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# Candidate Worldviews for Design Theory

Per Galle • [pga@dkds.dk](mailto:pga@dkds.dk)

Centre for Design Research, Danmarks Designskole, Strandboulevarden 47, DK-2100 Copenhagen.

*Abstract:* Our growing body of design theory risks being infected by more inconsistency than is justifiable by genuine disagreement among design theorists. Taking my cue from C. S. Peirce, who argued that theory inevitably rests on basic metaphysical assumptions that theorists ought to be critically aware of, I demonstrate how 'insidious inconsistency' may infect design theory if we ignore his admonition. As a possible remedy, I propose a method by which the philosophy of design may develop sound metaphysical foundations ('worldviews') for design theory – and generate philosophical insights into design at the same time. Examples are given of how the first steps of the method may be carried out and a number of candidate worldviews are outlined and briefly discussed. In its own way, each worldview answers certain fundamental questions about the nature of design. These include the ontological question of what the subject matter of design might be; and the epistemological question of how designers can rely on their predictions about the properties of a potentially novel artefact. The purpose of the paper is not to attempt any definitive answers to such questions, but rather to draw critical attention to the metaphysical (pre-empirical) and conceptual foundations of design theory.

*Keywords:* Design research, design theory, metatheory, philosophy of design.

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[0. Introduction]

Institutionalized design research has been undertaken for forty years or more, and for those of us involved it has generated a research community, complete with pioneers, ‘founding fathers’, and leading figures, learned societies, formal journals and conferences, and a continuous informal debate. Even though different schools of thought can be distinguished it seems uncontroversial to speak straightforwardly of ‘design research’ or ‘the design research community’ presupposing unity and coherence. For they are *social* constructs, and what keeps them together is the fascination of design that we share despite any disagreements on the subject.

But apart from its social functions, the societal function of the design research community is to do design research, the outcome of which in turn is a growing body of *design theory*. By this I do not mean theory about how to design, about how designers think or work, or about what design is; but all of this and much more: quite broadly theory that expresses scholarly knowledge and understanding of whatever is called ‘design’. But can we also speak straightforwardly of ‘design theory’ (the entire ‘body’ thus defined), presupposing unity and coherence? I’m afraid not. For a *theory*, as I use the term, is a *logical* construct: a (usually comprehensive) system of statements expressing human knowledge or understanding.<sup>1</sup> What would generate ‘unity and coherence’ is *consistency*. But in the face of disagreements on theoretical tenets within the design research community – and such disagreements there are – the ‘body’ of *design theory* threatens to disintegrate into mutually inconsistent *design theories* (each of which may be self-consistent; indeed must be, to express anything meaningful).

In a keynote address to the design research community, professor Buchanan (2004) contended that ‘One of the strengths of our field is that we hold different views’ (p 1). For example, we have no consensus about the definition of ‘design’, but ‘have come to recognize that battles over the correct definition of design are fruitless’; instead we should ‘understand that definitions serve the purpose of shaping a particular line of inquiry and that the field will be vital as long as definitions come and go [...]’ (p 15).

<sup>1</sup> Some closely related dictionary definitions: ‘the analysis of a set of facts in their relation to one another’ (Merriam\_Webster\_Online\_Dictionary); or ‘a formal statement of ideas which are suggested to explain a fact or event’ (Cambridge\_Advanced\_Learner’s\_Dictionary).

Nor is there any ‘dominant philosophy of design’ but rather ‘a remarkable pluralism of views’ (p 16). And further: ‘the differences, when they are intelligently expressed and discussed, are an ongoing source of new insight. Pluralism is the gene pool that ensures the sustainability of design inquiry.’

In the social context of the design research community he was right: different views stimulate good discussions, hence good thinking, and ultimately good research. Yet it is in the interest of the very same research community – and of community at large – that disintegration of *design theory* into rivaling *design theories* does not get out of hand. As researchers we have an obligation to produce theory that is generally credible and widely sharable outside our own circles; but the more such disintegration we allow, the less credible and sharable our products become. So how do we keep the plurality and the ensuing disintegration of our emerging ‘body’ of design theory within reasonable bounds, without jeopardizing the freedom of design research? That is the question I will (begin to) address. (*The Problem of Disintegration*, for later reference.)

Differences already acknowledged and ‘intelligently expressed and discussed’, are relatively harmless. If we state our definitions and other initial assumptions as *conditions* under which our theoretical results are asserted (rather than asserting them unconditionally), then at least in a logical sense, much inconsistency can be avoided; though not, of course, the underlying disagreements.

Much more treacherous are the non- and pre-empirical *metaphysical* assumptions we make about the ultimate nature of reality, often tacitly and unknowingly, because we tend to take them for granted. There could be no theory about design or any other aspect of reality without some understanding of reality in general. Hence there can be no theory without endorsement – tacit or explicit, inadvertent or deliberate – of tenets of metaphysics. Metaphysics is what provides us, as Wartofsky (1979) puts it, with ‘the most general and abstract account of the *conditions* under which anything whatever comes to be understood’ (p 70, emphasis added).

When I call our metaphysical assumptions *treacherous*, it is because we cannot help making them, any more than we can help eating. But just as food may cause infectious diseases if contaminated so, I submit, our metaphysical assumptions may be incoherent (i.e., allow a contradiction to be inferred) without our knowing, thus causing undetected

inconsistency in our ‘body’ of theory. (The *Suspicion of Insidious Inconsistency*, for reference.) Such ‘insidious inconsistency’ in our theories does not reflect genuine disagreement on their subject matter (design). Therefore, it should not be tolerated.

My suspicion calls for justification. However, ‘screening’ existing theories for the ‘disease’ of insidious inconsistency would be an onerous task. Although Love’s method (Galle, 2001; Love, 2000) might be applied to it (see 1.3 below), I shall justify my suspicion merely by presenting a few artificial but, I think, persuasive and scalable, ‘toy examples’ (section two). Suffice it for now to note and acknowledge that the basic idea of ‘insidious inconsistency’ is not new. Peirce (1931) wrote:

‘Find a scientific<sup>2</sup> man who proposes to get along without any metaphysics [...] and you have found one whose doctrines are thoroughly vitiated by the crude and uncriticized metaphysics with which they are packed.’

If I am right about the Suspicion of Insidious Inconsistency, this suggests at least a partial solution to the Problem of Disintegration: namely carefully and explicitly developing (indeed, designing!) consistent metaphysical theories on which new design theories can be based (a ‘prophylactic treatment’). I shall call such foundations *worldviews*. I see their proper development as a major task for the branch of design research known as the *philosophy of design* (see, for example, Galle, 2002). Alleviating the Problem of Disintegration is not the sole purpose of worldviews for design theory; they may also provide philosophical insights into the nature of design that are direct contributions to design theory in their own right. This will become clear in subsequent sections of the paper: in sections three and four a method for the design of worldviews for design theory is proposed and explained, while sections five and six exemplify two main groups of candidate worldviews developed according to the method. To prepare the reader for all this, section one will present general background and context material for the line of inquiry pursued in subsequent sections.

<sup>2</sup> Please do not surmise from the use and wording of this quotation that I might be pursuing some reductionist programme of turning design or design research into a (natural, positivist, ‘hard’, or ‘objective’) *science*. I am not.

## 1. Shaping the line of inquiry

Despite my reservations about Buchanan’s celebration of pluralism, I do not hesitate to take his dictum about *definitions* to heart: for indeed they ‘serve the purpose of shaping a particular line of inquiry’ (Buchanan, 2004, p. 15). So to shape mine, I’ll discuss how ‘design’ might be defined in the interest of unity. But first I’ll suggest an *analogy* to illuminate the key concept of ‘worldview’; which, I think, is another useful way of ‘shaping my line of inquiry’. And finally, I’ll shape it in a third way – by placing it in *context* of related work.

### 1.1. Worldviews: the software analogy

Let us expand our stock of metaphorical imagery, not only for general clarification, but also for later use as a vehicle for explanation. As *Table 1* shows, I see an analogy between *software development* and *design research*. (An analogy that could be generalised by substituting other terms for ‘design’.)

**Table 1.** Analogy between software development and design research.

| <i>Software development.</i>  | <i>Design research.</i>   |
|---|---|
| Application programs.   | Design theories.  |
| Underlying operating systems (‘platforms’) that enable application programs to run on the hardware. | Underlying metaphysical theories (‘worldviews’) in terms of which design theories describe reality. |
| Hardware.   | Reality.  |

Ordinary software development produces *application programs*; e.g., word processors, spreadsheet editors, and web browsers. A special branch of software development, known as ‘systems programming’, produces a more basic kind of software: *operating systems* (‘platforms’ in the jargon). An operating system (e.g., Windows, Mac OS, or Linux) provides ‘low-level’ functionality to the application programs (say, detecting a keystroke, allocating a file, sounding the beep, etc.), and enables them to run concurrently on the computer *hardware*, sharing its resources in a coordinated manner.

Analogously, ordinary design research produces (empirical) *theories* about design; e.g., about how designers make use of sketching, or about what designers can do to make the

products they design easy or pleasurable to use. Ideally, a special kind of design research, known as ‘philosophy of design’, should produce a more basic kind of theory: *metaphysical ‘worldviews’*. (In current practice, it would seem, this is often done tacitly and without conscious deliberation by the researchers who produce the empirical theories; and the problems to which this may give rise are the subject of this paper.) A good ‘worldview’ (examples will be proposed in sections 5 and 6) should provide design theories with ‘low-level’ means for understanding *reality* (say, conceptions of properties, time, reference, agency, etc.), and enable design theories to express knowledge and understanding of various aspects of design in a principled and coordinated manner.

Both software and design research are human activities, and since erring is but too human, it is not surprising that the outcomes of those activities (application programs and design theories, respectively) have their shortcomings. Our analogy propagates to the shortcomings, too, as outlined in *Table 2*.

