ON PRESCRIBING EXPERT DESIGNING.
A LOGICAL ANALYSIS

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ABSTRACT

In this contribution a logical analysis is given of the in design research regularly held *expert position* to prescribe expert design practices as favourable design practices to other designers. First I argue that despite its conservative starting point to consider only types of already existing expert design practices as favourable, the position allows for some room to also prescribe new types of design practices. Second, I analyse the very claim that expert design practices define types of favourable practices. It is shown that the expert position may be formulated in a way in which this claim is tautological, and in a way in which it involves empirical prediction. This latter formulation allows testing the expert position by determining whether designers when mimicking experts indeed engage in favourable design practices.

Keywords: Logic of Design Methods; Expert Design; Empirical Claims of Design Methods.

GLOSSARY

D: *the set of types of design practices by which an account of design describes the design practices that are actually carried out by designers;*

e_X: *an actual expert design practice that in an account of design is considered as a favourable design practice;*

E: *the set of expert types of design practices that by an account of design (in which the expert position is taken) are considered as favourable;*

f: *the favourable property of favourable expert design practices;*

G: *the set of general types of practices by which an account of design demarcates the practices that are accepted as design practices;*

P: *the set of types of design practices that an account of design prescribes to designers as types of favourable design practices;*

x: *factors that characterise a type of favourable expert design practices;*

X: *the set of types of design practices that by an account of design (in which the expert position is taken) are considered as favourable, abstracted from the set of types of favourable expert design practices E;*

INTRODUCTION

A position that is regularly held in design research is that the design practices by expert designers are favourable design practices and therefore define the types of design practices that are to be prescribed to other designers. This position – let us call it the expert position – is held in methodological work on product designing (e.g., Cross, 2006; Visser, 2006; Lawson & Dorst, 2009) and in analyses of design thinking generally (e.g., Brown, 2009; Verganti, 2009).

The expert position is a logically tenable position and a position that seems rather conservative (Vermaas, 2010). First, logical tenability seems straightforward and the expert position even appears to be simply tautological: taking expert designers *as* experts seems to imply directly that their design practices are favourable practices; prescribing types of expert design practices to other designers seems therefore immediately equivalent to prescribing types of favourable design practices. Second, conservatism seems inevitable: the expert position appears to imply that only types of already existing design practices can be prescribed; types of practices that have not yet been tried in designing cannot be prescribed since they have by definition not yet been carried out by experts.

In this paper I give a logical analysis of the expert position and its conservatism, considering schematically specific accounts of design in which this position is taken. I categorise the relations that can exist between the types of favoured expert design practices and the types of general, actual and prescribed design practices. And I explore the generalisation assumption part of the expert position that the favourable actual design practices by experts indeed define types of design practices that are favourable for all designers.
A first conclusion that is drawn is that the expert position is not categorically conservative: there are ways available to this position to prescribe also some new types of design practices.
A second conclusion is that the expert position may be formulated in a way in which it is a tautology and in a way in which it is logically contingent. In the latter case the expert position is advancing empirical claims about favourable design practices, and a position that therefore can be empirically tested.

The analysis is abstract. Details of specific accounts of design in which the expert position is adopted are used for illustration, yet not incorporated in the analysis itself. It is, for instance, not specified what *expert* and *favourable* means. I take these terms as primitives and assume that each account of design in which the expert position is adopted defines the meaning of these terms. This abstraction has the benefit of keeping the analysis generally valid since it does not depend on the specific meanings that the terms *expert* and *favourable* have in accounts. Yet, this abstraction may give the discussion a gloss of sterility.

I first describe a way to characterise an account of design by means of how it defines *general types of design practices, types of actual design practices* and prescribed types of favourable design practices (Vermaas 2010). Then I analyse the expert position by means of this characterisation. And finally I discuss the conservatism of the expert position, its generalisation assumption, and its empirical claims.

