Implementation of information- and comunication-technology within a ministry

Grass, A.; Boucsein, W.; Boehmelt, A.

Publication date:
1993

Document Version
Publisher's PDF, also known as Version of record

[redacted]

PAPER

Implementation of Information- and Communication-Technology within a Ministry: Are There Effects on Working Conditions or Health Consequences?

Andreas Grass, Wolfram Boucsein & Andreas Boehmelt

WORC PAPER 93.12.022

Paper presented at the
Workshop on Stress in New Occupations
Tilburg, WORC, December 1-3, 1993

December 1993

ACKNOWLEDGMENT

This paper was written for the WORC Workshop on Stress in New Occupations, Tilburg, December 1-3, 1993

Implementation of Information- and Communication-Technology within a Ministry: Are There Effects on Working Conditions or Health Consequences?

Andreas Grass, Wolfram Boucsein & Andreas Boehmelt
Department of Physiological Psychology
University of Wuppertal, Germany

I would like to present some preliminary results from an interdisciplinary project together with our business department, being performed in a ministry. Here, all 400 workplaces are supplied with information- and communication-technology using a PC-based-network with standard applications under WINDOWS. Since the introduction of technology is performed in different cohorts, a cross-lag-design can be used to study the effects on central characteristics of the working conditions (e.g. decision latitude, work demands, social support) and on the subjective well-being by means of a questionnaire. In addition, the effects of computerization can be assessed separately for three relatively homogeneous job categories that show different structure and qualification demands: management, assistance and typist-workplaces. Our emphasis is on the assessment of changes in working conditions and stress effects at the different workplaces as a consequence of the computerization. We originally planned to present results from the first two cohorts, but so far, only data from the first cohort is available.

Method

Design

As mentioned before, the complete investigation is based on a cross-lag-design (Fig. 1). Subject of this presentation are preliminary findings on the basis of data from department no. 1. This department is only concerned with organizational affairs, and doesn't work in the ministries actual field of work (pollution control and agriculture). Its functions are

rather heterogeneous, ranging from personnel-management to public relations. The follow up in department no. 5 couldn't be performed up to now. For that reason, the data could't be included in the analysis as we originally intended.

The evaluation strategy employed here is a pretest-posttest comparison: A preliminary examination before the installation of computer-technology is compared with a follow up after the systems full integration into the process of work (1.5 years later).

Questionnaire

For data-collection, we used a questionnaire, which was constructed on the basis of already existing methods. Most of the scales have been developed in the project "Psychological stress at the workplace" (Greif et al., 1983; Zapf et al., 1983). Modifications had been necessary since the scales had originally been constructed for the analysis of industrial tasks. The participants got the information, necessary to work on the questionnaire independently, within an information-meeting, where the questionnaires were likewise distributed. The questionnaire is composed of scales, measuring different aspects of the working conditions, relevant for the evaluation of computerization effects. In detail, it contains a stress- related work analysis, which is used to investigate changes in working conditions. Furthermore, items concerning the ergonomics of workplace design, stress indicators and questions with regard to user acceptance are included.

By stress-related characteristics of the working conditions we understand work demands and resources. Work demands are subdivided into qualitative demands (i.e. task complexity) and quantitative demands (i.e. time pressure). By resources we mean characteristics of the task, which can exert a compensating, possibly stress-reducing effect, as the variables decisions latitude and social support do. Finally, three categories of stress indicators are measured: Aspects of the general well-being, psychosomatic complaints and pain. General well-being comprises bodily well-being, work satisfaction and prolonged stress. By prolonged stress we understand a state of exhaustion, which is developed so far, that it cannot be reduced in daily poststress periods. Typical for that state is the inability to keep work-related problems out of one s mind, even in leisure time.

Statistical Evaluation

As a measure of reliability for the applied scales, we calculated Cronbach's alpha-coefficient (Table 1). For this, the pretests, which are accomplished in all 6 departments up to now and include data from 210 subjects, served as a database. We will only report those results, based on scales with a sufficiently high reliability score. Since the number of cases for the comparisons between pretest and posttest is relatively low, nonparametric statistical methods were used. Especially Wilcoxon's test was calculated for analysis of the repeated measurement.

Results

Subjects

The about 80 members of the organizational department's stuff were examined before the introduction of the computer system and in the period of use, approximately 1.5 years later. From the first measurement, about 2/3 of the participants sent back the completed questionaire; in the second measurement, the return rate was about 50 percent. Since the quote was lower in the second measurement and because of the high extent of job rotation in the department, only 21 persons were measured as well in the pretest as in the posttest (Fig. 2). The resulting sample consists of 7 managers, one of which already used a local PC before and of 12 assistants, with one previous PC-user among them too.

Managers (a kind of officials in charge), are leading personnel, who are frequently the head of a departmental section, concerned with a certain field of work. They have to coordinate the work within the departmental section and with other departmental sections. Assistants (a kind of referee) have to carry out tasks, assigned to them by the manager.

Two typists, who also participated in both investigations, were excluded from analysis, since the low number of cases doesn t allow to derive specific statements for this type of task, even when using nonparametric statistics.

The time daily spent at the computer by managers and assistants is shown by Fig. 3. Managers passed about 1.6 hours a day at the computer, which is equivalent to 18 percent of the daily working hours. For assistants, the time daily spent at the computer is about 1.9 hours, which is equivalent to 23 percent of daily working time.

A summary of the results from the pretest-posttest comparison shows Table 1. It contains scale-labels, arranged by the categories work demands, resources, subjective well-being, complaints and pain. Furthermore, for each scale, the number of items, the reliability-score and a total mean are listed. The mean is the average across both measurements and both groups of participants. This leads to an indication of the measured features general level within a possible range of between one and five points. The last three columns of the table report changes in the scale values as they occurred between the two repeated measurements: The total alteration across both groups of participants (i.e. management and assistants) and additionally both individual variations are specified.

Stress-related task characteristics

Work demands

The scale applied for the measurement of qualitative work-demands shows a high reliability of alpha=.81 which allows for further interpretation. Generally, the complexity of work is rated relatively high as it could be expected for the regarded types of task (average=3.8) (Fig. 4). A difference between the two measurements exists only for the management group: The complexity of work tends to be rated higher by managers in the posttest compared to the pretest rating ($p < 0.1$). The quantitative work demands (e.g. time-pressure) are generally rated as being high (average=3.6) but no differences between the two measurements can be identified. The scales reliability is sufficiently high to allow interpretations (alpha=.71; 3 items) .

Resources

Decision latitude is measured by a five-item scale which is highly reliable (alpha=.86). The perceived decision latitude is rated generally high (average=4.2). Gathering up both types of workplaces, there is a significant increase in decision latitude between pre- and posttest ($p < 0.05$). Tested separately for both types of job categories, this tends to be significant for

the management-group ($p < 0.1$) (Fig. 5). Social support, as the second potential stress-reducing ressource, is measured by a five-items scale with a high reliability of alpha=.85. The general rating of social support tends to be high too (average=3.5), but changes during the computerization cannot be identified.

Subjective well-being

The bodily well-being is measured using a 5-items scale, with a high reliability of alpha=.83. The general rating is positive (average=3.8); changes during computerization cannot be identified. For work satisfaction, measured by an 8-items scale (alpha=.79), the results are analogous. On the other hand, the scale measuring prolonged stress (8 items; alpha=.87), shows significant changes in the comparison between pretest and posttest (Fig. 6): Ratings decrease generally ($p < 0.001$), and also for managers ($p < 0.05$) and assistants ($p < 0.01$) separately.

