APPLIED PSYCHOLOGY: AN INTERNATIONAL REVIEW, 2000, *49* (2), 263-283

The Impact of Enactive Exploration on Intrinsic Motivation, Strategy, and Performance in Electronic Search

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On a réalisé une investigation expérimentale des effets de l'exploration énactive sur la motivation intrinsèque, la stratégie et la performance dans une tâche de recherche électronique. L'exploration énactive recouvre une part d'exploration autonome et de gestion des erreurs que les sujets de la condition expérimentale ont été incités à exploiter lors de la phase pratique d'un programme de formation. Les sujets contrôle bénéficiaient de la même formation de base et étaient confrontés à la même phase pratique sans l'incitation à l'exploration énactive. Celle-ci suscitait une motivation intrinsèque plus forte mais n'influençait pas les facteurs d'autorégulation. Les sujets expérimentaux avaient aussi de meilleurs résultats dans les tâches de transfert réalisées avec une expectation précise de la performance. L'efficacité perçue à l'issue de la formation et la satisfaction avaient un impact positif sur la qualité des stratégies retenues dans les tâches de transfert, mais la motivation intrinsèque nuisait à la qualité de la stratégie. La discussion porte sur la façon dont les consignes introduisant à l'exploration énactive influencent la motivation intrinsèque et sur l'impact de la motivation intrinsèque sur la stratégie et la performance dans les tâches complexes.

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An experiment was conducted to investigate the effects of enactive exploration on intrinsic motivation, strategy, and performance on an electronic search task. Enactive exploration includes elements of self-guided exploration and error management, which participants in the experimental condition were encouraged to utilise during the practice segment of a training programme. Participants in the comparison condition received the same basic training and completed the same practice segment without the enactive exploration intervention. Enactive exploration produced higher intrinsic motivation than the comparison condition but did not influence other self-regulatory factors. Participants trained in the enactive exploration mode also had higher performance levels on transfer tasks performed under stringent performance expectations. Post-training self-efficacy and satisfaction had a positive influence on the quality of strategies used on the transfer tasks but intrinsic motivation was negatively related to strategy quality. The ways in which enactive exploration instructions influence intrinsic motivation and the effects of intrinsic motivation on strategy and performance on complex tasks are discussed.

INTRODUCTION

As computerised information sources increase in range and diversity, electronic search is becoming a critical behaviour for decision making in work, education, and leisure. The amount of information that is being stored and presented electronically rather than in print form is increasing and now includes encyclopaedias, databases, library catalogues, journals, and personal information. Information technologists predict that increasing amounts of the world's information will be stored in electronic databases and will only be available by electronic access, thus creating a need for new skills to ensure maximum access to information (Cook, 1995). In the future, effective decision making will increasingly depend upon electronic search skills and electronic search will become a requirement for performance in many work settings.

Electronic search allows people to examine diverse sources of electronically stored information in an efficient and highly flexible way. Comprehensive and focused searches are made possible by the relative ease with which a wide array of external information sources can be explored. However, identifying appropriate sources of information and search methods places heavy demands on an individual's cognitive capacities and motivation. The cost of obtaining information has been reduced but the overwhelming amount of information that is readily available often makes it difficult to locate the relevant facts (Katz, 1992). Due to the large range of sources that can be tapped, the identification of proper strategies is increasingly difficult. Moreover, small variations in electronic search strategies can often lead to large variations in outcomes and progress is often not evident from interim feedback (Debowski, Wood, & Bandura, 1998).

When confronted by the complex nature of electronic search, novices often develop suboptimal strategies, lose their interest and underutilise the information available. Programmes for the widespread development of electronic search skills are critically needed. To be effective, such programmes must foster the self-regulatory processes and intrinsic motivation needed to ensure that trainees will continue to explore and experiment, despite setbacks and apparent lack of progress during the early stages of skill development.

In the current study we investigate the effects of a training programme for the development of electronic search skills called "enactive exploration" (Debowski et al., 1998; Wood & Debowski, 1998), which combines principles of self-guided exploration (Greif & Keller, 1990) and error management (Frese, 1995). In the study of human–computer interaction and computer training, exploratory learning concepts have been used in the development of practical approaches for the design of computer systems and manuals (Carroll, Mack, Lewis, Grischkowski, & Robertson, 1985) and the development of training programmes (Debowski et al., 1998). Prior applications of the error management approach have shown it to be advantageous on stable procedural tasks, such as the use of word processor packages, when compared to training programmes that emphasise error minimisation or error avoidance (Frese, Brodbeck, Heinboke, Mooser, Schleiffenbaum, & Thiemann, 1991; Frese & Altmann, 1989).

