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> "But, after all, brains are not the best things in the world," [said the Tin Woodman].
> "Have you any?" enquired the Scarecrow.
> "No, my head is quite empty," answered the Woodman; "but once I had brains and a heart . . . [and] . . . having tried them both, I should much rather have a heart."
>
> —Baum (1900/1960, p. 58)

In Frank Baum's classic fable, *The Wizard of Oz,* the Tin Woodman and the Scarecrow served as symbols—the one without a heart, the other without a brain—of the distinction between mind and body, between affect and cognition, that has been a central theme in Western thought since Descartes. Affairs of the mind and affairs of the heart, in the Western philosophical tradition, involve different systems, follow different rules, and serve different functions.

During the past century, it has fallen in part to psychologists to confront the implications of this separation of these two aspects of human experience and to consider the ways in which these systems might interact (cf. James, 1890; Wundt, 1907). In fact, one might view much of the history of American psychology in terms of the tension created by these two opposing facets of the person, a history that has involved an oscillation between periods in which psychology has focused principally on motivational issues and periods in which it has focused principally on cognitive issues.

In between, for brief periods, the two have lived together in precarious balance. Three decades ago, for instance, the study of motivation and the study of learning—albeit a very narrow conception of learning—were intimately intertwined. Drive and Incentive sat calmly next to Habit Strength in the same equation.

Those days of peaceful coexistence are gone. Over the past 20 years, the pendulum has again swung, this time particularly far to the cognitive end of this continuum. As developments in computer technology began to make

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the mind-as-machine metaphor increasingly useful, psychologists were drawn to models featuring "cool" information-processing mechanisms and principles, to the virtual exclusion of "hot" affective or motivational variables (cf. Abelson, 1963). As this "cognitive revolution" has swept the field, noncognitive factors have fallen increasingly into disrepute (cf. Zajonc, 1980). Motivation, personality, affect—the affairs of the heart—seem to have little place in the new world of cognitive science.

Their omission, however, may represent more than the absence of an active interest. Issues of motivation and affect, and their relationship to learning, simply do not mesh well with the models, the methods, and the mentality of cognitive science. Because the computer seems to provide a model for thinking divorced from feeling, a system in which "motivation" is not an issue and information processing proceeds in its absence, there has seemed to be little need for attention to such processes.[1]

In this article, occasioned by the publication of Susan Bobbitt Nolen's "Reasons for Studying: Motivational Orientations and Study Strategies" (this issue), it is suggested that the time for a closer rapprochement of motivation and cognition is at hand (e.g., Dweck, 1986; Lepper, 1985; Resnick, 1987). As the goals of artificial intelligence efforts shift, for example, from demonstration to application and from diagnosis to treatment, issues of motivation and affect will become increasingly significant. As expert systems begin to move out of the laboratory and into the classroom and as the audience for artificial intelligence programs shifts from experts to novices, questions of users' interests, attitudes, and preferences should become correspondingly more prominent (Lepper & Chabay, 1985, 1988). At the same time, as Nolen's article illustrates, researchers primarily concerned with motivational issues have been making a serious effort to begin to link that literature with recent advances in cognitive psychology (e.g., Dweck & Legett, 1988; Malone, 1981; Malone & Lepper, 1987).

THE NOLEN STUDY

Nolen's study poses a fundamental, yet surprisingly unstudied, question: By what processes might differences in children's motivational orientations

[1]Indeed, in a recent history of the cognitive-science movement, Gardner (1985) suggested that a studied *inattention* to such issues be considered one of five paramount features that serve as hallmarks of the current cognitive-science approach:

> The third feature of cognitive science is the deliberate decision to de-emphasize certain factors which may be important for cognitive functioning but whose inclusion at this point would unnecessarily complicate the cognitive-science enterprise. These factors include the influence of affective factors or emotions, the contribution of historical and cultural factors, and the role of the background context in which particular actions or thoughts occur. (p. 7)

toward activities influence their learning from those activities? Although this is a critical question and was once a central theme in the study of learning—in days, to be sure, when *learning* meant selecting the responses that produced reinforcement and *motivation* meant the provision of tangible incentives or rigid schedules of "goods" and "fines"—it is only in the last few years that there have been attempts to reconsider this question in light of the striking advances that have been made in cognitive psychology and cognitive science.

