BUILDING POWERFUL KNOWLEDGE: THE SIGNIFICANCE OF SEMANTIC WAVES[1]

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INTRODUCTION

What is 'powerful knowledge'? Some social realists (Young 2012) and educationalists (DfE 2011) argue that 'powerful knowledge' should be universally accessible, but what is this to call for? The term itself is powerful emotively, conjuring notions of something worth demanding for all. Yet, the idea is less powerful intellectually (Beck 2013) – we are only beginning to explore what 'powerful knowledge' might comprise. Following Bernstein's account of 'knowledge structures' (2000), one characteristic highlighted is a capacity for ideas or skills to extend and integrate existing ideas or skills. However, the nature of such cumulative knowledge-building, and how it can be enabled in practice, remain opaque. The notion of 'powerful knowledge' thereby raises a series of theoretical and empirical questions for research. In this chapter I will explore how Legitimation Code Theory (LCT), a social realist framework that builds on the sociology of Basil Bernstein, is helping to shed light on these issues.

Specifically, the chapter will discuss how a relatively new dimension of LCT – Semantics – is underpinning research into achievement and knowledge-building in education. Concepts from Semantics are being adopted by a growing number of studies into a diversifying range of institutions, disciplines and artefacts, from schools to universities, physics to jazz, and theoretical frameworks to classroom practice (Maton *et al*. 2014). This chapter aims to offer introductory insight into why these ideas are gaining traction by illustrating a conjecture that studies using these ideas are giving rise to. In short, research suggests that key characteristics of knowledge-building and achievement are *semantic waves* (recurrent shifts in context-dependence and condensation of meaning) that *weave* together different forms of knowledge. In contrast to much existing debate in which types of knowledge are alternately valorized and criticized, this research proposes that 'powerful knowledge' comprises not one kind of knowledge but rather mastery of how different knowledges are brought together and changed through semantic waving and weaving.

The chapter begins by defining the central concepts of *semantic gravity* and *semantic density*, and how they combine to conceptualize organizing principles of practices as *semantic codes*. Secondly, I summarize their provenance in the sociological framework bequeathed by Basil Bernstein and review how they advance that approach and overcome a dichotomy in educational thinking more generally. Thirdly, I describe how research is using the analytic method of *semantic profiling* to trace changes in semantic codes over time. I illustrate their use in exploring achievement, knowledge-building, 'critical thinking' and other valued educational practices, drawing on examples from studies of student assessments, classroom practice, and theoretical frameworks. For brevity I focus on illustrating the 'semantic waves'

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conjecture, emphasizing the diversity and complexity of such waves. Lastly, I discuss how the concepts themselves enable the cumulative building of powerful knowledge.

LEGITIMATION CODE THEORY: SEMANTICS

Legitimation Code Theory (LCT) is a sociological framework for researching and informing practice. LCT is associated with 'social realism', a coalition of approaches that construe knowledge as both socially produced and real, in the sense of having effects (Maton and Moore 2010; Wheelahan 2010). LCT comprises a multi-dimensional toolkit, where each dimension offers concepts for analysing a set of organizing principles underlying practices as *legitimation codes* (Maton 2014). There are currently five dimensions to LCT, each centred on conceptualizing a different form of legitimation code.[1] In this chapter I focus on the dimension of 'Semantics' which conceives social fields of practice as *semantic structures* whose organizing principles are conceptualized as *semantic codes* comprising *semantic gravity* and *semantic density*.[2]

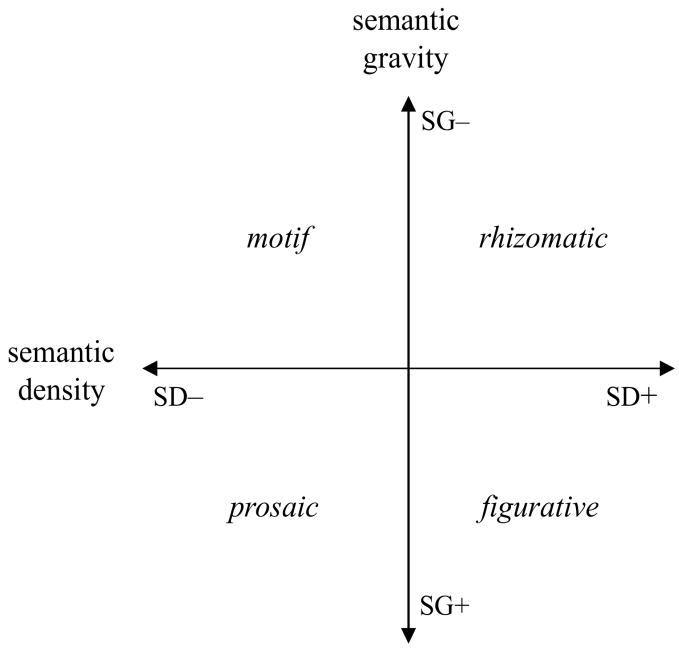
Semantic gravity (SG) refers to the degree to which meaning relates to its context and may be stronger (+) or weaker (–) along a continuum of strengths. The stronger the semantic gravity (SG+), the more meaning is dependent on its context; the weaker the semantic gravity (SG–), the less dependent meaning is on its context. For example, the meaning of the name for a specific plant in Biology or a specific event in History embodies stronger semantic gravity than that for a species of plant or a kind of historical event, which in turn embodies stronger semantic gravity than processes such as photosynthesis or theories of historical causation. Semantic gravity thus traces a continuum of strengths with infinite capacity for gradation. One can also dynamize this continuum to analyse change over time in terms of: *weakening* semantic gravity (SG↓), such as moving from the concrete particulars of a specific case towards generalizations and abstractions; and *strengthening* semantic gravity (SG↑), such as moving from abstract or generalized ideas towards concrete and delimited cases.