**Table 2.** Shortcomings in application programs and design theories.

| <i>Application programs.</i>               | <i>Design theories.</i>   |
|--|---------------------------|
| Incompatible file formats, no cut & paste. | Incompatible terminology. |
| Unavailability for same platform.          | Incompatible worldviews.  |
| Crashing.                                  | Inconsistency.            |

Though sometimes using ‘stand-alone programs’, we generally expect application programs to be ‘integrated’; i.e., smoothly exchange data. If they lack shared file formats or support for cut & paste, exchange is impossible, or else requires bothersome ‘conversions’. Analogously, two terminologically un-coordinated design theories may not immediately combine into a seamless picture, even if their authors agree on the subject matter.

More seriously, an application program you might wish to use may not be available for your platform. And just as we shall have to live with competing platforms, so we should probably never expect philosophers of design to agree on recommending a single worldview. Even if they did, it would probably not be accepted by all design theorists. What we *can* hope, is that a small number of worldviews will survive competition and

criticism (as was the case with computer platforms), and that each of them will integrate and unify theories based on it.

Worse still, are programs that crash because of fatal ‘bugs’. Their counterparts are design theories that are internally inconsistent; i.e. contradict themselves. Just as ‘bugs’ may lurk in both application programs and the underlying platform, inconsistency in theories may be local to them, or stem from a faulty underlying worldview.

### 1.2. Defining ‘design’

To bring to light the crucial conceptual foundations of our discussion – which might otherwise, like our worldviews, attract suspicion as a source of insidious inconsistency – we need to define ‘design’ as broadly and un-controversially as possible, without watering down the concept. Friedman (2003) recommends Simon’s much-cited definition as a ‘useful starting point’ because ‘it covers most forms of design’:

‘Everyone designs who devises courses of action aimed at changing existing situations into preferred ones.’ (Simon, 1996, p. 111).

Indeed, this ‘covers most forms of design’. It also covers (forgive me the example) my planning to pick my nose when no one looks. But I cannot imagine why we should extend the scope of design research that far; the definition needs fine-tuning. It centres on *planning*, rather than actual change. This conveniently allows us to talk of design that never gets ‘carried out’. What is wrong with the definition is the *aim* of planning, as we just saw. So for our present purposes, I would prefer the following modified version:

Everyone *designs* who devises courses of action aimed at the production of an *artefact*.

Which still leaves us with the burden of defining ‘artefact’. Fortunately, this has been dealt with in great philosophical depth by Dipert (1993), and more recently by Hilpinen whose basic definition reads:

‘[Artefact:] an object that has been intentionally made or produced for a certain purpose.’ (Hilpinen, 2004).

Note how the phrase ‘for a certain purpose’ preserves the teleological content of Simon’s definition, when Hilpinen’s definition is used to complete our modification of

Simon's. The notion of 'devising courses of action' itself is wide enough for our definition of 'design' to accommodate both of the traditionally opposed conceptions of design, Simon's (1996) and Schön's (1983); or in Visser's terminology, the 'Symbolic Information Processing' view and the 'Situativity' view, respectively (Visser, 2006). And it is of some importance for guarding the generality of our discussion of worldviews, to show that for the purposes of that discussion, we need not subscribe to either of these two major schools of thought.

Another equally general and accommodating but perhaps slightly more precise definition would be:

*Design: A designer's production of representations according to an idea, so as to enable a maker to produce an artefact that the designer will recognize as being in accordance with his idea.*

This seems to capture the essentials of the view of design as production of representations that we find in different forms in (Galle, 1999) and (Visser, 2006), and which Visser uses to bridge the gap between the Simon and Schön schools of thought.

However, keeping in mind Buchanan's words about the futility of 'battles over the correct definition of design' let me point out that I claim no degree of 'correctness' of my definitions. My brief consideration of definitions merely serves the entirely peaceful purposes of (1) eliminating whatever doubt about my fundamental assumptions that might otherwise have lingered; and (2) to indicate the independence of the present inquiry with respect to the particular paradigms represented by Simon and Schön.

But even so, some doubt may still linger around the concept of *artefact*. To some of us, the term 'artefact' (let alone the phrases '*production of an artefact*' and '*to produce an artefact*' that occur in my definitions) may have a distinctly *materialist* ring – bringing to mind, perhaps, columns of sturdy Soviet tractors and the like. Nowadays, however, artefacts may include non-material products such as software, organizations, and processes. Here and in what follows, I shall use 'artefact' in the wider contemporary sense, unless in a particular context it's meaning is obviously or explicitly restricted.

### 1.3. *The quest for unity*

Whatever diversifies design and design research is potentially a source of disintegration in the overall 'body' of design theory. But the history of *controversy* in design research is long (Bayazit, 2004; Cross, 2000; , 2006, Ch 7). Let me concentrate instead on the few deliberate attempts at promoting *unity* that I am aware of (apart from Visser's just mentioned).

Hubka and Eder (1996) attempted to lay down foundations for a general 'Design Science'. They limit their scope to *engineering*, but even then, the project is ambitious. They define their science as 'a system of logically related knowledge, which should contain and organize *the complete knowledge about and for designing*' (p 73, emphasis added). I sympathize with their notion of 'logically related knowledge', but fail to see how it could ever become 'complete' in an ever-changing world.

Love's meta-theoretical method (Galle, 2001; Love, 2000) devised to 'clarify the existing state of design theory' and 'assist with the establishment of coherence and compatibility between concepts in disparate theories' shares its aim with the method I am about to present. I believe the methods may supplement each other. Love's elaboration of the vision of unified cross-disciplinary design theory (Love, 2002b) motivates his method. In metaphorical terms of computing, however, he advocates a single 'platform' for all 'application programs' to run on. This is a notch above what I consider the suitable level of ambition. And we must part company when it comes to his proposal that coherence in design theory be based on 'brain and neurological research' (Love, 2002a).

Given our definition of design in terms of artefacts, it is interesting to note how the range of artefacts has expanded during the 20<sup>th</sup> century. In addition to traditional graphic and material artefacts, less tangible ones, such as services and organizations, emerged during the 20<sup>th</sup> century: 'the four orders of design' (Buchanan, 1998, 2004). As each 'order' is diverse in itself, this poses a tremendous challenge to design researchers, if they are to capture some notion of 'unity' across this broad spectrum. As a promising approach to this problem Stacey *et al.* (2002) suggest that unity, rather than stemming from a shared essence, comes from characteristics shared by many but not all design

processes – a perfect parallel to Wittgenstein’s (1984, §§67-68) idea of ‘family resemblances’ among games.

Let us conclude this brief review of ‘the quest for unity’ by making one thing clear: The aim of the work to be presented here is not to *eliminate* the Problem of Disintegration. A totally unified theory of design is neither attainable nor desirable, for there must be room for disagreement. But disagreement means contradiction, and contradiction creates disintegration. What I do hope to achieve, however, is to *alleviate* the Problem of Disintegration; namely by proposing the means to avoid such disintegration that does not stem from disagreement on subject matter, and which, consequently, should not be tolerated.

## 2. How sloppy metaphysics may induce insidious inconsistency in theories

To support the plausibility of my ‘Suspicion of Insidious Inconsistency’, I’ll first consider two examples by Goggans (1999) of how inconsistency may threaten if we are unaware of the (metaphysical) context in which we speak; and then add a more design-related example of my own.

Goggans’ simplest example (p 299) is not metaphysical in nature, but offers a powerful analogue. Imagine a captain standing at the helm of a sailing ship. Someone onboard the ship says,

(1) ‘The captain is not moving’.

Another observer on the coast says,

(2) ‘The captain is moving’.

Sentences (1) and (2) both correctly describe the situation, yet formally contradict each other! To solve this logical problem, Goggans argues, we must deny the sentences any *propositional content*, when considered in isolation. Each of them expresses a proposition only relatively to, and depending on, a *spatial frame of reference*. But since (1) and (2) were uttered within different spatial frames of reference (on the ship and the coast, respectively) there need not be any contradiction between the *propositions* they express. In other words, the contradiction only occurs if (1) and (2) are interpreted as if they belonged to the same spatial frame of reference (say, as if they had both been

uttered onboard the ship). The moral to the story: Never combine kinetic sentences with different spatial frames of reference!

Another of Goggans’ examples concerns two descriptions of a very simple world (pp 296 f, slightly condensed here):

- (3) There are three oxygen atoms with their centres located exactly two inches from each other. There are no other material objects than the three atoms.
- (4) There are three oxygen atoms with their centres located exactly two inches from each other. In addition there is another object of which all three atoms are parts. There are no other material objects besides the three atoms and that which they compose.

Here, too, we have two descriptions of the same facts, but again there would seem to be a contradiction, for does not (3) say that there are three material objects, and (4) that there are *not* three material objects (because there are four)? No, Goggans insists (pp 304 f): ‘[t]here is no such thing as the proposition that there are exactly three things, considered in abstraction from any *systematic way of describing the world*. There are the various propositions those words express, considered relative to various *interpretive frameworks*’ (my Italics). The interpretive framework, the ‘systematic way of describing the world’, corresponds to the spatial frames of reference of the previous example. For convenience of exposition, I shall use ‘*frame of reference*’ as a generic term covering the meaning of ‘spatial frame of reference’, ‘interpretive framework’, alias ‘systematic ways of describing the world’. And so the moral is analogous to the previous one: Never combine sentences about the material world that have different frames of reference!

Descriptions (1) through (4) can, I think, be read as toy examples of statements of a design theory, the ‘frames of reference’ corresponding to what I called ‘a worldview’. When Goggans warns us not to mix the frames of reference, it corresponds to our requirement that a worldview be *consistent*. Mixing frames of reference is to admit inconsistent assumptions into one’s worldview. (In metaphorical terms of systems programming: ‘introducing bugs into the operating system by composing it from modules that don’t work properly together’.) In the ship case we could spell them out as follows: ‘observations are made from the ship’ contra ‘observations are made from the coast’ (hence ‘observations are *not* made from the ship’). In the three-atoms example,

the inconsistency between (3) and (4) is similarly based on a deeper inconsistency in the world-view about accepting and not accepting the metaphysical principle of composition.

