Concept Deficiency: Remediation Alternatives for Teachers of Students working on Masters and Doctoral Dissertations: Pedagogical Insights from Recent Brain Research

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Abstract
Teachers have noted experiences of student conceptual formation difficulty in the production of theses and dissertations. The authors evaluated pedagogical approaches used to handle these normal research tasks. They sought research-supported ways for helping students to conceptually frame and shape patterns of refined descriptive and causative associations found within complex subjects. Criticism of a student's conceptual development capacity both within and outside the educational system expressed in both reading and writing challenges continues to be set apart from graduate department remediation efforts. Beyond experienced failure rates and especially the failure found among diverse and lower socio-economic groups, there are reports that over a third of doctoral students fail to cross this "threshold of knowledge" due to these deficiencies. Despite these facts, concept deficiency problems continue to lack teacher response.

Realized insights from brain studies and extrapolations of work done in socio-linguistics, sociological and psychological graduate teachers' responses to concept framing and development continues to be minimal. The insights of J. Paul Gee clarified the socio-economic and cultural nature of the conceptual difficulties problem. Articulations of brain research in the work of G. Edelman, E. Goldberg, and T. Deacon along with the pedagogical insights of D. Siegel and J. Duncan provided the foundation of the remediation method assessed by the authors. This realized pedagogical rationale and remediation involves recognition of brain facilitated abstract pattern making and an intensive refining of association, discrimination, and integration processes carried out within an ambience of teacher student attunement.

Keywords: conceptual formation, remediation, pedagogy, socio-economic

> These remarks may indicate why thinking, the quest for meaning … has so often been felt to be unnatural, as though men, whenever they reflect without purpose, going beyond the natural curiosity by the manifold wonders of the world's sheer thereness and their own existence, engaged in an activity contrary to the human condition. In all such reflecting activities men move outside of the world of appearances and use a language filled with abstract words which of course had long been a part and parcel of everyday speech before they became a special currency of philosophy. For thinking, then, thought for philosophy, technically speaking, withdrawal from the world of appearances is the only precondition.
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> Arendt (1978) pp. 78-79

Introduction

During the past decade, revelations of research on the Genome and, more recently, the use of various technologies (most recently of fMRI brain imaging) used to reveal the fact of brain plasticity (Doidge, 2007, p.292; Schwartz & Begley, 2002) have created a new awareness of the meaning of emergence. While these results have significant implications for the core tasks of pedagogy on all levels, cautious hopes for consilience between and even within disciplines has continued to founder far from the carefully stated objectives of teacher's lesson plans.

First, in practical terms, near revolutionary technological and theoretical advances have done little to bring about intra- and inter-disciplinary togetherness. Second, effective melding of theoretical revelations of hard and soft science research were not only *not* actively sought by the majority of the researchers themselves, researchers that laid out clear cut connections to the learning process did not, for the most part, apply them to the daily work of teachers and mentors. Third, when indications of relevant research created new understandings of brain function even more accessible psychological focus on cognition went largely unnoticed and uncommented upon by most educators.

After fifty years of education both inside and outside educational institutions, the authors' experience did not prepare them for teachers' lack of awareness of the term "plastic" in the sense of experience and learning that restructures the brain itself. Symptomatic of this lack of knowledge and/or interest indicates that (a) not only had educators generally not heard of the term, *plastic,* as applied to human thought, but (b) their understanding seemed so far on the fringes of learning and the brain that, for the most part, teachers could not begin to contest its application or implications to the work they do every day. Also, despite the healthy resurgence of the value of "self-work" and self-communication arising out of both fMRI revelations and research extrapolations derived from brain damage work (Damasio, 1999, 2003, 2010) these studies were still identified with those who found "talking to oneself" an imaginatively questionable form of folk psychology. This is a significant distortion of the known fundamentals of self-to-self communication found in much of the basic brain research carried out in the early 1970s and beyond (Damasio, 2010). Referring to the fMRI research of Kalina Christoff, Stein (2007) writes:

> "Whereas the PFC [prefrontal cortex] zone are dominant when we process externally generated information…the fronto-polor areas evaluate information

> that cannot be perceived from the external world, but is generated from the contents of the mind itself" (p. 91).