Semantic density (SD) refers to the degree of condensation of meaning within practices, and may be stronger (+) or weaker (–) along a continuum of strengths. The stronger the semantic density (SD+), the more meanings are condensed within practices; the weaker the semantic density (SD–), the less meanings are condensed. The strength of semantic density characterizing a practice relates to the *semantic structure* within which it is located. For example, the term 'gold' may be commonly understood to denote a bright yellow, shiny and malleable metal used in coinage, jewellery, dentistry and electronics. Within the discipline of Chemistry it may additionally signify such meanings as an atomic number, atomic weight, electron configuration, lattice structure, and much more. Many of these meanings involve relations to other meanings as part of compositional structures, taxonomies and explanatory processes; for example, its atomic number represents the number of protons found in the nucleus of an atom, identifies it as a chemical element, and is situated, *inter alia,* within the periodic table, among many other relations. Thus, in Chemistry 'gold' is relationally situated within a complex semantic structure that imbues the term with a greater range of meanings and thus relatively strong semantic density. This strength is, though, not intrinsic to the word itself. The semantic density of the knowledge expressed in research publications is likely to be stronger than in textbooks, which in turn may be stronger than in classroom discourse or student work

products, for apprenticeship into a subject area involves learning an increasingly articulated, complex and intricate semantic structure of meanings.

Semantic density thereby traces a continuum of strengths, with infinite capacity for gradation. This continuum can be dynamized to describe *strengthening* semantic density (SD↑), such as moving from a term, symbol or practice condensing a small number of meanings towards one implicating a greater range of meanings. For example, bringing together places, periods, customs, beliefs, etc. as 'Mycenaean Greece' in History, or relating cell structures, proteins, pigments, etc. of a leaf to describe 'photosynthesis' in Biology. Conversely, one can describe *weakening* semantic density (SD↓), such as moving from a highly condensed symbol to one involving fewer meanings. For example, 'unpacking' technical concepts from an academic source into simpler terms typically enacts a limited number of their meanings, weakening semantic density.

Figure 1: The semantic plane



(NOTE: Since making this document, 'figurative' was renamed 'worldly' and 'motif' was renamed 'rarefied').

As will become obvious, the examples given above for relative *strengths* of semantic gravity and semantic density are neither definitional nor definitive. The form taken empirically by different strengths depends on the specificities of the problem-situation under consideration. Accordingly, a major project is currently developing means for typologically embracing features characteristic of different strengths. However, 'semantic gravity' and 'semantic density' are not themselves dichotomous types. *All* practices are characterized by *both* semantic gravity *and* semantic density; what differs are their strengths, which may vary independently to generate *semantic codes* (SG+/–, SD+/–). Figure 1 includes four principal modalities:

- *rhizomatic codes* (SG–, SD+), where the basis of achievement or status comprises context-independent and highly complex meanings;
- *prosaic codes* (SG+, SD–), where legitimacy accrues to more context-dependent practices with simpler meanings;

- *rarefied codes* (SG–, SD–), where meanings of legitimate practices are relatively context-independent but also relatively simple; and
- *worldly codes* (SG+, SD+), where legitimacy is related to context-dependent practices that condense manifold meanings.

