Design Research Foundations

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Annie Gentes

The In-Discipline of Design

Bridging the Gap Between Humanities and Engineering

Springer

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Chapter 5
Design as Composition of Tensions

5.1 How to Organize a Design Crisis?

The irruption of radical designs creates crises that trigger the actors to dramatically question the status quo, reorganize themselves, introduce new products or new services, new values, and new aesthetics. Radical design challenges our habits, our views of the world, our comfortable set of ideas, and the organization of power. Eventually, these metamorphoses beget new configurations that we learn to understand and appreciate. The history of art and literature is the history of the permanent outrage brought by the new forms that pit the Moderns against the Ancients.[1] Each aesthetic new age has brought intellectual and public outcry where the merits of imitating the former generation of creators were debated. Whether in the seventeenth century with Charles Perrault[2] praising the "new way" against Boileau[3] who advocated the Antiquity as a model, or two centuries later, with Victor Hugo's play: Hernani (1830) that heralded the Romantic area, the clash between the protagonists is more often than not violent (Hernani is better known today for the intellectual – sometimes physical – battle that it triggered rather than for the play on its own merits). I think that we should keep in mind the fact that every design project is a quarrel of the Ancients and the Moderns. Whether art has more latitude to explore entirely new aesthetics, and design practice has to juggle between radical invention and easing itself into people's lives is beside the point. The crisis is embedded within the creative process because researchers as well as artists and designers have to extricate themselves from the seemingly pre-determined configuration of things.

[1] Armogathe et al. (2001).

[2] Charles Perrault (1628–1703) was a French writer, who, amongst other things wrote the famous Tales of Mother Goose that introduce the fairy tale genre. He led the "Modernist" movement in the seventeenth century, praising the new ways of writing that fitted best the King's times (Louis the XIV).

[3] Nicolas Boileau-Despréaux (1636–1711) was a French poet and critic who endeavoured to define the rules of poetry. He led the faction of the Ancient in praising the art of the poets of Antiquity.

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The question we need to consider is how they achieve such a revolution but also how, after climax and anti-climax, the new situation is accepted or at the very least understood as coherent. After all, new genres do not bring chaos forever.

To begin with, a state of permanent crisis defines the design work itself as a process and as a result. To answer one question, designers produce multiple scenarios, with different interactions, using different materials and techniques. In my experience with engineering and design students, the process is stressful not only because it taxes everybody's creativity but also because it is totally counterintuitive to the idea that there is one and only one good answer to a problem. It is also stressful because we ask the participants to accept and work on controversies more than they usually do. It is not only a confrontation of ideas but of media, textures, technologies, tools. Design education and design practices are repeatedly bringing in methods of confrontation or at the very least methods that diversify the sources and tools of design. They organize what I suggest to call "a field of tensions" where the main skill is not so much to manage a series of steps but to "compose" with different elements and properties to unfix views and challenge knowledge, and eventually to generate new coherent situations.

Rather than focusing on the psychological or managerial aspects of the question, I want to share observations about situations that deliberately orchestrate this field of tensions between materials, medias, and tools. The chapter is thus called "Design as composition of tensions" for three reasons. First, it is a pragmatic observation of how designers gather material to do their job. I like to show my students what an artist's studio looks like in particular Bacon's, Calder's, or Pollock's.[4] They are full of stuff, cluttered with artifacts, tools, cultural products, textures and materials that are arranged, rearranged, organized and disorganized. While collections are rationalized through archives like the "materiautheque"[5], artists' studios look like curiosity cabinets as David Hockney presented in his "Great Wall".[6] Second, it is a reflection on methodologies. The word "tension" is used here to describe the fact that heterogeneous elements are brought together to un-fix, that is to go beyond preconceptions and expand the design space. Third, to look at design as composition of tensions is to make a hypothesis regarding its epistemology. I will argue that "projective abductive processes" organize the whole composition activity. Abduction proper is a semiotic practice that brings to the forefront unforeseen connections out of a diversity of elements. What I call "projective abduction" is a semiotic practice that builds a world to be. Hence, tensions are solved in the new composition.

I will, therefore, try to understand why a field of tensions is both a disruptive force and a way of looking at the reorganization of knowledge in a new aesthetic. Doing so means switching from a temporal, chronological, model of the design project to a spatial, topological, model of design and to look at how the expression "design space" can be interpreted as a "matrix", as the French philosopher of design

[4] Some pictures of famous artists' studios can be found on this website: http://www.artistsandillustrators.co.uk/news/Buildings-Architecture/530/famous-artists-studios

[5] See for instance, in Paris, http://www.lelieududesign.com/la-materiautheque-materio

[6] Hockney (2006).

Pierre-Damien Huyghe, following Paul Klee's theory, suggests. To describe the designer's stage and elaborating on Huyghe's definition, I am trying to understand the design clutter as an apparatus that bridges different knowledge bases, power stakes, and aesthetics, so as to produce a new composition. Again, the history of art shows a great deal of possible compositions that each time defy what was expected in terms of aesthetics. At the same time, these unexpected compositions were ways to produce new meanings. I think that we need to take a closer look at how engineering research and design also compose.

To support my hypothesis, two examples will be presented in this chapter. I do not pretend that they are the only ways for researchers and designers to compose, but they came as a surprise to me, even as a quite unsettling experience when they challenged my personal relationship to writing tools. More importantly, they focus on material and media on the one hand, and on tools on the other, which is a way to tackle these two important nonhuman "actors" in the design space, while I deal with human stakeholders in Chap. 6. The first example presents a project where designers assembled a diversified corpus of heterogeneous sources. It took place in 2012 when the Codesign Lab helped design an innovative e-learning platform. We followed a group of designers and researchers to see how semiotic knowledge was acquired and then transferred to a new product within what we finally described with Marie Cambone as a "contradictory semiotic analysis" or a "contrasting semiotic analysis" to describe a confrontation of different sources for design. The second example focuses on "tools". It took place in 2002 and involved a multimedia artist, a group of students, and three professors who worked together to write an interactive show. The participants used different tools for the same purpose. On the one hand, they played and were played by these tools, which channeled their writing skills. On the other hand, using multiple writing tools was also a way to contrast different interpretations and to expand the scope of the design work. Thanks to Mathias Bejean, we came up with the word "constellation" as the best way to describe not a linear process but a group of versions of a theatrical play, all valid in their own ways. Both examples show design practices that organize the confrontation of design elements, and that play on tensions inherent in bringing diverse material together.

5.2 "Contrasting Semiotic Analysis": The Semiotic Organization of a Confrontation[7]

Experienced designers work with a wide-range of artifacts and media, technologies, contents and visual representations. This wide-ranging experience makes it possible for them to come up with an intricate balance of known and unknown in

[7] First versions of this section were published in Gentès, Annie, Cambone, Marie, « Designing empathy: the role of a "control room" in an e-learning environment », Journal of Interactive Technology and Smart Education, 2013.

the form of unexpected configurations of signs and forms. Closely following their work means seeing how they tap into their experience to build new designs. Books that teach design or architecture emphasize the need to learn through studying former buildings or artifacts.[8,9] The role of former knowledge in design is therefore extremely important and has been studied, for instance, by Willemin Visser who points out the reuse of knowledge in different circumstances and fields of design:

> Reuse of knowledge (from specific previous design projects) through analogical reasoning has been observed in many cognitive design studies as a central approach in design."[10] Former knowledge plays a part in the heuristics of the project as design memory[11] or design precedents.[12]

Eilouti also looks at design precedents and how they are part of an analogy process that feeds new artifacts. Closer to genre theory, the author shows that typologies are also a way to gather similar elements thanks to the identification of certain of their properties that can therefore be re-used and combined at this more abstract level.

> Typology can be described as the enumeration and categorization of collections of components based on pre-defined criteria in order to reflect certain characteristics of the individual components and relations among them in their combinations.[13]

Finally, understanding the common underlying structure of particular artifacts serves as a starting point for design/practice as well.

In other words, designers have to start somewhere. Analogy with previous artifacts and situations, typology of interactions and forms, and the analysis of former compositions, help at several stages of the design process to suggest ideas, to implement patterns in prototypes, to evaluate the design of the object. In this respect, the question of fixation seems particularly acute: though it makes perfect sense that a designer needs to learn from former projects and objects, how does he/she avoid getting stuck in a particular example, and repeating the same patterns? This part of the chapter considers how semiotic analyses play a central part in using design precedents. In the first case, there was an intense analytical and comparative stage that was instrumental in discovering structural and semiotic characteristics of a genre of artifacts as well as in displacing certain features and principles that were reinterpreted and embedded in a new configuration. This "contrasting semiotic analysis" will be detailed in the following section.

[8] Leupen et al. (1997).

[9] Unwin (2009).

[10] Wisser (2006).

[11] Oxman (1994).

[12] Eilouti (2009).

[13] Eilouti (2009).

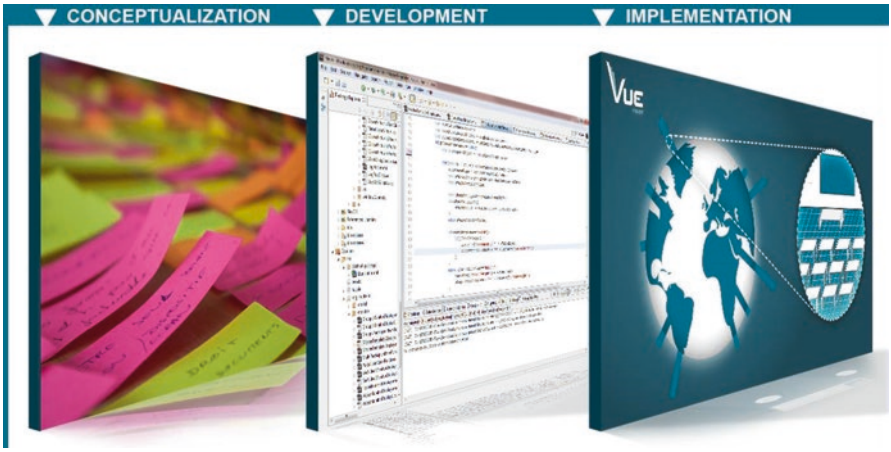

Fig. 5.1 3S Informatique's visualization of the project VUE. 2010

5.2.1 First Case: The e-Learning Platform VUE

VUE[14] (Fig. 5.1) is a research project on multimodality that was developed in a partnership between a service development company (Groupe 3S Informatique), the Signal and Image processing Department of Telecom ParisTech with Jean-Claude Moissinac, and the Codesign Lab. A team, including researchers in computer science, design, information and communication sciences, worked one year to develop an e-learning platform that prototyped specific ways of storing data so that it could be adapted and used on various media (computer, tablet, smartphone).

The Codesign Lab was in charge of several tasks: a survey of distant teaching and e-learning services; the definition of a set of specifications to develop the technical platform; the design of graphical interfaces; and, the definition, organization, and analysis of the end-user tests.

The project took place before the worldwide progress of MOOCs (what certain journalists called the tsunami MOOC in 2012). Nonetheless, in 2010, there were many e-learning platforms that provided similar services. As it were, a number of analyses were already available and all showed that attendance in distant learning was a recurrent issue. To encourage continued participation, educators primarily focused on designing activities promoting collaboration and interaction between students. In a virtual context, it requires the implementation of technical and social mediations because the distance is not only physical but also technical, socio-cultural, socio-economical and educational.[15,16,17] The interplay of learning and technology that was studied in particular by CSCW (computer-supported cooperative work) researchers, especially CSCL (computer-supported collaborative

[14] VUE means "sight" in French.

[15] Moore and Kearsley (2011).

[16] Holmberg (1995).

[17] Jacquinot (1993).

learning),[18] also showed that the way participants were represented influenced interaction.[19,20] On the basis of this first survey, the team decided to focus on the problem of attendance. However, the analysis of the situation was not enough to come up with an innovative proposal. The ethnography of long distance learning did not give us formal design cues. The team therefore turned to a semiotic analysis of e-learning platforms.