GENERAL, ACTUAL AND PRESCRIBED DESIGN

In the characterisation of accounts of design in (Vermaas, 2010) it is assumed that an account defines in principle three sets of types of design practices: a G-set which contains general types of practices that in the account are accepted as types of design practices; a D-set containing types of design practices that by the account are actually carried out by designers; and a P-set with models of types of favourable design practices that are prescribed by the account to designers.
Let us start with the D-set. In an account some tokens of observed practices are taken as design practices. These practices are analysed and described in terms of design concepts, defining types of design practices that may be called *types of actual design practices* since instances of these types have been actually carried out by designers. These types of actual design practices define the D-set of an account. For instance, in the account of Gero (1990) actual tokens of practices acknowledged as design are analysed in terms of reasoning from functional descriptions of products, via behavioural description, to structural descriptions of the products. These types of reasoning then define the D-set of Gero's account, capturing what in this account is taken as types of actual design practices.
An account may, secondly, define a larger set of types of practices that are in principle also taken as types of design practices but that need not necessarily have instances that have been actually carried out by designers. This larger set of types of actual and (possibly) non-actual design practices defines the G-set of an account, characterising what in the account is acknowledged as *general types of design practices*. For instance, Gero may generalise his description of actual design practices by acknowledging that in the future also social institutions rather than only material products can be designed. Gero's G-set contains in this case types of design reasoning that concern the functions, behaviour and structure of material products, *and* types of design reasoning that concern functions, 'behaviour' and 'structure' of institutions.
Finally, an account may take some types of design practices as favourable and prescribe these types of design practices to designers. These *prescribed types of favourable design practices* make up the third P-set. An account may, for instance, prescribe types of design practices that lead to eco-friendly design solutions. Or an account may prescribe types of de-

sign practices in which knowledge about user preferences are sufficiently taken into consideration.

The G, D and P-sets of an account capture part of the contents of the account, which can be called the account's GDP. It tells how an account demarcates design practices since its G-set contains those types of practices that in the account are accepted as design practices. The GDP captures also the descriptive part of an account since the D-set represents how designers are actually designing according to the account. Finally the GDP captures the prescriptive part of an account since the P-set contains the types of design practices that in the account are prescribed to designers. Moreover, by systematically assessing all set-theoretically allowed relations between the G, D and P-sets one can categorise accounts of design by their GDP. The G, D and P-sets are subject to a number of constraints, and these constraints allow only six general possibilities for the GDP of an account. These six possibilities can be grouped pair-wise, leaving three categories: *conservative accounts*; *progressive accounts* and *futuristic accounts* of design.

CONSTRAINTS ON THE GDP OF ACCOUNTS

Before giving this categorisation of accounts of design consider first the constraints on the GDP of accounts. The D-set is a subset of the G-set, for it would be inconsistent if an account accepts types of actual design practices that are not acknowledged to be general types of design practices. So a first constraint on the GDP of an account is that $D \subseteq G$. Similarly, P is a subset of G, so one also has the constraint $P \subseteq G$.
The second constraint can be strengthened if the prescription by an account implies that designers should *avoid* certain types of design practices. Such prescription means that there exist types of design practices in G that are not in P. And this means in turn that P is a *proper* subset of G, so $P \subset G$.
If the prescription by an account implies additionally that designers should *change* their design practices, then a third constraint becomes available. Such prescription implies that some actual design practices are not of the types of practices that are prescribed. So D is then not a subset of P, leading to the third constraint that it is not the case that $D \subseteq P$.

The third constraint and the strengthened second constraint do not hold necessarily. In the ideal case that all actual design practices are of types that are prescribed in an account, then one has that $D \subseteq P$. Moreover, in the trivial case that an account prescribes all general types of design practices, one still has $P \subseteq G$ but not that $P \subset G$. Imposing the third constraint and the strengthened second constraint to accounts of design thus expresses that the prescription by this account is non-trivial, and that designing has not yet evolved to the ideal case in which all actual design practices are of the prescribed types of favourable practices.

Consider, for instance, an account in which it is observed that actual design practices sometimes fail to produce eco-friendly design solution, and in which the prescribes types of design practices do lead to eco-friendly solutions. All types of observed actual design practices, including those that produce eco-friendly solutions and those that do not, are in the account taken as design practices, which is captured by the first constraint: $D \subseteq G$, or any type of actual design practices is also a general type of design practices. All prescribed types of design practices, being those that produce eco-friendly design solutions, are also general types of design practices: which is captured by the second constraint: $P \subset G$, or any prescribed type of design practices is also a general type of design practices. Finally, since designers are by this account sometimes producing non-eco-friendly design solutions, there is at least one type of actual design practices that is not a prescribed type of design practices, which is expressed by the third constraint: it is not the case that $D \subseteq P$.

The three constraints one has on the GDP of accounts are summarised in Table 1.

