gap in the literature on worker alienation because most research uses individual level data grouped by industrial categories. This organizational level approach is applied to individual level data on retrained union printers to analyze the impact of automation on the work of skilled craftsmen. Humanization of work in postindustrial society is examined. The relationship between technological advance and alienation is more negatively linear than curvilinear.

The Effect of Technology on Alienation from Work

**TESTING BLAUNER'S INVERTED U-CURVE
HYPOTHESIS FOR 110 INDUSTRIAL ORGANIZATIONS
AND 245 RETRAINED PRINTERS**

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Marx condemned the historical process through which industrialization robbed the craftsman of self-expression and gave the capitalist control over the means of production. In some kinds of factory production,

the automation itself is the subject, and the workmen are merely conscious organs, coordinated with the unconscious

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organs of the automaton and together with them, subordinated to the central moving power [Marx, 1906: 458].

Thus, workmen become cogs in the machine, powerless to enhance their self-worth, except through receipt of an “alien intermediary,” money. Moreover, in the Marxian prognostication, hardship was added to injury because wages were to decrease as technological advances reduced the demand for labor.

Blauner (1964) challenged the Marxian assumption that advanced technology has resulted in increased alienation. Comparing attitudinal measures of job dissatisfaction for employees in four industries—printing, textile, automotive, and chemical—he reported that those in the technologically advanced chemical industries as well as craftsmen in the printing trades were less alienated than those in the textile and automotive industries. Blauner cautiously interpreted these data (from a 1947 Roper poll) as supporting an inverted U-curve relationship between technological advance and alienation. His explanation was that although workers in chemical plants must monitor dials which are machine-paced, they have more freedom of movement than the typical assembly-line worker in an automotive plant whose job lacks the autonomy and challenge enjoyed by printing craftsmen.

Derived from Seeman (1959), Blauner’s concept of alienation included four dimensions: powerlessness, meaninglessness, social isolation, and self-estrangement. The multidimensionality of the concept and the ambiguity of its meaning have continued to pose problems for research, as Seeman (1975) notes in his review of the literature. Further, a theoretical problem is that attitudinal measures psychologize the concept, but the Marxian formulation necessarily postulates social relationships. As Israel (1971: 206) notes, a subjective approach runs the risk of “doing sociology without society.”

The most recent criticism of research on alienation is directed to the evidence Blauner (1964) presented in support of

the inverted U-curve hypothesis. While Berg et al. (1978: 44-45) contend that Blauner's data do not consistently support the hypothesis, our reexamination of Blauner's data indicates that the inverted U-curve hypothesis is supported, if the textile category is excluded.¹ Blauner's inclusion of the textile category may have been a mistake in that textiles are not more technologically advanced than printing by two conventional indicators—capital investment and value added (see Blauner, 1964: Appendix A). Indeed, most replications of Blauner's U-curve hypothesis have omitted this category (e.g., Fullan, 1970; Sheppard, 1969) using the automotive industry for the midpoint. The comparisons between printing, automotive, and chemical industries usually provide more support for Blauner's hypothesis than if the ambiguous textile industry is included.

Despite criticisms of Blauner, there is considerable evidence which supports his inverted U-curve hypothesis although it is based more on comparisons of certain categories of jobs rather than on interindustrial differences² (see Sheppard's [1977] summary of much of this literature). Sheppard (1969, 1971) replicated Blauner's inverted U-curve by comparing automotive craft workers, those on final assembly-lines, and control-room operators in an oil refinery. Sheppard (1971) and Kirsch and Lengerman (1971) extended the testing of Blauner's hypothesis to white collar work and confirmed the inverted U-curve pattern for specific categories of jobs. Fullan (1970) compared craft workers, mass production workers, and continuous process workers and observed that these categories have an inverted U-curve relationship with both social isolation (i.e., lack of perceived integration) and turnover. Cotgrove (1972) found that workers in automated settings were less alienated in terms of both extrinsic and intrinsic factors; Vamplew (1973) confirmed Blauner's view of work in chemical industries as being nonalienating; and Wedderburn and Crompton (1972) reported that textile workers with jobs similar to those of chemical operators were less alienated than others. While Sussman (1972a, 1972b),

criticized the technological factor as a determinant of alienation, his data for jobs show that workers performing continuous process tasks are less alienated. Although Goldthorpe et al. (1966, 1968) also oppose the technological determinism argument, they found that assemblers are more likely than craftsmen or operators in automated chemical plants to remain on the job because of pay, rather than because of intrinsic satisfaction. Thus, even critics of Blauner present evidence supporting the inverted U-curve hypothesis.