In particular, Nolen seeks to relate students' measured motivational orientations to their valuing and employing different types of study strategies. Her central finding is that students whose primary goal in expository reading is learning "for its own sake" will both value and use strategies that require deeper processing of information more than students whose primary goal is to demonstrate their superior ability at this task relative to others.[2] Because most schools in this country tend to value and stress the cultivation of individuals with superior abilities, it is particularly informative to observe that this emphasis may have unanticipated detrimental effects on the quality of student study behaviors.

Unfortunately, Nolen's study does not complete the cycle by demonstrating consequent differences in subsequent learning and retention among students who do make use of deeper processing strategies; this appears to be due to the considerable difficulty her students had with the selected passages. Nonetheless, the strength and variety of prior research findings suggesting a link between the use of deep-processing strategies and measures of subsequent learning or retention (e.g., A. L. Brown, Bransford, Ferrara, & Campione, 1983), coupled with the evidence of this use on both self-report and more objective dependent measures, suggest that Nolen's findings demand attention.

Rather than focusing further on the specific findings and procedures of Nolen's study, however, the goal of the present commentary is to place her experiment in a larger conceptual framework—to provide a more extensive examination of the general question that Nolen's study has so eloquently raised regarding mechanisms that may link student motivation to student learning.

CONTRASTING MOTIVATIONAL ORIENTATIONS

Approximately 30 years ago, researchers unhappy with the domination of discussions of motivational issues by the reinforcement theorists sought to

[2]Other findings (e.g., the negative relationship between the value and use of both superficial and deep strategies by students identified as "work avoidant" or "academically alienated") are, of course, also consistent with Nolen's general thesis. These further findings, however, seem more overdetermined, and hence less informative, than the difference between "task-oriented" and "ego-oriented" students.

distinguish between two fundamentally different forms of motivation—"intrinsic" and "extrinsic" (e.g., Berlyne, 1960; Bruner, 1961; Koch, 1956; White, 1959). Intrinsically motivated behavior was defined as behavior undertaken for its own sake, for the enjoyment it provides, the learning it permits, or the feelings of accomplishment it evokes. Extrinsically motivated behavior, by contrast, involved actions undertaken *in order to* obtain some reward or avoid some punishment external to the activity itself.

Clearly such a distinction seems closely related to the "task orientation"-"ego orientation" distinction employed in Nolen's research. As a first step in providing a broader context for the consideration of her results, therefore, it may be useful to consider the issues she raises in terms of several different approaches to the study of motivational styles and motivational orientations that characterize the recent literature on this topic.

Table 1 provides a comparison of three different, but obviously related, current approaches to these central issues. The first column presents the traditional contrast between "intrinsic" and "extrinsic" motivation. Such a distinction, although discussed in earlier theoretical accounts (e.g., Bruner, 1961; Koch, 1956) as well, became a particular focus of experimental research in social and developmental psychology in the 1970s (e.g., Condry, 1977; Deci, 1975; Lepper & Greene, 1978a; Malone, 1981). The second column presents the "task orientation"-"ego orientation" distinction suggested by Nicholls (e.g., 1984, 1988) and employed in Nolen's study (this issue). The third column, for comparison, presents the "learning goals"-"performance goals" contrast presented by Dweck and her colleagues (e.g., Dweck, 1985; Dweck & Leggett, 1988; Elliott & Dweck, 1988).

The considerable similarities among the three approaches are evident. In each case, the first state is one in which an activity is approached for the learning, enjoyment, or challenge inherent in engagement in the activity itself. In each case, this first state is contrasted with a second, in which engagement in the activity is motivated by external and instrumental concerns instead—in which the activity is undertaken "in order to" achieve some additional goal, rather than "for its own sake." Likewise, the conditions hypothesized to elicit or highlight instrumental concerns appear quite similar across these different models. In each instance, both situational variables, as well as more long-term or chronic individual differences in intrinsic motivational orientation (Gottfried, 1985; Harter, 1981), task orientation (Nicholls, Patashnick, & Nolen, 1985), or mastery orientation (Dweck, 1975), have been hypothesized to determine an individual's response to a particular activity in a particular setting.