Constraint 1	$D \subseteq G$
Constraint 2	$P \subset G$
Constraint 3	it is not the case that $D \subseteq P$

Table 1. General GDP constraints.

CONSERVATISM, PROGRESSIVISM, FUTURISM

Consider the G, D and P-sets of an account by means of Venn diagrams. Constraints 1 and 2 ($D \subseteq G$ and $P \subset G$) imply that G is always the biggest diagram.

There are now ten possibilities for D and P lying within G, depicted in the Figures 1 to 4. Constraints 2 and 3 ($P \subset G$ and the impossibility that $D \subseteq P$) rule out four possibilities given in Figure 1: P should not be as big as G ($P \subset G$ should not be violated); and D cannot be equal to P or lie within P (it is impossible that $D \subseteq P$). The ruled-out possibilities represent accounts in which the D-set describing types of actual design practices is taken also as the P-set of prescribed types of design practices. Such accounts, although logically impossible, sometimes seems to be available in the design literature. In, for instance, (Roozenburg & Eekels, 1995, p. 93), a descriptive model of designing drawn from an analysis of actual design practices, is also advanced as a prescriptive model. This position implies that all actual design practices are of types that are prescribed types of design practices. Yet if some of these actual practices are rejected as being of types of design practices that are not favourable, then the position is logically untenable.

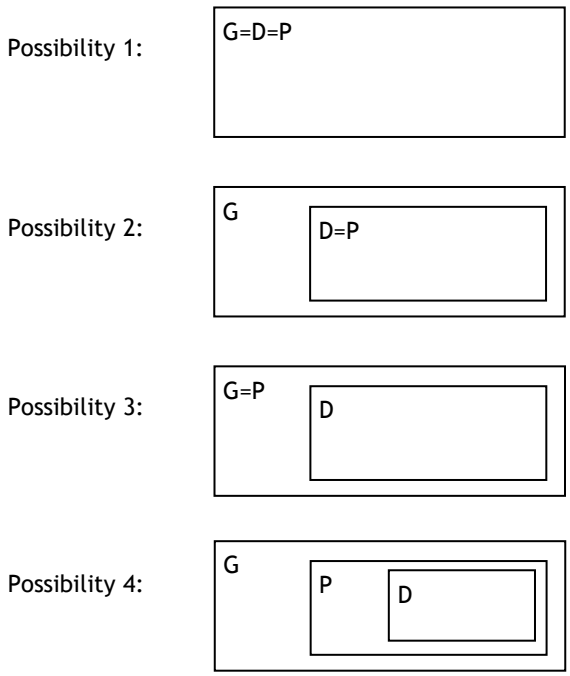

Figure 1. The ruled out possibilities 1, 2, 3 and 4.

Two possibilities that are allowed are characterised by P lying within D, see Figure 2. These possibilities 5 and 6 may be called *conservative*, for in accounts in which P lies within D, prescribed types of favoured design practices are always types of actual design practices; there is thus not a type of favourable design practices that has not yet been used in actual design. Accounts in which the expert position is adopted, may be cases in point, since on such accounts types of actual design practices by experts are taken as types that are to be prescribed (but this view is qualified later on).

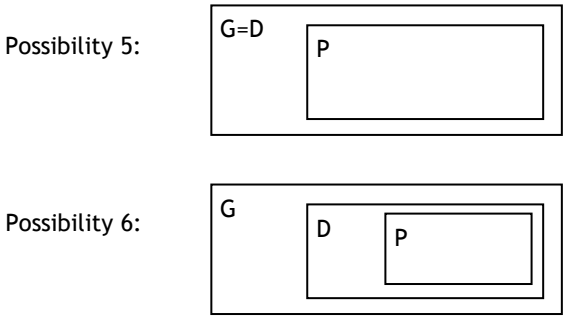

Figure 2. The conservative possibilities 5 and 6.

Two further possibilities 7 and 8 allowed by the constraints are characterised by D and P partly overlapping, see Figure 3. Accounts that are instances of these possibilities may be called *progressive*, for in such accounts there are types of favoured design practices that are not (yet) adopted in actual design. By such accounts there can thus be progress: there are new ways of designing available that are (also) favourable. The theory of axiomatic design (Suh, 2001) may be an example of such a progressive account that prescribes types of design practices that have already been carried out and types of design practices that are new.

