

Construction and Design

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Purpose: The purpose of the author in writing this paper is to establish the connection between design and constructivism. To that end, it is argued that design is a necessarily constructivist activity (both in terms of the design of concepts and the design of objects and processes); and that design preceded constructivism by many millennia.

Design/methodology: This argument is made through reference to concepts and developments in second order cybernetics, and an analysis of central activities that designers perform – particularly sketching and doodling, used in the manner of holding a conversation with oneself. **Findings:** The parallelism between design and constructivism (and second order cybernetics) is demonstrated; and a distinction between knowledge of (a situation) and knowledge for (an action) is drawn. Knowledge for is the knowledge that supports action, including the action of constructing. **Original value:** Design is placed at the heart of constructivist activity, validated by criteria that are sympathetic to designing. Thus, constructivist activity is reinforced by the analysis of design activity; and design activity is reciprocally reinforced by the analysis of constructivist activity.

Key words: Black Box, circularity, conversation, design, doodle and sketch, knowledge of and knowledge for, object..

A constructive position

There are two levels I would like to distinguish which we may be interested to investigate:

- 1 The individual level, on which we construct the *other*, our connection to the means of communication (language) in which we will communicate, and so on. On this level I believe we attempt to describe what is and how it comes to be what is.
- 2 The social level, on which we assume the *other*, assume and develop the language we communicate in, and so on. On this level we construct the *shared* – the domain of social agreement we often think of as a “reality.” I think of this level as being explicitly the level of Vaihinger’s (1911) “As if.”

In much of my work, I am interested in the first of these. This is the level of experience, the Heraclitian stream in which we live what we come to call (on the second level) our lives. It is assumed that experience is personal, unique, and lived. One question that dominates this level is how we can develop from this experience the means by which we can explore experience: which involves at least the presence of an *other* and a means of communication (for example, language). This is a

very difficult question, and it is made harder by the paradoxical requirement that to examine this experience we have to already have both the notions of the *other* and of language, and the use of these notions. In other words, we face a paradox: we are obliged to presume (live in) the outcome of an argument before and in order that we may make that argument. This paradox is similar to the paradoxical problem of psychological/conceptual development: that whenever we think in a developmental framework, we are accounting for what we believe was, from the position of where we are now, which itself depends on precisely the development we intend to show. I accept these contradictions. In doing so, I straddle the paradox and thus both maintain and transcend it.

It is also possible to take the view that society forms the individual rather than that the individual, in construing other individuals, makes society. And it is possible to discuss the generation of thought from language rather than the generation of language from thought. There are these (and many other) choices. One reason for being interested in a constructivist position is a wish to at least give breathing space to each, and to move beyond opposition and paradox through acceptance (see Foerster, below): to do so is to treat the so-

called problems in a positive manner: to be what we call, using a second social meaning, “constructive” about them.

In this paper, however, I am concerned to operate on the second of my initial levels (the social). Indeed, in a somewhat bizarre manner, I am even concerned with an assumption of a reality such as mentioned above. Designers make objects with which they populate “the real world.” The question of Mind Independent Reality (MIR) scarcely raises its head because designers are too busy making things for and in their assumed real world to ask questions about it – especially to question whether it “really” exists! They add what in common parlance might be called “real objects” to the “real world.”

Designers have a way of acting that can be studied; and which is studied, albeit implicitly, by most teachers of the subject. In order to help each student designer find their own voice, the general teaching strategy in the design culture I was brought up in and chose still to inhabit is to try to understand and encourage the particularity of each (student) designer. This involves watching how they design, and giving them what may be thought of as tools that help them. Amongst these tools is the tool often identified with sketching, still the central activity through which designers find the means to tap, as the source of their acting, the individuality and uniqueness they search for. Sketching leads to the creation of the particular and unique “new.” This should be understood in contrast to the repeatability that is more commonly sought in, for instance, science.¹