Some salient differences among these approaches are also apparent. Most prominently, the contrast between intrinsic and extrinsic motivation involves a distinction that is broader than the alternatives in at least two senses. First, a student may be extrinsically motivated by a variety of

TABLE 1
A Comparison of Three Current Models of Contrasting Student Motivational Orientations

	Basic Theoretical Concepts	
Intrinsic Motivation Versus Extrinsic Motivation	*Task Orientation Versus Ego Orientation*	*Learning Goals Versus Performance Goals*
Intrinsic motivation: activity undertaken for its own sake	Task orientation: educational activity undertaken for the sake of learning itself	Learning goals: educational activity undertaken for the sake of increasing one's own competence
Extrinsic motivation (comparative): activity undertaken in order to achieve performance superior to that of others	Ego orientation: educational activity undertaken in order to demonstrate one's high level of ability relative to that of others	Performance goals: educational activity undertaken in order to gain favorable judgments of one's competence compared to that of others
Extrinsic motivation (noncomparative): activity undertaken in order to obtain extrinsic reward or avoid extrinsic punishment		
	Illustrative Situational Factors Demonstrated to Produce an Extrinsic Motivational Orientation, Ego Orientation, or Orientation Toward Performance Goals	
Extrinsic rewards or punishments, expected evaluation of performance, unnecessarily close surveillance, superfluous temporal deadlines, and so forth	Expected evaluation of performance, presentation of activity as test, desire to please teacher, and so forth	Expected evaluation of performance, presentation of activity as test, expectation of potential failure, and so forth

extrinsic rewards, punishments, or constraints that do not involve competition or comparison of one's performance with others. For example, in classrooms in which token economy programs are employed, children may often be asked to undertake academic tasks in order to obtain some tangible extrinsic reward (e.g., Kazdin, 1977; Lepper & Greene, 1978a). Or students may feel extrinsically motivated even if given a test for which success is defined simply by an absolute score or a percentage increase over one's own prior mark. Hence, Table 1 includes two categories of extrinsic motivation in order to make clear the parallels with other distinctions. Second, the concepts of intrinsic and extrinsic motivation may be applied to any sort of activity, not just to those with an explicit educational goal or achievement focus, although only achievement-oriented activity is examined here.[3]

The present commentary, however, explores primarily the points of similarity across these models in order to illustrate the implications of the more general approach they all represent for the study of instruction. In the process, the terms *intrinsic motivation* and *extrinsic motivation* are used in a generic sense here to refer to the common elements of the several models outlined in Table 1.

MOTIVATIONAL ORIENTATIONS AND LEARNING

What difference, then, does it make if learning *is* intrinsically motivated or task-involved? Do students learn better, or worse, or simply differently, under different motivational orientations? By what processes might differences in motivational orientations influence students' learning from different tasks?

Table 2 presents an abbreviated conceptual analysis and summary of the social-psychological literature concerning the potential consequences of engagement in learning activities when students are intrinsically versus extrinsically motivated—or task-oriented versus performance-oriented (e.g., Condry, 1977; Deci, 1975; Deci & Ryan, 1985; Dweck, 1986; Dweck

[3]There are many more subtle differences between these two traditions as well. Because the task-orientation and learning-goals analyses are specifically tied to achievement-relevant activities, for example, it is possible to tie these distinctions more directly to differences in the attributional styles and "theories" about school success and intelligence that children have developed. Thus, attributions concerning the *causes of one's outcomes* (i.e., Why did I/he/she succeed or fail?) will play a central role. In the literature on intrinsic versus extrinsic motivation, the analysis is more focused on the *reasons underlying one's voluntary actions* (i.e., Why did I/he/she do that?). Moreover, there are some interesting cases in which these different analyses may make differential predictions (e.g., activities in which competition is inherent—chess, tennis, debating—or activities undertaken in order to achieve mastery *in order to* then display one's superiority to others). These more subtle issues are not addressed in this commentary; instead, the common elements in these analyses are stressed here.

& Leggett, 1988; Lepper, 1981; Lepper & Greene, 1978b; Nicholls, 1988). In the first column of the table appears a set of hypothesized intervening variables that may be differentially influenced by different forms of student motivation. In the second and third columns, the distinctive characteristics of intrinsically versus extrinsically motivated activity are detailed. The fourth column presents several consequences of intrinsic versus extrinsic motivation that have been empirically documented.[4]

At the most general level, the comparisons provided in Table 2 reflect a variety of consequences that follow when an activity is considered a "means" to some ulterior end rather than an "end" in itself—that is, when an intrinsic or task orientation (in which task selection, engagement, and performance are determined by the individual or by the task itself) is supplanted by an extrinsic or ego orientation (in which these same responses are based on their instrumental value in helping the student obtain some external reward or avoid some external punishment). When an activity is considered a means, decisions can be made on the basis of individual interests, feelings of mastery and self-efficacy, curiosity, and the like; when an activity is considered an end, decisions are more likely to be based on a "least-effort" or "minimax" principle in which the student seeks to maximize extrinsic rewards with a minimum investment of thought and effort (Kruglanski, Stein, & Riter, 1977; Salomon, 1983).