Code theory extended: Semantic codes

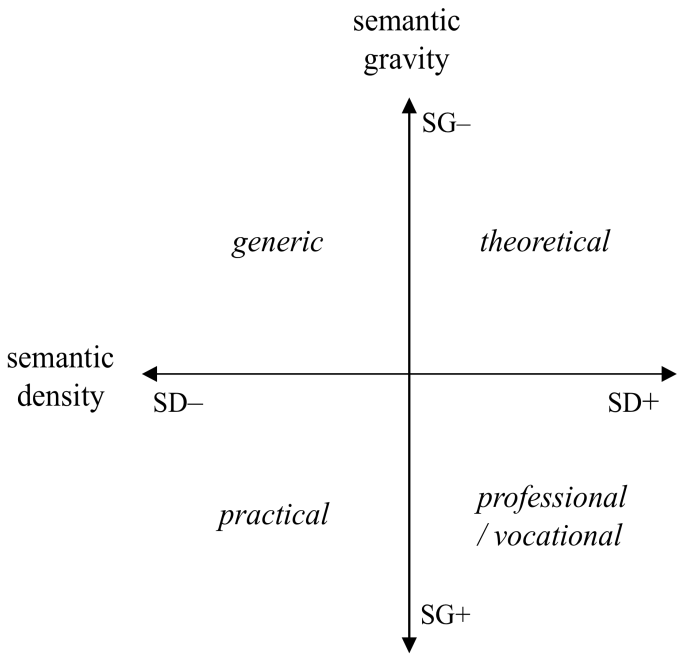
Concepts from Semantics were first presented at conferences (2007 in Lyon, and 2008 in Cardiff) and in associated publications dedicated to exploring Basil Bernstein's sociology (Maton 2008, 2011a). As further discussed in Maton (2009, 2011b, 2013, 2014), 'semantic gravity' and 'semantic density' originate from developing ideas latent within Bernstein's framework to meet the demands of empirical research. Studies using other dimensions of LCT increasingly highlighted issues of context-dependence and condensation as significant for understanding their objects of study (Maton *et al*. 2014). Turning to Bernstein's theory, context-dependence is highlighted in early work distinguishing 'elaborated codes', which 'orient their users towards universalistic meanings' and 'are less tied to a given or local structure', from 'restricted codes' that 'orientate, sensitize, their users to particularistic meanings' and 'are more tied to a local social structure' (1971: 176). Context-dependence also resurfaced in Bernstein's later distinction between segmented 'horizontal knowledge structures' and integrating, generalizing and abstracting 'hierarchical knowledge structures' (2000). Both models also point towards condensation, albeit in different ways: the earlier distinction (1971) foregrounds 'condensed symbols' in terms of whether understandings are explicated or shared among actors and left unarticulated; and 'knowledge structures' (2000) raise questions of how ideas are interrelated in ways enabling more or less complexity of meaning.

Though latent as possibility, conceptualizations of context-dependence and condensation within Bernstein's framework remained tacit, entangled, and descriptive. Both models offer suggestive dichotomous types but, as Bernstein argued, at this stage of theorization understanding of the principles organizing such dichotomies is 'limited' and 'very weak' in its 'generating power' (2000: 124). This power was increased by the concepts of 'classification' and 'framing' that generate one set of organizing principles as 'pedagogic codes' (*Ibid*.). However, these concepts did not capture all characteristics described by the dichotomous types. As Bernstein emphasized, they were not intended as the end of the story – further theorization of this kind would be required. The concepts of 'semantic gravity' and 'semantic density' that generate 'semantic codes' extend the framework by revealing another set of organizing principles. They represent the same *kind* of concepts as Bernstein's 'pedagogic codes', but focused on different features underlying practices (Maton 2014: 125–47).

One implication of the greater 'generating power' offered by semantic codes is to avoid a deep-seated dichotomy in educational thinking more generally. As Bernstein (2000) highlighted, a contrast between 'theoretical' and 'everyday' knowledges has repeatedly reappeared in various guises; indeed, it recurs in debates over 'powerful knowledge' (Young 2012). These forms represent realizations of *rhizomatic codes* and *prosaic codes*, respectively, where semantic gravity and semantic density have inverse strengths (context-independent, condensed meanings; and context-dependent, simpler meanings). However, both may also be relatively weak (*rarefied codes*) or relatively strong (*worldly codes*); i.e. knowledge that is context-independent but

condenses little (SG–, SD–), or context-dependent but condenses manifold meanings (SG+, SD+).

Figure 2: Forms of curricula (adapted from Shay 2013: 10)



The concepts thereby highlight what the commonly-used dichotomy obscures. For example, Figure 2 summarizes Shay's analysis (2013) using semantic codes of different kinds of curriculum. Of these, the dichotomy would typically foreground 'theoretical' and 'practical' curricula but obscure 'generic' and 'professional/vocational' curricula. Such blind spots have consequences for education, such as erasing differences between 'theoretical' and 'generic' knowledges, and presenting a false choice to professional and vocational educators between emulating 'theoretical' curricula or becoming 'practical' (and typically work-based). On the former, semantic codes highlight that while they are abstract and generalized, generic curricula (SG–, SD–) do not constitute constellations of meaning as complex as traditional disciplines. On the latter, semantic codes reveal that professional and vocational practices (SG+, SD+) are not simply context-dependent but may also comprise highly condensed meanings; i.e., they are neither a contextualized version of 'theoretical' curricula nor a conceptualized version of 'practical' curricula but rather possess their own distinctive organizing principles.

