

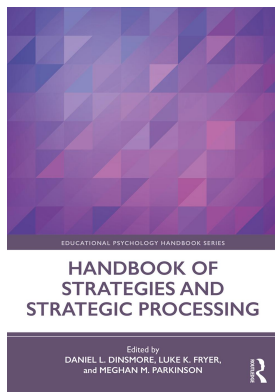
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Publisher: *Routledge*

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Handbook of Strategies and Strategic Processing

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The Future of Strategy Theory, Research, and Implementation

Publication details

<https://www.routledgehandbooks.com/doi/10.4324/9780429423635-25>

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Published online on: 10 Feb 2020

How to cite :- Patricia A. Alexander. 10 Feb 2020, *The Future of Strategy Theory, Research, and Implementation from: Handbook of Strategies and Strategic Processing*

Routledge

Accessed on: 29 Nov 2023

<https://www.routledgehandbooks.com/doi/10.4324/9780429423635-25>

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THE FUTURE OF STRATEGY THEORY, RESEARCH, AND IMPLEMENTATION

Roads Less Traveled

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Since the 1970s, my academic life has been intricately intertwined with strategies—text-processing, cognitive, metacognitive, problem-solving, learning strategies, and more. I was drawn to strategy research because I saw these intentional, effortful, and planful processes as a part of the answer to the question that brought me to graduate school in the first place: How can I help students who struggle to learn, especially when learning requires them to make sense of written language? By serendipity, I became intrigued by this question at a time when certain forces aligned. The Center for the Study of Reading led by Richard Anderson was in its heyday (Anderson, Reynolds, Schallert, & Goetz, 1977), John Flavell (1979, 1987) and Ellen Markman (1977) were unfolding their theory and empirical work on metacognition, and Ruth Garner (1987), my advisor, was a young, brilliant Assistant Professor at the University of Maryland exploring the boundaries between cognitive and metacognitive strategies. When I completed my PhD and headed to Texas A&M, more elements fell into place. I began to collaborate with Claire Ellen Weinstein (Weinstein, Goetz, & Alexander, 1988), a key player in learning and study strategies, along with colleagues like Diane Schallert and Ernest Goetz (Schallert, Alexander, & Goetz, 1988), who were alumnae of the Center for the Study of Reading. In a matter of a few short years, I was set on a path that I hoped would lead to deeper understanding about the very nature of strategies and the component processes they entailed—a path I continue to follow today.

However, this journey since the 1970s has been proven more challenging than I would have initially assumed. Before long, I came to appreciate that what appeared to be a fairly direct and well-demarcated road to understanding in concept was, in reality, meandering, obstructed, and even perilous at times. Nonetheless, the journey has been enlightening and has allowed me to contribute to a more detailed and, I trust, more accurate mapping of strategies and strategic processing than the one that guided my

initial foray. Along the way, I have attempted to chronicle my journey through the realm of strategy theory, research, and interventions (Alexander, 1997; Alexander & Judy, 1988; Alexander & Kulikowich, 1991; Alexander, Pate, Kulikowich, Farrell, & Wright, 1989). Now I have been given another opportunity to relive that 40-year journey, by reflecting on the diverse and informative collection of chapters populating this Handbook dedicated to strategies and strategic processing.

What I feared the most was that the obstacles to significant progress in strategy theory, research, and intervention that I repeatedly encountered in years past would still be visible, and that the road before me would likely be much the same as the one I had been trekking. Instead, what I discovered in this comprehensive volume was a panoramic and more unimpeded view of strategies and strategic processing. With this clearer vista, I could discern new roads being carved in the landscape of strategy research, and I could envision where these less trodden paths might carry future travelers. Despite these positive developments and the promises they hold, there are still cautionary signs that must be heeded and barriers to progress that have yet to be removed.

My mission in this final chapter is to revisit the impediments to significant progress in the strategy domain that I and others have charted (Dinsmore, 2017; Garner, 1990; Harris, Alexander, & Graham, 2008). Then, I will turn to the contents of this Handbook to illustrate how its contributors have either successfully navigated the barriers that have created problems for others in the past or have actively worked to dismantle them. Finally, with this analysis as the background, I project where those less traveled roads could carry the strategy researchers of today and tomorrow.

STRATEGY RESEARCH'S MEANDERING AND CIRCUITOUS COURSE

What are the persistent or re-emerging barriers within strategy's topography that have hampered progress for theorists, researchers, practitioners, and learners alike. Let me detail six that I have found to be most persistent and problematic.

- conceptual haziness;
- entrenched pathways;
- absence of navigational supports;
- insufficient time and space for maneuvering;
- inadequate preparations;
- outdated or poorly matched equipment.

Conceptual Fogginess

Let us take as a given that individuals' progress will inevitably be thwarted if they cannot determine where they are or where they are headed. Yet, that is precisely one of the more fundamental problems plaguing the terrain of strategy theory, research, and implementation. The conceptual fog that permeates the domain means that those journeying in this area are often operating with only a vague and sometimes distorted sense of what strategies are and what processes they encompass. Why this situation has persisted for decades is an enigma. Even in the 1970s and early 1980s, leading scholars

like Ann Brown (Brown & Smiley, 1978), John Bransford (Bransford & Franks, 1976), and Merle Wittrock (Wittrock, Marks, & Doctorow, 1975) were attempting to clear the air as to the nature of strategies and their importance to learning and academic development. These early trailblazers into memory, information-processing, learning, cognitive, and metacognitive strategies took care to specify that what they regarded as *strategies* were intentional, planful, and effortful procedures that aided learners' progress when their default, automatic ways of functioning proved inadequate. In effect, strategies were NOT habituated modes of operation or *skills*.