5.2.2 "The Loneliness of the Long-Distance Learner"

The design team observed that a virtual platform is not only a space for coordination between actual people, it is also a virtual platform that turns participants into actors and characters who play a role in a space that they animate. Building on the metaphor of the computer as a theater,[21] they considered that the screen was a dramaturgic space where represented interactions were taking place. After assembling a corpus of e-learning websites, the research team looked for recurring features in e-learning platforms so as to gather structural properties, functional and aesthetic qualities that defined the e-learning "genre". They also researched and analyzed the various representations of presence.

As we saw in Chap. 4, a corpus is a group of texts (linguistic and/or visual) or artifacts that is used implicitly in everyday life as a way to organize knowledge and communication.[22] But, in a research setting, corpuses are gathered by the researcher to analyze their characteristics and to validate or not their commonality so as to answer a research question. Often the question is to know if they belong to the same genre or if, on the contrary, some of the examples are original, either radically or moderately.[23] In any event, the corpus is not only formal but also pragmatic. The elements show what Wittgenstein called a "family resemblance" that is objects that are similar not because they share the exact same formal features but because they are considered to be analogous on a certain level by social actors. As Lakoff further developed: "interactional properties are prominent among the kinds of properties that count in determining sufficient family resemblance".[24] Taking the example of chairs, he observes that:

> The interactional properties relevant to our comprehension of chairs will include perceptual properties (the way they look, feel, etc.), functional properties (allowing us to sit), motor-activity properties (what we do with our bodies in getting in and out of them and while we're in them), and purposive properties (relaxing, eating, writing letters, etc.).

[18] Stahl et al. (2006).

[19] Stahl et al. (2006).

[20] Blandin (2004).

[21] Laurel (1993).

[22] Lakoff et Johnson (1980).

[23] Rastier (2002).

[24] Lakoff et Johnson (1980).

In our case, the team selected four e-learning platforms that had been identified as targeting the same audience (people involved in continuing education) and that offered similar services. We conducted a semiotic analysis on the following points: rendering of environments, representation of actors, terms of interaction, and possibilities of changing points of view (Figs. 5.2–5.4).

We then realized that most platforms strive to strike a balance between representing the students and offering working tools. Two aspects seemed equally important. First, users are given some leeway to personalize their tools and working environments. Second, users are given the possibility to access two screen spaces: the virtual rendering of the class (either a table of webcams or a 3D environment – Second-life like — not represented here) and the toolbox. Even so, as can be seen on the screenshots above, no interface represented the classroom as a whole with a compelling orienting view. What is more, students were not always shown on the screen (Fig. 5.2: only the teacher is present). On other interfaces, students were present through a line of their webcams (Fig. 5.3) or a table of their webcams (Fig. 5.4). These design choices made it very difficult to represent all students on the screen and thus did not easily contribute to a feeling of belonging to a class. In addition, these four platforms offered a single type of class: the conference mode. Group work or tutorials were not taken into consideration.

Then, the team was convinced that the “loneliness of a long-distance learner” was a major challenge. However, this motivational and psychological metaphor had to give way to a design solution that would actually offer a service through an interface. The question became how to fight the feeling of separation from the group, the loneliness, and provide a feeling of togetherness not only through activities but also from the interface and the representation of the situation. The combined questions

Fig. 5.2 Dim Dim e-learning platform (http://www.dimdim.com/)

Fig. 5.3 ISL iMeeting (http://v5.islonline.com/isl-groop/overview.htm)

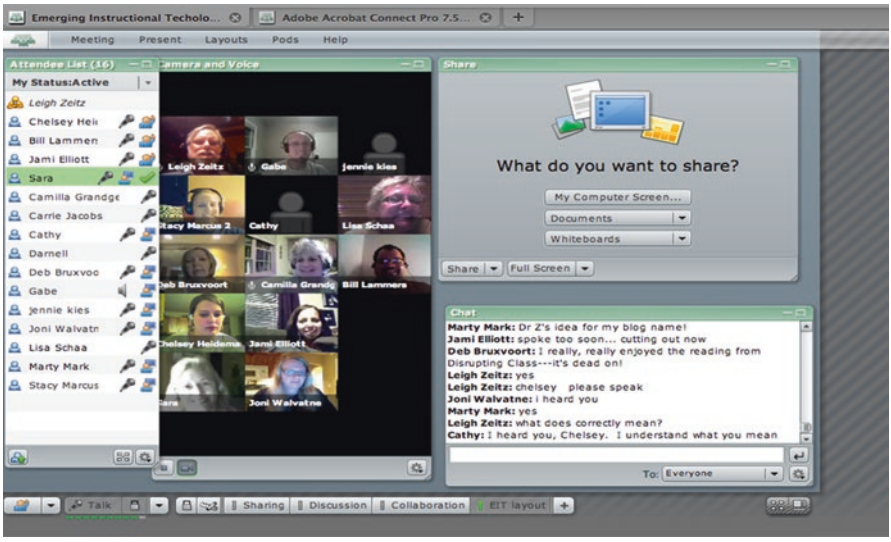

Fig. 5.4 Adobe connect (http://www.adobe.com/fr/products/connect/)

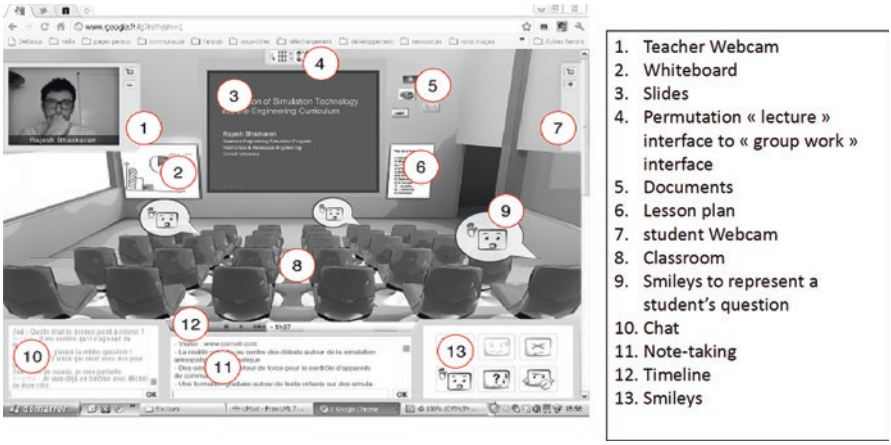

Fig. 5.5 Description of the interface for the student

of representation of self and others, global view of the group, and tools to communicate in multiple ways, led the team to emphasize points of view and changes of perspective, in particular because the previous interfaces did not connect different points of view to different activities. The keyword here is “viewpoint”. If one switches from the psychological to the visual plane, the situation can be described as managing different viewpoints during the interaction. The points of view are given by the actual position of the interlocutors. A person can, therefore, imagine the reverse shot of what she sees. Also important was the fact that the “togetherness” of a real class was not represented on the screen and that we needed to find a point of view that could represent it.

At that stage, the designers left the design space of e-learning platforms. They felt the need to explore how these feelings (togetherness) and representation of self and others were dealt with in other media to try to create an equivalent in VUE, a new branch in the family resemblance tree.

5.2.3 “Empathy” and Togetherness in Other Media

After the first analysis of e-learning platforms, the designers delineated another corpus composed of visual media: painting, photography, film, and comics. They especially analyzed how each media aesthetically treats the issue of self-representation and the representation of different protagonists at the same time in different spaces (to see different scenes at the same time, to make ellipses in space, etc.) So, the design team analyzed how these different media dealt with the issue/concept of viewpoints.

In film and video, they noted that the viewer shares the viewpoint of the characters either through a first person narrative viewpoint or with medium shot (to feel

closer to the actors, to simulate an immersion in the scene) and close-ups (to show facial emotions).[25,26] But empathy is not only built through first person narrative. Other shots give the spectator a feeling that she is part of a group, that she can share the general view that characters have from inside the movie: the experience of dialog in a group can be rendered through bird eye view or ¾ shot that have all the actors visible to the camera (in particular to allow complicated dialog scenes between more than two people without changing camera position). Editing techniques in cinema (and subsequently in video and 3D environment) provide dynamic change of viewpoints: shot and reverse-shot for example, to simulate a dialog, etc.[27,28]

The design challenge was to emulate both the visualization of different viewpoints and to provide the users with a flexible capacity to choose their viewpoint as they wished and in relation to their activities. The main question was: how does an interface support this process when trying to represent a group of 15 to 30 learners while also creating a way to represent team work (4 students) on an interface?

5.2.4 The Result: VUE as a Digital Control Room to Fight Loneliness

Alone behind their computers, students easily drop out of class. To fight the loneliness, the team decided to focus on supporting a community through several video options.[29] In conference mode, the designers produced two interfaces: the student's interface (Fig. 5.5) and the teacher's interface (Fig. 5.6). The interface of the teacher is a reverse-shot of that of the student. While VUE used a number of elements and tools that were observed in other e-learning platforms,[30] it also came up with original features such as the large place occupied by the classroom. The teacher faces the class as in a real situation. But more importantly, VUE supports access to multiple points of view of the class thanks to a control room.[31] The "digital control room" of VUE enables the user to select the "camera" that suits her need to understand the situation, to participate more effectively, or on the contrary to create some distance.

[25] Aumont et al. (1992).

[26] Doane (2003).

[27] Aumont et Marie (2004).

[28] Oudard (1969).

[29] A more detailed description of VUE can be found in Gentès and Cambone (2013).

[30] They included a space for slide presentations (which often occupies most of the screen), live performances of the teacher, student representation (via webcam, photos, avatars, virtual agents, a list of names...), communication tools (chat) and sometimes elements to measure the mood of the class (smileys, color code ...).

[31] The control room in television broadcast is the place where the video feeds from the different cameras can be watched. The production team selects the video feed that is going to be broadcasted by TV channels.

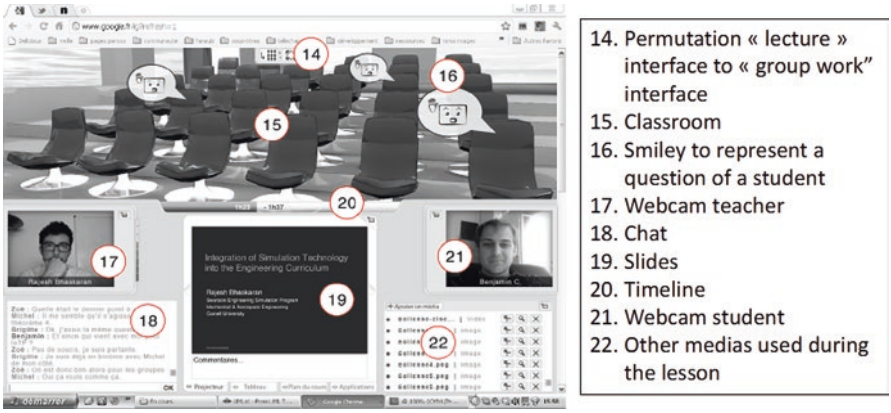

Fig. 5.6 Description of the interface "teacher"

Fig. 5.7 Codedoc project, Whitney Artport, 2002. http://artport.whitney.org/commissions/codedoc/ (retrieved 20 September 2017)

It is a visual tool directly affecting the way the information is accessed. Each user becomes his/her own digital screen director.

5.2.5 Definition of the "Contrasting Semiotic Analysis"

If we sum up the different planes of composition, we see that the survey raised a question: how to help with the attendance issue. But the question was not enough to come up with design ideas. The team therefore did two semiotic analyses. First, their analyses of e-learning platforms gave them the recurring features of the systems. Second, their analysis of viewpoints in different media provided a syntax to

deploy so as to enable users to change and share viewpoints. The team deployed a "contrasting semiotic analysis", an expression we coined with Marie Cambone to address this back and forth "dialog" between two corpuses and semiotic analyses that balanced the convergent effects within a genre (learning websites or points of view in cinema) and the diverging effects of bringing together two different corpuses where each element is contrasted so that new associations can arise. The first analysis looked at general features of the e-learning genre and reinforced the commonality of the genre and the second one was a direct counter-proposition on the basis of semiotic features borrowed from other media. The main advantage of using representations and media as a starting point was that it prevented any attempts to emulate "real life". The double and contrasting semiotic analysis helped the team to

- focus on the visual interface itself as a stage rather than to consider it as a mere tool for e-learning and therefore opening the opportunity to play with the semiotic possibilities of the system.
- rethink the question of users' representation and find an equivalent to a close-up in cinematic grammar,
- deal with the complicated issue of loneliness by allowing participants to change and share viewpoints.

