CHAPTER 2

SKILL MAY NOT BE ENOUGH: THE ROLE OF MINDFULNESS IN LEARNING AND TRANSFER

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Abstract

The gap between what learners can do and what they actually do can be narrowed down to a great extent by the notion of mindfulness. This construct is defined as the volitional, metacognitively guided employment of non-automatic, usually effortful processes. Mindfulness is a mid-level construct which reflects a voluntary state of mind, and connects among motivation, cognition, and learning. It is both a general tendency and a response to situational demands. This dimension of mindfulness–mindlessness, plays various important roles in different kinds of learning and transfer situations, and for different kinds of learners. Theoretical, operational, and educational implications of this dimension are discussed.

One entertains the implicit assumption that if individuals have a fair mastery of knowledge and skills, that they are likely to apply them when the opportunity arises. But such an assumption faces difficulties. The painful truth is that more often than not individuals do not make good use of what they know and master. Despite the availability of the necessary prerequisites, judgments are biased, often strongly colored by pet theories, reflecting attention to superficial and irrelevant cues and based on erroneous heuristics (e.g., Nisbett & Ross, 1980); knowledge that could have been generalized and transferred to new situations remains contextually welded (e.g., Bransford, Franks, Vye, & Sherwood, 1986; Glaser, 1984); strategies that are available are not always deployed autonomously (e.g., Thomas & Rohwer, 1986); knowledge acquired in school and college is not applied to the solution of daily informal problems (Perkins, 1985a); little spontaneous transfer takes place even when cues are provided (Gick & Holyoak, 1983); and few if any "powerful ideas" are spontaneously acquired, let alone generalized, from LOGO (Leron, 1985).

There is evidence to suggest that many individuals operate much of the time on the basis of a simple impression that what they do is correct because it "makes sense" (Perkins, 1985b), thus operating on the basis of a least-effort principle. Langer (1985) has concluded

from her extensive research that so-called mindless behavior in real life situations is far more pervasive than usually assumed. Bransford, Nitsch, and Franks (1977) have observed that as criteria for studying become less clear, and as moment-to-moment monitoring of students is reduced, many a student engage in blind guesswork and trial-and-error; only a few manifest what might be called mindful cue seeking. Skillful and capable individuals just do not always operate cognitively "at the top of their heads" even when the situation warrants it (Pascual-Leone, 1984).

Many of the failures mentioned above appear to us to result not from what is mastered but from the ways it is employed; the *how* of learning, not the *what*. In this paper we wish to discuss the issue of how learners go about using what they know, some of the factors that affect the ways they do it, and the learning and transfer consequences of using that knowledge and skill in different ways.

The present discussion of the "how" in learning, focuses in particular on the choice learners make as to the *mindfulness* they exert in the process. We argue that there is a gap between what learners can do in terms of the skills, strategies and knowledge they have already acquired, and what they actually do under normal, nontrivial learning conditions. In many such situations, they are often not very mindful, thus manifesting poorer learning and transfer than they could have, would they have been more mindful during the learning and/or transfer process. This gap, which we call *the zone of proximal learning*, is akin to the difference between competence and performance (e.g., Davidson & Sternberg, 1985). Our argument is that it can be narrowed by increased minfulness. Concerning transfer, we follow here the distinction between "low-road" transfer that results from relatively automatic generalizations based on much continuous practice, and "high-road" transfer attained through mindful abstraction (Salomon & Perkins, 1984). Many of the failures to show genuine transfer to novel situations where such would justifiably be expected, can be accounted for by the fact that neither road has been taken: Learning to be transferred was either lacking mindfulness or lacking practice-to-automaticity.

The Construct of Mindfulness

A Mid-Level Construct: Mindfulness

The reasons as to why individuals do not perform, learn or transfer knowledge as well as they could have, *given the knowledge they have already acquired*, are of course varied. Three clusters of factors are often considered in this respect. One cluster entails *cognitive factors* such as retrieval and production deficits, the application of erroneous heuristics, or strategic and metacognitive misapplications (e.g., Bransford *et al.*, 1986; Thomas & Rohwer, 1986). The second cluster entails *motivational factors* such as expectations, learned helplessness, poor perceived self efficacy, or inappropriate attributions of failure (see Dweck & Elliott, 1983, for review). The third cluster entails *personality variables* such as the tendency to rely on perceptual-gestalt like cues, data-driven vs. theory-driven inclinations, holistic vs. analytic inclinations, and the like.