A different approach for studying the effects of technology on alienation is to focus on the industrial organization as the unit of analysis and thereby facilitate the measurement of plant technology. Blauner's conceptualization of technology was rather loose and some of the research cited above as supporting his hypothesis (e.g., Fullan, 1970) derives its measure of technology principally from Woodward's (1965) comparison of 100 industrial organizations in Britain. Indeed, much of the predictive capacity of Blauner's three key categories may be better understood in terms of their fortuitous correspondence with Woodward's three types of technology: batch, mass, and continuous process production. Blauner's printing (craft) industry is analogous to Woodward's batch; the automotive, with mass production; and the chemical, with continuous process production. Woodward suggests that her industrial types are associated with basic characteristics of an organization such as span of control and what Burns and Stalker (1961) term organic versus mechanistic styles of management. Moreover, Woodward's industrial types have been given greater specificity by subsequent research which has demonstrated that they are associated with other technological measures such as capital investment per worker and the Amber (1962) scale of automaticity (Blau et al., 1976; Hull, 1977, 1979a). Thus, an approach which builds upon specific measures of technology offers promise for extending Blauner's insightful research into the relationship between technology and alienation.

One may assume that Blauner viewed technology as affecting alienation through intervening variables such as the division of labor. For example, Blauner (1964), Faunce (1958), and Sheppard (1969) argue that the technology of the assembly-line increases the division of labor, which in turn increases alienation. Indeed, Sheppard's (1977) review article suggests that a principal reason why technology is an important independent variable is because the type of technology dominating a work process is the primary (although not the only) determinant of the way in which labor is divided. However, organizational division of labor remains an unmeasured variable in most of the research testing Blauner's hypothesis.³

The data on 110 factories reported here extend the testing of Blauner's inverted U-curve hypothesis to the level of organizational analysis. We present technological measures which are then applied to individual level data on 245 union printers, skilled craftsmen whose tasks have been radically transformed by the introduction of computer technology.

THE NEW JERSEY FACTORY DATA

The 110 factories were surveyed in 1973 by the Comparative Organization Research Program under the direction of Peter Blau. The sample was randomly selected from plants with 200 or more employees (see Blau et al., 1976). With the exception that chemical plants are overrepresented, the 110 factories approximate the national distribution of 2-digit categories in the Standard Industrial Classification (Hull, 1977).

Utilizing the New Jersey factory data, the key measure for testing Blauner's hypothesis is employee turnover rates. There is a general relationship between quit rates and job dissatisfaction despite the fact that other variables unrelated to alienation may also affect "withdrawal behavior" (Hill and Trist, 1955). For example, research has shown that turnover rates are related to attitudinal measures of job dissatisfaction and low

morale (Price, 1977) as well as to measures of integration (Fullan, 1970).⁴ Because turnover data are only available for 102 of the total sample of 110, our analysis is restricted to this somewhat smaller number.

The turnover in the New Jersey factories was calculated as the percentage of employees terminating during the 12-month period, July 1972 to June 1973. The fact that these factories are concentrated in a relatively small Middle Atlantic state minimizes regional variations in turnover.

TURNOVER AND LEVELS OF AUTOMATICITY

An important dimension of factory technology is the sophistication of the machinery used for transforming raw materials into finished products. The automaticity of machinery can be conceptually linked with the alienation of its operator through the concept of powerlessness, or lack of freedom (Blauner, 1964). At low levels of automaticity (Amber levels one and two) the machine replaces physical exertion and some of the mental effort required, but the operator still exercises considerable control over the production process and has a relatively high degree of freedom in managing the machine.

At the middle level of automaticity (Amber level three), the machine removes the operator's discretion over the timing of the production process because its repeat cycles are initiated by self-feeding. The removal of time discretion is a crucial factor in rendering the operator dependent upon the machine. In most instances, at this level tasks become fractionalized and, in effect, the operator becomes an appendage of the machine.

At high levels of automaticity (Amber levels four and five), the machine is controlled by symbolic processes. Human effort in the production process is no longer immediate: Robots do the work. Operators become monitors and less dominant in the factory labor force as the machinery is designed by engineers, set in operation by programmers, and repaired by maintenance personnel. As Blauner (1964) noted, highly automatic produc-

tion processes involve a considerable degree of freedom for the few employees required for their operation.

Consistent with Blauner's inverted U-curve, the Amber scale of automaticity is hypothesized to reduce the power of operators most at the midpoint of the scale (i.e., level three). As may be seen in Table 1, factories with the bulk of their machinery at Amber level three have relatively high turnover rates, as do factories in which Amber level three represents the maximal advance in automaticity.