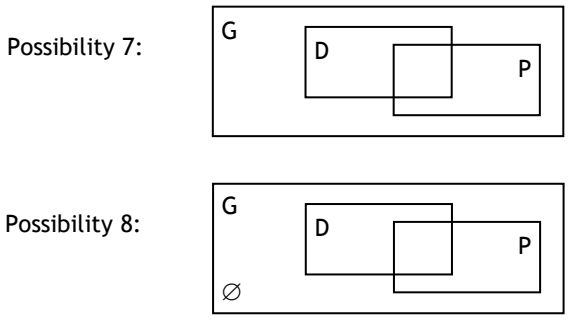

Figure 3. The progressive possibilities 7 and 8; ∅ denotes the empty set, which means that $G=D \cup P$.

The final two allowed possibilities 9 and 10 are characterised by D and P not overlapping, see Figure 4. In accounts falling under these possibilities all types of actual design practices are not types of favourable design practices that are prescribed. Yet types of favourable design practices exist and may in the future become actual. Let us call these possibilities *futurism*. The introduction of the first design methods at the time when artisan production ruled, may be reconstructed as such futurism: existing artisan

models are discarded and new types of design practices are made available.

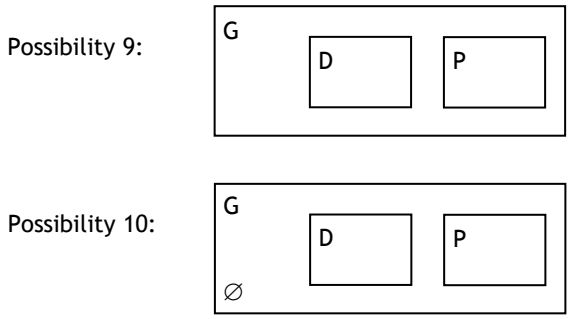

Figure 4.The futuristic possibilities 9 and 10; ∅ denotes the empty set, which means that G=D∪P.

THE EXPERT POSITION

Let us now consider accounts of design in which the expert position is adopted. In such accounts some designers are taken as expert designers and a number of actual design practices by these experts are singled out as favourable. These actual expert design practices are analysed as being of specific types of design practices and these types are prescribed to all designers. Let the favoured actual expert design practices be $\{e_1,e_2,...e_n\}$ and let E be the set of that contains the types of expert design practices of which $\{e_1,e_2,...e_n\}$ are instances.
Since the experts are actual designers and since the favoured design practices are actual design practices, it follows that E consists of types of actual design practices, so E is a subset of D. One thus has on the expert position the additional constraint that E⊆D (see Table 2).

Constraint E	E⊆D

Table 2. Expert position constraint.

A strict form of the expert position is that *exactly* the types of design practices followed by the experts are the types that are to be prescribed, that is, P=E. This identification transforms the expert constraint E into P⊆D. From constraint 3 it follows that it cannot be the case that P=D, so one has on the strict expert position the consequence that P⊂D. This consequence makes sense, since on the strict expert position there are also types of actual design practices in D that are not favourable and thus not prescribed: actual design practices by non-expert designers define such non-favourable types in D, for instance.

When returning to the six GDP possibilities for accounts, one can conclude that the possibilities 7 to 10 all violate the strict expert position consequence that P⊂D. Only the possibilities 5 and 6 provide two tenable options, as given in Figure 5.

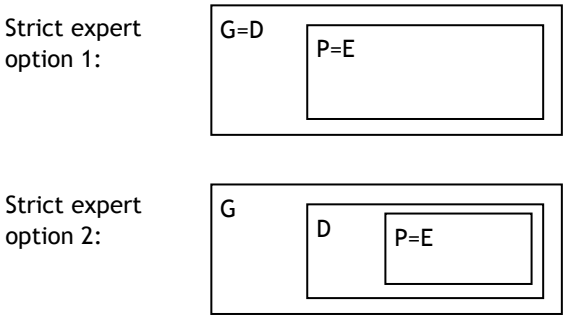

Figure 5. The two options for the strict expert position, by the conservative possibilities 5 and 6.