Many specific variables have been suggested as parts of these clusters to account for the kind of learning and application difficulties discussed here. These, however, are often local-, task- and situation-specific variables that defy generalization. Yet, there appears to be a common denominator for all this variety, a common underlying factor that may ex-

plain why available skill and knowledge are often not used. This underlying factor is *mindfulness*: a state of mind that is defined as *the volitional, metacognitively guided employment of non-automatic, usually effort demanding processes*. It is a mid-level construct that entails motivational, attitudinal and cognitive factors. It is based on the commonality between more task-specific processes such as "conceptual notetaking" during lectures, "the generation of imagery" during reading, or "comparative elaboration" during learning, and more general processes such as "hypothesis generation" during problem solving. The construct of mindfulness, in this sense, is analogous to Berlyne's (1965) construct of subjective uncertainty — a state of mind that can be brought about by a variety of stimuli (contradiction, incongruity, inconsistency, surprise), and whose manifestations vary yet share a common essential core of epistemic behaviors.

The Nature of Mindfulness

Mindfulness is a summary description of how one performs a task. One underlying assumption is that a task can be carried out more mindfully or more mindlessly even though the strategies employed may appear to be the same (cf. Morris, Bransford, & Franks, 1977). Another assumption is that some individuals are likely to carry out a task more mindfully than others. For example, Kiewra (1985) and Kiewra and Fletcher (1984) observed that only a few notetaking students really engage in conceptual rendering of main ideas, or integrate the new information with the old. Most others just record the lecturer's words verbatim.

Underlying the construct of mindfulness is a *dimension* defined by its extremes — mindfulness and mindlessness, based on the distinction between controlled and automatic processes (Schneider & Fisk, 1984; Shiffrin & Schneider, 1977). Automatic processes are fast, effortless, smoothly carried out in large chunks, unlimited by the constraints of the central processing capacity or working memory. They are usually controlled by external cues ("data driven") to which they have been associated through practice, or by internally overlearned responses. Controlled processes, on the other hand, are slow, effort demanding, relatively discrete, thus available to analytic reflection (Kellog, 1982; Langer & Imber, 1980), and volitionally controlled by the individual (Kuhl, 1985). The deployment of controlled processes implies, in turn, an executive function in the form of metacognitions that serve to monitor processing (Brown, Bransford, Ferrara, & Campione, 1983). Automatic processing, by its very nature, does not seem to require such a function (Lefebvre-Pinard & Pinard, 1985). Thus, automaticity is associated with passive processing (Langer & Imber, 1980).

When mindful processes are activated, the individual can be expected to withhold or inhibit the evocation of a first, salient response (Pascual-Leone, 1984), to examine and elaborate situational cues and underlying meanings that are relevant to the task to be accomplished (Kane & Anderson, 1978), to generate or define alternative strategies (Pressley, 1986), to gather information necessary for the choices to be made, to examine the outcomes (Bandura & Cervone, 1986), to draw new connections and construct new structures and new abstractions made by reflective type processes (Langer, 1985; Pascual-Leone & Goodman, 1979). Evidently, such behavior is typical to some of the activities of expert problem solvers (e.g., Chi, Feltovich, & Glaser, 1981), of individuals for whom "thinking is fun" (Cacioppo & Petty, 1982), and of cases where cognitively demanding,

confusing, inconsistent, or contradictory materials are encountered and arouse the experience of subjective uncertainty (e.g., Berlyne, 1965; Kintsch, 1977; Salomon & Sieber-Suppes, 1970).

When more mindless processes are activated, on the other hand, the individual relies on salient structural features of a situation, often erroneously taking them to represent its alleged familiar underlying meaning (Langer, 1985), hence activating existing scripts, schemata and strategies (Langer, Blank, & Chanowitz, 1978). Based on extensive experiences, often incorrect intuitions are mindlessly evoked, thus leading to many misconceptions in science (Clement, 1982; DiSessa, 1983) and mathematics (Fischbein, Tirosh & Hass, 1979).