In contrast to the lack of interest of most designers, the position I take, which lies behind much of this paper, is that we cannot assert that there is a MIR. Neither can we assert there is not. This leaves us with what Foerster (1989) referred to as an “undecidable proposition.” His noted aphorism is “Only the questions which are in principle undecidable, we can decide.”² The question of whether we could ever know if there were such a thing as a MIR, and therefore if we had any reason to

decide one way or the other, is undecidable. We therefore can from moment to moment freely chose how we will respond to this “structural uncertainty.” For Foerster, there were two choices: to act as if there were a MIR; and to act as if there were not. The choice between these, he reminds us, does not have to be made once and for all: it may (perhaps even must) be made from moment to moment. It is arguable that one may take both positions at once and that this is what designers do (see the comment on straddling the paradox, above).³

I consider there is another course open to us: that is to maintain the undecidability. This is, in essence, the position of the great super-sceptic, Pyrrho of Ellis.⁴ My position is that I chose to try to act as a guardian of the undecidable question, guarding against the forces that seek to force a decision (one way or the other, and usually permanently) on others, as a so-called “truth:” to maintain, and then sit on the fence, rather than to decide which side to stand on. It may be that this is, in effect, the position that is necessary not only so that we can chose one side or the other, but also so that we can occupy both positions at once, as designers may do.

Therefore, I neither affirm a reality that exists independent of the mind (MIR).

Nor do I deny it.

I maintain undecidability.

By doing this, I hope to avoid entering into an irresolvable argument, and to maintain the freedom to chose that is the result of this undecidability. In maintaining this freedom, it may be that I also aid the designer, who (it has been suggested) often straddles the undecidability.

Design

There are many ways of talking about design, and, indeed, the word has recently been appropriated in any number of fields, sometimes improperly. In the case of one university I know, social sciences joined a design school in order to benefit from working with designers, only to insist that the designers were wrong about design and that their (social science) appropriation was correct. Elsewhere I have seen research methodologists insist that design education is wrong because it fails to satisfy the criteria of the research methodolo-

gist. Both are examples of the all-too-common application of theory from other fields onto design (Glanville 2005a). It is therefore doubly important that I explain how I, as a designer and design educator, understand what design is.

Design is the quintessentially constructive activity. For thousands of years mankind has created new objects and processes (more or less physical), and has developed ways of doing this. It is the novelty sought through this activity that brings the particular quality those who call themselves designers pride themselves on. What is important is the giving of form – new form. Designers construct (new) realities at all scales from tiny components to cosmologies and theologies. They mostly do so in a world that is understood as being real in a most conventional sense, by creating realist objects. Designers, who construct realities, largely do so without questioning the conditions of the reality within which they construct these realities, or the nature of reality itself: it is an irony that they, with thousands of years of experience as constructivists, have not as a profession chosen to question whether they construct the reality in which they know they construct (new) realities. Nevertheless, in recent times, questions of the “reality” of that reality have become less avoidable, specially as we explore so-called “virtual reality” (meant in the widest sense and including computer games, the internet and mobile phones). Perhaps working with more virtual realities will give designers the opportunity to expand their conceptualising beyond their conventional view of reality.

Design, as I use the term, is intended primarily in the form of a verb. The word design in English is both a noun and a verb.⁵ This ambiguity is confusing, all the more so since the general interpretation of the word design seems to have become the noun form. I, however, speak as a designer, and teacher of design. I shall argue, later, that we are all designers.

Difficulties with the word do not, however, end with the ambiguity concerning which part of speech the word design takes. Design is also often confused with fashion and style, which are not at all what I intend in this paper.⁶

The etymological root of the word design doesn't help much, either. Design+are, its Latin origin, is as a verb closely related to the

contemporary English verb, designate. It is connected with the concept of sign. And that is also not what is intended in this paper.

So design, as used here, is a verb, indicating an action that leads to making something new. Quite how this is intended I will demonstrate later.