As indicated in Table 2, however, these effects may occur simultaneously at several different levels (cf. Lepper & Greene, 1978b). First, decisions about when to initiate and when to terminate engagement in an activity may vary as a function of motivational orientation. Intrinsically motivated students should select activities and continue with them primarily as a function of the inherent "rewards" (e.g., a sense of personal mastery, control, challenge, or curiosity) that the task provides for them. By contrast, extrinsically motivated students should choose to engage in particular educational activities only when those activities offer the possibility of external rewards (e.g., either demonstrations of one's superior performance or the attainment of some tangible reinforcers) and when students believe that they are capable of obtaining those rewards. Similarly, extrinsically motivated students should persist at activities in the face of failure only when these same conditions are true (e.g., Dweck, 1975; Dweck & Elliott, 1983; Dweck & Leggett, 1988).

During the period when students are actively engaged in an activity, analogous differences arise. When students are intrinsically motivated, their attention to the task and their willingness to devote significant mental

[4]Such a presentation naturally involves a considerable oversimplification of a complex literature. More detailed reviews of the literature in this area may be found in the general references cited in this paragraph.

TABLE 2
Characteristics and Consequences of Intrinsic Versus Extrinsic Motivational Orientations

Underlying Variable	*Intrinsic Motivation*	*Extrinsic Motivation*	*Comparison of Intrinsically Motivated (IM) Versus Extrinsically Motivated (EM) Students*
Time spent at activity	*Decisions to initiate/terminate activity based on:*		*Time on task*
	Criteria generated by person or task itself	Perceived probability of attaining extrinsic goal	If activity is of high interest, IM student is more likely to choose it.
			Persistence in the face of failure
			If perceived ability is low, EM student is more likely to quit after failure.
Focus of attention	*Attention during activity controlled by:*		*Learning from activity*
	Self-generated and task-generated goals, general orientation to exploration	Extrinsic contingencies, general orientation to instrumental parameters of activity	If task is algorithmic, EM student is superior on "central" task parameters, and IM student is superior on "incidental" task parameters.
			If task is heuristic, IM student may be superior even on "central" parameters.
			Creativity
			IM student is more creative, better able to "break set."
Selection of problems and subgoals	*Willingness to invest mental effort dependent on:*		*Mindful (elaborative) processing*
	Level of interest and involvement with task	Minimal effort required to achieve extrinsic goals	Generally greater for IM student
			Comprehension monitoring
			Generally more effective for IM student

Investment of mental effort in activity	*Subgoals or component decisions about activity based on:*		*Selection of problems within activity* IM student is more likely to select problems and subgoals of moderate difficulty; EM student is more likely to select "easiest" path to extrinsic goal. *Risk taking* IM student is more likely to take risks, explore freely.
	Self-generated or task-generated subgoals	Perceived instrumental value of subgoals	
Selection of performance and learning strategies	*Selection of learning and performance strategies based on:*		*Selection of study strategies* IM student is more likely to value and employ "deeper" study strategies. *Selection of performance strategies* If task is complex, IM student is likely to use more logical and efficient performance strategies.
	Perceived value of strategy in achieving personal goals	Minimal effort required to achieve extrinsic goals	
Effects on "definition" of and approach to activity	*Subsequent approach/response to activity determined by:*		*Subsequent choice of activity* Students who were previously extrinsically motivated at a particular activity are less likely to choose to engage in that activity further, unless rewards remain available for the activity. *Subsequent approach to activity* Continued inefficiency of performance strategies and continued selection of easier problems and subgoals if students were previously extrinsically motivated at the activity.
	"Definition" of activity as "end" in itself, activity seen as intrinsically motivating	"Definition" of activity as "means" to an ulterior end, activity seen as less intrinsically motivating	