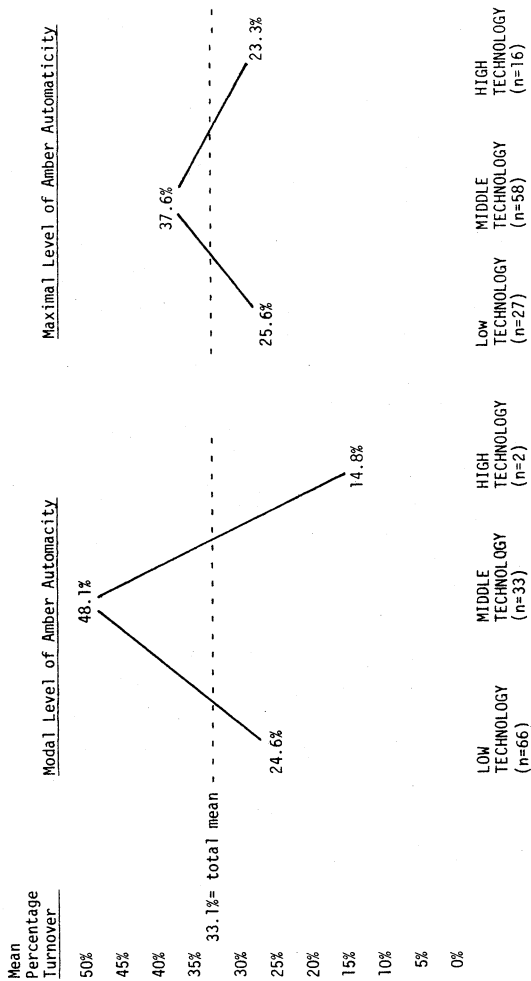
Although computers are used to monitor production machinery in only 4 of the 110 New Jersey factories, most use electronic data processing to manipulate symbolic as well as material objects. According to the curvilinear hypothesis, electronic data processing should reduce alienation because symbols mediate the nexus between man and machine. The pervasiveness of computer technology in the factory organization is measured by counting the number of functions for which a computer is used (Hull, 1977). In the New Jersey sample, the number of functions for which a computer is used is negatively correlated ($-.17$) with the turnover rate. This correlation tends to support the association between highly advanced technology and low levels of alienation predicted by the inverted U-curve hypothesis.

Woodward's scale of technical complexity approximates the Amber scale (Blau et al., 1976; Hull, 1977, 1979a) and Blauner's industrial categories. Thus, Woodward's scale should also display an inverted U-curve relationship with turnover rates. The mean level of turnover for each category in Woodward's (1965) scale is shown in Table 2. The curvilinear pattern is apparent although somewhat skewed to the left.⁵ Factories in Woodward's most advanced category—continuous process production—have the lowest turnover rates.

TURNOVER AND THE ASSEMBLY LINE

The affect of technology on alienation not only depends upon the extent to which machinery is automatic but also upon

TABLE 1
Mean Turnover in New Jersey Factories Grouped by Low, Middle, and High Levels of Automaticity



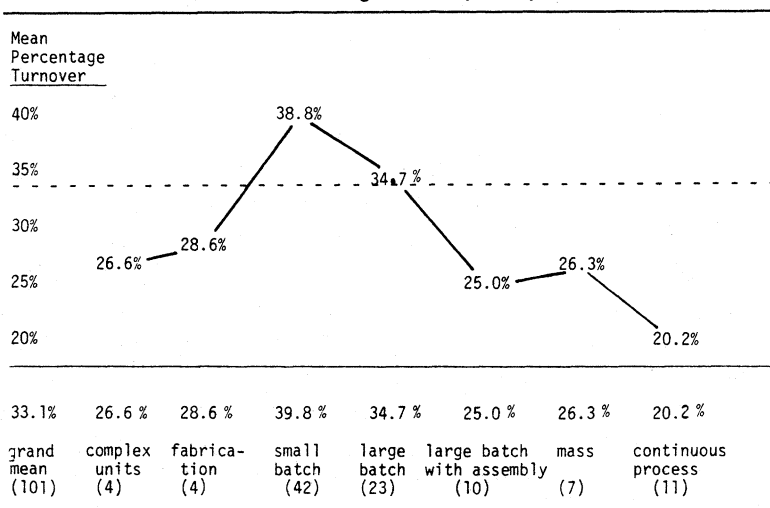
Amber Level of Technology

- Low 1. powered machines and tools
- 2. single-cycle automatics
- Middle 3. repeat cycle, self-feeding
- High 4. self-measuring and self-adjusting
- 5. computer controlled machinery

NOTE: One case missing information on the Amber score.

N = 101

TABLE 2
Mean Turnover by Categories in Woodward's Scale
of Technological Complexity^a



a. Categories not shown were absent in the New Jersey sample. See Woodward (1965) for the entire list of 10.

how the machinery is arranged in the production system. For example, an assembly-line is a mode of production which closely controls the behavior of workers, especially the pacing of their actions. The assembly-line is the systematic equivalent of a machine at Amber level three in that the arrangement involves self-feeding conveyors which repeat the cycle with monotonous regularity. The assembly-line in effect regulates the pace of behavior for operatives and appends them as cogs to a larger mechanical system. Thus, operatives on the assembly-line lose freedom of discretion in timing their behavior and are rendered powerless (Braverman, 1974).

