6 The Language of Design and Its Politics

[Robert] Moses used this phrase, so innocent in appearance, as authorization to write into contracts … on the design and relative desirability of construction projects …

Robert Caro, *The Power Broker: Robert Moses and the Fall of New York*, p. 705

Design, Language, Codes

We have presented the view that design designs through words, that the language of design performatively enacts design. The language of design can explicitly inscribe the designed work itself. As the epigraph reminds us, there are instances in which the language of design is performative in the Austinian sense – it was reportedly sufficient for Robert Moses to name a designed work to create the designed work. In many other instances, however, the patterns of language structuring are means by which design is produced by the performative operators of the language of design. The performative aspects of the language of design realize designed works which the language of design can speak of. The performative aspects write the relations that discourse about a designed work and design practice must establish. The performative aspects speak of and produce designed works by framing them (aggregating), forming them (accumulating), and rationalizing them (appraisal). In seeking a more capacious account imbricating the representational, constructive and instrumental roles of the language of design, our analyses have highlighted that the language of design is more than the use of symbols to designate design. Its performative operators render design. In doing so, language is seen not only as a message carrier but implicated directly in producing the carried.

Beyond the analysis of language realizing design practice and the designed work in describing it, we ought to consider if they are the only messages transmitted and produced through the language of design. Is there another layer operating with (perhaps 'behind') design discourse that regulates the way that designing can be (should be) accounted for? Arguing against essentialism, the concept of performativity claims that design is realized only to the extent that the performances cite prior, legitimized norms. The formation of the designed work and design practice takes place within a design praxis which set established traditions and obligations for those engaging in design. I have explained this issue to my more

A. Dong, *The Language of Design*,

'information technology-minded' peers in the following way. The architecture of network communication abstracts away the application protocol (e.g., HTTP, FTP) from the network protocol (e.g., IP) from the hardware protocol (e.g., Ethernet). This abstraction allows us to use a single type of data 'stream' to carry messages packaged for different application protocols. And, to a certain extent, the lower levels in the abstraction, such as the stream, control what is carried, such as breaking up a message into packets of data or wrapping the data with checks to ensure their integrity at the receiving end. Is the language of design just a stream of words that carries a message? Is it politically neutral or is the stream itself regulating what can be carried and how it can be carried? My argument in this chapter will be that the language of design is not ideologically free, and that accounts of design through the language of design are not necessarily fully willful accounts.

The political effects of the way that design is communicated are a topic that has not gone un-noticed. As I stated in the Preface to this book, much of what is known about design by 'non-designers' is gained through language-based communication about design – primarily through the media such as magazines about design, advertising, and television. Peter Lloyd, an academic in the Open University in the UK, conducts studies into the representation of design in the media, particularly television. In one study (Lloyd 2002), he analyzed three television programs to illustrate how the programs were effective in creating images of design – that is, lay knowledge about the process of designing and what designers do (including usefully dispelling the 'myth-conception' of the 'star designer' in depicting the cooperation of designers and design stakeholders). These television programs, as with other forms of mass media, are recruited to re-construct and reaffirm specific images of design. While the scene of recognition of design is the television program itself, there may be prior frameworks, such as Lloyd's training as an industrial designer, structuring how viewers judge and see design. Certainly, after watching one of these programs, people may develop new frameworks for seeing design. What I think studies such as Lloyd's are trying to locate are the sociology of design, that is, the structure and behavior of designers' relations with others and how these social relations affect the practice of design. The ways that design is communicated through language and the visual field are party to the sociology of design.

The question that I am approaching in this chapter is how the language of design can be seen as both producing and reproducing the social relations that are the backdrop to the sociology of design and that precede the accounts of design. This chapter raises the question how it was that the language of design 'taught' designers to become oriented to a particular socio-technical or socio-cultural system of design. Having highlighted the coupling between the language of design and the enactment of design, our attention now turns to how the language of design registers ideological assumptions that may regulate design and the way that designing can be acceptably characterized. What codes exist within the language of design that determine the way that design can be acceptably described and practiced? My contention is that if designers are giving accounts of design through language, then that language, and the 'canon' from which that language derives, becomes

"a structuring structure which is in a continuous process of reproducing itself, mediating its identity through market forces, and negating the social conditions of its production by covering the tracks of its arbitrary and subjective formations." (Steiner 1996, p. 217)

As we discussed in the chapters on aggregation and accumulation, the language of design is drawn from both the particular design situation and a broad set of voices. What I am asking for is a conceptual apparatus that uncovers the ontological evidence for codes which govern how designers come to be in a position to frame and organize their way of accounting for their design practice and of orientating themselves to a design profession in a way that makes their mode of designing acceptable and recognized. Of particular interest is whether we could apply the same performative operators, aggregation, accumulation, and appraisal, to register these codes. The goal of the analyses that I will present in this chapter is not to get at empirical evidence to stake claims about the sociology of design, or even the sociology of specific design professions. Rather, the aim is to consider how the 'structuring structure' of the language of design could expose how the sociology of design disciplines is being developed.

The Sociology of Design Education

Design education, regardless of the discipline, includes rigorous study in domain competency, processes, tools, and, sometimes, humanistic concerns. While there are often well-developed curricula in technical design communication, these tend to focus on presentation of design information. What is overlooked is that the presentation participates in the language of design not just as material for overhead slides but as a realization of its codes. The way that language is used in the presentation affirms a sociology of design education. Language is more critical to design education than mere technical communication.

To explain why language use in design is important to the sociology of design education, we need to revisit the ideas of the Russian school of psychology and namely the ideas of Vygotsky. Central to Vygotsky's theories on learning is his rejection of biological explanations of learning. That is, Vygotsky argues that if we were to remove culture, function, and situated activity from learning, then learning could be reduced to biology – biology is the explanation for learning. However, this could not be, as Vygotsky concluded from observations through his studies on infant learning without language and the infantile use of language. In contrast to Piagetian theories on infant learning as progressively staged through the first two years of human development, Vygotsky theorized that cognition needs to be studied as a practice which arises out of a socio-cultural system in which the child's environment, including its objects, tools and people, operate as agents for the development of thinking skills. Language use is relevant because the means by which social interactions are co-ordinated become the means by which the child not only acquires symbols but also by which metacognitive competences for goal setting,

planning and revising strategies for learning are constructed. The evolution of human linguistic competence notwithstanding (Tallerman 2005), Vygotsky approached the question of the role of language in learning from the perspective of language as a tool of cultural practice. His approach contrasts with the view of language as a grammatical system or language as encoding thoughts, which would be the basis of a linguistic or a psychological investigation, respectively.

What Vygotsky was searching for was a way to unify the elements of historical human cognitive development. Vygotsky theorized that cultural learning occurs in a zone of proximal development. Quoting Vygotsky's definition, Wertsch writes that "Vygotsky defined the zone of proximal development as the distance between a child's 'actual developmental level as determined by independent problem solving' and the higher level of 'potential development as determined through problem solving under adult guidance or in collaboration with more capable peers'." (Wertsch 1985, pp. 67–68) Schön's classic account of Petra learning with the studio master Quist is a prototypical example of the zone of proximal development in action wherein the studio master Quist performs "competences he would like her to acquire", (Schön 1985, p. 33) competences she would presumably not be able to acquire in his absence. For Schön, the zone of proximal development situates architectural education. Schön writes that architectural studio masters "make systematic descriptions of their practice and coaching, and the knowledge and appreciations embedded in them" (Schön 1985, p. 7) for the students.

The formulation of this difference allowed Vygotsky to characterize the transitions between the four historical domains of human development toward "higher mental functioning". Michael Cole characterizes Vygotsky's aim as a "full theory" of culturally mediated behavior that accounts for the "interaction of processes occurring at all the levels of human life system: phylogeny, cultural history, ontogeny, and microgenesis." (1995, pp. 191–192)

1. phylogeny – the evolution of the human species
2. history – the development of cultural tools and sign systems
3. ontogeny – psychological development
4. microgenesis – moment-to-moment changes of understanding when performing a task

According to Vygotsky, these four domains come together during social interaction. Social interaction is both a vestibule and an affordance for the transference of social capital. It is through such social interaction that cultural contents are transformed into differences in individuated cognitive processes.