More generally, the exploration of media based representations helped craft alternatives to support experiences that cannot be lived in "real life": to see different scenes at the same time; to be both very subjective and omniscient; to make ellipses in time and space.

As mentioned earlier, these observations fit what Schön calls the interaction between the designer and her material. He shows how a designer "shapes the situation, in accordance with his initial appreciation of it, the situation "talks back" and he responds to the situation's back talk".[32] But a situation does not talk back if a system of tensions and confrontations between social, technical, and semiotic systems is not organized as such. In other words, it seems important to define a meta-communication system that specifically addresses this question of confrontation. Here the "contrasting semiotic analysis" seems precisely to be one of the meta-communication systems since it turns a survey of existing platforms into a confrontation of services and contents on different media. It is therefore part of the converging / diverging semiotic process that expand concepts (here sharing / changing viewpoints) so that they can become operational in mediated interactions.

The next section presents another example of a meta-communication system that brings the differences to the forefront, while considering the different results as part of the same design continuum.

[32] Schon (1984).

5.3 Using Several Tools as a Confrontational Technique[33]

If we only focus on the results, we neglect the role of artifacts, machines, tools that creators handle and that shape the project too. Certain artists, for instance those who participated in the digital art exhibition CODEDOC,[34] make it clear that code is both their material and tool since certain types of code bring certain types of artwork (Fig. 5.7).

> *CODeDOC* takes a reverse look at 'software art' projects by focusing on and comparing the 'back end' of the code that drives the artwork's 'front end'– the result of the code, be it visuals or a more abstract communication process.

Hence some harsh criticism of certain software that do not seem to support creative activities but incorporate inane bureaucratic practices and legitimize institutional writing. I am thinking of Edward Tufte's criticism[35] of Powerpoint. Hence too the promotion of self-made software by some researchers like John Maeda[36] or Alan Kay.[37] These designers warn that the user can fall prey to the underlying model of their writing tool and I have to admit that it is exactly what happened to me and a group of professors and students in the following experience. Our experiment with a multimedia artist demonstrated how tools could shape our writing, how we actually were writing under influence!

Here, I want to show two things: first, software are somehow inhabited not only by a figure of the "user"[38] but also by a figure of the "text". Software – more or less explicitly – have a definition of what a text is, what information is, and what it is to read and write. Second, a tool is not only an artifact but also an apparatus and therefore can structure the way people contribute or create.

5.3.1 A Lesson from Art: Designing a Three-Stage Show

In 2002, with two researchers from the Department of Computer science, Alain Grumbach and Jean-Claude Moissinac, we invited twelve engineering students to participate in the early design phases of a live, interactive performance, to be held simultaneously on three separate locations connected with a (VTHD[39]) broadband network. My school wanted to test its broadband network but also wanted to explore the aesthetic and social potential of connecting three spaces that were both virtual

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[33] First versions of this section were presented at the IASDR conference Gentès and Béjean (2011).

[34] http://artport.whitney.org/commissions/codedoc/index.shtml."

[35] Tufte (2006).

[36] http://www.maedastudio.com/index.php

[37] Alan Kay, "People who are really serious about software should make their own hardware," http://en.wikiquote.org/wiki/Alan_Kay

[38] Akrich (1990).

[39] VTHD: Vraiment Très Haut Débit.

Fig. 5.8 Mephisto circus. Art Project at Telecom Paristech, 2002–2003

and real. The group was invited to imagine a scenario based on Goethe's play "Faust" (1829–1832), hence the name of the show: "Mephisto Circus" (Fig. 5.8).

We worked with the French video and multimedia artist Michel Jaffrennou and with the company Gaia and its director Guilhem Pratz. Originally a video artist, Michel Jaffrennou had been working for quite a while on the mix between real and virtual spaces for such shows as "Le Petit Théâtre de Diguiden" (Diguiden's Small Theater).[40] The creative sessions had to provide a scenario of use and indications for the technical requirements and feasibility. It should be noted that "Mephisto Circus" was eventually not produced for a number of reasons, including the cost of such an operation and the difficulty of adapting the available spaces (conference rooms or class rooms of the connected institutions in Sophia-Antipolis – close to Nice – Paris, and Brest (Fig. 5.9) to the needs of the theater (backstage, complete darkness, etc.) Nevertheless, the artist incorporated some of these ideas, for example in "The Phantom Public", 2005, produced with sound designer Thierry Coduys, whereby the public could vary the lighting and sound of the show at whim.[41]

[40] de Meredieu (2005).

[41] Latour et Weibel (2005).

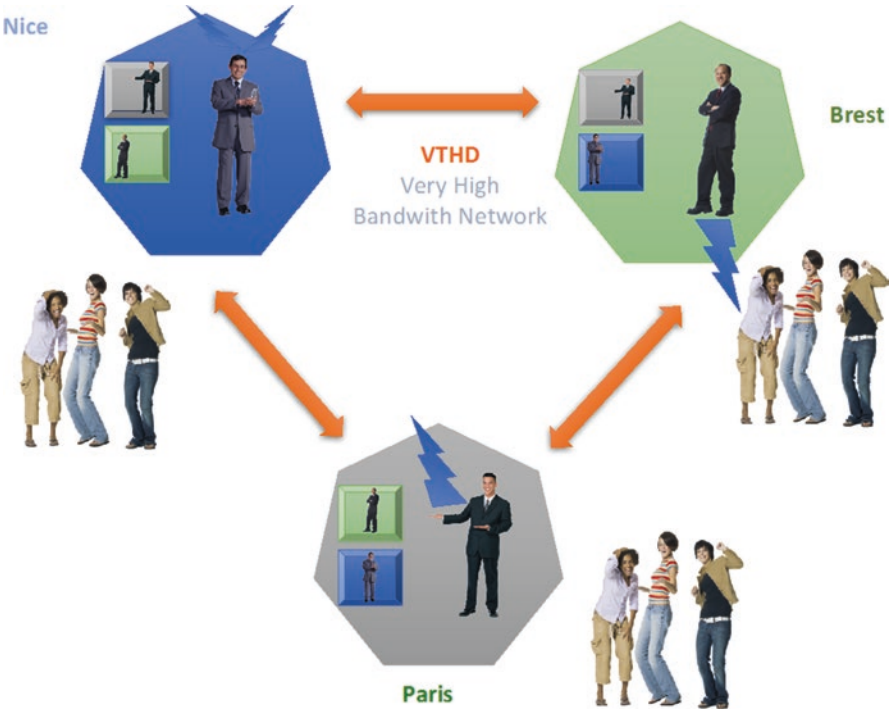

Fig. 5.9 Mephisto. Technical representation

5.3.2 From Writing a Text to Exploring Writing Tools

Before initiating the design work, all the participants of the group had to read Goethe's Faust that was the inspiration for the show. Then, brainstorming and writing sessions were organized with Michel Jaffrennou. During these sessions, the group produced a first text that was the starting point for the design process. To do so, the group used "Microsoft Word" as the more "natural" tool to tell a story. It allowed them to describe the characters as well as create the dialogs. For instance, they briefly defined the devil who would be the main character. This use of Word comforted their assumption that a show was a sequence of dialogs, as it is mostly taught in the French system of education. They thought that "designing a show" was like "writing a series of dialogs" that would then be staged with props, costumes, etc. In fact, stuck with a traditional model of theater, the participants did not imagine for a second that the public could be participative even though the goal was explicitly to create an interactive show. The use of the software Word did nothing to contradict this vision which we came to realize was not Jaffrennou's.

Coming from a contemporary branch of theater that combines different traditions (e.g. Antonin Artaud[42]) and very much influenced by the circus tradition,

[42] Artaud (1994).

Jaffrennou emphasized the physical impact of theater and its magical inspiration as well as the participation of the public. Without openly criticizing the results of the first writing sessions, Jaffrennou suggested that you use a flow chart (see Fig. 5.1), which enhanced the temporal structure of the show and its optional features triggered by the spectators. For instance, if the audience lighted the stage, Mephisto then disappeared. If the audience left the stage in semidarkness, Mephisto continued to play. When the group finally understood that the spectators were going to be part of the story, it radically changed the way they looked at the status of the audience: suddenly they were not only spectators but they became Faust, disillusioned and manipulative, trying some stage magic. They could be tricked by the devil, but they were also given some real power that could destabilize either Lucifer or another group of spectators (Fig. 5.10).

But this representation was not very helpful to visualize the three stages together and their interconnections. The artist suggested writing the show in "html pages" that would contain actors and actions and show the branching plot (Fig. 5.11). The hypermedia links between the different elements slowly turned the linear plot into the architecture of three interconnected places. The group was in fact struggling to move from a 2D representation to a 3D representation (Fig. 5.13).

Again, the artist shifted the group's emphasis from linear plot to a wider consideration of what is on stage and how the spectators can act in the play. We discussed the spectators' interventions (the why) but we did not really think about how: what would be the concrete props that could create not only a meaningful relationship between the stage and the actors but that could actually impact the progress of the show? The use of a spreadsheet application (Microsoft Excel), (see Fig. 5.12) took the group beyond the notion of the stage as a symbolic environment, to focus on the place as an ensemble of technical equipment and people. Jaffrennou had transformed this tool into a list "a la Prévert"[43] made of possible landscapes, characters, objects, etc. that could be diversely combined so that ideas of scenarios would appear by association. The show was then written again with a spreadsheet, introducing multiple objects and places as potential actors of the show (Fig. 5.12).

It should be noted that Michel Jaffrennou worked with the sociologist Bruno Latour with whom he shares an interest for the "grid" format as a flexible tool to play with signs. In particular, Jaffrennou used Latour's concept of "pedocomparator" defined as follows: "in *the regularity of its cube, their disposition in columns and rows, their discrete character, and the possibility of freely substituting one column for another, the pedocomparator belongs to sign. Or rather, it is through the cunning invention of this hybrid that the world of things may become a sign*".[44]

To consider the spatial dimension of the show, Jaffrennou finally led the group to use Adobe Director, an application that composes multimedia presentations (see Fig. 5.13). We could include the different tangible artifacts within a 3D representation with some perspective and the localization of screens and actors. The architec-

[43] Jacques Prévert (1900–1977) was a French poet and screenwriter who introduced the list as poetic material in the poem "Inventory" ("Inventaire" in the collection of Poems: Paroles, 1946).

[44] Latour (1999).

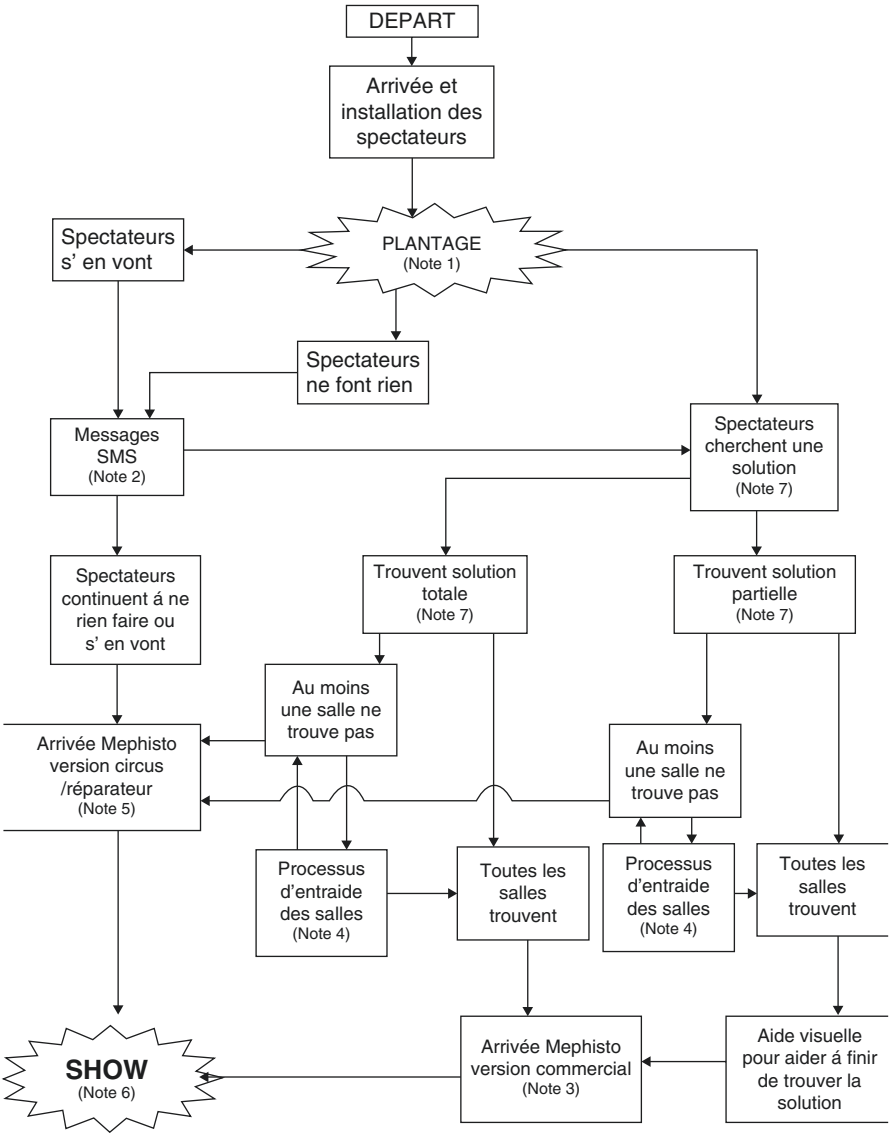

Fig. 5.10 Mephisto circus: Flowchart

tural dimension of the show and its scenography was at last fully perceived by the group. We no longer thought about the location as décor. Through Director, the value of artifacts not only as signs but as triggers to activate a new state of the show, was discovered. Eventually, we could define the show as a global architecture of events, people, and loci (the physical and symbolic spaces proper) (Fig. 5.13).

