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PROBLEM SOLVING IN DESIGN AND MUSIC

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0 Abstract

Comparisons are most interesting when the entities have partial correspondence. In this essay, product design and music are examined regarding creativity, improvisation and problem solving approaches.

Creativity is fundamental to both product design and music and Improvisation plays a role in both design and music via its role in creativity. Both rely on aesthetic means to produce desired effects in others. The fact design and music both depend on aesthetics and both use creativity suggests they might be usefully compared. The fact that product design is an applied art and that music is a performing art provides points of contrast.

Much has been written on how to organise product design with a view to rendering the process a rational one. Often the intuitive aspect of design is downplayed if not omitted. One can view the evolution of design as the taming of intuition. Yet product design is dependent on original solutions which do not emerge from successfully repeated routines. Design is a blend of natural science, social science, humanities and art. Other arts such as music, as a matter of course, use improvisation to explore creative space but also depend on just enough structure to give meaning. On that side, rational methodologies are underplayed and creativity emphasized. Problem-solving is only a part of design, and it can be viewed as a part of music to differing degrees and a comparison reveals something of the nature of product design and music.

1. Introduction

The aim of this paper is to consider approaches to problem solving in music and in design in relation to creativity and the linked concept of improvisation. In so doing we hope to bring forward the essential artistic and creative aspect of design that distinguishes it from engineering (natural science concerns) and management (social science concerns). It also casts light on rational, self-conscious attempts to guide or support creativity in music where improvisation is used as a means to compose themes and during performance, more so in jazz and rock than in classical (Alperson, 1984).

Both music and product design have a relation to the concept of problem solving. In design, problem solving is strongly-emphasised (Gerber, 2007, for example¹; Bryan-Kinns et al., 2004; Walker, 1997). In music problem-solving is seen as a technical matter (e.g. McAdams, 2004) and we consider the reason why the formulas known in design as methods and tools might be less applicable in music.

Problem solving in design is easier to delineate than in music. In that field, problem solving consists of a rational element which has been subject to the application of systematic methods beginning in the 1960s with the design methods movement (Jones, 1970). It also consists of an intuitive element drawing on inspiration, sub-conscious thought and improvisation. In music, problem solving might not even be

¹ Gerber sees improvisation in this way: “ improvisation can build perspectives and skills that are critical for designers, such as creative collaboration, fostering innovation, supporting spontaneity, learning through error, and presenting ideas.”

considered to be the right term. However, music composition, therapy, performance and recording can be seen as activities consisting of intuitive and improvisational activities. These carry the artist and her collaborators from the initial, basic problem of “what are we going to do” through how that will be done in general and in the particular, thus “solving a problem” of *‘How should this sound?’*.

In both design and music there are to be found a) rational inquiry and b) intuitive inquiry though which is foremost (at least at first glance) might depend on the discipline and the instance or case. If we consider design in the post-Design Methods movement era it is predominantly a rational process which bounds or corals instances of intuition. Music, in contrast, could be considered the reverse: acts of intuition and improvisation drawing on technical, rational behaviour and based on the feedback of the audience to reach a conclusion or the next step in the process.

Note that we assume for the purposes of the first half of this article a) that what we call music is the performance of written scores for an audience according to Western traditions and b) that design is a formalised process of problem solving. Both the western tradition of music and the formalization of design are result of the application or use of rationalist ways of thinking i.e. the search for generally applicable laws and rules. We return to examine these assumptions in the second part of the article. Another caveat is that this article is presented with a bias apparent in the fact we know more about design than we do about music.

One of us is not a trained musician (RH) and the other is (JM). The article is more of an attempt to discover in music something useful to design rather than to inform those deeply familiar with music anything novel. Some of the examples from music are drawn from popular music and hint at the way in which one of the authors (RH) has become interested in creative methods in music that might be useful in design.

2. Understanding the connections

Before progressing, we need to 1) present our understanding of creativity and 2) improvisation and 3) show how improvisation is linked to creativity.

2.1 Creativity:

Considerations of creativity might start with the high-level reflection on what creativity is, on the need to be creative and what strategies to employ. A person might consider the relative levels of creativity in their work and decide more was needed (the artist looking for a new direction). Do we consider creativity as seen from inside the person or as seen from the outside? From the inside one might not even be aware of being creative. From the outside, the paths to creativity as described in the literature may not achieve creativity due to a lack of inherent spontaneity. For example, Hsiao et al (2004) merely package the “sudden leap” part of creativity into a managerial structure. This not-unusual tactic would not be recognized as creative by the person who is intuitively creative. Rational inquiry into intuitive inquiry is the interaction of what might be incommensurate domains².