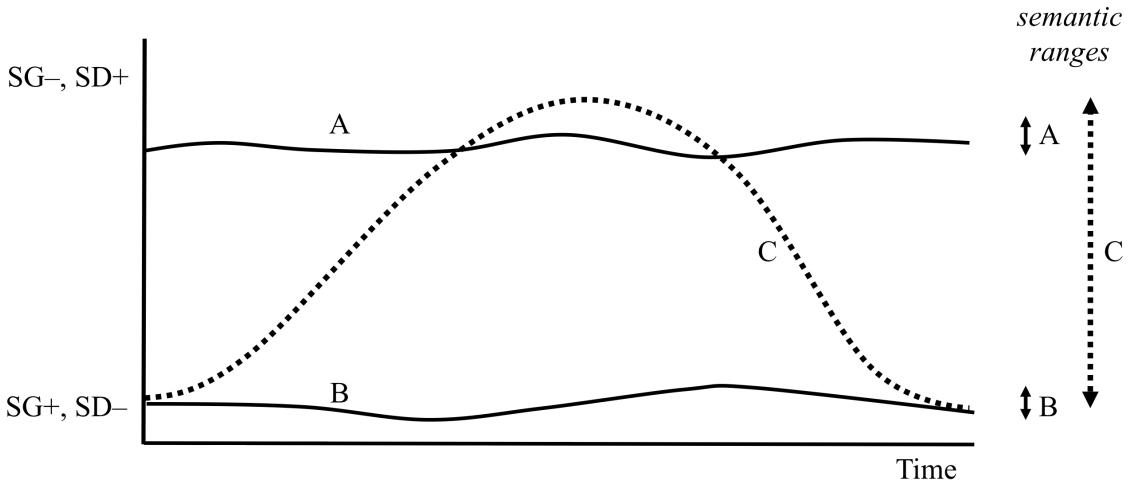
Code theory dynamized: Semantic profiles

Semantic codes go further than revealing additional kinds of knowledge practices. While integrating a typology, they also offer a topology; the semantic plane (Figure 1) represents a potentially infinite number of relational positions. This is invaluable for research. Many models of knowledge are of limited practical use. As researchers soon experience, simple typologies often struggle to capture both empirical practices, which rarely fit neatly within their categories, and processes of change within and between types. As I argue elsewhere (Maton 2013, 2014), the answer is not to abandon typologies but rather to additionally capture the organizing principles that

generate the knowledge practices they delineate. By avoiding homogenizing and strongly-bounded categories, the concepts comprising 'semantic codes' enable research to conceptualize differences and movements not only between but also within forms of knowledge practices. That is, one can analyse strengthening and weakening of semantic gravity or semantic density (SG↑↓, SD↑↓) both between and within semantic codes (across a quadrant of Figure 1).

The capacity of the concepts to explore processes of change is further enhanced by the analytic method of *semantic profiling* (Maton 2013). Tracing the strengths of semantic gravity and semantic density of practices over time gives their *semantic profile* and associated *semantic range* between their highest and lowest strengths. Figure 3 offers a heuristic representation of three illustrative profiles. Portraying a simple scale of strengths on the y-axis, and time on the x-axis (such as the unfolding of classroom practice, curriculum or text), Figure 3 traces a high *semantic flatline* (A), a low *semantic flatline* (B), and a *semantic wave* (C), and shows their respective *semantic ranges,* where A and B have much lower semantic ranges than C.

Figure 3: Three simple semantic profiles



I should emphasize: these and other profiles I discuss in this chapter are simplified for brevity. First, they combine semantic gravity and semantic density as a single line, with their strengths moving together inversely. This will bring out more clearly the argument, further below, that 'power' resides in neither side of the common dichotomy but from how such knowledges are related. However, as I have emphasized, the strengths of semantic gravity and semantic density may change independently. Tracing semantic gravity and semantic density separately (as studies often do) reveals where they are both relatively strong and both relatively weak, embracing all four semantic codes. Secondly, as I demonstrate below, semantic waves are not necessarily bell-shaped. Lastly, the featured profiles are heuristic. As mentioned above, research is currently developing sophisticated instruments for calibrating typological scales of strengths with precision.

Nonetheless, these simplified examples provide a starting point for illustrating that semantic profiling reorients thinking about how knowledge may be 'powerful' and

what enables building over time. By dynamizing analysis, it shifts the focus from particular forms to how knowledge changes over time. Crucially, it is also underpinning a growing body of studies into intellectual practices, curriculum, pedagogy, and assessment. This has been a constant thread. Rather than theoreticist comparisons of ideas or proclamations of meta-theoretical tenets, the concepts emerged from and for empirical research, and continue to evolve in close engagement with real data. Accordingly, I now illustrate their value through summarising several illustrative studies. For brevity, I confine my discussion to one conjecture emerging from research concerning the significance of semantic waves.

SEMANTIC WAVES

Educational achievement

A burgeoning range of studies are exploring the bases of achievement in education by analysing the semantic profiles of student assessments. This research increasingly suggests that knowledge practices expressing semantic waves – strengthening and weakening of context-dependence and condensation of meaning – is rewarded across subject areas and levels of education. For contrast, I shall briefly consider examples of the humanities in schooling and 'critical thinking' in higher education.