In summary, Vygotsky theorized that children engage in a form of cultural apprenticeship to develop competence. Through socialization, the social becomes mental. Vygotsky, Luria, and Bakhtin proposed that language is a principal form of cultural mediation through which social interactions and cognitive structures are organized. As a significant refinement of Vygotsky's ideas while still maintaining the essential claims of Vygotsky's work, James Wertsch points out that meaning of words is a tool of mediated action rather than representing mediated action. In his words, "While continuing to accept his claims about the importance

of semiotic phenomena in human mental functioning, I have argued that word meaning (or any other semiotic unit for that matter) is a unit of semiotic mediation of mental functioning, not a unit of mental functioning itself. I have also considered, and rejected as incorrect, the possibility that individual mental functions (memory, thinking) could serve as units of analysis in Vygotsky's approach." (Wertsch 1985, p. 208) That is, language is neither simply a linguistic system for the encoding and transference of symbolic knowledge nor to be construed as merely the outcome of cognitive structures that produce a linguistic output. Language is one of the means by which interactions in a social environment are coordinated and understandings of the world are discursively and socially negotiated.

The implication of these ideas is that language is both an agent of design and a mediating means for design. The Vygotskian notion of individual cognitive processes as internalized transformations of socially developed patterns of interpersonal interactions parallels our original motivation for delving into this exploration of the language of design as a way to get at the vectors of power that regulate the 'I/we' who is doing the designing. Language informs designers how to become oriented to a design praxis through codes that determine the way that design can be acceptably described and practiced in a design profession such as architecture or industrial design or engineering design. The question is whether the performative operators that enact design also set up implicit assumptions for the basis of the transformation of cultural variables into the identity of designers and their disciplines. Does aggregation set up expectations for the composition of actions, accumulation determine the allowable types of connections of these actions, and appraisal determine the criteria for significance of these actions?

We have already seen this behavior in the dialogue between Quist and Petra. As Quist is teaching Petra designing and learning about designing, what signals are available in the dialogue that allow Petra to abstract from the 'language of designing' (as Schön defines it) the codes that precede the language? Recall that for Schön, "Drawing and talking are parallel ways of designing, and together make up what I call the language of designing. The language of designing is a language of doing architecture, a language game which Quist models for Petra, displaying for her competences he would like her to acquire." (Schön 1985, p. 33) What I have been arguing thus far is that the language of design is not just paralleling design, not just describing design action as with Schön's "elements of the language of designing" (1985, pp. 44–45). Instead, the language of design has a role in tacitly registering the recognizability of a certain, legitimized design praxis.

When Quist is coaching Petra what to do next and different directions in which to take the design of the siting of the elementary school, he is not simply communicating design ideas or reframing the design problem. He is becoming a site for the relay and reproduction of reflection-in-action as a recognizable and legitimate design practice, putting the unregistered (and henceforth tacit) codes in the language of design to work as a way of claiming and norming his praxis. Reflection-in-action becomes part of the repertoire for architectural competence. More importantly, the procedure for gaining this architectural competence is social because it

occurs through language-based communication and interaction. It is presumably a competence that can only be learned in a social context.

While Quist's speaking about design is an aspect of the Schönian language of design in as much as his speaking parallels the logos of his actions, he is establishing what Karl Maton describes as a 'knower mode' (2000) pedagogy. A knower mode pedagogy is characterized by claims to knowledge based upon a specific object of study, such as a designed work, by a 'privileged' person, such as a studio master, rather than a set of specialized procedures that have been institutionally demarcated (such as statistically validated hypothesis testing in the sciences). Maton claims through his analysis of the field of cultural studies that, in a knower mode pedagogy:

> Based on the unique insight of the knower, claims to knowledge by actors within the intellectual field are legitimated by reference to the knower's subjective or intersubjective attributes and personal experiences (which serve as the basis for professional identity within the field). … This unique knowledge is specialised to the privileged knower such that actors with different subjective characteristics are unable to make claims about this knowledge, and attempts to do so risk evoking censure and even expulsion from the field. The knower mode thus exhibits strong classification and strong framing of its social relation. (Maton 2000, pp. 156–157)

From the position of pedagogic discourse, the language of design carries messages that allow the 'readers' to abstract 'codes' that precede the message. These codes determine whether the message is either a statement about design or some other statement. Referring back to the network communication metaphor, these 'codes' are like a 'checksum' as they serve to validate the content of the message. It is this second 'role' of language in design that we are interested in exploring in the context of pedagogic discourse in design education. To do so, we need to recover these codes that have been implicitly inscribed into the language of design. That is, an analytic device is needed for an analysis of pedagogic discourse in design. The eminent sociologist of British education Basil Bernstein calls such a device a 'language of description':

> [A] language of description is a translation device whereby one language is transformed into another. … A language of description constructs what is to count as an empirical referent, how such referents relate to each other to produce a specific text and translate these referential relations into theoretical objects or potential theoretical objects. … A language of description, from this point of view, consists of rules for the unambiguous recognition of what is to count as a relevant empirical relation, and rules (realisation rules) for reading the manifest contingent enactments of those empirical relations. (Bernstein 2000, pp. 132–133)

Bernstein is calling for analytical devices that describe aspects of pedagogic discourse by interweaving both empirical and theoretical descriptions and, simultaneously, a means for traversing between these two. That is, Bernstein would consider empirical descriptions of design as a socio-cultural system as an insufficient language of description if such a description were not accompanied by a theoretical reason why design is a socio-cultural system without relying on a tautological definition. Further, Bernstein argues for a conceptual way to move back and forth between the empirical and theoretical descriptions so that neither

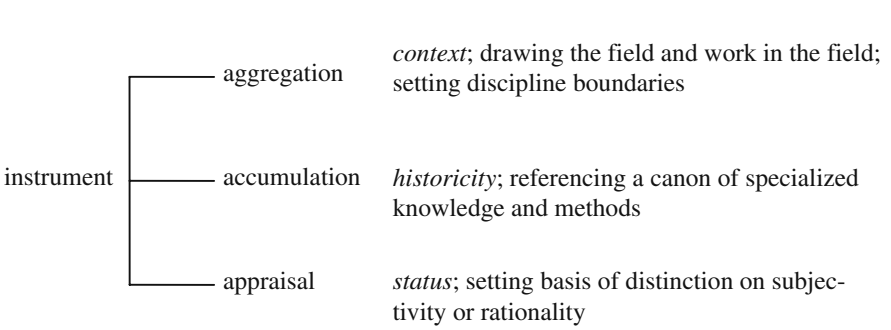

Fig. 6.1 Instrument to describe the transmission of design codes of practice through a sociology of design pedagogy

description remains impossibly estranged from each other. The language of design is for Bernstein a 'language of enactment' whereas the codes regulating this language offer a 'language of description'.

We have the basis for a language of description from the performative operators of the language of design. What is required now is to devise an instrument, using the same principles on the performativity of the language of design as before, to register these codes, thereby generating an empirical description. This device would then allow us to move back and forth between our theory of language and design and empirical descriptions of the sociology of design described by this device.

Figure 6.1 depicts an instrument for describing the pedagogic modality underlying design education in a specific discipline along the dimensions of aggregation, accumulation or appraisal. Rather than being viewed as producing a designed work, the performative operators here are regarded as producing a sociology of design and modes of behaving and orientating oneself within a design discipline. The instrument applies characteristic definitions for aggregation, accumulation and appraisal as in the previous chapters.

Table 6.1 depicts the corresponding coding scheme that can be applied to describe the underlying function of the language of design to regulate the social

Table 6.1 Coding scheme

Code	+	–
Aggregation	establishing and delineating disciplinary boundaries	opening of disciplinary boundaries; incorporating other disciplines
Accumulation	linking to established modes of practice and knowledge; design praxis linked to institutional or codified norms	practices not explicitly registered; specialized or specialist knowledge and procedures not demarcated
Appraisal	appealing to affect and subjectivity and designer's personal relation to design knowledge	appealing to technical rationality and empiricism

functioning of design (e.g., to establish a design discipline). Each code contains a set of characteristics for an analyst to locate representative empirical evidence within texts relating to the pedagogy of design. These determinants register how the message (e.g., pedagogy of design) that is carried in the language (e.g., pedagogic discourse in design) is also regulating the sociology of design (education). Further, let us use the notation Ag+/Ag–, Ac+/Ac– and Ap+/Ap– to denote the modality of each code. The modality registers the direction of emphasis rather than the strength of emphasis.

Let us consider specific examples of texts on the teaching philosophy of disciplines that teach design, comparing mechanical engineering, product design, and architecture. To sketch out how this instrument could indicate how a discipline of design registers the codes of norms, practices and currency, passages were taken from the Web sites of prominent schools. The semantics and grammatical structures were 'read' with an attention to the determinants specified in the instrument. The italicized texts support the discussion that follows.

