LCT Centre Occasional Paper

Taking autonomy tours

A key to integrative knowledge-building

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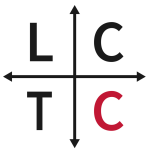
Full citation:

Maton, K. (2018) Taking autonomy tours: A key to integrative knowledge-building, *LCT Centre Occasional Paper 3*: 1–35.

Published by the LCT Centre for Knowledge-Building, University of Sydney, Sydney, NSW 2006, Australia.



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1 Maton, K. (2018) Taking autonomy tours: A key to integrative knowledge-building, *LCT Centre Occasional Paper 1*, pp. 1–35.

Taking autonomy tours: A key to integrative knowledge-building

Karl Maton[1]

Abstract:
This paper introduces the concepts of 'autonomy codes' and illustrates their usefulness for exploring how diverse knowledge practices are brought together. It begins by highlighting three obstacles to understanding integrative knowledge-building: knowledge-blindness obscures the forms taken by knowledge; essentialism (inherent in commonsense categories such as names of disciplines) constructs knowledge practices as self-evident, unsituated and unchanging; and typologizing creates models that struggle to embrace real-world data. The paper shows how the concepts of 'autonomy codes' overcome these obstacles. The complex and changing nature of relations among knowledges is captured by tracing shifts in autonomy codes along different 'pathways', and the socially constructed nature of knowledge practices is built into a 'translation device' for relating 'autonomy codes' to specific empirical data. The potential of these concepts for empirical research is illustrated through detailed analyses of classroom practice in secondary school History and science lessons. These analyses suggest that 'one-way trips' from one form of knowledge practice into another constrain knowledge-building while 'autonomy tours' that engage with, repurpose and connect other knowledge practices support knowledge-building. Finally, the usefulness of these concepts for exploring a greater range of practices in education and beyond is discussed, suggesting the potentially widespread implications of 'autonomy tours' for integrative knowledge-building.

Keywords: Legitimation Code Theory, autonomy codes, autonomy tours, knowledge-building, interdisciplinary, mathematics in science, school History, school science

Autonomy tours are pathways to integrative knowledge-building.

1. Introduction

'Knowledge must be brought together' is a mantra for contemporary education. A desire to integrate diverse knowledge practices appears almost everywhere. Research challenges are often described as 'wicked problems' that require interdisciplinary collaboration to resolve. Educational expansion and debates over 'decolonization' are foregrounding a need to meaningfully relate academic knowledge to the experiences brought by a diversifying student body. It is widely proclaimed that students must learn skills such as 'critical thinking' in order to become informed citizens and productive workers, raising questions of how they can be related to knowledge practices across the disciplinary map. Proliferation of new educational technologies underlines the urgency of determining how best to integrate into classroom activities an advancing array of devices, apps, animations, and much more. Colleges and universities are responding to political pressures to more closely cater to employers by connecting academic curriculum to workplace experience. Beyond education, policymakers and commentators regularly pronounce that economic success

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lies with integrating scientific and technological advances with the so-called 'soft skills' afforded by the arts and humanities. The popular acronym STEM, for 'Science, Technology, Engineering, Mathematics', has consumed 'Arts' to become STEAM. In these and numerous other ways the desire to productively integrate diverse knowledge practices – what I term here 'integrative knowledge-building' – has become ubiquitous.

Less widely to be found are convincing explanations of how to successfully achieve this desire. An ever-growing body of literature on each of these issues tends towards reproducing the divide commonly found in education research between freely-floating theory and context-dependent practice. For example, discussions of 'interdisciplinarity' are dominated by, on the one hand, disquisitions on its definition, necessity and virtue that leave largely unstated how to practically integrate knowledge from different disciplines and, on the other hand, recipes for specific research projects and classroom activities that are disconnected from theoretical frameworks capable of demonstrating whether they do indeed integrate rather than accumulate disciplinary knowledges.[2] This paper presents concepts from Legitimation Code Theory which help to fill this oft-found gap between manifestoes and guidebooks by enabling the detailed analysis and active shaping of social practice.

I begin in section 2 by sketching three obstacles to addressing integrative knowledge-building that dominate education research: *knowledge-blindness* obscures the very thing needing to be analysed; *essentialism* treats the forms taken by knowledge practices as self-evident, uncontested and unchanging; and *segmental modelling* leaves analysis perplexed by the complexity of real-world practices. Section 3 introduces Legitimation Code Theory as an approach that helps overcome these obstacles. Specifically, concepts from the framework's 'Autonomy' dimension are defined that reveal the organizing principles underlying relations among diverse forms of practice as *autonomy codes*. I then introduce ways of enacting these concepts in empirical analysis that embrace issues which evade existing approaches. That real-world practices are both variegated and dynamic are captured by tracing their changing relations with other practices along *autonomy pathways*. That practices are constructed by actors in ways that are contextual and contested is built into the heart of a *translation device* for relating the concepts to data.

Sections 4 and 5 then illustrate how these concepts can be enacted in close analysis of empirical data by drawing on a major research project into secondary school classroom practice. Section 4 analyses contrasting examples of History lessons in which syllabus knowledge is related to students' everyday experiences. Section 5 analyses contrasting examples of science lessons in which mathematical procedures are introduced. Both sections show that simply bringing together diverse knowledges is not enough. The analyses illustrate how pathways that represent 'one-way trips' from one form of knowledge practice into another constrain their integration while 'autonomy tours' that not only engage with but also repurpose and connect other knowledge practices can support integrative knowledge-building. Section 6 then stands back from these analyses of classrooms to emphasize the manifold diversity of potential applications of 'autonomy codes' in research and practice. I conclude by considering what light these ideas might shed on the much sought-after goal of integrative knowledge-building.

[2] The number of discussions and practical handbooks describing 'interdisciplinarity' is growing rapidly; see, for example, Frodeman *et al.* (2017), de Greef *et al.* (2017), Menken & Keestra (2016), Repko *et al.* (2017), among many others.

2. Obstacles to exploring integrative knowledge-building

2.1. Knowledge-blindness

One obstacle to understanding integrative knowledge-building is an endemic inability to see knowledge. Education research is characterized by a 'subjectivist doxa' (Maton 2014: 3–14) that constructs 'knowledge' as mental processes of understanding and appreciation that reside 'in the heads of persons' (von Glaserfeld 1995: 1). Accordingly, when ostensibly exploring 'knowledge', studies often focus instead on cognitive and emotional processes of knowing. The result is that knowledge as an object of study in its own right – one that takes different forms, and whose forms have effects for productively bringing that knowledge together with other forms – does not come into the picture.

For example, a common approach to interdisciplinarity is to focus on 'interdisciplinary thinking' or the 'capacity to integrate knowledge and modes of thinking of two or more disciplines or established areas of expertise to produce a cognitive advancement' (Boix Mansilla *et al.* 2000: 219). The forms taken by the 'knowledge and modes of thinking' being integrated are not the concern. Instead, interdisciplinarity is viewed as 'a complex cognitive skill that consists of a number of subskills' (Spelt *et al.* 2009: 366). Accordingly, the basis for success is found in generic 'cognitive-emotional-interactional' attributes of students (Boix Mansilla *et al.* 2016), such as curiosity, respect and openness towards collaborators (Bruce *et al.* 2004) or 'a willingness to admit the inadequacies of one's own point of view, to be wrong and to play the fool, and generosity in interpreting the position and motives of others' (Frodeman 2014: 48).

I am not discounting such cognitive and emotional attributes but rather highlighting that research often obscures knowledge as something beyond 'the heads of persons'. Knowledge is thereby treated as a homogeneous and neutral medium through which minds communicate. Integrative knowledge-building is then simply a matter of bringing together actors with open and curious minds, no matter whether the knowledges being related are abstract or concrete, complex or simple, strongly or weakly insulated, and so forth. The corollary is that failure to integrate knowledges must reflect a lack of curiosity, respect and openness among those involved. I shall show these are not the only causes to be found.

2.2. Essentialism

A second obstacle is the widespread use of preconstructed categories, such as 'academic' and 'everyday knowledge' or the names of disciplines, not as phenomena to be explored but as the basis for analysis. For example, 'interdisciplinarity' is typically defined as the integration of knowledge from different disciplines (e.g. Klein 2017) and studies argue that students need to be aware of differences among disciplines because dissimilarity can problematize this integration (e.g. Öberg 2009). Discipline names such as 'History' and 'science' are then used as if their meanings, and thus their similarities and differences, are self-evident. Such terms have the appeal of appearing grounded in reality: there are departments, courses and journals of 'History' and 'science'. Similarly, distinguishing 'academic' from 'everyday' knowledge mirrors the existence of formal academic institutions. However, as Bourdieu *et al.* (1991) warned, because such preconstructed categories are rooted in common sense, they often go without saying. Appearing self-explanatory, their referents are assumed to possess essential characteristics that are universal, stable and uncontested.

If essentialism were correct it would be straightforward to analyse, for example, teaching that integrates mathematics into science or that draws on everyday experiences to support the learning of History. One could easily identify what is 'mathematics' or 'science', what is 'everyday' or 'History', and whether and how they are being integrated. However,

mathematics is a central language of science: the point at which 'mathematics' content such as graphing becomes 'science' is not necessarily self-evident. Similarly, humanities and social sciences often incorporate everyday discourse: what is 'academic' or 'everyday' is not always transparent.

These are issues of boundaries and the varying degrees of insulation they generate. Analysing insulation between forms of practice is central to understanding their integration. However, preconstructed categories typically assume clear and stable boundaries between practices that are always and everywhere the same. In contrast, sociological and historical axioms hold that the external boundaries of disciplines – and of 'academic' knowledge more widely – are the focus of struggles, vary across contexts, and are subject to change. What is encompassed by 'mathematics', 'science' or 'History' is intensely debated, differs between research, curriculum and pedagogic practice (as well as changing through the years of education), and evolves through time. In short, the nature of boundaries around any particular set of knowledge practices cannot be assumed. However, these sociological commonplaces can themselves create problems by leading to the analytic paralysis of relativism. Acknowledging the contextual nature of how actors construct 'mathematics', 'science', 'History' and so forth can lead to the nihilistic conclusion that analysis is impossible, because they are whatever anyone decides them to be at a particular moment. This is to invert essentialism: now there are no boundaries to be analysed, no identifiable forms of knowledge practice to be related, only an endless flux. The possibility of analysis (and the potential for purposeful change) then cedes to the banal conclusion that boundaries are complex, contested and fluid.

Highlighting these problems is not to denounce common sense names, but rather to emphasize that they are labels for phenomena that require analysis rather than concepts for undertaking that analysis. To explore integrative knowledge-building thus requires breaking with preconstructed categories in favour of concepts that can, on the one hand, explore the heterogeneous, mutable and situational nature of knowledge practices without, on the other hand, succumbing to relativistic paralysis.

2.3. Segmental models

Even when knowledge is seen and preconstructed categories eschewed, a third obstacle to addressing integrative knowledge-building can emerge in the form of segmental models. Typically accounts of knowledge offer types, such as the 'Biglan-Becher' typology of hard/soft and pure/applied (Neumann 2001), Kolb's abstract/concrete and active/reflective (1981), and 'Bloom's taxonomy' (1976). There are innumerable similar kinds of typologies: explicit/tacit, propositional/procedural, vertical/horizontal, singulars/regions/generic, inter-/multi-/trans-/disciplinary and many others. Such models do begin to overcome knowledge-blindness, but attempts at analysing empirical data with these typologies soon reveal their limits.