How we do design

I am here concerned with what I think of as the central creative act that designers do: or, rather, how they do this. This is the act of form giving (one Dutch translation of design is vorm+geving: literally, form giving). Thus, I am not concerned with all those contingent activities and their associated problems and areas of influence (such as function, safety, production and cost) that, while critical to the success of a design project, are ancillary to this central act, and will not, in this paper, explore either how they are handled or how their handling fits in with the central act of designing.⁷

Designers create form: they give form to the unformed, informing it, bringing it into form (hence the ancient design as in-form-ation). Design is, perhaps surprisingly, properly considered the original in-form-ation science, where science is meant in its older and less specialised sense of knowledge. Because it is concerned with giving form to the unformed, it is necessarily creative. Designers learn to give form as unique and one off: their work is purposely and purposefully original. Thus, the familiar criterion of repeatability has no place in design.⁸ I know this both because I am a designer and because, as a teacher, I meet and discuss with designers at all levels and from many different sub-professions all over the world, which experience allows me to assert this categorically.

Over the years, I have used a metaphor to explain this process (Glanville 1978). This is it:

With a picnic hamper in hand (there is a purpose to the activity, but it's not the main point), I enter a wood. I have nothing in mind except that I hope, eventually, to find a place to have my picnic. I'm wandering. Without any particular reason I move onward in some direction, and after a moment something catches my eye. I follow it, and making an unpredictable number of difficult to justify choices, I eventu-

ally find myself somewhere lovely. It's just perfect. I sit down, open my hamper and enjoy my picnic. I can now (after the event) explain how I got here, but at the time there was no reasoning. I just ended up at this wonderful place, eating my picnic. It's bliss! It may not, of course, be the best place for a picnic, who knows where that is: but it's good enough, it fits the moment, and it's magic. In this sense (and only in this sense), it is perfect.⁹

Some would describe the above as an essentially emotional process, believing words such as "good enough," "magic" and "perfect" raise the question of where emotion is in design. The use of an emotional language to describe activities is currently on the upsurge. I have not, until recently, thought of using such a language, but am inclined to believe that it may soon offer great understanding and insights.¹⁰

The well-spring of design is, traditionally, the sketch¹¹ (or doodle) which is created in a manner that can be precisely mapped onto the wandering activity I described in the picnic example. Interestingly, composers also refer to the way they compose (= design) their music as sketching. The dictionary is more useful, here: to compose is to place together. And it better reflects the designer experience, when defining sketching: to sketch is to draw roughly or incompletely.

To doodle is (again according to the Oxford American Dictionary) to scribble absentmindedly; a doodle is a rough drawing made absentmindedly. It is this purposelessness and lack of traditional seriousness that exactly captures the difference in quality in the way of working through sketching. Do not be confused: the lack of explicit traditional seriousness does not mean the work is not serious but that the seriousness is expressed in a different manner. It is important to me that this is recognised, hence the choice of this apparently dismissive term.

The process of doodling and sketching

The process of doodling works like this. The designer makes some mark on a piece of paper. This mark is more of a question than a statement: it is tentative and uncertain – and almost certainly an absent minded-scribble.

It may be any shape that comes to mind, or even a quite undirected shape. Looking at it, the designer draws some more, often emphasising bits of the original, changing bits, adding, drawing over or erasing, wondering about (and through) it. Sometimes the bits of interest are copied and the doodle is started again. Sometimes an alternative is produced. Sometimes the process is an enrichment: adding in aspects that are directed to make a richer project. Sometimes the original is discarded. At some point the doodle becomes more particularly focussed: a particular form is being developed and explored. At this point we might say that the doodle has become a sketch.¹²

If the designer works in a group with others (who need not be in proximate location – or even time – or associated with one design company), they may all draw on each other's doodles and sketches, borrowing from, and giving to, each other. Indeed, the design studio, where this activity frequently takes place, is one environment where the stealing of the ideas of others is considered good practice and, consequently, theft is legalised!¹³ This is one way of sharing (and thus individually increasing) available ideas. It is also a reason that we need to reconsider notions such as copyright, to recognise origination without granting ownership: what is there to own and who could own it?

It is this pointless, undirected, seemingly purposeless, playful and dreamy activity that is at the heart of design. Designers are told to think with their pencils, and, if you talk with designers, you will find that many will doodle throughout your conversation, just playing with form, practising their central creative act, keeping in touch with the well-spring. Doodling is a practice that helps us create form and which allows us to enrich our proposals.