A liberal form of the expert position is obtained by taking the types of favourable design practices as *abstracted* from the types of actual design practices E followed by the experts. Let X be the set of these types of favourable design practices abstracted from E. For instance, E may contain only types of design practices that contain sketching with pencils, and it may be judged on the liberal expert position that the use of in particular pencils is not relevant to the favourability of the singled-out types of expert design practices in E. The set X then contains more general types of favourable design practices, in which sketching is done by pencils or by other means.
In an account of design in which this liberal form of the expert position is adopted, the prescribed types of design practices are the types X of design practices: P=X. One also has E⊂X since the more strict types of favoured expert design practices in E are special cases of the abstracted types in X. With P=X this means that E⊂P. The expert constraint E still gives E⊆D. On the liberal expert position one therefore has the consequence P∩D≠∅, since E is both in P and in D. This consequence also makes sense, since on the liberal expert position the types of actual favoured design practices by experts contained in E are both types of actual design practices and prescribed types of design practices.
The consequence P⊂D of the strict expert position need not hold anymore: the design practices that are prescribed still include the types E of actual expert design practices, but now may also include types of

design practices that are not yet actually carried out. For instance, design practices in which sketching is done with some (future) computer tool may also be prescribed, even though these practices have never been actually carried out.

Returning again to the six GDP possibilities for accounts, more possibilities become options for the liberal expert position; only possibilities 9 and 10 are still ruled out because they violate the liberal expert position consequence $P \cap D \neq \varnothing$.
The possibilities 5 and 6 give two tenable options as given in Figure 6, and the possibilities 7 and 8 give two other tenable options as given in Figure 7.

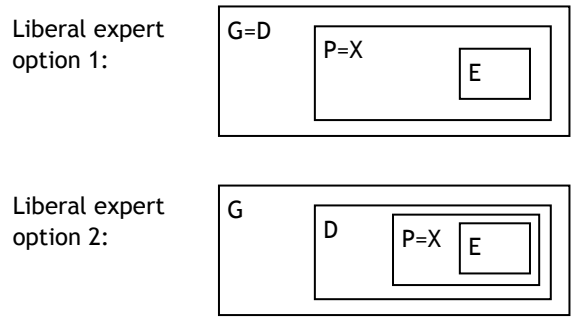

Figure 6. Two options for the liberal expert position, by the conservative possibilities 5 and 6.

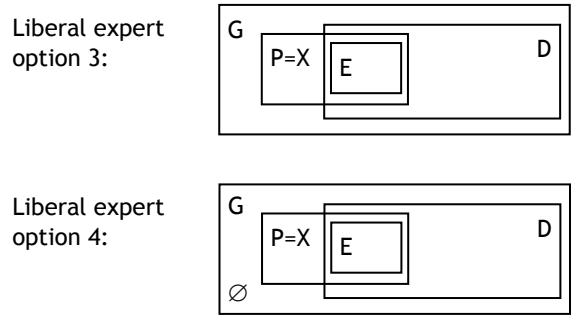

Figure 7. Two options for the liberal expert position, by the progressive possibilities 7 and 8.

THE EXPERT POSITION AND CONSERVATISM

The expert position is by its very starting point conservative. Some actual design practices of experts are taken as the favourable ones and their types are prescribed to all designers; types of design practices that only non-experts follow and types of design practices that have not yet been carried out are not favoured and thus not prescribed. The innovation of design solutions may be stimulated in this way, assuming that finding innovative design solutions is a hallmark of expert designing. Yet innovation of the prescribed types of design practices themselves is ruled out. Types of design practices defined by novel design methods developed in academia are not favourable on the expert position, and neither are alternative types of design practices that emerge among novice designers for meeting new demands such as sustainability, for coping with new situations such as *open design*, or out of dissatisfaction with existing design practices. The *cradle to cradle* vision (McDonough & Braungart, 2002), for instance, is on the expert position not defining types of design practices that are to be favoured or to be prescribed. Novices can learn good designing only by mimicking experts.
The expert position may appear to bring design methodology back to the craft tradition of guilds. This position may mean that designers are prescribed to follow exactly the same steps as expert designers take, using exactly the same design knowledge as the experts do. Yet the expert position is also compatible with visions in which designers should replace tradition by more independency, as proposed by, e.g., Friedman (1997). It may mean that designers should merely organise their practices as expert designers do, and be able to reflect on this organisation as experts do (Lawson & Dorst, 2009). The conservatism of the expert position may thus reside on the level of the *content* as well as on the level of the *process* of design practices.
Despite this conservatism it can be argued that the expert position allows for two routes to innovate the types of design practices that are prescribed. And on the second this position may even be taken as a progressive one on the GDP categorisation as presented above.