Enactive exploration is a mode of skill development in which self-direction and exploration are encouraged. The novice searcher is provided with unstructured opportunities to explore and to discover effective strategies. Learners are also encouraged to make errors as a way to discover more about the system and to avoid negative self-evaluative reactions to errors (Frese et al., 1991; Dormann & Frese, 1994). Enactive exploration can be contrasted to more structured approaches, such as guided mastery training (Bandura, 1997; Debowski et al., 1998). Guided mastery training is a form of skill acquisition that provides learners with the knowledge of appropriate strategies in a structured, step-by-step approach. In comparison to enactive exploration the guided mastery programme leads trainees through tasks of increasing difficulty in a predetermined sequence and supplements this with modelling of correct behaviour. The potentially debilitating effects of negative self-evaluative reactions are minimised through controlled exposure to the challenges presented by the task. Trainees do not get exposed to more difficult challenges until they have mastered the less difficult aspects of the task. In enactive exploration, trainees choose their own level of difficulty and, in the early stages of training, these choices may be ill-informed. Guided mastery training has been shown to be highly effective in transmitting task and self-regulatory competencies (Bandura, 1986, 1997).

On complex tasks, self-guided exploration is driven by the emerging problems and interests of the trainee and not imposed by the trainer or the training programme. The ill-structured nature of self-guided exploration poses two major risks for novice trainees. First, their search through the problem space may be highly inefficient and lead them to adopt suboptimal strategies due to their lack of understanding of the task and their inability to adapt their strategies based on the feedback received. Providing trainees with the understanding and basic skills needed to explore the different components of a task and to be able to interpret feedback will reduce this risk. Debowski et al. (1998) found that guided mastery was a more effective technique for the initial acquisition of competencies than enactive exploration, which was found to be wasteful of effort and less effective in the earlier stages of skill acquisition. However, an exploratory, self-directed approach may be more effective for strengthening task and self-regulatory competencies once they have been developed to a basic level through guided mastery. In the current study, all participants were provided with initial guided mastery training. In the experimental group this was supplemented with an enactive exploration intervention, described below.

The second risk associated with self-guided exploration on complex tasks is motivational and the effects depend upon the framing of the feedback received during exploration. Self-guided exploration has been found to be conducive to the development of intrinsic motivation (Deci & Ryan, 1980) and therefore enactive exploration was expected to lead to greater intrinsic motivation. However, this argument is based on the assumption that the setbacks and unexpected outcomes that arise during exploration will be framed by the trainee as a natural product of exploration and as an opportunity to learn and not as evidence of a lack of competence. When feedback is interpreted as evidence of failure, motivation and performance are often undermined by the resulting negative self-evaluative reactions (Bandura, 1997). Following failure, trainees may begin to doubt their capacity to perform the task. This can set off a spiral of negative motivational and performance effects in which the resulting drop in trainee self-efficacy influences performance directly and indirectly through ineffective search strategies, diminished capacity for interpreting feedback, negative affect, and reduced interest in the task (Wood & Bandura, 1989).

When people doubt their capacity to perform, they react more negatively to setbacks with feelings of self-dissatisfaction and frustration. On complex tasks, negative affective reactions undermine the capacity needed for maintaining attention and completing short-term memory components of the task (Wood, George-Falvy, & Debowski, 1999). Trainees who experience self-doubt and dissatisfaction with their progress quickly lose interest in the task, which further reduces their willingness to explore and experiment with the task (Bandura, 1997; Debowski et al., 1998). In summary, the errors and mistakes that are a natural byproduct of exploratory behaviour can undermine motivation through their impacts on the cognitive and affective reactions of trainees who interpret the resulting feedback as evidence of failure or lack of progress and not as an opportunity to learn.

Error management is an intervention that encourages trainees to frame feedback from errors and mistakes as an opportunity to learn and as a natural byproduct of task performance (Frese, 1995). Framing mistakes, errors, and setbacks positively can inoculate trainees from the debilitating effects of the negative self-evaluative reaction cycles described above (Dweck, 1996). The inclusion of an error management intervention in enactive exploration prepares the novice trainee to confront setbacks and to learn from errors and not to get caught in a spiral of self-doubt and dissatisfaction due to a perceived lack of progress.

Freed from the impacts of negative self-evaluative reactions, self-guided exploration leads to a more positive cycle of enhanced intrinsic motivation and greater willingness to explore and experiment. In the enactive exploration mode, achievements are more likely to be attributed to internal factors rather than external determinants such as the trainer or the programme. This leads to a strengthening of personal mastery beliefs and greater interest in the task (Bandura, 1997; Deci, 1975; Deci & Ryan, 1980; White, 1959).

In summary, the present study tests the argument that, once basic competencies are developed through guided mastery training, enactive exploration training will lead to greater intrinsic motivation and more effective performance on a transfer task. In order to test the proposed argument, the training was conducted in two phases. In the initial acquisitional phase all participants received guided mastery training following the procedures used in the guided mastery condition of Debowski et al. (1998). Enactive exploration was not introduced until participants had received sufficient guided mastery training to have developed a basic skill level. During the practice phase, following the guided mastery training, an experimental group received enactive exploration instructions while a comparison group received no further instructions.

Competencies developed while participating in a training programme will be most useful if they are applicable beyond the training situation. In most cases, this transfer involves a change from a learning situation to a performance situation. Accordingly, the effectiveness of the enactive exploration approach in strengthening competencies and intrinsic motivation was assessed during a post-training segment in which participants from both conditions were required to demonstrate their search skills on two search tasks under more stringent performance expectations. The following hypotheses were tested:

H1—Enactive exploration trainees will develop greater intrinsic motivation for the electronic search than trainees in the comparison group.