Complaints

Cardiovascular complaints and stomach ache were measured using 4-items scales with sufficient reliability of alpha=.7 and alpha=.76. The frequency of complaints is rated low in general and no changes can be shown to accompany the computerization.

Pain

Pain-symptoms, possibly associated with a non-optimal posture of the body at work, are shoulder-, neck-, and back pain. The frequency of those pain symptoms is low. The most frequent symptom is back pain. Only shoulder pain tends to increase during the computerization ($p < 0.1$) (Fig. 7).

In summary, the essential differences between pretest and posttest are an increase in decision latitude and a decrease in prolonged stress. A possible cause for the general low effects of computerization can be identified in a more detailed consideration of the time, daily spent at the computer (Fig. 3). Its length of 18 and 23 percent is considerable high. But on the other hand, the standard deviations of 1.4 hours for managers and 1.2 hours for assistants are very high in relation to the average values. As Fig. 8 additionally shows, the distribution of the daily time of computer-use is oblique: Many participants use the computer to a little extent,

whereas some work serveral hours a day with their computers. Therefore, a common analysis of data from users with such different extent of VDT-use may lead to an unjustified conclusion in the sense, that the effects of computerization on the working condions will be underestimated.

As the user profile indicates (Fig. 9), only three of the provided application programs are actually used: Word processor and - to a lesser extent - spread sheet and electronic mail. All the other programs are used rarely or not at all. A similar impression results with regard to the usefulness of the programs in the context of work (Fig. 10).

Since the low effect of computerization on working conditions can also be caused by high interindividuell differences in the frequency of computer-use, we additionally carried-out a regression analysis. The aim was to clarify the relation between extent of VDT-use and stress-related characteristics of the working-conditions: For that, the daily time of computer-use served as a predictor and the different scales mentioned above, were the criterions. To increase the number of cases in the sample, the analysis was carried-out on the basis of all participants in the posttest (Fig. 11). Therefore, the sample consisted of 15 managers and 22 assistants.

Separate regression analysis were carried-out for managers and assistants (Tab. 2). For managers, there is a trend to report increased time-pressure ($p < 0.1$) when the extent of VDT-use is high. Furthermore, they report significant decreased social support ($p < 0.01$) and work satisfaction ($p < 0.05$) under this condition. In the group of assistants, there is a trend to report higher decision latitude ($p < 0.1$) and a significant lower prolonged stress is found ($p < 0.05$) when the extent of computer-use is high.

As Fig. 13 indicates, the distribution of time, spent at the computer, is oblique in the total sample too. Furthermore, the number of cases with a high extent of VDT-use is small. Therefore, the low possible range of the predictor can be seen as a cause for the low reported associations between extent of computer-use and stress-related work characteristics.

Discussion

One may assume, that there were other stressors, that possibly affected the working conditions in the course of computerization (e.g. reorganizations). This possibility can be ruled out since we have close contacts with the ministries management. Therefore, the differences between pretest- and posttest measurement can be interpreted with regard to effects of the computerization.

The comparison of preliminary examination and follow-up only leads to a low extent of changes in working conditions as a consequence of computerization. Mainly, an increase in decision latitude and a reduction in prolonged stress can be reported. The increased decision latitude, especially in the management, may be caused by the now available possibility to make changes in text-drafts themselfes. Originally, the text was spoken on a dictating-machine by the author, typed be the typist, using a wordprocessor and sent back to the author as an outprint. Then the author made corrections on this paper and sent it back to the typist who made the corrections in the wordprocessor-document. For the production of the documents final version, several iterations with the awkward recourse to the typist could be necessary. Since the composition of texts is a essential part of the managers work, the direct access to the text documents, using their own wordprocessors, can be regarded as an extension and flexibilization with regard to the selection of working methods and the temporal structuring of work. This results in an extension of decision latitude as we reported above.

The reported reduction of prolonged stress has to be considered as an effect of a failed information policy, concerning the introductional process: On the occasion of quality circles, shortly after the preliminary examination, many members of department no. 1 reported, that the possible consequences of VDU-use with regard to their individual working-conditions were mainly unclear. Therefore, at the time of the preliminary examination, a high level of uncertainty concerning the forthcoming changes of the working conditions must be supposed. The reported elevation in prolonged stress, with the typical inability to keep work-related problems out of one's mind, even in leisure-time, may have possibly resulted from the uncertainty about forthcoming changes.

As a possible cause of the reported, in general low effects of computerization on working conditions, we have to take into consideration, that there are high interindividual differences in the extent of VDT-use. As noted above, this fact may have lead to an underestimation of the changes, resulting from computerization.

Therefore, studies aiming to investigate the effects of computerization on the working conditions, should by all means quantify the actual extent of VDT-use. Furthermore, it should be avoided to combine stress-related data from people with different extent of computer-use in the same analysis. Therefore, the sample should be separated into subsamples with similar extent of VDT-use or the extent of computer-use should be used as a covariate.