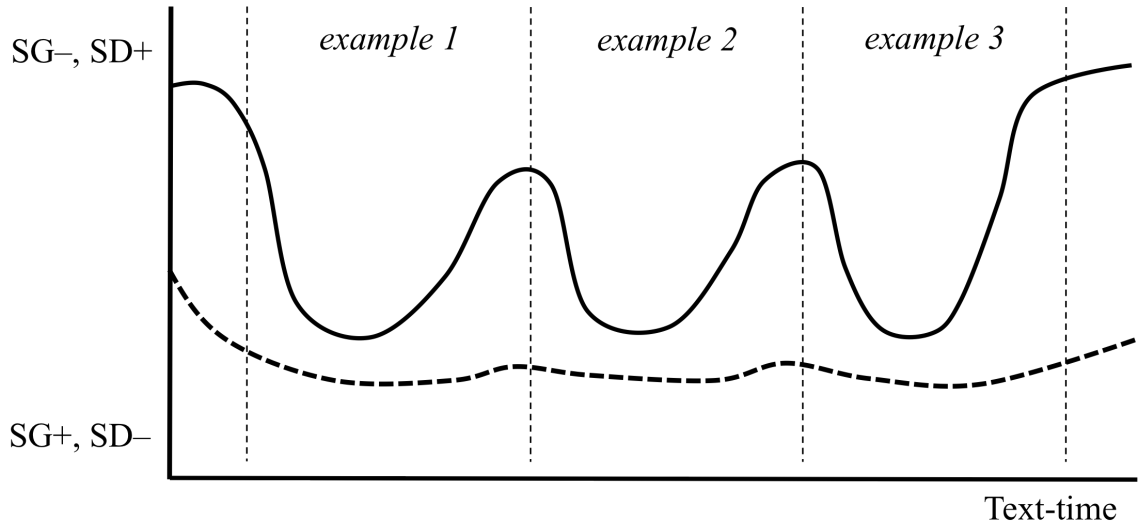
A compulsory unit of secondary school English for students taking the Higher School Certificate (in New South Wales, Australia) requires students to explore abstract notions such as 'the journey' in relation to diverse texts (Maton 2014). In 2005–08, students drew on three textual examples to answer: 'To what extent has studying the concept of imaginative journeys expanded your understanding of yourself, of individuals and of the world?'. Figure 4 represents the semantic profiles of two essays. The high-achieving essay (unbroken line in Figure 4) was included in official syllabus documents as an exemplary model. This essay begins and ends by drawing on condensed literary meanings (stronger semantic density) to bring together its examples in relation with a generalizing and abstract idea (weaker semantic gravity); for example:

> The journey, especially in the imaginative sense, is a process by which the traveller encounters a series of challenges, tangents and serendipitous discoveries to arrive finally, at a destination and/or transformation.

(quoted, Maton 2014: 118)

From this relatively high start, the essay moves down to describe simply the concrete particularities of each example, before moving upwards towards more generalized and condensed 'literary' ideas concerning the text. This movement is repeated throughout the essay, tracing a series of semantic waves across its three textual examples (Figure 4).

Figure 4: Semantic profiles of English essays

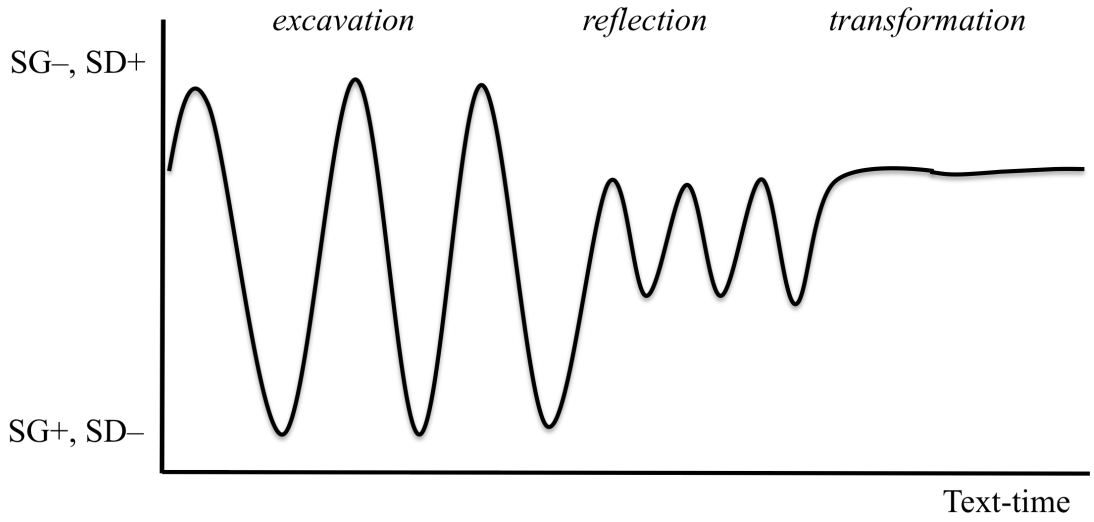


In contrast, the low-achieving essay (dashed line in Figure 4) traces a relatively low semantic flatline. Here knowledge is expressed through a non-technical, non-literary discourse (weaker semantic density) that is firmly grounded in the context of each specific text's relations to everyday life (stronger semantic gravity). For example, discussing the novel *Ender's Game*, the student writes:

> It wasn't hard at all to imagine battle school as a real place because I was familiar with several scientific objects which surrounded us. For example, the 'Desk' sounds very familiar to a lap top computer.