Creativity requires both originality and effectiveness, which is the consensus surrounding the standard definition of creativity (Runco et al., 2012; de Sousa, 2008; Abraham, 2013). However, there are also debates arguing whether innovation, originality and productivity cannot fully define creativity per se (Runco, et al., 2012; de Sousa, 2008; Abraham, 2013). Creativity has an elusive quality that comes from it being rooted in the unexpected response to a situation. In addition, creativity is not monolithic. It comes in several flavours and degrees of complexity. From problem-solving to expression, everything we do requires

² Rather too late (the day before submitting this, we realise this point could be elaborated).

some form of creativity (Abraham, 2013). The point of interest here is the term “some form of” – what is the minimum standard of creativity? We’re most interested in the creativity that is general-level and rather than particular to one person (e.g. their new recipe for lasagna with more garlic). The approach to creativity in different situations and contexts could come in several different types such as combinatorial, exploratory, and transformational (Boden, 2004; Agres, et al., 2016) and also usefully or at least interestingly so. Combining custard and lasagna is new but not good, we would assume. The Irish band the Fatima Mansions (on *Against Nature*, 1989) combined the slick, synthesized sound of chart pop with dark lyrics (one level of combination). They combined those superficially commercial tracks on albums composed of otherwise bravely uncommercial and highly original music (another level of combination). Creativity starts often with some other goal in mind as well as with the high-level reflection on the need to be creative and what strategies to employ. Or the person might consider the relative levels of creativity in their work and decide more was needed (an artist looking for a new direction, for example). The reference here is David Bowie’s marked shift of course when abandoning radio-friendly music for the discordant sounds of *Tin Machine* (1989), what guitarist Gabrels called artistic survival ahead of commercial survival.

On first analysis, creativity is a concept mired in difficulty, a construct that is contested. It is also construct that can interfere with the phenomenon in question: thinking about creativity can interfere with creativity. JS Mill suggested happiness was found whilst looking for other things and creativity has something of the same character.

What we can do at this juncture is to park these concerns, having registered them, and turn our attention to a related aspect of creativity, improvisation.

2.2 Improvisation

“What are the ways in which something can be ready-to-hand, or that we might imagine that something might or could be ready-to-hand? This is how we move from predicament to possibility, by interrogating the aesthetic materials and by accumulating a plurality of ways in which they might become useful to us, thereby transcending predeterminations (whether they be social, historical, aesthetic, formal, etc.)—this is the very goal of the epoché.” (Stover, 2013, p.261).

Stover is here trying to describe the need to suspend criticism while in the middle of the act of making new from what is to be found in a situation. This transcendence runs through the concept and when one considers the wealth of associations deriving from improvisation, creativity seems a little more like a butterfly on a pin. Improvisation’s transcendence of predeterminations can rephrased as adding new meanings and knowledge.

Understood as taking some idea or material and reworking it to serve a new purpose, improvisation is a broad concept within the broader concept of creativity. Stover was probably not thinking of the kind of improvisation where one uses an elastic band to jam a shower head on its vertical rail³. Rather, we are apparently interested in the nobler cause of using an idea, in whole or part, to do something artistically new, to solve a worthwhile problem or create a new work (painting, music). Yet the example of the rubber band leads us into the vast grey zone of making do and on towards the more celebrated and spotlighted podium of lasting achievement. Improvisation is the union of both intuition and rational thinking, it is the once-only situation that requires imagination based on contextual factors (Ryle, 1976, p. 77). An example here from

³ This is taken from the author (Richard Herriott’s) own experience, along with the use of a fleece as a pillow for six months. Necessity, is as they say, the mother of invention.

music might be when the performer intellectually recognizes the need for an intervention into the flow of a composition and reaches for a “rubber band” in their subconscious. It is a kind of a leap in the dark.

Alperson (1984, p.17) in his essay on music and improvisation writes: “Musicologists and historians of music (...) point out that most musical performances in classical Greece appear to have been improvisations and that improvisation has had a steady role to play in the practice of Western music at least as far back as the music of the Church liturgy of the fourth century”. It is also quite uncontroversial to note the use of improvisation in performance of rock music in both recording/composition and in live performance. In the making of the track *Red Sails* on David Bowie’s 1979 album *Lodger*, producer Brian Eno recorded improvisation by lead guitarist Adrian Belew, and edited them to make sound sequences that are not performable (Buckley, 1999, p.305) a process called compositing. On stage, guitarist Reeves Gabrels (Resnicoff, 1991) would play stretched and extended notes within a framework of songs’ chord sequences. This is called modal chromaticism and puts into the repertoire unexpected elements consistent with the song’s overall point.

In design, the improvisation takes place on the page when one casual line suggests another which then builds up to the rules we call a form language. It can also be in the form of the hacking and sanding of modelling foam into rough shapes; these constitute bridges from clean two-dimensional sketches to resolved three-dimensional models. Improvisation is the ability to adopt a variety of strategies and modalities through kinaesthetic and intellectual control, it is a type of creativity that has potential to be reflective as well as ephemeral and transformative in nature (Boden, 2004). The designer or artist and the musician have kinæsthetic as well as visual and auditory moments of improvisation, with a dialogue from physical to verbal to physical in a kind of feedback loop. It is creativity in action (Gongora, 2006; Schön, 1984) that encourages awareness through reflection during the creative process by drawing attention to physical aspects of the creative process during their enactment.