effort to the task will be determined by goals generated by the students themselves or derived by the students directly from the structure of the task itself (cf. Kahneman, 1973; Simon, 1967). However, the presence of salient extrinsic incentives or constraints, or the desire to demonstrate one's superior mastery of the activity, is likely to focus students' attention and efforts more exclusively on those aspects or parameters of task performance that have potential instrumental value, that are likely to lead to the attainment of external goals (cf. Easterbrook, 1959). Several consequences follow from this difference. On the one hand, given a highly algorithmic task, extrinsically motivated students are likely to prove superior on parameters of task performance or learning that are "central" to the attainment of the external goals but may prove inferior on performance dimensions that are "incidental" to the attainment of these goals (cf. McGraw, 1978). Thus, an extrinsic motivational set may enhance rote learning but may simultaneously decrease conceptual learning (e.g., Grolnick & Ryan, 1987). On the other hand, given a complex and more heuristic task, extrinsically motivated students may do less well even on indices of central task performance (cf. McGraw, 1978). Thus, even "central" task performance has been shown to deteriorate in the face of superfluous extrinsic incentives for tasks requiring creativity (Amabile, 1979; Kruglanski, Friedman, & Zeevi, 1971), insight (Glucksberg, 1962, 1964), or the ability to "break set" (McGraw & McCullers, 1979).

Similarly, decisions regarding particular problems to address or specific subgoals to be pursued while working with an activity will vary for intrinsically versus extrinsically motivated students or for task-involved versus ego-involved students. Intrinsically motivated students are likely to select problems that involve a moderate degree of difficulty and challenge for themselves, whereas extrinsically motivated students are instead likely to select the "easiest" possible problems, the solutions of which will be sufficient to obtain the extrinsic reward (Harter, 1978; Pittman, Emery, & Boggiano, 1982). Intrinsically motivated students, by comparison, will be more likely to take risks and to explore the activity freely (Condry & Chambers, 1978).

Differences may also arise in students' willingness to invest significant mental effort in a learning activity that permits students to take a more deliberative and thoughtful approach to problems. Here one would expect intrinsically motivated students to take a more "mindful" approach to such activities—to be more likely to engage in richer and more elaborated processing (Salomon, 1983; Salomon & Perkins, in press) and to monitor their own comprehension of the material more frequently and more effectively (Markman, 1981).

Even more powerfully, the strategies that students will value and select for studying or performing the activity may differ with differing motivational orientations. As Nolen's data (this issue) so clearly illustrate, students who are intrinsically motivated are more likely to value and to employ more effortful, but "deeper" and correspondingly more effective, strategies for studying. Likewise, as Condry and Chambers (1978) showed, intrinsically motivated students faced with a complex intellectual task use more efficient and more logical strategies for gathering information and for making decisions than their extrinsically motivated counterparts.

Finally, it is particularly significant that several of these effects appear to persist and to generalize to later situations in which there are no longer any extrinsic incentives or constraints available. Thus, a large literature exists to establish that the imposition of functionally superfluous extrinsic incentives or constraints on a student's engagement in an activity of initial intrinsic interest will undermine later interest in that activity, leading students to be less willing to engage in the activity in the later absence of tangible rewards or punishments (e.g., Deci & Ryan, 1985; Lepper, 1981, 1983; Lepper & Greene, 1978a).

Less well-known but equally important effects also appear to occur with respect to several task-performance variables. In a particularly elegant demonstration, Condry and Chambers (1978) showed that students who were offered a tangible reward for their successful solution of a classic concept-formation problem displayed less efficient, less logical, and less effective techniques for seeking information about the nature of the underlying concept. Moreover, when students were later confronted with a similar task under new conditions—in a setting in which guessing was forbidden and no further extrinsic rewards of any sort were available—they *continued* to employ less logical and efficient information-gathering procedures. Similarly, Pittman et al. (1982) showed that students who had selected "simpler" problems in an earlier session in which rewards had been offered for correct answers continued later to select less complex problems, even when rewards were no longer available for correct answers.