Let me offer an additional example to show how a sloppy worldview may conceal inconsistency in a more subtle way. Suppose that a mathematically minded design theorist speaks of ‘the set of all chairs that ...’ (say, chairs that satisfy certain requirements); suppose that he thinks of chairs and other material artefacts as perishable (as normally we all do); and suppose that he conceives of sets as abstract entities (also quite a conventional thing to do). Then he has implicitly adopted a worldview in which sets are abstract and can have perishable members.

Note that unless I explicitly deviate from the conventional usage of the word ‘*abstract*’, I shall take it to mean ‘non-spatiotemporal’; i.e., ‘existing but not in space-time’ (Balaguer, 1998, p. 3; Lowe, 1995, p. 513 f), with the platonistic connotation of ‘being eternal and immutable’.

An abstract set  $S$  with perishable members would persist through the loss of one of its members,  $a$ . For, by the standard definition of ‘abstract’ just mentioned, sets are non-spatiotemporal, hence cannot perish themselves. But  $S$  before and  $S$  after the loss of  $a$  would not have the same members. According to the standard identity condition for sets, they are identical if and only if they have the same members. So  $S$  after the loss of  $a$  could not be the same set as  $S$  before the loss of  $a$ . In other words,  $S$  would *not* persist through the loss of  $a$ , which contradicts the initial assumption.

Moral: even apparently plausible and conventional assumptions can render a worldview inconsistent!

Even though the three examples are artificially simple, it is easy to imagine that one could speak of captains, oxygen atoms and chairs in the manner indicated, without noticing the ‘insidious’ inconsistency. Or, as Goggan’s two examples suggest, one might notice the inconsistency, but mistake it for genuine disagreement on the subject matter.

### 3. How to develop candidate worldviews for design theory

One of Goggan’s important insights is that *in principle, frames of reference are arbitrary; be they spatial or metaphysical* (1999, p. 305 f). Thus we can observe the captain equally well stipulating observations from the ship as a frame of reference, or observations from the coast. And (taking another example by Goggans) we can describe the movements in the solar system relatively to any stipulated frame of reference; e.g. assuming either the Sun or one of the planets to be ‘stationary’. The same arbitrariness applies to metaphysical frames of reference for descriptions of physical objects, as in the three-atoms example. The two descriptions (3) and (4) are about the same reality; the question of whether or not there is a fourth composite object is not a matter-of-fact to be decided by observation. It is a metaphysical question. The answer we stipulate defines one frame of reference, or another incompatible but equally good one. (‘More than one good computer platform is on the market.’)

Another point that Goggans seems to be making (p 306), is that just as putatively empirical sentences about movements or about material objects are void of propositional content as long as they are considered in isolation from a suitable frame of reference (‘no application programs run without a platform’), so statements about the frames of reference, although they make sense, say nothing about the world (‘what’s the use of a platform without applications?’). If I say, ‘the Planet Earth is stationary’ it is a mere stipulation of the Earth as my spatial frame of reference, not a fact about the world (outside me). Similarly, if I adopt the metaphysical doctrine that for any multiplicity of material objects, there exists a material object composed of them, I have said nothing about the material world. But I have stipulated a way in which I want to understand and describe the material world. This neutrality of frame-of-reference talk with respect to the world explains, I think, the freedom we have in choosing frames of reference: there are no empirical facts to dictate our choice.

But even so, the choice of a frame of reference is significant. For, as Goggans concludes his analysis, ‘we may resolve to describe the world [...] in a way that is outwardly consistent with [the frame of reference], that is, [...] in a way that does not *formally* contradict [it]. This results in a description that is more principled and systematic than our ordinary descriptions.’

Producing descriptions of the world that are ‘more principled and systematic than our ordinary descriptions’ is precisely what researchers should do. As already suggested in section 2, I see nothing that prevents us from scaling up Goggan’s insights, *mutatis mutandis*, to apply to design theories in general. All it takes is to translate his talk of ‘descriptions of the world’ relatively to ‘frames of reference’, into similar talk of ‘developing design theories’ relatively to *consistent worldviews*.

This is what made me suggest (at the end of the introductory section) the somewhat ambitious project of ‘designing’ the foundations of design theory. What I mean is that we should seek out candidate worldviews in terms of which we may state our findings about design in a ‘more principled and systematic’ way than we could otherwise do. The design metaphor seems appropriate, because the problem is ‘ill-defined’ in that, as just explained, our ‘solution space’ is virtually unlimited. Yet there are certain ‘design criteria’ to be observed (among them aesthetic ones, which strengthens the design metaphor):

- *Consistency*, in order to avoid such pitfalls as discussed in section 2.
- *Viability* under philosophical criticism and competition from alternative theories.
- *Elegance*, e.g. in terms of conceptual parsimony, and non-violation of intuition and common linguistic practice.
- *Philosophical relevance to design*; i.e., ability to provide conceptual and terminological resources for explicating design and related notions. This amounts to supporting a *philosophy of design*.
- *Theoretical relevance to design*; i.e., ability to support, likewise, the formulation of (empirical) theories of design research, in a ‘principled and systematic’ way. This amounts to supporting the desired body of design theory itself.

To generate and evaluate candidate worldviews I propose the following steps:<sup>3</sup>

- Raising one or more philosophical ‘Seed Questions’ about fundamental aspects of design; i.e., questions judged to have a potential for leading to answers that constitute philosophically relevant worldviews).

- Using these questions as ‘seeds’ from which to grow sufficiently comprehensive metaphysical theories, the candidate worldviews.
- Subjecting the resulting candidate worldviews to philosophical scrutiny including, but not limited to, evaluation against the criteria of consistency, viability, elegance, and philosophical relevance to design.
- For a number of design theories, develop each of them *in terms of* (‘outwardly consistent with’, in Goggan’s words) as many of the candidate worldviews as possible, and compare their theoretical relevance to design.

Obviously, this amounts to a comprehensive research programme, much of which remains to be carried out. In the present paper we shall consider the first step in some detail in section 4, and somewhat briefly illustrate the second and third ones by a number of sample worldviews outlined and discussed in sections 5 and 6. The last step is entirely left as a proposal for future work.

#### 4. Raising the Seed Questions

To exemplify what Seed Questions could be like, let me first explain why I think *prediction* is a fundamental aspect of design, and then develop some philosophical questions about, and related to, prediction in design.

##### 4.1. Prediction in design

For the production of an artefact to succeed, the designer must make reliable predictions about what the artefact will be like: how it will look, behave or serve its user (Bucciarelli, 2003, p. 54; Roozenburg & Eekels, 1995, Ch 8). For example, an architect in charge of an opera house project might point to one of his drawings, saying ‘every seat on this balcony has an unobstructed view of the stage’. If we could not rely on such design predictions as largely true<sup>4</sup>, we should hardly be able to make artefacts at all, except perhaps very simple ones by pure chance. For without reliable predictions one

<sup>3</sup> For the sake of presentation I list them as a linear sequence. As in any non-trivial design project, the actual process will be more chaotic, involving iterations and overlaps.

<sup>4</sup> There is no need for them to be infallibly or necessarily true; the occasional mistake will not render rational and successful production impossible in the long run.



course of action would seem as good as another, and we should soon lose our sense of direction. As Friedman (2003, p. 521) explains (in the teleological language of Simon's definition, see 1.2 above), design must be able to 'cause change toward desired goals'; hence to 'create *predictable* – or reasonable – changes to reach them' (italics mine).

The production of complex artefacts sometimes takes place concurrently with their design, for reasons of efficiency. But that does not eliminate the need for prediction through and during design. At some sufficiently detailed level, *prediction is prior to production*. (Otherwise designing would be utterly futile, for whatever someone designed would either have been produced already, or no such thing would ever be produced.) For example, we might construct the basement walls of an opera house before finishing balcony design; but presumably basement wall design is completed before the basement walls are produced, and balcony design is completed before the balcony is produced.

On the face of things, making predictions in design amounts to describing relevant properties of artefacts. In design practice such predictions are accepted without qualms. However, at the time an artefact (e.g., a balcony) was designed there was no such artefact to have any properties. Returning to our example about the architect in charge of the opera project, let us suppose he utters the sentence 'every seat on this balcony has an unobstructed view of the stage' while he is in the middle of his balcony design. Then, strictly speaking, there *is* no balcony to have the property of *affording users a good view of the stage*. (Indeed, there may be no stage either, to have the property of *being visible from the balcony seats*.<sup>5</sup>) So for (at least some of) the singular terms of the designer's predictive statements ('this balcony', say) there would seem to be nothing to refer to. Thus contrary to our *prima facie* understanding of design predictions, and contrary to what they purport to be, it is not at all clear that they are descriptions of properties of an artefact.

<sup>5</sup> One might talk about a *relation* between balcony and stage, or among balcony, stage, and seats, rather than properties of either balcony, stage, or each of the seats. The distinction is unimportant here, so we subsume relations under properties.

#### 4.2. Seed Questions

From a philosophical point of view such puzzlement is not to be shrugged off, but to be taken seriously as a call for clarification. A challenge that, as I see it, can be expressed by the following four questions:

- (5) If the singular terms of design predictions do *not* refer, how and in what sense can the predictions be true or even meaningful?
- (6) If those terms *do* refer, to what category of entities are they referring?

Questions (5) and (6) form a kind of dilemma: no matter whether we assume that the singular terms refer or that they do not, we are left with a non-trivial question to answer. By overcoming this '*dilemma of reference*' as I shall call it, we may be able to clarify the fundamental *ontological* question:

- (7) What is the subject area of design (given that it cannot be the actual artefacts themselves)?