Those considerations take us back to what we referred to as the spotlight podium of lasting achievement mentioned above. The small-scale improvisations of designers at the level of pen-strokes, cuts in modelling foam and hacking of components correspond to the gathering and re-clustering of musical information that occurs in live performance or during composition. In design the end result is the proposal for a complete product in which the improvisation is invisible: the product stands on the podium in a stable, final state. In music the end result is in the composition and in the instantaneous live performance, under the spotlight. Again, from the outside the improvisation is invisible – the seamless unity of the work is recognizable only on reflection, leaving us dazzled by what Kant might think of as a pure judgement of beauty.

That thought allows us to find a step in the progression from improvisation as mere making-do towards improvisation as a positive phenomenon leading new behaviour patterns. The rubber band is not immediately aesthetically satisfying; rather it might even be ugly just as rough assemblages of breeze blocks, zinc work and untidy mortar identify building work of low-quality⁴. Referring to David Pye’s (1968, p.72) craftsmanship of risk some repeated improvisation in the form of variable craft has strong appeal. The partially controlled quality of hand-craft can strike us as more appealing than the smooth perfection of injected moulded plastic. The point here is not to argue hand-craft is always preferred to machined perfection but that it can be preferred.

⁴ Or just a modern building with bad detailing. We seem mostly to be thinking of good improvisation and not the bad sort.

Further up the ladder of excellence improvisation becomes, as it were, regularized. If the designer or musician is lucky the new action or approach becomes worth repeating exactly in the form of the regular recital or the invariant faultlessness of mass production.

2.3 Connecting Improvisation and Creativity

In this section we wish to discuss the links between improvisation and creativity. The previous section may have suggested answers to this already. Are there any links? The question makes apparent the open matter of the directionality of the link: does creativity promote improvisation or does improvisation promote creativity?

We start by asking whether you can be creative without improvisation. That is to ask if improvisation is necessary for creativity. Creativity involves internal and external acts (thinking and doing). We might try to separate these acts into those which are and those which are not improvisational. Let us think of a creative act that is not improvisational such as the act of putting trace of paint on a canvas, striking a key on a piano or using a known sequence of code. Such basic steps could be called mere use. The paint remains paint, the note is just a "c" and the code is not doing anything new. In information terms, no significant new information has been created and in terms of meaning, the paint, struck note and code are not conveying *much* that is novel in isolation or in relation to other things. However, it remains a slippery and vague delimitation since a splash or line of paint traces can turn, via improvisation, into an unexpected painting; jazz piano seems to consist of unexpected steps based in some recognizable chord sequences or note sequences. The qualifier "significant" is not an absolute term but relative. The use of a knife to slash a canvas was on one level mere use. However, Fontana's 1958-1968 series of works consisted of slashes on canvases. This was, it is commonly agreed among art critics, significant. Is that improvisation though? To answer yes, one admits that the knife was pressed into service in a new way and also that the resultant slash was partially uncontrolled (and therefore not routine). To say no, one is saying the knife did only what knives do and that the uncontrolled aspect of the slashing was unimportant. Arguing the work was not an act of creation is not worth pursuing. We would say that the work was marginally improvisational and that without repurposing the knife (giving it new meaning) the work would remain uncompleted. There's no good reason to slash a canvas other than to see what aesthetic effect is achieved in so doing. The result of this line of thinking is that there is a steep and slippery slope from mere use to improvisational creativity. We have not thought of a creative act (thought or action) that doesn't seem to contain an element of improvisation.

Creativity can come from a programme or a sequence of steps such as drawing a new version of an object or recombining existing patterns to make a new one. Yet parts of the process need to be joined up in unexpected ways, ways not planned and which are contingent. It would seem from this that improvisation exists in creativity on many scales, from the unpredictable pen stroke to the wholesale repurposing of material and ideas. The more one tries to imagine a creative act the without improvisation the harder it is to find a space where originality can be found, be it personal or historic creativity (De Sousa, 2008).

Now we will approach this from the other direction and ask if improvisation can exist without creativity. Let us look at the terms. The standard understanding of creativity is that it requires 1) originality and 2) effectiveness (Runco et al., 2012; de Sousa, 2008; Abraham, 2013). This means we want to think of improvisation that is not original and not effective. Dealing with the easier, second term first: in design and engineering, effectiveness can be determined reliably enough by defining a measure of effectiveness. In music, it might be harder to assess other than by asking if the work had the desired impact on the listeners. Either way, we can test for effectiveness. Improvisation that has no effect is tantamount to doing nothing, an act without aim. We learn here improvisation is aimed at a goal (make them cry or dance or fix the shower head, let us propose by way of example). Now the first term, originality. What does that consist of? Novelty which might be personal (I invented my own skateboard but it's like every one else's) and historic (we have invented an instantaneous soup maker and nobody has done this before). Even if we are

most interested in historic originality, we won't bother with the distinction on the grounds that few know in advance if creativity is going to be personally or historically significant. From the previous section we decided improvisation led quickly to creativity and so originality came along for free (improvisation leads to novel use or novel forms).