Despite these early efforts to map the boundaries between strategies and skills, the conceptual foggy continued to invade the literature and confound instructional practice. This remained true even with repeated attempts to remind the educational community that *strategies* and *skills* were not synonymous terms (Afflerbach, Pearson, & Paris, 2008; Alexander, Graham, & Harris, 1998; Paris, Lipson, & Wixson, 1983). However, these periodic efforts have seemingly had limited effect. Moreover, this problem of conceptual foggy is not isolated to the boundaries between strategies and skills. It has occurred, as well, in the demarcations between cognitive and metacognitive strategies (Brown & Campione, 1996; Flavell, 1979, 1987; Garner, 1987, 1990), and between metacognitive and self-regulatory strategies (Brown, 1980; Dinsmore, Alexander, & Loughlin, 2008).

Why has this conceptual fog not lifted after so many years and after such concerted efforts? Clearly, there are multiple reasons why this phenomenon persists. Among those reasons, I have argued, are neglect or disregard (Alexander, 2018b). The neglect comes about, in part, from those who are experienced travelers within this realm who simply fail to chronicle the meaning by key terms, perhaps under the mistaken assumption that those terms represent common knowledge. I have witnessed such neglect far too often in the literature (Alexander & Dochy, 1995; Alexander, Schallert, & Hare, 1991; Dinsmore et al., 2008). The consequence of this neglect is that there is increased opportunity for researchers' intentions to be misinterpreted and for actions of those who follow to be ill-informed and misdirected. On the other hand, the problems I am describing may also reflect the disregard of the conceptual markers or explicit linguistic signs that have been put into place. I cannot help but wonder, how many of today's educational researchers and practitioners are aware of the rich history on strategies and strategic processing that exists? Sadly, the lack of such a panoramic view of landscape that encompasses strategy and strategic processing means that obstacles that could have been needlessly avoided continue to impede forward progress.

Set Pathways

In the early 1980s, at a point relatively early in my career, I had a somewhat contentious encounter with a very prominent strategy researcher. This established researcher was sharing results of a strategy intervention study at a national conference, and had presented her findings for participants by grade level. When the chair called for questions, I posed what I regarded as a rather benign question to this researcher. I asked whether she had examined her data to see if any groups of students who received the training demonstrated little or no effects or even some decrement in performance. The researcher responded in a rather terse manner that testing for differential impact of

the strategy based on learner characteristics was not of concern to her. Such a statement struck me as illogical given what was known about the power of prior knowledge at that time.

In that researcher's defense, however, the prevailing belief at the time was that strategy training should benefit all students, and that the more strategies students reported using during task performance, the better their outcomes would be. Personally, I was not convinced. After years of teaching middle-schoolers from very diverse backgrounds and with wide-ranging abilities and interests, I had witnessed important differences in why, when, and how they operated strategically. As I saw it, the more knowledgeable certain students were about a specific topic or how familiar they were with a given task, the less they need to operate strategically. Also, the more that students' individualistic approaches to addressing a problem or task were working well, the less likely they would benefit from training in what would be a more rudimentary strategy. For these reasons, I set out to explore the relation between domain-specific knowledge and strategic processing (Alexander & Judy, 1988; Alexander et al., 1989; Pate, Alexander, & Kulikowich, 1989). What I was able to establish was that students' relevant knowledge impacted their need for certain strategies, the manner in which strategies were implemented, and whether training of specific strategies would prove advantageous or disadvantageous.

A survey of more recent strategy training studies suggests that with relatively few exceptions (e.g., Harris & Graham, 2016; Murphy et al., 2018), researchers still cast strategies in rather algorithmic, non-strategic language. Even when individuation or personalization are mentioned, they are infrequently incorporated into the experimental design. Instead, this facet of strategies is relegated to either the limitations or future directions.

Absence of Navigational Supports

Perhaps you have experienced the phenomenon of trying to find your way in some unfamiliar locale equipped with only a rough map of the area to guide you. Navigating the locale can prove quite challenging for you depending on the quality of the map, the complexity of the surroundings, your orientating skills, and your urgency of getting from point A to point B. Personally, if it were not for my GPS, I would find myself hopelessly lost in many cases. Analogously, such navigational problems have been a reoccurring theme within the realm of strategies and strategic processing, especially for novice researchers and practitioners who must rely on often sketchy and incomplete depictions by which to navigate the domain. This unacceptable situation arises in part because those conducting strategy research and devising interventions do not produce renderings of their work that are sufficiently detailed and precise for replication or implementation. There is only so much detail that can be inserted into a research article, after all. So, inevitably, anyone attempting to retrace the steps of strategy researchers will have some unmarked territory to navigate.