Given the range of potentially detrimental effects on learning, performance, and later interest that an extrinsic motivational orientation may produce, it is important to be clear about two limiting features of the foregoing analyses. Hence, it should be stressed that all the comparisons shown in Table 2 *presume* that the learning activity in question is one that students would find intrinsically motivating in the absence of extrinsic rewards and constraints. Were this not so, task-involvement or intrinsic interest may be insufficient to produce the degree of engagement with an educational activity that is required for learning to occur. Stated differently, extrinsic motivations are often necessary in order to produce learning when the activity is one that students do not find of inherent interest or value; extrinsic motivations thus may actually produce positive effects on learning when tasks are of low initial value (e.g., Bandura & Schunk, 1981; Lepper & Greene, 1978a; McGraw, 1978; Schunk, 1985). Similarly, it must be emphasized that not all forms of extrinsic incentives have detrimental effects on intrinsic motivation. Such effects are particularly likely to occur when the external contingencies are both functionally superfluous (i.e., not needed to produce task engagement) and relatively uninformative regarding the student's level of ability or expertise at the task. Other conditions pose more complex problems, as discussed in recent reviews by Deci and Ryan (1985), Lepper (1981, 1983), and Morgan (1984).

PROMOTING INTRINSIC MOTIVATION FOR LEARNING

Both Nolen's study and the broader literature considered here suggest that a task orientation or an intrinsic motivational orientation may have significant instructional benefits. If so, it is important to ask how educational activities might be designed and presented so as to maximize intrinsic motivation. Table 3 presents a brief summary of several complementary approaches to the design of more intrinsically motivating educational activities, each focusing on a different potential source of intrinsic motivation.[5]

A first set of strategies for promoting an intrinsic motivational orientation derives directly from the preceding literature establishing the potential instructional benefits of such an orientation. These strategies are based on the premise that people are motivated to control their environments—to experience themselves as "origins" rather than "pawns" (deCharms, 1968; see also Condry, 1977; Deci, 1975, 1981; Lepper & Greene, 1978b; Malone & Lepper, 1987). The central issue of instructional design in this case is how to maintain a sense of control or self-determination on the part of the student without an actual abdication of control by the teacher.

Three basic strategies are suggested here. If the activity is one that students may already find of initial intrinsic interest, a first concern will be to avoid the introduction of superfluous or unnecessarily powerful extrinsic incentives or constraints. As in Hippocrates' injunction to the physician, the first goal is "to do no harm." Instead, techniques of presentation of educational materials that involve the use of the "minimally sufficient" external pressure required to produce task engagement should be sought (Lepper, 1983).

By contrast, if the activity is one that seems likely to be of little initial intrinsic interest to students, more powerful extrinsic incentives or constraints may be required to get students to engage in the task. Under such

[5]More detailed analyses of most of these issues may be found in earlier literature that presents a more complete analysis of the various sources of intrinsic motivation (Malone, 1981; Malone & Lepper, 1987) and a consideration of the instructional-design implications of each (Lepper & Malone, 1987).

TABLE 3
Proposed Design Principles for Promoting Various Sources of Intrinsic Motivation in Instructional Activities

- Control: Promote student's sense of control over the activity
  - Minimize extrinsic constraints on activity
    - If the activity is of initial intrinsic interest, avoid use of superfluous extrinsic contingencies, use minimal sufficient external pressure
  - Decrease extrinisic constraints over time
    - If the activity is of little initial intrinsic interest, use extrinsic contingencies as required, then gradually withdraw them
  - Minimize salience of extrinsic constraints
    - Whenever possible, embed extrinsic constraints in the activity itself
- Challenge: Provide student with a continuously challenging activity
  - Provide goals of uncertain attainment, and feedback regarding accomplishments
    - Present goals of intermediate difficulty to student
    - Provide multiple goals, or multiple levels of goals, to ensure that the activity provides goals appropriate for students at different levels of accomplishment
- Curiosity: Provoke student's curiosity
  - Highlight areas of inconsistency, incompleteness, inelegance in student's knowledge
  - Employ activity involving domains, actors, problems of inherent interest to student
- Contextualization: Highlight functionality of activity
  - Present activity in a naturalistic context of use
  - Present activity in a functional simulation or fantasy context

conditions, one may wish to consider a "fading" strategy in which initially necessary extrinsic constraints may be gradually withdrawn as the student gains greater ability and self-confidence at the activity (Lepper & Greene, 1978b). A variety of strategies for the gradual withdrawal of external contingencies—in order to promote persistence and generalization of behavior change—are contained in the literature on behavioral control techniques (e.g., Kazdin, 1977; Turkewitz, O'Leary, & Ironsmith, 1975).

