Review of Educational Research
Winter 1990, Vol. 60, No. 4, pp. 549–571

Interest and Its Contribution as a Mental Resource for Learning

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It is argued that interest is central in determining how we select and persist in processing certain types of information in preference to others. Evidence that shows that both individual and text-based interest have a profound facilitative effect on cognitive functioning and learning is reviewed. Factors that contribute to text-based interest are discussed, and it is suggested that interest elicits spontaneous, rather than conscious, selective allocation of attention. It is further proposed that the psychological and physiological processes associated with interesting information have unique aspects not present in processing information without such interest. Current advances in neuro-cognitive research show promise that we will gain further knowledge of the impact of interest on cognitive functioning and that we will finally be in a position to integrate the physiological and psychological aspects of interest.

It has been generally recognized that purely rational models of human cognition are inadequate to describe how information is selected, processed, and retained. Yet very little progress has been made toward integrating cognitive factors with affective and motivational aspects of thinking. Piaget (1981), who emphasized that all behavior has cognitive as well as affective components, argued that intellectual functioning depends on the energizing role that affectivity plays. He used the term *energetic* to describe this dimension of the human information processing system. I wish to argue that one energetic feature of the organism—interest—is central in determining how we select and persist in processing certain types of information in preference to others. Thus interest plays a major role in the course and outcome of our mental activities. Furthermore, the concept of interest should be recognized as an integral part of cognition and incorporated into expanded theories on the subject.

As early as the beginning of the 19th century, the German philosopher Herbart (1806/1965, 1841/1965) recognized that a close relationship exists between interest and learning. Schiefele (in press) recently summarized Herbart's position as follows: "In his opinion, it is first and foremost interest that allows for correct and complete recognition of an object, leads to meaningful learning, promotes long-term storage of knowledge and provides motivation for further learning" (p. 3). Around the turn of the century, several psychologists noted the role of interest in energizing and regulat-

The preparation of this article was supported in part by the Ontario Ministry of Education, through a transfer grant to the Ontario Institute for Studies in Education. I would like to thank my friends and colleagues, Valerie Anderson and John McLaren, for their editorial assistance and continuous support and Yvonne Lucas for her help and patience. I also gratefully acknowledge the input of those who reviewed an earlier version of the manuscript: Andreas Krapp and an anonymous reviewer. Finally, I am especially indebted to Ann Renninger who contributed so many valuable suggestions for the final version of the article.

ing human behavior (e.g., James, 1890; Claparède, 1911). Dewey (1913, 1916) was one of the first North American psychologists to emphasize the important role of interest in learning and to argue that interest should be seen as a result of an interactive process between an individual and his or her environment: In interest the "self and world are engaged with each other in a developing situation" (Dewey, 1916, p. 126). Dewey, and later, Thorndike (1935), both acknowledged that learning is influenced not only by personal interest but also by the interestingness of tasks and objects. Bernstein (1955), in an early and isolated study on reading comprehension and interest, also emphasized that interest is derived from the characteristics of the reader, factors inherent in the text, and the interaction of the two. This interactive view forms a common basis of much of contemporary interest research (e.g., Fink, in press; Hidi & Baird, 1986; Prenzel, Krapp, & Schiefele, 1986; Renninger, 1990; Renninger & Leckrone, in press).

Bartlett (1932) stressed that interest plays a major role in human remembering. Many scientists have admitted this role, but few have empirically demonstrated its importance. With the advent of Behaviorism, the notion of interest, together with other energetic concepts, became dormant; one notable exception from this period, that will be referred to later, is the work of Berlyne. As cognitive psychology emerged, energetic factors, in general, and interest, in particular, continued to be neglected in favor of the rational and structural aspects of cognition. Recently, however, there have been several prominent researchers who, recognizing the restricted nature of a purely cognitive focus, have called for an expanded concept of cognition (e.g., Bereiter, 1985, in press; Brown, Collins, & Duguid, 1989; Csikszentmihalyi, 1975, 1988; Larson, 1988; Piaget, 1981; van Dijk & Kintsch, 1983). These calls for extended theories of cognition suggest that environmental as well as energetic aspects of information processing should be included in theoretical models of cognitive functioning. Interest can be conceptualized as emerging from an interaction between an energized individual and the external world, and thus it represents the two aspects of cognition that have been neglected.

There indeed has been a recent resurgence of interest research. After lamenting for several years that most studies in the area of discourse processing have used structural importance to explain comprehension and the learning of discourse, (e.g., Hidi & Baird, 1983, 1986), it is particularly satisfying to be able to report that, finally, the effect of interest on learning in wide-ranging task situations is being investigated experimentally by both North American and European researchers. Important questions are being studied, including which factors cause interest and which psychological processes are triggered by interesting information and account for its facilitation of learning.

Before reviewing some recent findings from this literature, I would like to point out a distinction made in an article by Hidi and Baird (1988) between two different ways of investigating the role of interest in cognition. One is to focus on individual differences, whereas the other is to focus on how interest affects most subjects, regardless of individual differences. Traditionally, the former approach, referred to as *individual interest research,* has been more common; investigators assessed personal preferences and interests and examined their contribution to cognitive performance. The second and more recent way to look at interest is to consider how interestingness in a situation influences cognitive performance across subjects. In this type of investigation, the focus is on interest that has been elicited, for example, by

seeing something in the environment, hearing a conversation, or reading a text. It has been suggested that such interest, which is evoked by certain features or characteristics of stimuli, might be called *situational interest* (Krapp, 1989a).

It is important to note that these two aspects of interest not only reflect differences in how the topic has been researched but also describe two different ways in which interest may be generated (Krapp, Renninger, & Hidi, in press). Personal, individual interest develops slowly over time and tends to have long-lasting effects on a person's knowledge and values. Situational interest, on the other hand, tends to be evoked more suddenly by something in the environment and may have only a short term effect, marginally influencing an individual's knowledge and values. While the focus of individual interest is the person and the focus of situational interest is the environment, person/environment interaction is a crucial aspect of both (Hidi & Baird, 1986; Hidi & McLaren, 1990).