Also, there is a scarcity of individuals who are willing and able to serve as the navigational guides that educators require to put strategy research into practice. This scarcity has long existed because of the unique qualifications required of effective navigational guides between empirical research and educational implementation. Specifically, those

who play this invaluable role must be quite knowledgeable about strategies and strategic processing and well versed in the academic domain or tasks involved (e.g., mathematics and working fraction problems). These guides must also be quite familiar with contemporary school cultures and skilled at speaking the language of teachers. If the qualifications required of these guides were not enough of an obstacle, there is often little professional incentive or institutional support for those who might take on this demanding role (Murphy, 2015).

One other reason that this navigational problem persists is because too many researchers are not expressly invested in communicating directly with teachers or school leadership. Their audience tends to be members of the research community, their peers. Even those engaged in intervention studies carried on in classrooms rarely leave behind the cache of materials, comprehensible guides, or continued supports that would allow teachers and school leadership to pursue strategy interventions on their own. This situation represents a true paradox. This is because these educational practitioners who are not the primary audience for strategy researchers will be the very individuals responsible for ensuring the success of the interventions these researchers have devised. Thankfully, there are rare exceptions in the field of strategy research, such as Graham and Harris (2016) dedicated work on Self-Regulated Strategy Development (SRSD) or Murphy et al.'s (2018) more recent classroom-based studies of Quality Talk, that serve as models of what can be done to dismantle this imposing barrier. Whether others would be willing and able to assume this mantle of both researcher and navigational guide remains to be seen.

INSUFFICIENT TIME AND SPACE

For the sake of argument, let us assume for a moment that the translational and navigational barriers I just described have been addressed and the methods and procedures for facilitating strategic processing are available. There are still formidable obstacles that impede progress for those that this research are intended to help—students and teachers. Those impediments come in the form of adequate allocation of time and space within the learning environment. As with the other obstructions I have noted, the insufficiency of the time and space students and their teachers need to develop and hone strategies or to function strategically within the classroom context is a longstanding problem. In fact, Garner (1990) identified this situation as one of the reasons why children and adults fail to be strategic. As Garner convincingly argued, educational researchers and practitioners cannot expect to witness strategic processing in schools if the learning environment does not demonstrate a valuing of strategies and strategic processing by the time devoted to scaffolding those procedures or by the mental space allocated for thinking and self-monitoring. Instead, when there is too little time and mental space, students will naturally fall back on their habituated routines, rather than invest in planful, effortful strategic processing.

If anything, since Garner published that insightful review, classrooms have become even more focused on performance goals and school curricula have become even more information dense (Alexander, 2018a). Thus, if time and space are markers of the learning environment that value and support strategic processing, then we have made little, if any, progress in dismantling this particular barrier to optimal strategy use.

Inadequate Preparation

What 40+ years of strategy research has demonstrated time and time again is that effective and efficient strategy use does not simply happen by chance. It happens when learners have a rich repertoire of strategies upon which they can draw, an adequate base of domain or topic knowledge regarding the problems and tasks at hand, and intrinsic or extrinsic reasons to invest the requisite time and energy (Alexander, 1997, 2003). It happens when teachers and educational leaders understand the power of strategic processing not just for their students' learning and development but also for their own pedagogical effectiveness and professional growth. Moreover, it is unlikely to happen spontaneously for either students or teachers, but requires orchestrated experiences, expert models, continuous feedback, and ongoing supports.

So, why is it still the case, after all these decades, that we expect students and teachers to somehow miraculously display efficient and effective strategic behavior when the aforementioned prerequisites have not been assembled? How can we expect students with very little relevant knowledge of the topic or domain, with little explicit instruction in strategies (surface or deep), and with little incentive to abandon their marginally useful approaches to learning or studying, to progress in this realm? How can we look to teachers to be the paragons of strategic behavior or expect them to invest instruction time and valuable curricular space to strategies when they have not been prepared to do so or when the educational climate, professional supports, or incentives do not exist? The simple answer is, *we cannot*. Further, until these aversive conditions are eliminated or greatly reduced, the landscape for strategies and strategic processing for these key players will remain littered with obstacles to optimal learning and academic development.

Outdated or Poorly Matched Equipment

In a special issue of the *British Journal of Educational Psychology* devoted to the complicated relations between depth and regulation of strategic processing (Dinsmore & Fryer, 2018), I remarked about the challenges of unearthing data about strategic processing (Alexander, 2018b). Measurement concerns have consistently complicated any journey into the domain of strategy theory and research. It was certainly an obstacle in the 1970s and 1980s, and required the pioneers into this territory to devise creative tasks that would afford basic insights into when students and teachers were being strategic and what they were actually doing when they were being strategic. Error detection tasks, ambiguous passages, embedded prompts, and other sundry tools were part of the strategy researchers' equipment, along with think-aloud protocols and retrospective interviews (Flavell, 1979; Greene, Robertson, & Costa, 2011; Markman, 1977).