Derived from this line of thought, it is a defensible proposition that creativity and improvisation are hard to separate. The less improvisation there is the more the act becomes routine and the more familiar is the form. With more improvisation the more new "material" is needed to join the elements. Improvisation then is the genesis of novelty in the assembly of materials, actions (as in musical actions) or ideas. It is grounded in connections.

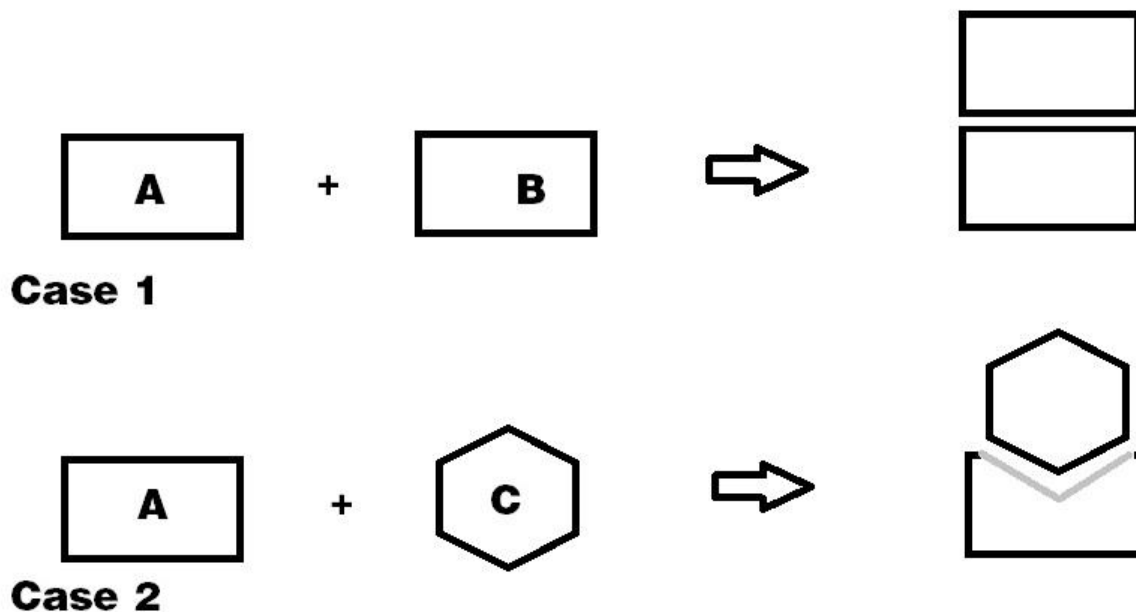


Fig. 1. In case 1, adding A to B yields a few routine results. In case 2, adding A to C forces an adaptation to A (represented by the light grey lines). Such changes are the bridging needed in improvisation.

Innovation theory such as Tidd et al. (2001) can be pressed into service here, on the grounds innovation depends on creativity (but has the essential element of utility bolted on). Tidd ranks innovation (and this is true of creativity) into incremental, radical and transformational. For art, these changes are perceptible visually and through hearing. For products, the visible differences between the existing and the innovative might be slight but the effect large (moving a button on an interface is a small detail but could have radically different effects for good or ill). What they have in common is the magnitude of the connections or the size of the logical step.

Improvisation is momentary, a part of a longer process of creativity. What we call "long" is relative. It can mean the entire process from identifying a problem or musical goal (weeks or months). Or it could also be the long process of incremental changes over time (years or decades) and here the evolution of horse-drawn carriages (Jones, 1971) or musical genres (Ford, 1971; Pachet & Cazelet 2000, p.3; Manabe, 2009) springs to mind.

We can think of improvisation as the mortar between bricks in a wall. The act is a contingent phenomenon and perhaps transitory but no less important. The results though tend to become solid and conventional: think how the musician's riffs then get repeated as repertory or how the designer's chopping of modelling foam turns into the mass produced item.

We started this section with three questions: Are there any links between creativity and improvisation, and are they necessary? The answer which comes back is that creativity and improvisation are strongly linked, tending at times to blur. Improvisation bridges the elements that need to be put together to solve a problem. The necessity question comes back qualified if one relies on the bricks-and-mortar metaphor. One could stack 200 bricks without mortar and create an original form. Where's the improvisation there? Is the use of bricks to make a sculptural form improvising or is that pretty much what one can do with bricks? But if we make the form without a plan then we have improvisation much as the piano player plays notes in a sequence with no plan. If we make a plan for the bricks we could say the improvisation (the accidental) moves back to the paper on which we could sketch. So it is that improvisation is unavoidable. It comes of not knowing what to do at some stage in the process of making or doing.