Before proceeding, two points need to be discussed. The relationship between *mindfulness and effort*, and the *operationalization* of the construct. Concerning the first point, it should be noted that mindfulness, by its very definitional nature, always entails effort; but not all expenditures of effort are necessarily manifestations of mindfulness, even when skill mastery is held constant. Consider field-dependent individuals who expend no less effort in solving a perceptually misleading problem than their field-independent age peers (Globerson, 1983; in press). Are the former more mindful? Not necessarily, because they may be effortfully but repeatedly attacking the problem using the same inefficient strategy without much consideration of its situational appropriateness and without considering alternative strategies. In fact, the performance of field-dependent children improves significantly when they learn to direct their mental effort to using appropriate strategies, and to guide their behavior by metacognitions (Globerson, Weinstein, & Sharabany, 1985). This stresses the point that mindful behavior is associated with more than merely effortful processing of information.

The second point concerns the operationalization of the construct of mindfulness. In most studies where this or related constructs were experimentally manipulated (e.g., Benware & Deci, 1984; Craik & Lockhart, 1972; Langer *et al.*, 1978), changes or differences in depth of processing, mindfulness or effort expenditure were inferred from subjects' posttest performance. More direct measures were taken when the secondary task performance paradigm was used enabling researchers to infer greater "cognitive capacity usage" from subjects' changed performance on the secondary task, e.g., responses to clicks during reading (e.g., Britton, Glynn, Meyer, & Penland, 1982). But, as pointed out elsewhere (Salomon, 1983), such a procedure introduces rather artificial and ecologically alien features, prohibiting the measurement of subjects' voluntary mindfulness.

Globerson (1983) has used a physiological index of mental effort expenditure, namely pupillary dilation. However, this measure requires sophisticated laboratory equipment, thus is impractical in many kinds of research conducted in more natural setting such as the classroom.

We have operationalized this construct in terms of subjects' self reports of (a) effort expenditure, (b) concentration, and (c) extent to which they have thought of the way they performed the task at hand (e.g., Salomon, 1983, 1984; Salomon & Leigh, 1984). One is fully aware of the limitations of self reports. Indeed, individuals' self reports often reflect their implicit theories of internal events rather than the actual employment of particular processes or strategies (Nisbett & Ross, 1980). However, as Kellog (1982) has pointed out and as current utilization of think-aloud methods indicate, this limitation may apply more to automatic processes, which by their very nature are unavailable to introspection, then to intentional, controlled processes. Self reports of mindfulness belong to the latter cate-

gory. Our previous research has yielded acceptable levels of reliability of such a measure (Cronbach Alpha coefficients ranging from .67 to .86), and satisfactory validating data (to be mentioned later on).

Using self reports, we distinguish between mindfulness as a general tendency, akin to trait anxiety, and on-the-task mindfulness, akin to state anxiety. The relations between the two are presently under intensive study. We will return to this distinction when we discuss next distal and proximal sources of mindfulness.

Sources of Mindfulness

Some sources of mindfulness are more distal than others. Distal sources — such as one's overall tendency to be mindful, or the intellectual climate a student functions in — can only be correlationally linked to the actual way particular materials are handled in a given situation by a particular individual. The causal link between such distal sources and actual behavior can, however, be only indirectly inferred as it does not allow direct experimental manipulation. Nevertheless, there is good reason to believe that distal causes, whether intra-personal or environmental, are of no lesser importance that the more proximal ones that allow direct manipulation (Scarr, 1985). Experimental manipulation of proximal causes tells us more about what *can* be made to happen, not about what actually happens under normal conditions. The latter limitation is particularly pertinent here, as experimentally and instructionally induced mindfulness allows us only to indirectly infer how mindful an individual might be when on his or her own.

One important distal source of mindfulness is one's *general tendency* to prefer problems and situations that are mentally more demanding. Cacioppo and Petty (1982) developed and validated a unidimensional measure of need for cognition, that taps one's general tendency to engage in and enjoy effortful cognitive activity vs. the tendency to minimize mental effort in handling incoming information. As expected, they have found individuals low on the scale to be more susceptible to persuasion, to have somewhat lower grades in college, to show less knowledge in general areas and to enjoy less mentally demanding tasks. We are presently developing a similar measure for children. Kruglanski and Klar (1986) developed and tested a related construct of need for validity (as contrasted with a need for structure) which disposes individuals to generate alternatives and carefully attend to relevant evidence. The status of such a measure of one's tendency to be more or less mindful in general is akin to that of trait anxiety. It may dispose one to be more or less mindful in a particular situation, but other, more proximal factors (e.g., the task's demands) serve as additional mediators.