First, real-world practices do not fit neatly into their categories. Typologies offer a series of categories into which practices are to be allocated, as 'pure' or 'applied', 'vertical' or 'horizontal', etc. Any examples offered to illustrate each type are usually sufficiently broad-brushed – often entire subject areas – to make intuitive sense. Accordingly, such typologies can be useful for thinking about knowledge practices in general. However, when pressed to account for real-world examples, when closely engaged in analysis of complex, diverse and changing practices such as classroom pedagogy, these models prove difficult to enact. Lacking explicit recognition criteria for translating between empirical data and their various types, it becomes unclear which specific type one is facing in the data at any one moment and at which point those practices switch to another type. Reality becomes too messy for the model.

Second, as just intimated, typologies struggle with capturing change between different forms of knowledge practice, a crucial element in integrative knowledge-building. Consider, for example, Bernstein's model of knowledge in higher education as strongly bounded 'singulars', such as physics, History and economics, or 'regions' that select knowledge from singulars and project that knowledge into a field of practice beyond education, such as engineering, medicine, and business studies (2000: 50–6).[3] (The use of whole subject areas to illustrate the types is Bernstein's own). This distinction highlights the key issues of external boundaries and integration. However, the concepts cannot unambiguously identify specific practices as 'singular' or 'region', whether those types of knowledge are being integrated, or what form integration may be taking, such as 'singular' knowledge becoming a 'region' or 'regions' knowledge becoming 'singular'. Like other knowledge typologies, they are suggestive in drawing attention to organizing principles for analysis, such as insulation and integration, but do not provide the means for their analysis.

Typologies can thus offer a first step, a way of moving beyond knowledge-blindness and preconstructed categories to start *thinking about* different kinds of knowledge practices. However, *analysing with* these models is problematic – engaging with detailed real-world data reveals their limits. To explore integrative knowledge-building, concepts are required which reach beneath surface appearances to reveal the organizing principles underlying practices in a way that provides explicit recognition criteria and captures change over time.

3. Legitimation Code Theory: Autonomy

Legitimation Code Theory (LCT) is a multi-dimensional framework for researching and shaping practice. Each 'dimension' includes concepts for analysing a set of organizing principles underlying practices, dispositions and contexts as a particular species of 'legitimation code' (see Maton 2014). Thus far the dimensions of Specialization and Semantics are the most theoretically elaborated and most widely enacted in substantive studies (e.g. Maton *et al.* 2016). Specialization explores the organizing principles of *epistemic relations* to other knowledge and objects of study, and *social relations* to ways of knowing and knowers, articulated together as *specialization codes*. Semantics explores the organizing principles of *semantic gravity* (context-dependence) and *semantic density* (complexity) as *semantic codes*. In terms of integrative knowledge-building, these concepts can help show what is being brought together by exploring the forms taken by different knowledge practices. However, neither dimension conceptualizes whether and how those knowledge practices are being integrated. For this I can turn to Autonomy, which conceptualizes the organizing principles underlying relations among practices as *autonomy codes*.

The concepts of 'autonomy codes' build most directly on Bernstein's 'external classification' and 'external framing' (1977, 1990), and Bourdieu's 'autonomous' and 'heteronomous' principles of hierarchization (1993, 1996). Though first discussed over a decade ago (Maton 2005), the definitions of 'autonomy codes' and the means for enacting the concepts in research have remained partial and underdeveloped. The current paper begins filling that gap. It results from over five years of intensive and iterative development, enactment and refinement of the concepts through close analyses of a diverse range of empirical data.[4] Space precludes discussing here how the resulting concepts integrate and extend previous ideas. This paper introduces the redefined concepts, discusses how they

[3] Bernstein (2000: 53) identifies a third type, 'generic', as commonly found in further education.

[4] The authors thank participants at *First International Legitimation Code Theory Conference* (2015), *LCT Centre Roundtable* (2016), *International Systemic Functional Congress* (2017), and public lectures at Stellenbosch University (2016), University of the Witwatersrand (2016) and Rhodes University (2018) for engaging with earlier versions of ideas.

can be enacted to overcome obstacles to addressing integrative knowledge-building, and illustrates their usefulness in fine-grained empirical analyses. It begins by discussing 'autonomy codes' in order to define the concepts.

3.1. Autonomy codes

Autonomy begins from the simple premise that any set of practices comprises constituents that are related together in particular ways. The constituents and the basis of how they are related together may take many forms. Constituents may be actors, ideas, artefacts, institutions, machine elements, body movements, sounds, etc.; how such constituents are related together may be based on explicit procedures, tacit conventions, mechanisms, explicitly stated aims, unstated orthodoxies, formal rules, etc. Autonomy codes explore the boundaries that practices establish around their constituents and the boundaries they establish around how those constituents are related together. These are analytically distinguished as:

- *positional autonomy* (PA) between constituents positioned within a context or category and those positioned in other contexts or categories; and
- *relational autonomy* (RA) between relations among constituents of a context or category and relations among constituents of other contexts or categories.

Each may be stronger (+) or weaker (−) along a continuum of strengths, where stronger represents greater insulation and weaker represents lesser insulation. Stronger positional autonomy (PA+) indicates where constituents positioned in a context or category are relatively strongly delimited from constituents attributed to other contexts or categories, and weaker positional autonomy (PA–) indicates where such distinctions are drawn relatively weakly. Stronger relational autonomy (RA+) indicates where the principles governing how constituents are related together are relatively specific to that set of practices, i.e. purposes, aims, ways of working, etc. are autonomous; and weaker relational autonomy (RA–) indicates where the principles governing how constituents are related together may be drawn from or shared with other sets of practices, i.e. purposes, aims, ways of working, etc. are heteronomous.

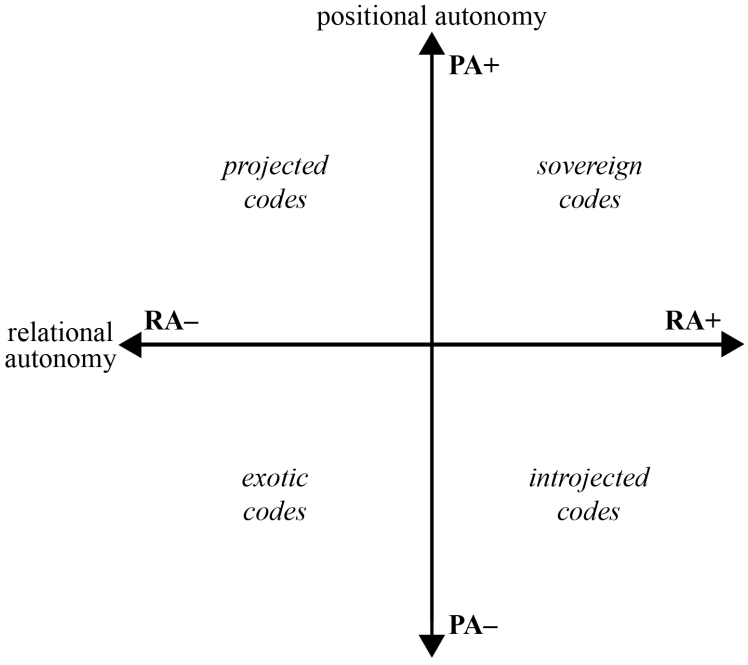

Figure 1. The autonomy plane

As shown in Figure 1, the two continua of strengths are visualized as axes of the *autonomy plane*. Varying the two strengths independently (PA+/–, RA+/–) generates four principal *autonomy codes*. As with all legitimation codes, these concepts explore the basis of legitimacy and thus what practices, dispositions or contexts are attempting to establish as possible and valued.

For *sovereign codes* (PA+, RA+) status is accorded to strongly insulated positions and autonomous principles. What is valued emanates from within the context or category and acts according to its specific ways of working: internal constituents for internal purposes. For example, I stated that the aim of this section is to discuss 'autonomy codes' in order to define the concepts; and I am here discussing 'autonomy codes' in order to define the concepts. I am not bringing in other constituents (such as examples from everyday discourse) or relating those constituents together for another purpose (such as entertaining the reader). So my constituents embody stronger positional autonomy (PA+) and my purpose embodies stronger relational autonomy (RA+): a sovereign code.

For *exotic codes* (PA−, RA−) legitimacy accrues to weakly insulated positions and heteronomous principles. What is valued are constituents associated with other contexts or categories and ways of working from other contexts or categories: external constituents for external purposes. Manchester United are the greatest football team the world has ever seen because their history and ethos are without equal. Given my description of the content and purpose of this section, that incongruous sentence represented weaker insulation around what I am discussing and why. It was not about 'autonomy codes' (weaker positional autonomy or PA–) and it was not serving to define the concepts (weaker relational autonomy or RA–): an exotic code.[5]

For *introjected codes* (PA−, RA+) legitimacy resides with weakly insulated positions and autonomous principles. What is valued are constituents associated with other contexts or categories but oriented towards ways of working emanating from within: external constituents turned to internal purposes. An example is the African cultural notion of 'umalokazana', describing how a daughter-in-law brings knowledge from her family upbringing into her new homestead.[6] Another example is expressed by the Anglophone proverb 'when in Rome, do as the Romans do': someone entering Rome from elsewhere must follow Roman ways of acting. Moreover, in this context my use of those examples itself embodies weaker positional autonomy (PA–) because they are from beyond 'autonomy codes', but stronger relational autonomy (RA+) because they are serving to define the concepts: an introjected code.

For *projected codes* (PA+, RA−) status resides with strongly insulated positions and heteronomous principles. What is valued are constituents from within that are oriented towards ways of working from elsewhere: internal constituents turned to external purposes. Given the intended content and purpose of this section, if I now discussed 'autonomy codes' for a purpose other than defining them, I would exemplify this code. For example, a joke suggesting the use of 'projected' and 'introjected' in the names of autonomy codes shows the authors have ingested too much psychoanalysis would embody stronger positional autonomy (PA+) by discussing the concepts but weaker relational autonomy (RA–) because its purpose is generating humour: a projected code.

[5] This sentence uses the statement about Manchester United (PA–) to help introduce the concepts (RA+) and thus represents an *introjected code*. However, the Manchester United statement itself remains an exotic code. The autonomy codes of preceding practices are not retroactively changed by those of subsequent practices – they remain the code they expressed at the time.

[6] I am grateful to Kevin Ncube (Cape Peninsula University of Technology, South Africa) for this example.

3.2. Overcoming obstacles with pathways and targets

The concepts of 'autonomy codes' allow the three obstacles discussed in section 2 to be avoided. First, against knowledge-blindness, the concepts enable knowledge practices to be seen as an object of study in their own right. Indeed, 'autonomy codes' can be enacted to analyse not only actors' knowledge practices but also their mental dispositions and their social contexts, enabling knowledge to be both brought into the picture and systematically related to knowing and to power (see section 6). Second, 'autonomy codes' break with preconstructed categories whose meanings are assumed, allowing essentialist definitions of practices to be eschewed in favour of embracing variation. Third, rather than label a limited number of empirical features, the concepts identify a set of organizing principles underlying practices, enabling diversity, contestation and change to be embraced.

However, these breaks with dominant approaches are not enough. As evinced by my repeated use above of 'allow' and 'enable', the concepts offer the *potential* for capturing in analysis that which evades existing models: relations among heterogeneous, changing and situationally-defined practices. Realizing that potential depends on *how* 'autonomy codes' are enacted. To take this next step I turn to other concepts from the dimension of Autonomy. The *autonomy plane* provides a means of capturing the variegated and unfolding nature of practice by tracing the *pathways* taken over time by autonomy codes.[7] *Translation devices* ensure empirical referents are defined sufficiently for close analysis of real-world data by providing explicit recognition criteria and, through the key notion of 'targets', embrace the contextual and contested nature of the boundaries being studied. I discuss each in turn.