Improvisation as knowledge generation.

We earlier discussed improvisation as having the effect of generating new meanings: the rubber band holding up the shower head, for example. In the case of music, the quotation of text in lyrics alters the meaning of the quoted material but knowledge of the original text informs the new use too. Jacques Brel's song *Amsterdam* contains the lines:

"In the port of Amsterdam

There's a sailor who dies

Full of beer, full of cries

In a drunken town fight

In the port of Amsterdam

There's a sailor who's born

On a hot muggy morn

By the dawn's early light"

In the song *She'll drive the big car* on the 2003 album *Reality* David Bowie re-purposes the lyric "by the dawn's early light", improvising with it as a part of the song structure and both referring back to Brel's original and also Bowie's own cover of the song from 1971:

"She slips beneath the sheets

A husband's quiet devoted wife

But strangers sad and nervous

By the dawn's early light

Loves lies like a dead cloud

On a shabby, yellow lawn

Up on riverside"

So in both cases meaning has been extended: a rubber band can serve as an adjustable détente on a metal bar, the lyric text has been re-purposed so its original meaning is altered though reference to the earlier meaning is retained. Up to the point the shower head has failed we only know the rubber band can do a list of X things. With the new application the number is now X+1. By the same token, the word sequence in Breil's song meant X and now it means X + Y when re-used.

Improvisation is in this understanding a path by which new knowledge is created. We will by-pass the possible dispute as to whether it is propositional, procedural or experiential (Niedderer, 2007) on the grounds that precise definitions of the terms do not necessarily mean the phenomenon in question can be mapped precisely. It is a level of precision we don't need at this point; the issue is that new meaning corresponds to some form of knowledge. The reverse statement, that meaning is *not* knowledge, is not tenable. Meaning is where A corresponds to B: "chien" means "dog"; water on the ground means it may have rained or someone has been using a garden hose; this kiss means A loves B and so on. For us to know their correspondence we must know about the terms. Meaning can't be understood without knowledge. So, we conclude meaning corresponds to knowledge and that repurposing material or concepts generates new meaning. That is then new knowledge.

Earlier we proposed that it was difficult to get a knife in between improvisation and creativity, that creativity depended on at least a minimal level of improvisation. Sweller (2009) sees knowledge generation as a creative process. We could re-label it as explorative. Improvisation, which is experimental and empirical, is the mechanism that allows the joining of ideas and materials to create new configurations of materials and ideas. These in turn can be used for further development, or what Peters (2009) calls "the constant renewal of what is already there".

If we conceive of knowledge as being points in idea space (the space in which all logical ideas exist) then improvisation is the mode by which initially tentative links are found between existing points. Creativity can be understood as that process which leads to a new pathway. A creative person finds pathways. A creative solution is one which has linked two previously unlinked things. Knowledge of the points in ideas space begets further knowledge through being able to see connections or to think to look for them. Hence the value of mind-maps (Beel and Langer, 2011), a much-used tool in design to organise information and to see what is there and, importantly, what is not there and to ask if it should be or could be.

The mapping of ideas in two-dimensional space (as in Fig. 2, below) is only an approximation of how ideas might be situated in relation to one another. Quite likely idea space is multi-dimensional and not homogenous. However, since we humans live in three-dimensional space and readily understand two-dimensional space, the analogy is at least practical if not fully accurate. Improvisation occurs where one tentatively joins nodes in the ideas space and our diagram helps us think of what that looks like. What we have argued is that creativity depends on improvisation. Creativity is present in design and in music and so therefore is improvisation. It generates new knowledge (has epistemic consequences) and