[MIT, Mechanical Engineering] Our educational mission is to prepare students for careers involving *technological innovation* [Ap–] and *leadership* [Ap+]. Our undergraduate educational program provides *a broad base* [Ag–] on which successful *careers in engineering* [Ag+] and *a number of other fields* [Ag–] can be founded, whereas the graduate program aims to *prepare specialists, professionals, and scholars in mechanical engineering* [Ac+]. The research mission of the Department – which is *to create knowledge, technologies* [Ac+] and *ideas* [Ac–] through *fundamental research and its application* [Ac+] – is closely intertwined with its educational mission.

The teaching and research programs in the Department are *organized* [Ag+] according to both *disciplinary* [Ag+] and *inter-disciplinary* [Ag–] themes. We cover *all of the core disciplinary* areas [Ag+] of mechanical engineering including *Dynamics, Controls, Solid Mechanics, Materials, Fluid Mechanics, Thermodynamics, Transport and Design* [Ag+]. We have *strong interdisciplinary programs* [Ag–] in *Manufacturing, Energy, Bioengineering, Information, Nano/micro-Technology and Ocean Engineering* [Ag+].

(http://www-me.mit.edu/GeneralInformation/Index.htm Retrieved 01-June-2006.)

[Parsons The New School for Design, Product Design] Through an *immersion in materials, processes, aesthetic consideration and proactive social engagement* [Ac+], Parsons Product Design Department *cultivates* [Ac+] the *technical skills* [Ap–] and *intellectual habits* [Ap+] essential to *imaginatively explore* [Ap+], *responsibly integrate and synthesize* [Ap–] the *swiftly expanding roles* [Ag–] of a successful, professional product designer.

The Product Design Department prepares students for *a broad spectrum of professional career directions* [Ag–]. In a three-year program, they learn to conceive

thoughtful [Ap+] and *functional* [Ap–] domestic and consumer products, and make *intelligent, responsible* [Ap+] use of the latest technologies and materials.

While being introduced to *a variety of design methodologies and the history of product design* [Ac+], students *master the fundamentals of computers, machinery, and tools, as well as presentation and research techniques* [Ac+]. They are *taught the design processes* [Ac+] through which a product is conceived, developed, fabricated, and marketed, while *developing an awareness of New York City's professional and cultural resources* [Ap+]. Students are also *taught to investigate* [Ac+] the impact the products they design will have on the environment throughout their life cycles. They also *begin to grasp marketing strategies and theories of ethical practices* [Ag–].

(http://productdesign.parsons.edu/html/about_html/deptmission1.html Retrieved 01-June-2006.)

[Harvard Graduate School of Design, Architecture] *Central to the school's philosophy* [Ac+] is the *commitment to design excellence* [Ap+] that demands not only the *skillful manipulation of form* [Ac+], but also *inspiration from a broad body of knowledge* [Ac–]. Instruction and research *encompass design theory as well as visual studies, history, technology, and professional practice* [Ac+]. The GS's information infrastructure provides *a foundation for design exploration and communication* [Ac+], offering students *new ways to access design references, model buildings, and present ideas* [Ac+]. *Intelligence* [Ap+], *creativity* [Ap+], *sensitivity* [Ap+], and *a thorough knowledge of the arts and sciences* [Ac+] are essential to achieving *distinguished architecture* [Ap+]. The educational experience at the GSD is *enriched and broadened* [Ag–] by *close interaction* [Ag–] among the *departments of architecture, landscape architecture, and urban planning and design* [Ag+], as well as by *many other resources* [Ag–] at Harvard University and MIT. *Architects draw upon knowledge and experience gained from the past* [Ac+] while *adapting* [Ap+] to the changing needs of the modern world.

(http://www.gsd.harvard.edu/academic/arch/ Retrieved 01-June-2006.)

Table 6.2 provides a summary of the codes from the above analysis.

The description of mechanical engineering is focused on defining the disciplinary boundaries. The field is distinguished by "core disciplinary areas" which are derived from the accumulation of knowledge from the disciplinary fields cited and the accepted methods of "fundamental research and its application". However, the program includes "interdisciplinary programs" which are nonetheless listed as

Table 6.2 Frequency of codes from analysis of course descriptions of university design courses

Discipline	Ag+	Ag–	Ac+	Ac–	Ap+	Ap–
Mechanical Engineering	6	4	3	1	1	1
Product Design	–	3	6	–	5	3
Architecture	1	3	6	1	6	–

distinct disciplines in and of themselves. Conversely, architecture is strongly anchored to a historicity of praxis: "design theory as well as visual studies, history, technology, and professional practice". In terms of personal disposition, students will need to acquire (or already have?) the characteristics of "intelligence", "creativity" and "sensitivity". However, architecture is open to other fields and disciplines, and it is suggested by the description that many architecture students will practice design in other disciplines such as product design. Product design, like architecture, is strongly defining a core set of practices. Given that the discipline of product design is often considered as situated somewhere between engineering and 'design' in the sense of allied arts, it is also open to integrating multiple disciplines. Product designers have "swiftly expanding roles" and their exposure to other fields such as marketing and ethics is intended to incorporate those disciplines into product design.

We could repeat the analysis for descriptions of the respective disciplines by professional associations. To illustrate the similar results, let us first examine the description of engineering by Engineers Australia.

[Engineers Australia] Professional Engineers apply *advanced skills* [Ac+] in the *analysis and knowledge of science, engineering, technology, management and social responsibility* [Ac+] to *problem solving and synthesis* [Ap–] in *new* [Ag–] and *existing fields* [Ag+]. … Professional Engineers lead teams or work in them and need to be *innovative and creative* [Ap+] to develop the best possible solutions. The engineer must frequently make *balanced judgements* [Ap–] between design refinement, cost, risk and environmental impact. … *Top level mathematics, physics and chemistry are highly recommended subjects* [Ac+].

(http://www.engineersaustralia.org.au/careers/occupational-categories/occupational-categories_home.cfm Retrieved 01-June-2008.)

There is an emphasis on a specific body of knowledge and rational approaches. Contrast their description with that provided by the Royal Institute of British Architects on the architecture profession.

[Royal Institute of British Architects] As professional experts *in the field of building design and construction* [Ag+], architects use their *unique creative skills* [Ap+] to advise individuals, property owners and developers, community groups, local authorities and commercial organisations on the design and construction of new buildings, … Architects can be *extremely influential* [Ap+] as well as being *admired for their imagination and creative skills* [Ap+].

(http://www.architecture.com/EducationAndCareers/BecomingAnArchitect/BecomingAnArchitect.aspx Retrieved 01-June-2008)

I have chosen to code the clauses by a single code, but it is possible to code certain sentences with two codes, for example, "*analysis and knowledge of science, engineering, technology, management* [Ac+, Ap–] and *social responsibility* [Ac+, Ap+]". The choice of analytical depth does not change the main point: the codes

point to ideological sentiments about design which gives a discipline its distinguishing context. Summarizing these analyses, there is an in-built logic in these statements which contribute to the social practice of design. It is not difficult to see that there are differences in the way that these disciplines and their professions are described and that the codes offer a way to abstract away from them what is valued and emphasized in terms of specialized modes of design practice and design identity.

Considerations of the constitutive levels of aggregation, accumulation, and appraisal in the pedagogic discourse of design has significant implications in design education, particularly in the area of the gender and ethnic minority gaps in engineering design[1] and certain 'creative' design disciplines such as architecture. While much has been written and researched on the gender gap in engineering and computer science, one theme that continually arises is that discourse on engineering design tends to focus on the historicity of knowledge in the field rather than the role of the discipline in society, its broader implications, and how students can contribute their dispositions to the field. Such an observation is consistent with the frequency of Ac+ and Ag+ codes and few messages of subjectivity (Ap+) in the above analysis of the teaching philosophy of engineering.