The indicator of assembly-line production systems used in this research is whether or not "waiting-time" is possible between successive stages of work (Hickson et al., 1969). The dummy variable representing the 29 of 110 factories with no waiting time is significantly correlated with turnover rates (.17). This correlation is consistent with the result from many

other studies which have shown that assembly-line work is alienating (Guest, 1955; Chinoy, 1955; Wild, 1970; Lefkowitz and Katz, 1969) and that lack of autonomy or powerlessness increases absenteeism and/or turnover (Ross and Zander, 1957; Turner and Lawrence, 1965; Taylor and Weiss, 1969a, Hackman and Lawyer, 1971; Walters and Roach, 1971). The argument that heavy assembly work precludes many aspects of job autonomy (Alderfer, 1969) is supported by Anderson's (1970) review of job enrichment in different industrial types. These data support the view that assembly-line technology (e.g., Blauner's auto industry) represents the crest of the inverted U-curve.

The importance attributed to technology as a determinant of alienation depends in large part upon its presumed consequences for the division of labor and degradation of skills. Blauner and other researchers have implicitly assumed that assembly-line technology alienates workers because of the meaninglessness of finely subdivided jobs. Although the work on mechanized assembly-lines may be minutely subdivided, this subdivision of work should be distinguished from the specialization of roles which are formally prescribed by the organization. The indicator used in this research for assembly-lines (no waiting time) has a significantly negative correlation with the number of job titles (-.19). This seeming contradiction may be accounted for by the fact that a general title such as "line worker" suffices as a label for many employees, each of whom may be performing somewhat distinctive motions. Thus the affect of organizational level measures of the division of labor on alienation may differ from individual level measures of job characteristics. This helps to explain why the formally defined division of labor in the New Jersey factories (as measured by the number of job titles) has an insignificant negative correlation (-.06) with the turnover rate instead of the commonly presumed positive one.

Technology and the division of labor are often assumed to reduce the skill level required of employees by breaking down complex jobs into simpler ones which can be mechanized. Factories in the New Jersey sample having unskilled workers, as measured by one week or less of training, have higher

turnover rates (.33). However, neither factories having machinery at middle levels of automaticity nor factories with production systems having no waiting time have significantly more unskilled workers although the relationship between the skill and technology measures faintly suggests a curvilinear pattern. The key determinant of alienation seems to be technological (e.g., powerlessness, repetition) rather than the complexity of work per se (Tudor, 1972).

Measures of technology have no significant relationship with the overall distribution of skill in the factories, but technology does affect the composition of the labor force. For example, both the Amber measure of automaticity and the Woodward measure of technical complexity are highly correlated with the percentage of maintenance personnel in the factory workforce and negatively correlated with that of machine operators. It is the maintenance employee who is emerging as one of the most characteristic types in the technologically advanced factory. The higher the percentage of maintenance personnel, the lower the turnover rates (-.18), which gives further support to the inverted U-curve hypothesis.

In Table 3, measures of Amber automaticity and other variables characterizing low, middle, and high levels of technology are correlated with the turnover rate. Variables characteristic of lower level technologies have negative correlations with the turnover rate, while those variables characterizing middle level technologies have positive correlations with the turnover rate. Variables associated with high level of technologies have negative correlations with the turnover rate. The dummy variable representing 19 chemical industries (the only one of Blauner's industrial categories sufficiently represented in the sample) has a slightly negative correlation with turnover rate. This correlation lends further credibility to the presumption that this type of industry, which is significantly associated with the Amber score and with Woodward's continuous process category, is one in which employees are less alienated.

Although the printing and automotive industries are insufficiently represented to use as dummy variables, these types are, respectively, indicated by the factories having a critical

TABLE 3
Correlation Between Measures Indicating Level of
Technology and Turnover

<u>Levels of Technology</u>	<u>Turnover</u>
LOW	
low level of Amber automaticity (66 factories with bulk of machinery at level 1 or 2)	-.22**
craftsmanship (18 factories having 33% or more craftsmen)	-.13
MIDDLE	
middle level of Amber automaticity (33 factories with bulk of machinery at level 3)	+.22**
assembly-lines (29 factories with no waiting-time)	+.17**
HIGH	
high level of amber automaticity (2 factories with bulk of machinery at level 5)	-.05 ¹
computer use for 16 functions	-.17**
percentage of maintenance personnel	-.18**
chemical industries (19 factories classified as SIC category 28)	-.15*

NOTE: For dummy variables, the number of cases coded as 1 rather than 0 is shown in parentheses.

1. A dummy variable representing only 2 of 102 cases cannot explain much variation, but as shown in Table 1, these two cases have decidedly lower turnover rates.

N = 102

*p = .05

**p = .10

mass of craftsmen (33%) and by factories with assembly-line systems. A comparison of the correlations with turnover rates for craft(-), assembly(+), and chemical(-) plants lend indirect support for the ideas behind Blauner's comparison of industrial types.