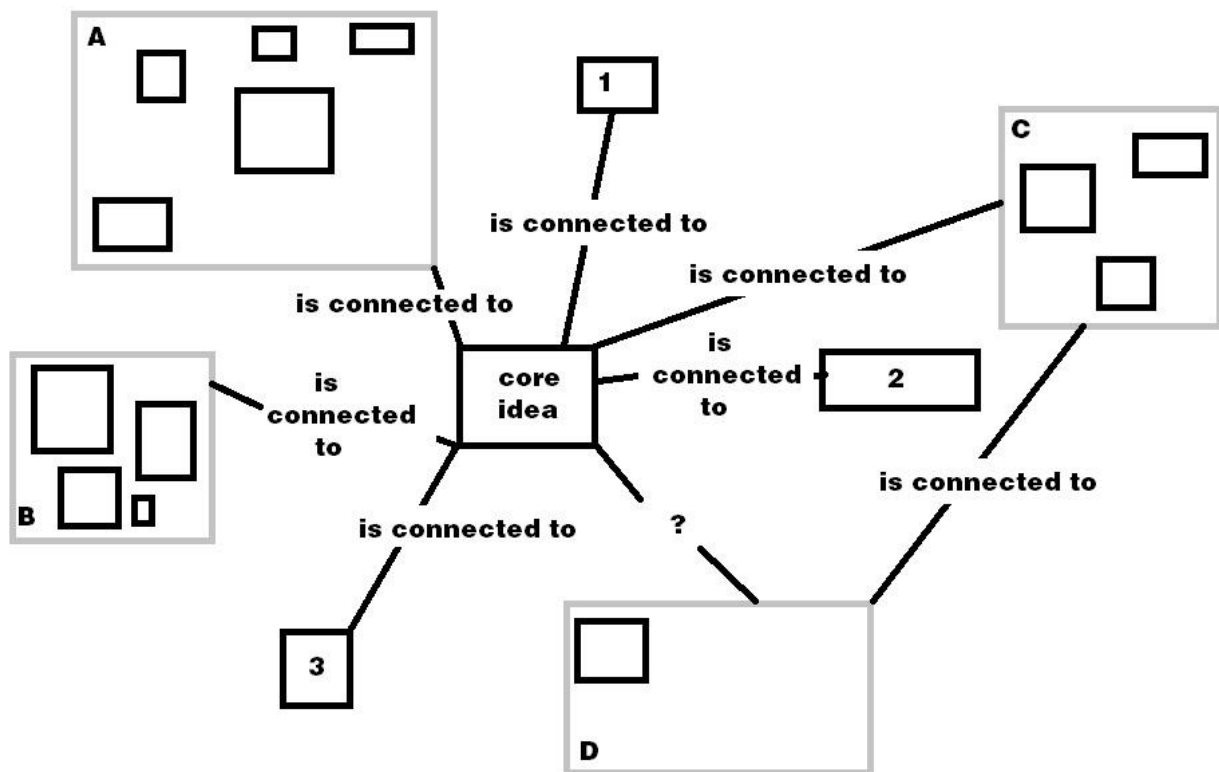


Fig. 2 A mind map shows the relation of idea clusters A, B, C, D and ideas 1, 2 and 3. How might D be connected?

generates new meaning (so we can *tentatively* say it has hermeneutic consequences). There is also a re-ordering of information which implies ontological consequences.

3.0 Systematisation in Design and Music

Up until this point in this essay, we have operated under the assumptions stated in Section 1, above, that music and design are both activities that are explained in terms of generalizable laws and rules. What we mean here is that we have discussed design in line with the generally accepted paradigm of design as it is explained in design literature (e.g. Broadbent, 2003). And for music we have done something similar, accepting that music is understood in terms of music theory, written scores and formal modes of performance. Given that music is performed by very many people on an informal basis (casual guitar strumming and self-taught performers) the dominance of the formal model of music is not as strong as the formal model of design⁵.

Having examined improvisation in design and music, we shall re-examine these assumptions.

⁵ But, if you go with Herbert Simon's 1969 definition of design ("To design is to devise courses of action aimed at changing existing situations into preferred ones") then the vast majority of *anything* we do is design and the formal paradigm of design we work with here seems even less applicable. But as design researchers, we take design to mean those activities that are explained by design theory and which are described by design theory as being made up of a set of procedures that follow some rational plans.

3.1 Systematisation in design

There is a well-accepted understanding that what we called design has evolved through four generations (Broadbent, 2003), from the local craftsman to international mass-production. Corresponding to this are methods of designing:

“Four generations in design methodology are recognized - craft, design-by-drawing, hard systems methods, and soft systems methods - and each is characterized in terms of its benefits and limitations in respect of design practice. To the extent that each new generation overlays the preceding one, a system of design methodologies is created which, being more inclusive of the real world, should be increasingly useful to design practice” (ibid).

The first generation is craft, where the designer is the maker. One thinks of the maker of shoes, combs or houses. This form is today almost extinct in the industrial west but persists in other parts of the world (e.g. Khumar, 2016). The archetypal example of the second generation, design-by-drawing, is the renaissance architect who does not use tools or touch material but who communicates by images (plans) the idea in mind. The two next stages share the ambition to use a rational process meaning a more impersonal, objective way of proceeding. What Broadbent calls hard systems (HSMs) corresponds to the application of positivist principles and involves a heavy emphasis on quantification. This is not to be confused with the early Modern movement (1920s). The early phases of the Modernist movement in both design and architecture sought to apply universal laws so as to banish subjective judgements (Michl, 1995) but they seemed to more or less guess what these laws were. It was lessons learned from organisational and systems theory in the 1940s and 1950s and applied science to design problems that form the third generation of design, HSMs. These approaches didn't address the human, emotional element though and the result was engineering presented as architecture with dreary results:



Fig 3. Machines for living in? Hard-Systems Methodology applied to buildings (Birmingham Mail, 1963)

Soft-systems methodologies (SSMs) bolts on social science to the hard-systems methodology so as to a) find out what the user might want and b) check the design proposal is what they want once it has been

worked out. It is a mitigation of HSMs, at worst, but at best is a good-faith attempt to ensure what is designed is needed and liked by the intended user.