3.2.1 Autonomy pathways

The autonomy plane (Figure 1) provides a relational topology with infinite capacity for gradation. I have defined four autonomy codes but, as sections 4 and 5 will illustrate, the plane is not limited to four 'settings' or positions. One may identify as many relative strengths of positional autonomy and as many relative strengths of relational autonomy, and so as many different positions on the plane, as required by the analysis at hand. Accordingly, one need not try to fit variegated empirical practices into a homogenizing conceptual box. For example, the diversity of autonomy codes encountered within one's data can be represented as a scatter pattern across the plane, with individual instances falling into a number of codes and occupying different positions within each of those codes. This allows the diversity found within a set of practices to be captured in a synoptic snapshot.

To additionally capture change one can trace the *autonomy pathways* taken by practices as their autonomy codes shift over time. There are an unlimited number of potential movements around the autonomy plane. Here I shall identify four kinds of pathways, of which Figure 2 offers examples:

- *stays* that remain within a single code;
- *one-way trips* that begin in one code and conclude in a second code;
- *tours* that begin in one code, move through one or more other codes, and return to where they began; and
- *return trips,* the simplest form of tours, that move back and forth between two codes.

[7] Pathways are not the only means; *autonomy profiles* can reveal patterns through time in similar fashion to 'semantic profiles' (see Maton 2014: 106–47).

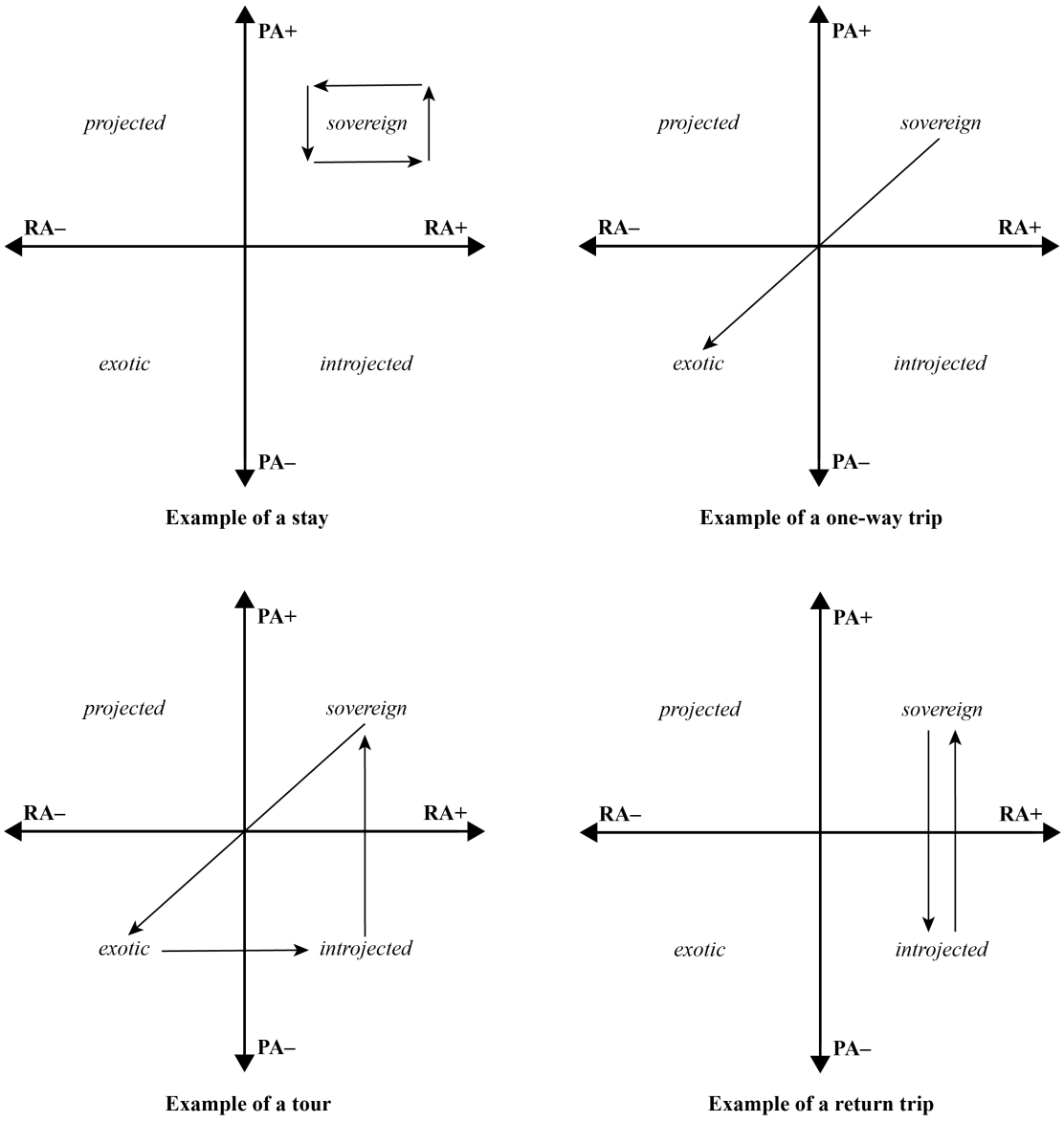

Figure 2. Examples of autonomy pathways

I cannot overemphasize that Figure 2 shows only examples and *not* definitions of each kind of pathway. Stays may remain in any code, one-way trips may shift from any code to any other code, and tours may start in, move through, and return to any code. Crucially here, my point is that tracing pathways moves beyond static types to explore a key feature of integrative knowledge-building: changes in the insulations between practices.

3.2.2. Translation devices and targets

Tracing pathways raises the question of how to identify positions on the plane, or what I earlier described as the need for explicit recognition criteria when enacting concepts in analysis. As section 3.1 demonstrated, 'autonomy codes' are defined at a distance from specific empirical referents. This allows the concepts to be enacted in analyses of a panoply of phenomena (see section 6). However, to do so the 'discursive gap' (Bernstein 2000: 209) this creates between theory and data must be traversed by defining the forms taken by autonomy codes within a particular object of study. LCT closes the gap through

'translation devices'.[8] Table 1 shows the *generic translation device* for autonomy codes. This sets out a principled means of dividing up continua of strengths of positional autonomy and relational autonomy, with progressively finer-grained levels of delicacy, from simply stronger/weaker ('target'/'non-target') through subdivisions, use of which depends on the needs of the researcher. The generic device provides a framework for individual studies to develop *specific translation devices* that translate between these categories and the concrete specificities of their data. (I include a basic example further below). Together these translation devices close the discursive gap by enabling researchers to identify strengths of positional autonomy and relational autonomy in their data and, conversely, to allocate empirical instances to strengths of positional autonomy and relational autonomy. Space precludes a fuller account; here I confine ourselves to discussing how the generic translation device realizes the potential of autonomy codes to embrace the situational nature of knowledge practices.

Put simply, to analyse insulation one must first ascertain what is being insulated. Using the generic translation device accepts that knowledge practices are contextually construed but overcomes analytic paralysis by making this situational definition a starting point rather than a conclusion. The device poses the question of what makes the context or category being studied a context or category for the actors involved. As befits a device for enacting concepts, this is not a philosophical conundrum but rather an empirical question concerning the object of study at hand. It is to ask: what constituents and what principles of relation (e.g. purposes, aims, ways of working) are considered constitutive of *this* context or category, *here, in this space and time, by these actors*? The result is a 'target' that provides a starting point for determining autonomy codes. As shown in Table 1, target constituents embody stronger positional autonomy and all other, non-target constituents embody weaker positional autonomy; target principles for relating constituents embody stronger relational autonomy and all other, non-target principles of relation embody weaker relational autonomy. For greater delicacy, these categories can be divided by asking which target constituents and principles are considered *core* and which *ancillary* to the context or category, and which non-target constituents and principles are considered closer to (*associated*) or further from (*unassociated*) the target. Asking the same basic questions again generates a third level comprising *inner* and *outer* forms of core and ancillary targets, and *near* and *remote* forms of associated and unassociated non-targets.

Table 1: Generic translation device for positional autonomy and relational autonomy

PA/RA	1st level	2nd level	3rd level
+ ↕ −	*target*	*core*	*inner*
			outer
		ancillary	*inner*
			outer
	non-target	*associated*	*near*
			remote
		unassociated	*near*
			remote

[8] On translation devices, see Maton (2014: 136–9), Maton & Chen (2016), and Maton & Doran (2017a).

You have already encountered a *target* in this article. I stated that section 3.1 would be 'discussing "autonomy codes" in order to define the concepts'. That set my target constituents and my target purpose. The examples of each autonomy code I offered in section 3.1 were then related to those targets: stronger positional autonomy when content was 'autonomy codes' and weaker positional autonomy for any other content; stronger relational autonomy when relating together constituents to define the concepts and weaker relational autonomy when doing so for any other purpose, such as engaging readers.

How one determines a target depends on the object of study. It may not be explicitly stated, directly asking participants may not be possible or appropriate, and more diffuse markers, such as the unspoken conventions of a social milieu, may be key. Howsoever explored, the purpose is to provide a *starting point* for analysis rather than a finalized model. Thus, the categories of the device are not a typology of knowledge but rather a means for enacting the concepts of autonomy codes. Moreover, the categories do not assume strong or clear-cut boundaries: recursively finer levels of delicacy enable exploration of fuzzy contexts or categories. The target depends on who and what is being analysed, so no specific action, idea, belief, discipline, etc. is always and everywhere a particular code. Thus one can also analyse contested or conflicting views: the target of one person, group or society may be the non-target of another person, group or society. Actors within a social context are likely to possess a number of different targets that may match or clash in different ways. Which targets, if any, are dominant is a matter for empirical research; whose targets form the focus for analysis depends on one's research questions. The key point here is that Autonomy provides a means for getting a grip on these issues. The generic translation device begins from the situational, shifting and contestable nature of knowledge practices without abrogating explanatory power. With the notion of 'target', one can deny the false dichotomy of essentialism or relativism.

3.2.3. Enacting autonomy codes in this paper

To illustrate how autonomy codes can illuminate integrative knowledge-building, I shall analyse pathways traced by classroom practices in secondary schooling. I draw upon a major study of how teachers select, assemble and enact knowledge in their classroom practice.[9] The project focused on lessons in science and History in Years 7, 8 and 9 at three schools in New South Wales, Australia. Analysis focused on video recordings of lessons across whole units of study (6–8 hours each), interviews with teachers, all teaching materials (including the 'scope and sequence' for History and science at each school, lesson planning, and all classroom resources), and student assessments and workbooks.

My focus was on the choice of classroom practices made by teachers. In interviews and their teaching materials teachers described their lessons in terms of engaging with specific content (positional autonomy) for specific purposes (relational autonomy). Table 2 presents in simplified form a specific translation device for the analyses I shall discuss here. The teachers described their target content (PA+) as the syllabus for Stage 4 of the New South Wales Board of Studies for the subject area of the class, and their target purpose (RA+) as teaching students that content.[10] Their *core* targets (++) for the lessons studied concerned the specific unit being taught, with other units in Stage 4 considered *ancillary* targets (+). (Their *inner-core* targets concerned the content points they created for each specific lesson). In terms of non-targets, teachers viewed other educational knowledge (such as other subjects or other Stages and levels of education in the subject) as *associated* (–) to their target, and knowledge from beyond education as *unassociated* (– –).

[9] The analyses draw on research funded by the Australian Research Council (DP130100481).

[10] The New South Wales Board of Studies has been subsequently renamed the New South Wales Education Standards Authority.