The distinction made here between individual and situational interest is not one that has been universally accepted or acknowledged by researchers working in the area of interest. In fact, it is a distinction that tends to be blurred, because investigators of situational interest typically do not distinguish this type of interest (individuals' responses to external objects and/or environmental features) from individual, personal interests. For example, Shirey and Reynolds (1988) and Reynolds and Shirey (1988) had college students read and recall sentences that were rated for interest by a peer group. Thus, in their research paradigm, interest is based on the general interestingness of text elements, rather than on subjects' personal choices or predispositions. Nevertheless, Reynolds and Shirey (1988) argue that interest that is examined in their studies is a reader-based, internal characteristic. According to the view expressed in the present paper, interest generated by reading interesting sentences across subjects is a prime example of a specific form of situational interest referred to as *text-based* (Hidi & Baird, 1988). Text-based interest results from the interaction of textual features and individuals reading the text.

A review of the literature shows that, even though researchers have examined either individual or situational interest, they have not usually made a distinction between the two. I am only aware of one study that has considered concurrently the two factors: Renninger (1990) examined the flexibility of children's play actions with play objects identified as individual interests or noninterests in light of the general possibilities for action (or affordances) those play objects represented to the children. However, it is important to note that individual and situational interest are not dichotomous phenomena that occur in isolation from each other. On the contrary, both types of interest can be expected to interact and influence each other's development. For example, an individual with a well-developed personal interest may react differently from one without such interest to certain potentially interest-evoking situations. On the other hand, situational interest triggered by some environmental factor may evoke or contribute to the development of long-lasting personal interest.

Hidi and Anderson (in press) suggested that a distinction between individual and situational interest might help to sort out one of the most confounded questions on the topic of whether interest always involves some form of positive emotion. They propose that while activities that involve well-developed individual interests are likely to be accompanied by positive feelings activities that are associated with situational interest might not have such intensely affective emotional correlates. This question is far from settled, but it seems that the advocates of the interest/positive

feeling association have tended to focus on indivividual interests (e.g., Izard, 1977; Prenzel, 1988), whereas others who deny such a necessary connection have dealt with some form of situational interest (e.g., Berlyne, 1971; Iran-Nejad, 1987).

As the teasing out of the relationship between individual and situational interest remains for future research, the organization of the rest of this paper must reflect the dichotomy of the research literature. First, some research findings demonstrating that individual interests have profound effects on learning are reported.[1] These are followed by a discussion of how this type of interest develops and how it can be utilized in education. The focus is then switched to the kind of situational interest that is most relevant to learning: text-based interest and its effect on cognitive performance. Following a review of this literature, the role of interesting information in psychological processes is addressed together with concomitant physiological considerations suggested by the role of interest in cognition.

Individual Interests

The Effect of Individual Interests on Cognitive Performance

Table 1 summarizes selected examples of individual interests. For example, in one of the early studies, Estes and Vaughan (1973) reported that fourth graders scored significantly higher on a test designed to evaluate retention and inferencing when

TABLE 1
Some examples of research on the effect of individual interests on cognitive performance

Study	Grade	Findings
Estes & Vaughan, 1973	Fourth	Personally interesting passages lead to superior performance on test involving retention and inferencing
Asher, 1979, 1980; Asher, Hymel, & Wigfield, 1978; Asher & Markell, 1974	Fifth & sixth	Superior comprehension of passages written on high interest topics
Fransson, 1977	College students	Superior comprehension and recall of interested and personally affected students
Nenniger, 1987	Fifth & sixth	Content oriented motivation towards mathematics is affected by interest in mathematics
Prenzel, 1988	College students	Students who develop interest in a subject will reengage and persevere in subject related activities
Renninger, 1987; Renninger & Wozniak, 1985	Young children (about 3 years of age)	Objects of interest as opposed to non-interest affect children's attention, memory, and representation of possibilities for play actions
Renninger, 1988, in press	Fifth & sixth	Individual interest influences comprehension of passages and mathematical word problems
Schiefele & Krapp, 1988	College students	High interest produces qualitative knowledge differences in learning

they read passages they rated as personally interesting versus passages of low interest. Subsequently, Asher and colleagues investigated the effect of individual interest on the comprehension of fifth and sixth graders (Asher, 1979, 1980; Asher, Hymel, & Wigfield, 1978; Asher & Markell, 1974). The results of these studies also showed that children's comprehension of passages on topics they rated as interesting was superior to passages on topics they rated as uninteresting. Fransson (1977) showed that interest factors also strongly affected college students' comprehension and recall. Interested and personally affected students showed superior comprehension of text and author intentions, when compared to students not so affected. In a more recent investigation, Schiefele and Krapp (1988) and Schiefele (in press) reported that topic interest resulted in a higher degree of cognitive organization in college students' knowledge structures. They concluded that interest-based learning might manifest itself more in qualitative than quantitative changes.

Renninger and her colleagues have conducted several important studies on how individual interest affects the learning of young children. Renninger and Wozniak (1985) investigated the individual interests of children between 2.9 and 4.2 years of age in freeplay sessions. They found that particular interests varied widely among young children, but nonetheless they had strong, stable, and relatively focused individual interests, that served as powerful determinants of their attention, recognition, and recall. Renninger and Wozniak concluded that "individual interests reflect the knowledge and value systems that individuals bring to the task of organizing experience, memory and activity" (Renninger, 1987, p. 234). Renninger (1988) also examined how fifth and sixth graders' reading comprehension and mathematical word problem solving was affected by the context in which the tasks were embedded. She found that students tended to be more competent in both their reading and mathematical performances when the passages or the word problems involved contexts that included both high levels of knowledge and high levels of value (interest contexts) rather than contexts that involved high levels of knowledge but low levels of value (noninterest contexts). Although interesting contexts meant students stayed with their tasks longer, it did not guarantee that they performed the requisite skills.