Design

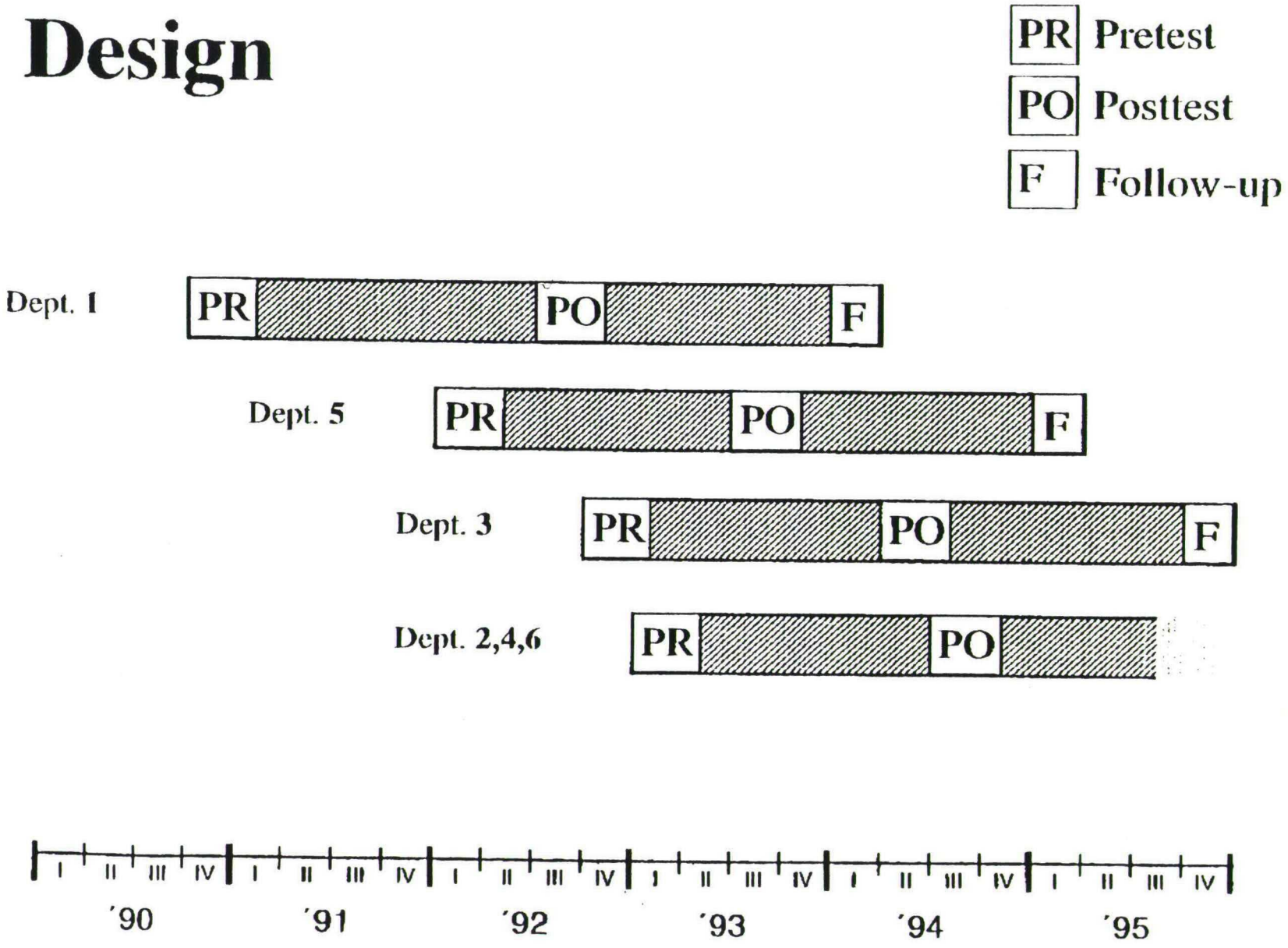

Figure 1

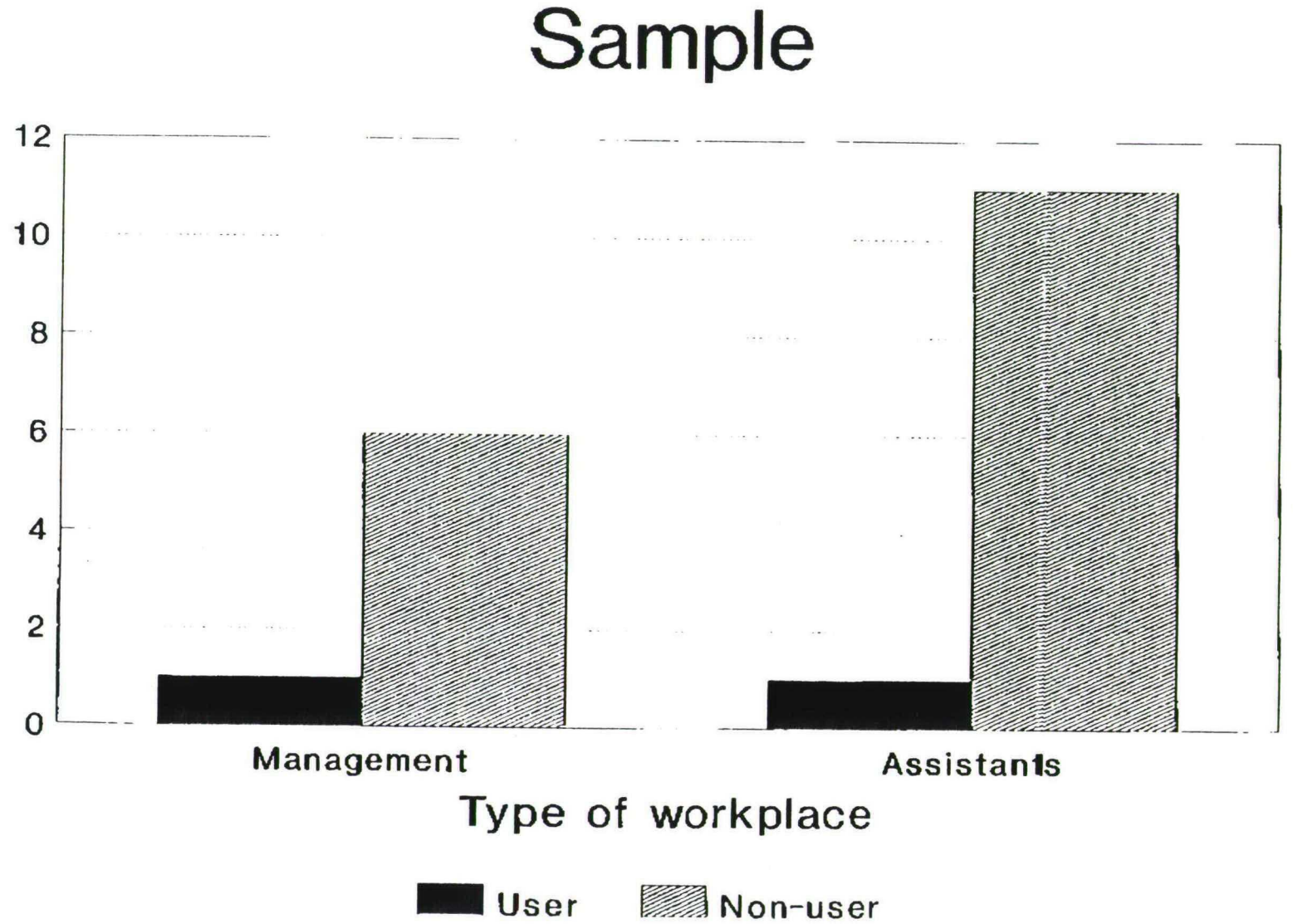
Sample
12
10
8
6
4
2
0
Management
Assistants
Type of workplace
User
Non-user

Figure 2

Tab. 1: Scale values and changes of the scale values between the repeated measurements (~=p<0.1; *=p<0.05; **=p<0.01; ***=p<0.001; up=increase; down=decrease).

Scale	items	reliab.	Mean/Sd *(total)*	change *(total)*	change *(management)*	change *(assistants)*
demands						
qualitative dem. (complexity)	7	.81	3.8/0.5	.	~ (up)	.
quantitative dem. (time-pressure)	3	.71	3.6/0.8	.	.	.
ressources						
decision latitude	5	.86	4.2/0.8	* (up)	~ (up)	.
social support	8	.85	3.5/1	.	.	.
subj. well-being						
well-being (body)	5	.83	3.8/0.8	.	.	.
job-satisfaction	8	.79	3.8/0.1	.	.	.
prolonged stress	8	.87	2.1/0.6	*** (down)	* (down)	** (down)
complaints						
cardiovascular c.	4	.7	1.4/0.4	.	.	.
stomach ache	4	.76	1.8/0.7	.	.	.
pain						
shoulder-pain	1	/	2.0/1.2	.	~ (up)	.
neck-pain	1	/	2.1/1.2	.	.	.
back-pain	1	/	2.6/1.2	.	.	.