Table 2. Specific translation device for this paper

PA/RA	1st level	In this study:	2nd level	In this study:
+ ▲	*target*	New South Wales Stage 4 syllabus for subject area	*core*	specific unit in target
			ancillary	other topics or years in target
▼ –	*non-target*	other contents or purposes	*associated*	other educational knowledge
			unassociated	knowledge from beyond education

Using the specific translation device the autonomy codes expressed by classroom practice through the lessons were analysed. Of the various pathways discovered, I shall illustrate the implications of one-way trips and tours in History lessons (section 4) and science lessons (section 5). I argue that one-way trips leave different knowledge practices segmented from one another and that tours are a key to integrative knowledge-building. Put simply, integrating different knowledge practices requires not only leaving one code to engage with others but also bringing knowledge back to that code. To mitigate conceptual overload in the examples, I shall limit discussion in the main text to the level of the translation device required to reveal the pathway, but I touch on deeper levels in footnotes to explain specific locations on the plane shown in accompanying figures.

4. Autonomy pathways in History lessons

To illustrate the effects for integrative knowledge-building of different pathways I draw on examples that are otherwise similar. Examples in this section are all from History lessons in Year 7 of secondary schools that draw on the same state curriculum. In teaching materials and interviews, both teachers described their target content (PA+) as the History syllabus for Stage 4 of the New South Wales Board of Studies and their target purpose (RA+) as teaching students that content. The lessons are from the same state syllabus content area, 'The ancient world', differing only in whether discussing ancient Rome or ancient Greece and the specific topics of lessons.

4.1. A one-way trip out of History

The first pathway comprises a distinct phase of a lesson for which the teacher's (inner-core) target was what she called 'today's question': 'Where was ancient Rome?'. The phase begins after the teacher emphasizes this question to the students. Using several maps she draws on ideas from history, geography, politics and everyday life to describe Rome as like a capital city and modern-day Italy as shaped like a boot. While doing so, the teacher and students embark on a *one-way trip* from her sovereign code into exotic codes, moving away from her target content and purpose. The phase ends with 'today's question' being postponed until another day.

4.1.1. Tracing the pathway

After writing down 'today's question' on the whiteboard, the teacher begins addressing 'Where was ancient Rome?' by pointing to a map on the interactive whiteboard (IWB) entitled 'The Roman Empire':

> Teacher Looking? This tells us that the Romans – the people who are from Rome – they didn't just have one city. It expanded – the places where they lived expanded and they had a whole empire, which means a huge area of land where they spread out and they owned it all and they lived. Okay?

The teacher thereby begins by discussing content about the Roman Empire (stronger positional autonomy) for the purpose of teaching about ancient history (stronger relational autonomy): her *sovereign code*.[11] She then displays a map showing borders of countries in modern Europe, with Italy highlighted:

> Teacher So this is now. Modern. Not ancient, but modern. This [pointing to map] is Rome, the city, and [gesturing more widely] this whole country is Italy, the country. So the capital city is Rome, like our capital city is Canberra, and this whole country is coloured in orange. If you see the map I just put on your desk, [holds up handout] this side, you can see they've written "Italia" because that's how the Italians said the name of their country.
>
> Students Italia!

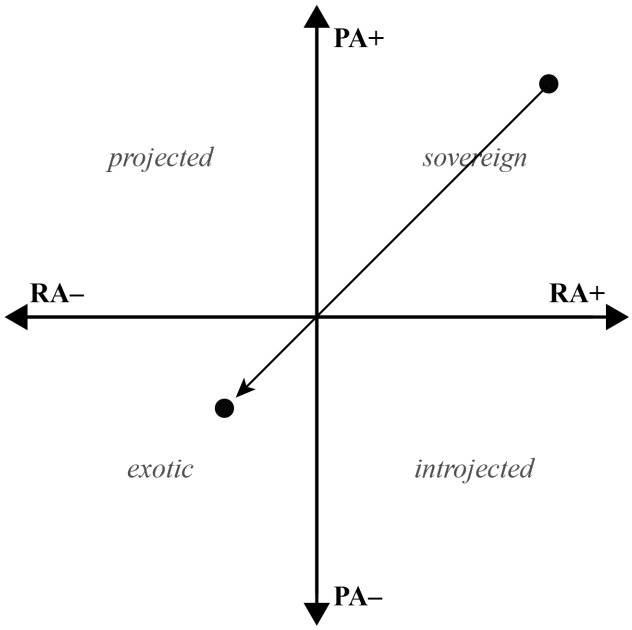

Figure 3. Shift from sovereign code to exotic code

The modern map, notion of capital cities, and examples of Canberra and the modern nation-state of Italy, introduce content from beyond her target of the History syllabus. Analysis of teacher interviews and teaching materials identify their source as the secondary school geography syllabus. This educational knowledge is *associated non-target* content and so embodies weaker positional autonomy (PA–). In terms of relational autonomy, the

[11] The teacher begins within her *inner-core* target, so positional autonomy and relational autonomy are both extremely strong; the Figure 3 pathway thus begins deep inside her sovereign code.

teacher could have turned the mention of Canberra to her target purpose of explaining relations between the city of Rome and the Roman Empire. However, she does not make this link, so the purpose remains simply teaching the geography content, an *associated non-target* purpose that represents weaker relational autonomy (RA–). Thus, the knowledge being expressed now embodies an *exotic code* (PA–, RA–). As portrayed in Figure 3, the teacher has shifted from deep inside her sovereign code to just within an exotic code. She then continues by moving further into this exotic code:

Teacher	Okay. It's Italy, right? That's Italia – Italy. And you can note Italy – does anyone already know this? Italy is easy to spot because it's the shape of something.
Student	A boot.
Teacher	Yes, a boot. See how this [pointing to handout] is a lady's high-heeled boot? There's the high-heel, there's the toe and it's a big long boot. Can everyone see that?
Student	Yep.
Student	I can.
Teacher	Yep? Okay.
Student	Miss, what's the top then?
Teacher	I don't know. Just pretend. Up until there [pointing to handout] it's a boot.

By discussing the shape of high-heeled boots in order to identify the modern country of Italy on a map, the teacher further weakens both positional autonomy and relational autonomy. Both content and purpose are now from beyond education. As portrayed by Figure 4, this move from *associated* to *unassociated* non-target content and purpose represents a drift deeper into an *exotic code* (PA– –, RA– –).

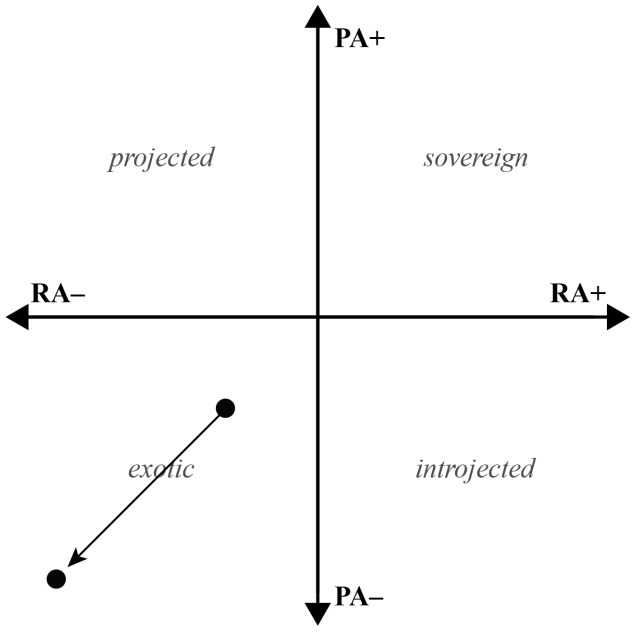

Figure 4. Drifting deeper into an exotic code

At this point the teacher tries to return students to her sovereign code. She strengthens positional autonomy by moving back from the boot (PA– –) through the location of modern Italy and notion of a capital city (PA–) to reach the ancient world (PA+) and specifically her core target of ancient Rome (PA++):

Teacher	So the city is Rome, but now in modern day, the whole country is Italy. Do you get it? Okay. But we're talking about *ancient* Rome.
Student	Yeah.
Teacher	Now, the city of Rome has always been in the same place and it's along the river, but where was the Roman Empire? [Returning to first map] Look at this – it's massive. Here's Italy with the boot, but [gestures to map] all of the red part, all of the red parts were owned by the Romans. And their headquarters – their capital or their headquarters was in Rome. But they owned all the red.

She then attempts to strengthen relational autonomy by reminding students they will need this knowledge to answer the question, 'Where was ancient Rome?'. The teacher thereby returns to deep inside her sovereign code. However, the students do not follow her. Instead, classroom practice remains in the exotic code as students attempt to find boots on the map. A series of students ask for her help finding the boot and question whether the shape she indicates resembles a boot; for example:

Student	Miss, I can't find the boot on the paper.
Teacher	You can't find the boot on the paper?
Student	I can.
Teacher	Okay.
Student	The boot is the white one.
[…]	
Teacher	Okay? So, you found it? Okay. alright. What were you going to say?
Student	Miss … that was a boot?
Teacher	Yep.
Student	There's lots of them.
Teacher	It's still a boot.
Student	Look, that's where you put your foot in.

After several more minutes of students discussing boots and searching for boot-shapes on the map, the teacher finds she is unable to return students to discussing her target and draws this phase of the lesson to a close. She states that 'today's question' will now be addressed another day and turns to a different activity that involves spelling words.

4.1.2. Summary

The autonomy pathway here represents a *one-way trip* out of the teacher's target of secondary school History. As illustrated by '1→2→3' in Figure 5 (below), the knowledge expressed in classroom practice shifts from (1) her sovereign code to (2) an associated exotic code and then to (3) an unassociated exotic code. I must emphasize that I am *not* criticizing exotic codes or the inclusion of non-academic knowledge in the classroom. As I shall illustrate below, non-target knowledge can support student engagement and understanding. The problem here is that the teacher is unable to bring classroom practice back to her sovereign code. She retraces her steps back to the question of 'Where was ancient Rome?' but the students do not follow: most of the class remained in an unassociated exotic code, focused on boot shapes. As a result, whatever lessons could be

learned from an excursion into everyday meanings are not bought back to support learning school History, the teacher's target. Rather than integrative knowledge-building, classroom practice has left different knowledge practices separate. The ability to find a boot shape on a map remains strongly segmented from knowledge of ancient Rome.

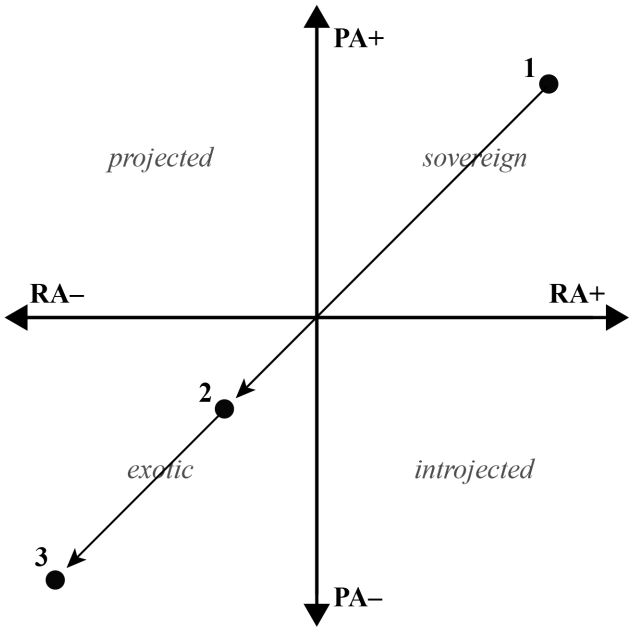

Figure 5. A one-way trip

4.2. Autonomy tours in History

I now illustrate two kinds of *autonomy tour* by a different teacher at a different school but who shares the same target content and target purpose and teaches the same unit ('The ancient world') of the same level (Year 7 secondary school) of the same subject (History). Her core target is also the same – 'The ancient world' – though focused on Greece rather than Rome. The first example is a simple *return trip* that integrates research findings from archaeology into a discussion of jobs in Sparta. The second example illustrates a longer and repeated *autonomy tour* that integrates educational knowledge of ancient Greece government with everyday understandings of modern Australian politics.