It would seem that if the singular terms of design predictions do not refer, then design does not *have* any subject area; but if they do refer (but cannot refer to an artefact), then it is by no means evident what design discourse is all about, and so what the subject area of design might be. Either way, we face considerable embarrassment about the status of design as an intellectual discipline. It is part of our challenge to avoid such embarrassment.

Finally, a testing stone of any candidate ontology for design is that it helps or enables us answer the *epistemological* question of design:

- (8) How can the designer *know* the truth of his predictions (or at least justify his faith in them)?

#### 4.3. General philosophical context of the Seed Questions

Just as design theory may draw on auxiliary disciplines (such as ergonomics, psychology, materials science, etc.), so the philosophy of design may draw on other philosophical disciplines; in our case the *philosophy of language* is of particular relevance.

The dilemma of reference as stated in (5) and (6) above is a design-related version of a more general problem of the philosophy of language. It is a commonplace within that discipline that in some descriptive statements of natural language the singular terms apparently fail to refer; at least we cannot point out actual entities to which they refer in an obvious way. I shall call such statements *descriptive non-factual statements* (descriptive non-factuals, for short). Cases often discussed by philosophers involve mythical figures (Pegasus, unicorns) or fiction. An example of the latter might be:

- (9) Sherlock Holmes and Watson shared ‘a couple of comfortable bedrooms and a single large airy sitting-room, cheerfully furnished, and illuminated by two broad windows’.<sup>6</sup>

Such descriptive non-factuals may be considered pathological variants of *descriptive factual statements* (descriptive factials) whose singular terms refer in a fairly obvious way to actual entities. For example, in the statement

- (10) George W. Bush is president of the United States and lives in the White House, there are singular terms that (at the time of writing) refer to an actual man and an actual building. A puzzling feature of descriptive non-factuals is that we sometimes have an intuition about them as either true or false, just like descriptive factials. We can state *the dilemma of reference* in a general form by asking, as we did in the design context:

- (11) If the singular terms of descriptive non-factuals do *not* refer, how and in what sense can the statements be true or even meaningful?  
 (12) If those terms *do* refer, to what category of entities are they referring?

According to (Vision, 1986), widely accepted contemporary thinking about reference, and the adjoining themes of predication and truth, is ‘embodied in three closely related principles’:<sup>7</sup>

- (13) One can refer only to existing entities. (Known since Searle as *the axiom of existence*, but proposed in its original form by Parmenides as far back as the early 5<sup>th</sup> century B.C.)

<sup>6</sup> Literal quotation from Sir Arthur Conan Doyle’s ‘A Study in Scarlet’.

<sup>7</sup> I have re-phrased the three principles to make the terminology more uniform throughout the paper, while trying preserve their meaning.

- (14) One can predicate properties only of existing entities, and  
 (15) For a statement to be true, its singular terms must refer to existing entities.

Vision challenges various arguments that have been offered in support of the axiom of existence, and more briefly criticizes the other two principles. I shall make no attempt to review his discussion here, nor indeed the entire controversy to which it contributes. Suffice it to note that some 2,500 years of philosophical debate about reference has not managed to settle the issue, and with all due respect to Vision’s arguments, I don’t think they settle it either.

By stating my ‘dilemma of reference’ (inside and outside the design context) the way I have, I implicitly endorsed what Vision calls the ‘orthodoxy’ expressed by (13)–(15). For if (13) were false, the absence of the artefact could not prevent us from referring to ‘it’ during design (whatever may be meant by ‘it’ here). And if one could refer to something not existing, then presumably one could predicate properties of ‘it’, and utter true statements about ‘it’ as well, contrary to (14) and (15).<sup>8</sup> To me, understanding design under the assumption of the three principles is difficult enough. But understanding design without them seems impossible. Admittedly, this is nothing but gut feeling, but I can hardly be blamed for making such initial assumptions as my guts tell me are least likely to lead to failure.

We should note, however, that by endorsing principles (13)–(15), we have already narrowed the metaphysical ‘solution space’ in which we can search for our candidate worldviews. So, returning once more to the analogy between the present meta-theoretical enterprise and a design process, the general stance taken with respect to *reference* would seem to play a role similar to the role that a ‘primary generator’ may play in a design process (as described in a classical paper by Darke, 1979).

### 5. *Growing the Seed Questions: some nominalist worldviews*

The next step of the method suggested in section 3 was to develop answers to the Seed Questions (section 4.2), ‘growing’ them into metaphysical theories comprehensive enough to serve as candidate worldviews. The ‘dilemma of reference’, as stated by Seed

<sup>8</sup> I believe this conditional statement is true, but only because its antecedent is false.

Questions (5) and (6), indicates two main directions in which to look for candidate worldviews: Either we can take a *nominalist view*<sup>9</sup> that a design prediction is a play with linguistic symbols ('linguistic' suitably generalized so as to include graphic 'languages' as well) where the singular terms do *not refer* to any non-linguistic entities; or we can take the *realist view* that they *do* – that indeed there are entities in a non-linguistic reality for them to refer to. I shall sketch a few candidate worldviews exemplifying each case, in this section, and in section 6, respectively.

Assuming for now that the singular terms of a design prediction do *not refer*, our first task, according to (5), will then be to explain how and in what sense the prediction can be true or meaningful; that is, can guide rational decision-making in design. The next task will be to judge the outcome of that exercise with respect to how well it enables us to answer questions (7) and (8). Question (6) will be irrelevant, given the initial assumption.

### 5.1. Frege and second-order predictions

Harking back to Frege's (1892) classical distinction between '*Sinn*' (sense) and '*Bedeutung*' (reference), we note that in the absence of a '*Bedeutung*' of the singular terms of a design prediction *P*, it has no truth value, on Frege's view (*op. cit.* p. 48). This flies in the face of our initial presupposition that a design prediction *itself* has to be 'largely true' in order to guide rational decision-making (section 4.1). Fortunately, however, it seems safe to assume that the singular terms of *P* will have a Fregean '*Sinn*', and so, Frege would say, *P* nevertheless expresses a '*Gedanke*' (thought). From here we proceed by adding that precisely because of this '*Gedanke*', we are able to estimate (or, indeed, predict!) whether *P* will *become* true or false should its singular terms ever *get* a reference through suitable artefact production in the future. Since this estimate can be expressed by a statement of the form *E(P)* (a second-order statement referring to *P* and therefore not deprived of a truth value), the lack of truth value in *P* is

<sup>9</sup> *Nominalism* and *realism* are alternative views on what exists. Being a realist is to claim the existence (reality) of entities of some kind; e.g., numbers or properties. Being a nominalist is to explain away such a claim in terms of language. (For example, the nominalist might argue that we can use number-names such as 'five' and '4+1', and property-names such as 'hard', in meaningful ways without assuming that there are numbers or properties for those expressions to refer to. So why make such extravagant assumptions, if we can do without?)

compensated for by the presence of a truth value in *E*. So, to the extent we trust the truth of *E*, it serves as a *surrogate* for the missing truth value of *P* itself. Thus using *E* as a crutch, *P* limps along and eventually manages to fulfil its purpose of guiding rational decision-making. This completes our answer to Seed Question (5).

How does this proposal work when it comes to Seed Question (7) about the subject area of design? Even though the singular terms of *P* do not refer and, consequently *P* could be neither true nor false at the time of designing, such predictive statements were supposed (as a crucial move of the argument) somehow to express '*Gedanken*'. This leaves us two options: We could pick such *thoughts* as the subject matter of design. If so, the literature on design cognition (e.g., Cross, 2006; Visser, 2006) acquires a special significance not only as a source of insight into the psychology and behaviour of designers, but also as a means of illuminating the concept of design itself. Alternatively, we could point out the predictive statements themselves as the subject matter of designing; in other words choose to see design as primarily a linguistic activity (taking 'linguistic' in a sense wide enough to include the graphical means of expression so common in design).

To handle Seed Question (8) about how the designer can know the truth of a prediction, we argue that since prediction *P* itself is neither true nor false, this question no longer makes sense. However, it can be rephrased to make sense by allowing for the 'crutch' *E* as follows:

- (16) How can the designer know the truth of the predictions of the truth of his predictions?

Thus having to account for the nature and workings of second-order predictions rather than the original first-order predictions is a challenge we must accept if we wish to proceed under the present 'Fregean' worldview. One approach would be to assume that what enables the designer to make reliable second-order predictions is an awareness of general *truth conditions* for various kinds of first-order predictive design statements (including those expressed graphically), and then try to specify such truth conditions. Apart from being of philosophical interest, such general truth conditions might themselves constitute a body of instrumentally valuable design theory.

### 5.2. Concept platonism

Philosophers of mathematics have tried to explain how mathematicians experience a ‘mathematical reality’ that determines what is and what is not correct mathematics, despite the fact that such ‘reality’ can only be accessed by thought. Isaacson (1994) rejects the notion of a mathematical reality consisting of ‘objects’: there is no particular entity that is the number 5, for example, to render mathematical statements such as ‘ $5 + (-5) = 0$ ’ true. His picture of mathematical discourse thus parallels our tentative hypothesis that there are no objects (artefacts or anything else) for the singular terms of design predictions to refer to. His contention, however, is no mere stipulation, for, as he says: ‘The compelling and immediate reason for rejecting the idea that mathematics is about particular objects is that for any mathematical theory the domain of objects [it is] taken to be about can always be replaced by a domain consisting of different objects, so long as the second domain has a structure isomorphic to that of the first’<sup>10</sup>. He wraps up his view in the maxim: ‘mathematics is inherently to do with structure’.

A couple of mathematical and non-mathematical examples may clarify this. In algebra such structures as ‘groups’ are studied. A group is a set on which a binary operation is defined so as to satisfy certain axioms. The set of integers under the operation of addition is one example of a group; a set of geometric symmetry transformations under composition is another. However, regardless of whether we are dealing with integers or symmetry transformations, the structure is the same: the behaviour of operations is ruled by the same laws. The structure constituted by the operations is what counts, not the operands they are applied to. In the same way, chess is about the moves (operations) that can be applied to the pieces, whereas the pieces themselves (their material, shapes etc.) are irrelevant to the game. Finally, social and legal phenomena such as promises, agreements, marriages etc. may be viewed as structures that can be studied in their own right independently of the particular persons involved. In all these cases the focus is on the *structure* formed by various kinds of relationships, rather than on whatever is related by them.