Siegel (2007) writes that direct teaching about the brain itself can also support reflection:

> When people - children, teens or adults – learn about the correlations between brain function and structure, neural development and the impact of experience and how their lives unfold, a kind of discernment develops in which people come to see their own minds in a new light. (p.273-4)

When we extend this awareness to the kind of self-work necessary for developing refined concept formation, we find even more distance between teacher-constructed courses and brain researchers' work with the self. Every aspect of communication is a major part of the undergraduate and graduate curriculum; despite this *everyday academic fact*, we find a lack of course work available in the moment-to-moment, intrapersonal communication with the self.

Once engaged, the teacher will find a refreshingly optimistic clarity to be found in the "discovery" of understanding in the material realizations of the self-to-self dynamic and its stunning role in the everyday thinking of all human beings. The weight of this realization:

> "…seems to have made an incredible quantum jump. We now experience the totality of these impulses as forming a distinct self, capable of taking charge of the domain of consciousness and deciding which feelings or ideas have precedence over the rest…" **(**Csikszentmihalyi, 1993, p.23).

This optimism has led to the awareness of the possibilities of mindfulness. Siegel's (2007) work in the area of mindfulness is so clear: "…we are suggesting that this same social cognitive circuitry is harnessed for the intrapersonal resonance of mindfulness as is used when we have compassion and empathy for others. We can propose that this involves a form of self-empathy…" (p. 354).

Despite the research in biology, sociology, anthropology, let alone such exotics as socio-cultural and socio-linguistics study, these insights are relevant for teachers. Nevertheless, the graduate teacher's desk affords so little space for ideas of new depth while his or her role is focused on the organizing of one's immediate classes or the mulling over anxious political speculations about the next curriculum committee. Blame for this anemic response can be found in nearly all quarters of academic effort from hard and soft science research's narrow focus on "smallness" to teachers all too ready to be impressed with workshops that find statements like, "We want students to learn to learn" to be filled with serious profundity.

The research of Frost (2014) and others found that teachers readily order texts in graduate courses largely untouched by the application of research in management realized in the past two decades. Not only do the texts fail to note the implications of recent research, the teachers seem not well read enough to notice that researchers' most recent understandings have been orphaned by both the authors and publishers of text books in favor of work done largely in the 50s and 60s. In the end, teachers are

deeply complicit in their lack of active interest in accessing available insights into directly related areas of hard and soft science research and/or in the practical applications of this research to subjects as divergent as medical and managerial studies. All of this "dumbing down" despite the fact that "evolution carved out in the brain design a space for *tabula rasa*, but one empowered by an exquisite neural capacity for processing complexity of any kind and filling itself with content" (Goldberg, 2005, p. 105).

When utilization of this "space" is engaged, on both the teachers' and the students' part, more energy is expended as multi-level "scaffolding" of conceptual thought progresses. Deacon (2012) describes the exciting and very human dynamic involved in this elevation of thought toward more refined concept formation. When we "scaffold" conceptual work above the surface thinking of subjects in multiple (more than one) levels, we humans can begin to experience the expenditure of more directed effort:

> And the more differentiated the mental content and more present to mind, so to speak, the more elevated the regional network metabolism and the more organized the attractors of network activity. The level of differentiation achieved should be correlated both with sustained high levels of activation and with the length of time this persists. Generating more precise mental content takes both more "effort" and more sustained "focus" of attention. (Deacon, 2012 p. 519)

Whether qualitative or quantitative, descriptive or causative, a review of recently published dissertations and masters theses indicates only episodic instances of teachers and students driving toward progressively refined multi-level discovery. Even more rare is the clear intention to call recent theory or practically established understandings into question. All too often this surface level graduate teaching restricts focus on knowledge in a way that calls for very little beyond a serviceable short-term memory and demonstration of barely-below-the surface abstract knowledge. As teachers go from semester to semester, thesis to dissertation, they are not feeling an expenditure of "effort" and "focus" largely because they are not co-actively working with students to develop the more refined concept development found in new levels of "differentiation … correlated both with sustained high levels of activation" (Deacon, 2012).

From the first two years of higher education to the first years of graduate school, these students, having experienced as much as 16 years of this kind of surface level mentoring, repeat the sad story of concept formation failure written before the first hours of graduate research methods. Surface level, largely descriptive and only rarely causative concept- formation, is found as the central thrust of the graduate school challenge. However, even with no challenging demand to "go deeper" is made among mainstream educationally privileged teachers and students, the more serious lack of a mentored history of conceptual awareness among non-mainstream students persists through to lower achievement scores. Socio-economically disadvantaged students, after years of social passes, resign themselves to premature withdrawal.