4.2.1. Taking a return trip

We begin at the start of the first lesson of a new unit. The teacher's (inner-core) target for this lesson is trade in ancient Greece and she begins by asking students to name jobs:

> Teacher So what sort of jobs do you think in Ancient Greece an ancient Greek may have? Let's think of some of the jobs.

Students offer a series of suggestions – blacksmith, carpenter, weaver and others. After several minutes, the teacher highlights that something is missing:

> Teacher Okay. What else? Some really obvious ones you've been leaving out for jobs people do. Yes?
> Student A soldier?

Teacher	A soldier. That's pretty obvious, yeah. Especially if you're in which of the polises? Think about it. … In which of the polises is a soldier a really important one? … Yes?
Student	Sparta?
Teacher	Sparta! Basically if you're a Spartiate, that's your main job.

Thus far the knowledge comprises content from the unit on 'The ancient world' (stronger positional autonomy) expressed for the purpose of teaching 'The ancient world' (stronger relational autonomy): classroom practice is in the teacher's *sovereign code*.[12] She then draws on research findings from archaeology to clarify why they are discussing professions other than soldiery:

Teacher	Now, there's lots of new research that actually says some Spartiates may have had other jobs, which in the past they used to say, "No, they didn't have other jobs." But there's some research that says, "Maybe they had other jobs, but they were like second jobs." Okay? The new research comes from things like when they've been doing some archaeology – remember we did archaeology?
Student	Yep.
Teacher	Okay, well they've dug down deeper, okay? And they've actually found things like an oven kiln inside Sparta. Now, if only Spartiates can live inside the walls of Sparta, that means they must be doing something else – making pottery.

By discussing new findings from archaeological research, the teacher introduces non-target content and so weakens positional autonomy. However, relational autonomy remains strong because of the way she links this forthcoming content to her target purpose of learning about the ancient world, stating that 'new research' suggests Spartiates 'had other jobs'. When explaining that archaeologists have 'dug down deeper' and 'found things like an oven kiln inside Sparta', the explicit purpose is to explicate historical knowledge. Non-target content is related to her target purpose: an *introjected code*.[13] The teacher then connects this to target content that the students have already been taught ('only Spartiates can live inside the walls of Sparta') to elaborate its implications for the activities of Spartiates. This elaboration returns discussion to her sovereign code. Unlike the example of the boot, students here do not latch onto non-target content but rather continue within the teacher's sovereign code by suggesting other jobs in ancient Greece.

As illustrated by Figure 6 (below), the teacher's brief aside generates a return trip from her sovereign code to an introjected code (1→2) and back to her sovereign code (2→1). In contrast to the one-way trip above, the teacher introduces non-target content without losing sight of her target purpose, and then connects this non-target content to her target content. In other words, she selects from other knowledge (archaeology research), repurposes that selected knowledge (to help teach 'The ancient world'), and connects that repurposed knowledge to discussion of target content ('The ancient world'). The teacher thereby enables integrative knowledge-building. I now turn to a more complex tour by the same teacher.

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[12] This lies within the teacher's *inner-core* target, so the pathway in Figure 6 begins deep inside her sovereign code.

[13] Specifically, the content is *associated* non-target (PA–) because it is educational knowledge, and the purpose is the *core* target of teaching the unit of 'The ancient world' (RA++). Accordingly, in Figure 6 the position of '2' is not at the bottom of the plane (representing weaker but not the weakest strength of positional autonomy) and does not move left from '1' (the strength of relational autonomy remains the same).

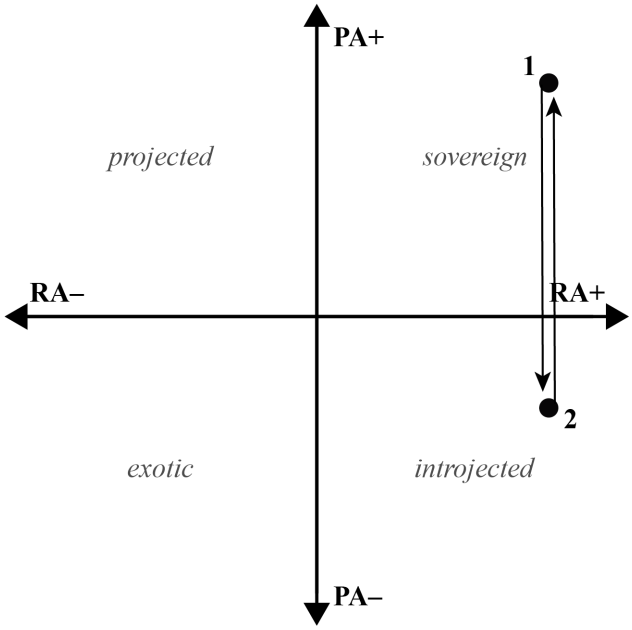

Figure 6. A return trip

4.2.2. Taking longer tours

Through all the lessons of the unit the teacher repeatedly takes a particular autonomy tour that integrates everyday understandings into educational knowledge. The examples here are from the third lesson of the unit in which she moves between explaining political arrangements in ancient Sparta and soliciting students' understandings of modern Australian politics. We begin with the teacher discussing how the 'Gerousia' (a group determining law and policy in Sparta) made decisions differently to the 'ephors', which had been discussed previously:

Teacher	It's not like the ephorate, because the ephors can actually say 'yes' or 'no' right at the end. … Do we ever say just 'yes' or 'no' in Australia?
Student	Sometimes.
Teacher	Sometimes. When sometimes? … What's it called, do you know?
Student	A referendum?
Teacher	A referendum! Yes! Well done!

This begins deep inside her sovereign code: both content and purpose pertain to 'The ancient world' and, indeed, to her inner-core target of government in ancient Greece. As illustrated by Figure 7 (below), the teacher then shifts to deep inside an exotic code by soliciting from students unassociated non-target content (whether yes/no voting occurs in Australia and its name) for an unassociated non-target purpose (clarifying whether such voting occurs today).

The teacher then briefly returns to her sovereign code and repeats this shift to an unassocated exotic code:

Teacher	Some people look at it [the Gerousia] and say, 'Well, they're not really having a debate because they can only say "yes" or "no".' Well, we have referendums when we want to change our constitution, and in a referendum the government can only ask you a question where you say 'yes' or 'no'.

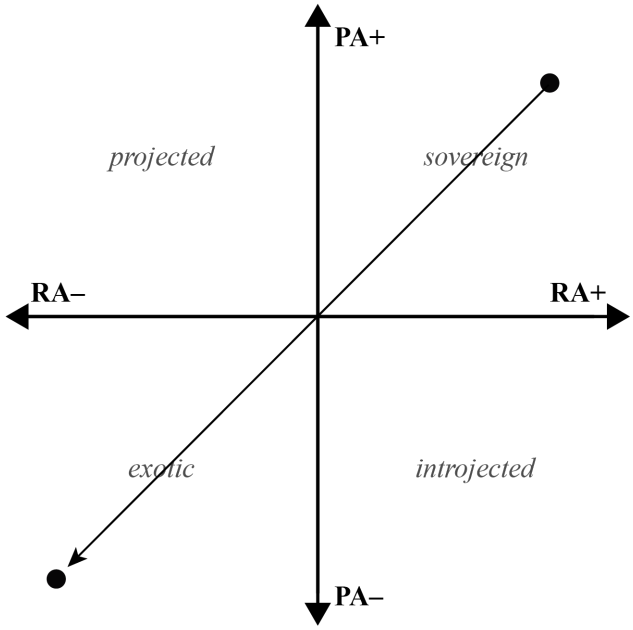

Figure 7. Shift from sovereign code to exotic code

Thus far the teacher has moved between her sovereign code and exotic codes, swiftly juxtaposing but not explicitly connecting knowledge about ancient Greek government and modern Australian politics. However, at this point she pivots to her target purpose:

Teacher And that's the exact same thing in Sparta.

This turns discussion of modern referenda (PA– –) to the purpose of teaching about ancient Greece (RA++), strengthening relational autonomy and thereby shifting to an introjected code (PA– –, RA++). From here she proceeds to a sovereign code by returning to her target content and purpose:

Teacher When the discussion is held, they come and they present things to them at their meeting, and then they say to them: "Do you want this or not?" But they don't stand up and down and yell "yes" or "no" … What they do is they do it by who gets the loudest clapping.
Students Whoa! Wow!

As illustrated by Figure 8 (below), this traces a pathway from sovereign code to exotic code, then back and forth again (1→2→1→2) before moving through introjected code (2→3) to sovereign code (3→4). Indeed, the teacher repeatedly traces the tour represented in Figure 8 by 1→2→3→4. For example, continuing directly on from above:

Teacher So, for example, if you want Miss [teacher] to have the happy dance music on after you do your exam: yes?
Students [Clapping]
Teacher Stop! And no?
Students [Clapping]
Teacher Well, I think we have to say that that bit of legislation went through under the Spartan system, because it was certainly louder for 'yes'…
Student If it was like really close, by one clap, how could you tell?

Teacher You couldn't tell. It keeps going until they can get a clear definition of 'yes' or 'no'.

Student But then how would you remember who was louder between 'yes' and 'no'?

Teacher Because they do it all the time, sweetie. This is how they vote.

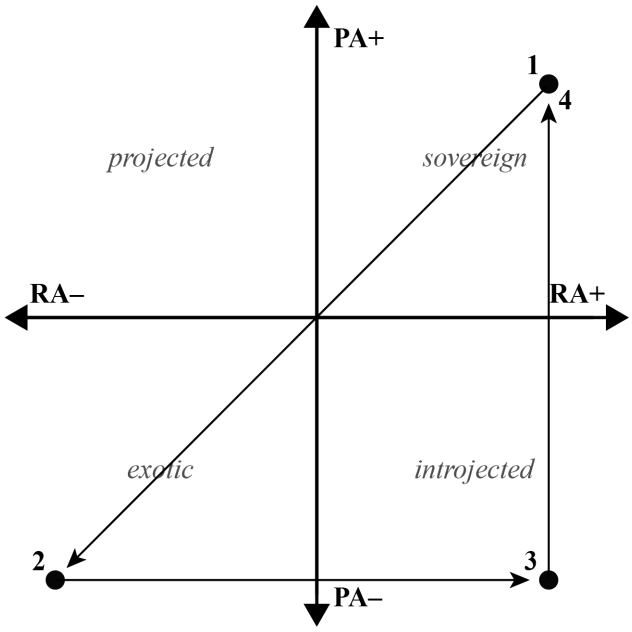

Figure 8. Autonomy tour with 'Gerousia'

This takes the same tour by moving from (1) the sovereign code ending the previous quote to (2) an exotic code (voting for happy music), then to (3) an introjected code (turning that vote to the purpose of illustrating the Spartan system) and on to (4) her sovereign code (how Spartiates could determine the result). The teacher repeatedly circles through these codes in this order, taking this tour numerous times through the lesson – it is a well-trodden pathway. For example, here she continues directly on from above into another tour:

Teacher We think it's really difficult. But if you were to say to them: 'Well, you've got to go into this little cardboard box…' – because that's what you have when you're voting: you go and stand in this little cardboard box and you get a pencil that they give you and a piece of paper, where someone's looked down a great big list and crossed off your name, and then you've got to read the piece of paper and put numbers in every single one of those boxes – they'd be looking at us saying 'Are you crazy?' It's the way you get used to. So, they would actually go till there was a clear winner or loser.

Again she shifts from her sovereign code to an exotic code (describing voting practices in modern Australia to ensure everyone in the class knows the details of this example), through an introjected code (imagined Spartan astonishment to make the point they have different expectations), and back to her sovereign code (Spartan voting process).