In other design disciplines, there exist gaps between ethnic minorities in large multicultural societies, such as the rather small number of Aboriginal Australians who take up architecture as a profession. Conjectures abound that architectural design practice is seen as an elitist profession in which success (at least in terms of reputation) is strongly determined by subjective peer appraisal and cultivated dispositions[2]. Unless students believe that they have sufficient social capital or 'cultivated taste' in accord with the dominant (established) peer appraisers, then they may be dissuaded from the profession. Again, this is consistent with the frequency in which personal dispositions coded by Ap+ are mentioned in the teaching philosophy of architecture. In other elitist 'creative' design fields, such as the arts, these appraisers are often called the "gatekeepers", a term used in the Systems Model of Creativity by Mihaly Csikszentmihalyi (1996) to describe people who determine creative people by selecting them for inclusion within a field. We should note here that the bias for cultivated tastes can work in many directions, such as gender bias in cultural studies. While the reasons for disparities in the demographics of students who take up specific disciplines of design, and the arguments for them, are complex and tenacious, unarguably, the point is that different disciplines of design operate with a certain set of ideological sentiments how design practice should operate. Being able to explain the politics of disciplinarity to design students allows them to recognize the values of a discipline. With this

[1] The National Academies Press (www.nap.edu) has a rich set of freely available (online) publications dealing with the subject of gender equity and minorities in engineering and sciences.

[2] According to the US National Science Foundation Division of Science Resources Statistics (SRS) data on Women, Minorities, and Persons with Disabilities in Science and Engineering there were, in 2004, there were 207,000 architects and 1.8 million engineers in the US. 187,000 (90%) of the architects and 1.511 (84%) million engineers were white. This data, based on Bureau of Labor Statistics, Current Population Survey, 1994–2004, is not encouraging for diversity.

understanding, they can decide how a variation on repetitive practices within the discipline could give them an agency to realize an individual design identity.

While the values of the modality of the codes certainly vary within the disciplines, we should not discount the specialized criteria operating to define these disciplines and the expected codes and currency of conduct of design within them. Whether the authors of the Web site texts consciously intended to write about engineering or architecture as they did or whether the way that the pedagogy and practice has been defined by these institutions is the 'official' way that the disciplines operate is somewhat immaterial. It is not entirely immaterial since these institutions are producing activities within the area of the pedagogy of design and thus creating the pedagogic modalities. It is not immaterial since Engineers Australia is a professional body representing the discipline as it is practiced in Australia. Even if you disagree with me that what the values of the modalities are, that is not the point of the analysis. As Bernstein has argued, the visibility of what the transmitter (e.g., educational institution, media) intends for the student to acquire may not be visible. It may only be tacitly stated. The aim of the performative operators as codes to analyze pedagogic discourse in design is to provide explicit and consistent descriptions of the modality of the pedagogy in these disciplines.

The concern here is to sketch out a way to expose the underlying structuring principles of accounts of design professions as provided through discourse (in texts) about design education to illustrate how the theory of the performativity of the language of design can also be used to expose the ideologies behind 'design is' statements by design-related professions. The analyses here are neither intended to propose a conclusive statement about the aforementioned design disciplines nor to define how design is practiced by these disciplines. Rather, my intent is to present a style of analysis. Conceiving of design in terms of the performative operators of the language of design may clarify debates about the sociology of design that appear to differ at the level of individual, socio-technical, or socio-cultural but are possibly recurrent forms of similar principles but with different emphases on each principle.

According to Bernstein (2000), any pedagogic discourse, whether it occurs at the societal, institutional, or classroom level, is about a regulated function, namely the function of regulating the formation of a specific discourse of knowledge about and within a specific field. Bernstein proposes three types of rules of pedagogic discourse which regulate the formation of specific discourses: *evaluative* rules which perform the role of managing continuous evaluation of the discourse, *recontextualizing* rules which produce principles by which discourses can be brought into a special relationship with each other for the purposes of their selective transmission and acquisition, and *distributive* rules that regulate the relationships between power, social groups, forms of practice, and who may transmit knowledge and under what circumstances. Bernstein claims that the pedagogic discourse that takes place in a classroom will likely reproduce the codes that regulate the discourse within a field. That is, within an instructional discourse which aims to transmit specialized skills for a field, there will operate a regulative discourse which creates order (how knowledge is organized within a field and its modes of

realization), relations (the extent to which the knowledge is kept apart (symbolic isolation) from other fields) and identity (how knowledge and knowledge possessors are recognized and labeled as a consequence of participating in a field).

We might question then whether the pedagogic discourse that we analyzed above, in producing an identity for the discipline, also operates at the level of conversation between designers in the same discipline? Do designers working in industrial design re-produce their discipline's order, relations and identity and does it differ from designers in architectural design?

Let's examine discourses between two sets of designers, an industrial design team comprised of product designers and engineers taken from the Delft Protocols Workshop, and the classic dialogue between Quist the studio master and Petra the student by Schön. Again, we will use the same codes as before, but this time looking for micro-level evidence of the reproduction of the pedagogic discourse that takes place at the institutional level in its production of the order, relations and identity of a discipline.

First, let us start with the Delft backpack design team. I will again use the same code names and the spirit of the codes from the scheme of Table 6.1. To relate the coding to the production of design content, I will, in this analysis, pay attention to

Table 6.3 Backpack design team discussion (Cross et al. 1996)

Speaker	Segment	Statement
Kerry	(t 1)	What do we need? I guess **we should look at their existing prototype**[Ac+], huh?
John	(t 2)	Yeah, em, let me think **we could also just sort of like try to quantify the problem** [Ag–] because what's your understanding of the problem first of all?
John	(t 3)	They uh **they want a combination market product this backpack mountain bike product** [Ac+] and they've made a prototype and it hasn't been they're not pleased with it so far and the users' tests have some in in fact **it would be nice if we could see those users' tests to em see what the shortcomings were** [Ac+]
John	(t 4)	It it sounds to me that **what they're looking for is not they're kinda looking for a an interface a thing that will allow you to carry or fasten an existing backpack to an existing mountain bike** [Ac+]
Ivan	(t 5)	Yeah
John	(t 6)	**Is that how you guys interpret it?** [Ap+]
Kerry	(t 7)	Well also **they've got this em Batavus Buster** [Ac+] that em
Ivan	(t 8)	**Sorta pops on the bike?** [Ac+]
Kerry	(t 9)	**We can make it a special mountain bike so it could have the stuff required attached something to it** [Ag+]
John	(t 10)	OK
Moderator	(t 11)	I should point out that the bicycle which we have in the room is not the Batavus Buster but it is a typical mountain bike but the backpack which we have is actually the HiStar backpack which is uh is to be designed for it
John	(t 12)	OK

aggregation as setting the limits of design content [Ag+] or meta-processing about design content [Ag–], accumulation as about utilizing prior knowledge [Ac+] or introducing new knowledge [Ac–], and appraisal as either subjective [Ap+] or technical [Ap–].

At the start of their discussion (Table 6.3), the team begins by agreeing upon what it is that they should be designing. In discussing the design objectives and constraints on the problem, the group consistently refers to prior knowledge [Ac+], in segment (t 1) (the initial prototype made by the company), (t 3) the customer feedback, and (t 7) and (t 8) referring to the Batavus Buster. The Batavus Buster is an existing line of mountain bikes upon which they must base their design solution. In referring to prior knowledge through factual accounting, they justify the designed concept according to prior data (knowledge). After John engages in meta-processing about the design process in (t 2), he tries to get the group's understanding of the design problem. What is interesting is that in soliciting the group about their understanding of the problem, he is not asking for their personal dispositions but rather their factual knowledge and understanding of the design problem. John justifies his understanding of the problem based on factual data that also delimits the scope of their design work in segments (t 3) and (t 4) in which he repeats the key customer needs and the design brief. What is most striking is that when John asks for the group's appraisal of the design objective in (t 6), rather than providing an affirmation of the proposal, Kerry responds through a further elaboration of the requirements with reference to the Batavus Buster and Ivan by specifically by linguistically technicalizing about fastening the pack onto the frame. Kerry and Ivan continue this type of commenting on their understanding of the design problem by examining the Batavus Buster. There is very little in the way of discussion of empathy for the user of the backpack, or personal goals in the design of the backpack. In what other researchers have characterized as the design team naming and framing the design problem before moving forward (Valkenburg and Dorst 1998), the team uses grammatical features in which the actor of the clauses is either the client (e.g., "they want a combination market product") or the design work itself (e.g., "it could have the stuff required"). Here, then, in the conception of the design objectives and constraints, we see the group re-producing a normative engineering mode of design praxis which is to refer to prior solutions and empirical validation. In fact, the group is essentially following the prescription set by Pahl and Beitz (1999) in which the first step in design is to collect information about the requirements and constraints that will be embodied in the solution.[3] This empirical, fact-based approach to design, set forth in the pedagogic discourse about mechanical design and in the textbooks on engineering design are then reproduced in the forms of discourse.