Table 1

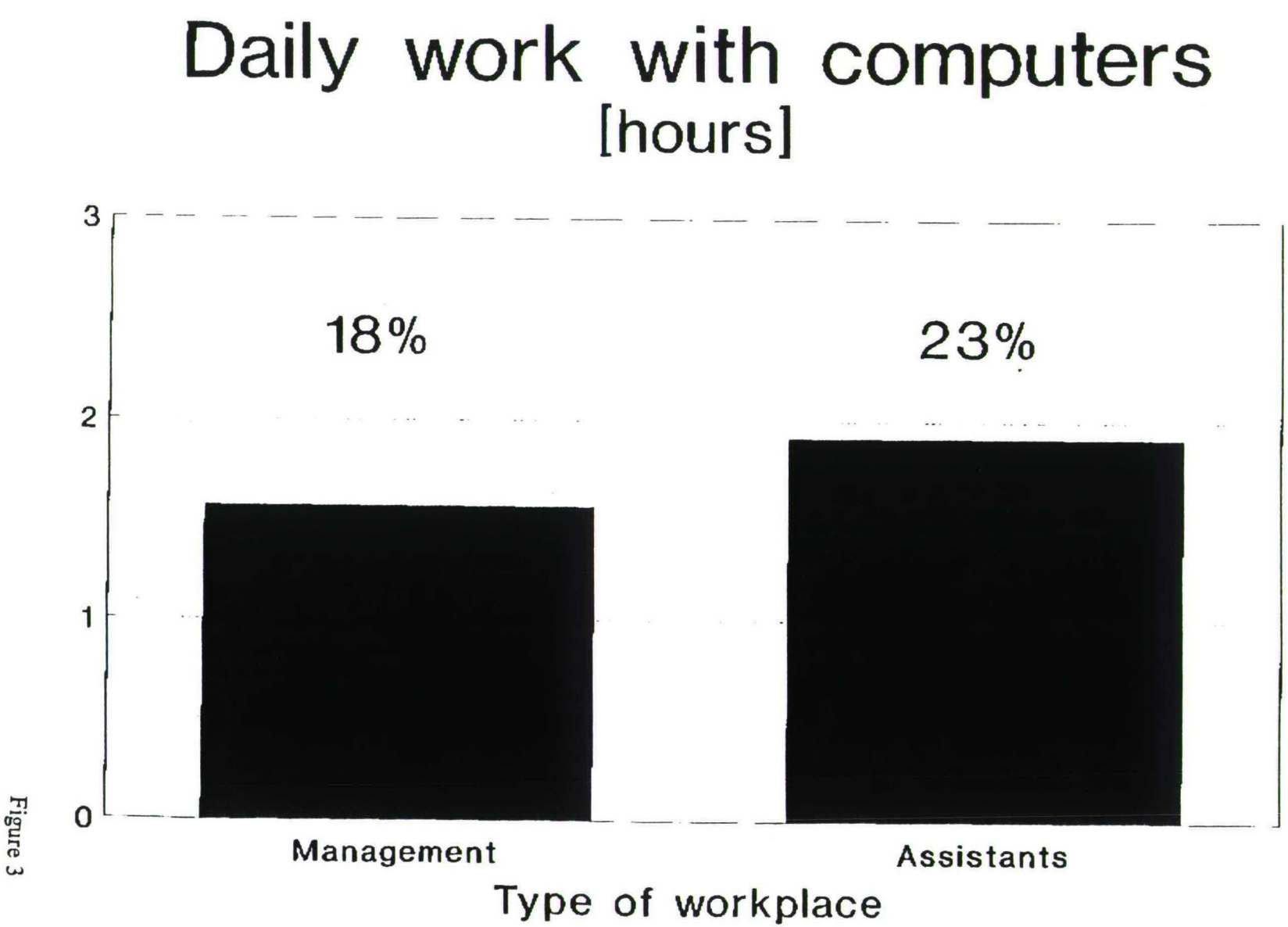
Daily work with computers
[hours]
3
2
1
0
18%
23%
Management
Assistants
Type of workplace

Figure 3

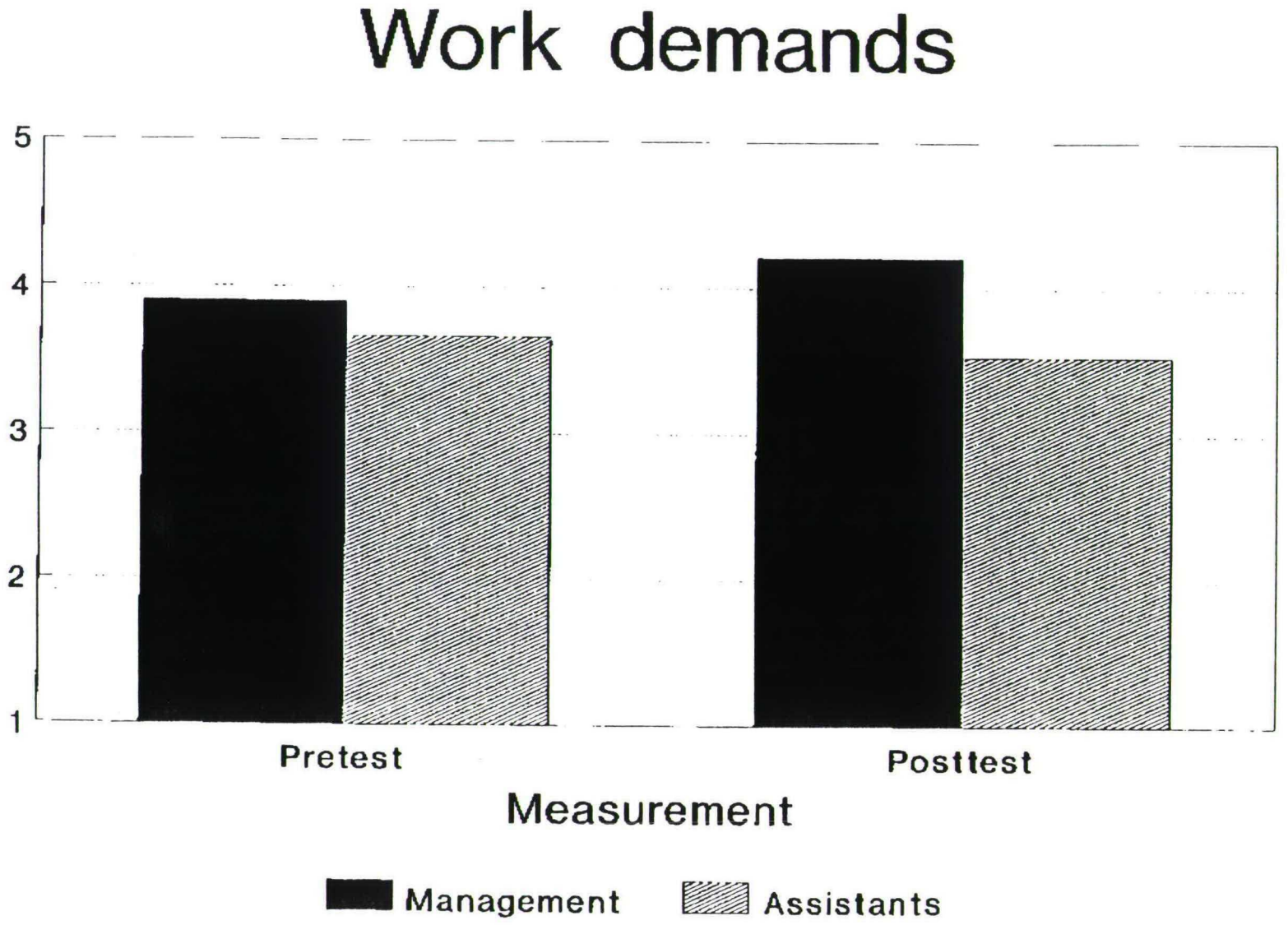
Work demands
5
4
3
2
1
Pretest
Posttest
Measurement
Management
Assistants