Other distal sources of mindfulness include *socio-cultural factors:* culture, intellectual climate, common ways of perceiving a situation, shared habits, and the like. All of these may compel one to rely on already acquired "scripts", commonly made attributions, "obvious" solutions, implicit, experientially based and socially shared intuitions, and "standard operation procedures". Miller (1984) found cross-cultural differences in explanations of everyday behaviors given by north American and Hindu children. These stem from ready-made socio-cultural notions invoked with little thought and effort. The better accepted and shared such notions, the more often are they likely to be invoked with relative mindlessness. In fact, they become resistant to mindful reexamination even in the face of situations that may require it (Weick, 1979).

Next come the more proximal sources of mindfulness, the ones more amenable to experimental and teacher manipulation. One quite obvious class of sources is *situationally specific motivation* which affects the way one handles a task. Meichenbaum (1980) has suggested that as long as one lacks a desire to employ non-automatic processes based on one's perception of efficacy and potential, no effortful or mindful cognitions are likely to be deliberately employed. A related source is *volition*, which according to Kuhl (1985) is a necessary link between motivation and effortful behavior; volition sustains that behavior in the face of conflicting motivations such as "I'd better leave this task to another day". (More on the relations between motivation and mindful learning behavior can be found in the thorough review by Dweck and Elliott, 1983.) One conclusion that can be drawn from the research in this area is that different kinds of motivation converge as to their effects on one's more mindful or mindless behavior in a given situation. Thus, more mindful behavior can be expected to result from a strong need for achievement, moderately positive perceived self efficacy, a state of conceptual uncertainty, a general perception of success as a function of effort, and the like.

Another kind of proximal source is *the perceived demands and value* of a task, a situation, or more generally, source of information. Generally stated, when a situation is perceived to be highly familiar, well mastered, undemanding, or too demanding, relative to one's perceived efficacy and capability, little mindfulness can be expected. This may often result from *overlearning* (Langer & Imber, 1980), as well as from a perception that a particular authority "knows best", thus allowing the individual to forgo any mindful examination of the information. Conversely, when a task or source of information are perceived to be demanding, but within the reasonable range of required effort, more mindfulness can be expected.

In our research (Salomon, 1984) we have found that children tend to preconceive the overlearned process of televiewing, unlike reading, as an easy, undemanding process. Failures to comprehend TV are attributed to "dumbness" (failures to comprehend print — to its difficulty), and success in its comprehension to its "ease" (print — to "smartness"). Consistent with these a priori perceptions, they process even a highly demanding TV program with the expenditure of little mental effort and show, accordingly, poor inferential learning from it. The correlation between general preconceptions of the medium and actual effort expenditure (self reports) is .57; the correlation between the reported expenditure of effort in the program and inferential learning is .58 (Salomon & Leigh, 1984).

If culturally held views and habitual, overlearned ways of handling a problem promote mindlessness, mindfulness may be instigated when more proximal factors become involved. These involve the nature of the materials as well as the instructional procedures. When moderately complex, novel, ambiguous, contradictory and conflicting situations and materials are encountered, more mindfulness can be expected. Concerning instructional procedures, Salomon and Leigh (1984) show that telling learners to view a demanding TV show "to learn" rather than "for fun" makes all learners more mindful. Correlations between ability and learning change from −.09 under the "fun" condition to .59 under the "learn" condition.

Indeed, a great many *instructional procedures* — ranging from the guidance of learners to elaborate the materials to providing them with game-like challenges (Lepper, 1985) — have the potential of instigating mindfulness. Consider a number of typical examples. Benware and Deci (1984) told students to learn with the intent to explain the materials to another person. Wittrock (1986) told students to generate imagery scenarios of materials

they read and relate the materials to knowledge they already possess. In both cases learning outcomes have improved. Perkins (1985a) found that when subjects were probed and guided, their ability to reason about informal daily problems was improved. Globerson *et al.* (1985) found that when subjects' metacognitions and self-awareness were encouraged, their reasoning about formal-operational problems was improved. Mintz, a graduate student of us, found that interactive learning increased both learning outcomes, and mindfulness on the task, as measured by subjects' self reports.