H2—Enactive exploration trainees will have superior search strategies and better performance on post-training transfer tasks in a performance-oriented setting, than trainees in the comparison group.

H3—Intrinsic motivation will be positively related to quality of search strategies and performance on a transfer task in a performance-oriented setting.

METHOD

An experiment combining training mode as a two-level between-subjects factor with repeated measures of motivational states, strategies, and performance was conducted.

The Sample

Participants were undergraduate students who had little previous experience with CD-ROM searching. Participants had an average age of 28 years and included 17 males and 17 females. The participants were randomly allocated to the experimental group ($N = 17$) or the comparison group ($N = 17$), balanced for gender.

The Task

The task used was the CD-ROM database search employed in the Debowski et al. (1998) study. CD-ROM databases store records from a variety of sources including published journal articles, unpublished papers, books, and technical reports. Participants were given search problems for which they had to find relevant records on the database. In order to find documents related to a certain set of concepts participants need to construct a search statement combining keywords and connectors. Keywords are used to describe a concept from the problem statement and each record stored in the database is indexed by a number of keywords, which may be obtained from the database index, a thesaurus, outputs of searches, or from personal knowledge. The thesaurus provides a list of related keywords that can be used to construct searches of greater breadth and depth than alternative sources. Identifying keywords in the thesaurus requires more effort but generally results in more effective searches than search statements based on keywords from more easy-to-access sources.

The keyword terms used in a search statement are linked together by Boolean connectors like "and" and "or". Using "and" will narrow the scope of the search and result in a more focused search since only those records indexed under all the combined terms are retrieved. On the other hand, using the "or" connector will broaden the focus of the search, as all records indexed under any one of combined keywords will be retrieved. On the CD-ROM database used in this study, the search statement "technology *and* satisfaction *and* management" produced 50 records, while the search statement, "technology *or* satisfaction *or* management" retrieved 43,424 records! Thus small changes in the formulation of a search statement can lead to wide variations in the number of records retrieved. This can be overwhelming for novice searchers who are not sufficiently confident in their strategic knowledge to identify the impacts of combinations of keywords on the output retrieved.

Database searching is an interactive activity. The records retrieved with the search statements can be viewed on the computer screen and assessed for their relevance to the search problem. The insights gained are then used to adapt the search statement so that the number of relevant records is increased and the number of irrelevant records decreased. In practice, this process can continue until the searcher is satisfied with the library records retrieved. In pilot studies, participants have been found to spend an average of 16.5 minutes ($SD = 2.3$) per voluntary search problem. In the current study, participants were given a maximum of 20 minutes per search task.

Training Programmes

Participants were trained individually or in small groups. When there was more than one trainee, participants were physically separated and had no contact with one another. In both conditions, the trainer followed a rehearsed script.

The training programme consisted of two parts. The first part, the guided mastery segment, was identical for both groups. For the second part, the practice segment, only the experimental group received the enactive exploration instructions described below. A skilled librarian, who was an expert on CD-ROM searching and an experienced trainer, conducted both segments of the training for all participants. The guided mastery programme presented to all participants in the initial segment of the training was taken from the Debowski et al. (1998) study. It consisted of an overview of the CD-ROM database, description of the most effective search strategies to be used for retrieving records, and instructions in the use of the various computer operations and their functions. The different search tools were described and the trainer demonstrated how to use the Quick Reference Guide, the Thesaurus, the Keyword Index, and the Help and Guide services. After this general introduction, participants in both training conditions were given a sheet containing a summary of the steps involved in developing a search strategy and were told that they could refer to this during the instruction and practice segments of the training. The sheets were removed at the end of the training, before the beginning of the transfer performance phase.

Following the overview, participants received specific guided mastery instructions and modelling on the completion of the search problem: "What impact has mass media had on violent behaviour?" The instructor talked the participants through the step-by-step build-up of a strategy while cognitively modelling the search method. For example, when explaining how to identify the correct keywords for concepts in the search problem, the instructor might say: "Violence is one of the keywords I have identified to describe this concept, but I know I will be more successful if I find some other related keywords in the thesaurus". The instructor would then use the thesaurus to identify several other keywords. The strategy demonstrated during the instruction segment proceeded from the development of keywords for concepts followed by the linking of concepts. This has been shown to be an effective search strategy for CD-ROM databases (e.g. Michel, 1994; Quint, 1991). The guided mastery instruction segment lasted 30 minutes.

During the practice segment of the training, participants in both conditions worked on the same three problem tasks. These were to identify relevant records for "The link between drunkenness and scholastic performance", "The factors that impact on migrants learning a new language", and "The effects of childcare on social skills". The problem statements for each task were removed after completion of the task. All participants completed the practice tasks in the same order and were given written instructions that practice tasks were an opportunity for them to develop the search skills they had just learnt in the initial segment of the training programme.