Figure 4

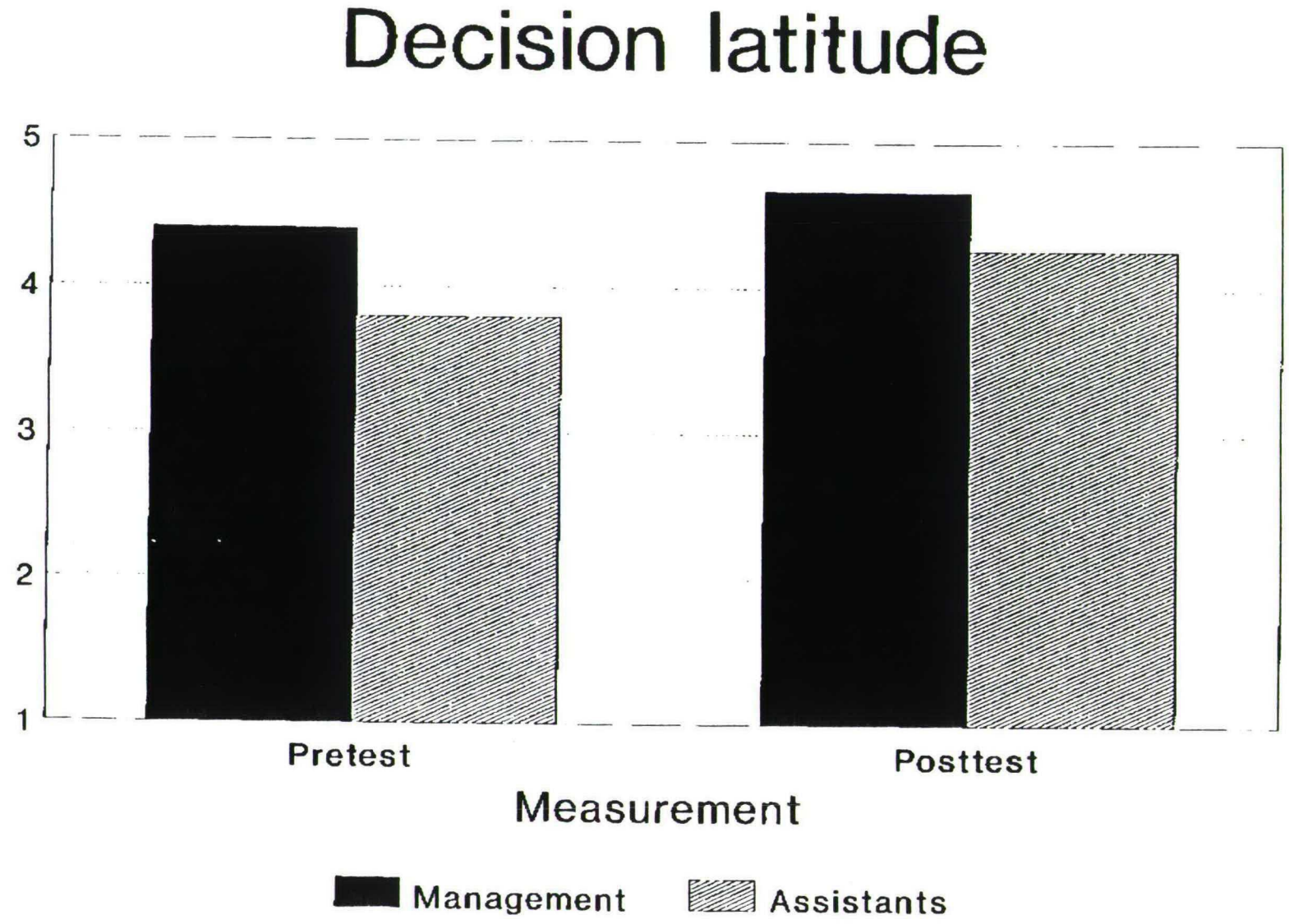
Decision latitude
5
4
3
2
1
Pretest
Posttest
Measurement
Management
Assistants

Figure 5

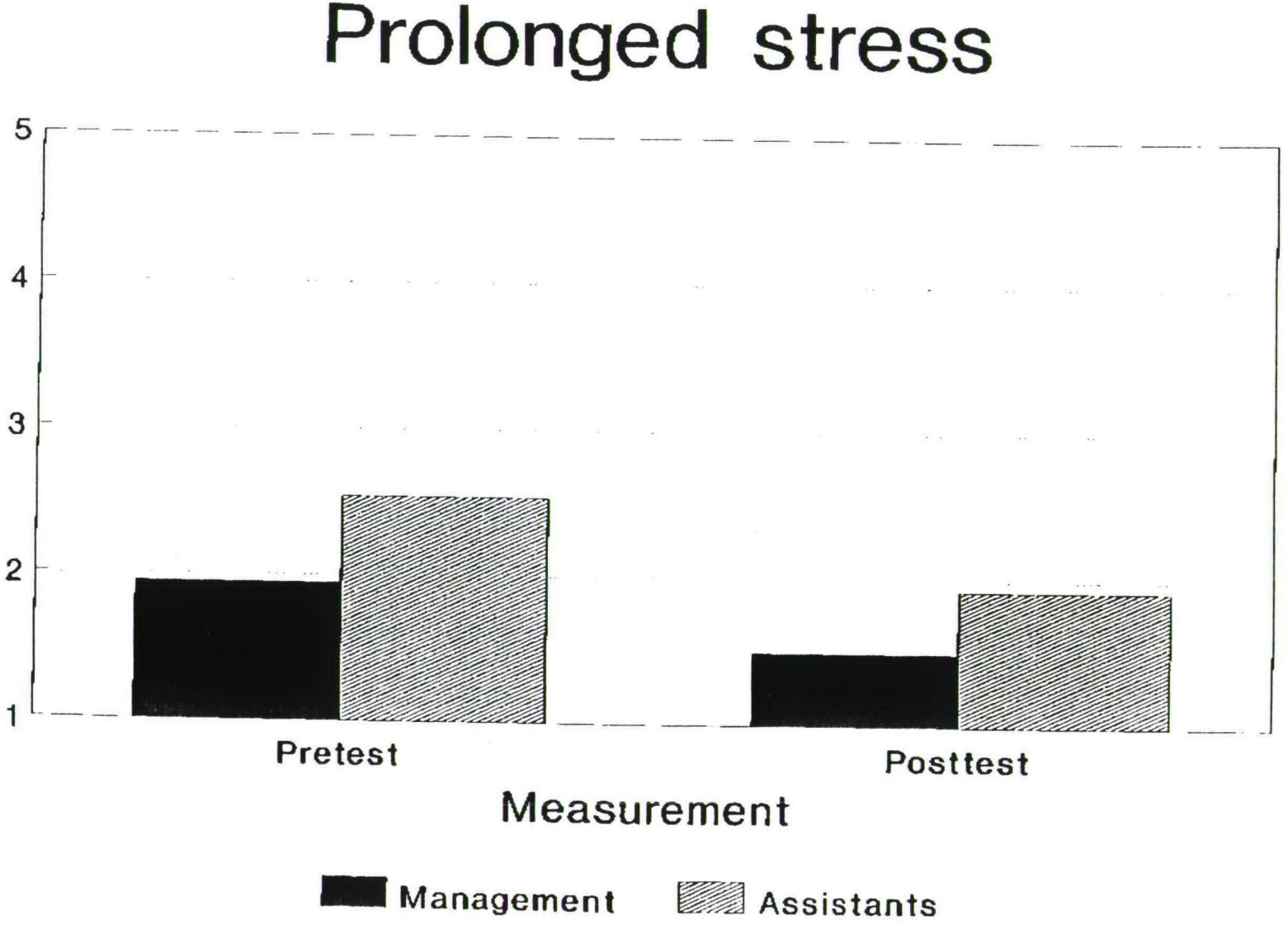
Prolonged stress
5
4
3
2
1
Pretest
Posttest
Measurement
Management
Assistants