Over the past decades, it is important to appreciate that even as new data-gathering techniques and measures have become available, such as logfiles, eye-tracking, or fMRIs, the domain of strategies and strategic processing has itself expanded. Now, as I will discuss in the subsequent section, we must contend with multiple rather than singular texts, materials that are not just one-dimensional but also multimedia (e.g., print versus mixed media), and with an inundation of information to be processed that is both accurate and inaccurate. Consequently, we have progressed beyond simply struggling to disentangle strategies from skills to wrestling with issues of general

versus domain-specific strategies, levels of strategic processing, and the conceptual and operational distinctions between cognitive, metacognitive, and self-regulatory strategies. Thus, it is fair to ask whether the methods, measures, or data-analytic tools required to accurately and richly identify, gauge, or track strategic processing will ever get us to where we need to go in this complex domain.

PROMISING NEW INROADS

As I stated in the opening for this chapter, I have spent a good portion of the last four decades encountering impediments to forward progress in the strategy domain. Thus, I was understandably a bit leery to set out again to travel that very familiar path. Yet, the more I delved into the content of this Handbook and explored the avenues of inquiry laid out by these established experts, visions of where the field is headed become clearer and far more promising than I would have expected. Almost from the outset, it was apparent to me that this foray into what I regarded as familiar terrain was going to be a different experience. Here I discuss four inroads into the domain that I regard as particularly encouraging.

- demarcating boundaries;
- looking wider and going deeper;
- encountering complementary routes;
- experiencing tectonic shifts.

Demarcating Boundaries

From the opening chapter and for various chapters thereafter, contributing authors systematically and thoughtfully established the boundaries for specific concepts they were mapping. Such conceptual demarcations were especially evident in the first section of the Handbook on “Definitions, Forms, and Levels of Strategies,” when authors were focused on defining the foundational term, *strategy*. I also found a level of conceptual consistency in the authors’ conceptualization, as signified by their use of such descriptors as *effortful*, *intentionally*, or *purposefully* to denote those processes invoked when problems or questions arise that cannot be resolved by students’ habituated routines or *skills* (e.g., Afflerbach, Hurt, & Cho, this volume; Dumas, this volume; Newton, this volume; Rogiers, Merchie, de Smedt, DeBacker, & van Keer this volume).

However, evidence of conceptual specificity also extended to discussions of more particularized forms of strategies, including learning, domain-general, domain-specific, and science learning strategies. In his examination of strategic processing within and across domains for example, Dumas (this volume) offers definitions of *domain-general strategies* (i.e., useful across a number of domains) and *domain-specific strategies* (i.e., useful in a single domain). Then, he goes on to explain how the clarity of the theoretical distinction between strategies classified as domain general and domain specific gets muddled when these strategies are enacted in research. Similarly, in their chapter on science strategy interventions, Lombardi and Bailey (this volume) took great care in defining strategies. These authors did so, in part, by differentiating them from tactics. What the authors set out to establish, particularly for the domain of physics, was that strategies, in effect, consist of *tactics*, which they characterize as

an array of simple actions that collectively allow for the completion of specific tasks or activities. Even with this conceptual variation, Lombardi and Bailey still attach the descriptors planfulness, effortfulness, and goal-directed to the concept of strategies.

Further, for their review of reviews on levels of strategic processing, Dinsmore and Hattan (this volume) begin by offering working definitions of surface-level and deep-level strategies, as well as metacognitive and self-regulatory strategies. *Surface-level strategies*, according to the boundaries that Dinsmore and Hattan set, entail intentional actions taken to grasp the problem at hand and to initiate solutions, whereas *deep-level strategies* involve transforming or reframing the problem or approaching its solution in novel or creative ways. Moreover, when learners are engaged in *metacognitive strategies*, they are attempting to actively monitor their thinking or their cognitive processing, whereas *self-regulatory strategies* are broadly applied to the monitoring and control of not only learners' cognition but also to their physical, motivational, and social-emotional actions.

Regrettably, the conceptual precision found in the aforementioned chapters was not evident in all the chapters populating this Handbook. As to why this explication failed to occur in certain contributions, I can only speculate. Perhaps those contributing authors felt those terms were already well established in the literature. Yet, this is not a valid assumption. Maybe those authors were working under the assumption that at least the notions of strategies and strategic processing had been set for this Handbook in the editors' opening chapter (Dinsmore, Fryer, & Parkinson, this volume). Even if this is a more defensible position, it does not free these authors from explicating the concepts guiding their individual contributions. So, improvements in clearing away the conceptual debris that obstructs journeys into strategy theory, research, and interventions are certainly apparent in this volume, even though continued improvements are warranted.

Looking Wider and Going Deeper

A greater specificity was also evident across these contributions that investigated *how*, *when*, *why*, or in *what way* strategies are enacted within academic domains, such as history, science, or mathematic (de la Paz & Nokes, this volume; Lombardi & Bailey, this volume). For example, Newton (this volume) describes the procedural flexibility that students must manifest when they are tackling algebra or fraction problems, while Graham et al. (this volume) specify four tenets of strategic writing derived from decades of theoretical and empirical research, including numerous intervention studies:

- Skilled writers operate more strategically than less skilled writers.
- With age and appropriate experiences, writers can become more strategic.
- The unique behavioral patterns that individuals manifest in their strategic writing predict writing performance differences.
- Writing performance can improve with instruction designed to increase strategic writing.