This diagram shows the features of the design generations:

	Methodology				
Feature	Craft	Design-by-drawing	Hard systems	Soft systems	Next generation
Emerging cognitive state	Reflective consciousness	Reductionist science	Structured systems thinking	Holistic systems thinking	Evolutionary systems thinking
Scale	Local	Usually regional/national	National/global	National/global	Global and local
Grounding in science	Mostly pre-scientific; trial-and-error	Mathematical sciences	Mathematical and natural sciences	Mathematical, natural and social sciences (reductionist)	Holistic and reductionist sciences
Typical design cycle	Centuries	Decades/years	Years	Years/months	Months/weeks
Technological support	Simple hand tools	Manual/mechanical	Mechanical/electronic	Mostly electronic	Extensive electronic support
Knowledge base	Largely personal, tacit	Tacit and explicit; limited	Extensive information flows, mostly text-based	Huge information flows, mostly electronic	Knowledge management/information visualization/artificial intelligence
Interdisciplinarity	Mostly pre-discipline	Within design discipline	Interdisciplinary, across professions	Interdisciplinary, across professions and wider community	Inclusive of all stakeholders

Table 7: Features of four generations in design methodology, extrapolated to define the next such generation.

Table 1: Generations in design methodology (Broadbent, 2003). Remember that according to Broadbent (and we agree with this) that each system includes aspects of the previous one.

Notice on the left side column, under “grounding in science”, that craft design is pre-scientific and involves “trial and error”. This is the point at which we now recall the discussion of improvisation in design (above): Trial-and-error approximates to improvisation and improvisation runs through design, even at its most positivistic. To spell it out, design as a problem solving method demands creativity founded on improvisation. But the equivalent of improvisation nestles in Table 1 as one box among 47 others. This somewhat underplays the relevance of trial-and-error within design theory and also the point made by Broadbent that later design generations build on (and include) earlier ones. Even the architects engaged In HSMs must have sketched and modelled along the way.

3.2 Systematisation in music: the dominant if not predominant view.

The next and perhaps more difficult part is to show a corresponding situation in music. Alperson (1984) refers to what he calls “the conventional” account of music: “we hear music performed which we assume was composed previously”. Alperson also reminds us that the “prominent (if not predominant) view” of music as “text for the production of sounds” (ibid p.27) only goes back to perhaps the 16h century and Listenius’ emphasis on text. Alperson describes our common sense understanding of music as a two-stage process, composition as a cause of performance (p.18). This simplified view is considered by Alperson to be similar to the one “advanced by Goodman in Languages of Art”. Alperson writes that the distinction

between composition and performance makes it possible to consider two ways of thinking about musical improvisation. One, composition is itself a form of improvisation in that the composer does not throw ready-made bars of music down onto the page. The ideas are imagined, toyed with, written down and revised (see Rodgers, 2020) and two, improvisation is a form of performance. Alperson goes on to point out the blurring of the boundaries between composition, performance and improvisation. "The composer is already, in an important sense, his or her own executor or performer. This is obviously so in the familiar case where a composer sits at a piano, imagining various musical formulations, actually playing (performing) this or that formulation at the key board" (ibid. p.19). Further, argues Alperson, performance requires composition which he describes as "formative decisions about how the piece shall sound". This is not to say these three things are an undifferentiated mudge; more that in among them are these elements in various proportions. An interesting point here is that improvisation bridges: "By focusing on the more comprehensive notion of 'the creation of musical work' this way of thinking about musical activity bridges the distinction between composition and performance" (ibid. 21).

3.3 Improvisation is the obscured core of design and music (though less so)

What we have dug out of the last two sections is the important sense in which design rests on improvisational experiments that test ideas of fact and of imagination. In contrast it is presented in much academic literature as being a rational and orderly process with a small area set aside for intuitive activity. The design literature doesn't say so much about this black box or even aesthetics⁶ yet it is that design is founded on work of "the lunatic in the cellar" whose commands are made palatable by the veneer of process. And we have made more apparent the way in which the conventional ("prominent if not predominant") understanding of music as being an obstacle to the underlying improvisational methods used to generate a tune. Since Alperson wrote in 1984 there has emerged a large body of literature on the philosophy of musical improvisation (e.g Benson, 2003; Bresnahan, 2015; Alperson in Lewis & Peikut, 2016) so at least among philosophers, improvisation in music is not an obscure topic. Perhaps we can reformulate Alperson's judgement to say that the conventional view of music is quite prominent if not quite as predominant as it was.