HARMONIE

Description brève de la fiche

Paris Brest Nice

Totems	*?*
Ecrans	*Actifs.*
Acteur	*Absent.*
Lumières	*ambiance lumineuse*
Son	*ambiance sonore*
Eléments utilisés	*liste des éléments déjà utilisés*
Action	*Les spectateurs utilisent les technologies de manière harmonieuse. Les différentes salles ont choisi de collaborer pour que le spectacle reste vivable. Mephisto est vaincu, l'élaboration d'un document collectif entre les salles vient sceller cette union qui permet de rejeter Mephisto.*

Description de la suite 1	*Description de la suite 2*	*Description de la suite 3*
Suite 1	Suite 2	Suite 3

Fig. 5.11 Mephisto circus – webpage

	A	C	D	E	F	G
1		ORINATEUR PILOTE				
2	TYPOLOGIE	SCENARIO	EVALUATION	TRAITEMENT OUT	QUI/QUOI ?	minute 001
3	HUMAIN/ACTEUR	scénario/acteur-1		ordres ecrits	acteur1	prompteur1
4	HUMAIN/ACTEUR	scénario/acteur-2		ordres ecrits	acteur2	prompteur2
5	HUMAIN/ACTEUR	scénario/acteur-3		ordres ecrits	acteur3	prompteur3
6						
7	HUMAIN/TECH/SPECT/PHONE	scénario/spect-1			téléphon	
8	HUMAIN/TECH/SPECT/PHONE	scénario/spect-2			téléphon	
9	HUMAIN/TECH/SPECT/PHONE	scénario/spect-3			téléphon	
10	HUMAIN/TECH/SPECT/PHONE	scénario/spect-4			téléphon	
11	HUMAIN/TECH/SPECT/PHONE	scénario/spect-5			téléphon	
12	HUMAIN/TECH/SPECT/PHONE	scénario/spect-6			téléphon	
13	HUMAIN/TECH/SPECT/PHONE	scénario/spect-7			téléphon	
14	HUMAIN/TECH/SPECT/PHONE	scénario/spect-8			téléphon	
15	HUMAIN/TECH/SPECT/PHONE	scénario/spect-9			téléphon	
16						
17	HUMAIN/TECH/SPECT/OBJET	scénario/objet-1			objet1	
18	HUMAIN/TECH/SPECT/OBJET	scénario/objet-2			objet1	
19	HUMAIN/TECH/SPECT/OBJET	scénario/objet-3			objet1	
20	HUMAIN/TECH/SPECT/OBJET	scénario/objet-4			objet1	
21	HUMAIN/TECH/SPECT/OBJET	scénario/objet-5			objet1	
22	HUMAIN/TECH/SPECT/OBJET	scénario/objet-6			objet2	
23	HUMAIN/TECH/SPECT/OBJET	scénario/objet-7			objet2	
24	HUMAIN/TECH/SPECT/OBJET	scénario/objet-8			objet2	
25	HUMAIN/TECH/SPECT/OBJET	scénario/objet-9	temps/vitesse 1		objet3	
26	HUMAIN/TECH/SPECT/OBJET	scénario/objet-10	temps/vitesse 2		objet3	
27	HUMAIN/TECH/SPECT/OBJET	scénario/objet-11	temps/vitesse 3		objet3	
28	HUMAIN/TECH/SPECT/OBJET	scénario/objet-12			objet3	
29	HUMAIN/TECH/SPECT/OBJET	scénario/objet-13			objet3	
30						

Fig. 5.12 Mephisto circus – excel file

5.3.3 Mixing Software: The Organization of the Confrontation

The observation shows that the participants' writing was influenced by the software because they engage a vision of what a "proper theatrical text" is: either a series of dialogs or a series of events, either the architecture of living and non-living actors

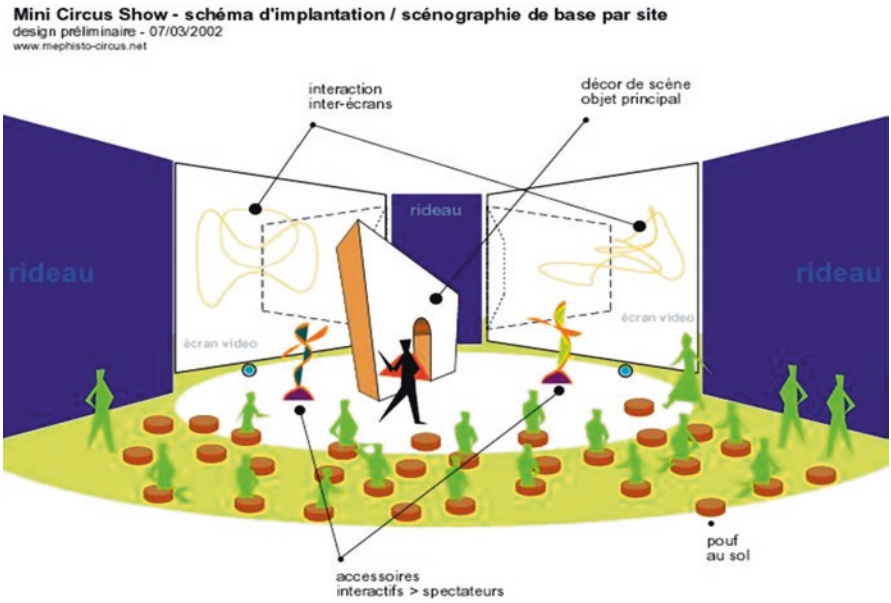

Fig. 5.13 Mephisto – Director file

or the participation of spectators, etc. Consequently, we need first to better qualify what these "tools" are. In fact, following Genette, Souchier and Jeanneret, I think that we need to get rid of the word "tool" and rather use the concept of "architext" to describe the pragmatics of these writing activities. Then, we need to look at the whole situation as yet another meta-system of writing that organized the confrontation of different versions of the show. Writing was not so much about using one particular software to achieve a goal but using a constellation of architexts that contrasted different visions of a show.

5.3.3.1 From Tools to "Architexts"

Design research has focused on design tools used at different stages of the design process: for instance sketching as shown by Schön and Wiggins,[45] Goldschmidt,[46] Kavakli and Gero,[47] or rapid prototyping.[48,49] The relevance of computer assisted design is also questioned for example during conceptual design.[50] Here, I want to

[45] Schön and Wiggins (1992).

[46] Goldschmidt (1994).

[47] Kavakli and Gero (2001).

[48] Sass et Oxman (2006).

[49] Cuff (1992) .

[50] Bilda et al. (2006).

consider the semiotic and pragmatic properties of the softwares and study them through the concept of "architext".

The word "architext" was first used by the literary theoretician Gerard Genette[51] (1979), and describes rhetorical patterns that underlie a group of texts. Each text is built and understood with explicit quotations, but more subtly because formal, stylistic, and rhetorical characteristics help the reader to recognize the genre of the text. Under the diversity of styles, the reader can perceive a relationship between texts that does not make them equivalent but similar. The focus here is on categories of texts rather than details between specific texts. Genette's concept takes into consideration the editorial dimension of these texts, the way each social group classifies them (prose versus poetry, for instance), gives them a status (commercial versus informational), legitimize them (legal or ludic).

Second, the depth and freedom of the interpretation depends on the culture of the reader. The architext may not be perceptible to a reader of elementary competence, like a kid who learns to read. A more confirmed reader recognizes the architext because she captures some of the stylistic characteristics that make it part of a genre. This competence is part of the "re-creating experience" described by Panofsky: "the recreating experience of a work of art depends on the natural sensibility of the spectator, on her visual training, but also her cultural background and experience[52]". Panofsky contrasts two relationships to works of art: anybody can appreciate the aesthetics of a work of art, but the recreating experience is based on an ability to compare it to others and to replace it at the time of its creation. The more skilled spectator will of course enjoy the experience but she will also judge its material characteristics, its qualification as an object of contemplation as well as some of the institutional dimensions of the work of art, and its place and role in the dynamics of art History.

The concept of architext has been used again with a slightly different meaning by Jeanneret and Souchier[53] as the tangible and visual pre-organization of a text as it appears in the window of laptops, with signs, tabs, and a model of text (typically with a professional feel and not a rough copy). The authors point out that the etymology of the word encompasses two ideas: first a beginning (the writer is not confronted with a white page) and second management (the process is spatially and temporally organized). The digital architext structures the practice of writing.

Our experience of writing and rewriting Mephisto with different "architexts" showed how these intellectual technologies provide resources to imagine a new text. At the same time, these architexts enclose the writer in a framework that can be detrimental to the ideation process because they incorporate models of what a proper text is (professional typewriting and publishing industry versus private sketching space, for example).

Of course, privileging one writing tool has never prevented authors from exploring different genres. In our case, what is at stake is not only the form of the docu-

[51] Genette (1979).

[52] Panofsky (1969).

[53] Jeanneret and Souchier (1999).

ments but also the definition of what a show is, as well as the relationships between a show and texts. In this example, designing means considering what these tools mobilize in terms of models and how they can orient and disorient, but also how they need to be used together to actually organize yet another confrontation. The concept of architext also helps us consider that tools engage a representation of knowledge and defend a certain aesthetic. As we have seen, each architext offers a different model of writing, but also a different distribution of power as each of them emphasizes or downplays the role of actors, authors, props, technologies. In other words, they are part and parcel of an apparatus as it is discussed by Foucault. I will come back to the concept of apparatus at the end of this chapter.

5.3.3.2 Multiplying Architexts as a Writing Strategy

In the debate between those who design their own tools (as John Maeda or Antoine Schmitt presented earlier[54]) and artists or designers who use a tool of their choice and consider that the outcome matters more (Agnes de Cayeux working in Second Life for instance[55]), a third path advocates using several architexts with a critical distance, as was obviously Jaffrennou's position. The "constellation of texts" was a strategy to "de-naturalize"[56] (Barthes) the implicit model of text that is built within the software. The manipulation of different tools destabilized each result by a new one. What I therefore learned was that using different architexts was not necessarily a strategy to avoid the limitation of one of them, but rather to redefine what a theatrical text is. First, each tool produced different versions that not only built the show differently but also questioned the group's presuppositions of what a show "is". Each version was as valid as the other. It is worth noting that some theatre creators, like Jaffrennou but also Jean-François Peyret,[57] exhibit these documents not as sketches and drafts, but as creative spaces as well. They want to make a point that there is a variety of "works" and not a hierarchy or a succession of works leading to the triumphant "final" result: the show.