Indirect evidence suggests that team work may increase learners' mindfulness. When students work together, have to share information, to verbalize their decisions and thus to explore alternatives, more mindfulness ensues (Webb, Ender, & Lewis, in press). Seen from a Vygotskian point of view, team members may be assumed to provide externalized metacognitions to each other. Clements and Gullo (1984) and Clements (1985) have shown that when children learn LOGO programming in teams, while also being initially guided by adults, impressive learning and transfer take place. It withstands to reason that under such conditions more mindfulness was instigated.

While the above procedures differ in many important ways, activating different specific kinds of processes, *they appear to converge as to the mindfulness they arouse*. Their instructional utility, then, is mainly a function of whether they activate task-relevant, non-automatic processes. As it has been shown in a great many studies, making students mindful of one aspect of the material while then testing them on another, may obviously lead to poor learning outcomes. Thus, while whatever makes students use non-automatic processes is a potential source of increased mindfulness, its utility depends on the match between what has been activated and what is really required.

However, instructional instigators of mindfulness interact with more distal sources of it. Much may depend on whether the individual is inclined to mindfully respond to such mindfulness arousing situations and instructions. Indeed, there is a division of labor between distal sources such as one's inclination to be mindful, and more proximal ones such as instructional procedures. Distal factors can be expected to activate a general state of mindfulness manifested in greater alertness, attention to detail, activation of metacognitions, and suspension of immediate action. More proximal factors, on the other hand, may determine the kind of specific strategies and schemata to be employed and the specific way in which they are employed. This implies that the more distal factors may in fact constrain the proximal ones: individuals who do not tend to be very mindful may fail to notice situations that call for greater mindfulness and treat them in unwarranted routinized ways. For example, students who are "entity theorists" (Dweck & Bempechat, 1983) i.e., perceive their ability to be a fixed commodity on display (rather than a flexible resource for more learning), may fail to engage in mindful programming of LOGO even when the situation calls for it (Zelman, 1985).

The Role of Mindfulness During Learning and Transfer

Mindfulness and Learning

Let us now return to our point of departure. Learners, we claimed, often learn and use less than what their knowledge would have allowed. We called the difference between what persons actually learn and what they could learn, the zone of proximal learning. Our

argument was that learners' mindfulness, whether experimentally induced, aroused by instructional procedures, or a matter of inclination, is an important factor in narrowing that zone. The research we have mentioned and in which mindfulness has been manipulated by one or another instructional means provides indirect and direct support for our claim: learning can be improved when mindfulness is evoked.

But learning of what? Greater effort expenditure, an important component of mindfulness, as we have found (Salomon & Leigh, 1984), did not affect recall of factual details which apparently was carried out quite well without resorting to non-automatic processes. It did affect however the number and quality of inferences generated. *Increased mindfulness is apparently important where automaticity of skill employment is not enough.* Thus, much may depend on what exactly is more mindfully processed or mindfully focused on. For example, d'Ydewalle, Swerts, and De Corte (1983) found that students instructed to prepare for an open-questions test peformed better on both such a test and on a multiple-choice test than students who were told to prepare for a multiple-choice test. Expecting an open-ended test apparently makes students be more mindful, as indeed reflected in the longer time taken for preparation; it also makes them mindful of a wider range of issues in the material, as manifested in their success on both open-ended and multiple-choice test items.

Ostensibly, it might be argued that, as a general rule, the more mindful one is in the process of learning the better the learning outcomes. However, while the claim that more mindfulness leads to more learning is obviously correct and to an extent, also empirically supported, it may lead us to overlook alternative routes to learning.

Consider the case of how novices become experts. While experts are engaged in various kinds of mindful activity, they are also engaged in repeated practice which plays an important role in the process of learning and problem solving (e.g., Chi, Feltovich, & Glaser, 1981). It is reasonable to assume that much of the practice involved in attaining relative expertise does not involve much mindfulness. Once a modicum of mastery has been attained, one performs a task not for its own sake but for the sake of other goals (driving to arrive at the office, reading to obtain some information, calculating to check the bill, etc.).