Nenniger (1987) focused on two dimensions of content orientation: interest in a particular subject matter and readiness to work on a specific content area. He concluded that individual interest in subject matter is an important variable affecting the outcome of learning. In a related study, Prenzel (1988) demonstrated that individuals who develop an interest in computers are more inclined than others to reengage and persevere in computer tasks. He reported that such reengagements were characterized by a high degree of absorption and positive feelings.

The Development and Utilization of Individual Interests

Once we accept the premise that individual interest facilitates learning, we must consider how interest develops, how the interest/learning relationship actually works, and how it could best be utilized in schools. Much of the recent empirical work on the development of individual interests deals with young children in play situations (e.g., Krapp & Fink, 1986, in press; Renninger, 1989, 1990; Renninger & Wozniak, 1985). Unfortunately, it is difficult to know what part these early individual interests play in later cognitive performance. In fact, it is remarkable how little we know about how early interests begin and what they lead to. Take, for example, two children who are equally able and equally exposed to computers in school, although neither has a

computer at home. One may develop a lifelong interest in computers and, eventually, a wide knowledge base. The other will acquire basic information but will never have a true interest in computers and consequently will develop only a limited knowledge. At this point, we do not have a scientific explanation for such differences, nor do we know how to encourage or overcome them.

Csikszentmihalyi (1988), however, recently raised the questions of why a person becomes interested in information in a particular domain and where strong interest originates. Although he has no conclusive answer, he first cites Gardner's (1983) theoretical view that there are at least seven major types of intelligence based on different neurological organizations. He then suggests that perhaps precocious interest in some aspect of the environment might be based on a peculiar sensitivity to those stimuli, a sensitivity that is either inborn or developed early as a result of interaction with adults who are also interested in the same range of phenomena. It seems reasonable, as well, that individual interests may develop from situational interest created by certain environmental features. However, these hypotheses on the origins of interest are still largely speculative and lack empirical support.

Although few investigations have focused on how individual interests emerge, there have been a number of attempts made to develop theoretical models that can explain the relationship between individual interests and learning (e.g., Krapp & Schiefele, 1986; Krapp, 1989b; Renninger, 1989, 1990). These theories will not be reviewed here in detail; however, it is important to acknowledge a few of their common aspects. Interest-based activities (whether playing with a toy or reading on a topic of interest) are seen as highly motivating and involve attention, concentration, persistence, increased knowledge, and value. Renninger (1989, 1990) especially emphasizes that individual interest always involves stored knowledge and value and may or may not be a psychological state of which the individual is reflectively aware. Here, *knowledge* refers to cognitive representations stored from past experience; *value* refers to related affective responses, such as a feeling of competence. According to this view, individual interests and related knowledge are interdependent factors that develop hand in hand and influence how the individual engages in current as well as in subsequent tasks.

Individual interests have a profound effect on cognitive functioning and performance (individuals interested in a task or activity have been shown to pay more attention, persist for longer periods of time, and acquire more and qualitatively different knowledge than individuals without such interest), but immediate application of individual interests in schools is quite problematic. First, identifying and using individual interests to promote subject-matter learning could prove to be a time and effort consuming task for teachers, particularly where the teacher-student ratio is high. Although most teachers agree that individualization is desirable in their classrooms, few teachers have the time needed to individualize efficiently enough to profoundly affect learning. Second, it appears that all children have some interests, although those interests may not be equally well expressed or appropriate to school settings. Until we know more about how to develop educationally relevant individual interests and the metacognitive awareness of those interests, their utilization across children will be problematic.

An alternative to the individualization of interests in instruction is an approach that focuses on the more general text-based interest. As this particular form of situational interest is one that is elicited by certain text segments, through ideas, topics, and themes, it seems to be germane for educational goals.

Text-Based Interest

The Effects of Text-Based Interest

Text-based interest was first investigated by researchers who were looking at the role of interest in narrative comprehension and appreciation. (Examples of sentences that create text-based interest are given in Table 2.) Evidence from this research began to accumulate that interesting stories not only motivate people to read but also influence comprehension and learning (see Hidi & Baird, 1986, for a review). In a study well ahead of its time, Bernstein (1955) had children read a high and a low interest story of equal readability and found that high interest resulted in superior comprehension. In addition, high interest also evoked fuller, more adequate, and more creative responses. In studies dealing with isolated sentences, Anderson and his colleagues (Anderson, 1982; Anderson, Mason, & Shirey, 1984; Anderson, Shirey, Wilson, & Fielding, 1987) have also shown that interest is a very powerful determinant of children's learning. Shirey and Reynolds (1988) have recently replicated these results with undergraduate education majors.

It is possible, however, that interesting text segments may not enhance overall learning. Luftig and Greeson (1983) and Luftig and Johnson (1982) argued that interesting but relatively unimportant ideas may be highly salient and actually draw

TABLE 2
Some examples of sentences that have been found to generate text-based interest

Study	Example
Anderson, 1982; Anderson, Shirey, Wilson, & Fielding, 1986; Shirey & Reynolds 1988	The huge gorilla smashed the bus with its fist.
Garner et al., 1989	When a Click Beetle is on its back, it flips itself into the air and lands right side up while it makes a clicking noise.
Garner et al., 1989	When a fly moves its wings about 200 times in a second, you hear a buzzing sound.
Hidi & Baird, 1983	No advertising is allowed on Swedish television, and there are no commercial stations.
Hidi & Baird, 1983	Adult wolves carry food home in their stomachs and bring it up again or regurgitate it, for the young cubs to eat—the wolf version of canned baby food.
Hidi & Baird, 1988	Thomas Edison became the most famous inventor of all time even though he left school when he was only six years old.
Hidi & Baird, 1983; Taylor, 1980	A canary can also bluff by playing dead. A frightened canary may go limp in someone's hand.
Wade & Adams, in press	The Battle of Trafalgar was the greatest naval victory in British history, and it was the war for Great Britain.
Wade & Adams, in press	She (Lady Emma Hamilton) fell in love with the battered, one-eyed, one-armed naval hero and became his mistress.