Second, revisiting a text with a different tool is a way of expanding how we think about contents and media (including the show) in relation with others. The emphasis here is on inter-textuality: the interdependence of texts creates a rich structure of evocations, contrasts, nuances, that echo each other and expand our perception of each. For example, the participants interpreted their first texts in Word differently after producing the Excel spread sheet. Each document influenced the interpretation of the others and the contrast of texts brought forward new unexpected interpretations and potential productions. It is a learning and expansive process.

[54] http://www.gratin.org/

[55] http://www.agnesdecayeux.fr/

[56] Barthes (2012).

[57] http://www.theatrefeuilleton2.net/, http://fr.wikipedia.org/wiki/Jean-Francois_Peyret

5.3.4 *Designing a Field of Tensions to Fight the Apparatuses*

In both examples, the creators did not only design something new, they redesigned the situation into a confrontation so as to expand the conception of their "product". In the first case —VUE, the constitution of a double corpus supported the defixation from the techno-semiotic characteristics of a communication platform and helped redefine e-learning solutions. In our second case —Mephisto, the diversity of tools provided a diversity of texts and viewpoints that allowed the theatrical production to be redefined. These operations were part of a design situation of confrontation that structured the dialog with models of texts and situations.[58] In other words, tensions appeared between versions, visual grammars, contents, and through them, different systems of values, different perceptions of interactions, different worldviews. Understanding these situations of confrontation can therefore help us understand the human, social and technical interplay in design but in this section I want to emphasize their aesthetics goals and the role of composition.

The concept of "dispositif" or "apparatus" as it was developed by the Italian philosopher Giorgo Agamben[59] after Foucault, can help us focus on the design situation. The word "dispositif" was used by Foucault to describe sets of human, tangible, even architectural constraints that organize the way people live and produce. An apparatus is both a way to organize knowledge in different fields (psychology, psychiatry, medicine, etc.) and to organize power (a prison, a hospital, a church, etc.). In a discussion published as "The Confession of the Flesh" in 1977, he describes the dispositif as: "a thoroughly heterogeneous ensemble consisting of discourses, institutions, architectural forms, regulatory decisions, laws, administrative measures, scientific statements, philosophical, moral and philanthropic propositions–in short, the said as much as the unsaid. Such are the elements of the apparatus. The apparatus itself is the system of relations that can be established between these elements."[60] His definition focuses on the strategic elements of such configurations: "which means that we are speaking about a certain manipulation of relations of forces, of a rational and concrete intervention in the relations of forces". Agamben further employed the word to mean:

> literally anything that has in some way the capacity to capture, orient, determine, intercept, model, control, or secure the gestures, behaviors, opinions, or discourses of living beings. Not only, therefore, prisons, madhouses, the panopticon, schools, confession, factories, disciplines, judicial measures, and so forth (whose connection with power is in a certain sense evident), but also the pen, writing, literature, philosophy, agriculture, cigarettes, navigation, computers, cellular telephones and--why not--language itself, which is perhaps the most ancient of apparatuses--one in which thousands and thousands of years ago a primate inadvertently let himself be captured, probably without realizing the consequences that he was about to face.[61]

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[58] de Grazia and Furlough (1996).

[59] Agamben (2009).

[60] Foucault (1980).

[61] Agamben (2009).

An established genre (like the e-learning websites in VUE) or a writing tool are therefore apparatuses that structure the way we think about learning or writing. This has important consequences on how we consider certain matter of fact operations such as making "a state of the art". When researchers and designers build a state of the art of existing corpuses they augment their knowledge of the field. However, they also reinforce the evidence of the apparatuses and fix the representations of the common, usually admitted aesthetics traits of this field. Similarly, architexts not only support tasks. As apparatuses, they also create blind spots. The design space consists therefore in clashing these different apparatuses to challenge the way we relate to tools and texts and how we define ourselves in relation to them. This second aspect is fundamental as it focuses on the designer's practice of tools: should it be one of mastery? Or one of play?

Agamben's definition is also helpful in that it recognizes a double relation to the apparatus that was actually very much felt by the participants in the writing process of Mephisto. Each tool/apparatus helped the participant to write and, therefore, expand their subjectivity. For each of us, it was not only about inventing something it was also a personal journey of self-discovery. Agamben points out that indeed this interplay between the living actor and the apparatus defines the subject. In other words, the interaction between living and nonliving actors (to use the Actor Network Theory vocabulary) builds the subjectivity. As designers, it was important to let ourselves be influenced by the tools that we used, rather than to try and control them. We needed the tools to surprise us in shaping us in particular ways. In his creative writing workshop, Jaffrennou let the production be led by the inherent design of each architext. He let the participants be played by the architexts. But at the same time, he created a system of confrontations to counter the limiting effects of each architext/apparatus. Had we used only one tool in confidence that it could support our whole creative process, we would have been closed into one model of thinking about the theater. To organize a situation where there is not one but several architexts was to painfully recognize that subjectivity has to find a way in between all of these tools. Whether through a contrasting semiotic analysis or through the use of several architexts, the designers not only manage a project but also let the situation, artifacts, tools, shape the production by exposing the multiple facets of a new media, service, or artform.

The concept of "dispositif" also foregrounds the questions of format, shape, and, more generally speaking, of aesthetic composition. In Agamben's definition of the "apparatus",[62] which is yet another way to translate the French "dispositif" and the Italian "dispositivo", this interplay of structure and people also creates specific aesthetics. In Latin, the word "dispositio" means the composition. While only one tool or one corpus of references would have limited the composition, bringing in more tools and sources opened up the elements to compose with. Composition here is not only the strategic guiding of sources and tools it is also how we are led by these elements, their here and now "material agency" as Knappett and Malafouris[63] have

[62] Agamben (2009).

[63] Knappett and Malafouris (2008).

elaborated. From this perspective, the "idea" – that is the starting point in most design models – is obtained at the end, after the confrontation of media and the use of multiple tools and not at the beginning. This is an important aspect of a model of design as a plane of composition. Through confrontation, designers engage in a dialog with previous artifacts as sources for the composition. The contrasting semiotic analysis as well as the constellation of tools, but also moodboards,[64] or materiautheques[65] are a deliberate organization of the composition space, a net to catch the elements that might lead to a new design. They build the matrix that will make it possible to create something new. To think about the design process as systematically starting with the ideation phase then could seriously be misconstrued.

A serious criticism of the starting "idea" is presented in Henry James' short story: "The Figure in the Carpet" (1896). In this short story, Henry James comments on artistic work with an underlying critique of what people expect it to be: that is an idea well performed. The protagonists of the story therefore look for an idea – hidden but at the origin of the books – an idea so powerful that it could change their lives. A young critic (the narrator of the story) meets the writer so as to ask him about this idea. The writer does not want to answer but repeats that the answer is in the several volumes that he has already written: "It stretches, this little trick of mine, from book to book, and everything else, comparatively, plays over the surface of it. The order, the form, the texture of my books will perhaps some day constitute for the initiated a complete representation of it". Before Duchamp, at approximately the same time as Paul Klee, Henry James loses his readers in a quest for meaning and lets us know that the work of art is the work of art, without precedent, but each time as it is recreated by the viewer. As we read the short story, wondering about its meaning, we forget to look at what is there: the work of words. The use of the carpet metaphor is not innocent. James has an idea of art as weaving things together. The idea emerges from the weaving, not the weaving from the idea.

Similarly, in our two cases, the starting point is vague and the ideas and the productions emerge together gradually through the confrontation of materials. The "image of the text" is, therefore, not only an idea put into a shape but a gradual building of an aesthetic that is material and ideological both and at the same time. Such viewpoint is sustained by the anthropologist of material culture, Tim Ingold, who, elaborating on Klee, also speaks of the "The Textility of Making"[66] that I further discuss in the next section.

5.4 Conclusion: "Two to Start"

Many creative activities and situations described by artists, designers, or even engineering researchers, undermine the managerial model of design where linear time rules design organization as a sequence of events, and where each activity feeds the

[64] Gentes et al. (2015).

[65] http://www.citedudesign.com/fr/materiautheque/

[66] Ingold (2010).

next one. We need to switch from a chronological model of design to a spatial model of design where the focus is on the elements in presence, in the situation, where all the actors living and nonliving are being composed to beget a new unknown.

5.4.1 Going from a Metaphysics of Design to a Pragmatic of Design

The philosopher of design, Pierre-Damien Huyghe, in a small and interesting book called: "Commencer à Deux" – "Two to start"[67] – analyzes the fact that since Aristotle we consider design – or architecture – as a linear process starting with an idea that eventually leads to its implementation. Looking at the word architecture and at how it is considered in the Occident, he points out that in this one word there is:

– the root: "archi" the starting point, the idea that is also the archive,
– and the final touch: the roof that the carpenter puts on a building. In other words, the idea leads the whole construction process.

In this model, the primary idea is all that matters because it is all that is needed for the project to be fully archived. Huyghe qualifies this as a metaphysics of design, that is a theory based on a representation of ideas as holding all of the creative power. Indeed, in Nicomachean Ethics,[68] Aristotle describes the three stages that deploy this process from abstract to tangible. The first is the conception that is a way to consider what "could be", what we would call now ideation. The architect is the perfect embodiment of this stage. Around 15 BC, Vitruve, in De Architectura,[69] considers that the essence of architecture is indeed to contemplate the possibility of something.[70] The second stage is about building, that is to say to pass from the generality of the conception to the particular case (what today such researchers in design as Willemien Visser[71] after Tulving and Thomson[72] qualify as "episodic knowledge") that is to say the capacity to re-use some experience of the same kind. Finally, the third stage is about the "know how", the craft of skilled workers. What we just described is the very model that the industry has implemented in its hierarchy, organization, and processes. While the model has its merits, Huyghe, not without a sense of humor, suggests that we should consider design, or conception, as the meeting of two sources that would otherwise produce nothing on their own. The birth of an unknown might not be the result of this metaphysics of conception but a far more tangible meeting of parts, here and now, that beget the invention. To sup-

[67] Huyghe (2009).
[68] Aristotle (1999).
[69] Vitruve (1995).
[70] Ibid.
[71] Visser (2006).
[72] Tulving et Thomson (1973).

port his criticism of the Aristotelian model of design, Huyghe borrows his vision from one of the founders of the Bauhaus, Paul Klee, who in "On Modern Art",[73] suggested that we should move our vision of design from "the model" to "the womb of nature, at the source of creation". In Klee's words the "model" depicts industrial design, that is a chronological process starting with an abstract idea that gradually takes shape and is materialized through sketches and prototypes. But he suggests that design can also be analyzed as a platform supporting a palette of materials, colors, shapes, and a variety of processes. In his view, the emergence of ideas and shapes happens "at the same time" through the frictions between the elements that the designer brings together. Design in this instance is more about the organization of confrontations of material elements. Design, therefore, is not only project based. It depends on a matrix, where hybridization can take place, through rejection, overlap, aggregation, etc. The two views are probably complementary. A design project does start with a briefing that different stakeholders discuss and through different stages brings about the finished product. But these discussions and stages are also supported and contrasted, in many instances, by getting bits and pieces of material, images, texts, building elements, drawings, schemas and the presence of multiple tools. One way to look at this practice of discourses and drawings is to say that it helps to embody one precise idea, another is to say that it explores shapes and lets new ideas emerge.

The anthropologist Tim Ingold, also elaborating on Klee, further develops this discussion by pointing out that a model of creation as a "matrix" pays attention to different aspects of the creation: in particular, the forces and materials that are shaping the ideas.

> Contemporary discussions of art and technology continue to work on the assumption that making entails the imposition of form upon the material world, by an agent with a design in mind. Against this hylomorphic model of creation, I argue that the forms of things arise within fields of force and flows of material. It is by intervening in these force-fields and following the lines of flow that practitioners make things. In this view, making is a practice of weaving, in which practitioners bind their own pathways or lines of becoming into the texture of material flows comprising the lifeworld. Rather than reading creativity 'backwards', from a finished object to an initial intention in the mind of an agent, this entails reading it forwards, in an ongoing generative movement that is at once itinerant, improvisatory and rhythmic.[74]

Huyghe and Ingold therefore not only offers new concepts (also taken up by Deleuze and Guattari in A thousand Plateaux[75]) but suggest a program for designers and human scientists that we want to focus on in the next section.