Two main routes of learning appear to emerge. One route implicates much deliberate, effortful utilization of non-automatic processes; it is a mentally demanding route to the acquisition of knowledge and skill. We call it the *"high road"* of learning. The other is a route that relies on much incidental practice where skills are employed in an increasingly more automatic manner (e.g., Schneider & Fisk, 1984). It is a mentally undemanding but practice intensive road to learning (Salomon & Perkins, 1984). By necessity it takes much more time than the high road, hence we call it the *"low road"* of learning. Although two distinctive routes to learning, they are often taken together — you practice what you already know while at the same time you mindfully reflect on those components that are still new. In this sense the high road of mindful learning often, though not always, precedes taking the low road of incidental practice (e.g., Davidson & Sternberg, 1985). For, as it becomes clear, mentally undemanding practice presupposes a modicum of skill mastery which itself is likely to be attained and carried out by more mindful means. Thus, for example, Derry & Murphy (1986) observe that one needs to be able to identify important ideas in, say, a text, as a prerequisite for the application of more routine mnemonic techniques such as notetaking or outlining. Here, then, high-road learning leads to later low-road practice and application. But the opposite is apparently true as well: As reviewed by Salisbury (1984), performing complex intellectual tasks presupposes the ability to automatically

carry out many of the underlying subskills. Low-road learning allowing high-road learning.

Still, there is a division of labor between the high and the low road to learning. The low road is typical of tacit knowledge, skills, attitudes, beliefs, habits and behavior patterns, the acquisition and development of which is mainly experientially based, not a matter of logical deduction and comprehension. Thus, low-road learning appears to underly what we have come to call socialization and other kinds of learning based on experience, social reinforcement, and modelling. The high road of learning, on the other hand, is more typical of explicit instruction aimed at activating non-automatic strategies ("think of what would happen if. . .") with materials that afford mindful reflection, consideration of alternatives, and the like. It is taken when tasks are demanding and cannot be carried out by reliance on already well mastered skills. The high road comes also into play when low-road practice runs aground — a well rehearsed and overlearned solution ceases to be effective and alternatives need to be deliberately and effortfully sought.

Perhaps the most important difference between the two routes is not so much what it is that is learned through each of them but rather the nature of the *resultant knowledge*. Low-road learning results in relative automaticity of mastery. Incidental repeated practice in a variety of situations short-circuits, so to speak, the link between situational cues and behaviors or cognitions: learned behaviors come to be carried out under situtional, not person control. Once automaticity sets in, the learned behavior (or sequence of processing steps) comes to be carried out smoothly and effortlessly in a rather inflexible way (diSessa, 1983; Pascual-Leone & Goodman, 1979).

High-road learning, on the other hand, characterized as it is by much mindfulness, often results in better comprehension and memory as the deeper processing involved establishes contact with more schemata and leaves more memory traces (Kintsch, 1977). It also can lead to the generation of principles, ideas, and strategies that have been decontextualized from their initial context. Such non-automatic generalizations cannot be arrived at via the low road. Moreover, the metacognitive guidance of the high road implies the empirically supported correlation between one's knowledge of one's own learning processes (the metacognitive component of mindfulness) and one's learning ability (e.g., Pressley, Levin, & Gathala, 1984). No such correlation would be expected when learning takes the low road. In fact, the involvement of metacognitions in low-road learning may impede performance.

As already pointed out earlier, many different procedures can facilitate high-road learning. But this is a potential only. As the learners' freedom of choice increases and they have to rely more on their own resources, voluntary mindfulness comes to play an increasingly important role, accounting for a large portion of learning variance (Brown *et al.*, 1983).

We appear to face here a paradox. Instructional procedures may potentiallly evoke mindfulness, but its evocation may greatly depend on one's a priori inclination to become mindful. As teachers are well aware, facing students with the unsettling contradiction between, say, the intentions and deeds of the French revolution does not make them storm into the school library. Chanowitz and Langer (1980) point out on the basis of their research that "The apparently structured environment suggests certain modes of humanly minded engagement, but it does not *dictate* that mode" (p. 102).