This process cannot, in any conventional sense, lead to an "optimal" solution. To start with, the problem is not defined and, I would argue, is not definable. (Any viable definition will come into being after the event: the solution defining the problem.) Attempts at definition contain contradictions as well, for there are many opinions and misunderstandings to be supported. There is no measurable means of comparison between alternative proposals. It is always possible to continue with the process, perhaps producing a more

satisfying outcome, perhaps not. The notion of "satisfying" depends on the judgement of the designer involved, or of some design or client peer group (hence the common use of "juries" to judge work). Indeed, it is the notion of satisfying that is central: the question is not is this optimal, is it the best; but is it good enough? – as in the case of wandering in the wood. This is how adequacy is and can be determined, in designing.

What is a doodle/sketch?

In one sense this question has already been answered. But there is another way of characterising the act of designing that can help us understand how design and constructivism/cybernetics¹⁴ go together, and, through this conjunction, will throw light on the manner in which the doodle/sketch work as (necessarily constructivist) design acts.

Doodling/sketching as circular

The process followed in doodling and sketching, as described above, is formally a circular process. It is important to try to be specially clear about the manner in which it is circular.¹⁵ That which I claim is circular is the route followed between drawing and viewing, returning to drawing again: if you like, the drawing and viewing aspects. Often these two complementary activities go hand in hand (one views as one draws and one draws as one views), but there is a division of labour. Some would prefer to consider the path followed a spiral: that is, the drawing and redrawing demonstrate an activity that, while it may pass over earlier points, is nevertheless somehow above them in that there is a continuous change in the path, indicated by the number of times circled, which leads, potentially, to recursive enrichment. This also holds if you are concerned with the history of the paths drawn, or the path as message. But that is a way of describing which is interested in the "product" at each point, rather than the route which goes from one activity to the other and back again. Formally, in terms of the roles, the process is circular: I, as designer, move from drawing to viewing to drawing, in a potentially endless circular switch between the two. The difference in these views may be thought similar to that between a wheel (circular) and the trace a wheel may leave (spiral) (Glanville

1998). It can also be thought of (as already suggested) as the difference between circularity and recursion, where circularity indicates the form and recursion the value of the message passed around the form.

Doodling/sketching as conversation

This circularity is, however, not the whole of the matter: for a conversation is being held.¹⁶ Conversations are also circular, in the manner described. Most commonly, they are held between a minimum of two participants. The great advantage of a conversation is that it does not assume that meaning is transmitted between the participants, but that participants build their own meanings which seem, to the other participants, to function in a similar enough manner to be taken to be the same. (Thus, it is as if they are the same). However, though they function similarly, the meanings cannot be the same, because they are made by and belong exclusively to different individuals. These individually generated differences in understanding are expressed, and thus effectively offer other participants in the conversation insights and ways of seeing that are initially foreign to them. In effect these offerings are gifts: each participant, having created his or her own meanings, expresses them so that the other participants can create their own meanings from them, and these meanings are likely to contain the previously unthought of, the unconceived. Thus, conversation is a potential source of perpetual individual novelty and refreshment (Glanville, in press).

The designer: Taking two roles

Some might argue that the design conversation as described above (often) only has one participant, the single designer – making the notion of the conversation irrelevant/inappropriate, because it requires at least 2 participants.

I can offer two responses to this observation. Firstly, design is generally carried out in teams, so there are always other people involved, even if sometimes they are not present in person at the time of exchange. Very few designers are ever without conversational partners, in the conventional understanding.

Secondly, and much more importantly, designers learn to take the two roles themselves.¹⁷ They learn to switch between viewer and drawer, sometimes very rapidly (one

views as one draws and one draws as one views). In the extreme, some may even consider that they do both simultaneously. This is hard to determine. Regardless, the designer takes both roles and can, therefore, hold a conversation with him/herself via paper and pencil.