In addition to the general written instructions, participants in the *enactive exploration condition* received specific verbal and written instructions encouraging self-guided exploration and a tolerance for errors during the practice segment of the training. These instructions encouraged participants to explore the database, to test alternative approaches, and not to worry about making mistakes or errors. It was stressed that exploration and making mistakes were a natural part of the learning process. The verbal instructions were supplemented with two signs that were posted next to the computer screen on which the participants were working. The first sign stated: "If you strike a problem, regard it as a learning opportunity; I have made an error: Great!; There is a way to solve this problem; I can learn from this error". On the second sign the following text was printed: "Don't forget to watch the screen; view the screen and see what is changing". These signs were adopted from a study by Frese et al. (1991). The signs were read out to the participants and were reinforced at several points during the practice segment.

Participants in the *comparison condition* did not receive any supplementary instructions or guidance on how to approach the practice segment. They completed the three practice tasks in the same order as participants in the enactive exploration condition.

During the practice segment of the training, trainees in both the enactive exploration and comparison conditions received supplemental feedback that included evaluations of their strategies and performance along several dimensions at the completion of each task. This supplemental feedback is not normally part of the electronic search task output. Searchers normally have to infer the quality of their strategy and performance from the list of retrieved records in the task output. Novices find this natural feedback from the task ambiguous and very difficult to interpret. Previous studies have shown that supplemental feedback on strategy and performance can be used to boost the development of base level competencies during initial training (Wood & Debowski, 1998). Performance feedback was reported as a percentage score of relevant records retrieved for each task. Strategy feedback was reported as ratings of participants' search breadth, depth, sequence and thesaurus usage for the task. The procedures for calculating the performance and strategy scores are described below.

For participants in both the enactive exploration and comparison conditions the total training period, including the guided mastery instructions and practice segments, was 110 minutes. This was longer than the 60-minute training period in the Debowski et al. (1998) study but shorter than six hours of practice in the Frese et al. (1991) study. The implications of the length of training are taken up in the Discussion section.

Post-training Performance Tasks

After completing both segments of the training programmes, all participants received written and verbal instructions that provided a strong evaluation framework for their performance on two post-training tasks. These were to identify relevant records for " The impact of building design on the use of new technologies" and "The link between physical activity and personality problems".

Participants were told that their performance on each of the two tasks would be used to assess their level of skill by comparing the records they retrieved to performance norms for other students with similar backgrounds. They were shown a sheet containing the fictitious performance norms for each task. The instructions were based on the expectations and framing of performance associated with performance-oriented situations (Ames, 1992; Ames & Archer, 1988; Dweck & Leggett, 1988). Before proceeding with the post-training tasks, the sheets containing the summary of the search steps were removed.

Measurement Procedures

Before the commencement of the study, background data were collected on gender, age, year of study, and previous experience with computers, library, and CD-ROM searching. Perceived self-efficacy, satisfaction and intrinsic motivation were each measured three times: pretraining, post-training, and after the two post-training performance tasks were completed.

Perceived Self-efficacy. This was measured using a 14-item scale previously validated by Debowski et al. (1998) and found to have high reliabilities ($\alpha \geq .95$). The items tapped participants' efficacy in relation to the activities involved in conducting an electronic search; such as keyword identification, search breadth, search depth, and search sequence, and their perceived capacity to retrieve varying percentages of relevant records for an assigned search task. An example of the latter type of items is "I can perform a search in which I retrieve at least 75% of the relevant records on the CD-ROM database for the assigned problem". For each efficacy item, participants indicated whether they thought they could execute the particular action described (yes/no), and their level of confidence in their ability to execute the described action. A 10-point scale was used, anchored at the endpoints with 1 = "totally unconfident" and 10 = "totally confident". A principal component factor analysis with varimax rotation showed that the self-efficacy items had a single factor structure for each of the three measures taken. The combined self-efficacy score was the average of the confidence ratings for the 14 items in the scale. The internal reliability coefficients were high (α's $\geq .94$) for all three measures of self-efficacy in the current study.

Satisfaction. This was based on the average of five items in which participants recorded their satisfaction with their CD-ROM searching. For example, participants were asked "At this point in time, how satisfied are you with your skill in conducting CD-ROM searches?" Answers were recorded on a 10-point scale ranging from 1 = "very satisfied" to 10 = "very dissatisfied". A principal component factor analysis with varimax rotation revealed that the satisfaction items loaded as a single factor for each of the three measures. Internal reliability coefficients were relatively high (α's $\geq .83$), consistent with previous use of this scale (Debowski et al., 1998).

Intrinsic Motivation. The scale for intrinsic motivation was based on a combination of the measures introduced by Mossholder (1980) and Daniel and Esser (1980). The Mossholder (1980) scale consisted of four items assessing participants' desire to continue working on the task, their level of interest in the activity, their perceived degree of challenge, and their enjoyment of the task. These were rated on a seven-point scale with 1 = "not at all" and 7 = "to a large degree". The two items from the Daniel and Esser (1980) scale were seven-point semantic differential scales with the following anchors: "monotonous–exciting" and "boring–interesting". The principal component factor analysis showed that the six items loaded on a single factor with relatively high internal reliability coefficients (α's $\geq$ .88) for all three measures of intrinsic motivation.