In both the Newton (this volume) and Graham et al. (this volume) chapters, and in others that target foundational domains of learning (de la Paz & Nokes, this volume; Lombardi & Bailey, this volume), contributors thoughtfully characterize their

respective domains and then reveal how strategic processing must yield to the nature of those domains in nontrivial ways. Even while acknowledging the influence of the domain, these authors retain the conceptual core that defines strategies—their playful, effortful, and intentional nature.

What this symbiotic relation between domain and strategic processing brings to light is that the well-marked borders between strategic forms (domain general and domain specific; deep and surface; cognitive and metacognitive) are far more permeable in situ, as Dumas (this volume) suggests. In essence, there are no purely domain-general or domain-specific or cognitive or metacognitive strategies—no true dichotomies—when these contrasting strategies are instantiated in research or practice. Rather, the distinctions between strategic forms are determined, in part, by the features of the immediate environment, including the task at hand, and the degree to which that task requires the transformation or iteration of relevant strategic forms.

When strategies are viewed in this more flexible or fluid light, the notion of what it means to be metacognitive or self-regulatory takes on a somewhat different meaning. It means that part of being “meta” or self-regulatory when strategically engaged requires students to recognize the level of strategy transformation or iteration that needs to be undertaken in Domain A for Problem B versus for Problem D in Domain C. This reframing of differences in strategic forms also has implications for the manner in which strategies are taught. For instance, it has been long understood that strategies cannot be taught or applied rigidly, even in domains such as mathematics or science, as Newton (this volume) reinforces. I appreciate that when a strategy is being introduced, especially with young learners, those with specific learning difficulties, or those for whom the domain or task is especially challenging, it may be necessary to overly simplify its nature. I have done precisely that when training very young children to reason analogically (Alexander et al., 1987; White & Alexander, 1986). But with time and experience and with cognitive maturation, the more fluid nature of the trained strategy must be embraced so as to allow students to personalize the strategy or modulate its character to fit the specific context or task. This is why effective strategy interventions (Harris & Graham, 2009, 2016; Murphy, 2015; Murphy et al., 2018) provide for fading of external support and personalization of the trained procedures. I grant that this proposed permeability of the boundaries between strategic forms demands more investigation, but I regard it as worthy of further exploration, nonetheless.

This novel thought engendered by the chapters in the “Strategies in Action” section gave rise to a related notion. The editors of this Handbook are among the leaders in the field probing the issue of “levels” of strategic processing. I have already commented on the conceptual clarity that Dinsmore and Hattan (this volume) brought to the notions of deeper and more surface-level strategies. However, from my perspective, those pursuing this topic (myself, included) have applied this designation to the degree of problem modulation or transformation in which learners strategically engage (deeper) in contrast to their attention to the features of the problem and potential solution paths (more surface). What I am proposing here is that these levels could also reflect the degree of transformation or iteration the learner envisions in the strategic process itself. Whether this turns out to be a viable addition to the existing concept of levels of processing remains to be seen, of course. Nonetheless, the thought-provoking contributions of this volume were the catalyst for my cognitive ruminations.

Encountering Complementary Routes

Another pleasant excursion that I had when delving into this volume came in the informative section surveying the measurement of strategies and strategic processing. It was not just the richness of the individual contributions that I found appealing, but the alternative and complementary pathways the authors laid out for chronicling and evaluating students' strategic journeys. I have long been frustrated by the limited avenues available for measuring strategies and strategic processing (Alexander, 2018b; Alexander et al., 1998; Alexander, Grossnickle Peterson, Dumas, & Hattan, 2018). However, while the contributing authors in the section did not present me with any wholly new paths for uncovering what remains largely in the minds of individuals or groups, they did expand and extend those paths. Consequently, I was afforded fresh vistas onto the nature and effects of strategic processing. For example, it was delightful to read an entire chapter devoted to person-centered analyses (Fryer & Shum, this volume), accompanied with an up-to-date examination of variable-centered analytic approaches (Freed, Greene, & Plumley, this volume).

The Freed et al. exploration of variable-centered analyses offered a nice synopsis of statistical procedures useful in strategy research; from correlational analyses and structural equation modeling to case studies and mixed methods designs. I certainly concur with these authors that variable-centered approaches hold an important position within the field of strategy research—and will continue to do so well into the future. Further, the number of techniques that can be utilized in person-centered analysis are far fewer in number than exists for variable-centered analyses. Yet, these alternative approaches allow researchers to examine the complex and often intricate interplay between learner characteristics and strategic performance for a given problem within a specific context (Fryer & Shum, this volume). In effect, person-centered approaches provide insights into *what*, strategically, is working for *whom* and under *what conditions*.

However, whether the approach that researchers take in strategy research is variable- or person-centered, the fact remains that the outcomes are only as good as the data analyzed. There is both good news and bad news on this front for strategy researchers. The good news is that new and improved tools for unearthing markers of strategic processing and for making sense of the resulting data have made an appearance since the 1970s. The new tools include more portable and sophisticated eye-tracking devices, and advancements in neuroimaging techniques (e.g., fMRI, functional near-infrared spectroscopy) and biophysiological monitoring (e.g., skin galvanic or electrodermal responses). The proliferation of digital devices also permits researchers to record relevant information (e.g., time stamps, navigation paths) as students engage in academic tasks (Bråten, Magliano, & Salmerón, this volume; Cho, Woodward, & Afflerbach, this volume; List, this volume).