Too often, teachers have translated "terminal degrees" into a role justification for terminating anything beyond the most topically presented interdisciplinary reading.

Pages of yellowed lectures have been replaced with "pre-packaged" modules where a "click" can locate illustrations of materials meant to act as a learning safety net. In those instances where these surface-level courses have not been made simplistic enough, a further "dumbing down" level of "work" and "effort" can be found. Every pedagogical meeting is exerted to make these pre-packaged concatenations of simplex thought more accessible and less effortful for students. In replacing discovery with theses and dissertations that skate over slowly warming but highly structured surfaces, the "quest for meaning" objective and more complex originality are all but forgotten. After almost three years of this structured adherence to the departmental manual, a doctoral student concerned about the supposed need to make some originally discovered connection asks his dissertation mentor "What do I do after chapter four?"

None of this organized and carefully tutored simplification of our increasingly complex world has gone unnoticed. Arendt (1978) has indicated the need for increased shaping of ever more refined pluralistic associations available to those trained in managing and mentoring student attention and concentration. Brain research relating to core objectives in learning and the relationships between teachers and students when engaged in learning have written about the value of thinking and Arendt's "withdrawing" into the thinking "space." Geertson (2003) writes:

> This reflective, extrapolative thinking involves a broader focus and tends to enlarge thinking; contextualization directs attention to linkages that extend across multiple layers and consequences to human experience. This dimensional judging addresses the multi-dimensional nature of reality; theory building explores logical relationships between broad areas... (p. 12).

This separation of the thinker from his or her every day social "space" must be seen, generally as an entirely normal experience even when this "staring away" or noticeable lack of being engaged in valued work being done seems to teachers and others as being utterly *contrary to the human condition.* Far from a low interest in an interdisciplinary pedagogy, one would expect professors of so-called higher education to be the first to promote the advantages of moving toward this space. One would expect them to be arguing that doing this "effortful" work is natural and normal and so much more than a rarely engaged academic obsession.

More recently, among students faced with serious trouble in refined concept formation and development, there is a renewed effort to introduce students to the familiarity of mental withdrawal in concentration and attentive "reentry" work within this space of focused attention and concentration. Leshem and Trafford (2007) showed that "despite clarifying research questions and reading-around-their-subject "*one third of (doctoral) candidates* [emphasis added] still had problems in visualizing concepts within a framework" (p. 1). They found that "workshops for doctoral supervisors also show some unawareness of the pluralistic function of conceptual frameworks, consequently some supervisors encounter difficulties in guiding candidates on this issue" (Leshem & Trafford, 2007, p.1). In essence, the students inability to progress beyond descriptive accounts of facts to conceptualization of underlying theoretical perspectives restricted their learning and doctoral development (Leshem & Trafford, 2007). Needless to say, their "supervisors" can hardly help remediate a deficiency in pluralistic thought when thesis and dissertation mentors

have some difficulty holding the pluralistic complexity of pattern discrimination and abstract thesis formation in their own minds.

This inability to progress beyond the descriptive accounts of facts is an excellent indicator of a carefully structured but an entirely wrong-headed approach to teaching and learning, and especially reflective thinking in so much of higher and graduate education. Teachers have begun to make a clear but wrong-headed choice between the difficulties of complex thought to be found in discovery sought in masters and dissertation projects and the safety to be found in structuring evidence in the latest academic penchant for columns of analysis of "accepted journals" and "authors of the first rank" underwritten by the recent fad for Evidence Based Management and even more structure (Homes, D., Murray, S., Peron, A., Rail, G., 2006). Despite the normal availability of the brain's facility to comprehend progressively discriminated patterns and refined concept formation, Damasio (2010) reminds us of the potential of the "environment of the mind":

> For example, as a possessor of extended consciousness, you are probably paying attention to a number different mental contents simultaneously: the printed text; the ideas it evokes; questions it raises; perhaps music or a specific noise somewhere in the house; and you yourself as a knower (p. 201).