readers' attention away from thematically important or superordinate ideas. Garner (in press) and Garner, Gillingham, and White (1989), who have reported the persuasive effects of interest on the learning of expository text, also found that when interest is associated with unimportant information, these *seductive details* may disrupt children's, as well as mature and expert adults', expository text processing.[2] These results support our own research group's findings. In a number of studies (Baird & Hidi, 1984; Hidi & Baird, 1983, 1986; Hidi, Baird, & Hildyard, 1982; Hidi & McLaren, 1988), we have shown that text-based interest plays an important role in the processing and learning of text. Highly recalled information was found to be associated with interest factors as well as structural importance. We concluded that children do not simply recall important information and forget unimportant information when studying school texts. In addition to a facilitative effect, we also found that interest can be disruptive. Interesting anecdotes, when inserted into expository material, actually interfere with the recall of important information. Van Dijk and Kintsch (1983), who reported that interest caused by surprise guaranteed that information was perceived by college students as macrorelevant, also warned that interest strategies for macrostructure formation sometimes can produce unexpected results.

Wade and Adams (in press) investigated how structural importance and text-based interest jointly affect college students' recall of a biographical text. Four categories were established through independent ratings: high importance/high interest (main ideas), high importance/low interest (supporting details), low importance/high interest (seductive details), and low importance/low interest (personal events unrelated to the main ideas). Only interest was found to have a powerful effect on immediate as well as delayed recall. It is not surprising that main ideas (high importance and interest) were well recalled. However, it is certainly noteworthy that seductive details (low importance/high interest) were the best recalled of all segments and that the lowest level of recall was for supporting details (high importance/low interest). The authors concluded that interest played a key role in learning: Interesting material was memorable; uninteresting but important factual material was not.

In a recent study, Sadoski and Quast (in press) compared college students' long-term recall of three feature articles from popular magazines. In a surprise task, students were asked to recall the most memorable parts of the texts. Each article was rated independently for mental imagery evoked, affect created, and degree of importance. The imagery and affect rating as well as paragraph length were significant predictors of paragraph recall; importance was not. Students spontaneously mentioned the presence or absence of feelings and interests as the predominant subjective reason for their recall of ideas. The researchers concluded that personal involvement and interest in the people and events in the articles appeared to mediate free recall.

Most of the research on situational interest has focused on text comprehension and learning. The role of interest in expository writing has yet to be seriously investigated. Hidi & McLaren (1988, 1990, in press) failed to find research that systematically investigated how children's expository writing is affected by interesting stimuli. Consequently, they examined how the general interestingness of higher level text features, such as topics and themes, influences children's reading and writing performance. There were two results of particular importance. First, in the reading study, the general interestingness of topics and themes affected subjects' recall

patterns rather than the overall quantity of their learning. Hidi & McLaren (1988) concluded that because interest resulted in qualitative changes, qualitative analyses, rather than quantitative measurements, might be more suitable to investigate the effect of text-based interest on the processing of extended prose. The second major conclusion of the research was that the role of interest on writing is unusually complex primarily because knowledge factors have such an inordinate influence on writing performance. The motivating effect of high interest materials would be expected to help children overcome knowledge deficits in reading and learning by contributing to their cognitive processing and persistence in staying with the task. The same compensating effect might not be found in writing. To write well on any topic, a wide range of ideas must be generated, and the motivating effect of high interest topics alone cannot overcome the lack of a solid and retrievable knowledge base.

Factors That Contribute to Text-Based Interest

It seems important to identify the kind of information that creates a heightened sense of interest in texts. Berlyne (1960, 1971, 1974) was one of the first researchers to consider environment-based causes of interest. He did not focus on text processing but rather examined how stimulus characteristics affected perceptual processing of and response to visual and auditory patterns. He concluded that interest is a function of *collative variables,*[3] which he defined as structural or formal properties of stimulus patterns, such as variations along the lines of familiar-novel, simple-complex, expected-surprising, clear-ambiguous, and stable-variable (Berlyne, 1974, p. 5). The common, underlying characteristic of these properties is that they create conflict and uncertainty. Similarly, Mandler (1982) thought that interestingness resulted from incongruity. Schank (1979) acknowledged that certain concepts like murder, power, or sex are universally and inherently interesting but also argued that, in general, unexpectedness results in higher interest.

Hidi and Baird (1983, 1986) reported that high recall of school texts was associated with surprising information, goal-directed activities, and human interest factors, even when these elements were incidental to the main points of texts. Similarly, Anderson et al. (1987) suggested four attributes that may contribute to text-based interest: novelty, character identification, life themes, and activity level. That is, information is interesting that is novel or unusual, has characters or life themes with which readers can identify, and/or involves high activity or intensity level. In a recent investigation, Hidi and Baird (1988) wrote texts based on these characteristics and found that the interest-evoking strategies were effective in increasing children's recall of concrete, active, and personally involving information. However, these strategies did not help the recall of more abstract and important ideas.

In addition to acknowledging that certain qualitative properties of external stimuli contribute to heightened interest, Kintsch (1980) and Iran-Nejad (1987) emphasized the role of intellectual activity in response to such stimuli. Kintsch suggested that the degree to which information is interesting is related to its *postdictability*—that is, how well the information can be related meaningfully to other sections of the text or to prior knowledge. Iran-Nejad demonstrated that, in surprising stories, interest is caused particularly by postsurprise incongruity resolution and is not simply a function of surprise or expectation failures in general.