Contributors to this volume expand on these new and improved tools and what they can reveal about strategies and strategic processing. For example, Catrysse, Gijbels, and Donche (this volume) illustrate how eye tracking and fMRI data can offer invaluable clues as to the level of students' strategic engagement. As Catrysse et al. rightly acknowledge, there are still challenges in reaching conclusions from such data sources, including the degree of inferencing and interpretation involved. There is also the concern for ecological validity, since these data are gathered under conditions far

different from what students typically experience. Also, Taboada Barber, Cartwright, and Klauda (this volume) detail how data on executive function derived from neuro-imaging techniques can contribute to a richer understanding of what is occurring in the minds of students confronting cognitive or linguistic challenges in the classroom, and the concomitant motivational, emotional, and social issues that co-exist. What this chapter reinforced for me is that strategic processing is not solely a cognitive enterprise, but is intertwined with motivational, emotional, and social factors that must be considered when devising interventions. As with Taboada Barber et al., my colleagues and I have found the literature on executive function invaluable in our investigations of relational reasoning. Relational reasoning is a higher-order executive function that involves the extraction of meaningful patterns from seemingly unrelated information through the perception of similarities and dissimilarities (Alexander, 2017; Alexander, Jablansky, Singer, & Dumas, 2016).

Despite the progress in measurement tools and data-analytic procedures (Freed et al., this volume; Fryer & Shum, this volume), far too many strategy researchers continue to rely on survey and self-report data without corroborating information. The shortcomings of this practice have been discussed at length (Mayer et al., 2007). For one thing, humans are not the most reliable information source when it comes to their internal operations and the conditions that may have prompted those actions (Alexander, 2013). Interestingly, Vermunt (this volume) presents a more positive, contrasting view of survey and self-report data. Beginning in the 1970s and running to the present day, he frames his discussion in a historical context, describing several generations of survey and retrospective self-report instruments. Whether I accept this more optimistic view of survey and self-report data, especially in the absence of any direct measures, I found several aspects of Vermunt's discussion intriguing.

For one, the concept of learning styles, which was a focus of the early generations of survey instruments, was explicated. Specifically, *learning styles*, which are now referred to as *approaches to learning*, are conceived as learners' disposition to adopt a learning or studying routine regardless of the specific context or task demands (Schmeck, 1983). From my perspective, and that of other contributors to this volume (Afflerbach et al., this volume), this conception has more in common with the definition of skills than strategies; more habituated than intentional and more rigid than flexible. That being said, Vermunt offers three rationales for the continued use of surveys and retrospective self-reports. First, the decades of research using these measures has led to a rich literature on college students' learning and study practices. Second, these tools have served as a catalyst for students' reflections on their actions when studying. Third, rather than serving as a self-evaluation tool for students, Vermunt considered the later generations of these survey and self-report measures to be viable for assessing the instructional environment.

Finally, in their chapter, Cho, Woodward, and Afflerbach (this volume) delve into another form of self-reporting, verbal protocols, but they do so through what they classify as a qualitative lens. Consistent with Vermunt's rationale, these authors see merits to employing verbal protocol analyses as a mechanism for probing the thinking and reasoning of students engaged in online reading tasks. I found other aspects of this chapter thought provoking. For one, I was struck by the authors' claim that qualitative research is primarily inductive and informed by the data, "rather than deductive or

beholden to theory.” This claim was puzzling to me because much of the chapter established how the authors’ analysis was, in fact, driven by theories of epistemic beliefs, text comprehension, argument, and more.

Perhaps Cho et al.’s choice of word, beholden, was intended to signal a strict top-down process that allowed for no variability or flexibility based on trends emerging from the data, task, or situation. As a counterargument, I would contend that the distinction between inductive and deductive in strategy research that the authors pose represents a false dichotomy. The complexity of the phenomena being explored almost inevitably forces researchers to move rhythmically between induction and deduction. Otherwise, studies of strategies and strategic processing would either be atheoretical and, thus, uninterpretable, or led wholly by the data, in which case, there would be no sense of what might be relevant or whether inferences seemed reasonable or realistic.

Bråten et al. (this volume) also explore verbal protocols in their chapter on concurrent and task-specific self-reports. Addressing the concern that thinking aloud while engaged in a cognitive task alters normal strategic processing by directing students to share what otherwise would be tacit, habituated actions, these authors describe alternative approaches to gathering verbal protocol data. In addition, they discuss the coding of these verbal protocols and consider what steps are required to ensure the validity of those data. One recommendation they offer is to look for correspondence between the strategies identified from the verbal protocol data and what would be expected based on individual differences data. Similarly, there should be a reasonable relation between what individuals verbalize about their processing and the quality of their performance. In effect, more knowledgeable or more competent learners should be more likely to describe deeper-processing and regulatory strategies than those for whom the task at hand is unfamiliar and cognitive demanding. Likewise, the students who verbalize more instances of deeper, regulatory processing should tend to have higher outcomes than those whose strategic processing is limited and surface-level. Another approach to validation could involve corroborating what students report with some objective markers such as logfiles, eye tracking patterns, or neuro-imaging data.