A first way in which the expert position allows for innovating the prescribed types of design practices is by enlarging the set of favoured actual expert design practices $\{e_1, e_2, \ldots e_n\}$. A new actual design practice e_{n+1} may become acknowledged as expert designing, implying that the designer involved is taken as an expert. If this new design practice e_{n+1} is defining a new type of design practices not yet included in E and X, this new type is prescribed as well. So, when results by McDonough and Braungart are eventually accepted as favourable, designing by the *cradle to cradle* vision is prescribed on the expert position.

This first route for innovating prescribed types of design practices holds for both the strict and liberal forms of the expert position.
A second route for innovating prescription is available only for the liberal form of the expert position. The prescribed types of design practices X are in this form abstracted from the types of actual expert design practices E, allowing that other types of design practices not (yet) actually followed by expert designers are prescribed as well. These other prescribed types of design practices may be types of design practices non-expert designers actually follow (the liberal expert options 1 and 2, Figure 6). And these other prescribed types of design practices may be types no designer yet has carried out (the liberal expert options 3 and 4, Figure 7), turning the expert position into a progressive one. Whether the cradle-to-cradle vision may be prescribed on a liberal expert position depends on whether the design practices it has in mind can be seen as instances of the abstracted types of favoured design practices X.

The view that the expert position is a conservative position because it implies that new types of design practices can never be prescribed (Vermaas, 2010) should be qualified (see Table 3).

Innovate design practices 1	by taking new design practices as favourable expert design practices
Innovate design practices 2	by abstraction from types of favourable expert design practices

Table 3. Two routes for innovating prescribed types of design practices on the expert position.

THE EXPERT GENERALISATION

The analysis of the expert position has so far been focussed on the relations between expert designing, demarcation, description and prescription, and on the consequences of this position. I now focus on a key assumption on which the expert position is based. This assumption is that a number of favourable actual expert design practices define types of design practices favourable for all designers. This assumption can be taken as consisting of three sub-assumptions, which are of similar form for accounts of design in which the strict expert position is adopted and accounts in which the liberal expert position is advanced:

1. there are a number of actual token expert design practices $\{e_1,e_2,...e_n\}$ that have a favourable property *f*;
2. these design practices $\{e_1,e_2,...e_n\}$ define types of design practices E or X;[1]
3. all instances of a type of design practices in E or X have the favourable property *f* as well.

Let us accept the first two sub-assumptions and focus on the third, which may be called the generalisation assumption of the expert position. Take one type of design practices in E or X, and assume that it is characterised by a number of *x*-factors. For instance, in Verganti's (2009) analyses of expert design practices in firms aimed at defining innovative product families, *x*-factors include collaboration with key interpreters outside the firm, "open innovation"-style sharing of knowledge, and restraints on in-between "return on investment" assessments. One can now distinguish four cases how such *x*-factors and the favourable property *f* are related.
In the first case the favourable property *f* is itself one of the *x*-factors. The generalisation assumption is then a logical truth and the expert position becomes a tautology: all instances of types of expert design practices are favourable *because* they are all characterised by the favourable property *f*. This tautology does not make the expert position useless: the *x*-factors may characterise the *process* of the types of favoured design practices whereas the favourable property *f* is (also) about the *design solutions* these practices generate. Engineering design methods like Pahl and Beitz's (2007)[2] define design processes by *x*-factors that include analysis steps in which it is checked that design solutions meet the initial requirements. That the design solutions meet these requirements may be taken as the favourable property *f*. And these methods then have this favourable property automatically, which is useful.
In the second case the *x*-factors are taken to be implying the favourable property *f*, meaning that the *x*-factors become sufficient conditions for *f*. In this case additional work is needed to maintain the generalisation assumption. The empirical basis of the

[1] Choose here and in the rest of the discussion E for an account with the strict expert position, and choose X for an account with the liberal expert position.
[2] The method by Pahl and Beitz (2007) is not an account of design in which the expert position is adopted.

expert position is that there are a number of actual token expert design practices $\{e_1,e_2,...e_n\}$ that meet the *x*-factors and that have *f*. This basis is insufficient for concluding that *all* design practices that meet the *x*-factors have the favourable property *f*. What is needed for this conclusion is, first, an argument that the considered expert design practices $\{e_1,e_2,...e_n\}$ have the property *f* because they meet the *x*-factors, and, second, an induction from these considered practices to all design practices that are characterised by those *x*-factors. Both this argument and the induction are typically given by a general explanation of the favourability of the considered expert design practices. For instance, Verganti's (2009) develops explanations of why the expert design practices in firms that include key interpreters, open innovation, et cetera, have led to the definition of innovative product families. And this explanation is aimed at establishing that all such open innovation-style design practices with key interpreters will lead to the same favourable outcomes.