In a controversial study, Graves et al. (1988) asked three pairs of experienced writers (text linguists, composition teachers, and former Time-Life editors) to revise

two 400-word passages on Korea and Vietnam from a high school history text in order to make the passages more comprehensible and memorable. The texts went through two cycles of revisions and only those of the former Time-Life editors resulted in significant improvements in recall; the revisions of the others did not improve learning of the texts. The Time-Life editors considered the passages to be extremely dry and resistant to interesting presentations, and to improve the texts they intensified action and added metaphors, excitement, a sense of drama, and a string of *nuggets* (vivid anecdotes). In other words, they attempted to increase text-based interest for the readers by including interesting but unimportant ideas (seductive details). In two separate studies, researchers failed in their attempt to replicate these results and found that only the revisions of the composition teachers improved subjects' learning (Britton, Van Dusen, Gulgöz, & Glynn, 1989; Duffy et al., 1989). Duffy et al. argued that, because Graves et al. did not have their revised texts rated for interest, they might be incorrectly assuming that the texts revised by the Time-Life editors were more interesting than the other revisions. Recently, Graves (1990) graciously acknowledged that his own attempt to replicate his results was unsuccessful and that, indeed, the composition teachers' version produced significantly more learning.

The finding converging now, that the Time-Life editors' strategy of inserting seductive details does not improve the overall recall of text, is not difficult to explain if one considers the research on seductive details previously mentioned. The literature clearly shows that interesting but unimportant information frequently disrupts the learning of more important ideas. In addition to these disruptive effects, it has also been shown that interest does not easily generalize across text segments (Anderson, Mason, & Shirey, 1984; Hidi & Baird, 1988). Although seductive details might be well recalled, it is unlikely that the interest they create would favorably affect the recall of other, potentially important, but not closely related ideas.

A less resolved question is why the composition teachers' second version was so superior. Even though in this version the teachers made both content and structural changes, Duffy et al. imply that it was the group's striving for coherence, clarity, and structure that was responsible for the results. Alternatively, I would suggest that it was the combination of these factors, plus an increased interestingness in the changed content that resulted in improvement. In fact, it seems to me that, in their second revisions, the composition teachers did what the Time-Life editors meant to do—made the text more interesting—but did it better. Rather than creating interest by adding irrelevant anecdotes, or nuggets, the teachers added interest that focused on main ideas. Supporting this hypothesis are the interest ratings of both the Duffy and Graves studies, that found significant differences in favor of the teachers' second version.

In addition, a study of the second version of the Vietnam passage suggests that several of the teachers' changes correspond to some of the interest-evoking text characteristics defined by Anderson et al. (1987), Hidi and Baird (1983, 1986), and Schank (1979) that were discussed above. For example, the rewrite focused on Johnson as the man who was central to the escalation of the war. The language was also more expressive and described more intensive actions and universally interesting concepts—for example, " . . . he did not want to send young men to die in Vietnam," " . . . enormous increase," " . . . they failed to squelch the inevitable flow . . . ," " . . . mighty military power," "ESCALATION," " . . . Vietnamese were

both stronger and wiser . . . " "America wallowed in the quicksand for six more years. (Graves et al., 1988, p. 264)" (This last, lovely metaphorical statement is sure to be memorable, not because of structural clarity and cohesion but because of the interesting image it creates.) Thus the teachers' revision was not only a more cohesive and better structured text but also a much more interesting one.

In summary, it seems that two types of factors contribute to text-based interest. One group of factors corresponds to Berlyne's collative variables. These are formal, structural characteristics: novelty, surprisingness, unexpected events and/or ideas. The second group of factors is more content bound; among these are universally interesting concepts, human activity, intensity factors, and life themes. Given the diversity of these factors, it is crucial to establish how the interest affect is created.

The Effect of Interesting Information on Psychological Processes

I will now consider how text-based interest affects learning and suggest that, although the empirical evidence to date is inconclusive, attentional factors play an important role in the profound effect that text-based interest has on information processing.

As evidence began to accumulate that showed the strong, facilitative effect on learning of text-based interest, researchers attempted to explain why readers were so likely to remember interesting material. Asher (1980) suggested that readers' superior recall of interesting information may be due to having more elaborated and differentiated cognitive structures for high interest topics. The distinction previously made between individual and situational interest suggests that, even though Asher's hypothesis may help to explain the facilitative effect of individual interest on the way in which text is processed, it has little bearing on the effect of text-based interest. Whereas individual interest can be seen as being highly and positively correlated with knowledge, situational interest, that in general is elicited by external objects or environmental features, might be seen without a preexisting interest context involving increased knowledge and value. In fact, as the previous review of the factors that contribute to text-based interest showed, this type of interest is often guided by the very opposite of increased knowledge and familiarity: novelty, uniqueness, and surprise. This aspect of text-based interest not only indicates that Asher's hypothesis cannot explain the facilitative effect of text-based interest but also suggests serious difficulties for all theories arguing that learning is facilitated by information that fits existing slots in long-term knowledge structures. (See Iran-Nejad & Cecil, in press; Schallert, 1982; Thorndyke & Yekovich, 1980, for related discussions of this point.)

Anderson (1982) and Anderson et al. (1984) first hypothesized that interesting sentences might increase learning by affecting the depth of children's processing, just as meaning emphasis instruction does. Both of these factors were thought to encourage more active involvement in generating coherent representations. The results of their study, however, showed that sentence interest and meaning emphasis were produced by different underlying processes. There was no interaction between interest and a depth-of-processing manipulation that involved either emphasizing accurate and fluent oral reading or providing a continuation of what might happen next. The researchers concluded that teaching meaning emphasis and interest influence different underlying facets of the reading process and proposed that the extra attention given to interesting text segments might be causing the increased learning.