Too often, teachers privileged with a middle to upper class socio-economic background accompanied by an above average educational experience underestimate the concept difficulties of a student with a different family and neighborhood, a lower class socio-economic culture and a distinctively different before-college educational experience. Teachers underestimate the K through 12 educational system's incapacity for grasping student difficulties in understanding and expressing basic pluralistic concepts. Neither can they meaningfully empathize with students who struggle to think clearly enough to do research on subjects barely below the surface levels of most term paper demands. This lack of empathy on the part of the teacher is reinforced by a lack of the teacher's own development in most recent understandings of learning and the brain. This deficiency leads willy-nilly to the assumption of an intrinsic lack of competency on the part of the student*;* only in very rare circumstances do teachers question their own competency or even their roles as mentors of concepts or transformative efforts potentially able to remediate student inabilities. Instead of remediation, teachers are satisfied with their efforts to "select out" those students as "just not made for graduate school."

Institutionalized and ritualistically enacted and affirmed roles of the teacher of graduate school students allows less set aside social and mental "space" within the tightly networked and scheduled constraints of the educational system's reifying culture. This is a system that year after year trains and demands a surface awareness pedagogy while it only episodically alters– for both teachers and students - anything like progressively refined scaffolding of in-depth, pluralistic knowing even in the minds of mentors of master's theses and doctoral dissertations themselves.

The management of thought involves repeated reentry into consciousness in ever more refined ways within articulated environments of increased attention and concentration. Establishing associations of seemingly unrelated aspects of one's research is the core reward for a student trained in refined and progressively

scaffolded concept development. Developing an abstract confirmation of discriminated associations and discovered patterns is a normally available "skill" of the brain. *The teacher need only develop the ability to explain this relationship between located patterns of associations articulated as abstract premises in ways the student finds understandable and creditable.* This is the pivotal point at which and in terms of which this article urges the teacher to step back from the pseudo-profundity of the most recent educator's catchphrase. We believe teachers can and must penetrate the pedagogical crust of these increasingly reified simplicities with at least a modicum of interdisciplinary reading. This effort must include a serious analysis and review of qualitative or quantitative research and an even more accessible synthesis of research regarding the lack of basic utility of the "learning to learn" mantras of current teaching lore.

Remediation of Conceptual Deficiency

This article only outlines the concept "threshold" problem, its sources in both the teacher and the student and certain suggestions of a basic pedagogical direction for its remediation. Subsequently, the text of our co-authored book on concept formation is expected to be complete in late spring of 2015. At base, our work should be seen as an intense effort to understand the implications of biological, social-psychological and social anthropological research when applied to the remediation of concept work at the graduate level. This research offers significant suggestions for teachers as mentors of students working toward the development of potentially defensible abstract statements of discovered patterns of thought.

Surface Level Discourse

Gee's (1989) work in *primary* and *secondary* discourse continues to offer fundamental insights for our understanding of the sources of difficulty in reflexive and reflective thought as they might play a role in conceptual framing and formation of abstract, progressively refined higher order thinking. In simplest terms, Gee places significant importance upon the *primary* discourse of the family and immediately available relationships as distinguished from the *secondary* discourses in the surround of formal education. Once understood, "diversity" of thought across all "diverse" groupings – while different in each strata and whether typified as racial, gender, or just lower socio-economic levels – give a renewed focus on the cultural disadvantages of the non-mainstream student in nearly all areas of thinking.

Teachers must confront the general perspective that supports the so-called "unnaturalness" of higher order thinking and abstract, and conceptual thought. This "unnaturalness" is actually the result of the exposure and participation of most students and their teachers to little more than surface-level discourse. This widespread tendency to devalue thought patterns beyond surface level reaction, directly or through omission, necessarily implicates a lack of occasion for experiencing complex pattern formation and exploring multi-level explorations even in everyday discourse.

> Some people are more aware of certain layers of information than other people are. For example, the capacity to conceptualize the 'nature of a relationship" will vary quite a bit. Some individuals may take a phrase and expound on it for

> hours on their pattern of relating with others. Others will hear the phrase and may only be able to respond with it is "good" or "bad." These individuals may have the ability to form complex representations of relationships but these representations may be inaccessible to translation into words. (Siegel, 1999, pp.168-9)

Known as the "threshold problem" the difficulties experienced in concept development in higher education derive largely from little or no chronic exposure to in-depth concept formation in everyday and, even, to large extent, in common professional discourse. However, even when a student's education (primary and secondary) affords minimal or episodic demonstrations of conceptual thought, remediation to the point of readiness for graduate work is wide open for "catch up" efforts. Given the brain's natural inclinations, this normal effort is relatively open to basic pedagogical and recent brain articulated methods. Teachers who see some students as "naturally" not very "bright" and "naturally" incapable of the conceptual abilities demanded by graduate work are not aware of this readiness of the brain to do conceptual formation and expression. Supported by the most recent brain research, the authors of this paper have a strong "natural" bias: given available social space for concentration and attention, student reflective capacity for making associations within and among various aspects of simplex and complex patterns and abstract thesis confirmation is normally available in selectionistic and integrative facilities of the brain (Duncan, 2010; Edelman, 2006; Torey, 1999).