The induction step implies in principle that all possible design practices meeting the *x*-factors have the favourable property *f*: all designers that engage into design practices that meet these *x*-factors will engage into design practices that have *f*. Specifically non-expert designers can profit; for them the favourable property *f* is in reach by mimicking the types of expert design practices E or X. For the work by Verganti (2009) and also Brown (2009) the induction indeed may be to all designers: these authors indeed suggest that if non-expert designers mimic successful experts, the non-experts will share in the experts' successes.

The induction step may however be more subtle and effectively be limited to only other expert designers. If the *x*-factors contain factors that can only be met by more experienced designers, say, when an *x*-factor is to frame design problems on the basis of a rich body of design experience (expert design precedence), then novice designers can hardly engage into the prescribed design practices of type E or X. The expert position then effectively does not define favourable design practices novices can follow, but spells out the reasons why novices cannot engage in these favourable practices. The work by Lawson and Dorst (2009) may be taken as representing this version of the expert position. It analyses expert design practices, not for spelling out what novices should do in their design practices, but for defining what these novices should be learning in order to become experts themselves.

In the third case the *x*-factors do not imply *f*. The *x*-factors may, for instance, be necessary conditions for the favourable property *f*, or there may be simply no logical relation between the *x*-factors and *f*, yet there is a stable correlation between the *x*-factors and *f*. One then obtains a probabilistic relation that a design practice meeting the *x*-factors has with probability p(*f*) the favourable property *f*, and this probability may be large or even be equal to 1. Although the expert generalisation assumption does not hold in this third case, the expert position still makes sense: the types E or X of expert design practices can still be prescribed since they are with probability p(*f*) favourable design practices.

The fourth case is that there is no specific correlation between the *x*-factors and *f*. The expert generalisation assumption then also does not hold and now the expert position makes less sense; no specific prediction can be given of whether type E or type X design practices have the favourable property *f*. I will ignore this fourth case in the remainder of this paper.

The four cases are summarised in Table 4.

Case 1	*f* is an *x*-factor
Case 2	the *x*-factors imply *f*
Case 3	the *x*-factors imply f with probability p(*f*)
Case 4	there is no specific correlation between the *x*-factors and *f*

Table 3. Four cases for the relation between the x*-factors and the favourable property* f.

EMPIRICALLY TESTING THE EXPERT POSITION

In the first case describe above, the claim of the expert position that types of expert design practices are types of favourable design practices is tautological. As a tautology the claim is always true, so no empirical claims are made. Devising an empirical test for trying to falsifying an account in which this position is adopted is then meaningless. Yet in the second and third case, such tests make sense. The analysis holds again for both accounts of design that

advance the strict expert position and that advance the liberal expert position.

In the second case the expert position implies that all the design practices of the prescribed types E or X[3] of expert design practices have the favourable property *f*. This implication is now an empirical claim that can be tested.

Consider an account of design in which the expert position is adopted, and assume that it specifies the experts, the expert design practices $\{e_1,e_2,...e_n\}$, E or X, and the favourable property *f*. A test of such an account can now consist of carrying out a design practice of type E or X and then determining whether it indeed has the property *f*. In this second case, one counter-example is sufficient to falsify the account considered. One could, for instance, invite a non-expert designer to carry out a design practice of type E or X. And if this does not lead to a practice having the property *f*, the account is falsified. Or, when the types E or X of prescribed design practices can effectively be carried out by only expert designers themselves, one could invite an expert to carry out a design practice of type E or X. One could, for instance, consider a firm that already has managed to define innovative product families through the design practices prescribed by Verganti, and follow this firm when it attempts to define a new innovative product family with these prescribed practices. Again, in this second case, one counter-example of a prescribed design practice that does not lead to *f* is sufficient to falsify the account considered.