4.2.3. Summary

By leaving her sovereign code the teacher includes knowledge from beyond the History syllabus but, unlike a one-way trip, this does not only lead away from her target. In the return trip the teacher includes other content but retains her target purpose, maintaining stronger relational autonomy (introjected code) which supports its swift integration into her discussion of target content. In the tour she first discusses non-target content on its own terms (exotic code) before 'turning it to purpose' by strengthening relational autonomy (introjected code) and then discussing further target knowledge (sovereign code). She thus selects knowledge from beyond her target, repurposes that knowledge, and integrates the repurposed knowledge into her target. By doing so, the teacher was able to augment and enrich the educational knowledge she was imparting with archaeological findings in the return trip and to engage students with and illustrate educational knowledge in accessible ways (with modern cases, analogies and practical examples) in her tours.

5. Autonomy pathways in science lessons

To show that trips and tours are not confined to teachers engaging with everyday meanings in humanities subjects, I turn to science lessons. To foreground the effects of different pathways I again use otherwise similar examples. Both analyses presented in this section are from Year 7 of secondary schools that teach the same state curriculum, in New South Wales, Australia. Both teachers described their target content (PA+) as the Stage 4 Science syllabus of the New South Wales Board of Studies and their target purpose (RA+) as teaching students that content. Both lessons are from units on 'Earth and space sciences' and both involve teachers drawing on 'mathematical' ideas they construct as beyond their target knowledge. In the first example, the teacher takes students on an *autonomy tour* that integrates non-target knowledge about creating graphs into her target knowledge about Earth's seasons. In the second example, a different teacher leads students on a *one-way trip* from science to a 'maths' activity that remains segmented from his target knowledge.

5.1. Autonomy tours in science

In the opening lesson of a unit on the causes of Earth's seasons, students conducted an experiment to explore the effect on temperature of the angle at which sunlight strikes the Earth's surface. In groups, students used a lamp to represent the sun and a wooden block to represent the Earth and, varying the angle of the lamp to the block (15, 30, 60 and 90 degrees), recorded temperatures at different times (initial, 2.5 minutes, 5 minutes) from an attached thermometer. Prior to the experiment each student wrote a hypothesis of whether increasing the angle would increase, decrease or have no effect on the temperature. The second lesson, which I analyse here, continues this focus. The teacher begins by setting out her (inner-core) target:

> Teacher What we will be doing today is looking at those results, graphing the results and then talking about what it is that we were actually trying to model.

Over the next 35 minutes the teacher leads students on an autonomy tour through those activities: from her sovereign code (discussing their results), through an exotic code (recapping 'graphing rules'), and an introjected code (applying those rules to graph their results), before returning to her sovereign code (relating graphs to Earth's seasons).

5.1.1. Tracing the pathway

The teacher begins by recounting the experiment and then solicits students' overall findings:

Teacher	So looking at your results there, who can give me a statement about what their results did?
Student	As the angle of the block increased, the temperature increased.
Teacher	Fantastic. I love that. That's a really great statement. Did someone get something different in their results?

The teacher thus begins deep inside her sovereign code: both content (experiment modelling a factor in Earth's seasons) and purpose (to learn about that experiment) are located within her target.[14] After discussing the findings of several students, she announces: 'We are going to graph… I want you to think about the graphing rules'.

As emphasized earlier in section 3.2.2, no specific practice is intrinsically a particular code. To determine the autonomy codes embodied by this graphing activity we must consider the teacher's target: the Stage 4 Science syllabus. A strand of the syllabus entitled 'science inquiry skills' includes for Year 7: 'Construct and use a range of representations, including graphs, keys and models to represent and analyse patterns or relationships in data'.[15] So, graphing is potentially within the teacher's target. However, the syllabus emphasizes that such 'science inquiry skills' give students 'the tools they need to achieve deeper understanding of the science concepts'. Procedures such as graphing are only considered 'science inquiry skills' when 'closely integrated' with learning the 'science knowledge' outlined in the strand 'Science understanding'. This includes 'how changes on Earth, such as day and night and the seasons, relate to Earth's rotation and its orbit around the sun'. Thus, whether graphing is within the teacher's target depends on whether she integrates its content or purpose with learning about Earth's seasons. Here, as I shall show, she begins by separating graphing in terms of both its content and purpose, then integrates its purpose, before finally integrating its content.

The teacher sets up the task by recapping 'graphing rules' separately from Earth's seasons. Continuing on from the quote above, she says:

Teacher	So, who can remind me about what the rules are for graphing?
Student	Y versus X.
Teacher	Y versus X. How do we know which one goes where?
Student	The independent variable goes on one side.
Teacher	The independent variable goes on one of them. Yes, that's good.
Student	And the dependent variable …
Teacher	… goes on the other one. The thing that is the most regular, which is usually your IV [independent variable], goes on the X, and your DV [dependent variable] goes on the Y.

This embodies: weaker positional autonomy (PA–), as the 'graphing rules' are not related to Earth's seasons; and weaker relational autonomy (RA–), as its purpose is recapping

[14] The example begins in the teacher's *inner-core* target for the lesson, so the pathway in Figure 9 starts deep within her sovereign code.

[15] All quotes here are from the New South Wales Board of Studies (now New South Wales Education Standards Authority) science syllabus content descriptions for Stage 4 (Years 7–10), as outlined on https://syllabus.nesa.nsw.edu.au/stage-4-content/ (retrieved 21 May 2018).

'graphing rules' rather than learning about Earth's seasons. As portrayed in Figure 9, the teacher has shifted from her sovereign code into an exotic code (PA–, RA–).[16]

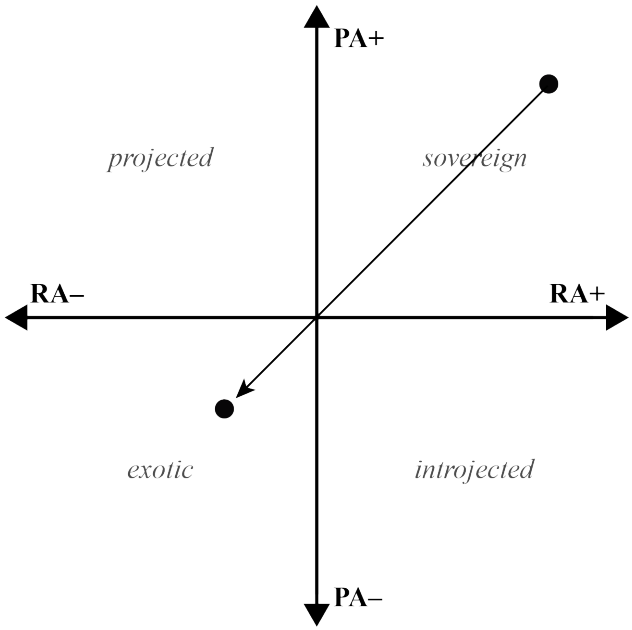

Figure 9. Shift from sovereign code to exotic code

The teacher then shifts to a third code by repurposing this knowledge of 'graphing rules':

> Teacher Now, in *this* experiment, who can tell me – there's a little problem. Have a look at our data. Can you tell me which one goes on the X and which one goes on the Y?

One student suggests 'the angle' should go on the Y-axis, another suggests the X-axis, and the teacher asks students for the locations of 'temperature' and 'time'. After a student exclaims 'Wait! What?', the teacher explains the problem:

> Teacher So in this experiment we've got three sets of data, okay? So, this one's going to kind of break the rules a tiny bit. The easiest way for us to do this is that you're going to have […] 'time' on the X, 'temperature' on the Y, and four different lines. The four lines you're going to draw is one line for 15 degrees, one line for 30 degrees, one line for 60 degrees and one line for 90.

The content of discussion – locating variables on axes and drawing lines – remains weakly integrated with what the experiment reveals about Earth's seasons: weaker positional autonomy. However, the purpose is to create a graph that can show this knowledge: stronger relational autonomy. As portrayed in Figure 10 (below), this shifts classroom practice to an introjected code.[17]

[16] Here both content and purpose concern educational knowledge, so Figure 9 portrays the shift to an *associated* exotic code (PA–, RA–).

[17] Creating a graph for the experiment's results is within the teacher's *inner-core* target purpose for the lesson, so the Figure 10 pathway shifts to extremely strong relational autonomy.

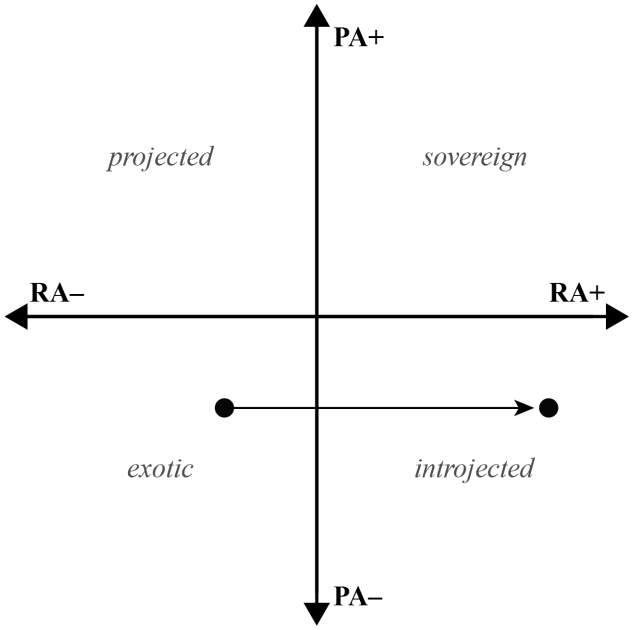

Figure 10. Shift from exotic code to introjected code

This introjected code is maintained throughout the graphing activity. While students apply the adapted 'graphing rules' to their results, the teacher alternates between addressing the whole class and advising individual students; for example, to the class:

> Teacher All right! Along the X-axes, there will be three values: the X-axis has your time on it. There will be a time for five minutes, there will be a time for two and a half and there will be a time for 'initial', which we can call zero, zero minutes. Okay? …

Then, looking at a student's workbook, she asks:

> Teacher Why is this word here?
> Student 'Angle'.
> Teacher We are not doing 'angle' like that.
> Student Oh, whoops!
> Teacher Just follow what's going on here. This is the X.
> Student Okay.
> Teacher Okay? So 'temperature' does not belong there. X along here is 'time'. Y along here is 'temperature'.

Discussion continues in this vein for 12 minutes as students draw graphs. As the quotes above illustrate, the content involves locating variables on axes, ranges for variables, using symbols, labelling, evenly spacing intervals, creating a key for symbols, and avoiding overlapping lines. Content is thus not related to what results reveal about Earth's seasons: weaker positional autonomy. However, the purpose is to create graphs which do just that: stronger relational autonomy. As the teacher explains: 'This is a better way of presenting the data … Straight away when you look at this graph, you can see which one has increased in temperature fastest.' Graphing thus manifests here as an introjected code.

Once students have completed graphing, the teacher shifts classroom practice to her sovereign code. Students write in their workbooks a 'conclusion' of what their graphs show, whether this supports or refutes their previous hypothesis, and what they could do to test the idea further. Discussion of graphs now concerns what they reveal about the focus of the experiment; for example:

Teacher	What did we learn? […]
Student	We learned that the steeper the angle, the hotter the temperature.
Teacher	Good. The steeper the angle of the block, we got a greater increase in our temperature. Who can tell me why? Why did it get hotter? …
Student	Because the core of the block is closer to the light.
Teacher	Good. The middle part of the block, as you increase the degrees, makes it closer to the light. Good.
Student	Because it's getting more direct rays when it's on a higher angle as opposed to when it's on …
Teacher	Good. When we have a higher angle, we have more of those light rays striking the block, and those light rays then can heat up the block more effectively than the ones that are just skimming over the top.