The evidence examined for the New Jersey factories supports the inverted U-curve hypothesis, but there could be reasons

other than a low level of alienation that makes employees in technological advanced factories unlikely to quit their jobs. One reason is wage level. There is a strong positive correlation between the Amber scale of automaticity and the average wages of production workers (.51 for the 46 factories supplying this information). However, the average wage level is not significantly correlated with the turnover rate. Nevertheless, the possibility remains that highly advanced technology means that intrinsic job satisfaction is sacrificed for extrinsic rewards. Workers may be alienated in the sense of self-estrangement, but remain on the job for the money.

In order to investigate self-estrangement more closely, this article also presents data from a study of newspaper printers who experienced a radical change in the technology of their work. In the technological terms used in the organizational analysis, the machinery used by these printers increased from Amber level two to five within a short period of time. These data on printers provide an unusual opportunity for studying response to automation because so many traditional crafts no longer exist. This cohort of printers is especially interesting because they were the subject of an earlier well-known study by Lipset et al. (1956). To the extent that the work of printers today has become like that of Blauner's chemical operators, they should not experience alienation, especially since the middle level was skipped entirely.

FROM CRAFTSMANSHIP TO AUTOMATION: JOB SATISFACTION AMONG RETRAINED PRINTERS

Although most crafts are now history, some printers were able to utilize their highly developed skills as late as the 1970s. Only then did printers in the newspaper branch of the industry in New York City have to confront the total automation of their craft.

As a group, printers have considered themselves the elite of blue collar workers, master craftsmen in a trade that was often passed from father to son, and for decades they comprised a tight occupational community (Lipset et al., 1956). With the support of their strong union, the International Typographical Union (ITU), they won many struggles to maintain their craft, to gain better wages, and to secure their jobs.

Research has shown that printers have been more satisfied with their jobs than most workers (Lipset et al., 1956; Blauner 1960, 1964; *Work in America*, 1973). More than a decade ago Blauner (1964: 57) described the printer as “almost the prototype of the non-alienated worker in modern industry.” However, he warned:

Yet it is not certain how long printers can maintain this position for technological innovations and economic developments threaten to eliminate not only the typesetter’s control but the job itself. The newspaper industry has developed a process by which printed type can be set automatically [1964: 57].

And, by the late 1970s, most craftsmen who had worked with linotype machines had either retired or been retrained to work on computer-based machinery.

The changeover began in the 1950s and accelerated in the 1960s, when punched tapes were introduced to augment the old linotype machines. This technological advance raised the Amber level of automaticity for printing machines from levels one and two to level four, skipping entirely level three which the data on New Jersey factories show is alienating. At level four on the Amber scale, a printer is able to operate three machines and produce more output than seven or eight regular linotypists (Kelber and Schlesinger, 1967: 99). Recent advances have eliminated the linotype entirely so that typewritten paper is “read” by an optical scanner and translated into photocopy using computer programs. This latest technological advance raised the level of automaticity for printing machinery to level five on the Amber scale. Thus, retrained printers provide a

strategic research site for exploring how a technological advance has affected skilled craftsmen.

Research on retrained printers was conducted in 1976 at the *Daily News*, the *New York Post*, and *The New York Times*, the three largest newspapers in New York City. In 1974 the union representing the printers at these papers, Local 6 of the International Typographical Union, had negotiated an 11-year collective bargaining agreement that gave management complete freedom to introduce automation and to make job assignments. In return, printers obtained lifetime job security, the right to voluntary retirement, and periodic cost of living increases.

Of the 408 printers included in the research two years after the contract was signed, 245 had been retrained to work with the automated equipment. The data on these retrained printers may be compared with an earlier study (Lipset et al., 1956) to learn how printers' attitudes toward their jobs have changed. As may be seen in Table 4, the rating of extrinsic rewards, such as pay and job security, has increased between 1950 and 1976. However, the prestige which printers themselves accord their occupation has dropped during this same period of time. This decline may be linked to the introduction of automation, but it probably also reflects the fact that printers no longer regard themselves so differently from other blue collar workers. Indeed, the 1970 census shows that printers have lost the educational edge they once held over other blue collar workers.

Although today printers are more satisfied with the extrinsic rewards of their job, what are their intrinsic satisfactions from working with automated equipment? Some express nostalgia for their old craft skills, but a majority of retrained printers report that their newly automated jobs are physically less demanding and intellectually more challenging. The positive response of these retrained printers is not due to differences in experience, educational background, or age. The age variable is particularly important. Since the craft is dying, older printers might be more accepting of change because they have little alternative (Berg, 1972). However, the retrained printers in this

TABLE 4
Comparison of Printers' Ratings of Pay, Job Security, and
Job Prestige: 1950 and 1976^a

RATING	PAY		SECURITY		PRESTIGE	
	1950	1976	1950	1976	1950	1976
Excellent	22%	32%	35%	52%	41%	23%
Good	53%	58%	43%	39%	47%	51%
Fair or Poor	24%	10%	22%	8%	12%	26%
(N)	(500)	(245)	(492)	(245)	(493)	(244)

a. The data for 1950 are from the files of the study by Lipset et al. (1956). The data for 1976 are for the retrained printers in the study by Rogers and Friedman (1980).

sample were relatively younger than those not retrained (43 years compared to 53 years), and their adjustment to automation belies the assumption that automatic production techniques are necessarily more alienating than craft methods. Moreover, in an earlier study by Kelber and Schlesinger (1967), many printers responded favorably to automation, claiming that automatic processes, such as photocomposition, actually elevated the extent of craftsmanship required.

