A comparison of part and whole training methods with mildly mentally retarded workers

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A whole method of training mildly retarded young women to thread an industrial sewing machine was compared with a pure-part and a progressive-part method. All three methods produced comparable learning, as defined by performance on the complete task one month after initial training. However, part methods were markedly superior to the whole method; fewer errors were made during trials to criterion and less training time was required. Although the progressive-part method produced satisfactory training with least errors and in the fastest time, differences between progressive-part and pure-part procedures were not statistically significant.

There has been some controversy concerning the relative superiority of part and whole methods of training (Annett & Kay, 1956; Naylor & Briggs, 1963). However, there would seem to be agreement that where a task can be meaningfully split up into a number of relatively independent operations, then learning by a part method should be easier if information-processing requirements are high, or if responses within one aspect of the task might influence the nature of cues received subsequently. Part training methods should therefore be an advantage when dealing with the backward or mentally retarded, since such people usually find it difficult to learn new tasks. Although some research has suggested that the whole method can be most efficient when intellectual deficit is involved (Brown & Sellin, 1967; Blake & Williams, 1969), most training procedures have favoured breaking down the task into sequential steps which can be learned separately, and in a logical order (Clarke & Clarke, 1965; Denny, 1966; Gold, 1968).

Holding (1965) critically examined the experimental evidence reflecting upon the relative advantages of progressive-part training, in which the various operations are gradually combined and synthesized after initial isolated practice (Seymour, 1954, 1955, 1956). He tentatively concluded that progression methods did not have any marked advantages over the pure-part procedure, whereby the trainee learns each operation separately and then combines these immediately to form the complete task. However, Salvendy & Seymour (1973) have continued to argue that while gains due to progression may be small in a laboratory setting, they are usually substantial in an industrial situation where transitions between the various task components are likely to be more complicated than in simple laboratory tasks.

The present experiment examined the relative advantages of whole, pure-part, and progressive-part methods when teaching mildly mentally retarded young women to thread an industrial sewing machine. This task was previously found to be difficult for mildly retarded girls to learn. It was easily subdivided into four operations which,
although separate, were such that an incorrect response at some stages would increase the likelihood of error subsequently. This task should therefore be learned more quickly by part training. Furthermore, it was a practical industrial task, and might therefore be learned most efficiently by the progressive-part method.

Part methods should place less load on the trainee's capacity to remember what each section of the task entailed. Moreover, the gradual combination of subtasks by a progressive-part method should aid the trainee to pay close attention to critical cues when linking component operations (Nettelbeck & Kirby, 1975). In the procedure chosen, the task to be learned was first divided into parts, and each part practised separately before being combined into progressively larger groups. This procedure appeared to have special advantages for the mentally retarded over the 'cumulative-part' method, which is similar except that each new part is not practised in isolation before being combined with other parts. The progressive-part method would seem to combine the beneficial features of both the pure-part and cumulative-part methods, since it allows the trainee to master each new component separately as well as facilitating the synthesis of these into a coherent whole. Furthermore, the progressive-part method would provide additional practice on earlier components of the task, as well as more opportunity for trainees to obtain positive feedback about the results of their actions when learning.

METHOD

Subjects

Thirty females aged 17 – 33 years (mean 22 years) and employed at a vocational rehabilitation centre served as subjects. Full Scale IQ scores on the Wechsler Adult Intelligence Scale ranged from 48 – 83, with a mean of 67 and standard deviation of 9. Although some subjects had other than intellectual handicaps, none were characterized by Down's Syndrome, or had physical disabilities likely to prevent them from learning the task. No girls had had any previous experience with a sewing machine and all remained naive with respect to the aims of the experiment.

Materials, experimental design, and procedure

Thirty subjects were allocated randomly, ten to each of three groups which learned the task using different training methods. As can be seen from Table 1, the three groups were reasonably well matched for IQ and age.

<table>
<thead>
<tr>
<th>Training method</th>
<th>IQ</th>
<th>Age</th>
</tr>
</thead>
<tbody>
<tr>
<td>Whole</td>
<td>65</td>
<td>24</td>
</tr>
<tr>
<td></td>
<td>(6-5)</td>
<td>(4-3)</td>
</tr>
<tr>
<td>Pure-part</td>
<td>70</td>
<td>22</td>
</tr>
<tr>
<td></td>
<td>(6-7)</td>
<td>(2-8)</td>
</tr>
<tr>
<td>Progressive-part</td>
<td>65</td>
<td>22</td>
</tr>
<tr>
<td></td>
<td>(11-7)</td>
<td>(5-3)</td>
</tr>
</tbody>
</table>

Subjects were required to thread an industrial sewing machine. The steps involved were as illustrated in Fig. 1. These were combined to produce four separate component operations A, B, C and D.
The group trained by the pure-part method learned each operation to criterion in isolation, before combining all four operations in complete task practice. The group trained by the progressive-part method practised A and B separately to criterion before combining A and B. These subjects then learned C, A+B+C, then D, and finally A+B+C+D. The group learning by the whole method practised the complete task from the outset. At all stages the criterion accepted for learning was four successive trials without error.