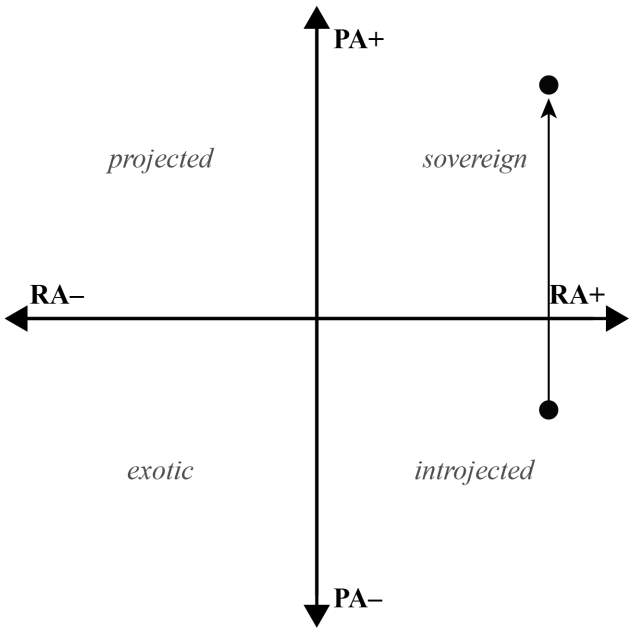

Figure 11. Shift from introjected code to sovereign code

This shift to a sovereign code is then consolidated by the teacher, first by emphasizing the experiment's purpose – stronger relational autonomy (RA+):

Teacher	Okay, but what's the point in doing this? Are we really interested in whether or not blocks can heat up with a lamp?
Student	No!
Teacher	No? Who can remember the word I used to describe what this experiment was? Starts with an 'm'.
Student	A model?
Teacher	A model. Fabulous. This was a model. It was a model of the Earth and the sun.

Second, she explains differences between the model and reality and how those differences shape the experience of heat on Earth – stronger positional autonomy (PA+). As portrayed in Figure 11 (above), content is now from the syllabus and for the purpose of learning that syllabus – her sovereign code.

5.1.2. Summary

As portrayed by Figure 12, classroom practice here traces a pathway through: (1) the teacher's sovereign code by discussing results of the experiment; (2) an exotic code when discussing 'graphing rules'; (3) an introjected code when adapting those 'rules' to graphing results of the experiment; and (4) her sovereign code when translating graphs into conclusions about what was modelled by the experiment

Given that graphing can be discussed in ways that locate it either within or beyond the teacher's target, it could have been integrated from the outset. So why did the teacher leave her sovereign code? By constructing 'graphing rules' as an exotic code, the teacher keeps that knowledge distinct from the experiment. This allows her to connect to ideas students already know but also to clarify how graphing will be different in this context. This distancing move allows her to then select from those ideas, repurpose those she has selected, and integrate their use into her target knowledge. This the teacher achieves in two further steps: strengthening relational autonomy by turning the 'rules' to the purpose of graphing results from this experiment (introjected code), and then strengthening positional autonomy by translating the resultant graphs into knowledge about Earth's seasons (sovereign code). Leaving her sovereign code is thus a first step towards a return that supports integrative knowledge-building.

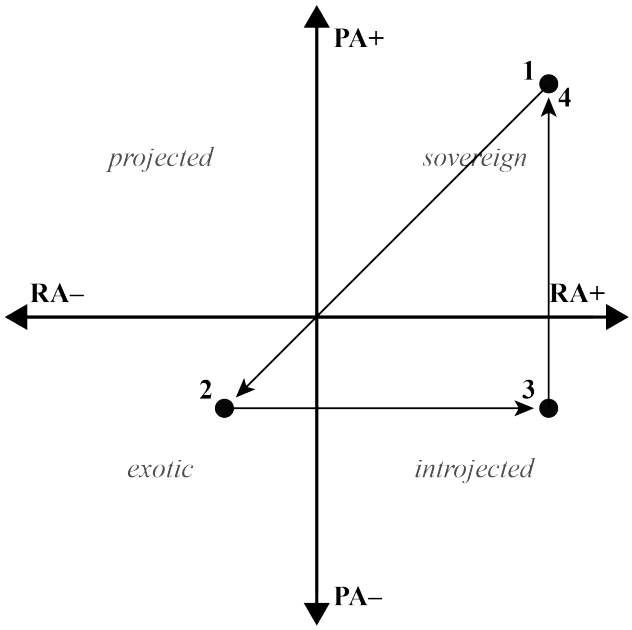

Figure 12. Autonomy tour with graphing results of an experiment

5.2. A one-way trip out of science

A contrastive pathway comprises a distinct phase of activity spanning an entire lesson. This involves a different teacher at a different school but the same unit ('Earth and space sciences') in the same level (Year 7 secondary school). The teacher's core target is the same: to teach students 'about the universe and our solar system and what's beyond Earth… How we get night and day or how you get the different seasons' (teacher interview). Again,

the phase involves 'mathematical' practices: students calculate relative diameters of planets and distances to the sun as percentages of those for Earth. The teacher begins in his sovereign code but quickly shifts into an exotic code of using numbers to calculate other numbers, taking students on a *one-way trip* that never returns to his target content or purpose. After 52 minutes, the teacher ends the lesson by declaring: 'I know it's confusing'.

5.2.1. Tracing the pathway

Prior to the activity, the teacher began the lesson by showing students a six-minute video entitled 'The smallest to the biggest thing in the universe'. Starting from hypothesized entities in quantum physics, the video zooms outwards through ever-larger phenomena to conclude with the known galaxy. The teacher then introduces the activity by telling students that 'because we just can't fathom the distances involved', they will translate measurements from the solar system into multiples of the Earth. He directs them to 'draw up a table' of 'seven columns and 10 rows'. At this point, classroom practice is exploring content about the solar system (stronger positional autonomy) for the purpose of understanding the solar system (stronger relational autonomy); i.e. within the teacher's sovereign code (PA+, RA+).

Table 3. Teacher's table for activity

	Radius (km)	Distance from the sun (km)	Time to orbit around the sun	Time taken to turn once on its axis	Diameters as % of Earths	Distance as % of Earths
The Sun	695800					
Mercury	2439.7	57910000	88Ed	58d15h30m		
Venus	6052	108200000	224.7Ed	116d18h0m		
Earth	6371	149600000	365.25Ed	1d		
Mars	3390	227900000	686.97Ed	1d0h40m		
Jupiter	69911	778500000	12Ey	9h56m		
Saturn	58232	1433000000	29Ey	10h39m		
Uranus	25362	2877000000	84Ey	17h14		
Neptune	26422	4503000000	165Ey	16h06m		

The teacher continues by showing a PowerPoint slide of a table, to which he adds two column titles by hand on the whiteboard – reproduced here as Table 3. He asks students to 'copy down this information if you haven't already got it' and reminds them that in a previous lesson they had written down diameters of planets and their distances from the sun. He directs them to add further details from the table and explains:

> Teacher I want you to add this information, these two [points to third and fourth columns] … are relative to the Earth. … Since we've already got the information just do four columns, because we're going to do some maths.

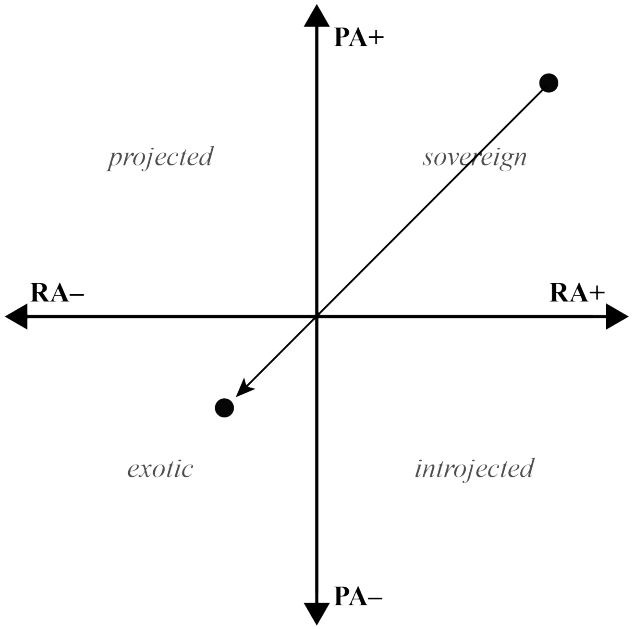

Figure 13. Shift from sovereign code to exotic code

As illustrated by Figure 13, this shifts the task into an exotic code (PA–, RA–) in which non-target content is used for non-target purposes. The teacher weakens positional autonomy by repeatedly describing the table contents as 'information' (five times within a minute), abstracting its content from his target topic. He also weakens relational autonomy by describing the purpose as 'to do some maths' without relating this to learning syllabus content.[18] Indeed, he re-emphasizes this aim when responding to questions from students about the task; for example:

> Teacher Just do the last two columns and then add two more because we're going to do some maths in the last two.

Thus far, classroom practice traces the same pathway as the start of the autonomy tour discussed above. However, where that teacher then turned non-target content to her target purpose, here the lesson remains in an exotic code. Students begin by copying numbers from the table, during which a series of students ask the teacher which numbers they should copy. After eight minutes, he tells the whole class how to fill the two added columns:

> Teacher Alright, do we know how to work out the percentage for ….? So which one do we have to divide by? [Student name], what do you think? To work out Mercury, the percentage compared to Earth? What do you think we'd have to do?
>
> Student Divide it by a hundred?
>
> Teacher No, no, no. Alright. What we do [draws on whiteboard: $\frac{Mercury}{Earth}$x100]. Alright, so distance percentage [pointing to last column title] is the distance from the sun. Okay? So to work out the percentage, you divide each of the planets by the Earth's diameter.

[18] Given the teacher's repeated description of the task as 'maths', both content and purpose concern educational knowledge. Accordingly, Figure 13 portrays the shift to an *associated* exotic code (PA–, RA–).

Over the next 15 minutes the teacher repeats similar instructions to a series of individual students, each time describing what 'information' must be multiplied or divided to 'give you a percentage'. When names of planets are mentioned, he is referring to empty cells in the table rather than to the planets themselves. More often, the teacher simply refers to 'information' or 'number', such as:

> Teacher Divide that number [pointing] by that number [pointing] for the distance; that number [pointing] by that number [pointing] for the diameter. Alright? That's what you're supposed to be doing.

Thus far the content is from neither the teacher's target of the syllabus nor his core target of learning about the solar system and Earth's seasons, and the purpose is to 'work out the percentage' or 'easy maths'. The knowledge being expressed thus remains within an exotic code.

During the course of the activity some students, distracted from the task, drift further into an exotic code. For example, one student asks the teacher whether people are made of 'planks', another asks him what is smaller than a 'string' (both mentioned in the earlier video), and a third asks 'Are we made of stardust?'. The teacher's responses – 'No', 'Didn't you watch the video?', and 'What do you think?', respectively – do not add target content or turn their questions to his target purpose of learning about the solar system or Earth's seasons.

After 38 minutes the teacher asks students to call out numbers for the column 'Diameters as % of Earths'. He then raises the question: 'What do these percentages actually mean?'. This is an opportunity to strengthen relational autonomy by turning these figures to the purpose of learning about the solar system. However, one student suggests 'A lot of numbers' (accurately reflecting the exotic code that has characterized the activity) and the teacher leaves his question unanswered. The pattern outlined above is then repeated: students make calculations (this time for the 'Distances' column), the teacher repeats similar instructions to students, and numbers are then solicited from the class. Classroom practice remains in an exotic code. The activity is concluded after 52 minutes with the teacher saying to the class, 'I know it's confusing' and announcing they will look at 'day and night' in the next lesson.