The conversation that I claim is the means by which what designers do can be understood, is a primary cybernetic system. It is the circularity which is at its centre that, above all, makes this so. Cybernetics studies the circular: the earliest contemporary writings in the subject,¹⁸ infused with the notion of feedback, are clearly involved in circularity (feedback feeds a sense of the output of a system back to its input, normally with the intention of making the resulting, next output of that system better match some goal). Circularity is the essential quality of cybernetic systems. Designing is a circular process, and, for this reason, cybernetics is its suitable bedfellow (Glanville 1981, 2005a). This is not a matter of forcing a theory from one subject onto another subject, but of finding a central concern (circularity) that is in one case examined and in the other used, so that circularity, as it appears in each subject, may inform the understanding of circularity in the other (Glanville 2005b).

Outcomes of this process

If we consider this circular, conversational, cybernetic activity to be at the heart of design, we may ask what sort of outcome there might be when we act in a circular, conversational, cybernetic manner; and, by contemplating these outcomes we may consider just how important, how basically human, is the designer's way of acting.

BOX 1: COMPUTER AIDED DESIGN

The question arises concerning what will happen to those who, working with computers, generate form in a quite different way (see note 12); just as the question arises, with computers, of what will happen now that repetitive and mindless tasks such as cross hatching have been automated. In the case of cross hatching, what is lost has at least two aspects: firstly the element of hypnotic tension reduction that doing a mindless repetitive task brings to people who work in very dangerous environments (designers – as opposed to problem solvers – deal with the vastly complex, the contradictory and the ill-defined, challenges often considered undesirable for good mental health); and secondly the trance-like removal of conscious purpose and intention which allows the “back of the brain” to get on with the task at hand, uninterrupted by conscious acts and will. Both these aspects benefit from a “trancy” involvement (which can also describe the activity of doodling/sketching (the absent-mindedness), and is perhaps relevant to any moment when we are totally lost in the work we do, to the extent that we are hardly present at all, as personae). This seems essential to the sort of creative involvement being sought in designing. The use of the computer may not allow these “trancy” moments and, as a result, there may be an increase in bad mental health and a reduction of sensitive form giving: we do not yet know, but we may do well to look for computer-based equivalents to sketching and doodling; ways of working in the computing medium that support this sort of mindlessness.

The obvious outcome is designed objects¹⁹ – where the nominal form of the word “design” is converted for use as an adjective. Normal use of this concept would not include everything that we make: the word “design” tends to be reserved for more exclusive objects, with a higher than usual intentional aesthetic content (and price). When design is being used as a synonym for style and fashion, this is particularly so. But we should not allow ourselves to be trapped by an interest in outcome, which is essentially a distraction, any more than we should allow one area of application of design to pre-emptively determine all. While not all objects produced by humans are the product of design, many are. Apart from those which are simply shoddy and where no one has bothered, those that are not designed tend to be those where there are overriding (and generally rather simple and/or unique) problems that can be clearly defined and which have to be solved. But even such objects can often be designed, as, for instance, is the case in most of the world's great bridges.

The point is not, anyhow, to argue about this. The point is that design as a process practised by designers leads to the production of many objects (and processes). How many, as a percentage of human production, is a matter of definition and conjecture.

Rather less obvious is the second use: concepts. I maintain we design concepts. If this is so, then we (humans) are, according to the argument of this paper, necessarily and inescapably constructivists.

Conversation, the Black Box and objects

To argue, here, what I wish to argue, about the design of concepts, I need to revisit the conversation and ask what we know of what goes on in the mind of our conversational partner, who we believe is making their own meaning of/from what and how they hear our utterances? The answer is we don't know. Indeed, I have yet to meet anyone who would strongly claim to know what's going on in even their own head. We make descriptions of what we believe might be happening, but the key point about a description is that it is not the thing it describes (de Saussure 1966): for if it were the thing it would not be the description of the thing and could not perform its function in describing.²⁰

There is a powerful way of looking that allows us to consider that we don't know what is going on in something (that we are essentially ignorant), permitting us to depend only on behavioural changes while we learn to explain the changes of behaviour we observe, understood as inputs that, through change, become outputs – and that is the Black Box. Although some who use this concept talk of whitening the Black Box, the source of its effectiveness lies in its blackness, a blackness that derives from it being an invention (of an observer, who also locates it, thus creating the input and the output) which, while allowing change to be treated as input and output, is nevertheless also a phantasm – an invention, a thought experiment: there is no Black Box other than the one I have imaginatively inserted.²¹