Step 1
raise lever to release tension

Step 2
thread over stand from rear

Step 3
thread through peg

Step 4
thread through upper and lower holes of side peg

Step 5
pass thread inside upper guard, around tension wheel, over wire spring

Step 6
thread under lower guard

Step 7
thread back behind upper guard

Step 8
thread through eye of mobile bar, right to left

Step 9
thread through upper guide

Step 10
thread through lower guide

Step 11
thread needle, left to right

Step 12
lower lever

Fig. 1. The 12 steps required to thread the industrial sewing machine. Steps 1, 2, 3 were combined to produce operation A, steps 4, 5 to make B, steps 6, 7, 8 to make C, and steps 9, 10, 11, 12 to make D.

Each subject was trained individually. The task or operation required was first demonstrated once by the experimenter, and then carried out once by the subject with guidance from the experimenter. During learning trials subjects did not receive any instructions or assistance. At the conclusion of each trial any errors were pointed out and the subject guided once more through the correct procedure. If no error was made the next trial followed immediately. Each trial was timed and all errors recorded.
After a period of one month during which time no subject had an opportunity to rehearse the task, 29 out of the 30 subjects were retested on the whole task without prior instruction. One girl in the progressive-part group could not be retested because of prolonged illness. Once again, guidance was provided at the conclusion of those trials in which errors occurred. The criterion for learning was again four successive error-free trials.

RESULTS AND DISCUSSION

The results of training are shown in the upper part of Table 2. These are based upon all trials preceding but not including criterion trials. Although mean performance in the whole method group was substantially slower and involved more errors than that in either of the two part training groups, there was still some overlap in performance scores between the three groups. However, while three girls made few errors when learning by the whole method, there was only one whose time on trials prior to criterion was comparable with times recorded for members of the part training groups. Planned comparisons (Hays, 1963) established that part methods of training were superior to the whole method, both in terms of the number of errors made before achieving criterion for the complete task ($F=5.9, \text{d.f.}=1,27, P<0.025$) and the time taken during trials prior to criterion trials ($F=7.4, \text{d.f.}=1,27, P<0.025$). While the progressive-part method appeared to be more effective than pure-part training, the differences between these groups were not statistically significant for either errors made or time taken.

When subjects were retested one month later on the complete task, performances within the three groups were very similar. There were no significant differences between groups for the number of trials to criterion, the number of errors made during those trials, or the time taken to relearn the threading task. These results are shown in the lower section of Table 2. The somewhat longer mean time for the pure-part group was largely caused by the markedly poorer performance of two subjects, and this is re-

<table>
<thead>
<tr>
<th>Training method</th>
<th>Whole</th>
<th>Pure-part</th>
<th>Progressive-part</th>
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<tbody>
<tr>
<td>(a) Initial training</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>errors</td>
<td>15.3 (12.4)</td>
<td>8.6 (5.7)</td>
<td>5.8 (3.4)</td>
</tr>
<tr>
<td>time (sec)</td>
<td>933 (570)</td>
<td>517 (350)</td>
<td>414 (290)</td>
</tr>
<tr>
<td>(b) Test after 1 month</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>trials</td>
<td>4.0 (2.1)</td>
<td>4.4 (3.5)</td>
<td>3.0 (1.5)</td>
</tr>
<tr>
<td>errors</td>
<td>7.3 (3.3)</td>
<td>7.1 (4.6)</td>
<td>7.9 (3.9)</td>
</tr>
<tr>
<td>time (sec)</td>
<td>509 (245)</td>
<td>691 (587)</td>
<td>419 (215)</td>
</tr>
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</table>
COMPARISON OF PART AND WHOLE TRAINING METHODS

fleeted also in the larger standard deviations associated with the number of trials required and the errors made by that group. These results simply confirmed that the criterion for learning adopted during the experiment was satisfactory, and that once the task had been learned initially, no procedure had particular advantages for the long-term retention of the skills involved.

Within the different groups, no evidence was found to indicate any relationship between IQ and performance, all correlations being extremely small. Similarly, in the subsequent retest, correlations between IQ and both the number of trials required and the time taken were negligible. There was some tendency for those subjects with higher IQ scores to make fewer errors when relearning the task, but the trend was not marked (Pearson $r = -0.3$, d.f. = 27, $P > 0.05$, two tailed).

CONCLUSIONS

The results confirmed the relative advantages of using part training procedures as opposed to the whole method when teaching mildly retarded workers a task required frequently in an industrial setting, and which could be conveniently subdivided into a number of relatively independent components. With only one exception, performance during training of those trained by the whole method was poorer than that of trainees taught by part procedures. However, while the savings in time taken to learn by the part procedures were substantial, the progressive-part was not significantly better than the pure-part method. Thus, although the gains found in the pure-part group might be considered to have outweighed the additional time required to establish a pure-part method of training, it is possible that in the task used here the much greater preparation and effort required to train by the progressive-part method might not have been warranted. Progressive-part demands much more of a training officer’s time and attention than the pure-part procedure. In addition to checking that each separate operation has been mastered the training officer must ensure that all new combinations of parts have been learned satisfactorily. Further, where an item is being manufactured or assembled the progressive-part method can use substantially more training material, since additional material is required for each new combination of parts. In practice, these considerations can be important, particularly if those responsible for carrying out training which has been planned by others are not already thoroughly familiar with the procedures involved. Toye (1969) has emphasized the importance of training methods which, although not necessarily the most efficient when examined from a theoretical viewpoint, are sufficiently robust to withstand day to day changes in the work situation. It remains possible, however, that a progression procedure might be more effective where the synthesis of various skill elements was more complicated than required here, or with particular individuals who found it difficult to learn by any other method.

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REFERENCES


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