Search Strategy. All measures of search strategy were derived from the search statements developed and submitted by participants during each task. Each statement submitted by a participant was recorded in an electronic file for later retrieval and analyses. This information provided an objective means of operationalising the search strategy construct. An index for search strategy was constructed from assessments of the breadth, depth, sequencing, and sources of keywords used. An expert librarian assessed the line-by-line search statements and scored them in terms of breadth, depth, sequencing, and sources of keywords, as described below. A second librarian with CD-ROM expertise scored 25% of the records using the same scoring descriptions. The inter-rater reliability for the two experts was high (r = .93).

The four components of the search strategy index were standardised and then added together to get the aggregate strategy score. In this way, the strategy score reflects the breadth, depth, sequencing and use of sources in the development of search statements. Internal reliabilities for strategy scores on the training (α's $\geq$ .81) and post-training phase (α's $\geq$ .80) were relatively high.

Breadth of Search. This was a count of the number of concepts included in search statements and the correct use of connectors to link the concepts. Points were given for each of the elements of breadth. The more concepts effectively linked in each line of search, the greater the breadth of search. Scores ranged from 0–12 for each search task.

Depth of Search. This was the number of keywords used to describe a search concept and the number of concepts correctly linked with the "or" connector. The more alternative keywords used to cover a concept, the deeper the search for that concept. Scores ranged from 0–12.

Search Sequence. This was assessed by the degree to which the searcher was able to construct statements describing each concept and to combine these in a comprehensive search statement covering multiple concepts. This provided a measure of how well a participant's search matched the sequence demonstrated in the guided mastery segment of the training and shown on the summary sheets that participants were able to refer to during the practice segment of the training.

Sources of Keywords. The sources of the keywords used to construct search statements was the fourth component of strategy. Keywords could be obtained from several sources, including the initial search statement, the thesaurus, the keyword index, interim outputs of the records retrieved, and the searcher's personal knowledge. These sources vary in difficulty of use and the quality of terms they produce. Keywords found via the thesaurus provide the most detailed representation of concepts and it is the source most commonly used by expert searchers. Increased use of the thesaurus is generally considered evidence of a more strategic approach to database searching (Debowski et al., 1998). Alternative sources, such as the output, personal knowledge, and the keyword index are easier to access but offer lower quality solutions. The frequency of thesaurus usage was included as a measure of quality in the strategy index.

Performance. This was the proportion of relevant records retrieved for a given problem statement. A librarian with extensive CD-ROM searching experience constructed a list of all possible relevant records for each problem statement. This list was used to score the number of relevant records retrieved by participants. Participants received performance feedback on the percentage of relevant records retrieved following each task. Prior testing of the five tasks had established that they were of equivalent difficulty (Debowski et al., 1998).

RESULTS

Before testing the hypotheses, analyses were conducted to establish whether the groups in the two training conditions had equivalent levels of experience and similar backgrounds before the commencement of the training, and if their skill levels were equivalent at the end of the training. This was necessary to ensure that any differences observed on the transfer task were attributable to the motivational components of the enactive exploration training and not due to differences in the information content of the training or the skill levels of participants in the two conditions.

ANOVAs showed that the enactive exploration and comparison group did not differ in their attitude towards computers, previous exposure to computers, CD-ROM instruction, university grades, or age. CD-ROM experience, the most relevant background variable, was also comparable for both groups [$F(1,32) = .03$, n.s.]. Prior to their commencing the training, the two groups did not differ in self-efficacy [$F(1,32) = .67$, n.s.], satisfaction [$F(1,32) = .01$, n.s.], or intrinsic motivation [$F(1,31) = 1.40$, n.s.]. Tests of the relationships between the background variables and the study variables did reveal one significant relationship. Prior CD-ROM experience was positively related to intrinsic motivation ($r = .36$, $p < .05$). Therefore, past CD-ROM experience was included as a control variable when testing for the effects of the training programmes on intrinsic motivation.

Repeated measures ANOVAs, with the three practice tasks as a within-groups factor and experimental condition as a between-groups factor, revealed equivalent levels of effort, search strategy and performance by the enactive exploration and comparison groups during the training programme. Both groups spent equivalent amounts of time [$F(1,31) = 1.40$, n.s.], achieved similar levels of strategic capability in their searching [$F(1,31) = 1.40$, n.s.], and did not differ in their performance levels [$F(1,31) = 1.40$, n.s.] across the three practice tasks.

Differences observed on the post-training performance tasks were, therefore, attributable to the motivational differences induced by the two training modes and not due to different levels of skill or performance attainments during the practice segment of the training programmes.

Table 1 shows the means, standard deviations, and correlations for all study variables. The reciprocal effects of strategy on intrinsic motivation show that the use of more exploratory, but less effective, search procedures led to higher intrinsic motivation ($r = -.40$, $p < .05$).This effect was still evident on the final training task ($r = -.40$, $p < .05$).