When we hold conversations with an *other*, we can describe what goes on as a change in (observed) behaviour that we may understand as an output appearing from

(consequent upon) an input. This is a Black Box description: we are making no claim about what “actually” happens. Rather, we assert that we can make a description that accounts for our observations, which we hope will continue to account for what will happen (the optimism of belief, not the mechanism of certainty). This sort of description we call an explanation. We consider the outputs as resulting from the inputs, and try to construct and describe a relationship that accounts for this. To test our understanding we can feed the output back as a new input and predict the new output that will appear: if our prediction is correct, we may well believe we understand the behaviours we observe, that are converted by our application of the Black Box into input becoming output. The more we can account for, the more stable the relationship we have described seems to become.

Now let us consider what happens in the case of the conversation with the self (as both speaker and listener, drawer and viewer). Is there a difference? Scarcely! The moment we consider (as I have argued above is the case in design) the paper and pencil (or whatever else) we use – together with our ability to switch roles – as behaving like our conversational partner, we are holding a conversation with ourselves. And we still don't know how the change we observe from what we thought we were drawing to what we view we have drawn takes place; yet it nevertheless stabilises in the lines we draw that begin to indicate to us, the designers, a form. We have effectively used what we may think of as a Black Box in order to end up with a stable form: an object that is reproduced through our constant (recursive) redescription (redrawing) of it. This, I have insisted, is strongly analogous to how we design.

But we now see it also as a way of generating reflexive recursive descriptions that form what are Piaget's constant, conserved objects (Piaget 1955) – the (mental) objects that he claimed we construct as concepts and with which we populate our worlds of experience.²²

And, therefore, I argue that the development of the concepts that constitute Piaget's conserved objects is a design activity, being exactly the situation described by Piaget as he accounts for the way that children develop their notions of conserved objects, upon

ABOUT THE AUTHOR

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which ability our other mental abilities rest. At the base of our thinking, we are designers: design, the making of form, the bringing of something out of nothing, the creation (at least to the designer) of the new – the unique – the stabilising of an actuality out of potential and the reification of experience. Seen in this light, design is to be understood as the most fundamental of human activities, as the way we think and work.²³

In this view, we design our world. We create our concepts from which we can conserve our objects. This is our world. It is designed. Thus, it is constructed.

Assembling concepts

There is another aspect of the design of concepts which I must mention, if briefly. It is the assembly together of different concepts such that we can form new concepts or we can organise the different concepts we have designed into heterarchical organisations (I picture the composing together of George Kelly's 1955 Personal Constructs). This act of construction, whether concerned essentially with the organisation of concepts or with the creation from several concepts of new, more general concepts, or the splitting of concepts into new, smaller and more detailed concepts, is also a design act.

In what manner are these modes of assembly design? They all involve the iterative and critical circular process that is at the centre of design, for the assembly is always by trial and error and is always subject to reconstruction: a new organisation, a new assembly of parts and sub-parts, often involving the creation (construction, design) of further new concepts or the radical revision of older ones. This need is a major component in Kelly's definition of pathologies that arise from problems experienced in how we have constructed the heterarchies in which we locate our personal constructs.

Types of knowledge

We can now return to what I see as the main question on which constructivism sheds a new light, which concerns how we can know (and, therefore, what we can know); the question is essentially epistemological. In taking a constructivist position, however, a secondary

question arises that concerns the type of knowledge²⁴ that might be created from that position. Von Glasersfeld (1990), for instance, writes of the "viability" of knowledge produced within a constructivist framework. However his interest is a little different from mine in this paper.

I have been arguing that design is a constructivist action not so much because of an unresolvable question about the nature of the connection of an observation to a so called Mind Independent Reality, but rather because it is concerned with making the new (by definition, unknowable before it is made); and the (sort of) knowledge that would support this. Furthermore, designers make their designs in virtual worlds: it is rare that designers actually make (in the physical world) what they design, and designs exist, before it is manufactured/constructed, only in the virtual world of imagination, and paper, model or (nowadays) electronic "representation." (How exactly you can present again something that is not yet is a moot point.) It can be argued, in the world of the design profession, that design is needed precisely because manufacture is at one level of remove.