Finally, independent of the initial intrinsic appeal of the activity, one may wish to minimize the *salience* of extrinsic contingencies. Although there are several ways in which this goal might be approached, two deserve special attention. In terms of instructional-design considerations, the more the extrinsic constraints and contingencies to be applied to students' actions can be *incorporated* into the activity itself, rather than imposed on the student's engagement with a less inherently constrained activity, the less likely those constraints are to produce detrimental effects (Lepper, 1983). In terms of chronic student motivational orientations, researchers have begun to examine strategies for altering dysfunctional general orientations. Techniques involving "attributional retraining" (e.g., Dweck, 1975; Foersterling, 1985) or "motivational inoculation" (Hennessey & Amabile, 1987) have both shown promise.

In contrast to the foregoing strategies, which involve attempts to minimize the potential detrimental effects of supplanting intrinsic with extrinsic motivations, two additional approaches to the problem involve attempts to structure educational activities themselves so as to sustain and to increase the inherent motivational appeal of an activity. The first of these involves attempts to enhance the degree to which educational activities are experienced by the student as being challenging. The second involves attempts to increase the level of curiosity that educational activities evoke in the student.

That people seek and enjoy activities that they find challenging is a fundamental tenet of many traditional theories of intrinsic motivation (e.g., Bandura & Schunk, 1981; Csikszentmihalyi, 1975; Deci, 1975; Harter, 1978; Lepper & Greene, 1978b; White, 1959). Activities that provide an optimal, usually intermediate, level of difficulty and challenge—activities that are neither impossibly hard nor trivially easy for the student—should stimulate the most intrinsic motivation. What seems required for an activity to be challenging to a student is for that activity to provide meaningful goals about which there are (a) uncertainty about success and (b) clear performance feedback regarding one's progress toward these goals. Malone and Lepper (1987) provide a detailed analysis of techniques for enhancing the meaningfulness of goals, the uncertainty of goal attainment, and the effectiveness of performance feedback. However, note that, in order to maintain a student's interest over time, an activity must afford opportunities for the student's goals to change as his or her proficiency increases. On the one hand, an explicit progression of goals, contingent on the learner's accomplishments, could be built into the sequencing of problems and topics within a series of activities. On the other hand, activities can be designed so that they simultaneously present an array of hierarchically organized goals at different levels of abstraction and difficulty, permitting the student to select goals providing an appropriate level of challenge at any point in the learning process.

Equally prevalent in traditional theories of intrinsic motivation is the idea that people will be motivated by curiosity—stimulated by the recognition of some incongruity, discrepancy of new information from prior knowledge, or disconfirmation of present expectations (e.g., Berlyne, 1960, 1965; Hunt, 1961, 1965; Kagan, 1972). As with challenge, there is also some presumption that intermediate levels of discrepancy or incongruity should be most effective in producing curiosity. Indeed, Malone (1981) sought to identify the cognitive underpinnings of curiosity with the desire to bring "good form"—that is, parsimony, consistency, and completeness—to one's cognitive structures. In addition to suggesting these "structural anomaly" aspects of the arousal of curiosity, however, Malone and Lepper (1987) suggested a second possibility. This "spreading interest" model of curiosity predicts that people will be interested in new information or knowledge to the extent that it relates to other topics or areas of prior interest to them, much as information propagates along links between nodes in classical "spreading activation" theories of memory (Collins & Loftus, 1975). Both models have obvious instructional implications. Collins and Stevens's (1982) work on "Socratic" tutoring strategies, for example, may be viewed as an illustration of one set of strategies for exposing inconsistencies and incompleteness in a student's knowledge structure. Anderson, Shirey, Wilson, and Fielding's (1987) work on the effects of the interest value of reading materials on learning, to be described more fully later, provides an example of the latter approach.

A final approach to the design of educational activities to promote intrinsic motivation involves the notion of "contextualization" as discussed by Bruner (1966) and others. Motivation is so frequently a problem (especially in school settings), the strong form of this argument goes, because "school learning" is so often abstracted and removed from the contexts in which students might see and experience the real-world functionality of the knowledge they are being taught. If such "decontextualization," as is argued, really provokes motivational problems, it would seem important to create educational activities that maintain or approximate the functionality of knowledge in the larger world. This can, of course, be done by presenting curriculum topics in their natural contexts of use, the trite but still relevant example being the teaching of long division through practicing the derivation of statistics for the student's favorite sports team. At other times, when this may be impractical, it may prove useful to embed the information to be conveyed in a simulation or fantasy context that makes contact with the student's prior interests. Such a strategy, recent data suggest, may have beneficial effects not only on students' motivation, but on how much they will learn from a given educational program in a fixed period of time (Lepper & Hodell, 1988).