Thus, while the low-achieving essay remains within a prosaic code (SG+, SD–), the high-achieving essay not only includes both a prosaic code and a rhizomatic code (SG–, SD+) but also relates the two codes within a wave-like structure.

Figure 5: Semantic profile of a 'critical reflection' journal in undergraduate Business (adapted from Szenes *et al*, forthcoming)



This brief summary highlights contrasting semantic profiles that resonate with studies into other disciplines and levels of education that are revealing both the ubiquity and diversity of semantic waves. Szenes *et al*. (forthcoming), for example, explore how 'critical thinking' is assessed within Social Work and Business university degrees by analysing student work products. Figure 5 portrays an example of a high-achieving 'reflective journal' from a Business unit. The journal comprises three principal stages. The first stage, ostensibly excavating the student's values ('excavation' in Figure 5), is characterized by a rapid series of deep semantic waves as the journal shifts quickly between decontextualized, conceptual ideas of cultural values (such as 'individualism') and straightforward, concrete examples from the student's cultural context embodying those values (such as the cricketer Sir Donald Bradman). In the second stage, the student relates his/her own behaviour during teamwork with other students to these values ('reflection' in Figure 5). Here semantic waves are milder: discussion of behaviour is generalized and conceptualized rather than simply recounted; and theoretical ideas are more context-dependent and simplified as their meanings are delimited to those concerning the behaviour. In the final stage ('transformation'), the journal not only brings these forms of knowledge into relation but transforms them further as the student provides a list of generalized skills for successful participation in future teamwork situations that are claimed to embody the concept of 'intercultural competence'. Semantic shifts now lessen to reach a midway point in the scale.

Analysis of 'critical reflection' essays from Social Work highlight differences in their semantic profiles, reflecting specificities of subject matter and differences of assessment, such as requiring a 'critical incident' to be simply and concretely described at the outset (Szenes *et al*., forthcoming). Nonetheless, they share this overall pattern of semantic waves that weave together different forms of knowledge. This general finding is echoed in studies of curriculum, textbooks and student assessment across the disciplinary map, including biology (Hao 2012), design (Shay and Steyn 2014), engineering (Wolff and Luckett 2013), jazz (J.L. Martin 2013), journalism (Kilpert and Shay, 2013), physics (Georgiou 2014; Zhao 2012), and teacher education (Shalem and Slonimsky 2010). Moreover, studies of intellectual practices are suggesting that mastery of semantic waves is also crucial to knowledge-building in research. Maton (2014), comparing the frameworks of Bernstein and Bourdieu, argues the former has a greater semantic range that enables cumulative development through semantic waves that weave the concrete particularities of empirical phenomena with abstract and highly condensed concepts. In contrast, Hood (2014) reveals the segmentation characterizing ethnographic writing in cultural studies, as research both fails to achieve semantic waves that reach beyond the specificities of each context and leaves theory and data relatively separate and unchanged.

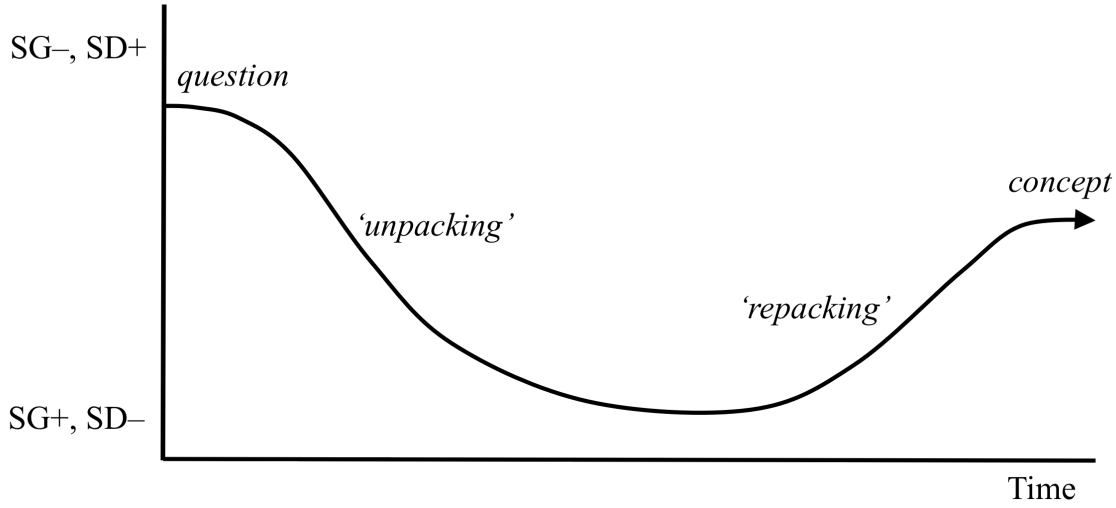
Classroom practice

Mastery of semantic waves may underlie achievement in education, but it is unevenly distributed across society. Students from different social backgrounds come to education with dispositions that encompass different semantic ranges. Maton (2014: 204–5) briefly re-analyses Holland's iconic study (1981) to highlight how schoolpupils from social classes have different semantic coding orientations. As this and other research (Hasan 2009) reveals, the ability to move between concrete, simpler meanings and abstract, generalized and complex meanings is associated more

with socialization practices in cultural middle-class families than those of working-class families. Among the questions such 'semantic variation' raises for education are whether classroom practices help model semantic waving to all students and, if not, how they can do so.