Students may work in teams, be probed, or interact with sophisticated computer programs, and still not operate at the top of their abilities. The ones to actually become more mindful (where mindlessness would perhaps suffice) are likely to be the ones already in-

clined to be more mindful from the outset. Apparently you have to be mindfully inclined to take advantage of mindful-inducing procedures, to notice discrepancies and to see underlying components rather than surface ones.

This apparent paradox can however be broken down into two components: increased mindfulness during instruction vs. increased mindfulness during later performance. The paradox just described may be less typical of times of instruction when one is reasonably well guided. When mindfulness is instigated during the process of instruction it may compensate those who would not tend to be particularly mindful otherwise. As Mayer (1980) shows, inducing elaboration strategies benefits more the ones who are less inclined to engage in such mindful activity on their own. It is a different story during later performance, when one has to rely on one's own resources and become mindful *voluntarily*. Under such conditions, it is the more mindfully inclined individual who is more likely to employ non-automatic, meta-cognitively guided processes and strategies. The less mindfully inclined is more likely to fall back on routinized automated procedures. This, then, leads us to the discussion of mindfulness during transfer, to which we turn next.

Mindfulness and Transfer

The literature on transfer is frought with contradictions and disappointments. In some situations where transfer was expected hardly any was detected, as, for example, transfer from unschooled literacy of the Vai tribe in Liberia to more general cognitive skills (Scribner & Cole, 1981), from studying a problem to an analogous one (Gick & Holyoak, 1983), or from programming in LOGO to planning skills (Pea & Kurland, 1984). In other cases, impressive transfer was found: Clements and Gullo (1984) found transfer from LOGO to cognitive and metacognitive skills, Gick (1985) observed how, under specific cueing conditions, learners successfully transferred the essence of one solution to an analogous problem, and Ringle and Springer (1980) found that induced self-monitoring of mnemonic use enhanced transfer. It is obvious that transfer does take place as we often apply old ideas to entirely new situations, but that at the same time, little transfer takes place even between two rather similar situations. Are such inconsistencies accountable by the notion of mindfulness?

Salomon and Perkins (1984) have outlined a theory of transfer that is based on the distinction between the two roads of learning. It follows from this distinction that low-road learning, with the near-automaticity to which it leads, facilitates relatively automatic transfer in the form of generalizations to somewhat novel situations. Low-road transfer can be expected to be of great amounts but to travel relatively short distances to only those new instances that have clear and salient similarity to the already practiced ones. As this kind of transfer is mainly stimulus and situation controlled, not a matter of choice, it is necessarily based on cues of similarity that do not require any mindful search or abstraction. Transfer takes care of itself, based on the similarity of surface features; they trigger the overlearned response which has come to be associated with them as a result of repeated practice. Here lies the strength of such learning: it frees one from having to turn everything, familiar and unfamiliar, into a problem-solving process. Allowing the system, so to speak, to automatically recognize salient features in a situation and then automatically apply overlearned behaviors is often very effective. It requires mindful control to *prevent* the behavior from being transferred to a new situation (think of an American driving in England,

having to mindfully avoid driving on the right, i.e., the wrong side of the road).

High-road transfer, on the other hand, is a result of what might be called *mindful abstraction*. Such abstraction is to be distinguished from simple response generalization that takes place even in the absence on any mindful involvement. Mindful abstraction involves the deliberate and metacognitively guided decontextualization of non-salient features, principles or procedures, that are then candidates for transfer. Equipped with such abstractions, high-road transfer can travel far distances, leading to the application of ideas learned in one area to an entirely different one, e.g., applying thermodynamic principles to the analysis of family relations.

Two related components are involved in high-road transfer: *mindfulness*, and *abstraction*. Mindful involvement, attainable via a number of elaboration techniques, facilitates the assimilation of the material into existing schemata and activates them. As shown by the studies of Mayer (1980) and of Ringle and Springer (1980), the transfer that results from different elaboration techniques is essentially similar as they commonly increase the learner's mindfulness. But such procedures, as Gick and Holyoak (1983) show, may not suffice. For example, associative elaboration, so well suited for paired-association learning, is not very likely to lead to transfer as it entails no abstraction of underlying features. Transfer is better served when learners have to (or tend to) derive from the material essential features that are on a more abstract level than the material itself. Gick (1985) provided subjects during the learning phase with a ready made graph that represented the decontextualized essence of the solution-to-be-applied: gathering a strong but spread force at a focal point where it is needed. Although providing a graph that depicted this principle facilitated transfer to an extent, much more transfer could have been found if subjects would have become actively engaged themselves in mindfully abstracting the problem's underlying principle. Having an abstraction is not the same as mindfully deriving one.