Highly automatic equipment may give some workers more control over their output, especially those who now use symbols rather than physical effort to produce the printed page. With this equipment, the operator's effort is not set by the pace of an assembly-line or the cycle of a machine at a middle level of automation. A printer with over 30 years in the trade who is now working at a video-display terminal typifies the response of many:

I can see what I'm creating and it gives me a real feeling of self-satisfaction. Setting ads this way is a creative skill—it's a whole new craft to learn.

In effect, automation at the newspapers has meant that the technological means of performing the work have changed, but many characteristics of the printer's job remain intact. Perhaps most important, automation did not render the printers power-

TABLE 5
 The Retained Printer's Evaluation of the New Methods

New methods are <u>physically</u> :	
less demanding:	58%
no difference	24%
more demanding	18%
	(245)
New methods are <u>intellectually</u> :	
more challenging	53%
no difference	21%
less challenging	27%
	(245)

less to control the pace of their work as is the case on an assembly-line. Except under pressure of getting out the first edition, printers can speed up, slow down, or take a break at their own discretion. This recent study reveals little change since Blauner (1964: 42) wrote: "A printing craftsman not only sets his own work rhythm, he is free from pressure on the job."

But does the new technology require that printing be more intensely supervised or more bureaucratically controlled? If so, as Hull (1979b) has shown, this may be experienced as alienating. Skilled craftsmen, who have internalized standards of workmanship, are particularly likely to resent such control from foremen whose level of competence may differ little from their own. However, Rogers and Friedman (1980) did not find that either supervisors or printers felt that the new automation had in any way changed the nature or degree of control over their subordinates. Many printers indicated that one of the major assets of the job was the lack of pressure imposed by direct-line supervisors or higher level foremen:

You don't feel that you're always being watched. They give you a lot of freedom and that's important.

I like the fact that I'm left alone. No one's pushing or bothering me. If you do your job they don't bother you—you can work at your own pace and no one's on your back.

With few exceptions, these craftsmen define good supervision as less supervision. They like their jobs precisely because they can work at their own pace. Whether the printer expressed pleasure or displeasure with the nature of supervisory control, however, no one suggested that the situation was any different depending upon whether he was working with the old or the new equipment. Apparently, the relationship between printers and their supervisors has not changed as a result of the new technology. This lack of contrast in supervisory intensity between craft and highly automated production systems is consistent with Woodward's (1965) findings and those from the New Jersey factories reported in this article (i.e., a U-curve relationship as shown in Blau et al., 1976, and Hull, 1979a).

While the nature of supervisory control over the immediate work process has not changed with automation, a significant change has occurred in the degree of bureaucratic control exercised over the printer. Before the 1974 contract, "The job . . . [belonged] to the man rather than to the printer or the shop" (Lipset et al., 1956: 24). A printer who decided to take a day off could hire a substitute to take his place, but this is no longer permitted. Similarly, moving a man from one part of the composing room to another formerly required union consent, but today this has ended. The introduction of automated equipment has led to a variety of new tasks that a printer may be trained to perform and the new contract has given management the right to assign printers to work in the composing room—without regard for priority. Thus for these union printers, automation has resulted in the loss of some independence and power; for management, a gain in its prerogatives. Centralization of decision making in organization is positively related to alienation in many instances (Hull, 1979b) and may prove related to alienation in many instances (Hull, 1979b) and

may prove alienating for printers because they are clearly more powerless as a result of automation.

Automation, however, has not increased the specialized division of labor in printing, as work in the composing room does not involve the elaborate subdivision of tasks characteristic of assembly-line technology. The majority of men had experience with all phases of the work and do not feel that their work is alienating in the sense that it is meaningless. Many remarked with pride:

There's no phase of this operation that I can't handle. They can put me on anything and I'll turn out a good job.

But automation has had an effect on the composition of jobs in printing, as was the case for the New Jersey factories. Some new tasks have been created while others have been eliminated. Further, tasks such as machine maintenance have gained in importance while others, such as proofreading, have lost prestige. The ascendance of the machinists signals the destruction of the printing craft and underscores the fact that control of the highly automatic machines rests outside the power of the operators. In this regard, printers have become more like other workers.

The reaction of these printers to automation was remarkably parallel to the adjustment of British steel mill workers to new process technology (Chadwick-Jones, 1969). The mill workers enjoyed reduced physical effort, increased job interest (at least initially), and higher pay. But they felt their status was depreciated and the bureaucratic power of management enhanced. Moreover, the occupational community of the steel mill workers was dissolved, as also happened in the case of the printers. To the extent that this pattern of effects of automation is replicated in other studies, a more comprehensive model of how radical technological innovation impacts on workers may be constructed.