Collectively, what these chapters on methodology revealed is that there are multiple paths that can be traversed in the study of strategies and strategic processing and that researchers should be able to follow one or more of these paths in pursuit of their goals. What I also came to realize is that these paths may diverge as certain junctures in the journey, but they are also apt to cross or even overlap at other times. The bigger question that lingers for me is whether these complementary routes reach similar points in the end. My guess is that they will ultimately afford different vistas onto the strategy landscape, but the topography will be recognizable, nonetheless.

Tectonic Shifts

There is absolutely no denying that the ground upon which educational researchers and practitioners stand has shifted significantly since the 1970s. The picture of this shift I have tried to paint in words cannot do justice to those tectonic movements nor to the seismic effects on learning and development they engendered (Alexander, 2018a). Students populating today’s classrooms have never known a world without readily transportable technology, social media, and smartphones that have more

computing capacity than the full size computers of past generations. Also, the population of post-industrial countries are truly awash in all manner of information 24/7—a good portion of which can be flawed or intentionally misleading.

Of course, one could argue that inaccurate or misleading information has always been part of human existence and has inevitably contributed to misunderstandings or misconceptions. While that may be true, the situation today is significantly different for various reasons. The first is an exponential increase in the amount of information individuals encounter, and thus a concomitant increase in the amount of erroneous information being communicated. Second, because there is far greater ease and speed of access to information for those living in post-industrial societies, and far fewer filters in place to monitor the quality of that information flow, even young children can be exposed to false, biased, or malicious content. Third, with the enhanced technological savvy that exists and the “innovations” that savvy has produced, such as bots, there are even more opportunities for individuals or groups to intentionally fabricate or distort information for the purpose of misleading or misdirecting others. For these reasons, the need for effective strategic processing seems even greater for those who want to become more knowledgeable and more competent and who, therefore, want to be able to cull the distorted, malicious, and clearly incorrect information from that which is less biased, more factual, and better substantiated (Alexander, & the Disciplined Reading and Learning Research Laboratory, 2012).

Within the pages of this Handbook, there is evidence that many contributors are attuned to these topographical shifts, which is encouraging for the future of strategy theory, research, and interventions. I saw traces of it when Bråten et al. (this volume) were describing the intelligent systems that can be applied to analyze verbal protocols. But, there were several chapters in particular that gave the contemporary nature of strategic processing notable attention. For one, List (this volume) specifically addresses the strategic processing of multiple texts rather than a single text, which is an increasingly common occurrence in students’ lives. The very description that she puts to multiple text use (MSU)—a complex, challenging, effortful, goal-directed, and contextualized process—parallels the conception of strategies framing this Handbook. The six core questions that List poses are revealing in terms of what strategies seem especially relevant to MSU and about the nature of strategic engagement when more than one document must be accessed and processed. While the empirical literature and theoretical models of MSU have abounded of late, there is still much to be learned about students’ strategic processing of multiple texts that are most often multimedia (text plus pictures or video) in nature.

One reason I feel that the field has only begun to scratch the surface of strategic processing in MSU studies is because current findings have come almost entirely from highly orchestrated studies. In effect, participants are not only presented with specific task parameters and a prescribed topic that researchers deem controversial, but they are typically given a library of more or less credible sources that forward *pro and con* positions on the topic. Thus it is unclear how students free to select their search topic and to locate relevant sources would be engaged strategically. Even in the study described by Cho et al. (this volume) that the researchers labeled an “authentic” task involving “authentic reading,” students were expected to research the topic of mountaintop mining the researchers viewed as controversial. Students participating in the

study were required to verbalize their thinking over the course of one hour. Why this qualifies as an “authentic” task encompassing “authentic” reading was not apparent to me. Consequently, until more naturalistic studies of students’ processing of multiple documents are undertaken, the *what*, *when*, *how*, and *why* of strategic processing of multiple texts remains an open question.

In their contribution to this Handbook, Lawless and Riel (this volume) share research on what they refer to as *technology-mediated strategies* with a particular eye toward extracting meaningful patterns from “big data” about students’ strategic processing. Such a topic would have been alien to strategy theorists and researchers 40 years ago, but is in keeping with today’s world. As these authors explain it, so much human activity in contemporary society leaves behind digital footprints. When these thousands upon thousands of footprints are amassed for the purpose of examination, they are referred to as *big data*. While the commercial and sociopolitical power of big data is becoming quite evident in this age of bots, trolling, and phishing, the potential value for investigating strategic processing is still underdeveloped. I was especially taken with the authors’ statement that: “Education has yet to fully leverage the plethora of data available on students’ learning and strategic processes in instructional environments as a means to automate and leverage the adaptable affordances of technology for teaching, learning, and assessment in situ.” The authors then set out to illustrate what that leveraging could encompass. The result was a glimpse into the possible future for strategy theory, research, and intervention.

FORGING AHEAD

In bringing this chapter to close, I want to address several sectors within the strategy domain that remain underexplored and underdeveloped. Even with the promising new inroads just described, the disregard of these regions should not be allowed to persist for fear of thwarting further progress. The specific sectors I want to pinpoint relate to:

- focusing greater attention on teachers as strategic guides;
- nesting strategy research in more naturalistic contexts;
- generating multidimensional, developmental representations.