These issues were broached by a major interdisciplinary study of knowledge-building in secondary schooling. The research included analysis of teaching texts, student assessments and video-recordings of 100 History and Biology lessons in Years 8 and 11 in New South Wales, Australia. The study is discussed elsewhere (Maton 2013, Martin 2013, Matruglio *et al*. 2013, Macnaught *et al*. 2013); here I simply highlight two semantic profiles traced by knowledge expressed in classrooms. The first comprises a segmented series of downshifts from decontextualized and condensed ideas (SG–, SD+) towards more concrete and simpler understandings (SG+, SD–). This profile was typically associated with teachers 'unpacking' meanings from source documents such as textbooks by explaining ideas in less technical language and using everyday examples. After each 'unpacking', rather than moving back into specialized academic discourses by 'repacking' these meanings into terms of greater generality and abstraction and interconnecting them with other ideas, teachers often returned to the text to unpack and exemplify further. In short, this widely-found profile reflected a tendency to repeatedly model only shifts down the semantic scale (the right-hand side of C in Figure 3).

Figure 6: A semantic wave in a secondary school History lesson



This was not, however, the only semantic profile. Though not as widespread, the study found classroom practices that additionally modelled upshifts to create semantic waves. One example offered in Maton (2013) is from a Year 11 History classroom discussion of a take-home assignment on 'the influence of Greek and Egyptian cultures in the Roman Empire'. The question includes terms from the pedagogic discourse of History characterized by relatively weak semantic gravity and relatively strong semantic density: 'Greek culture', 'Egyptian culture' and 'Roman Empire' embrace a range of meanings concerning time periods, geographical locations, practices, beliefs, etc. The question also condenses causal relations: explicating 'influence' requires understanding historical processes. The knowledge evoked by the question thereby sits relatively high up the semantic scale ('question' in Figure 6).

The teacher signals this position at the outset by acknowledging the difficulty of the question:

> Teacher This is a little bit hard, "H. THE INFLUENCE OF GREEK AND EGYPTIAN CULTURES." What does that mean? What would the influence of Greek and Egyptian cultures mean, okay? No idea, right?

She then moves this knowledge down the semantic scale ('unpacking' in Figure 6) by providing a series of examples of what 'influence' would mean in this case:

> Teacher What it means is, if we started to look at all the things in Pompeii and Herculaneum, what objects may be showing Greek design? Or Egyptian design? Or Greek mythology? Or Egyptian mythology? Or what building techniques, like columns? Are there Greek columns? Do, you know, are the themes of their artwork reflecting it?

With the examples of 'objects' that 'may be showing Greek design', 'Egyptian design', 'Greek mythology' and 'Egyptian mythology', the knowledge expressed by the teacher begins to move down the semantic scale by specifying and unpacking meanings from the wide-ranging, abstract terms of the question, a move continued by the more specific and concrete example of 'building techniques' and 'columns', which is in turn exemplified by 'Greek columns'. The teacher also grounds the question in the historical period (through examples of prior events in history) and the current discussion of the question in the context of previous lessons:

> Teacher So, it's saying …remember when we started, we said that Pompeii had originally been settled by Greeks? Okay? And if we look at where Italy is, it's not that far from Egypt at this time, umm, we've, we've had, umm … Cleopatra has been killed by the time the volcano erupts, she and Mark Antony are dead and Egypt is part of the Roman empire.

Thus far, the teacher has downshifted the knowledge being expressed. However, rather than return to the question and repeating this procedure, she moves knowledge back up the semantic scale. The teacher weakens semantic gravity by discussing recurrent events (trade and diplomatic visits) rather than specific events, and strengthens semantic density by 'packing up' various activities being conducted between countries as 'trade in ideas', and then into the technical term 'aesthetic trade' ('repacking' to 'concept' in Figure 6):

> Teacher So, there would be massive amounts of trade going on, and umm, you know people visiting their diplomats you know or their, their, ambassadors… like their envoys and things like that all going back and forth across the countries. So, ideas. When you get trade in ideas - you wouldn't have heard this word before - we call it 'aesthetic trade'. Have you heard of it? Yeah.
>
> Student You told us before.

Teacher Ohh! Told you before great, *excellent*! You remember aesthetic trade! 'Trade in ideas'. So, of course, when you've got contact with the country you're gonna get the trade in ideas coming as well.

Reaching the weaker semantic gravity and stronger semantic density embodied by the question required a series of progressively higher waves over a more extended period than included here. (As the arrow in Figure 6 highlights, this excerpt forms part of a longer passage of classroom practice). Nonetheless, in this short passage the teacher almost completes a semantic wave, transforming (to put it crudely) 'academic' discourse into more 'everyday' discourse and then back again, thereby weaving together different forms of knowledge to explain a key aspect of the knowledge students are being asked for by the question. In particular, the passage illustrates how the teacher modelled not only downshifting but also upshifting from plain, contextualized meanings towards more condensed, decontextualized meanings.