<sup>10</sup> This non-uniqueness argument, originating with Benacerraf, was later shown by Balaguer (1998) not to be so compelling after all (op. cit. p 50 and Ch 4).

Returning to design, we might answer Seed Question (7) in much the same way: *the subject area of design is structure*; that is, artefact-structure rather than artefacts and their parts or elements or the material from which they are or will be constructed. Thus in our opera example, the important thing is the balcony-stage *relationship*, not the balcony or the stage themselves, or the steel, wood and concrete from which they may one day be built. And in this light we can at least suggest an answer to our Seed Question (5) by saying that design predictions can be meaningful and true because, like mathematical discourse, they acquire their meaning and truth from the structures they describe (artefact structures, rather than mathematical structures), regardless of whatever makes up those structures.

Indeed, such an ontology of artefacts-as-pure-structure is what Alexander (1979) advocates for architecture. In discussing the example of a medieval cathedral, he observes that what makes the aisle what it is, ‘is just the pattern of relationships which it has to the nave, and other elements around it’ (p 88). But the aisle which seems to be an element related to other elements, ‘is *itself* also a pattern of relationships between its length, its width, the columns which lie on the boundary with the nave, the windows which lie on the other boundary ....’ (p 89); and thus illustrates how ‘the element itself is not just embedded in a pattern of relationships, but is itself entirely a pattern of relationships, and nothing else’. He generalizes his insight in the statement: ‘we may forget about the idea that the building is made up of elements entirely, and recognize instead, the deeper fact that all these so-called elements are only labels for the patterns of relationships [...]’ (p 89).

When it comes to epistemology (Seed Question (8), about how we know that design predictions are true or reliable), there is also a parallel between Isaacson and Alexander, but it is more difficult to draw. Isaacson’s answer to the mathematical counterpart of Seed Question (8) revolves around concepts. ‘Thought is the capacity to consider the absent object’, he says (p 126): a particular unicorn, for example, may be thought of not because there is any such object, but because we have a *concept* of it, and because ‘[c]oncepts are the sort of things with which the mind engages’ (p 125). Similarly, we may think of a number, a function or a metric space not because there are any objects of such descriptions, but because we are ‘in possession of the requisite concepts’ (p 126).

Concepts of Isaacson's variety are 'primary'; i.e., do not presuppose instantiation by objects: they are 'not given in extension. Rather, they involve the element of understanding inherently' (p 127). The term '*concept platonism*' was used by Isaacson to characterize his ontology of concepts without objects (and to contrast it with what he calls '*object platonism*': the view that there are mathematical objects as well).<sup>11</sup> As mathematics has developed, most of its concepts no longer arise from experience in the external world, but some do: for example, '[a]ddition and multiplication of natural numbers can be seen as abstractions from physical situations' (p126).

Likewise, I submit, Alexander's design patterns might be construed as concepts: indeed non-extensional ones if we accept Alexander's radical claim 'that all these so-called elements are only labels for the patterns of relationships', and if we can reconcile this view with the fact that (unlike most mathematical concepts) all or many of Alexander's patterns are abstracted from physical situations. Alexander himself seems prepared to accommodate both of these claims in his theory, for he associates each of his 'patterns of relationship' with *empirical* statements about the ability of the relationships to prevent certain problems from occurring in certain architectural contexts (*op. cit.* Ch. 14; see (Galle, 1991) for a detailed discussion). Thus selecting certain patterns for a design project, Alexander would maintain, ensures that artefacts constructed accordingly will not exhibit those problems.

Drawing on the design-mathematics analogy, this suggests an answer to Seed Question (8): We can speak of the artefacts being designed not because there are any such things (at the time of designing), but because we have *concepts* about them: the patterns. As far as the patterns go, we can know about and rely on the predictions associated with them (i.e., predictions about problem-avoidance), because they are concepts supported by empirical evidence, and because 'concepts are the sort of things with which the mind engages'.

So this approach (for which I adopt Isaacson's name 'concept platonism') enabled us to answer our questions, but it does not explain all design predictions. Only the general predictions about problem-avoidance that are associated with the patterns are accounted

<sup>11</sup> In a footnote he acknowledges that his view might be characterized as 'Kantian', and perhaps more appropriately so than 'platonistic'.

for; more specific ones about the peculiarities of a project are not. (An example of the latter might be 'every seat on this balcony has an unobstructed view of the stage', discussed in section 4.1.) Furthermore, if I am right in understanding Isaacson's mathematical concepts as well as Alexander's patterns of relationships as concepts about structures that are always or potentially without objects, then I suspect that we are walking on soft ontological ground. For structures without objects would seem, in Isaacson's version, to involve (instances of) relations without relata, which sounds like a contradiction-in-terms. In Alexander's version they seem to involve an infinite regress of relations among relations among relations ... and so on forever.

### 5.3. Fictionalism

Once again, I shall exploit work already done in the philosophy of mathematics, this time in support of a conception of design predictions as a variety of fiction, whose truth is relative to the 'story' a designer is telling. Fictionalism about *mathematics* is a position denying that there are mathematical objects, and understanding mathematical discourse as fiction. Its statements are taken to be literally false, but true relative to the (or *a*) 'story of mathematics'. It was advocated by Hartry Field, and compared by Balaguer (1998) to the opposing view, that there *are* such things as mathematical objects. Balaguer found both views equally tenable; i.e. defensible against the strongest counterarguments available. Results such as these strongly motivate serious consideration of an analogous worldview of fictionalism about *design* (and equally serious consideration of a design-analogue of the opposing view, of course; we shall return to that in section 6.3).

On such a fictionalist view of design, the design predictions, though 'literally false', would nevertheless have a non-literal or *relative* truth-value (either false or true); namely relatively to 'a story of design'. Design predictions that are professionally made, are presumably true in this relative sense, much more often than false, since a design prediction that is false relative to 'a story of design' would simply be mistaken.

We can disregard the fact that design predictions are 'literally false', for we are not interested in them as literal, descriptive statements about the world at the time they are uttered. Design predictions are only interesting in the context of the 'story of design', to which the designer adds them incrementally as design work proceeds. Let us

furthermore disregard cases where, even relatively to the ‘story of design’, predictions are false simply because the designer makes a mistake. (Such cases may be of legal, practical and economical interest; but accounting for mistakes is not our concern here.) This leaves us with our Seed Question (5): the problem of accounting for how and in what sense (non-mistaken) design predictions are true, on the fictionalist view of design we are considering.

Let us consider an example. The ‘story of design’ of the opera house whose balcony I discussed in section 4.1, would consist of statements (most likely in some non-verbal form, encoded in graphics or geometric models) about the size, shape, position and materials of the balcony and of the stage – among many other details. When in this context the architect ventures the prediction that ‘every seat on this balcony has an unobstructed view of the stage’, he is right – his prediction is true in the relative sense – if and only if it is *consistent* with the statements of the story so far.

In this particular case the consistency could be tested in terms of straight-line segments connecting the stage with the seats without anything in the story to indicate that they intersect solid bodies; say, columns or chandeliers. In cases of design of non-material artefacts such as organisations, the notion of consistency would presumably be closer to the familiar logical notion of non-contradiction.

However, in much design, verbal statements play a minor role as compared to drawings and other geometric representations. To make design in general amenable to analysis along the fictionalist lines suggested here, where consistency is a key concept, we would have to broaden the concept of consistency so as to apply to a mixture of geometric representations and verbal ones. One approach might be, first, to stipulate *propositions* as something that both verbal statements and geometric representations express, only by different means (much like ‘Peter has no money’ and ‘Peter hat kein Geld’ may be said to express the same proposition in English and German, respectively). Secondly, one should add that consistency is not really a relation among statements but among propositions. But this would open a Pandora’s box of issues about the nature and ontological status of propositions, and so it would soon take us beyond the scope of this paper.

By entertaining the idea of fictionalism, we may have betrayed our principle of reference to existing entities as a prerequisite for truth (15); but also, arguably, made up for it by adopting the notion of a non-literal truth, relatively to ‘a story’ instead. This shift in foundational assumptions may be the reason why – judging from this admittedly very loose sketch – fictionalism holds some promise as regards a satisfactory epistemology of design. For, given the approach I have outlined (and assuming the issue of extending consistency to geometric representations can be settled in a satisfactory manner), Seed Question (8) may be answered fairly straightforwardly in terms of consistency with a growing collection of already consistent statements (be they verbal or geometric) that comprise ‘a story of design’.

The strength of design fictionalism is that it attempts to defuse the dilemma of reference by purporting to refer while not really referring, and by replacing or supplementing literal truth with non-literal truth ‘relative to a story’. But that is also its weakness, for by the same token fictionalism makes it less obvious how to give a satisfactory answer to the ontological question about the subject area of design, Seed Question (7).

We might attempt an answer to the effect that the subject area of design is the kind of ‘fictional entities’ that Rescher (1999, section 3) seems prepared to accept, but he accepts them only as ‘pseudo-particulars’, as schematically describable ‘abstractions’, as ‘thought-beings’, or mere ‘thought instruments’. To my mind, there is too much pretence and double-talk in this: not only do we *pretend* to refer but (being fictionalists) don’t really refer; we also *pretend* to talk about objects but only talk about ‘pseudo-particulars’ etc.

A more clear-cut answer to Seed Question 7 would be that contrary to all appearance, design is not about artefacts at all, but is merely a play with symbols – be they words, graphics or whatever designers produce at their drawing boards and computer screens. While such overt nominalism seems natural in a context of mathematics (a discipline of formal thought if ever there was one), it may take some explanation to justify in the context of design, whose thinking one would expect, *prima facie*, to be connected with the practicalities of everyday life in a rather more robust way.