In contrast, let us examine the portion of the dialogue between Quist and Petra (Table 6.4) in which Quist assists Petra in re-forming the direction and hence

[3] Further, Pahl and Beitz define a design methodology as "a concrete course of action for the design of technical systems that derives its knowledge from design science and cognitive psychology, and from practical experience in different domains." (Pahl and Beitz 1999, p. 10) This is a positively accumulating (Ac+) definition.

Table 6.4 Conversation between Quist and Petra (Schön 1983, pp. 82–85). Reprinted by permission of BASIC BOOKS, a member of Perseus Books Group

Speaker	Segment	Statement
Petra	1	**I am having trouble getting past this diagrammatic phase** – [Ap+] I've written down the problems on this list. **I've tried to butt the shape of the building into the contours of the land there** [Ag+] – but **the shape doesn't fit into the slope** [Ap–]. **I chose the site because it would relate to the field there** [Ap+] but the approach is here. So **I decided** [Ap+] **the gym must be here** – [Ag+] so **I have the layout like this** [Ag+].
Quist	2	What other big problems?
Petra	3	**I had six of these classroom units** [Ag+], but **they were too small in scale to do much with** [Ap–]. So **I changed them to this much more significant layout** [Ap+] (the L shapes). **It relates one to two, three to four, and five to six grades** [Ag+], which is more **what I wanted to do educationally anyway** [Ap+]. What **I have here is a space in here which is more of a home base** [Ag+]. **I'll have an outside/outside** [Ag+] **which can be used** [Ap–] **and an outside/inside** [Ag+] **which can be used** [Ap–] – **then that opens into your resource library/language thing** [Ag+].
Quist	4	This is to scale?
Petra	5	Yes.
Quist	6	Okay, say we have introduced scale. But in the new setup, what about north-south?
Petra	7	**This is the road coming in here** [Ag+], and **I figured** [Ap+] **the turning circle would be somewhere here** – [Ag+]
Quist	8	Now **this would allow you one private orientation from here** [Ag+] and **it would generate geometry in this direction** [Ag+]. **It would be a parallel** … [Ag+]
Petra	9	**Yes, I'd thought of twenty feet** … [Ag+]
Quist	10	**You should begin with a discipline, even if it is arbitrary** … [Ag–] **The principle is that you work simultaneously from the unit and from the total and then go in cycles** … [Ag–]

objectives of her design work. This is a rather complex dialogue between Quist and Petra in which the contours of the dialogue have more nuances than the reflection than Schön wrote about. Specifically, I would like to draw attention toward how Petra describes and then justifies her actions. In the statements where Petra names the design content, I coded them as Ag+. What is intriguing is that she rationalizes the basis of the design content with appraisals that relate to her personal stance to the design content, coded as Ap+. Almost after every instance of naming a reference or a design move, she appraised the work or action relative to her subjective preferences. Specifically, she uses language such as "I decided" and "what I wanted" much more commonly than referring to objective data about the current state of the design such as "the shape doesn't fit into the slope". When she states that the layout is "what I wanted to do educationally" she is displaying her empathy for the students. Her subjective method of appraisal contrasts with the way that the backpack team made references to objective data such as the feedback about the initial prototype in the customer surveys. Her interpersonal

negotiation of her attitude about her designed work with Quist using subjective stances seems entirely consistent with the Harvard GSD description of practitioners of architecture requiring sensitivity. In not interrupting the way that she describes designing, Quist is tacitly affirming her account. He then displays what Schön called reflection at the end of this dialogue, which I have coded as Ag– to indicate meta-processing on the design content as a response to her strong linguistic technicalizing to describe her design content [Ag+].

Most importantly, in modeling reflection in the final segment, he is modeling the production of an identity, specifically the identity of an architect. The identity is a function of a way that designing should be accounted for if that identity is to be legitimate. Quist creates the identity of an architect through the following means. Quist models for her what counts as a legitimate display of accounting about architectural design. He is performing what Bernstein calls evaluative rules, rules that define what standards must be reached within a field to count as knowledge. In this case, segment 10 is not just a reflection but rather a statement that in order to attain recognition within the field, she must begin with "a discipline" to "work simultaneously from the unit and from the total". Quist affirms that architectural practice is done by having a vision and a way of working. In countermanding rationality with reflection-in-action, Quist is distinguishing architectural design practice from industrial design engineering. In performing the meta-processing, he is grounding Petra to an accepted modality of practice.

As this section has shown, the politics of the language of design is not contained in the content alone. Instead, its politics are formed by a way of making and realizing pedagogic relationships. The analyses of the macro-level discourse of institutional texts on design disciplines and design pedagogy and the micro-level discourse of design conversations illustrate a way to utilize the performative aspects of the language of design as codes to show how designer identities and their relations to the discipline are an outcome of these codes. As such, Bernstein's theory allows our analysis of the politics of the language of design to attend to the production of designer identities and relations in a way that seeing design communication as about design content alone cannot. We thus circle back to our original question: who is the 'I/we' who is doing the designing, who is speaking and writing about doing the designing? The politics of the language of design create, legitimize, and reproduce boundaries between disciplines of design and what constitutes the field. It is the same performative aspects of the language of design, which designers 'use' to realize design, which reciprocally set limitations on the way that designing can be described in order to be called design. I suggest that the issues raised by the question of who is the 'I/we' who is doing the designing could be analyzed through Bernstein's theory of pedagogic discourse. The performative aspects of the language of design expose the semantics within design discourses that set up modalities for knowledge production, transmission and acquisition.

In terms of producing disciplines of design, the performative operators constitute a set of operating principles behind the language that describe how design disciplines shape the identity of their disciplines. Through emphases on different aspects of these operators, the various design disciplines can assign significance

and meaning to the principles. By practicing design as to value disciplinarity (i.e., Ag+), they create a design discipline that emphasizes disciplinarity. Owing to the performative nature of these processes in enacting design and the designed work, the above analyses suggest that the mode by which design is realized, and the disciplines realized, is regulated by the negotiation of identity and authority through the emphasis of one or more of these processes.

Various design disciplines may emphasize knowledge differentially depending upon how knowledge is valued and legitimized within the specific discipline. One dimension of Karl Maton's work on Legitimation Code Theory (LCT) (2004; 2007) claims that 'specialization' is what makes someone or something different, special and worthy of distinction. Through the specialization, the actors in the field determine what should be considered the dominant basis of achievement within the field. The orientation toward knowledge within a field may follow either an epistemic relation (ER) or a social relation (SR). This dimension of legitimation code is based on the premise that every practice, belief or knowledge claim is about or oriented towards something and by someone, and so sets up an epistemic relation to an object (ER) and a social relation to a subject (SR), respectively. Each relation may be more strongly (+) or weakly (–) emphasized in practices and beliefs. These two relative strengths of emphasis together give the LCT codes. Different fields may emphasize these relations to different degrees, and, as a result, these relations may be represented as being stronger or weaker within a continuum of strengths.

This means that knowledge can be seen as specialized by its epistemic relation, by its social relation, by both or neither, depending on how the field has negotiated what counts as legitimate knowledge in the field. As a result, LCT proposes four possible codes for how knowledge is specialized and legitimized in a field: *knowledge code* (ER+/SR–), *knower code* (ER–/SR+), *elite code* (ER+/SR+) and *relativist code* (ER–/SR–). The knowledge code emphasizes procedures; the possession of specialized knowledge, skills or procedures is emphasized as the basis of achievement whereas the dispositions of authors or actors are downplayed. In the knower code, the emphasis lies on personal characteristics of the knower. The personal characteristics could be natural (e.g. 'genius'), cultivated (such as an artistic gaze) or socially based (such as a specific gender, e.g. feminist theory, or sexuality; e.g. queer theory). The elite code emphasizes both the possession of specialist knowledge and the 'right kinds' of dispositions. In the relativist code, neither knowledge nor dispositions are necessarily required. In the language of LCT, we might expect to find architecture as an elite code discipline, engineering as a knowledge code discipline, fashion as a knower code discipline, and probably no design discipline as being dominantly relativist.

