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ABSTRACT

A computer-based attention reduction model of training is presented, and associated issues related to instructional systems design are outlined. Attention reduction training (ART) is based on the dual task assessment procedure developed by researchers in the area of memory. The technique involves having subjects respond to two tasks simultaneously. The issue of vertical transfer of training is central to the model. Vertical transfer describes a condition in which a subordinate skill is used when performing a superordinate skill; the notion that two or more skills may be related in a hierarchical fashion becomes paramount to this view of transfer. Whereas training aimed at skill mastery focuses primarily on performance accuracy, ART extends skill performance criteria to include speed (reaction time) and other measures related to the reduction of attentional resources (i.e., the ability to process two or more tasks concurrently). From this perspective, it is maintained that the development of fluent or automatic intellectual skills is content specific and should be approached from the perspective of detailed hierarchical analysis techniques. The consistent mapping practice procedure can be used to reduce attentional resources related to the secondary skill/task and to test the hypothesis that this ART facilitates vertical transfer. Issues related to instructional development include motivation, incrementing task workload, use of multiple primacy tasks, optimal primary task workload, and speeded training techniques. Two figures are included. (TJH)

ATTENTION REDUCTION TRAINING: OVERVIEW AND IMPLICATIONS FOR TRAINING AND RESEARCH

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Paper to accompany a roundtable discussion at the 1990 meeting of the American Educational Research Association, Boston, MA.

Background

Recent research in automaticity training suggests that reducing attentional resources related to certain intellectual skills can be engineered and this type training facilitates later transfer of learning. One potentially useful attention reduction training technique requires learners to respond to two tasks simultaneously. Since primary task variables can be manipulated with concomitant increases or decreases in secondary task (i.e., the task of interest) performance, it is suggested that automaticity be viewed as being continuous rather than discrete in nature. The technology for applying this dual task technique has been considered by Jacobs, Dempsey, and Salisbury (in press). Although the approach appears promising, much work remains to be accomplished before attention reduction training may be used as a practical application.

Purpose.

The purpose of this presentation is to present a computer-based attention reduction model of training and outline important issues, especially those related to instructional systems design, that must be addressed before the model can be incorporated into an educational setting.

Automaticity Training

Historically, theorists have postulated at least two separate aspects of attention: mental activities requiring a minimum of attention, referred to as automatic processes (Posner & Snyder, 1975; Schneider & Shiffrin, 1977; Shiffrin & Schneider, 1977) and mental activities requiring increased amounts of attentional capacity. The latter type of mental processes have been referred to as conscious (Posner & Snyder, 1975), controlled (Schneider & Shiffrin, 1977), and effortful (Hasher & Zacks, 1979). The idea of variable attentional capacity is based on a model of human information processing that assumes the total amount of attentional capacity is limited (e.g., Kahneman, 1973). Kahneman's model also postulates that attentional limitations interact with processing demands at any point in the information-processing sequence (between encoding and responding) and that attentional requirements necessarily increase as processing nears the response end of the system (see also Posner & Keele, 1970).

Researchers in cognitive psychology have extended this view of differential capacity requirements for mental activities and have argued that complex operations can, with extensive practice, occur with a minimum amount of attention allotted to them (Posner & Snyder, 1975 Schneider & Shiffrin, 1977; Shiffrin & Schneider, 1977).

Attention Reduction Training

Attention reduction training (ART) is based on an assessment procedure developed by researchers in the area of memory (see e.g., Britton, Piha, Davis, & Wehausen, 1978 Eysenck & Eysenck, 1979; Tyler, Hertal, McCallum, & Ellis, 1979). This procedure is referred to as the dual task technique. The dual task technique involves having subjects respond to two tasks simultaneously. This task, as originally employed, was used to assess the amount of attentional resources consumed when performing memory-related tasks. Subsequent research has, in some cases, not supported the use of this task as a valid assessment tool due to incomplete or

inaccurate accounting of methodological assumptions thought to underlie the dual task technique (see e.g., Fisk, Derrick, & Schneider, 1982).