CONCLUSIONS: IMPLICATIONS FOR WORK IN A POSTINDUSTRIAL SOCIETY

To optimists, technological advance is ushering in a postindustrial era in which the proportion of the labor force in factory production will decline just as happened in agriculture. Tertiary occupations which involve working with symbols instead of with machines will dominate (Bell, 1973). The alienating, large-scale bureaucracies typical of the industrial era will be succeeded by smaller professional organizations (Faunce, 1968; Hage, 1980).

The prospect that technological advance will reduce alienation in a postindustrial society is predicated on the assumptions that: (1) technology is a determinant of the size and form of organizations; (2) large-scale bureaucratic forms of organization are alienating; and (3) the net effect of technological advance is to create better jobs in the nonindustrial labor force. But available data do not presage the actual arrival of postindustrial society (Heilbroner, 1973).

First, there is little evidence that technology is either a strong determinant of the bureaucratic form of organization (Hickson et al., 1969; Hull, 1977) or consistently related to size, except from a historical perspective. The New Jersey factories that are either highly automated or have continuous process production systems have only slightly fewer employees and written rules.

Second, the association between technology and large-scale bureaucracy is of reduced importance because there is little evidence (with the exception of Aiken and Hage, 1966, and Miller, 1967) that either organizational size or bureaucratic formalization is positively related to job dissatisfaction. For example, Kohn (1976) did not find that the number of hierarchical levels was associated with alienation, and Eden (1975) found the bureaucratically employed no more alienated than the self-employed. Nor do such bureaucratic devices for specifying roles (e.g., written rules of job titles) appear to increase job dissatisfaction or withdrawal behavior, possibly because they facilitate a clearly defined exchange of work for pay (Porter and Lawler, 1973; Byrman, 1976; Hull, 1979b).

Although the size of work groups does increase job dissatisfaction, it is uncertain that the size of an organization affects job satisfaction in any meaningful pattern (Porter and Lawler, 1973; Hull, 1979b). Thus, cross-sectional data lend little support to the reasoning that work in large-scale bureaucracies is necessarily alienating. Of course, the possibility exists that employees in bureaucratic organizations are alienated, but unaware of their condition because of competition in false hierarchies (Mouzelis, 1967). And, the exchange of work for pay may have only increased the fetishism of commodities at the expense of self-estrangement (Marcuse, 1964), but these explanations are conjecture at this time.

Third, the assumption that industrial employment will decline has not been borne out: The percentage of the labor force in factory occupations has remained almost constant since the turn of the century. Technological displacement of industrial jobs amounts to about 3% of the jobs each year (Mueller et al., 1969), and American investment in technology during the 1970s declined. For example, of the 110 New Jersey factories studied, only 16 had any equipment at Amber level four or five and only 2 had the bulk at these high levels. Moreover technological advance does not seem to have any readily discernible relationship with the skill levels acquired in the overall labor force, and it is not evident that more complex work results in greater job satisfaction (Tudor, 1972). Some mental work is not creative, such as dial watching, and may entail psychological tension, especially if employees do little else in the factory (Zvorkyn, 1977). The potential of automation for eliminating such dull jobs has yet to be achieved.

Dual labor market theory helps to explain why some jobs in the industrial sector may be as desirable as white collar jobs, especially if one takes into account the extent to which they are sheltered (Freeman, 1976). For example, the printers discussed above occupy highly sheltered jobs: security, stability, good pay, and favorable working conditions. Employees in capital-intensive industries are less likely to quit even though they may not be fully satisfied with their jobs, as these industries usually

pay well and offer good benefits. Further, employment in a capital-intensive industry compared favorably with white collar clerical work (Glenn and Feldberg, 1977; *Work in America*, 1973).

Blauner (1964) noted that intellectuals often take a condescending view of industrial jobs as dull and boring without really understanding the work, but data from the 1972-3 *Quality of Employment Survey* do not support this view of industrial work. Workers are neither more dissatisfied with their jobs nor more likely to quit than nonindustrial employees. The analysis of the New Jersey factories suggests that turnover increases only with certain specific conditions of work such as lack of control over pacing or repetitive motions. Similar job characteristics are pacing or repetitive motions. Similar job characteristics are correlated with job dissatisfaction in studies of individual workers (1972-3 *Quality of Employment Survey*; Mueller et al., 1969). Because the overwhelming proportion of industrial jobs do not have the alienating characteristics of the assembly-line, an amazing 73% of workers in the survey by Muller et al. (1969: 31) reported that they regard the machine with which they work "like a friend." The retrained printers discussed above not only found their newly automated jobs more intellectually challenging but also less physically demanding. The surprising appreciation of machines by the industrial employees who work with them is obviously related to a savings in effort. Muller et al. (1969: 122-123) noted that "nearly one-half of those experiencing a machinery change reported that they had to work less hard physically, and only 15 percent reported the opposite." Moreover, 53% of these employees said that their new jobs required "more skill." Granted that workers may not always be aware of the overall costs of technological advance (except as an immediate threat to their jobs), the blue collar view of automation seems to differ from intellectuals'. Cross-sectional data for blue collar workers suggest more of a negative linear relationship between level of technological advance and job dissatisfaction with only a relatively small percentage of the labor force fitting in with the