Using the concepts of LCT on claims to knowledge, we might ask then whether design practices across disciplines exhibit their discipline's varying emphases to an epistemic or social relation to knowledge, that is, appeal to affect and subjectivity (SR+) or technical rationality and empiricism (ER+). What specific practices within a discipline tend to link to established modes of practice (Ac+) rather than non-specialist procedures (Ac–)? I suggest that the performative operators of the lan-

guage of design as operating principles of design along with the LCT codes' description of a discipline's orientation to knowledge define axes for the production of different practices within each discipline. Each discipline will have set up a prior emphasis on each operating principle and mode of knowledge legitimation to negotiate the authority of the discipline and what counts as legitimate practice within the discipline. The negotiation sets up what can be recognized as legitimate design practice and the expectations for what designers must do in order for their behavior to be ontologically described as designing.

The outcome of different practices emerging from common operating principles of design and how knowledge and knowers are perceived in a design discipline is depicted in Fig. 6.2. Let's take aggregation as the sample operator which, for the purposes of this example, is characterized by an emphasis on drawing together a set of ideas that could be framed into a design concept [Ag+]. The choice of emphasis along each performative operator then leads to a choice of emphasis on the legitimation of knowledge. At the end node, we would expect to find the space of possible choices (practices) for Ag+ along the routes ER+/SR+, ER–/SR+, ER+/SR–, and ER–/SR–. Different practices relate to different realizations of the choices (made by actors in various design disciplines) to conform (or not) to the principles of specialized design disciplines. Nonetheless, we are more likely to find practices such as the theory of inventive problem solving (TRIZ) (Altshuller 1999) being developed within and arising out of engineering design rather than fashion design, and that artistic gaze is more commonly cited in architectural design discourse than in structural design, given what these fields emphasize. I am not suggesting exclusivity; certainly there are soaring examples of artistry in structural engineering such as the Golden Gate Bridge in San Francisco, Santiago Calatrava's Oriente Station in Lisbon, and Frank Gehry's Guggenheim Museum in Bilbao. The point is that there is an emphasis on different techniques in these different disciplines and that what is commonly valued in engineering is specialized methods rather than having a vision and an identity, which is valued in architecture[4].

While all designers practice design in its broadest sense – the intentional production of a material work to satisfy functional needs – they also perform design in different ways. Such differences can be understood as reflecting the various values, beliefs, and mores held by a design discipline, or what Strickfaden has called the "culture medium" (Strickfaden et al. 2006). These values and beliefs function as structuring principles which generate and organize design practices; they are related to what Pierre Bourdieu defines as 'habitus' (1983) in that these values become internalized codes which equip the designer to operate successfully within the 'rules of the game' of a design discipline. How knowledge is put to use to practice design within a discipline is thus premised on what counts as knowledge and what counts as a recognizable design practice within the discipline. The operating principles of design set the foundation for explicitly foregrounding these criteria.

[4] Having attended both engineering design and architectural design conferences, I have observed strong differences in the style and content of presentations. To summarize my observations, I would suggest that displaying artistic gaze at an engineering design conference or, conversely, very high technical prowess at architectural design conferences is unlikely to win you friends.

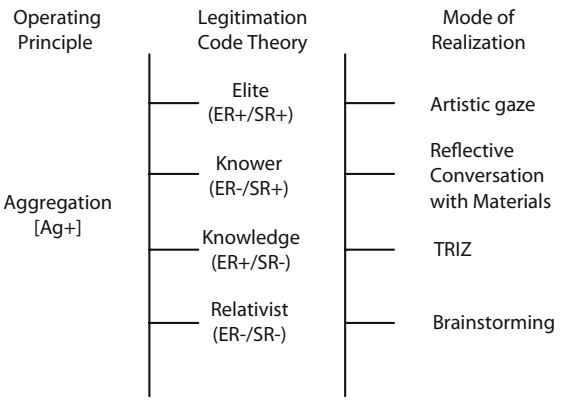

Fig. 6.2 An operating principle of design and its realization according to varying emphases on claims to legitimacy of knowledge

The possibility for different modes of realization to stem from a common set of operating principles provides a space for the intentionality of the designer to enter into the negotiation of the designer's identity within a discipline. Thus, we have a slightly more nuanced version of performativity in which the identity done by a designer relates to the discursive processes that constitute the mode of knowledge legitimation in a discipline of design. While a discipline may place emphasis on the knowledge code, for example, it is still possible for a designer to emphasize the knower code depending upon the designer's orientation to knowledge. While a discipline may emphasize strong disciplinary boundaries [Ag+], this does not preclude a mechanical engineer from working at or outside the disciplinary boundary, though this choice may result in the engineer finding it difficult to gain credibility within the discipline. In mapping between the operating principles of design and specific modes of realization of those principles, there can still be an element of intentional practice. The identity of the discipline does not foreclose the potential identity of the designer completely. Thus, while designers and designers' behavior will come about as "the resulting effects of a rule-bound discourse" within a system of power, our line of thinking is that the operating principles of design still give designers some agency in selecting the type of emphasis in realizing the operating principles. Variation along the codes allow the designer to be "A person [who] is not simply the actor who follows ideological scripts, but is also an agent who reads them in order to insert him/herself into them – or not." (Smith 1988, pp. xxxiv–xxxv). Even if the designer were performing (designing) in a theater (a discipline of design), the designer is nonetheless an actor with a personal history and who has some agency in choosing which theater to perform in. As such, the designer "has to be questioned as to its capacity for decisions, choices, interventions, and the like which are not specifically or solely determined by such categories as class or economics – however much they may be at the behest of ideology in general." (Smith 1988, p. 24) The performative operators as codes for organizing principles of the field of design along with the LCT codes give us the theoretical handles to impute the designer's choices for performing within an envelope of agency.

Non-cognitive Enactments of Design

Up to this point, the enactment of design by the performative operators is nonetheless achieved by a cognitive agent. We could call these cases cognitive enactments of design. We should be asking, however, whether design requires a cognitive agent. After all, computational models of design exist in which there is no cognitive agent other than the agent who assembled the algorithm. Simulated annealing and genetic algorithms are examples of such algorithms. Yet, even in these algorithms, we can see the performative operators at work. We find these operating principles for design operating in algorithms such as simulated annealing and genetic algorithms which have been adapted and adopted to enact design but are often not considered designing in and of themselves. Table 6.5 summarizes the relationships between the operating principles and simulated annealing and genetic algorithms.

Simulated annealing is a stochastic optimization algorithm modeled on the process of annealing in metallurgy. Often used for the optimization of a known design and for generating new designs, simulated annealing operates by formulating a design problem in an algebraic form. New design solutions are generated randomly through a stochastic, 'hill-climbing' algorithm. Design solutions are generated by modifying the value of a variable, and in doing so, enumerating the potential set of design solutions. One design solution is generated per iteration at a given temperature `T`. At each temperature, the quality of the solution is evaluated. If the quality of the solution is better than the prior solution, it is saved and modified in the next iteration. If it is not better than the prior solution, it might be saved depending upon the satisfaction of the Monte Carlo criterion at temperature `T`. The annealing schedule determines how quickly the system is 'cooled' and ultimately what 'imperfections' (non-optimal configurations) become 'frozen' into the solution. Thus, the stochastic design generation process looks like aggregation in the sense of finding areas in the design space which contain characteristics of the optimal solution and using those optimal characteristics to generate future solutions (accumulation). The annealing schedule determines the connectivity between the characteristics solidified into the designed work depending upon how quickly the system is allowed to cool. The Monte Carlo criterion is an appraisal of each solution generated.

Table 6.5 Operating principles for design operating in two computational design algorithms

Operating Principle	Simulated Annealing	Genetic Algorithms
Aggregation	Stochastic, 'hill-climbing' exploration of the search space	Genotype population production
Accumulation	Annealing schedule	Genetic operators of crossover and mutation
Appraisal	Monte Carlo criterion	Fitness function and roulette wheel selection

Genetic algorithms are a type of evolutionary algorithm based on the theory of evolution. Genetic algorithms evolve populations of design solutions. Each design solution (the phenotype) is encoded as a genetic string, typically in a binary string encoding, and together are known as chromosomes. Each bit in the chromosome is known as a gene. An encoded phenotype is called the genotype. In contrast to simulated annealing, genetic algorithms operate on multiple potential solutions simultaneously, or what is known as the population of candidate designs. An entire population of chromosomes is produced initially (typically randomly) and through various mechanisms of reproduction. At every generation, chromosomes can be modified through genetic operators such as crossover and mutation. Not all chromosomes 'replicate' to the next generation. A fitness function is applied to each chromosome and a technique known as roulette wheel selection is used to determine which chromosomes to use as parents for crossover and which chromosomes advance to the next generation. Modifications to the algorithm have been made to improve performance based on heuristics such as immigration to inject new genes into the population. Thus, the process of population production and heuristics such as immigration are akin to aggregation, systematic genetic operators that modify existing chromosomes are conceptually similar to accumulation, and fitness-based selection is a type of appraisal.