The Need for an Attuned Mentor

Since this "readiness to do conceptual work" is a normal brain facility, with an aware mentor, it is equally ready to be remediated. Successful remediation of these difficulties will most likely occur when using the interdisciplinary work of a transformable teacher. He or she acts as co-acting mentor in an attuned relationship of progressively managed concept transformation (Siegel, 1999, 2007). The suggested method of concept remediation recommends narrative commonly found to be a part of normal reflexive process. The method includes the explication of exercises in attention, concentration, and "reentry" management of an overall reflective process able to embed more conceptual and linguistic functions in the brain than the reflexive component alone. Teachers of graduate students challenged by theses and dissertations will become more effective when they *assume* that a student's failure – no matter the nature of the student's background - is primarily a teacher's failure in the inability or refusal to interpret the student's problem as a poorly framed pedagogical one. The problem is only as intractable as a teacher's refusal to facilitate both the teacher's and the student's transformation and remediation. As Siegel (1999) puts it: "Systems achieve stability as they flow between these extremes in their movement toward maximal complexity. Within this optimal flow are connections of the processes both within a single mind and between minds" (p. 321).

Once the teacher has a basic understanding of this material, they can creatively grasp and untangle conceptual formation problems to the point of satisficing remediation. When an expertise in managed co-enacting attunement of resonant ambience progressively develops, the teacher will have begun the building of an effective learning platform. When this platform is achieved, a transformative trajectory can be constructed.

In this attunement approach, the teacher must enact the same multi-level model conversation with the student and facilitate the same discourse model they need to teach concept formation. They will be negotiating transference between working within the familiar layers of self-to-self conversation to the less familiar problem solving of interpersonal pattern discrimination. These twin approaches go together. The authors' of this paper's method argue for a concept remediation approach as one that should involve both mental and a cultural sources and resources with an emphasis on visual representation of internal and external communication. This method urges the use of visual modeling of autobiographical "layering" made transparent in the explicit examples of progressively defined scaffolding discourse as developed by Siegel (2007). Articulated in conjunction with the cognitive enclosure model of Duncan (2010) these adopted methods offer promising beginnings toward teaching concept development. Both of these enable the explicit use of "a form of internal modeling" that would "embody a representation of the spatial, temporal, and causal relationships among the events and entities of the situation described by the narrative" (Nersessian, 2008, p. 108).

Beyond Surface Discourse and "dumbing down."

The daunting challenges of teaching and the realization of accomplishing remediating efforts in concept formation and development underwritten by recent brain research offers new pedagogical vistas. The teacher and the student begin with an understanding available to both only very recently. Given this awareness they must comprehend their joint effort as a co-enacting one with a singular awareness. The implications of plasticity are so far-reaching. While all normal people can think, thinking is a gradient activity open to trained and untrained management abilities learned through exercises in the practice of critical, reflexive and reflective thinking. Again, when we learn well or when we learn only poorly, the brain is actively being sculpted. But, as far as we know, the brain is without intention. We are without a lot of evidence supporting some hidden teleological purpose.

While there is a resurgence of interest in the lack of achievement as noted in grade disparity among and between diverse groups identified in racial, gender and socio-economic "divides," that interest, in the graduate school, has accomplished little beyond ritualistic pattern of pseudo-concerns and faculty lunchroom hand-wringing over that divide's persistence. Irrespective of the group being taught, the teacher should be bound to develop the same gradient levels of "effort" and "work" required in the patterning and multi-level construction of concepts; They should take the same "extra" effort to teach construction of abstract premises that comprehend the student's "natural" readiness to locate qualitative and quantitative discoveries.

So much of this "effort" and "work" is facilitated naturally and normally for the teacher who understands and can communicate the facts of pattern association and discrimination and can relate plausible abstract formations in available basic brain function holds the future of mental conceptual performance. Selectionistic and integrative brain function can deliver "abstraction" to the student in more practical and usable ways. The student can learn to see abstraction as a "*key tool that allows human beings to move gracefully from one category to others*, [emphasis added] and to perceive the world efficiently and to interact with it profitably" (Hofstadter & Sander, 2013. p. 255).