Effects of Enactive Exploration on Intrinsic Motivation

The left panel of Fig. 1 shows the intrinsic motivation levels of participants in the enactive exploration and comparison conditions at the pretraining, post-training, and post-transfer phases. Hypothesis 1 was initially tested in a 2×2 ANCOVA, with training mode as a between-subjects factor, the pre- and post-training measures of intrinsic motivation as repeated measures factor, and CD-ROM experience as a covariate. The interaction term, which tests for a difference in the changes between the pre and post measures of intrinsic motivation, was not significant. In the 2×3 ANCOVA with the three measures of intrinsic motivation as a repeated measure factor, and CD-ROM experience as a covariate, the interaction term was again not significant but there was a significant main effect for training mode. As shown in Fig. 1, the enactive exploration trainees had higher average intrinsic motivation across the three measurement phases [$F(1,31) = 3.48$, $p < .05$].

Tests of the mean differences between the enactive exploration and comparison groups at each of the three measurement phases, with CD-ROM experience as a covariate, showed that there was no difference in the pre-training levels of intrinsic motivation, as previously reported, but that the

TABLE 1
Means, Standard Deviations, Internal Reliabilities, and Correlations for Study Variables

	1	*2*	*3*	*4*	*5*	*6*	*7*	*8*	*9*	*10*	*11*	*12*	*13*
Self-efficacy													
1 pretraining													
2 post-training	.36*												
3 post-transfer	.51**	.83**											
Self-satisfaction													
4 pretraining	.55**	−.01	.11										
5 post-training	.05	.61**	.45**	.03									
6 post-transfer	.31	.41*	.59**	.10	.63**								
Intrinsic motivation													
7 pretraining	.08	.11	.20	.07	.27	.19							
8 post-training	.07	.05	.14	.08	.20	.10	.77**						
9 post-transfer	.15	.13	.24	.16	.22	.28	.79**	.85**					
Training tasks													
10 Search strategy	.06	.24	.07	.13	.26	−.03	−.24	−.26	−.30				
11 Search performance	−.36*	−.04	−.17	−.23	−.04	−.30	−.26	−.19	−.29	.04			
Transfer tasks													
12 Search strategy	−.08	.40*	.18	−.11	.41*	.14	−.32	−.40*	−.40*	.77**	−.01		
13 Search performance	−.08	.27	.25	−.19	.15	.27	−.15	−.07	−.08	.08	.47**	.08	
Mean	5.55	4.74	4.81	5.71	3.82	4.01	5.25	4.87	4.82	2.52	5.46	2.65	9.37
Std Devn	2.09	1.85	1.99	1.71	1.48	1.88	1.11	1.04	1.04	1.49	6.55	1.37	9.30
Alpha	0.95	0.93	0.94	0.86	0.83	0.85	0.90	0.89	0.88	0.81		0.80	

* $p < .05$
** $p < .01$

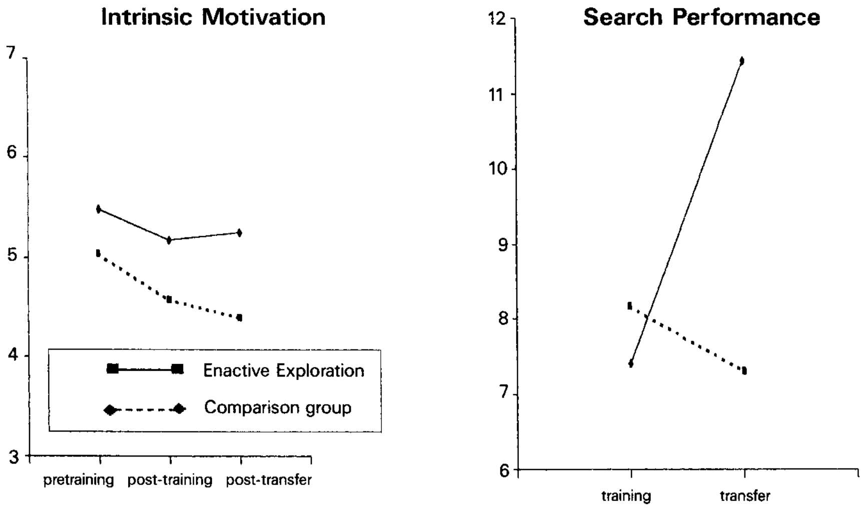

FIGURE 1. Effects of enactive exploration versus comparison condition on intrinsic motivation and search performance.

enactive exploration trainees were marginally more intrinsically motivated at the post-training [$F(1,31) = 3.80$, $p < .06$], and that this effect became stronger following completion of the transfer performance tasks [$F(1,31) = 8.23$, $p < .01$]. As outlined in the introduction, self-efficacy, self-satisfaction, and intrinsic motivation for the task are interrelated cognitive-affective components of the self-regulatory system (Mischel & Shoda, 1998). Therefore, the tests of the group differences in intrinsic motivation at each measurement phase were repeated with the associated measures of self-efficacy and self-satisfaction, as well as prior CD-ROM experience, as covariates. The additional motivational covariates strengthened the previous findings. The two groups did not differ in pretraining levels of intrinsic motivation but, immediately following the training, the intrinsic motivation levels of the enactive exploration trainees were significantly greater than those of the comparison group [$F(1,29) = 4.09$, $p < 0.05$], and remained so after completion of the transfer performance tasks [$F(1,31) = 8.82$, $p < .01$]. Interestingly, following the training, intrinsic motivation was not significantly related to either self-efficacy ($r = .05$, n.s.) or satisfaction ($r = .20$, n.s.). Therefore, the differences in the enactive exploration and comparison groups' post-training intrinsic motivation levels were not a product of related motivational states.