Speaking to colleagues who work in the area of genetics, I find that cell biology is a homologous domain to connect with these organizing principles from the language of design. Cell biologists use the terms aggregation and accumulation to describe cellular mechanisms associated with cell development. The issue of how non-cognitive models of design that enact design vis-à-vis the performative operators could be connected to cell biology is conjectural, but the conceptual views on cell biology seem consistent with the principles that have been described above. The mechanisms of human cell development are of course inextricably linked with life; with the widespread debate about stem cell research, the vocabulary of cell biology is infusing into the mainstream vernacular. In Chap. 3, we briefly discussed cellular aggregation. Links to our ideas on accumulation and appraisal in design also exist.

In normal development, when we are at the two cell stage just after fertilization, cells aggregate according to polarity and gravity comes into play. Polarity is defined in a biological context as the "persistent asymmetrical and ordered distribution of structures along an axis" (Cove et al. 1999). Polarity at the level of individual cells is central to the development of complex, multicellular organisms. The division of a polar cell generates non-equivalent daughter cells which eventually become differentiated cells. What is intriguing about cell development is that gravity is known to exert effects on the topographic relations of structures formed. The development of a polar axis often requires an input provided by a biological signal or by the physical environment such as light or gravity. The availability of space-based research where gravitational forces less than that on earth are possible allowed researchers to investigate the effect of microgravity on polarity in individual cells. Some studies in microgravity environments have shown that not all organisms require an input signal from the physical environment and that the

effects of gravity may not be as significant in some organisms as it is for other organisms. Nonetheless, gravity clearly does have an effect and so gravity could be thought of as having an appraisal effect, directing the orientation of aggregated and accumulated cells. Hydrostatic pressure is also known to affect the morphology of yeast cells; different morphological structures in fungus arise due to environmental stimuli including heat and blue light.

Can we characterize the production of the multiplicity of cell structures as designing? I would tend to believe that cells are designing themselves and higher-order systems, with some inherent preprogramming, through the basic organizing principles of (cell) aggregation and accumulation (cell binding controlled by surface receptors, affinities for ligands on opposing species, adhesion processes and other biological variables) and the appraisal effect of external forces such as light, gravity, and pressure. Perhaps cells are enacting the organizing principles for design, principles which enable them to design new varieties of cells. Certainly, cells seem to be designing new forms of cancers for which the mechanisms of expression are not likely to be accountable for in terms of the mutation of genes alone. The functional pathways for gene expression effect different realizations depending upon a multitude of internal biological factors and external stimuli and continue to provide exciting challenges to biologists and geneticists unraveling their inner workings.

Many of the biological functions of cells are carried out by proteins. All of the information needed for the protein to carry out the function is contained in its amino-acid sequence which specifies the three-dimensional structure of the protein. Under a set of conditions, the proteins spontaneously fold into their native states which then enable them to carry out their biological functions. Here too we find a homologous domain to the organizing principles for the language of design.

Proteins are synthesized on ribosomes in cells based on the genetic program encoded in the cell's DNA. In order to produce the various chemicals that sustain life, the proteins undergo a process called folding. The folding of proteins into specific three-dimensional structures is a biological activity that has allowed living organisms to develop remarkable diversity and selectivity through underlying chemical processes. Proper protein folding and misfolding is linked with both healthy cell behavior and regulation of cellular growth and differentiation as well as disease. What is remarkable about protein folding is the role of the proteins themselves in promoting, regulating, modulating protein folding and disassembly, and their role in the degradation of proteins. Protein folding is dependent upon an abundance of certain chemicals (enzymes) to facilitate and catalyze molecular bonds. An unstructured protein can be formed from a chain that was newly synthesized by a ribosome or from a disordered aggregate. In this case, proteins are recruited into aggregations to provide the basis for folding into new structures (Dobson 2003). The existence (aggregation) of an abundance of these sets of chemicals is required for protein folding. Wright et al. (2005) propose in fact that the diversity of sequence identities between proteins plays a role in safeguarding

proteins against misfolding and aggregation[5]. The folding topology then provides cavities which serve as active sites for binding; they are implicated in what we have been calling accumulation. The amino-acid sequence determines the "energy landscape" which determines when amino-acid sequences come into contact with each other, the bonding between the amide and carbonyl groups of the main chain (Dobson 2003). Finally, a series of molecular chaperones and folding catalysts (Gething and Sambrook 1992) recognize and modulate the state of folding. Critical to the prevention of disorganized prefibrillar aggregates which can harm cells, they neutralize such aggregates before they can cause disease. These chaperones behave in a manner similar to the performative operator of appraisal by promoting, inhibiting or reversing folding and assembly. They stabilize protein structures. They disentangle improperly folded proteins. They stabilize protein structures before assembly or translocation. The proteins, like words in the language of design, provide both the substrate for protein folding and the biological mechanisms of protein folding. All the information required for protein folding and unfolding is contained in the protein's polypeptide chain. Proteins, like words, realize their own narrative through self-assembly and dis-assembly, performatively producing specific protein structures.

I have taken some liberties in the description of protein folding using the conceptual apparatus of the language of design. Recent research in protein folding takes the view that the physics of protein folding are largely determined by the topology of a protein's native state (Baker 2000). The homology between the mechanisms of protein folding, or at least in the conceptual view of protein folding, and the organizing principles of design vis-à-vis the language of design, are rather surprising. While the prevailing view is that the energy landscape encoded in the amino-acid sequence evolved through natural selection, perhaps we could take the alternative view that the encoding has allowed proteins to design themselves. The physics and biochemical properties of proteins provide proteins with the capacity to enact design.

Our outlook suggests that design is an enactment of the operating principles of aggregation, accumulation and appraisal, derived from the performative operators of the language of design. Cognitive enactments are varied through the social structuring of knowledge. Non-cognitive enactments are varied through internal programming, such as in the genes constituting cells, enzymes and proteins associated with protein conformation, or the physics of crystal formation which follow the second law of thermodynamics. The functions of the genes involved in cell

[5] I should note that in this discussion on protein folding I use the term aggregation in a different way than biologists do when they discuss protein aggregation. Protein aggregation is (generally) an undesirable biological phenomenon arising from a population of partially unfolded proteins deposited in cells. Generally, the aggregation of misfolded proteins results in neurodegenerative diseases including Alzheimer's disease and Parkinson's disease, and type II diabetes. Protein aggregation is a competing process to protein folding. In my definition of aggregation, aggregation is taken to mean the collection of the base materials that provide a substrate for designing; in the domain of protein folding, my definition of aggregation concerns living cell environments containing the appropriate, diverse set of protein sequences.

development are not yet known nor are the mechanisms of external stimulus perception and their eventual effects clear. The complex and at times converging, interlocking, imbricating and cross-interactions of the performative aspects of the language of design and their expression as operating principles of design in cognitive and non-cognitive enactments of design make us question if design could be thought of as a set of abstract processes that can be enacted through a variety of systems and agents. As theorized by both Foucault and Deleuze, knowledge is afflicted by forces and systems which exceed knowers. Perhaps thinking of design as a capture of a flow of Deleuzian 'forces' in the form of the performative operators will allow us to make a new schemata for design that is capacious enough to include and inform those systems which enact design and yet delimit design from production systems; not every practice in the production of a reality is, after all, design.

Performance and Tension

In this final section, I would like to consider the dimension of the performative aspects that has to deal with their conditions of possibility. What are the conditions of possibility of the performative aspects in the language of design? My interest in this question is not to continue in an exercise in circular reasoning, wherein one might continue to ask for further underlying causes. Instead, my interest is in opening up a space for changes in power and control relations in design. In understanding what conditions of possibility propel or attenuate the language of design, we might then be in a position to appropriate these conditions in order to change the way that design is enacted.

My reaction is that we cannot look into the language itself for the answer. As we spoke about these performative aspects, we made a rather glib oversight about the possibility of existence of the performative aspects. While we have made arguments about their effect, we have as yet said nothing about how much power they need in order to produce their effects nor commented on the situational characteristics that set the stage for the formation of the performatives. There is a Bengali proverb that Amartya Sen cites in his book *Development as Freedom* that I think summarizes my point here. "Justice is like a cannon, and it need not be fired (as an old Bengali proverb puts it) to kill a mosquito." (Sen 1999, p. 254) Thus, the question that I would like to consider here is how design situations furnish the conditions for the emergence of the performatives. Do we always need the 'big gun' performatives in order to enact design?