[73] Klee (1966).

[74] Ingold (2010)

[75] Deleuze and Guattari (1987).

5.4.2 *The Art of Composing*

Multiplying ideas and confronting alternatives are a way to trigger crises and "surprises" that create new questions and framings. While it can be left to chance, most designers will organize a situation so that it does not give one "straight answer" but provides many options that challenge pre-existing conceptions. That is exactly the point Schön makes when he describes a design situation and comes up with a model of design as a conversation with tangible artifacts, situations, representations, even the designer's body. While Schön speaks of "transaction",[76] I suggest that composition might help us better understand the way that the process of confronting elements actually brings a new artifact.

There is no art without composition. Composition organizes how parts are being assembled, the relations between the parts, but also the relations between lines, between light and dark areas, between colors, textures, sounds, etc. While artists have always composed, Rosenberg[77] explains that the concept itself is quite recent. The first autonomous treatise on composition in painting dates back to 1784: *Saggio sulla composizione della pittura*, by Baldassarre Orsini. This book is a full-fledged treatise that put together analyses of works of art and recommendations on how to structure clair/obscure, foreground / background figures, perspective, etc. Orsini was elaborating on Alberti's *De pictura* (1435), who described the process of painting as:

> We divide painting into three parts, and this division we learn from Nature herself. As painting aims to represent things seen, let us note how in fact things are seen. In the first place, when we look at a thing, we see it as an object which occupies a space. The painter will draw around this space, and he will call this process of setting down the outline, appropriately, circumscription. Then, as we look, we discern how the several surfaces of the object seen are fitted together; the artist, when drawing these combinations of surfaces in their correct relationship, will properly call this composition. Finally, in looking we observe more clearly the colours of surfaces; the representation in painting of this aspect, since it receives all its variations from light, will aptly here be termed the reception of light. Therefore, circumscription, composition and reception of light make up painting;[78]

In this model of design, the work of art does not come from an idea that is slowly implemented, it comes from these three operations: delineation/circumscription, composition, reception of light. The first step is "circumscription". Circumscribing is a two-step process. Alberti came with the metaphor of the window because the painting sets a delimited space that structure the representation and the way people will look at the painting. The work of art therefore depends on the definition of a territory: not only the canvas and frame but also all the elements that are going to be used for the composition. The second stage is composition. Composition has to do with the *de facto* surprising arrangement of elements. The third stage is the reception of light. It refers to the appearance of the elements and therefore stands in between the choices of the media and the conditions of reception. The three operations are totally interdependent and of course have been interpreted in multiple ways

[76] Schön (1992).

[77] Rosenberg (2008).

[78] Alberti (2013).

up since Alberti. However, even in the most contemporary forms of performance[79] and diffusion (the post office for "art letters"[80]) the operations still define how the creative space is built and how it balances the elements of the composition.

5.4.3 *From Inductive/ Deductive Methods to Projective Abductive Methods in Design*[81]

In this section, I want to discuss some of the epistemological differences between a model of design as a project and a model of design as a composition. In my opinion, these models endorse different ways of building knowledge along with making new artifacts.

In addition to its practical advantages in the industry, the theoretical strength of the model of design as a project is that it can actually benefit from an inductive/ deductive methodological structure. The design project appears as a hypothesis derived from observations and the analysis of existing situations to deduce some unforeseen practice or aspiration that can then be changed, augmented, fulfilled. The hypothesis is implemented in a demonstrator that is tested and that produces new knowledge. In other words, the hypothesis is confirmed by the designed object. On the contrary, the model of design as a composition of tensions puts in the forefront abductive methods. I will try to show the rationale behind such a view of design, a view that seems more and more to be shared by researchers studying design activities. For example, it appears in Liam Bannon's[82] summary of the evolution of Human computer interaction in the industry. He first describes deductive phases, where the problem is known, and the process consists of verifying the design hypothesis through tests. He also describes inductive phases, where the designers gather information about users to understand their behaviors and come up with design question. Finally, he emphasizes an abductive phase where the designers' contribution consists of looking for clues and making unusual connections.

While induction and deduction have been discussed in epistemology of sciences, abduction has received less attention, but is now the subject of a renewed interest in design to explain "lateral thinking", free associations, hypotheses, and more generally projection in the design work.[83,84,85] These activities are part of the meaning-making process at play in design as studied in design semantics[86] or design

[79] Feuillie (2002).

[80] Saper (2001).

[81] This part of the chapter relies on workshops on Peirce's semiotics organized with Camille Jutant, Mathias Béjean, and Cedric Mivielle.

[82] Already quoted in Chap. 3 to address the question of the user.

[83] Roozenburg (1993).

[84] Sowa and Majumdar (2003).

[85] Schurz (2008).

[86] Krippendorff (1989).

semiotics.[87] Coming from design and innovation research, Buxton,[88] Kelley,[89] and more recently Dow et al.,[90] have also pointed out how parallel design supports learning and innovation. Amongst these different analyses, I find Chow and Jonas' demonstration which is explicitly based on Peirce's semiotics and theory of logic particularly useful in particular because they focus on "creative abduction",[91] that is abduction turned towards the possibility of something rather than the discovery of some hidden connections. Design/practice includes a sequence of activities: observing, reflecting, deciding and acting. Jonas points out that these activities involve three different types of knowing: analysis, projection, and synthesis. What is questioned is the very sequence of this macro process. Nelson and Stolterman[92] consider that though analysis enriches the design solution it does not "cause" design. More to the point, the idea that an analysis of the situation precedes the design itself is related to an idea of design as problem solving. As we have seen, if design is problem solving, then identifying all traits of the situation is necessary to the design process. But if design is seen as an expansion of the real[93] then what matters more is a domain of knowledge (for example teaching) and a series of concepts that challenge the situation as it is traditionally understood. Chow and Jonas contend that "existing artifacts are knowledge sources for projection of the new".[94] They qualify as "transfer" the fact that "we can take knowledge from one artifact and put it in another domain or context to create something new".[95] In the e-learning case—VUE, for instance, this transfer occurred at several levels: it worked on the form of the service (as it recognized similarities), on the context of the service (as it took from one context to place in another) and on the underlying design principle (to share someone's point of view). From their perspective, transfer is related to Peirce's theory of sign and meaning making, and more specifically his theory of abduction.

It is actually difficult to find a definitive version of what Peirce meant with abduction in his writings as he produced several examples and explanations. The first definition of Pierce's abduction is that it recognizes a hidden relation between two elements.[96]

> All that makes knowledge applicable comes to us via abduction. Looking out of my window this lovely spring morning I see an azalea in full bloom. No, no! I do not see that; though that is the only way I can describe what I see. That is a proposition, a sentence, a fact; but what I perceive is not proposition, sentence, fact, but only an **image**, which I make

[87] Chow and Jonas (2010).

[88] Buxton (2007).

[89] Kelley (2002).

[90] Dow et al. (2010).

[91] Eco and Sebeok (1988).

[92] Nelson and Stolterman (2012).

[93] Hatchuel and Weil (2002).

[94] Chow and Jonas (2010).

[95] Chow and Jonas (2010).

[96] I would like to thank Warren Sack for his judicious remarks and discussion on Peirce.

> intelligible in part by means of a statement of fact. This statement is abstract; but what I see is concrete. I perform an abduction when I so much as express in a sentence anything I see. The truth is that the whole fabric of our knowledge is one matted felt of pure hypothesis confirmed and refined by induction. Not the smallest advance can be made in knowledge beyond the stage of vacant staring, without making an abduction at every step.[97]

Here, abduction means uncovering relations that were already there. Hence the comparison between abduction and a detective enquiry that puts together the different clues to solve a mystery.[98] As emphasized by Warren Sack in our discussions, Peirce says in its most basic form that abduction is guessing. Peirce wrote, "Abduction is no more nor less than guessing,...".[99] This first definition of abduction leans towards a static and not expanding world of signs. However, Schurtz analyzes that there is a major difference "between selective abductions, which choose an optimal candidate from given multitude of possible explanations, and creative abductions, which introduce new theoretical models or concepts".[100] I would like to elaborate on abduction as a dynamic production of new meaning based on the quality of things (Firstness), something that I want to call "projective abduction" to mark the creative nature of the cognitive operation. In the next section, I am therefore less interested in the signs proper and more in the operations that lead to the signs.

5.4.4 "Projective Abduction"

I will not sum up here the whole of Peirce's theory.[101] However, I want to follow a few threads to understand how the composition is based on "projective abductions". In the case of deduction, a law is imposed on things. This law is a social phenomenon as it is fully stated in symbolic terms in the linguistic form of a hypothesis. Deduction is therefore a process based in Thirdness, that is a plane of meaning that relies on socially shared knowledge. Thirdness in Peirce's philosophy, is the category of language and representation which makes social communication possible. In the case of induction, the elements are reduced to the symptoms of a law. Induction depends on Secondness as it observes events, objects, here and now. Induction means that the observer looks at things without yet coming with a socially sharable theory or hypothesis. It is essentially the plane of practical experience and the plane of elements in action-reaction, of witnessed causes and consequences. In the case of abduction, there is the idea that elements could have a meaning if taken together. What I find interesting at that point, is that the abduction process is intuitive

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[97] 'The Proper Treatment of Hypotheses: A Preliminary Chapter, toward an Examination of Hume's Argument against Miracles, in its Logic and in its History' (MS 692), HP 2:899–900, 1901).

[98] See for example, Harrowitz (1984).

[99] Prolegomena for an Apology to Pragmatism, (MS 293), NEM 4:319–320, c. 1906.

[100] Schurz, « Patterns of abduction ». p. 201.

[101] For a first introduction to Pierce's semiotics, see http://www.signosemio.com/peirce/semiotics.asp

and based on feelings of a possible connection. It is a perception of quality that starts an interpretive process. Abduction is therefore based in Firstness, that is the plane of the possibility of something, the experience of a latent potentiality. Firstness is detached from the actual practical experience, or the social experience. It is a subjective experience that is not yet embodied in a full recognition of elements in tension, nor in a shared social rule or habit, or law.

I find that Shank's reformulation of Peirce's categories of sign[102] is interesting in that it translates Pierce's terminology in expressions that give a vision of design practice. Peirce also used some of these words as alternatives to his final terminology. Here is Shank's model with Peirce's final terminology in brackets.

- Open (rhematic) Iconic Tone (qualisigne)—**hunch**
- Open (rhematic) Iconic Token (sinsigne)—**omen**
- Open (rhematic) Iconic Type (légisigne)—**metaphor**
- Open (rhematic) Indexical Token (sinsigne)—**clue**
- Open (rhematic) Indexical Type (légisigne)—**pattern**
- Open (rhematic) Symbolic Type (légisigne)—**explanation**
- Singular (dicent) Indexical Token (sinsigne)—**fact**
- Singular (dicent) Indexical Type (légisigne)—**hypothesis**
- Singular (dicent) Symbolic Type (légisigne)—**theory**
- General (argumental) Symbolic Type (légisigne)—**demonstration**

The "open" or "rhematic" signs are those that play on a latent potentiality (Firstness). Here I suggest that this potentiality is not only something that "might" exist in relation to a present experience but something that "could" potentially exist. "Open" or "rhematic" signs explore possible futures. In other words, the potentiality affects what could happen in another place or another time.

What matters is the fact that the first three signs – "hunch, omen, metaphor" – as they are reformulated by Shanks – are iconic. An iconic sign is one that has a relationship of similarity from a certain angle to its object. The "hunch", to follow Shank's terminology, is the first inkling that things could be connected. At the beginning of the enquiry, the observer notices things that could be related to a possibility by similarity. If we go back to our use case VUE and the contrasting semiotic analysis, this is precisely this "hunch" which was at play. There was the hunch that the point of view in cinema would somehow be similar to the aesthetics in e-learning platforms. In the use of architexts for the Mephisto show, the different written versions were also deemed to be somehow similar with the potential future show.

Shank then goes on to describe the omen as "a sign of the possibility, based on current resemblances, **of a future event**". Here the relation to design is quite obvious. Abductive reasoning is about things that are not there on a certified basis but that could happen. If we consider design as a reasoning that precisely builds on the potential to actually produce new artifacts, then the omen as a projection in the future is a necessary abductive function of design reasoning. In our two use cases,

[102] Shank (2001).

the potential for new forms of representation and performance was at the basis of the whole design activity. In Jaffrennou's case the writing process that confronted different tools was announcing a future show that was not precisely defined. In the e-learning case, the comparison between different media was not made for comparison's sake, but to see through the analysis the chance of another form of representation.