The assumption of a link between interest, attention, and learning can be found in a much less elaborated form in many now classic works (e.g., Berlyne, 1960; Dewey,

1913; James, 1890; Thorndike, 1935). It has been repeatedly upheld by current researchers (e.g., Izard, 1978; Renninger, 1990), and even kindergarten children seem to be aware of it (Miller & Weiss, 1982; Miller & Zalenski, 1982). However, Anderson and colleagues were the first ones to have an elaborated hypothesis of a causal relation. They have based their explanation, of why interesting information is better recalled than other information, on a modification of the Selective Attention Model, formulated by Anderson and his colleagues (Anderson, 1982; Reynolds & Anderson, 1982; Reynolds, Standiford, & Anderson, 1979). According to the original model—intended to account for the increased learning of important information—text elements are graded for importance and extra attention is selectively allocated to them in proportion to their importance. As a result of the extra attention, the more important text elements are better learned than other elements. This model was extended to explain the facilitative effect of interesting information on learning. Anderson (1982) and Anderson et al. (1984) hypothesized that text processing also involves grading text elements for interest and the selective allocation of attention in proportion to such interest ratings. Thus increased learning of interesting information was also assumed to result from extra allocation of attention. It is significant that this assumption presupposes that the reading of interesting information involves the same processes as the reading of important information. Shirey and Reynolds (1988), in fact, suggest that interesting information is merely information made important by internal criteria.

There were two empirical studies that specifically evaluated this hypothesis. One study examined fourth-grade children's text processing (Anderson, 1982; Anderson et al., 1984); the other focused on college students (Shirey & Reynolds, 1988; Reynolds & Shirey, 1988). The procedures were identical in the two studies. On a computer, students read a series of unrelated sentences that had been previously rated for interest by a peer group. In a secondary task, they were also asked to respond to a tone while reading. Attention was measured as a joint function of attention duration, as indexed by reading time, and attention intensity, as indexed by the time it took to respond to the secondary task. The extended version of the Selective Attention Model predicts that longer reading and reaction times are associated with the more interesting sentences and that the more interesting sentences will also be recalled better than the less interesting ones.

The results of the two studies are difficult to interpret. In the Anderson (1982) and Anderson et al. (1984) study, fourth graders did spend more time reading and reacting to the secondary probe task and recalled more interesting sentences. However, when a statistical test was performed to establish a causal relation between attention and learning (see Anderson, 1982, for a detailed discussion of this procedure), it was concluded that such a causal relation did not exist. Results from the Shirey and Reynolds (1988) study showed that adults process interesting sentences in a different way from children. Although the college students also recalled interesting sentences better than less interesting ones, they spent less rather than more time reading as well as responding to a secondary task given interesting sentences. Once again, the researchers concluded that attention is not causally related to the learning of interesting information.

I would like to suggest that neither of these studies has demonstrated conclusively that attentional factors are not associated with the superior learning that subjects demonstrate with interesting text segments. As long as we assume that people

consciously allocate and maintain attention when reading interesting text segments, just as they do when reading for importance, it is also reasonable to assume that attention will be manifested by longer reading and secondary reaction times. However, one might argue that interest elicits spontaneous rather than conscious, selective allocation of attention. Given such spontaneous attention, interesting text-segments could be associated with faster reading and reaction times as a function of the more flexible, efficient processing of information afforded by interest.

The idea of spontaneous attention is presently not in vogue, but it is certainly not new. It has been referred to in the literature under a variety of names, such as involuntary, automatic, and instinctive, as opposed to voluntary, intentional, and deliberate. Dewey (1913) stated that attention flies to that which is of interest. Berlyne (1960) suggested that spontaneous attention is attracted by certain physical properties of the environment, such as novelty, complexity, or significance. Kahneman (1973) acknowledged that voluntary selective attention can be differentiated from involuntary attention. He further argued that whereas momentary intentions rule voluntary attention, enduring dispositions govern involuntary attention. Examples of favored stimuli, toward which such attention is spontaneously directed, are novel objects, ideas and events, objects in sudden motion, and conversation in which one's own name is mentioned. Kahneman also pointed out that spontaneous attention can describe the significance of certain stimuli that would be otherwise unpredictable. (Perhaps the lack of interest in unpredictable events in present-day cognitive psychology explains why the notion of spontaneous attention has been neglected in current research.)

Neisser (1976) and Sokolov (1963, 1965) also presumed that certain attentive mechanisms operate autonomously outside of the voluntary control of the organism. Eckblad (1981) similarly argued that schemes may become spontaneously active and result in specific attentional and affective attributes. Iran-Nejad and Ortony (1984) suggested that incongruous information spontaneously draws attention. More recently, Iran-Nejad and Chissom (1988) and Iran-Nejad and Cecil (in press) named two types of control factors in learning: Those that are under the active control of the learner, and those that are dependent on more dynamic factors. The allocation of conscious, selective attention is under active control, but affective responses, such as anxiety or excitement, may be associated with dynamic control. Interest triggered learning may also be under dynamic control rather than under the active control of the learner. Renninger (1990) argues that individual interest leads to more complex and differentiated levels of information processing, but also acknowledges the possibility that individuals are not reflectively aware of their interests.

A hypothesis that spontaneous attention is evoked by interesting text segments might predict that these text segments are read faster than segments that do not get such automatic allocation of attention.[4] There is some experimental data, in addition to that reported by Shirey and Reynolds (1988), that suggests that interesting text segments may be associated with faster reading times. In an earlier study, Kintsch, Kozminsky, Streby, McKoon, and Keenan (1975) compared reading times and memory performances on science and history passages and found that the history passages took significantly less time to read than the science passages, although the texts did not differ in word frequency, sentence length, or abstractness. Interest was not measured directly in this investigation, but it seems reasonable to assume that history texts, dealing with human factors, characters, and activities, are more inter-

esting to the average college student than the more esoteric science passages. In a study that applied multiple regression techniques to sentence reading times, Graesser and Riha (1984) found that reading times decreased with both higher sentence interestingness and higher passage interestingness.