One way that we can conceptualize this question is to think of the elements of performativity through a model. In this model, we need the following elements: a system that precedes the effect, a performative action, and the performance (the effect of the performative). Being a mechanical engineer by training, one example that comes to my mind is a string vibrating, particularly since the physics of vibrations will allow me to dramatize what sustains the performatives. Let us imagine that we have a string of constant length (fixed ends), gauge and material. This is

our system. The tension, and I will return to this important concept of tension later, placed on the string is a condition that we can apply to the system. While the tension produces no manifest, it imposes a condition on the performance achievable by the string and any performative effect placed on the string. The string is set into motion by a performative action, being plucked; the performance (effect) is the harmonic vibration of the string. Under equivalent performative actions, the vibration in the string is different because of the varying tension in the string. The speed of the waves on the string depends on the string tension. Specifically, it is proportional to the square root of the tensions. Waves travel faster on a string with higher tension than another string and the frequency is therefore higher for a given wavelength. In musical instruments, strings under higher tension produce sounds different from strings under lower tension, all other aspects of the string being equivalent.

I propose that tension is a primary resource for the performative aspects of the language of design. Tension is the dimension that attenuates and amplifies the conditions of being of the performatives' effect. The performatives express the agency afforded by the tension. It is tension that propels the communicative reality.

Our analysis of the language of design has relocated the performance of design into the multiplicity of language. This is perhaps not so controversial. However, what opposes this model of design as discursively produced is not only the conflict between tradition and modernity and contemporaneity but also the intensification of coalitions of incompatible epistemological and political beliefs conjoined by the very process of designing. The latter point would suggest that there is no other model of design other than a discursive model, wherein various kinds of reasons and beliefs create a viscosity for the design situation. I am suggesting that it is in fact this viscosity, this tension, that propels the performative operators to subtend borders and muster the agency in order to produce an effect.

Thus, when the language of design is speaking, the language is not speaking from an individual, from a performer, to the participants, to the audience. The language of design is speaking about the relations between designer, participant, designed work, and praxis. The point then is not the model of performance but how the performance speaks of these modes of relations. What the performative operators display in their effect is the tension in which these relations hold.

I would like to briefly illustrate this concept of tension, performatives, and the language of design through two examples, one an electronic art installation and one a design cooperative. *Uzume* is an electronic art installation that uses a projection based virtual reality system known as a CAVE, developed at the Electronic Visualization Lab at the University of Chicago. Created by Roland Blach, Petra Gemeinböck and Nicolaj Kirisits, the production of the work is produced discursively between the work and the participant in the following way:

> This communication resembles the attempt to carry on a conversation with someone whose language one does not understand. Although the virtual environment reacts to the user's slightest movement, it does develop independently to a certain degree and challenges the visitor to try to figure out its peculiar linguistic code. (Blach et al. 2003)

Uzume's world is bound to the physical projection space of the CAVE and is based on the spatial representation of the temporal behavior of so-called "strange attractors". When the visitor moves about within the projection space, he/she crosses the attractors' parameter fields and thereby changes the respective state of their environment. Moreover, his/her presence triggers minute changes in *Uzume*'s medium, a force field in which both the user and the whirling structures are embedded.

The constitution of the performative effects of the participant's movements is made contingent on the viscosity of the force field. Whether or not the performative aspects are in the recesses of the dialogue between the participant and the art work is unknowable. What is manifest however is that the tension in the medium produces varying effects regardless of the regularity of the vocabulary of the dialogue.

Teddy Cruz is an architect whose work deals with the tension between the developed world and the developing world, with particular reference to the border between Tijuana, Mexico and San Diego, USA. Here, the tension that Cruz works with is not only the difference in economic and social strata in which the populations on either side of the border exist, but rather the attitudes towards being-in-the-world. Cruz writes of the generative possibilities of this tension in the following way:

> … the growing tension between the various communities of San Diego and those of Tijuana have elicited a multitude of creative responses – new opportunities for sharing resources and infrastructure, for recycling at the most outlandish levels, and for normalizing local – not just international – relations between the cities of Tijuana and San Diego. (Cruz n.d.)

The above two examples suggest a politics of design(/er) identity and authorship, returning us to the original question posed at the start. Our response to this question is that the identity of the designer and the authorship of the designed work are intimately tied into the operating principles of design and the performative aspects of the language of design, aggregation, accumulation and appraisal. The designer, the designed work, design practice, and design praxis is not immune from the legitimizing codes that they produce. Kwame Anthony Appiah in his book *The Ethics of Identity* cited a quote that John Stuart Mill wrote regarding his book *On Liberty*. "When two persons have their thoughts and speculations completely in common; when all subjects of intellectual or moral interest are discussed between them in daily life … when they set out from the same principles, and arrive at their conclusions by processes pursued jointly, it is of little consequence in respect to the question of originality, which of them holds the pen." (Appiah 2005, p. 26) Bearing in mind the social justice issues that Mill writes about, the issue becomes one of self-creation. Given the entanglement of the designed world with the creation of the matrix of conditions which form individual identities, the politics of the language of design is not only regulating itself; it is also expanding or diminishing the space of possibilities for political choices in realizing the designed world. Thus, it is not the I/we who is speaking about design that matters

most and who it is and what the identity is; rather, it should be the embodied political choices for enacting design that matter. It is the set of choices (and what these choices are) which speak of the policy of design and of Bourdieu's formulation on the reproduction of social authority through embodied practices.

Michel Foucault wrote, "How is it that words, which in their primary essence are names and designations, and which are articulated just as representations itself is analyzed, can move irresistibly away from their original signification and acquire either a broader or more limited adjacent meaning?" (Foucault 1994, p. 109) This is the question that we have been wrestling within the context of design – how is it that words can become the designed work? How can words produce a content which is a designed work? What we find is that the language of design thus has several layers of features: communicative, performative, and political. As communicative linguistic events, language represents ideas in order to record and transmit them. Language use coordinates work, lexicalizes concepts, and represents the residue of cognitive processing. As a performative, the language of design produces the designed work and design practice. Through aggregation, accumulation, and appraisal, the language of design is constitutively involved in the production of design. Finally, as political acts, the language of design takes on the role of registering sociological and ideological conceptions.

In practice, design is characterized by social processes involving evaluation, reflection, and negotiations of shared meanings, leading to a shared understanding of both the design process and the design work. The design process progresses through stages including analysis, synthesis and evaluation. The effect of the design process is the design work. Each design project is a contestation of knowledge; the result of the contestation is the designed work. One could argue that all that is required is robust debate and negotiation to come to a shared understanding of the design work. Yet, this may be a meritocratic illusion for two reasons. Herbert Simon once wrote, "Seldom will the goals and constraints be satisfied by only a single, unique design; and seldom will it be feasible to examine all possible designs to decide which one is, in some sense, optimal." (Simon 1995, p. 246) Even if it were possible to negotiate to find the optimal design, the problem will be the negotiation process itself. The negotiation will necessarily presume that there is a shared ground as to what design is, what constitutes knowledge in design, and how the language should be realized to display competence in design. Yet, this may not be true. The question of what design is shapes who is viewed as having insight, who is entitled to participate in the negotiation, whose voice is more legitimate, and so on – whoever is able to claim the definition of 'design' can frame the negotiation. The consequence of discourses of design producing design according to the operating principles of design is that these negotiations will never be neutral because there is no single enactment of design. The choice of emphasis on the mode of knowledge legitimation defines different systems of discourse within design which results in different disciplines of design and different practices within each discipline. Each discipline negotiates the authority of the knowledge that has been generated and what counts as legitimate practice; each discipline, simply put, defines status in its own way. The negotiation sets up what

can be recognized as legitimate design and sets up in advance the expectations for what designers must say and do in order for their behavior to be ontologically described as designing. As a consequence, we need to ask what kind (modality) of design is performed as the designer maps the operating principles of design to an individuated practice.

The language of design is an assemblage of performative aspects which systematically realize the objects which they describe. The question is whether a common system defines the emergence of these performative aspects or whether the performative aspects define a common system that regulates the emergence of meta-design phenomena. What is at stake in addressing this question, then, is not to examine what is said while designing but the generative conditions preceding the language of design and their effects *post-hoc*. If design is produced through rule-bound discourses, it will certainly be worthwhile to identify those rules.