Despite these potential problems, we believe that this assessment tool may be a potential alternative as a training device, given two conditions. First, both tasks are computer-based, thus allowing close and accurate monitoring of critical performance components of each task. Second, an independent assessment of automatic processing should be conducted. One such measure is vocalization latency, which is currently being used for studying automatic processing of critical prerequisite skills in reading (e.g., Stanovich, Cunningham, & Feeman, 1984a, 1984b). Another promising measure concerns the use of event-related potentials (Meador, Hammond, Loring, Feldman, Bowers, and Heilman, 1987; Novich, B, Lovrich, D., & Vaughn, 1985).

The notion that task components may be trained to an automatic level has been the focus of increasing interest over the past several years. One training procedure that has proven effective for producing automatic processing was developed by Schneider and Shiffrin (Schneider & Shiffrin, 1977; Shiffrin & Schneider, 1977) and is referred to as the consistent mapping training procedure. These researchers have provided evidence that extensive practice (often over thousands of trails) using this procedure results in automatic processing of skill components, supposedly due to the reduction of attentional resources needed for performing these requisite components. Regardless of the nature of performance gains (e.g., fluency, automaticity, or reduced attentional resources), the idea that certain types of training may positively influence transfer, above and beyond traditional mastery level training, is both intriguing and may prove beneficial to many areas of training and education.

To summarize, the ART model involves training designed to extend training outcomes beyond those expected from traditional training that uses a mastery-level criteria. Whereas training aimed at skill mastery focuses primarily on performance accuracy, attention reduction training extends skill performance criteria to include speed (reaction time) and other measures related to reduction of attentional resources (i.e., ability to process two or more tasks concurrently).

Dual Task Methodology

As an assessment tool, the dual task paradigm relies on the following three assumptions: (1) both the primary and secondary tasks share a common pool of attentional resources (See Figure 1), (2) primary task performance remains consistent relative to when processing is independent of any competing tasks, and (3) primary task components don't become automatized with practice (Fisk et al., 1982). To satisfy the first assumption, it must be demonstrated that performance on one task necessarily decreases in the presence of the other, time-shared task. Because the competing (time-shared) task must consume a consistent amount of attentional resources (assumption 2), it is usually labeled the primary task, that is, the task of primary importance for the subject. The fact that the subject performs the primary task at a level equal to when it is processed independent of any competing task allows one to infer that performance decrements related to the secondary task result from reduction of available attentional resources (when performing both tasks simultaneously). The final assumption is particularly relevant to the ART model. Specifically, if both tasks being performed simultaneously are maintained over time or if independent trials in which they are repeated, then one must consider the effects of this practice.

FIGURE 1 ABOUT HERE

Vertical Transfer and its Implications Concerning the ART Model

This discussion of transfer focuses on a specific aspect of transfer described by Royer (1979), and referred to as vertical transfer by Gagne' (1965). Because vertical transfer describes a condition in which a subordinate skill is used when performing another, superordinate skill, the notion that two or more skills may be related in a hierarchical fashion becomes paramount to this view of transfer. When used to assist trainees in learning complex job tasks, instructional theory dictates an instructional analysis be performed focusing on the types of required learning.

From this perspective, we maintain the development of fluent or automatic intellectual skills is content specific and should be approached from the perspective of detailed hierarchical analysis techniques.

Methodology for assessing ART model.

Based on previous research (Schneider & Shiffrin, 1977; Shiffrin & Schneider, 1977), one way to reduce attentional resources related to a skill is the use of the consistent mapping practice procedure. Using this procedure, one can reduce attentional resources related to the secondary task and test hypothesis that this type training facilitates vertical transfer.

An alternative paradigm may also be used for examining aspects of vertical transfer using the dual task procedure as a training device. This methodology, as well as related practical concerns, are central to any further development with the Attention Reduction Model. Figure 1 illustrates a model of the ART training process, based on Jacobs, et al. (in press).

FIGURE 2 ABOUT HERE

Related Issues

Several issues must be empirically addressed before the ART model would be feasible for educational applications. These issues include the following:

(1) Motivational considerations. Providing systematic motivational support during and after attention reduction training is an extremely important concern. Without continued, high motivation on the part of the subject, training may become unduly long and arduous.

(2) Incrementing task workload. That is, what is the best way to increase primary task workload? The deciding factor here may be the learner's response to failure.

(3) Optimal primary task workload for producing durable attention reduction processing. In general, the ART model views attentional resources as being continuous in nature. Given this training technique facilitates training and transfer in some meaningful way, there is a need to determine the optimal levels of reduced attention for specific tasks and individuals.