John McLaren and I (McLaren & Hidi, 1990) have been examining adults' and children's reading times with interesting and less interesting text segments embedded in extended prose passages that have topical switches. Unexpectedly, we found that the topical switches were significantly better predictors of reading times than either importance or interestingness. Specifically, whenever a sentence involving a topical switch occurred, adults' average reading times increased by about 25%, compared to other sentences. Children's reading times also increased with topical switches, although the effect was less significant. We have concluded that when one reads extended prose, reading times reflect two aspects of the reading process. The first is the processing of the information contained in the text segment, and the second is the integration of previously read with currently read information. When such integration is more difficult (e.g., a topical switch occurs), reading times will increase, reflecting this second process. Unfortunately, there does not seem to be a way to separate out the effect of the two processes by using simple reading time measures; rather, more complex physiological measurements might be needed to sort out the separate effects of these two components.

These results would predict that reading of seductive details take extra time as they always tend to involve a topical switch. Wade and Schraw (1990), independently of our research, found that interesting but unimportant information took on the average 50% longer to read than interesting and important ideas. If indeed topical switches result in less automatic and more effortful processing, they raise serious doubts as to the efficacy of using reading times as one measure of attention in the case of connected prose. Reading times of isolated sentences (e.g., Anderson, 1982; Shirey & Reynolds, 1988) should reflect attentional factors more accurately, as these sentences do not have to be integrated with other text elements.

If we assume that interesting text segments are spontaneously given attention (as opposed to its being consciously and selectively allocated), their comprehension may involve less overall effort and place less demand on processing resources than uninteresting text segments. Similar claims have been made with respect to automatic processes in memory (e.g., Hasher & Zacks, 1979). A further implication may be that the freed-up cognitive resources become actively involved with generating more coherent representations.

Most people intuitively would argue that reading that involves individual or situational interest requires less conscious effort. I know, however, of only one study that empirically supports the claim that the processing of interesting information involves less effort. Nell (1988) reported that subjects were asked to rate a number of well-remembered books for concentration effort from 0% (you concentrated effortlessly) to 100% (you had to force yourself to concentrate as hard as you could). Mean effort rating was 5.4% for interesting, enjoyable books, 39.6% for hard reading (workbooks), and 67.2% for uninteresting, dull reading. These highly significant results further suggest that readers are aware of the differences in their efforts.

It has been suggested that interesting information, in addition to requiring less effort and resulting in more coherent representations, may also be more intensively processed as a part of the situational model (van Dijk & Kintsch, 1983). Uninterest-

ing information, on the other hand, may tend to be processed under the propositional text base. Hidi and McLaren (1988) have argued that the situational type of model may apply when individuals process interesting information. Schiefele and Krapp (1988) and Schiefele (in press) suggested that personally affected students develop a situational model of the text, but students not personally affected tend to form a propositional model.

This theoretical position is highly tentative at this point because no empirical study has examined the relationship between interesting information and situational processing. However, according to existing research on the situational model (e.g, Perrig & Kintsch, 1985; Schmalhofer & Glavanov, 1986), the processing and retrieval of information with a strong situational model component can empirically be distinguished from information processed without such a component. Our research group is presently involved in an effort to compare the processing of two parallel texts that vary only in their interestingness. If this research shows that interesting text segments are more likely to result in situational representations, we will move a step closer to understanding why and how text-based interest affects learning and how it could be utilized better in schools.

The Effect of Interesting Information on Physiological Processes

It is important to consider some related evidence that suggests that the processing of interesting information may involve specific physiological activities. In an early study, Sokolov (1972) reported that if subjects lack interest, the electrical activity of their speech musculature is lowered. Later, in a study dealing with infants, Langsdorf, Izard, Rayias, and Hembree (1983) hypothesized that facial indicators of interest, visual fixation, and heart rate all respond differentially to stimuli that vary in face relatedness. The stimuli were a human, a department store mannequin, and an inanimate object with scrambled, face-like features. The underlying assumption of this research is that infants should find a person more interesting than a mannequin and that an inanimate object is the least interesting of the three. The findings generally supported the hypothesis that the more preferred, interesting stimuli tend to be positively correlated with facial indications of interest, visual fixation time, and, especially, heart deceleration, which others have also reported to be a reliable correlate of visual fixation of stimuli within a certain range of novelty (e.g., Kagan, Kearsley, & Zelazo, 1978).

Working with college students, Libby, Lacey, and Lacey (1973) measured simultaneously two types of autonomic response patterns: heart rate and pupillary response to pictorial stimuli. They intended to establish the importance of certain stimulus attributes such as interestingness, hedonic value (pleasantness-unpleasantness), and complexity in producing variations in the above responses. One of the most relevant findings of the study was that interesting, attention-getting, unusual slides elicited dilation of the pupils and deceleration of the heart rate. Similar findings have been reported by Pratt (1970) and Collen and Libby (1971). The Libby et al. (1973) investigation also confirmed the independence of interestingness from pleasantness and complexity. In addition to demonstrating that measurable physiological changes accompany the detection of interesting stimuli, there was another important aspect of the study. The authors reviewed previous studies that deceleration of the heart beat accompanies interest in simple tasks such as observing, noting, and detecting interesting stimuli. In contrast, more demanding tasks involving mental

work such as storage, retrieval, and internal manipulations of representations have been shown to result in acceleration of the heartbeat.

These results have two significant implications for the arguments presented in this article. First, if it is true that reading interesting information is an easier, more spontaneous, and less effortful activity than reading for importance, measurable physiological differences may be involved in the two types of processing. Second, as reading of any kind (even interesting texts) is a more demanding task for children than for adults, we might also expect measurable physiological differences accompanying the reading performances of children and adults. If such differences exist, they may help explain children's and adults' conflicting reading times of interesting sentences reported by Anderson et al. (1984) and Shirey and Reynolds (1988). Verification of these inferences, however, must wait until developmental studies are conducted that measure autonomic response patterns in response to texts that vary in interestingness and/or personal interest.