Shank also describes the "metaphor". His works leads him to assess different degrees of resemblances that range from being identical or equivalent to looking alike: "When we reason to a metaphor we are deliberately manipulating this tension between equivalence and resemblance. That is, a metaphor is stronger than a resemblance claim but weaker than an equivalence claim […] a metaphor is a rule or law based on nothing other than possibility".[103] The design practices that we observed were indeed considering options by creating a surprising confrontation of semiotic systems based on a metaphoric process. In the e-learning use case, the team created the conditions for abductive thinking first by analyzing the semiotic characteristics of existing systems then by comparing them to other semiotic systems from different media. In the theater case, the use of different tools while working on the same "theme" produced the same kind of confrontation. This metaphorical process presupposes similarities and differences. I will further develop how the presupposition is made in the next section.

Considering "projective abduction" as the way we elaborate on future possibilities helps us recognize the meaning of the field of tensions and the way the composition works. Designers do not make a collection of data and materials for the collection's sake. They need to force the chance encounters of different elements, to "perceive an image", to build a new meaningful artifact bearing enough resemblance to other activities and artifacts while detaching itself significantly from the rule (Thirdness). Firstness as a feeling of possibility is therefore specifically provoked by practices that are built from the confrontation of elements proper to the Secondness of Peirce's theory. The general potential "sensemaking of our world" depends on the capacity of designers to make connections where none primarily exist or none are even imagined. But contrary to our everyday relation to the world, or a scientific approach to surprising events, abduction in design is carried a step further because it is provoked by a specific organization (semiotic comparisons, moodboards, various writing tools, etc.) that lets the imagination project new possibilities, creates its own surprises, and retroactively finds meaning for them. In other words, it tries new combinations and forces the mind to exercise its creative power of interpretation to address the new form. Organizing a confrontational dispositive as a matrix for future design therefore consists in preparing a situation, or building intellectual tools that support projective abductive thinking. Contrary to the CK theory elaborated by Weil, Hatchuel, and Lemasson, and later described, that starts with a concept, the theory of the matrix and projective abduction starts with materials and their aesthetics. In the realm of language as a poetic material, the metaphoric process analyzed by Eco and Paci describes how projec-

[103] Shank Ibid.

tive abduction is both "crazy" and finally coherent. Elaborating on their analysis, I want to close this chapter on paradox and coherence.

5.4.5 *"The Earth Is Blue Like an Orange". The Claim to Paradox and Coherence*

"The earth is blue like an orange" writes Paul Eluard[104] who goes on saying: "Never an error, words do not lie". This poem is for me the archetype of what I understand about the double claim of an original composition. Less talented, but working in the same way, "the e-learning situation is the loneliness of the long distance runner", or "the show is an excel sheet", are all oxymorons (breakthrough) that end up in metaphors (coherence), in other words impossible associations that finally make sense on a certain level because they redefine the way we think about the earth, the orange, learning, or the theater: "Never an error, words do not lie", that is the claim of any original associations that want to say something true and meaningful from a certain vantage.

The semiotician, Umberto Eco, notes that the metaphor simultaneously exploits similarity and difference not from an ontological point of view (that is not because the elements of the metaphor have some real common features), but from a semiotic point of view. In their article on "The scandal of metaphor[105]", Eco and Paci retrace the different perspectives about metaphors since Aristotle. They demonstrate that the metaphor is a semiotic process where two elements work paradoxically because they must have enough similarity to place them in the same paradigm, but enough difference for the comparison to have the necessary element of contrast.[106] The metaphor therefore changes both initial elements as in a "condensation" process (Eco and Paci use Freud's terminology about the interpretation of dreams[107]) where the original elements are transformed in the work of the dream. Umberto Eco points to the logical process at play in particular as a metaphor is grounded in what he calls the encyclopedic meaning-making process. He explains that in the semiotic process we undertake an impassioned "hermeneutic circle":

> One assumes a code, which is verified against the simile, whose metaphorical transformations are appraised in advance; or one starts from the simile in order to infer a code that makes it acceptable; [….] Analyzing further this process of trial and error, we would realize that we are dealing with multiple inferential movements: hypothesis (or abduction), induction, and deduction.[108]

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[104] Eluard (1966).

[105] Eco and Paci (1983).

[106] Warren Sack remarked that Amazon.com's recommendation system works on the same principle when it is matching one buyer's profile to its database of profiles in order to suggest other similar books to buy.

[107] Freud (1997).

[108] Eco and Paci (1983).

The metaphorical process in Eco and Paci's definition "posits" (in a philosophical sense, but also in a physical sense, as in "putting before the eyes") a proportion that is unexpected. It is like an oxymoron: a figure of speech in which apparently contradictory terms appear in conjunction. The composition starts a process of interpretation that actually builds new meaning to make sense of it. In our examples, the design of the artifacts somehow demonstrates that the oxymoron is not only aesthetically interesting but cognitively valid. The design validity is discovered after the fact through a process that Eco and Paci call the "Porphyry's tree", named after its author, neoplatonist philosopher and logician Porphyry.[109] The Porphyrian tree is the representation of the logical path of a metaphor that can be claimed after the new object is produced. But rather than considering it from the standpoint of an already existing and discovered relationship, I think that we need to consider the process as the invention of a future potential relationship.

At this point, I would like to go back to the two use cases of this chapter and show how the design solutions, that seemed paradoxical, actually could be presented as converging at a certain level. I am interested in getting to understand how a seemingly "crazy concept"[110] can claim a rationale by reorganizing two knowledge bases as the CK theory demonstrates.

Paradoxical metaphors (or oxymorons) were at play in both use cases as a way to merge seemingly divergent propositions. In the theater case, the artist implicitly told the group that a show is like an html tree, or like a spreadsheet. Excel is a spreadsheet to execute operations while a play is actions, people, props. There is obviously no common point. But the metaphor still works because it merges at a certain level as shown on the following diagram. It works because on the one hand, it reduces excel to its aesthetic qualities: it is a grid that organizes data through a matrix. It also works because it narrows down the scope of the theater by omitting the narrative structure of a theater play and by limiting it to a set of actions. At the same time, it enlarges the purely accounting vision of excel as a spreadsheet by giving it a creative capacity and it augments the perception of the theater by giving the same attention to things as to people and actions. Finally, the oxymoron induces a reflection on the mechanisms of the theater by focusing on its malleability and playful nature. The coherence is not pre-existing but is built through a reorganization of what Hatchuel et alii call the knowledge base (Fig. 5.14).

The same metaphoric process was at play in the abductive reasoning of the e-learning case. The intuition of the design group was to focus on how to provide a rich visual experience that could counterbalance the effects of the students' loneliness. They used the metaphor of the "control room" as defining the learning class. But between cinema – or live TV feed – and a learning environment, there is very little in common. Again, for the metaphoric process to work, it had to narrow down and converge the new definition of cinema and of e-learning platforms. On the one hand, cinema was considered in relation to its contribution to image syntax: close-up, wide angle, shot/reverse shot, etc. The design team also questioned how such syntax could be done "live". They subsequently followed that lead up to the TV control room. On the other

[109] http://en.wikipedia.org/wiki/Porphyrian_tree

[110] Hatchuel et al. (2014).

hand, rather than listing all the tools available in e-learning platforms, they focused essentially on people's presence and forms of representations. The main image of e-learners is the front shot of their face, provided of course by their webcam. This image seemed like a reduction of the variety of angles and views that an actual class provides. The metaphor came as a visual solution to a participatory question (Fig. 5.15).

In both cases, the metaphorical process is substantiated by a claim of coherence that is apparent in the logical Porphyrian tree. The coherence is "guaranteed" by the change of meaning of both primary concepts that finally borrow from each and therefore expand beyond their original meaning. The spreadsheet is no longer considered only as a combinatorial tool that "treats" only numbers but also as a mechanism that combines actual things, people, situations, and therefore reveals their malleability. The theater is no longer considered as a story put on stage, but as a dynamic, compositional space, where everything contributes to the experience of the show. In the e-learning case, people are no longer seen as live individuals but as characters on a stage, who can suddenly direct theirs' and others' image. The Porphyrian trees are a way to analyze a claim to a rationale and to observe the reductions and expansions of meaning.

5.4.6 Open Conclusion: Design as an Apparatus of Tensions

As I started this chapter on design as composition of tensions, I evoked the students' experience of discomfort. This discomfort is not only a psychological consequence of innovation. It is the consequence of a semiotic process bringing into coherence seemingly different events, knowledge bases and patterns. The psychological key to a scientific behavior is the feeling of surprise that is related to the challenge of preconceptions. Peirce talks about "genuine doubt" and notes that this state is uncomfortable. He also notes that we generally try to "fix" it as soon as possible. The two

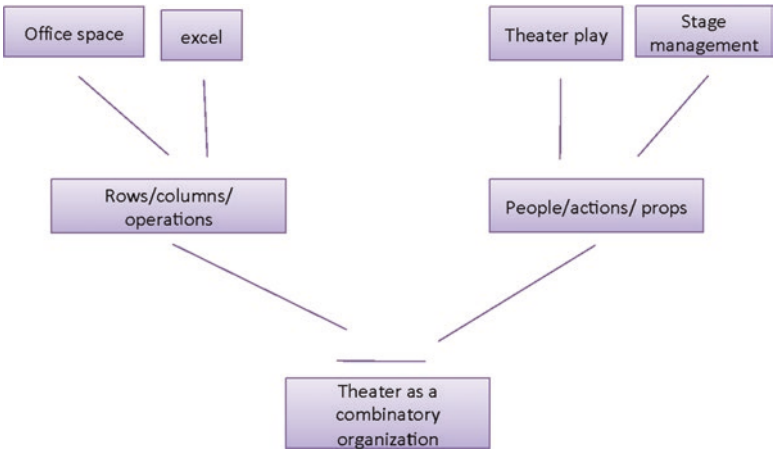

Fig. 5.14 Porphyrys' tree of the theater use case: Mephisto

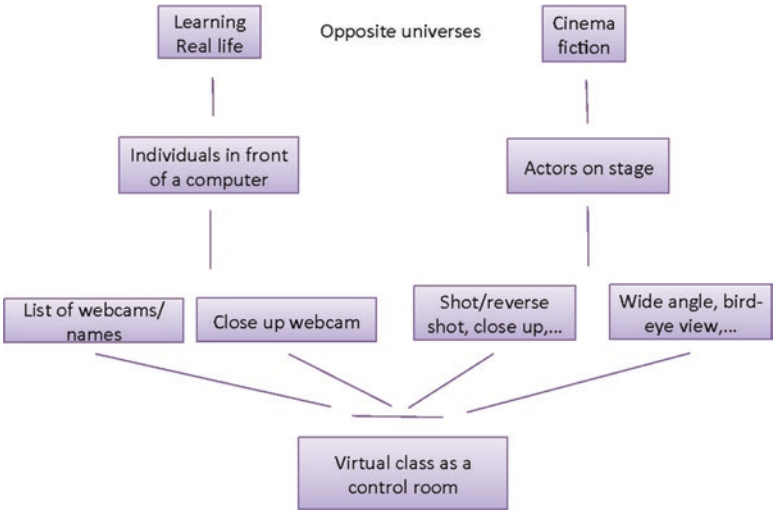

Fig. 5.15 Porphyrys' tree of the e-learning platform VUE

examples in this chapter describe two dispositifs of confrontation – two "matrices" to evoke Paul Klee's words – that triggered and organized such discomfort but also helped the design process. First, they were a way to generate divergent conceptual and aesthetic options, which is a crucial challenge in design work. The semiotic analysis of other media dealing with the same issue and the use of a constellation of writing tools were a way to reduce convergent thinking and break free from one single mind frame. The analysis of these situations led us to consider them as dispositives that structure not only knowledge but also power and aesthetics.[111] In these dispositives, the confrontations as they are embedded in the software or contents themselves, are the sign of an abductive process. From a design perspective, it seems important that abduction should also be seen as an aesthetic process. Because abduction is based on the open iconic semiosis, the design process is not only about ideas leading to forms but also forms leading to ideas. This challenges a general view of design organizations that focuses on a strict chronology of ideas, sketches, implementation, production, and tests. Organizing a field of tensions so that ideas emerge from materials can be just as important.[112]

What the notion of dispositive brings into the equation is the material conditions of such a form of reasoning: abduction is incarnated. It has to be explicitly embedded in situations that force design practice into abductive mode. In Shank or in Eco's analyses, the situation is mostly a given: the analysis in the detective story or the structure of a successful poem. But the situation is not a given in design: the use of multiple architexts or of contrasting semiotic analyses are only two examples of such organizations that need to be deployed when some design work has to be done.