We began by taking fictionalism about mathematics as a model for design fictionalism. However, outside the philosophy of mathematics work has also been done that may

support or inform further development of the present worldview of design. Thus in (Phillips, 1999), truth and inference in fiction is treated by relativizing a statement  $P$  to a story or fiction  $F$ , by prefixing  $P$  with an operator ‘In the fiction  $F$ ,  $P$ ’, and then specifying truth conditions for the resulting statement. Phillips offers such an analysis, proposing truth conditions in terms of author and reader of  $F$ , and taking the cultural background of society at large into account as well. In the design context,  $F$  would be the incrementally growing ‘story of design’.

Not all theories of fiction are relevant to design fictionalism, however. For example, some theories of fiction assume Lewisian possible worlds (Lewis, 1986; Predelli, 1997), and that would be unnecessarily extravagant for our present purposes, for assuming the existence of possible worlds is a way of providing reference for terms of design predictions (an idea we shall consider in section 6.2), and once we had that, there would be no need for fiction any more. A similar remark applies to the theory of fiction developed by Thomasson (1999), because it involves an ontology that grants fictional characters such as Sherlock Holmes – and other kinds of fictional entities such as Holmes’ and Watson’s rooms – genuine existence, hence provides candidate referents for the terms of design predictions (see section 6.3.1), contrary to our present assumption about non-reference.

### 6. Growing the Seed Questions: some realist worldviews

Let us proceed to the second horn of our dilemma of reference, and assume in this section the *realist* stance that the singular terms of a design prediction actually refer to existing non-linguistic entities. Hence by Seed Question (6), we must now face the issue of what category of entities they refer to. Once we’ve made a proposal, the answer to Seed Question (7) about the subject area of design, might be expected to follow almost as a corollary. (As we shall see in section 6.3, this optimism turns out not to be justified in all cases.) A critical test of the proposal will be the epistemological Seed Question (8).

#### 6.1. Eternalism and future artefacts

One strategy we might consider is to insist on taking the apparent reference of design predictions at face value. That is, maintaining that predictions refer to *artefacts* after all,

precisely as they purport to do. The problem we then face is to explain how they can do so at the time of designing. This problem can be more or less tamed, it would seem, by playing down the importance of *time* itself: namely by adopting an *eternalist theory of time*, according to which everything there is in the (concrete) world – notably artefacts – inhabits a region of a 4-dimensional space-time continuum,<sup>12</sup> such that past and present entities have no privileged status over future ones (Loux, 1998, p. 207 ff.). In other words, future entities are considered just as ‘real’ as present ones. The predictions then reduce to mere descriptions of *future artefacts* (Seed Question (6)) which are what design is all about (Seed Question (7)), and we can know about them (Seed Question (8)) because they are of the same nature and ontological stature as past and present artefacts.

Such eternalism might have something to recommend it from a logical point of view, as Quine appears to think. Quantification and predication in standard mathematical logic is tenseless: “ ‘ $\exists x$ ’ says neither ‘there was’ nor ‘there will be’, but only, in a tenseless sense, ‘there is’ ” (Quine, 1982, section 31). He advises us – to the extent that time is significant at all – to paraphrase our sentences to fit standard logic, rather than introducing tensed logic, which, he contends, ‘would be needlessly elaborate’. When appropriate, one should regard the values of ‘ $x$ ’ as ‘four-dimensional denizens of space-time’ to which, he urges, ‘we can attribute dates and durations [...] as we can attribute locations and lengths and breadths to them’.

Seductively simple though this strategy may seem as a means of understanding design predictions, it only works for our purposes if we assume that every act of designing eventually leads to the production of an artefact; otherwise there would not always be a ‘future artefact’ for the designer to describe (make predictions about) at the time of designing. A problem for this approach is therefore to explain (away) the fact that design is often undertaken as part of a project that is given up before any artefact is produced.

<sup>12</sup> This view accommodates not only material artefacts (such as buildings and corkscrews), but also intangible ones such as events (parties, exams, exhibitions) or processes (procedures for handling patent applications, or for making strawberry jam). Even though they are intangible, they can be considered part of the concrete world, since they, too, ‘take place’ at particular locations and at particular times.

Independently of this objection, the eternalist view would also have to be defended against arguments in support of the incompatible thesis that ‘the past is different from the future because the past exists and the future does not’ (Diekemper, 2005, p. 239).

### 6.2. Modal realism and possible artefacts

There is another idea that is closely related to the notion of future artefacts that we just considered: the idea of *possible artefacts* existing in other possible worlds than the world that is actual at the time of designing.

*Possible worlds* could be considered repositories of referents for the singular terms of design predictions. Given the axiom of existence (13), we need a conception of possible worlds that grant them genuine existence. It would seem that hardly anything short of Lewis’ modal realism (Lewis, 1986) will do for this purpose; i.e. the view that possible worlds exist just like the actual world of ours.<sup>13</sup> This proposal has its merits, for it enables us to contend that after all, design predictions refer to precisely what they *seem* to refer to: artefacts and their parts. Hence the subject area of design (Seed Question (7)) would be *artefacts* (albeit artefacts in other possible worlds; and augmented with, say, knowledge about their construction and use in our world). A standard problem with possible worlds is the question of how we can know about them, (cf. Seed Question (8)), but we need not go into that controversy here. I shall simply skip the proposal without further discussion because, as I will try to show, ontologically less extravagant proposals will do.

### 6.3. Object platonism

A candidate answer to Seed Question (6) which has been discussed at some length in (Galle, 1999), is that the referents of design predictions are ‘artefact-ideas’, to be understood either as *mental* states (‘thoughts’), or as *abstract* entities like numbers, sets, and functions under a conception of mathematics that allows such objects. Such a conception is called ‘object platonism’ in (Isaacson, 1994), and I shall borrow the term

<sup>13</sup> Had we not chosen to be constrained by the axiom of existence (13), we could have followed Rescher (1999) and accepted possible worlds as mere ‘thought-objects’ (what Kant calls ‘Gedankendinge’). Rescher contends that they can meaningfully be discussed at a general level but cannot be individuated and therefore cannot be granted existence (*op. cit.* section 6).

here to emphasize the contrast with section 5.2 on ‘concept platonism’.<sup>14</sup> (Note that object platonism about design is particularly well aligned with the last definition of ‘design’ proposed in section 1.2.)

As for artefact-ideas understood as mental states or thoughts (cf. section 5.1) they pose the vexed problem of intermittent existence: depending for their existence on human brain activity as presumably they do, they seem to exist only intermittently, when someone happens to think about them. Let us therefore leave mental states aside and consider the second option a little closer.

Since I conceive of abstract entities as ‘entities *existing* but not in space-time’, the axiom of existence (13) will not preclude reference to them. Moreover, the timelessness of abstract entities that they have by definition make them available for us to refer to at all times, independently of any artefact we may or may not have produced ‘according to them’, as expounded by Galle (1999). This speaks in favour of ‘abstract entities’ as a candidate answer to Seed Question (6).

And so we may have a partial answer to Seed Question (7) as well: the subject area of design is a suitable compartment of the category of abstract entities: not exactly mathematical objects, perhaps, but something similar to them in nature. The number 5 is a mathematical object, and so is a symmetry group; but you cannot build a chair, a town hall, or an organization according to any of them. To produce such artefacts you would need, on the present view, to have knowledge about some abstract chair-object, town-hall-object, or organization-object; a knowledge that would guide your actions of artefact production.<sup>15</sup> But what then distinguishes such design-relevant abstract objects from other abstract objects? Until we have clarified that distinction, we only have a crude partial answer to Seed Question (7).

Let us leave it at that for the moment and proceed to the epistemological issue of Seed Question (8). In the present context of object platonism, that question is a special case of Benacerraf’s problem of how we, as spatiotemporal creatures, can know anything

<sup>14</sup> In (Balaguer, 1998) the term ‘platonism’ (simpliciter) denotes the same overall view of mathematics which Isaacson calls ‘object platonism’.

<sup>15</sup> ‘Producing’ an organization would involve the creation of social relations among actual people; hence affect the concrete (spatiotemporal) world, even though the organization ‘itself’ may be considered abstract.



about abstract objects which by definition are non-spatiotemporal. The difficulty of this puzzle has been held against mathematical (object) platonism: the view that there are abstract mathematical objects. However, Balaguer (1998) has shown how a version of object platonism which he calls ‘full-blooded platonism’ (FBP; roughly the view that all *logically possible* mathematical objects exist) allows human beings to acquire knowledge of abstract mathematical objects without being in any contact with them. A central idea of his argument is that since according to FBP all conceivable mathematical objects exist, we can know of them simply by conceiving of them. He also defends such FBP against other attacks and presents an extended argument to show that FBP is a tenable position. (With equal thoroughness he shows fictionalism to be tenable as well; a result we utilized in section 5.3.)

I see no reason why Balaguer’s defense of platonism should not carry over from the domain of mathematics to the design domain. But even if Balaguer’s argument may reassure us that we can have knowledge about design-relevant abstract objects despite the fact that we can have no contact with them, it does not explain how we can have *empirical* knowledge about their usefulness in our production of artefacts. I suppose, however, that such knowledge can be expressed in terms of Cambridge properties (Francescotti, 1999) of them.<sup>16</sup> (Being abstract, they are immutable and so cannot gain or lose genuine properties.) For example, just as we can know of real numbers that they are useful in certain ways for the measurements of velocities, distances, and other properties of things in the concrete part of the world, so we can come to know (by experience) that certain artefact objects among the abstract entities are useful in certain ways for our construction of artefacts according to them. Likewise, the predicate ‘material objects produced according to  $x$  are able to carry a load of 200 kg per square metre’ might ascribe a Cambridge property to some abstract floor slab object denoted by ‘ $x$ ’.