(4) Use of multiple primary tasks. This approach may be more realistic in the sense that in real-life situations, our attention is divided into several tasks simultaneously. In practice, setting up and monitoring several simultaneous tasks may be especially challenging, if for no other reason the mode of response of one task may interfere with encoding or responding to other (competing) tasks.

(5) Use of speeded training techniques for accomplishing attention reduction training. Because researchers in this area have suggested that speed may be a critical component of automatic processing, there is a need to explore the relation between ART and training aimed at decreasing speed (e.g., repetitive reading). Results from such studies could be used to bolster the assumption that increases in speed may be attributed, in part, to a reduction in attentional resources. Conversely, it may be the case that automaticity is composed of two separable factors: reduced attention and increased speed. In either case, the results would be useful for designing and evaluating future models of training that view skill mastery as only one facet of efficient learning.

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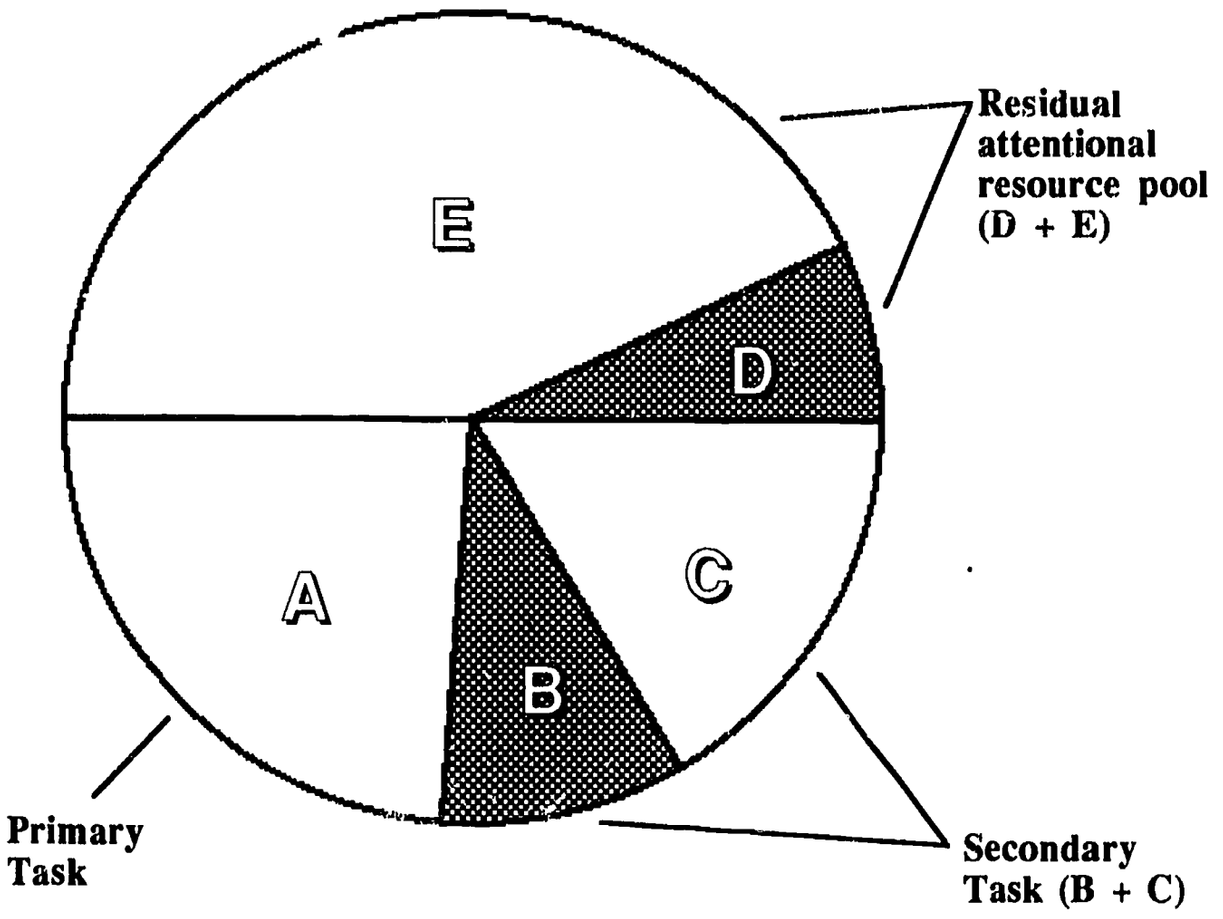