crest of the inverted U-curve. Fewer than 5% of American workers have assembly-line jobs, and even in the automotive industry such jobs are held by less than one-quarter of employees. Most of the crest of the inverted U-curve represents a rather infrequent type of work.

Thus it is difficult to view technological advance as an inevitably alienating phenomenon. Although nearly all workers in an industrial society are separated from the means of production and hence are alienated in this objective sense, the plasticity of industrial man (Inkeles and Smith, 1970) makes generalizations difficult. Is industrial man adaptive to the extent of compromising his humanity, or does his strength persist despite changing technological conditions?

Ambivalence toward mechanization is deeply rooted in Western intellectual history. On the one hand, the machine is viewed as a servant. The term *energy slave* may be used to describe the fact that the citizens in an industrial society utilize hundreds of human-power equivalents every day by having powered machinery do their bidding, whether at work or at play. On the other hand, reliance on powered machines makes industrial workers vulnerable in the event of inevitable breakdowns and further removes them from the natural conditions of Rousseau's noble savage. That human beings may lose control over the utilization of technology is a frightening prospect (Ellul, 1968), but this article has provided evidence that those working with automated machinery may not fear this possibility as much as some intellectuals.

NOTES

1. Examination of Blauner's 18 indicators of job dissatisfaction reveals that automotive workers are in general above the all-industry mean (15/18) while printers and chemical operators are below it (13/18 and 17/18, respectively). Because Blauner suggests that the textile industry represents the upswing of the inverted U-curve, employees in this industry should be more dissatisfied than the average worker. However, textile workers are more dissatisfied than the all-industry mean for only 7 of

18 comparisons. The mixed response of textile workers seems to fit a pattern in that they are more dissatisfied with their powerlessness or lack of freedom (Blaunder appendix tables 33-36) but less dissatisfied with meaningless, social isolation, and lack of integration with the company (appendix tables 37-39, 42-43, 46, 48, 52). One explanation for the divergent responses of textile workers may be that even in 1947, half of them were located in the South where mill work in a small town often provided the only alternative to farming. Another reason may be that a high percentage of textile workers were women. In any case, textile workers provide the least persuasive evidence for the inverted U-curve, even though they are generally more dissatisfied than printers and chemical operators (13/18 and 15/18, respectively) and less dissatisfied than automotive workers (13/18).

2. Although the focus of this article is on organizational determinants of alienation, one purpose is to demonstrate the convergence between organizational and individual levels of analysis. Therefore, some results of our analysis of 346 industrial employees in the 1972-3 *Quality of Employment Survey* (see Quinn et al., 1974) are noteworthy. First, Blauner's comparison of selected industrial types illustrates the inverted U-curve better than comparisons for all industries ranked according to their level of capital intensity. Second, job characteristics indicating lack of control over the pace of work and the repetition of events are significantly correlated with overall job dissatisfaction ($r = .14$ and $.19$, respectively). As we argue in this article, organizational level characteristics of production technology, such as the assembly-line, are associated with such alienating characteristics as lack of control over timing and the repetition of events.

3. A parallel study of the effect of organizational measures (as the division of labor) on absenteeism and turnover in these same New Jersey factories is reported elsewhere (Hull, 1979b).

4. It would be desirable to combine organizational and individual level data, thereby permitting alienated attitudes and turnover to be simultaneously analyzed. But few data sets are so encompassing as to include both a sample of organizations and also a sample of employees within each. But one such data set provides some evidence that morale measured for individual employees and aggregated by organization is negatively correlated with turnover. In three national samples (matched for size, product type, and status of factory), there are negative correlations between morale and turnover: British ($-.37$), Japanese ($-.18$), and Swedish ($-.55$). The Swedish correlation is significant at the .05 level, each sample consisting of 12 organizations (Hull and Azumi, 1980).

Another advantage of individual level data is that characteristics of the workers associated with withdrawal behavior may be controlled statistically. Although available characteristics of the workforce, such as mean level of skill, were controlled in the New Jersey factory data, this does not preclude the possibility that individual characteristics might account for some of the variation in factory turnover rates.

5. The restudy of these same 110 factories currently under way by Hull and Hage suggests that one reason the curve is skewed to the left may be that it is difficult to use Woodward's measure to distinguish between large and small batches across different industry types (e.g., 300 airplanes may be a large batch but 3,000 cookies may be a small batch). The extreme ends of the scale are easier to identify than points in the middle.

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