Figure 6

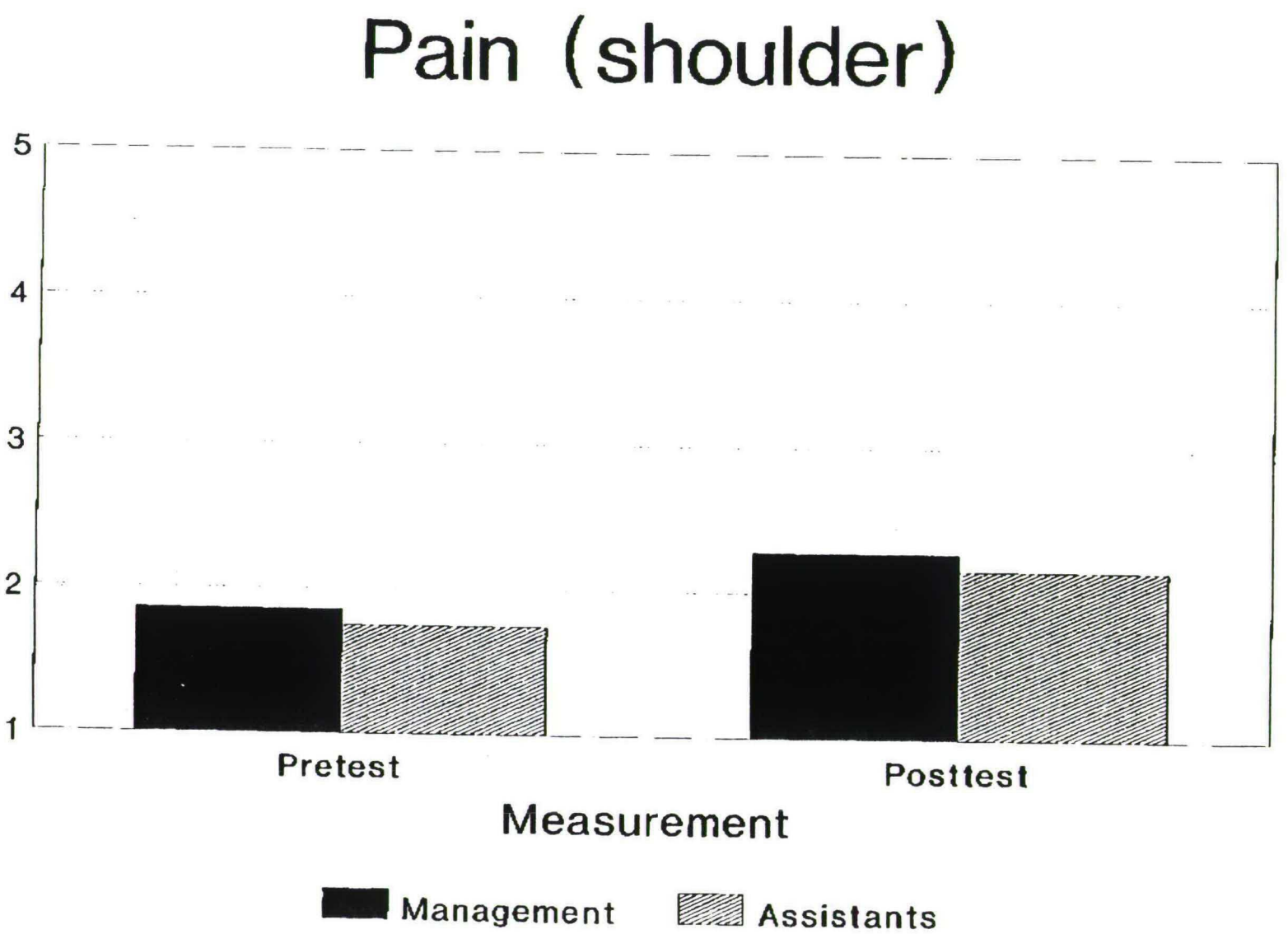
Pain (shoulder)
5
4
3
2
1
Pretest
Posttest
Measurement
Management
Assistants

Figure 7

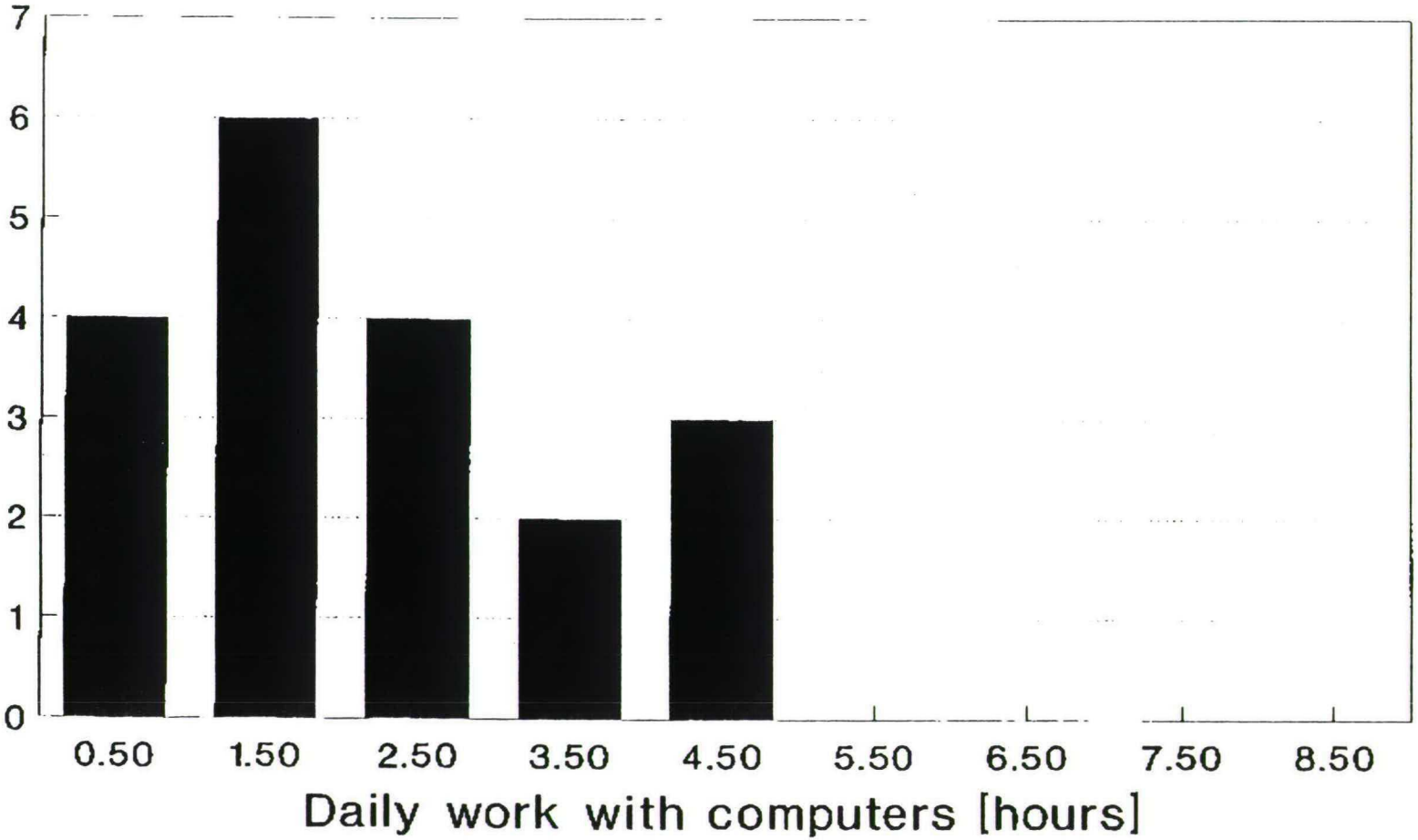
Daily work with computers
(Distribution)
7
6
5
4
3
2
1
0
0.50
1.50
2.50
3.50
4.50
5.50
6.50
7.50
8.50
Daily work with computers [hours]