Earlier in this commentary, it was suggested that this may be a particularly propitious time for a reconciliation of motivational and cognitive theorists. As cognitive scientists interested in education have begun to move from the laboratory into the classroom, the significance of motivational issues has correspondingly increased (e.g., J. S. Brown, 1985; Burton & J. S. Brown, 1979; Dede, 1986; Lepper & Chabay, 1988). For example, in their analyses of shared design features in current pedagogical "success models" that might be incorporated into the construction of effective computer-based learning environments, Collins and J. S. Brown (1988; Collins, J. S. Brown, & Newman, in press) have discussed the significance of motivational variables of the sort considered here in producing sustained involvement and increased learning. Conversely, as motivational theorists seek to cast their ideas in terms of current information-processing models, it becomes easier for these issues to be integrated into such models. Thus, it is important to note that almost all the principles for enhancing intrinsic interest in educational activities noted in Table 3 could be easily and effectively programmed into a variety of different forms of computer-based educational activities (Lepper, 1985; Malone, 1981; Malone & Lepper, 1987).

Similar issues, however, also arise in the consideration of more traditional instructional methods. In work in progress,[6] my colleagues and I have been examining the strategies that expert human tutors use to interest and instruct children in elementary mathematics. In this work, it is easy to observe the use of techniques designed to focus on each of the sources of intrinsic motivation appearing in Table 3. Most strikingly, expert tutors seem able to exert an enormous amount of control over students' work—yet leave students with a strong sense of personal control—by providing assistance only indirectly and only when absolutely necessary. At the same time, these tutors also appear highly alert to opportunities for challenging students and for highlighting inconsistencies in students' approaches to problems. Finally, the best tutors also seem most effective in providing examples, analogies, and contexts that illustrate or provide a functional context for the skills being taught.[7]

CONCLUDING COMMENTS

There are two basic reasons one might value an intrinsic motivational orientation or task orientation of the sort that Nolen has studied. In one case, helping students to enjoy the process of learning may be viewed as an end in itself; in the other case, intrinsic motivation may be valued as a means of enhancing students' learning from educational activities. In neither case, however, should one assume that all educational activities can, or ought to be, intrinsically motivating for students. Indeed, it is certainly possible to argue that it is crucially important for students in school to be occasionally forced to complete projects in which they have no particular interest and for which they have no particular aptitude (cf. Dreeben, 1968).

In those cases in which it *is* possible and appropriate to promote an

[6]"Expertise in Human Tutoring: Motivational and Informational Considerations in Successful Tutorial Relationships," current research being conducted by Mark R. Lepper, Ruth W. Chabay, Jill H. Larkin, Lisa Aspinwall, Jean-Luc Gurtner, Donna Mumme, Judith Swanson, Constance Stillinger, and Maria Woolverton. Some preliminary results are presented in Lepper, Aspinwall, Mumme, and Chabay (in press).

[7]The results achieved by truly expert tutors are quite impressive on both motivational and informational grounds. One student, who had solved a problem only after 12 different prompts from the tutor, observed the tutor preparing the next problem and said, "Why don't you [give me] a *harder* one? Because *I* [already] *did* one [like that]."

intrinsic motivational orientation, however, it may be important to recognize the potential practical significance of such efforts. For instance, in a series of studies on children's learning and recall of sentences, Anderson et al. (1987) found that student "interest" in materials accounted for at least as much variance as student reading comprehension scores and for 30 times as much variance as the "readability" index of materials that is routinely used across the country to determine the appropriateness of school reading materials for different grades. Similarly, Asher and colleagues (Asher, 1981; Asher, Hymel, & Wigfield, 1978; Asher & Markell, 1974) have found that variations in the interest value of reading materials are a powerful predictor of students' memory for the subject matter contained in these materials.

At the outset of this commentary, it was suggested that attention to motivational issues, among those concerned with the process of instruction, has waxed and waned during this last century. In fact, of course, these issues and this controversy, like most broad questions in education, are much older. In his *Essays,* written four centuries ago, Montaigne (1590/1925) put the case for attention to student motivation as follows: "In the education of children, there is nothing like alluring their interest and affection; Otherwise you create only so many mules laden with books" (p. 236).

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