Thus, designers are involved in a very special type of activity that is based in action. There have been many ways of distinguishing types of knowledge, including those concerned with a similar distinction between these two types of knowledge, but I like to use "knowledge of" what is (Ko) and "knowledge for" acting (Kf) (Glanville 2005a). The sort of knowledge that we have been used to collecting (and valuing) in research is not intended as *knowledge for* action, but *knowledge of* what is. The importance of the designer's *knowledge for* has, I believe, been underestimated.

There are not many fields that have specifically nailed their flags to the mast of action,²⁵ and yet we live in a world of action and, at a more banal level, our task masters constantly ask us to show usefulness (applicability) of our research and philosophical and academic work. It therefore seems to me that the notion of Kf (or any of its close relatives) may be critical, to be urgently developed, perhaps using as a base the often tacit knowledge designers use in their quest to create the new.

I believe that *Knowledge for* is the *knowledge for* action. It is important that it is not studied and developed as *knowledge of knowledge for*, but as *knowledge for knowledge for* (in the manner of second order cybernetics – the cybernetic study of cybernetics). In other words, that it is examined in a manner that reflects what it is. And this is another place where design and construction intersect, or (as I would prefer it) are essentially the same. This sort of knowledge, Kf, is actually the knowledge that constructivists use: for they make their worlds, rather than recording them: and making is the action of the designer.

Conclusion

Design is clearly, even in the associations of every day language, both closely connected with and a form of construction. In this paper I have explored how design is a constructivist activity, how it is explicitly concerned with making the new, and how as an activity it is all-pervasive. It is perhaps worth bearing in mind, as a souvenir to take away from this paper, that one German word for design is *Gestaltung*.

Notes

This paper is based on an invited presentation at the annual conference of the American Society for Cybernetics conference held in Washington DC, October 2005.

1. I will not argue the point about novelty, or how it is achieved through conversation (and/or variety imbalance), in this paper. I have covered both in recent lectures, and written extensively about variety and (up to now) rather less about conversation.

2. Foerster was Particularly fond of aphorisms. A collection may be found at this url: <http://www.cybsoc.org/heinz.htm>, accessed 26 February 2006.

3. I owe this insight to one anonymous reviewer who suggested "the argument might be strengthened if the author maintained undecidability by allowing that both Mind Dependent [Reality] (MDR) and Mind Independent Reality (MIR) might coexist as working assumptions in minds of many designers. The

constructs that are used to predict the behaviour of MIR in the virtual world of design (for example, finite element structural analysis) could be thought of as very different to the properly teleological MDR knowledge that relates to the social appreciation and understanding of design."

4. Von Glasersfeld often points to the Roman Sceptics, but earlier the Greek super-sceptic, Pyrrho of Elis (ca. 365–275 B.C.) maintained "...a form of extreme scepti-