After this brief preview, I think we can conclude, if only tentatively, that abstract objects may work epistemologically (Seed Question (8)) with only modest use of

<sup>16</sup> *Cambridge properties* are, as Francescotti explains in more technical detail, properties that have ‘nothing to do with the objects that have them’. An example stemming from Kim and cited by Francescotti, is, ‘being fifty miles east of a burning barn’. My gain or loss of such a property does not change me, as opposed to my gain or loss of a genuine property such as ‘being suntanned’.

philosophical gadgetry. Completing the answer to Seed Question (7) is a more serious challenge: how do we draw the line between those abstract objects that are relevant to design and those that are not? In the following subsections we consider two approaches to that question, resulting in two different versions of object platonism.

### 6.3.1. Thomasson-Ingarden ‘abstract artefacts’

In her book on the metaphysics of fictional characters, Thomasson (1999) proposes a conception of them as ‘abstract artefacts’ (*op. cit.*, ch. 3), a notion which, *mutatis mutandis*, can be used as a key to the question just raised. (The fact that Thomasson is concerned with *fiction* is unimportant here, and does not lead us back to the fictionalist worldview already discussed in section 5.3. That view belonged to a family of nominalist views, and we are now considering a family of realist views.)

Thomasson’s notion of ‘abstract artefacts’ involves a conception of abstract entities different from the conventional one we have so far employed. She follows convention in seeing abstract entities as non-spatiotemporal (neither located in space nor time), but she does not accept the received assumption that they are also eternal and immutable. In her view, they can be created, changed and destroyed. For the purpose of explicating fiction, Thomasson rejects simplistic ontologies such as the dichotomy of everything there is into abstract and concrete entities, and instead develops a richer system of categories defined in terms of *existential dependence* (ch. 8); an idea originating with Roman Ingarden (Thomasson, 2005). Quite a comprehensive theory of various dependence relations lies behind this ontology, but we need not go into that here. Suffice it for the present purpose to note that a fictional character (Sherlock Holmes, for example) depends for its existence on

[1] ‘the creative acts of its author or authors’, and on

[2] ‘a literary work’.

The literary work in turn, depends (like the character) on

[2.1] a creative act of authoring (‘the acts of its creator’), but also on

[2.2] ‘some copy or memory of it’ and on

[2.3] ‘an audience capable of comprehending it’ (Thomasson, 1999, p. 36, numbers added).

Such ‘abstract artefacts’ as Sherlock Holmes lack a spatiotemporal location: Holmes cannot be encountered in Baker Street, for example, and never could; but they are not eternal. Sherlock Holmes came into existence when Conan Doyle first wrote about him, and Holmes would cease to exist if all copies of all stories about him disappeared and no-one remembered the stories.

Apart from Sherlock Holmes himself, his friend Watson and the other characters of the Holmes stories, Conan Doyle wrote about their environment, including Holmes’ and Watson’s two ‘comfortable bedrooms’, their ‘single large airy sitting-room’ etc. (9). And if Conan Doyle’s creative act brought Holmes and Watson into existence as abstract artefacts, nothing I can think of could prevent it from also bringing the bedrooms and the sitting-room into existence in the same way.<sup>17</sup>

So if we accept the Thomasson-Ingarden category of abstract artefacts as a realm of entities brought into existence by creative acts of writers of fiction, why then should we not accept similar abstract artefacts as the results of *designers’* creative acts? Designers obviously use different means of expression, such as technical specifications and drawings, rather than story telling, but that seems irrelevant. For example, an architect who specifies and drafts a dwelling (perhaps even one matching everything Conan Doyle ever wrote about the rooms at 221B Baker Street), thereby creates an abstract artefact in the sense of the Thomasson-Ingarden dependence-based ontology, where only trivial modifications to the above dependence hierarchy are needed: The (as yet abstract) dwelling depends for its existence on

[1] the designer’s creative act of conceiving of the dwelling, and on

[2] the design documentation, which in turn would depend on

[2.1] the designer’s creative act of producing the documentation, on

[2.2] there being some copy of the documentation, and on

<sup>17</sup> The same argument would apply to non-material artefacts as well; e.g. *Professor Moriarty’s criminal organization* of which Sherlock Holmes spoke with awe: ‘You can tell an old master by the sweep of his brush. [...] A great brain and a huge organization have been turned to the extinction of one man.’ (Conan Doyle’s ‘The Valley of Fear’, Ch. 8).

[2.3] an audience capable of comprehending it.

When evaluating his efforts, the architect would make predictions whose singular terms (under the present version of object platonism) would be referring to *abstract artefacts* in the Thomasson-Ingarden sense (Seed Question (6)). As for Seed Question (7), we can now answer it more fully; namely by characterising the subject area of design as the kind of abstract artefacts that can be described by the same means by which we describe ordinary, concrete artefacts. The chair I am sitting on, for example, was produced according to an abstract artefact (in the above sense) described and evaluated by its designer by means of certain drawings and verbal descriptions, presumably; and this same documentation now describes the concrete physical object that I sit on as well (and might have been replicated more or less exactly by a relevantly knowledgeable observer who studied the concrete chair).

This dual applicability of design documentation has the advantage of suggesting a straightforward answer to Seed Question (8): that we know the truth or reliability of our design predictions about *abstract* artefacts because they resemble other predictions made earlier that turned out to hold true of the *concrete* artefacts to which they applied.<sup>18</sup>

However, the same dual applicability also poses a slight problem to anyone wishing to endorse a Thomasson-Ingarden conception of design. For if we contend that the terms of design predictions (and design discourse in general) refer to abstract artefacts at the time of designing, what happens to their reference when concrete artefacts are constructed accordingly? Do the references shift from abstract to concrete entities, or must we accept some kind of divided reference or equivocation?

Except for Thomasson’s elaborate underlying theory of existential dependence, her ‘abstract artefacts’ seem closely related to Popper’s ‘world 3 objects’ (Popper, 1974, 1979). They, too, are man-made (hence non-eternal) ‘abstract’ entities, which he describes as ‘products of the human mind’. Among his examples are symphonies, dramatic works, scientific theories, languages, ‘aeroplanes and airports and other feats of engineering’ – taken as thought *content*, and not to be confused with thoughts as

<sup>18</sup> Again, concrete artefacts need not be material artefacts; artefacts may include organizations etc. which are concrete in the sense of being spatiotemporal.

brain processes. According to Popper, they may or may not be ‘embodied’ in physical (‘world 1’) objects; namely by causally affecting our thoughts (‘world 2’), which, in turn, enable us to produce the physical embodiments (artefacts): specific airplanes, performances etc. Like Thomasson-Ingarden ‘abstract artefacts’, Popperian ‘world 3 objects’ exist prior to their embodiment; hence provide us with referents for the singular terms of design predictions. For our purposes, the present worldview could have been developed in virtually the same form using Popper’s theory.

### 6.3.2. Regions of space

The attractiveness of abstract entities, whether conventional or of the Thomasson-Ingarden variety, was their availability for us to refer to at the time of designing. We shall now consider another kind of entities that offer the same availability, and which may help us overcome the difficulty encountered in fully answering Seed Question (7).

Rather than uncritically assuming the conventional concrete – abstract dichotomy and blindly picking abstract (non-spatiotemporal) entities as the referents of the singular terms of design predictions, let us analyse ‘spatiotemporal’ into its constituents, ‘spatial’ and ‘temporal’ and group entities into categories according to whether or not they have spatial and temporal location. Thus the usual dichotomy dissolves into four categories instead, as shown in Table 3.

**Table 3.** Four combinations of spatial and temporal location, each defining a category.

| <i>Temporal location</i> | <i>Spatial location (3-D)</i> | <i>Category</i> |
|--------------------------|-------------------------------|-----------------|
| Yes                      | Yes                           | Concrete entity |
| Yes                      | No                            | Period          |
| No                       | Yes                           | Region (3-D)    |
| No                       | No                            | Abstract entity |

And so it becomes clear that abstract entities (as conventionally conceived<sup>19</sup>) are not the only ones that are available for us to refer to at all times; so too are *regions*. A region is a portion of 3-D space, a place that can be void or filled with material. Given a region of

<sup>19</sup> Nothing here forces us to conceive of abstract entities in the conventional way, as eternal; we can do so, or we can follow Thomasson in according them only a limited life span.

a manageable size, shape and position, we can fill it with material, or we can remove material from it; but the region itself remains unaffected by such activity; indeed by any event whatsoever. (I see no way of conceiving of regions other than as timeless and immutable.) At Ground Zero, we can still point out the region of space that was occupied by the twin towers until the disaster of Sep. 11, 2001. The attack affected their material, not the region of space they occupied. Regions are also there before the material we fill into them. The intricately shaped region of space that now contains Utzon’s Sydney Opera House was there, in the Harbour of Sydney, long before Utzon was born. He picked it out among an infinity of others with which it shares the space.<sup>20</sup>

In the light of the above considerations the following answers to our Seed Questions emerge: The singular terms of design predictions refer to regions of 3-D space (6), so these regions are what design is basically about (7). Hence ‘regionism’ would be a suitable name for the current version of object platonism, and accordingly what Cross (2006, p. 9 f) calls ‘designerly ways of knowing’ about products can be conceived of as knowledge about ways and effects (be they physical, social, semantic, or emotional) of filling regions with material. The more practically oriented parts of design theory should be concerned with expressing and preserving such knowledge. Characterising the relevant shapes would be part of such theory, and though far from being trivial, it no longer poses a *philosophical* challenge.