Figure 8

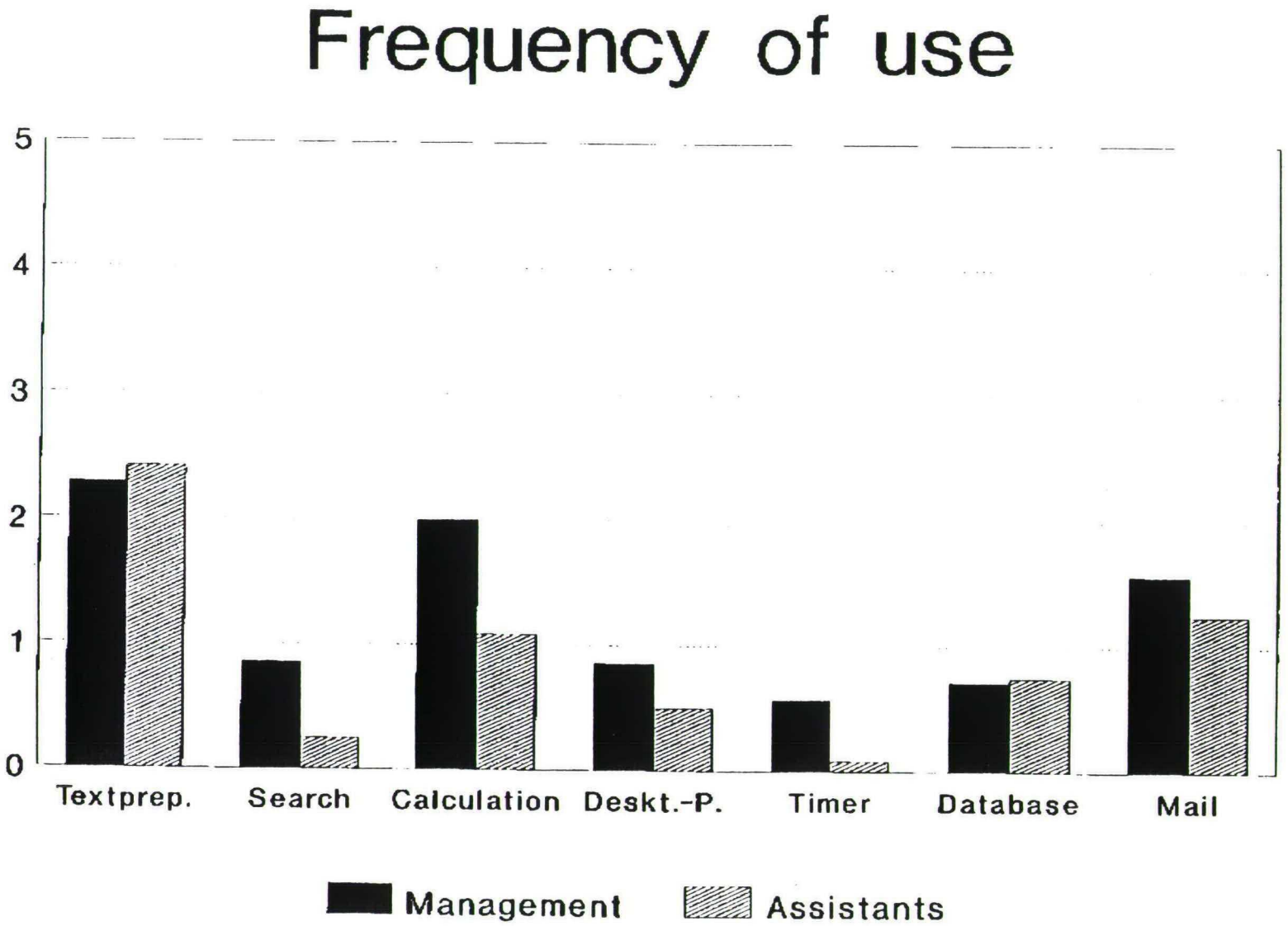
Frequency of use
5
4
3
2
1
0
Textprep.
Search
Calculation
Deskt.-P.
Timer
Database
Mail
Management
Assistants