- cism which held that judgement must be suspended about whether it is possible to know true reality. Pyrrhonism asserted that suspension of judgement (*epoché*, a Greek term which refers to a cessation) about the true nature of reality leads to serenity and equanimity... See Scott, <http://www.angelfire.com/md2/timewarp/skepticism.html>, accessed 25 February 2006.
5. Dictionary comments are based on the Oxford American Dictionaries included in Apple's Mac OS 10.4, Tiger.
 6. The classic definition of design comes via Architecture from Vitruvius. In the English translation of Sir Henry Wotton, it is made up of three components: firmnesse (well constructed), commodotie (functional) and delight. See Wootton (1968).
 7. See note 6 on Vitruvius/Wootton.
 8. Which is not to say that the object or process resulting from the act of designing may not be produced in multiples.
 9. I.e., the fit (in a true Darwinian sense) is perfect: this is the fittest.
 10. I am grateful to the second anonymous reviewer, who reminded me of the development that sees a language of emotion enter into studies of design.
 11. The first "regular" academic to recognise the distinctive value in what designers do and how they do it (including the importance of doodles and sketches) is Donald Schön (1985). Of course, designers had already known this for millennia.
 12. There are societies that do not draw, doodle, or sketch in this manner. But they have similar processes even if they use different technologies. For instance, they may make multiple variations on a bowl until they, as a society-that-is-designing, reach the form they find ideal, and then reproduce it in a sort of hand-made multiple – a craft production line. One reason we draw is that many of the things we make cannot sensibly be made on a trial and error basis – for any number of reasons, including danger and cost. New computing technologies may change the detail of how we doodle but will not, I believe, change the form or substance.
 13. As a student at the Architectural Association School in London, I enjoyed an extreme, pre-electronic version of this. The Ching's Head, a student cafeteria in the school, had white melamine covered tables that acted as a remarkable prototype of the *shared*, collaborative white board. Students would sit together at these tables, drawing their designs in new-fangled felt tipped pen. As the day wore on, more drawings were added, including ones drawn over, and often incorporating part of earlier drawings. There was a sort of collective generation of architecture practised, institutionalising the free borrowing of ideas, which would migrate to drawing boards in the studios upstairs.
 14. I will not argue, here, the close relationship that many (including Ernst von Glasersfeld and Heinz von Foerster), as well as I, believe holds between cybernetics and constructivism.
 15. While not forgetting that it is the listener who makes the understanding and is therefore responsible for it, not the speaker. How each of us likes to listen to (and understand) what I write is clearly up to us, the listeners.
 16. I use the term conversation here in the sense of Gordon Pask. Pask's use was based on an everyday English understanding, but had a strong formal element. It became, in his hands, a very powerful way of understanding communication and interaction. Pask's work is currently difficult to access, but good a introduction can be found in Pask (1975), and Scott (2001). See also my short web piece describing his work at: <http://projects.iss.org/Main/GordonPask>
 17. The role switching here was first developed in my work in the Theory of Objects. Objects (in my technical usage) are self observing structures or entities that, by observing themselves, become participants in a universe of observations and thus themselves observable by other Objects. They provide a structure that supports us believing that, while we all observe differently, we believe that, nevertheless, we observe the same "thing." The switch in roles also gives rise to (observationally generated) time, and a logic based on time in observing (Glanville 1975).
 18. The origins of cybernetics can be taken back to Ancient Greece. The modern subject is usually dated to Norbert Wiener's 1948 book, *Cybernetics*. But there are earlier examples even by Wiener, such as Rosenblueth, Wiener & Bigelow (1943). Another path takes the origins back to the Macy Conferences on "Circular and Causal and Feedback Systems" (Pias 2003)
 19. And, on occasion, processes.
 20. There may be special conditions when the difference is, at most, slight: one example that exercised de Saussure is onomatopoeia. But these special conditions have no relevance to the argument.
 21. The Black Box is a conceptual device developed by the Scottish mathematical physicist, James Clerk Maxwell. It has been used in engineering, where the concept of revealing what is happening through study leading to a whitening of the Black Box. For some time I have argued that the Black Box cannot be whitened: its nature is that it is black. I claim its power (and its use in helping us understand design and constructivism) comes from exactly this interminable blackness (Glanville 1982, 2005a).
 22. This process can also be seen in Heinz von Foerster's *Eigen forms*, and it is taken to be the form of what I have called Objects (Foerster 1976). I am currently finalising a draft on this topic, "Design and Mentation: Piaget's Constant Objects."
 23. The assembly together of different concepts (conserved objects) is a similar matter. We can now say: thinking is designing, and designing is thinking. "L'intelligence organise le monde en s'organisant elle-même," as Piaget tells us.
 24. I do not like the word knowledge, which suggests to me that what is known can exist without a knower. I prefer the word knowing, but will stick to conventional usage, here, so as not to (further) muddy the waters.
 25. There is, of course, a special field for converting Ko to Kf: technology. But this requires an extra stage, and there is no necessary connection between Ko and an ability to act (i.e., Ko may not be translatable). With the term Kf, I am talking about knowledge directly intended for action. Technology does not convert Kf to Ko.

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