Repeated measures ANOVAs showed that the levels of self-efficacy [$F(2,64) = 3.95$, $p < .05$] and self-satisfaction [$F(2,64) = 16.42$, $p < .001$]

dropped for all participants, the longer they worked on the search task. Self-efficacy and satisfaction were not affected by the enactive exploration intervention. The general decline in the efficacy and self-satisfaction levels of participants was, we believe, related to the difficult nature of the task and the stringent performance expectations introduced for the two performance tasks.

Effects of Enactive Exploration on Search Strategies and Performance

Repeated measures ANOVAs revealed no differences in the strategy or performance scores for the first and second transfer tasks. Therefore, the averages of the strategy and the performance scores for the two transfer tasks were placed in ANCOVAs, with training mode as a between-subjects factor and the post-training measures of self-efficacy, satisfaction, and intrinsic motivation as covariates, for tests of hypothesis 2. These analyses showed no differences in the search strategies of the two groups on the transfer tasks. As shown in the right panel of Fig. 1, the enactive exploration group did retrieve more relevant records on the transfer tasks than the comparison group [$F(1,29)=4.2$, $p<0.05$]. Therefore, hypothesis 2 was supported for the performance outcome but not for search strategy.

Supplemental analyses also revealed that the enactive exploration participants worked more efficiently, taking less time ($X=17.40$ minutes) to finish the transfer tasks than the comparison group [($X=19.40$), $F(1,31)=5.32$, $p<0.05$]. A repeated measures ANOVA including the training and transfer tasks showed that all participants improved their search strategies [$F(4,88)=4.03$, $p<0.05$] and performance [$F(4,128)=3.65$, $p<0.05$], the longer they worked on the search task.

Effects of Intrinsic Motivation on Search Strategies and Performance

Hypothesis 3, which predicted that trainees' levels of intrinsic motivation following training would have a positive influence on the quality of strategies and performance on the transfer tasks, was not supported. Contrary to our expectations, intrinsic motivation was negatively related to the quality of search strategies ($r=-.40$, $p<.05$) and unrelated to performance ($r=-.07$, n.s.) on the transfer tasks. Two additional results suggest that this relationship is not due to the more stringent performance expectations of the transfer tasks. First, pretraining levels of intrinsic motivation were negatively, but not significantly, related to strategy on the training tasks ($r=-.24$, $p<.10$). Second, a 2×2 ANOVA, with training mode as a between-subjects factor and the post-training and post-transfer measures of intrinsic motivation as a repeated measures factor showed no significant changes in the post-training levels of intrinsic motivation following completion of the transfer tasks. Neither the repeated measures factor [$F(1,32) = 0.26$, n.s.], nor the interaction term [$F(1,32) = 1.50$, n.s.], were significant. Therefore, the negative relationship between intrinsic motivation and strategy on the performance tasks appears to be due to the continued use of nonsystematic, exploratory mode by those with high intrinsic motivation and not related to the introduction of the stringent performance expectations for the transfer task.

Supplemental analyses were conducted to test for a possible curvilinear relationship between post-training intrinsic motivation and quality of strategies used on the transfer performance tasks.[1] Following the procedures recommended in Aiken and West (1991), the intrinsic motivation predictor was centred about its own mean and squared to create a quadratic term. The linear and quadratic terms for the centred intrinsic motivation variable were then included in a multiple regression model as predictors of strategy use on the transfer performance tasks [$F(2,31) = 5.00$, $p < .05$, $R^2 = .22$]. These analyses did reveal a curvilinear relationship, with an overall negative linear trend ($b_1 = -.56$, $t = 2.44$, $p < .05$) and a marginally significant concave downward curve ($b_2 = -.47$, $t = 2.02$, $p < .06$), indicating that participants with high levels of intrinsic motivation used less systematic and more exploratory search strategies on the transfer performance tasks. In equivalent tests for a curvilinear relationship between intrinsic motivation and performance on the transfer tasks, neither of the betas for the linear or quadratic terms approached significance.

Post-training levels of self-efficacy ($r = .40$, $p < .05$) and satisfaction ($r = .41$, $p < .05$) were both strongly and positively related to the quality of search strategies used on the transfer tasks. These results replicate those obtained in studies of the cognitive and affective determinants of strategy on complex tasks in many other studies (Wood et al., 1999).