According to the two-roads view of learning and transfer, many of the failures to find transfer when one would logically expect it are due to the fact that *neither the low road nor the high road* were taken during learning. Consider the failure of Scribner and Cole (1981) to find transfer from the Vai literacy to cognitive tasks. The Vai literates rarely used their literacy, and when they did it was for more or less inconsequential purposes (e.g., writing a rare letter to a relative). Pursuing inconsequential hobbies does not meet the low-road conditions and thus can rarely be expected to profoundly affect cognitions. The only ones in the Vai who could be expected to have taken the high road were those who taught literacy in the tribe. And, indeed, as would have been predicted by the present theoretical framework, only the teachers in the Vai showed any significant transfer from their literacy. Similarly, in the case of transfer from programming (Kurland, Pea, Clement, & Mawby, 1986; Pea & Kurland, 1984), the children were never given enough and sufficiently varied practice to meet the low-road conditions, nor were they taught programming in the high-road fashion.

In contrast with the above studies, Clements and Gullo (1984) and Clements (1985) found transfer from programming in LOGO, because the children in these studies worked in pairs and were systematically guided by adults who served as sources for externalized metacognitions (e.g., "What is it that you want to get?" "What did you actually get?" "What else could you have done?"). Under such conditions it is assumed that the high-road of learning was taken.

But having learned something mindfully, even having abstracted a principle or decontextualized the essence of the phenomenon, may not suffice for transfer. After all, high-

road learning makes the acquired knowledge or skill available, but not necessarily accessible (e.g., Davidson & Sternberg, 1985). One needs to distinguish here between high-road learning and high roadedness during the solution of a new (transfer) problem. We are entertaining the hypothesis that mindfulness during learning, particularly when aimed at arriving at mindful abstractions, is only a *necessary*, but not a sufficient condition for transfer. For as long as the conditions of low roadedness have not been met, transfer requires mindfulness not only during learning but also *during the solution of the new problem* such that whatever abstractions are available would also become *accessible* (see e.g., Voss, this issue).

It is apparently not enough to have, say, an abstracted conception of how energy can be dispersed and then focuses again (Gick & Holyoak, 1983); one also needs to recognize that the new problem calls for such a principle. And such an identification requires the same mindful, metacognitively guided abstraction as the learning process which serves as a candidate for transfer (Lefebvre-Pinard & Pinard, 1985). Thus, mindfulness during transfer — whereby one deliberately searches one's memory for cases that are similar *in essence*, not just coincidental appearance — seems to be the sufficient condition. One has to perceive the new situation as *essentially* a variant of an already learned one, to apply the familiar to the less familiar. Given that this process is effort demanding, it becomes apparent that non-automatic transfer in real life situations can take place mainly where one faces a problem to which no prior procedures have been associated by means of repeated practice, and which one is sufficiently motivated to solve via the effortful high road. In the absence of a mindful approach to the new problem, there is little chance for transfer to take place, even if the prerequisite knowledge and skill have already been mastered.

Concluding Remarks

We have suggested a theoretical, mid-level construct, the dimension of mindfulness–mindlessness, based on theoretical considerations and initial empirical findings. Mindfulness as such has hardly been investigated directly so far. We have tried to set the stage for such a construct by showing that it cannot be reduced to any of the other theoretical notions known in the psychological literature, such as motivation, metacognition, mental effort, and so on.

Most of what has been said here requires thorough investigation. For one thing, it should be shown that mindfulness as a state of mind, either stemming from general inclination or from situational factors, plays the important roles we have assigned to it both for learning and transfer situations. Furthermore, mindfulness should be shown to be different from although it may be related to, other constructs, be them personality inclinations (e.g., need for achievement), capabilities (e.g., mental capacity), or good strategy usage.

A detailed account of the mechanisms of mindful and mindless processing should be delineated, including their interaction with one another. Unless we understand how these processes function, the conditions for their employment, their relative advantages and disadvantages in various task situations, and their different outcomes, our understanding of both learning and transfer situations will be rather limited.

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