Once these basic brain processes are understood by the teacher and are comprehended and found credible by the student, the enterprise of moving "gracefully" among the discovered patterns and levels becomes surprisingly realizable. The amount of effort needed on the part of the teacher is, again, surprisingly little with very rewarding outcomes.

> (1) Even in the first stages of dawning awareness, the student will find the results of her work stimulating and motivating while, at the same time, the teacher can feel free to move from working with a "stuck" student to one of expanding first premise discoveries and the management of abstract work well into areas of more refined conceptual development.
>
> (2) When teacher and student work together to attain ever more powerful attunement, they are creating between them the enactment of shared capacities involving "attunement, reflective dialogue, constructive narrative, memory talk, and the interactive repair of disruptions in connection are all fundamental elements of secure attachment and effective interpersonal relationships." (Siegel, 1999, p. 336)

All of this and more derive from "the capacity for integrating coherence…from dyadic communication." The promise of this inter-subjectivity "emerges with this horizontal form of integration is a new way of knowing, a bilateral consciousness. Horizontal integration enables us to broaden our sense of ourselves, as often distinct layers of processing of perception and thought, feeling and action, are brought into alignment" (Siegel, 2007, p. 303).

Our method relies on:

(1) Orchestration of the autobiographical narrative as the fundamental vehicle for transferring the multi-level complexity of everyday pattern-making already a part of the student's internal conversational history to the creatively attuned interpersonal milieu between a teacher aware of the selectionistic and integrative capacities of the brain;

(2) Working with a student already on the edge of realizing the normal accessibility of these capacities in their intra-personal life can transfer this experience to an ever more refined and refine-able concept formation.

Use of the method briefly indicated in this short paper is certainly not the only approach for creating effective success in concept formation. But taken as a whole our method relies on the integration of recent understandings of core brain functions into teaching of fundamental aspects of concept formation: integrative functions like narrative; pattern discrimination and formation; iterative reentry into memory and consciousness along with the formation of abstract premises for creating and questioning theory. The brain can readily be implemented for engaged, reflective processes augmented by a knowledgeable, attuned teacher as manager of focused conceptual thought.

Even in these early days of workshop planning and teacher and student assessments, we are mindfully aware of the potential and the limitations of the various concept

formation facilities afforded by the brain and the need to transform traditional educational approaches when working with graduate students. Deacon's (2012) work is fundamental to both our understanding of brain function and our understanding of the thinking "space" demanded by reflective thought and the "self-initiated shifts" to that space required by work in graduate theses and dissertations:

> "…self-initiated "shifts" in cognitive activity will require something analogous to work in order to generate, and that stimuli from within or without that are *capable of interrupting ongoing cognitive activities are also doing work what is contra-grade to current mental processes* [emphasis added]. … Because of the time it takes for non-linear recursive circulation of these signals to self-organize large-scale network dynamics, mental content should also not emerge all or none into awareness, but *should rather differentiate slowly from vague to highly detailed structures. And the level of differentiation achieved should be correlated both with sustained high levels of activation and with the length of time this persists. Generating more precise mental content takes more 'effort' and more sustained 'focus' of attention* [emphasis added]*."* (pp.518-519)

While the material will be slightly more complex, the substance and direction of instruction will be fundamentally the same. If teachers' desire for more refined concept and theory is to be realized, work like Deacon's *must be made with more serious individual teacher effort*, more readily accessible. The product of this accessibility must be applied in work with students advancing toward serious conceptual development. Students will find the task of generating more precise mental content more effortful and the job of managing sustained focus of attention to be memorable challenges. Students need teachers to be committed enough to creatively relate this material and to teach the management of attention and concentration in concept work.

As the dynamics of the authors' workshops and, through practice, the exercises continue to be altered; the adaptability of these "short courses" in brain and learning is becoming evident. The authors are enthused by the applicability of recent research promising seriously advantageous remediation possibilities. After more analysis, trials, and teacher and student assessments, the authors will have the kinds of training, exercises, and visual representations to make this material more effectively and efficiently teachable for teachers of concept formation. The assessment approach currently being utilized in this work is based on the Sternberg (2010) Kaleidoscope assessment, which has been used at Tufts.

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