Space precludes further discussion, but one conjecture arising from this study was that semantic waves not only model the form required to succeed but also, unlike the aforementioned profile of repeated downshifts (where 'unpacking' dominates), help students access the complex semantic structures of academic knowledges. LCT concepts are, however, not restricted to analysis and generating conjectures - they can form the basis for praxis. As part of this study a pedagogic intervention involved training teachers to engage in 'joint construction' with students as a means of teaching them how to move up the semantic wave and master the linguistic resources required by assessment (Macnaught *et al.* 2013).[3]

CONCLUSION

This chapter has only touched the surface of how LCT can help explore knowledge, curriculum, and pedagogy. Semantic gravity and semantic density are not the only concepts in Semantics, and Semantics is not the only dimension of LCT. Indeed, these concepts involve not only the epistemological forms of condensation and gravitation discussed in this chapter but also axiological forms (Maton 2014). Moreover, space allowed mention of only a few illustrative studies enacting the concepts. Nonetheless, it begins to illustrate the capacity of the concepts to underpin research and praxis and how they are revealing the contours of 'powerful' intellectual, curricular and pedagogic practices.

By building on the capacity of the concepts comprising 'semantic codes' to embrace change, the analytic method of semantic profiling offers a fresh perspective that dynamizes thinking about education, including debate over 'powerful knowledge'. The chapter focused on the conjecture emerging from empirical research that semantic waves are a key characteristic of intellectual and educational practices. Rather than valorizing or criticizing particular types of knowledge, this highlights that what may be 'powerful' is not one form of knowledge but rather how different forms are related and changed. In short, power resides in *semantic waves* that *weave* together and transform knowledges.

However, as I have also emphasized and illustrated, this is not to suggest practices are identical. Studies are revealing the diverse forms of semantic waves generated by their complex features, including:

- *semantic range* – emerging findings suggest that the optimum range not only increases through the curriculum, as previously expressed knowledge is built upon, but also may have upper limits at any particular point, such that one can venture too high (Georgiou 2014);
- *entry* and *exit points* – while knowledge practices in some subjects begin and end high, creating U-shaped waves, more practically-oriented subjects often begin and end with concrete examples and simpler meanings, creating bell-shaped waves;
- relative emphasis on *upshifts*, where theorizing is foregrounded, or *downshifts*, where applications in practice are central (Shay and Steyn, 2014);
- *semantic flow* or degree of connectedness between points – discontinuous leaps up and down the semantic scale may or may not be permissible; and
- *semantic threshold* or the degree of accuracy appears from ongoing research to vary between subject areas and through the educational career.

While not the only variables, they highlight the differences to be discovered amid overall similarity. The concepts thereby provide the means to analyse both generic and specific aspects of educational practices.

I should emphasize that, though research suggesting the 'semantic waves' conjecture has served to illustrate the usefulness of Semantics, the value of the framework does not rest on this hypothesis: concepts and conjecture are not the same (see Maton 2014: 15–17). If the notion that semantic waves are crucial for achievement proves to be erroneous, the concept of 'semantic waves' may remain useful; indeed, the concept may be the basis for disproving the conjecture and developing an improved hypothesis and basis for praxis. The concepts are also not limited to this focus. As the chapter has illustrated, Semantics can be enacted in studies of practices in intellectual, curricular, and pedagogic fields, across the disciplinary and institutional maps of education. Moreover, they also enable the analysis of the dispositions that students bring to those contexts by virtue of their past experiences. The concepts thereby not only build upon Bernstein's framework but also embody the relational principles of code theory. Like his 'pedagogic codes', the concepts of semantic codes enable the dominant organizing principles of educational contexts to be related to those characterizing actors' dispositions, revealing who is predisposed to succeed or fail and suggesting ways forward for social inclusion and justice. This is an area requiring further research. In recent years code theory and social realism have largely sidelined analysis of what knowers bring to education in favour of the forms of knowledge they encounter there. Semantic codes offers a means of extending the generating power of Bernstein's framework to address this issue, both through new research and, as suggested above, re-analysis of existing studies.

Turning the tools of Semantics upon themselves helps explain the burgeoning productivity touched upon in this chapter. The concepts embrace an extensive semantic range, from abstract, generalizing, highly condensed and complex meanings as part of the wider sociological framework of code theory, to concrete, specific and simpler meanings in practical application and praxis. The concepts thereby enable analyses of an expanding range of apparently different phenomena to be brought together, highlighting their underlying uniformities and differences. Thus, while

always provisional in its findings, LCT aims to not only analyse but also embody powerful knowledge.

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[1] Specialization is the most widely used dimension and, *inter alia*, overcomes a problem of much social realism by conceptualizing the organizing principles of the arts and humanities (Maton 2014).
[2] See Maton (2013, 2014) for more extensive introduction and exemplification of these concepts.
[3] On how LCT concepts can inform praxis, see Carvalho *et al*. (2014).