In the third case the expert position implies that the design practices of the prescribed types E or X of expert design practices have the favourable property *f* with probably p(*f*). This is again an empirical claim that can be tested. Now the test consists of letting designers – novices or experts – carry out a number of design practices of type E or X and then determining whether they indeed have the property *f* with probability p(*f*). One counter-example is not sufficient to falsify the account adopting the expert position; the outcomes should in this third case be evaluated statistically, determining whether the frequency at which the property *f* is realised is coherent with the predicted probability p(*f*).

[3] Choose E for an account with the strict expert position; choose X for an account with the liberal expert position.

Test for case 2	let a designer carry out a design practice of type E or X, and determine if this indeed amounts to a design practice having the property *f*; the expert position may imply that non-expert designers cannot carry out this test, yet this position does imply that experts can carry out the test
Test for case 3	let a number of designers carry out design practices of type E or X, and determine if this indeed amounts with probability p(*f*) to design practices having the property *f*; the expert position may imply that non-expert designers cannot carry out this test, yet this position does imply that experts can carry out the test

Table 4. Empirical tests for falsifying the expert position for the cases 2 and 3 given in Table 3.

CONCLUSIONS

In this contribution I gave an analysis of the expert position to prescribe expert designing as favourable design practices to other designers. This analysis has been a logical one that focuses on the assumptions made in the expert position, and on the implications of these assumptions. Details of specific design methods and accounts that adopt the expert position have been left out of the analysis, or were used merely as illustration. Notably the key terms of *expert* and *favourable design practice* were not specified but taken as primitives. By abstracting from these details two general conclusions about the expert position could be argued for.

First, in its strict form of prescribing design practices that are exactly the types of practices experts follow, the expert position is conservative by prescribing types of design practices that have already been carried out. In its liberal form of prescribing types of design practices that are abstracted from the types experts follow, some new types of design practices can be prescribed. In both forms the expert position can prescribe new types of design practices once new design practices are acknowledged as favourable expert practices.

Second, the assumption part of the expert position that specific favourable expert design practices define types of favourable practices for all designers, can be analysed as being tautological and as being logically contingent. In the latter case the expert

position has empirical consequences: when designers carry out the prescribed practices, they will – necessarily or with a specific probability – arrive at favourable design practices. This prediction can be tested, opening the possibility to falsify accounts in which the expert position is adopted.

Especially the second conclusion that accounts of design may be falsified, may raise doubts. One can argue that this possibility may follow for the abstract accounts considered in this contribution, but not for the more detailed accounts advanced in the design research literature. Moreover, design practices in real life are too complex, too situated and too contextual to reasonably carry out an experiment as proposed in this contribution; when in real life prescribed design practices are carried out, external or other uncontrollable factors are bound to determine whether they become favourable practices or not. Hence a test to falsify an account of design is hardly feasible, so one can argue, especially if the test concerns a series of similar practices.

The objection may make sense, yet, if it holds true, reveals also a weakness of design research. If it indeed cannot be controlled whether or not a design practice that is meant to be of a specific type is actually of that type, it becomes hard to assess accounts of design. Attempts to design according to some prescription may end in favourable design practices, yet since it cannot be controlled whether design practices are indeed of the type prescribed, it is unclear whether the favourability is due to that the design practices are of the prescribed type. Reversely, if a design practice turns out not to be favourable, proponents may always defend the account concerned by claiming that the practice was apparently not of the prescribed type.

To avoid this vicious circle, the objection can be turned around and taken as an indication that in design research accounts of design should be formulated in a manner that it become (more) controllable to determine whether real life design practices are of the types prescribed. If such formulations are feasible, accounts become in principle testable. It then becomes, moreover, necessary to be clearer about what is in fact claimed by accounts when they prescribe specific types of favourable (expert) design practices. Cross (2006), Brown (2009), Lawson and Dorst (2009) and Verganti (2009) prescribe their respective types of expert designing as types of favourable design practices. But they do not explicitly specify whether all or only some designers will arrive at favourable design practices when they follow the prescription (that is, if case 2 applies, or case 3; see table 3). When testing these accounts this clarity is needed: if the claim is indeed that all designers will arrive at favourable design practices when mimicking expert designing, then one example in which the resulting design practice is not favourable would falsify the account concerned.

The logical analysis given in this contribution is indeed abstracting from the details of the accounts in which the expert position is adopted. Yet it leads to more precision about what these accounts imply, it defines how they can be tested, and calls for precision about what actually is claimed by these accounts when prescribing expert design practices.

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