Figure 9

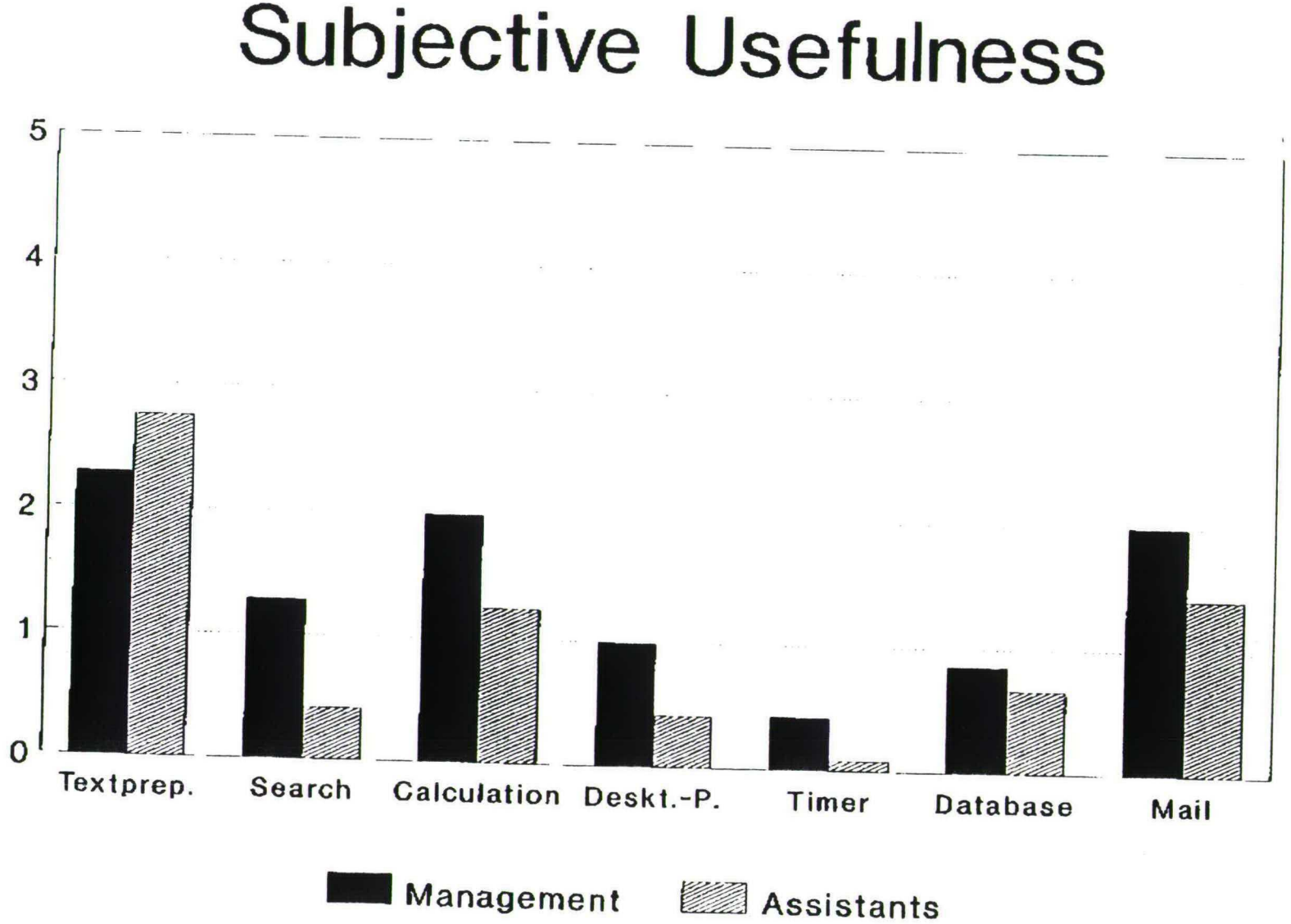
Subjective Usefulness
5
4
3
2
1
0
Textprep.
Search
Calculation
Deskt.-P.
Timer
Database
Mail
Management
Assistants

Figure 10


Sample
25
20
15
10
5
0
Management
Assistants
Type of workplace

Figure 11

Tab. 2: Regression of scale-values on percentage time spent at the computer on the basis of the total pretest-sample (~=p<0.1; *=p<0.05; **=p<0.01; ***=p<0.001; (+)=β positive; (-)=β negative).

Scale	*management*	*assistants*
demands		
qualitative dem. (complexity)	.	.
quantitative dem. (time-pressure)	~ (+) R^2=.29	.
ressources		
decision latitude	.	~ (+) R^2=.13
social support	** (-) R^2=.49	.
subj. well-being		
well-being (body)	.	.
job-satisfaction	* (-) R^2=.31	.
prolonged stress	.	* (-) R^2=.21
complaints		
cardiovascular c.	.	.
stomach ache	.	.
pain		
shoulder-pain	.	.
neck-pain	.	.
back-pain	.	.

Table 2

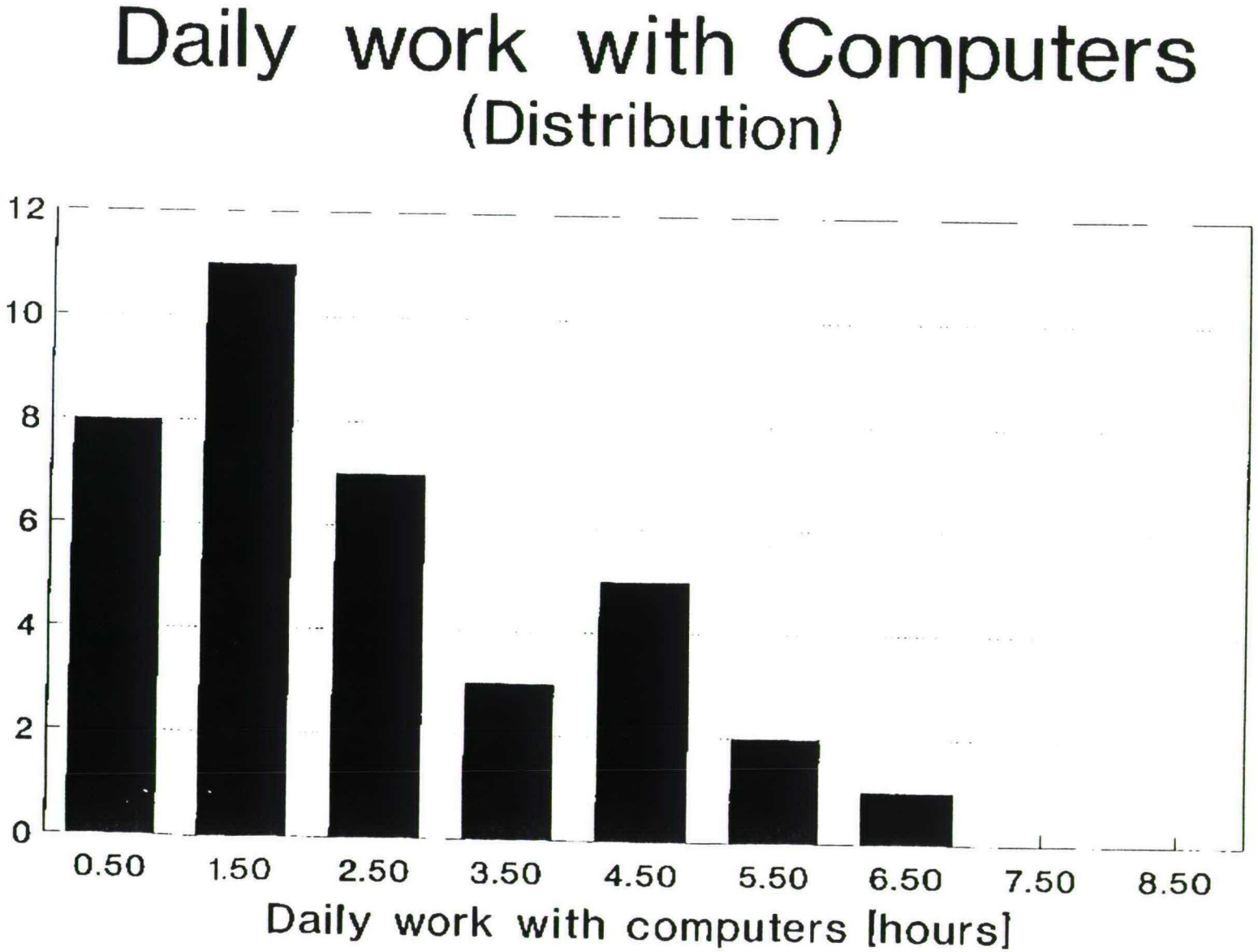
Daily work with Computers
(Distribution)
12
10
8
6
4
2
0
0.50
1.50
2.50
3.50
4.50
5.50
6.50
7.50
8.50
Daily work with computers [hours]

Figure 13

Work and Organization Research Centre
Warandelaan 2, P.O. Box 90153, 5000 LE Tilburg, The Netherlands