5.2.2. Summary

The autonomy pathway traced by this lesson represents a one-way trip out of the teacher's target. As portrayed by Figure 13 (above), the knowledge expressed in classroom practice shifts from a fleeting sovereign code to a very long stay in an (associated) exotic code. The teacher could have remained inside his sovereign code by closely integrating the numeric activity with the syllabus but instead chooses to project the activity as beyond his target, as doing 'maths' to 'work out the percentage'. While this echoes the start of the autonomy tour discussed above, it then diverges in content and purpose. First, instead of strengthening positional autonomy by returning to target content, he discusses numbers as numbers. Secondly, rather than strengthening relational autonomy by turning non-target content to his target purpose, he continues to construct the activity as using numbers to calculate other numbers. The shift to an exotic code is thus not a precursor to integration. Any lessons to be learned from calculating percentages remains segmented from knowledge of the solar system or Earth's seasons.

6. A plenitude of pathways

There are far more pathways to be found than are dreamt of in these analyses. The empirical forms taken by targets, autonomy codes and pathways in the examples above are but a fraction of those possible. Tours and one-way trips do not necessarily follow the routes above and are far from the only possible pathways. Grasping this plenitude is crucial. Reducing concepts to their empirical realizations in one specific study would reflect a limited understanding of their potential and a distorted view of how autonomy tours shape knowledge-building. Accordingly, I now explore the diversity and applicability of autonomy pathways for research.

6.1. Many targets

The participants here identified their targets with the state syllabuses of a specific subject area (History or science) and a level of education (Stage 4). However, targets of teachers in other subjects and levels differ. Targets of other practitioners (curriculum designers, professional developers, etc.), in other institutions (vocational colleges, universities, etc.), or other fields (law, healthcare, etc.) differ. Even the teachers I analysed identified different targets (such as generic study skills) for other classes. The range of potential target contents (art, industrial processes, religious beliefs, etc.) and target purposes (political persuasion, selling products, creating laughter, etc.) is enormous. In short, targets (and thus sovereign codes) need not involve educational knowledge, curriculum, or established disciplines.

Grasping the potential diversity of target helps avoid several facile misreadings. First, it shows that to suggest, as I have done, that autonomy tours can support integrative knowledge-building *is not an argument for disciplines or stronger boundaries*. For example, autonomy tours in problem-based learning may involve integrating exotic codes of disciplinary knowledge into a sovereign code of interdisciplinary knowledge. Second, it becomes equally clear that my conjecture is *not an argument for interdisciplinarity or weaker boundaries*. Though tours involve engagement with other knowledge practices, non-targets need not be disciplines; section 4, for example, involves tours into everyday understandings. More generally, a target may exhibit stronger or weaker boundaries and an autonomy tour may strengthen or weaken those boundaries – determining these strengths is a matter for empirical analysis. Third, it becomes clear that to advocate 'autonomy tours' is not to valorize any specific form of knowledge practice but rather to show how diverse knowledge practices can be integrated. Targets (and sovereign codes) may be anything.

Targets may also be missed or ignored. The notion of autonomy tours does not suggest, for example, that teachers do or should slavishly follow a syllabus. As sections 4 and 5 illustrate, teachers exercise considerable agency in their choice of pedagogic strategies. They also demonstrate that pedagogy cannot be reduced to or 'read off' a curriculum: teachers sharing the same syllabus target adopted very different pedagogic strategies, with contrasting effects for knowledge-building.

Finally, participants within a social context may have different targets, there may be struggles over which target is dominant, and dominant targets may not be recognized by all actors. For example, in the History one-way trip (section 4.1), many students came to view the target knowledge as identifying boot shapes on a map. What was an exotic code for the teacher was a sovereign code for those students, an autonomy code clash that was 'resolved' by the teacher ending the activity. On the autonomy plane nothing empirical is always and everywhere up or down, left or right: targets are set by the play of power among actors in a social context. One can thus enact autonomy codes to explore how different actors construct the same practices differently: one person's target may be another person's non-target. One can also enact the concepts to analyse the play of power within a social

context by exploring who is able to set the target: whose target is defining the autonomy codes here? How power, status, struggles and cooperation shape the limits of what is viewed as valuable and as possible is central to the approach.

6.2. Many pathways

The analyses here illustrated only one kind of one-way trip (sovereign→exotic) and only one kind of tour (sovereign→exotic→introjected→sovereign). It would be mistaken to extrapolate from these limited examples to the claim that sovereign codes build knowledge, exotic codes are segmental, and projected codes are irrelevant. I cannot overstate that no one code is better than any other code and that trips and tours may take many forms. For example, other studies of education are discovering autonomy pathways that support different goals, such as: autonomy tours that integrate videos into classroom practice by cycling through introjected→projected→sovereign→introjected codes (Maton 2017); and projected codes required by assessments in which students must apply target content to such non-target purposes as new problems.

More generally, I conjecture that autonomy tours are a generic feature of integrative knowledge-building but that different subjects, years of study, tasks, activities and so on have their own distinctive pathways to success. Ongoing studies are beginning to reveal different kinds of autonomy tours generated by such features as their departure and arrival codes, number of steps, sequencing of steps, length of time taken, number of distinct activities spanned, and degree to which steps are contiguous or breaks. This diversity suggests a key question for research is: what pathway serves what purposes, for whom, and in which contexts?

6.3. Many phenomena

Autonomy codes are not limited to studies of classroom practice.[19] Though the concepts are newly minted, studies are already beginning to enact autonomy codes to investigate issues at all levels of education, across the disciplinary map, and in diverse national contexts, as well as beyond education.[20] Ongoing studies of student assessments are also suggesting that students possess different capacities to recognize and generate autonomy pathways required for success. Though requiring further study, this work implies that analysing the dispositions of actors could reveal degrees of match or clash between the autonomy codes required for success and those which students bring to educational contexts by virtue of their previous experience. Not everyone may see or be able to hit a particular target. Such analysis has social justice implications. There is an ever-growing body of research and teaching drawing on the LCT dimension of Semantics to analyse and teach the 'semantic waves' required to succeed in education (Maton 2020). There is no reason Autonomy should not prove as fruitful in revealing the 'rules of the game'. Analysing the autonomy codes of achievement would thus represent a first step towards

[19] Code concepts in LCT are sometimes mistakenly identified with the object of study with which they are first illustrated, such as 'semantic waves' and classroom practice or 'specialization codes' and intellectual fields. Thus I repeat that 'code concepts overcome the gravity well of specific contexts' (Maton 2014: 207) – autonomy codes (like all legitimation codes) can be enacted to study a far greater range of phenomena than I can illustrate in this paper.

[20] See Locke & Maton (2018) on vocational education and Maton (2019) on television sketch comedy. See forthcoming work by: Karin Wolff on mathematics in STEM teaching; and Jo-Anne Vorster on academic development. Ongoing doctoral studies include: animation in online courses (Yufei He); professional legal education in the UK (Robert Tam); multilingual teacher-talk in Nigerian secondary school classrooms (Madu Bassi); English curriculum in Australian secondary schools (Daniel Anson); and professional development of school teachers in the USA (A.J. Jackson).

teaching more students the pathways to success and giving them the ability to consciously change those pathways.

6.4. Many dimensions

Autonomy tours are not all that matters. First, tracing pathways are but one way of enacting autonomy codes in research. Studies can explore the affordances of each autonomy code or the implications of code matches and clashes between, for example, an actor's dispositions and the dominant code of a social context. Second, autonomy codes are not the only organizing principles underlying practice. I thus conjecture that autonomy tours are *a* rather than *the* key to integrative knowledge-building: other legitimation codes may play roles. For example, the pathways of sections 4 and 5 can also be analysed in terms of their profiles of semantic gravity (SG) and semantic density (SD). The one-way trip in History from sovereign code to exotic code is characterized by a semantic downshift from generalized and complex meanings of school History (SG–, SD+) to more context-dependent and simpler meanings of finding boots on a map (SG+, SD–); and the autonomy tours in History involve semantic waves between government in ancient Greece (SG–, SD+) and modern everyday life (SG+, SD–). However, there is no equivalence between autonomy pathways and semantic profiles. The one-way trip from science into numeric calculation involves relatively little movement in semantic gravity or semantic density. Similarly, though the science tour involves a semantic wave – up to 'graphing rules', down when applying rules, and up to issues of Earth's seasons – these moves come together with different autonomy codes to those found in the History example.[21] As these examples illustrate, dimensions explore different features; for example, semantic waves do not reveal the key strategy of 'turning to purpose' using introjected codes. However, they can be complementary; for example, further research may show that autonomy tours require semantic waves to integrate different knowledge practices cumulatively.

Further research is also required into the semiotic resources that support autonomy tours. Research using systemic functional linguistics (SFL) to explore how linguistic choices support semantic waves has proven extremely productive and generated practical outcomes (e.g. Martin *et al.* 2020, Macnaught *et al.* 2013). Everything suggests similar research on autonomy tours would be just as fertile. The notion of 'autonomy tours' also raises questions for SFL scholars, such as concerning consistency of register. For example, the science tour (section 5.1) involves various combinations of fields (science and mathematics), modes (experiment, graphing, description, etc.) and tenors (monologue, discussion, etc.) not easily predicted by genre staging. Autonomy tours may provide one way to deepen understanding of such shifting assemblages and their effects for learning. The creation of Semantics in LCT heralded a new phase in productive collaboration with SFL that generated advances in both approaches (Maton & Doran 2017b). The development of Autonomy may urge this dialogic endeavour to greater heights.

7. Conclusion

The desire for integrative knowledge-building may appear ubiquitous, but desire is not enough. Neither are open-mindedness, curiosity or generosity. Contrary to beliefs that such attributes are sufficient for scholars, teachers or students to integrate diverse

[21] Among differences between the two tours: practices exhibiting exotic codes are characterized by a prosaic code in the History tour but a rhizomatic code in the science tour; the History tour involves semantic code shifts while the science tour does not (waving remains within a rhizomatic code); and their introjected codes involve a semantic upshift in History but a downshift in science.

knowledge practices, the knowledge practices themselves also play a role. This paper has introduced concepts from the Autonomy dimension of LCT that enable research to explore relations among different practices without succumbing to problems created by existing models. The concepts of *autonomy codes* avoid the essentialism inherent in such preconstructed categories as 'academic', 'everyday' and disciplinary labels. Enacted on the *autonomy plane*, their exploration of organizing principles moves beyond typologies to engage with complex, variegated and changing practices. The *generic translation device* further avoids relativist paralysis by making the situated construction of knowledge practices a starting point for analysis rather than its banal conclusion. With these concepts analysis can thereby steer clear of the sterile see-saw debate between attempts to pin down fixed characteristics of knowledge forms and repeated reassertions that knowledge is socially constructed.

The capacity of these concepts to be enacted in close analyses of real-world empirical data was then illustrated through detailed discussion of classroom practices in secondary school science and History lessons. As these demonstrated, autonomy codes explore the way knowledge practices are constructed by actors in the context being studied. For example, one science teacher constructed graphing as beyond her 'science' target before then integrating it within this target, while a second teacher constructed numeric calculations as beyond his target. Autonomy analysis thereby reveals the active construction of knowledge practices by situated actors, the moulding, recasting, transforming of practices, the 'boundary work' often proclaimed but little demonstrated in discussions of issues such as interdisciplinarity.

Moreover, the analyses suggest that bringing together different knowledge practices does not by itself lead to their integration. What matters is how practices are selected, repurposed and connected, as shown by autonomy pathways. In the examples, one-way trips left different knowledge practices segmented, while tours not only engaged with but also integrated other knowledge practices. However, I also emphasized the multiplicity of other targets, pathways, phenomena and dimensions to be considered. Research using autonomy codes has barely begun. It may quickly grow if the potential of these concepts for generating explanatory power proves an incentive for scholars and practitioners to venture from their substantive concerns, engage with these ideas, and turn them to the purpose of explaining and improving practice – taking autonomy tours as a key to integrative knowledge-building.

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