Berlyne (1960, 1974) argued that collative variables affect behavior through the physiological phenomenon of arousal. Volumes have been written on arousal (see Eysenck, 1982, for a review), but no recent investigations of interest examined if indeed arousal is implicated in the processing of interesting information (Krapp, 1990). Another line of physiological research that is relevant to the processing of interesting information concerns the *locus coeruleus* (LC), a structure in the brain thought responsible for vigilance as well as global orientation towards imperative, environmental stimuli (Foote, Bloom, & Aston-Jones, 1983; Svensson, 1987). Folkow (1985) argued that the LC not only responds to threatening sensory stimuli but also to any interesting or novel environmental stimulus of salient nature. Because the functioning of the LC has been (a) assumed to enhance the reliability and efficiency of feature extraction from sensory input, (b) implicated in the biology of memory processes, attention, and the arousal mechanism (Aston-Jones, Foote, & Bloom, 1984; McGinty, & Szymusiak, 1988; Sara, 1985), and (c) involved in "the interpretation of the meaning or relevance of a stimulus as well as its cognitive aspects" (Svensson, 1987, p. 2), a knowledge of its functioning and influence may ultimately be indispensable to our understanding of the role of interest in learning.

In general, recent developments in the study of brain functioning may bring us closer to understanding the differences between cognition with and without high levels of interest. As Wilson and Languis (1990) discuss, the measurement of brain electrical activity patterns is already involved in examining the nature of individual personality differences (extroverts vs. introverts) in cognitive tasks. These measurements include the collection of raw EEG data and more specific measures, such as that provided by the *Auditory Evoked Potential* (AEP), a brain mapping task used to assess neurocognitive processes such as selective attention and decision making. In the future, these types of assessments are expected to be involved with many more aspects of cognitive functioning, including the examination of how interesting versus uninteresting information is processed.

It is also of significance that advances in neuroaudiological techniques now allow the evaluation of cortical activity in living, working humans. For example, functional brain imaging techniques measure dynamic brain function and thus have the ability to measure physiological concomitants of mental phenomena (Berman, 1987). At present the brain imaging studies, such as those that measure regional cerebral blood flow (rCBF), focus on characterizing aberrations of brain function in neuro-

psychiatric cases (see Berman, 1987, for a review). However, they have the potential to examine the cerebral functioning of normal subjects who carry out specified cognitive tasks. In fact, Gur et al. (1982) have already suggested that certain forms of rCBF may be particularly sensitive to changes related to cognitive activity.

In general, the field of neurocognitive research shows promise for contributing greatly to our knowledge of the impact of interest on cognitive functioning. Once we have more knowledge of the physiological processes, we will be in the position to integrate them with the psychological aspects of interest. Only then can we start building cognitive theories that account for both.

Conclusions

I have tried to make two major points in this article. First, I have argued that interest is central to determining how we select and persist in processing certain types of information in preference to others. I have presented evidence to show that both individual and text-based interest have a profound effect on cognitive functioning and the facilitation of learning. Second, I have suggested that processing interesting information involves elements that are not present in processing information that lacks such interest. My position is quite different from that of other researchers, who do not clearly distinguish between the processing of interesting text segments and the processing of important ideas in text. I am convinced that both the psychological and the physiological processes associated with interesting information have unique aspects.

There are, however, many unresolved questions in the research on interest that need to be dealt with. For example, the conditions, the length of engagement, and the focus on external stimuli versus internal states are very different depending on whether interest is due to individual, personal significance, or the interestingness of text. But the cognitive and physiological functioning in these two situations must have common aspects. To date, I know of no one who has reported on how such processings are similar and/or different. Both psychological and physiological data pertaining to such comparisons are needed to clarify the question. It would be especially important to know how attentional factors compare across the two situations.

Another question that should be investigated concerns the role that individual interest versus text-based interest plays in learning. Because of the differences between these two types of interest, they may be contributing to different aspects of the learning process. Individual interest might play a strong (but so far neglected) role in writing and intentional learning as well as in difficult learning and expertise. Specifically, individual interest may be the key to explain the difference between expert and skilled performances. Situational interest, on the other hand, seems to be more relevant to reading and to easier learning. That is, it might best contribute to the beginning stages of knowledge acquisition.

Finally, it is important to clarify the relationship between interest and arousal. These concepts have been explicitly linked by earlier theorists, but even a reference to the concept of arousal has been curiously missing from most of the current surge of interest research. As arousal levels influence attentional capacity, this relationship must be investigated before the connection between attention and interest can be fully understood.

If the arguments presented in this paper gain further empirical support, they should lead to a wider recognition of the unique role interest plays in determining the

course and outcome of our mental activities. Then perhaps the potential impact of interest as a motivating force and as a mental resource can be fully realized, rather than assumed, by both researchers and practitioners.

Notes

[1]This article is not meant to be an exhaustive review of all areas of individual interest research. Notably, the considerable body of work on the relation of individual interest to vocational choices and/or general academic achievement has not been included. More complete reviews of individual interest research have been presented by Krapp (1989b), Renninger (1989, 1990), and Schiefele (1988) and will be covered in the forthcoming book, *The Role of Interest in Learning and Development,* edited by K.A. Renninger, S. Hidi, and A. Krapp.

[2]It is of historical interest that it was Dewey (1916) who first warned against the negative effects of seductive details on the learning of important information.

[3]According to Berlyne, specific curiosity and exploration also are caused by collative variables. Hidi and Anderson (in press) discuss how these concepts relate to situational interest.

[4]It should be noted that attentional consequences of interest may vary with tasks. For example, in tasks that require more complex and effortful processing or less automatized cognitive activity than reading, interest might also result in better sustained and persistent attention. In such cases, one would expect longer duration of activity rather than faster performance.

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