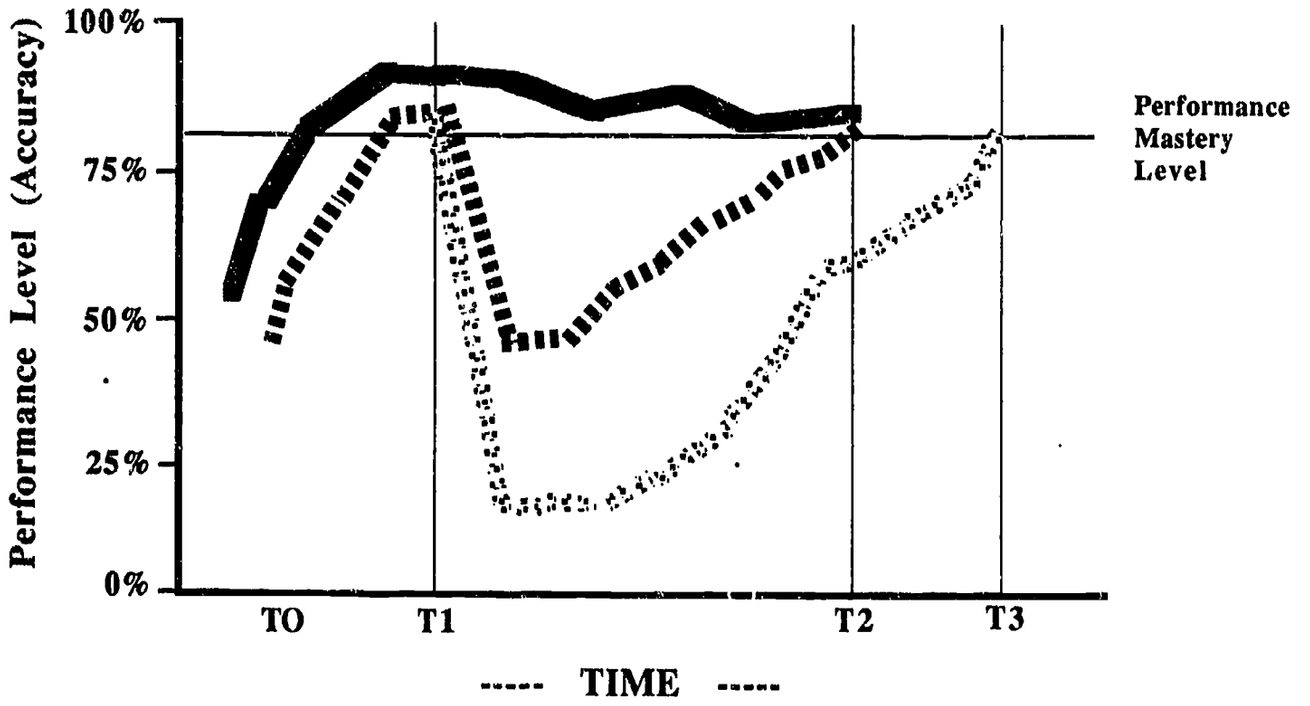
- Attentional resources needed for performance of dual tasks prior to training using ART procedures: A + B + C
- Attentional resources needed for dual tasks after ART:
  A + C (attention reduction hypothesis) or
  A + B + C + D (attention reallocation hypothesis)

Figure 1. Model of distribution of attentional resources produced by training using ART procedures

= Primary Task Performance Levels

= Secondary task performance levels

= Hypothesized secondary task performance levels resulting from increased primary task workload



TO = Training initiated (performance levels are not taken simultaneously

T1 = Mastery training criteria met; dual task training initiated

T2 = Dual task training complete; secondary task reaches original (baseline) levels -- criteria for determining "automaticity" reached

T3 = "Automaticity" criteria for secondary task reached when more difficult or variable primary task is used

Figure 2. Hypothesized primary and secondary task performance levels as a function of training aimed at producing mastery or dual task criteria