[111] Catellin (2004).

[112] Dow (2010).

In addition, the situation is also made of other living actants, who more or less actively multiply the possible projections. Who are they? How do they contribute to the design space? What are the powers at play in a design situation? These last questions will be considered in more detail in Chap. 6 as we look at who participates in the design process and at how the "object" is also a "thing" that is debated.

References

Agamben, G. (2009). *What is an apparatus? and other essays* (trad: Par David Kishik et Stefan Pedatella). Stanford: Stanford University Press.

Akrich, M. (1990). De la sociologie des techniques à une sociologie des usages. *Techniques & Culture, 16*, 83–110.

Alberti, L. B. (2013). *On painting*. Cambridge: Cambridge University Press.

Aristotle. (1999). *Nicomachean ethics* (2nd ed.). Indianapolis: Hackett Publishing Company, Inc.

Armogathe, J., et al. (2001, Folio). *La Querelle des Anciens et des Modernes : 17e-18e siècles*, Reprint.

Artaud, A. (1994). *The theater and its double* (trad: Par Mary Caroline Richards). New York: Grove Press.

Aumont, J., and Marie, M. (2004). *L'analyse des films* (2e éd.). Paris: Armand Colin.

Aumont, J., et al. (1992). *Aesthetics of film*. Austin: University of Texas Press.

Barthes, R. (2012). *Mythologies. The complete edition* (trans: Howard, R., & Lavers, A.). Hill and Wang.

Bilda, Z., Gero, J. S., & Purcell, T. (2006). To sketch or not to sketch? That is the question. *Design Studies, 27*(5), 587–613.

Blandin, B. (2004). La relation pédagogique à distance, que nous apprend Goffman? *Distance et savoirs, 2*(2/3), 357–381.

Buxton, B. (2007). *Sketching user experiences: Getting the design right and the right design*. Amsterdam: Morgan Kaufmann.

Catellin, S. (2004). L'abduction: une pratique de la découverte scientifique et littéraire. *HERMÈS, 39*, 179–185.

Chow, R., & Jonas, W. (2010). Case transfer: A design approach by artifacts and projection. *Design issue, 6*(4), 9–19.

Cuff, D. (1992). *Architecture: The story of practice*. Cambridge: MIT Press.

de Grazia, V., & Furlough, E. (Eds.). (1996). *The Sex of Things: Gender and Consumption in Historical Perspective*. Berkeley and Los Angeles: University of California Press.

de Meredieu, F. (2005). *Digital and Video Art*. Edinburgh: Chambers.

Deleuze, G., & Guattari, F. (1987). *A thousand plateaus: Capitalism and schizophrenia* (trad: Par Brian Massumi 1 ed.). Minneapolis: University of Minnesota Press.

Doane, M. A. (2003). The close-up: Scale and detail in the cinema. *Differences: A Journal of Feminist Cultural Studies, 14*(3, Fall), 89–111.

Dow, S. P. (2010, December 1). Parallel prototyping leads to better design results, more divergence, and increased self-efficacy. *TOCHI1704–18 ACM-TRANSACTION, 17*(4), 1–24.

Dow, S. P., et al. (1 décembre 2010). Parallel prototyping leads to better design results, more divergence, and increased self-efficacy », *ACM Transactions on Computer-Human Interaction, 17*(4), 1–24. doi:https://doi.org/10.1145/1879831.1879836

Eco, U., & Paci, C. (1983). The scandal of metaphor: Metaphorology and semiotics. *Poetics Today, 4*(2), 217–257.

Eco, U., & Sebeok, T. A. (Éds.). (1988) *The Sign of Three: Dupin, Holmes, Peirce* (1 ed.). Bloomington: Indiana University Press.

Eilouti, B. H. (2009, juillet). Design knowledge recycling using precedent-based analysis and synthesis models, *Design Studies, 30*(4), 340–368. doi:10.1016/j.destud.2009.03.001
Eluard, P. (1966). *Capitale de la Douleur suivi de L'amour la Poésie* (Gallimard French).
Feuillie, N. (2002). *Fluxus dixit. : Volume 1, Une anthologie*. Dijon: Les Presses du réel.
Foucault, M. (1980). *Power/knowledge: Selected Interviews and Other Writings*, 1972–1977, éd. par Colin Gordon, 1st American Ed edition (pp. 194–195). New York: Vintage.
Freud, S. (1997). *The interpretation of dreams*. Ware: Wordsworth Classics of World Literature.
Genette, G. (1979). *Introduction à l'architexte*. Paris: Seuil.
Gentès, A., & Béjean, M. (2011, October). Making sense of constellations of objects: A case study of computer-aided writing practices in theatrical staging. In *Proceedings of the IASDR (International association of societies of design research), 4th conference*, Delft.
Gentès, A., & Cambone, M. (2013). Designing empathy: The role of a "control room" in an e-learning environment. *Interactive Technology and Smart Education, 10*(1), 31–48. https://doi.org/10.1108/17415651311326437.
Gentes, A., Valentin, F., & Brulé, E. (2015). *Mood boards as a tool for the "in-discipline" of design*. In IASDR, https://hal.archives-ouvertes.fr/hal-01246049/
Goldschmidt, G. (1994). On visual design thinking: The vis kids of architecture. *Design Studies, 15*(4), 158–174.
Harrowitz, N. (1984). The Body of the Detective Model: Charles S. Peirce and Edgar Allan Poe. In Eco et Sebeok, *The sign of three* (pp. 179–197).
Hatchuel, A., et Weil, B. (mars 2002). C-K theory: Notions and applications of a unified design theory. In *Proceedings of the Herbert Simon International Conference on « Design Sciences »*.
Hatchuel, A., Weil, B., & Collectif. (2014). *Les nouveaux régimes de la conception : Langages, théories, métiers*. Paris: Editions Hermann.
Hockney, D. (2006). *Secret knowledge: Rediscovering the lost techniques of the old masters*. London: Thames & Hudson.
Holmberg, B. (1995). *Theory and practice of distance education* (2nd ed.). London/New York: Routledge.
Huyghe, P.-D. (2009). *Commencer à deux : Propos sur l'architecture comme méthode*. Paris: Editions MIX.
Ingold, T. (2010). The textility of making. *Cambridge Journal of Economics, 34*(1), 91–102. doi:https://doi.org/10.1093/cje/bep042.
Jacquinot, G. (1993). Apprivoiser la distance et supprimer l'absence? ou les défis de la formation à distance. *Revue Française de Pédagogie, 102*, 55–67.
Jeanneret, Y., & Souchier, E. (1999). Pour une poétique de l'écrit d'écran. *Xoana*, *6–7*, 97–107.
Kavakli, M., & Gero, J. S. (2001). Sketching as mental imagery processing. *Design Studies, 22*(7), 347–364.
Kelley, T. (2002). *The art of innovation*. New York: Broadway Business Books.
Klee, P. (1966). *Paul Klee on modern art* (Reprint ed.). London: Faber & Faber.
Knappett, C., & Malafouris, L. (Eds.). (2008). *Material agency: Towards a non-anthropocentric approach*. Berlin: Springer.
Krippendorff, K. (1989) On the essential contexts of artifacts or on the proposition that "design is making sens (of things), *Design Issues*, *5*(2), 9–39.
Lakoff, G., & Johnson, M. (1980). *Metaphors we live by*. Chicago: University of Chicago Press.
Latour, B. (1999). *Pandora's hope: Essays on the reality of science studies* (1re éd, p. 47). Cambridge, MA: Harvard University Press.
Latour, B., & Weibel, P. (Eds.). (2005). *Making things public: Atmospheres of democracy* (1st ed.). Cambridge, MA/Karlsruhe: The MIT Press.
Laurel, B. (1993). *Computers as theatre*. Boston: Addison-Wesley Professional.
Leupen, B et al. (1997). *Design and analysis* (1re éd.). New York: Wiley.
Moore, M., & Kearsley, G. (2011). *Distance education: A systems view of online learning*. Belmont: Wadsworth Publishing.

Nelson, H. G., & Stolterman, E. (2012). *The design way: Intentional change in an unpredictable world* (2nd ed.). Cambridge, MA/London: The MIT Press.

Oudard, J.-P. (1969). Cinema and suture. In N. Browne, & J. Hillier, (Eds.), (1989) *Cahiers du Cinema 1969–1972. The politics of representation* (Vol. 3, pp. 45–57). Boston: Harvard University Press.

Oxman, E. R. (1994). Precedents in design: A computational model for the organization of precedent knowledge. *Design Studies, 15*(2), 141–157.

Panofsky, E. (1969). *L'oeuvre d'art et ses significations*. Paris: Gallimard.

Rastier, J. (2002). Enjeux épistémologiques de la linguistique de corpus. In*Journées de Linguistique de Corpus*. available http://www.revue-texto.net/Inedits/Rastier/Rastier_Enjeux.html.

Roozenburg, N. F. M. (1993). On the pattern of reasoning in innovative design. *Design Studies, 14*, 4–18.

Rosenberg, R. (2008). Le schéma de composition, outil et symptôme de la conception du tableau. In La Documentation Française, *Histoire de l'art en France au XIXe siècle* (pp. 419–431). Paris: Roland Retch et al., s. d.

Saper, C. J. (2001). *Networked art* (1st ed.). Minneapolis: Univ Of Minnesota Press.

Sass, L., & Oxman, R. (2006, mai). Materializing design: The implications of rapid prototyping in digital design, *Design Studies, 27*(3), 325–355, doi:https://doi.org/10.1016/j.destud.2005.11.009

Schon, D. A. (1984) *The reflective practitioner: How professionals think in action* (1re éd., p. 79). New York: Basic Books.

Schön, D. (1992, March). Designing as reflective conversation with the materials of a design situation. *Research and Engineering Design, 5*(1, Springer), 3–14.

Schön, D. A., & Wiggins, G. (1992). Kinds of seeing and their functions in designing. *Design Studies, 13*(4), 135–156.

Schurz, G. (2008). Patterns of abduction. *Synthese, 164*, 201–234.

Shank, G. (2001). It's logic in practice, my dear Watson: An imaginary memoir from beyond the grave. *Forum Qualitative Sozialforschung/Forum: Qualitative Social Research*, *2*. http://www.qualitative-research.net/index.php/fqs/article/viewArticle/970

Sowa, J. F., & Majumdar, A. K. (2003, Springer). *Analogical reasoning* in International Conference on Conceptual Structures (pp. 16–36). http://link.springer.com/chapter/10.1007/978-3-540-45091-7_2

Stahl, G., Koschmann, T., & Suthers, D. (2006). Computer-supported collaborative learning: an historical perspective. In R. K. Sawyer (Ed.), *Cambridge handbook of the learning sciences* (pp. 409–426). Cambridge: Cambridge University Press.

Tufte, E. R. (2006). *The cognitive style of powerpoint: Pitching out corrupts within* (2e éd.). Cheshire: Graphics Press.

Tulving, E., & Thomson, D. (1973). Encoding specificity and retrieval processes in episodic memory. *Psychological Review, 80*(5), 352–373.

Unwin, S. (2009). *Analysing architecture* (3e éd.). London/New York: Routledge.

Visser, W. (2006). Designing as construction of representations: A dynamic viewpoint in cognitive design research. *Human–Computer Interaction, 21*(1), 103–152.

Vitruve. (1995). *Les 10 livres d'architecture de Vitruve* (2e éd.). et augm (Editions Mardaga).

Wisser, W. (2006). *Designing as construction of representations: A dynamic viewpoint in cognitive design research*. *Human Computer Interaction, 21*(1), 103–152.