The *predictions* of design can be understood and paraphrased as predicating *dispositional properties* of regions of space in terms of effects of filling them with material in certain ways. For example, the prediction about a prospective house, that ‘the column it has at that corner will safely carry its share of the weight of the roof’ might be construed as a shorthand for saying of a certain column-shaped region *c*, that if *c* is filled with such-and-such material (say, concrete), and such and such a load is imposed on the material, it remains within *c*. (At the time of designing, the region is there for us to refer to, and the material is somewhere for us to refer to, but it does not

<sup>20</sup> In his essay ‘Form and material’, Flusser (1999) seems to express a closely related idea: ‘When I see something, a table for example, I see wood in the form of a table. [...] [T]he table is being hard as I am seeing it (I bump into it), but I know that this state is transitory (it will be burnt and decompose into amorphous ash). But the table-form is eternal, since I can imagine it anywhere and at any time (see it in my mind’s theoretical eye)’ (p 24). However, his last remark suggests that he thinks of forms as not only timeless but also as un-located in space; i.e., that he considers them abstract entities in the traditional sense.

matter what particular pebbles, grains of sand etc. are used, so specific reference is unnecessary.)

Under our present regionist conception of design, what enables us to know that design predictions are true or reliable (Seed Question (8)) is everyday or scientific accumulation of *experience*. What holds of one region probably holds for another region of the same shape, but located elsewhere, if experience has shown that location is unimportant for the properties under scrutiny. As we saw, the column example suggests a conditional form of predictions: ‘if region *c* is filled with material in a certain way, then ...’. At the time of designing the antecedent is false, and so the entire statement trivially true (if considered an ordinary truth-function). What is of practical interest, however, is confidence that the statement remains true under circumstances that make its antecedent true (namely the construction of an artefact). If similar predictions about similar regions managed to remain true when their antecedents became true, then we have reason to infer *inductively* that the one at hand will do so, too. It is possible that work on induction such as Goodman’s can be brought to bear (Goodman, 1983) within this conceptual framework. Alternatively, we might take general statements about dispositional properties of regions of a certain shape, as Popperian ‘bold hypotheses’, and artefact production as ‘crucial tests’ of them (Brawne, 1992; Popper, 1989). What matters most is not which particular view of science we adopt, but the fact that we begin to make contact between the philosophy of design and the philosophy of science.

Whether we use induction or hypothesis testing, we are concerned here with generalization over similar cases; that is, abstraction from the particular case. Just as we can make predictions about particular regions, we can generalize such predictions to arrive at ‘laws’ about, say, column-shaped regions in general, and countless other kinds of regions and the materials with which to fill them: and that is what makes up practically oriented, or instrumental, design theory, as we teach it in civil engineering and other design disciplines.

Such abstraction from individual cases (regions) does not mean that we switch to talking about regions as *abstract* entities in the sense of Table 3; i.e., without location in space. It only means that in our talking and theorizing, we generalise by suppressing

information about the location that regions have. It is our statements and theories that are abstract in a linguistic sense, not the regions that are abstract in an ontological sense.

The very location in space of individual regions lends some plausibility to our claim that we can have faith in our predictions about them (Seed Question (8)). For unlike abstract entities, they are located in the same space that accommodates our bodies. From early childhood we have accumulated bodily experiences of movement and position relatively to regions as visualized by walls of rooms, fences, football goals, hopscotch figures, hand gestures in the air, and so forth. Among non-tangible entities, what could be more intimately familiar to us than regions of space?

Despite the merits of regionism with respect to providing satisfactory answers to our Seed Questions, it is however a serious limitation of this particular worldview that it is biased towards understanding design and production of *material artefacts*. That objection may be countered (somewhat feebly perhaps) by contending that design of material artefacts lies at the heart of designing, despite certain recent tendencies to broaden the meaning of ‘designing’ (Hjelm, 2005). But even then, regionism remains less general than the other candidate worldviews we have considered. As pointed out at the end of section 1.2, there are non-material kinds of artefacts such as software, organizations etc. that are designed, and it remains to be seen if and to what extent regionism can be generalized to account for such phenomena.

## 7. Concluding discussion

The point of departure for our inquiry was a worry about ‘The Problem of Disintegration’: how to limit the plurality and the ensuing disintegration of design theory – or positively stated, how to promote conceptual unity and logical coherence in design theory. There is no clear-cut answer to this that can be derived from a problem analysis and condensed into a few sentences as a conclusion. So instead of trying that, let us briefly review our main line of inquiry and, in doing so, take stock of what results have been achieved so far, and what remains to be done.

I argued that one thing we should do to manage the Problem of Disintegration was to become aware of, and actively resist, any ‘insidious inconsistency’ in our theories; that is, inconsistency that creeps in unnoticed without being justified by reflecting genuine

disagreement. I showed how particularly ‘sloppy metaphysics’ might be a source of insidious inconsistency (section 2) – either by way of mixing up incompatible worldviews, or by relying on a worldview with a built-in inconsistency (the ‘set of chairs’ example). This all served to elucidate the depth and nature of the problem (which I believe may count as a result in its own right), and moreover it served to put it in a philosophical context in terms of which I wanted to examine it. (There may be other, perhaps non-philosophical, approaches to the same problem that are worth exploring.)

Next, I proposed a method and a set of criteria by which sound metaphysical foundations for design theory may be developed: what I called worldviews. (Section 3.) While the method and the criteria do not constitute a solution to the problem, they were offered as tools for *obtaining* a (partial) solution, and as such they may be counted among the results of the inquiry. However, the value of a method entirely depends on its validation; i.e. evidence in support of the claim that the method actually works as intended. Therefore sections 4, 5, and 6 were dedicated to an attempt at providing such evidence, by making as much of a ‘test run’ of the method as could be accommodated within the scope of this paper.

Thus following the method, we raised the so-called Seed Questions (in section 4). While I made an effort to motivate the choice of these particular questions, the possibility remains that other questions might have served the purpose as well, or perhaps even better. Choosing other Seed Questions (with or without endorsement of ‘the axiom of existence’, section 4.3) would have branched off the line of inquiry into other directions, and might have led to other candidate worldviews than the ones we arrived at in sections 4 and 5. The samples presented in those two sections are by no means claimed to exhaust the possibilities; so producing more candidates (whether from the same or from other Seed Questions) is an opportunity for further research.

The candidate worldviews we managed to consider in this paper, were proposed and discussed with the ‘design criteria’ from section 3 in mind, and to the extent they succeed in satisfying those criteria, they may be claimed as contributions to design theory in their own right; not only as a means for alleviating The Problem of Disintegration.

The observant reader may wonder if producing more and more candidate worldviews will not *increase disintegration of design theory* rather than reducing it, contrary to my initial intention. However, what is produced by the method proposed in this paper is not, strictly speaking, new worldviews where none were before, but rather *awareness* of (good) worldviews that might have gone unnoticed otherwise. And what threatens to disintegrate our body of design theory is not the worldviews *per se*, but our lack of awareness about them. Such lack of awareness may lead a theorist to assume a faulty worldview or to mix up incompatible worldviews unknowingly, thereby corrupting his theory unnecessarily; or it may lead different theorists to speak from the vantage points of different incompatible worldviews, without realising that that is what they do. And if I am right that the lessons learned from the toy examples by Goggans and myself (sections 2 and 3) scale up to design theory at large, then such uncritical use of worldviews can lead to ‘insidious inconsistency’ in the overall body of theory; an unnecessary and avoidable inconsistency that is not justified by genuine disagreement. This I regard as a ‘disease’; and the method I propose is a means of providing a ‘medicine’ against it: the medicine of *metaphysical awareness*.

As for the design criteria of section 3, no systematic testing of candidate worldviews against them was done; nor is that possible in any mechanical way. Consistency, for one, cannot be established by a simple litmus test, but only indirectly through critical scrutiny. Yet in the brief critical discussions of the various candidates in sections 4 and 5 we have gone *some* way to evaluate them against our criteria – except the last one: ‘theoretical relevance to design’. The last step of the method is aimed at testing candidate worldviews against this criterion. Doing so would involve formulation of empirical theories in terms of the candidate worldviews in question, and that is far beyond the scope of this paper. It therefore constitutes an important project for further research.

No doubt, however, testing candidate worldviews for theoretical relevance to design is a labour-intensive process, so before any such project is launched, it would be prudent to narrow down the sample of candidate worldviews to test. This can be done, I believe, by a more thorough critical examination of candidates along such lines as were suggested in this paper. If necessary, by increasing the number of Seed Questions, which will

make it harder for any one candidate worldview to yield the resources for satisfactory answers to all of them.<sup>21</sup>

It is tempting at this place to begin the narrowing-down by recommending certain of the candidate worldviews we have been considering over others, based on the critical remarks that accompanied each of them. However, that would be jumping to conclusions. First, because the remarks seem too sketchy for that: they may be illustrative and suggestive, but they hardly amount to decisive arguments. And second, because there may well be further candidates that deserve consideration and comparison before the time is ripe for selecting any favourites.

For these reasons, the sketches offered in sections 5 and 6 are neither recommended nor rejected as candidate worldviews for further exploration; their main purpose was to test and illustrate the proposed method of world-view ‘design’ well enough for me to recommend the method for use in further research. I believe they served that purpose; and I hope they served the additional purpose of suggesting promising ways in which the phenomena of design may be explored by philosophical means.

I also hope, by describing and demonstrating the method the way I have, to have made a case for my contention about the importance of *metaphysical awareness*: that addressing the Problem of Disintegration by deliberately ‘designing’, criticizing and selecting candidate worldviews for design theory is not only possible, but – given the pitfalls of sloppy metaphysics – much preferable to sitting back and letting things happen.

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<sup>21</sup> One such fundamental question against which candidate worldviews could be tested, is this: Do we need or can we benefit from some concept of *types* to account for the fact that some design acts lead to multiple precisely similar artefacts (e.g. cars of the same make and model); others to a single unique artefact (e.g. St. Paul’s Cathedral), and still others to no artefacts at all (e.g. a studio exercise for design students)? Perice’s Type / Token distinction immediately comes to mind (Peirce, 1906, pp. 505-506). Could it be that the subject area of design is *artefact types* (from

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which any number of actual artefacts may be produced, including none at all), and if so, what is their nature?

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