Teachers as Strategic Guides

What was apparent from the contents of this Handbook was that contributors’ interests—whether addressing the nature, forms, and levels of strategies, their enactment in academic domains, or their measurement—was squarely on learners. While that is understandable, given researchers’ altruistic aim of improved learning and development for all students, it ignores one crucial principle:

It is ultimately the teachers, through their day-to-day interactions with students, their explicit or implicit instruction, and the learning environment they help create, who routinely mark the strategic paths that their students tend to follow.

However, even though teachers and teaching are mentioned in almost every chapter in this volume, they are most often addressed indirectly. There is not one chapter that

puts teachers in the foreground. This is true even for the several chapters that are specifically about interventions. Where are the studies of teachers' strategic processing? What does strategic teaching look like generally or within specific academic domains? How are teachers prepared to assume positions as their students' strategic role models, promoters, appraisers, and navigational guides?

Without more concentrated research attention on teachers' strategic knowledge and behavior both at a general and domain-specific level, and without strategic processing being an explicit component in teachers' professional development, there is no reason to expect significant improvements in students' strategic behaviors. That is because the value that teachers place on strategic processing, and the time and attention it garners within classroom instruction becomes a highly determinative factor in what their students do (Garner, 1990). Moreover, if you change the strategic knowledge and strategic behaviors of teachers, you change the instructional climate that exists for students.

Naturalistic Contexts for Strategy Inquiry

Earlier, I noted my concern over the ecological validity of research into students' strategic behaviors in online environments. Such concern is by no means new or surprising. There has long been tension between basic and applied research within the educational community—between laboratory studies and what transpires in natural settings. This is one of the legacies that traces back to E. L. Thorndike's dismissal of the classroom as a useful context for scientific research (Berliner, 1993). As with many false dichotomies, there is no reason to presume a paradoxical relation between research carried out in a more orchestrated or controlled setting and that which is conducted in situ. Both serve valuable and potentially complementary roles and there are always ways to make experimental research more ecological valid or classroom-based research more controlled.

The point that I make here is that strategy theorists and researchers cannot remain in the sector of highly controlled or contrived investigations if their intentions are to map the entire landscape of strategies and strategic processing. They must venture into the less cultivated and certainly more volatile terrain that students experience daily. By exploring this more dynamic and changeable environment, researchers should be able to more richly and accurately describe the strategic behaviors of the teachers and students who reside there. Further, these researchers should be better equipped to devise interventions that can be sustained within that more dynamic and volatile environment, and to lay out alternative routes that teachers and students can more readily pursue toward improved strategic processing.

Multidimensional, Developmental Models

When discussing the need for navigational supports, I mentioned the struggle of finding one's way when equipped with only a rough sketch of the landscape. The underlying premise of that statement was that: The better the map, the easier the journey. Certainly, the chartings of the strategy domain have improved noticeably since the

1970s. This Handbook is a testament to that fact. Yet, when it comes to the fundamental question of how strategic processing should change over time, current mappings are still in need of enhancement, as Rogiers et al. (this volume) so contended. The features these contributors would add to existing models (my own included) were four characteristic changes that they felt undergirded development: availability, diversity, efficiency, and adaptivity. That is certainly a beginning.

Yet, as was also evident in many chapters in this volume, strategy enactment is not a one-dimensional process, not solely a cognitive enterprise. Therefore, one-dimensional mappings are, by default, incomplete and potentially misdirecting. Rather, what seems required is a multidimensional rendering that incorporates knowledge, motivational, emotional, and sociocultural forces that are continually interacting with the cognitive and metacognitive elements that have long been part of existing strategy models. The Model of Domain Learning (Alexander, 1997, 2003) is a multidimensional mapping that includes individual and situational interest, domain and topic knowledge, along with deeper and more surface-level processing strategies, as driving forces in expertise development. Still there is more to chart. What I have acknowledged is that the MDL is a mid-range topographical rendering. It does not take into account more microlevel or global forces that are also influential in strategy development.

Thus, beyond multidimensionality, mappings of the strategy domain must take into consideration its highly idiosyncratic and dynamic character. No two individuals travel the same strategic terrain in the same way. Further, even the same individual experiences fluctuations in the knowledge and interest that fuel strategic behavior. This almost demands an interactive map that allows learners to pinpoint their current location within the landscape and to plot various courses of action, depending on the immediate conditions. Such an interactive and individualized mapping may seem unrealistic based on the current state of theory and research. But the knowledge base and technological capabilities have advanced so much that more detailed and individualized renderings may not be so far off. At the very least, I remain optimistic that the field will reach a point in the relatively near future where the representations of strategy processing it produces will be richer and more useful than in generations past. The contributors to this volume have already laid the groundwork and set the benchmarks for those who will follow.

IN TRIBUTE

I would like to dedicate this chapter to the pioneers into strategy theory, research, and interventions who have left this plane of existence, but who have, nonetheless, blazed a trail across this landscape for all who follow.

Ruth Garner
 Wilbert (Bill) McKeachie
 Paul Pintrich
 Michael Pressley
 Claire Ellen Weinstein
 Merle Wittrock

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