DISCUSSION

The main findings of this study are that guided mastery training supplemented with an enactive exploration intervention produces greater intrinsic motivation and superior performance than guided mastery training alone. Both of these effects were evident under stringent performance expectations for transfer tasks performed after the completion of the

[1] This analysis was suggested by a reviewer who pointed out that the intrinsic motivation measure included items, such as exciting and interesting, which could be correlated with participants' levels of arousal.

training. Following the training, enactive exploration trainees were more intrinsically motivated by the electronic search task than those who did not receive any enactive exploration instructions. This difference in the intrinsic motivation levels of the two groups of trainees became more pronounced following their completion of transfer performance tasks. However, in the current study, intrinsic motivation was not related to self-efficacy, self-satisfaction, or performance and was negatively related to the quality of search strategies used on the transfer tasks.

For complex, difficult-to-learn tasks, such as electronic search, the combined effects of self-guided exploration and the positive framing of feedback may affect learning and performance through several different cognitive and affective causal pathways. The relative independence of intrinsic motivation from self-efficacy and satisfaction points to a need for further research on the self-regulatory role of intrinsic motivation and how it contributes to performance on complex tasks. The results of the current study indicate that individuals do not, necessarily, have to be satisfied with their achievements or have high self-efficacy to be intrinsically motivated by a task. For participants in the current study, the electronic search task was both novel and relevant for the completion of assignments in their roles as students. It seems unlikely, however, that intrinsic motivation would continue to remain independent of self-satisfaction and self-efficacy if an individual worked on the electronic search task for long periods. Over time, dissatisfaction with progress or doubts about one's competence would lead to a lowering of interest in a task. Participants in the current study spent a total of 110 minutes working on the task during training and performance segments. Had we extended the performance period, intrinsic motivation might have come to be influenced by participants' (dis)satisfaction with their achievements and self-assessments of their skill levels.

Also of interest is how intrinsic motivation combines with other cognitive and affective components of the self-regulatory process, such as self-efficacy and self-satisfaction, to influence persistence, strategy, learning, and performance on complex tasks requiring significant cognitive effort. The superior performance on the transfer tasks by the enactive exploration trainees was not attributable to their greater intrinsic motivation. Being interested in a task can be translated directly into performance when effort and persistence have a direct and simple relationship with performance. This is rarely true for complex tasks where the cognitive processes required for information processing exert a strong influence on performance, and persistence only pays off if it is translated into learning and development of strategies. Intrinsic motivation has been shown to exert a strong influence on exploratory behaviour and persistence (e.g. Condry, 1977; Deci & Ryan, 1980); however, there is no direct evidence that it has a positive influence on the cognitive processes that underpin that behaviour. By way of contrast, self-efficacy and satisfaction both have been shown to produce more efficient and more effective information processing on complex tasks (Bandura, 1997).

Post hoc analyses suggest that the negative relationship between intrinsic motivation and the quality of strategies used on the transfer tasks is the product of two effects. Across both training groups, participants who were more intrinsically motivated at the end of the training continued to use the less systematic, exploratory search strategies that they had developed during the practice segment of the training programme. The stringent performance expectations introduced to all participants for the transfer tasks did not cause them to become more systematic in their search strategies. Analyses of the curvilinear relationship between intrinsic motivation and strategy also showed that at higher levels of intrinsic motivation individuals became even less systematic and more exploratory in their strategies on the transfer task. This result is consistent with the argument that high levels of intrinsic motivation are related to overarousal and a lack of control over the cognitive processes required in the search for, and processing of, information. However, the self-satisfaction measure of affective reactions, which should also be influenced by arousal, had nonsignificant and relatively weak relationships with intrinsic motivation (Table 1). Therefore, we suspect that individuals with high levels of intrinsic motivation were deliberately using more exploratory strategies but cannot rule out the possibility that high levels of intrinsic motivation were associated with an overarousal that undermined the conduct of systematic search strategies.

In summary, it is possible that the 110 minutes spent working on the electronic search tasks did not provide participants with enough experience for the benefits of the intrinsic motivation created by enactive exploration to exert a direct positive influence on their strategies and performance. A question for future research is whether the intrinsic motivation would lead to continued exploration and learning over a longer period and whether, with greater experience, this would be reflected in higher quality search strategies and even better performance. From a practical perspective, the results of this study are relevant for electronic search in a wide range of domains. The search task and search procedures used in the study are common to many database search tasks, including searches on the Internet and other electronic databases, as well as other library databases. Many of the popular search engines available for searches of the world wide web use the same keyword structure and Boolean connectors for searching as the CD-ROM database used in this study. The same or similar rules apply for searches that might be directed to find specific pieces of information, such as a particular website, or relevant records from databases. The breadth, depth, sequencing, and sources of keywords are general strategic considerations for searches of electronically stored information.

Electronic searching is becoming an increasingly important skill for decision making in today's society, and it is likely to play an even bigger role as new technologies develop. The increasing use of the Internet is a good example. Developing the skills and self-regulatory mechanisms to retrieve relevant information successfully via this medium may be done in a training situation. With technological change becoming a widespread phenomenon in a large variety of industries, workers do not always have the time or opportunity fully to develop their search skills in a learning environment. Guided mastery training supplemented with an enactive exploration intervention offers an effective way of developing the intrinsic motivation and resilience needed for continuing development of electronic search competencies on the job.

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