4.0 Improvising the start of a conclusion

Somewhere along the way in writing this paper, we had an insight or at least understood something which can be formulated as follows: "In design, art is used to solve problems. In music problems are solved to do art". For a better correspondence between the two sets of terms, we could re-write it as: "In design, art is used to solve problems. In music, art results from problems solved". This idea emerged as Ryle (1976, p.71) describes, without "interim considerations at all" or that we can remember. We have been "pitting partly trained wits in a partly fresh situation" (ibid, p.77) and some of what emerges is unplanned. It seemed too good a point to throw away. We come back to this at the end.

We started this article on the premise that a) design research obscures design's reliance on creativity and b) that "doers of music" neglect the problem solving side of the art. Point (b) is now understood as "doers of music" don't tend to think about their work as problems in the way designers might do. We hoped to show that design and music both use improvisation as part of originating novel and aesthetically satisfactory effects. In the course of doing this we argued that creativity involved improvisation which was a form of knowledge creation. That is clearer in design where the new use of the object or material corresponds to knowing more about it. In music we need to consider other types of knowledge case e.g.

⁶ See Herriott, 2017 "What is like to see a bat?"

using a metal tape reel as a cow bell constitutes new knowledge of tape-reels (Visconti, 2016). Or if re-using “by the dawn’s early light” amounts to new knowledge of Brel’s text. At the same time, improvisation generates new meanings which is clearer in music than in design such as when the meaning of a text is subverted or extended by re-use⁷. Changing tack, we argued that the way design (the process of design) is understood obscures the role of improvisation in solving problems. It is process-orientated and concerned with repetitions of known steps rather than the new work needed to fill the “gaps”. We tried to show that much of music performance and composition is based on improvisation and ad hoc judgements (supported by Alperson, 1984). Music and design have more in common than one might think.

We also hoped to show that in comparing and contrasting improvisation in design and music, we might discover something of interest to designers, an actionable outcome from this analysis. That actionable outcome is that one could challenge a class of students to design without improvising. What will result of this, we can’t say at this point but we hope in future to show to students what is perhaps taken for granted. We could also suggest they reconsider the things known as tools (Herriott & Akoglu, 2019) and what they mean for creativity.

After some thinking, we have concluded that design research’s emphasis on the scrutable part of what designers do has led the possibly mistaken understanding that the bricks of routine matter more than the mouldable, squashy mortar of improvisation that joins them together. Design methods are useful in establishing the ready-made vocabulary of expressing a solution. It would be foolish to have to re-invent bricks each time one wanted to make a wall. As vernacular design exemplifies, every wall is different: no two half-timbered houses are the same and a lot of work went into adapting given materials to fit what were probably quite standard needs. That was hard work (for which we are grateful).

⁷ In this case, reusing “by the dawn’s early light” changes the meaning of the text but it is questionable if we know any more about Brel’s *Amsterdam*, or the phrase of the song in which Bowie re-used it. So new meaning without new knowledge?



Fig. 4. Half-timbered house in Lübeck, product of design by making (improvisation as the whole of design). Wallenberg, 1934.

In trying to reduce this repetition of work, some creativity infant has been discarded with the repetition bathwater. One way to understand the evolution of design methods from hard systems methods to soft systems methods is to see it as the attempt to re-individualise design. The science and sociology of design is there to replace what was lost when we moved away from custom ordering. *“This is exactly what I want and is exactly the way I want it”*: one can say that about a pair of hand-made shoes but not about a pair of mass-produced runners, good and all as those runners are.

On the music side of the ledger, the designer-reader might now have a little bit more insight into music composition and performance. The performance of jazz, the composition of rock and the performance of jazz, rock and classical contain varying amounts of improvisation, a balance of freedom and constraint (Iyer 2002, pp. 408–9). The predominant model of write-it-then-play it (which corresponds to plan-it-then-make-it) can be put to one side and the designer-reader can see that there is something shared in sketching, sculpting and hacking that resembles experimental finger runs along the keyboard. We had hoped to show the musicologist-reader that design’s process-fixation with problem solving might provide an opportunity to reflect on method. A point of further research is to inquire deeper into the methods of music creation and to see where they are mostly applied.

At this point, it becomes possible to bring in the equivalent of the “process bricks” from design methods. The specific example we would like to propose here are the Eno/Schmidt Oblique Strategies (OS) cards (1975). The set consists of 100 cards with phrases of a more or less obvious nature. Some are quite clear and others are more cryptic. If the artist is faced with a blockage (we could call this a problem) they choose a card and, if possible, act on it. An example might be “What mistakes did you make last time?” or “What are you really thinking about just now?”. A creative problem may be approached by thinking really hard

and coming up with thoughts similar to the ones in the Eno/Schmidt Oblique Strategies. The OS cards save time. One can just pick a card which then provides a ready-made example of the kinds of improvisational ruses that help move a work to completion.

Since they are ready-made, the oblique strategies cards amount to pre-formed chunks of improvisation. Designers have a corresponding set of method cards (e.g. Khalid et al 2019; Shinohard et al, 2019; Jacobo, 2019; Kwiatkowska et al. 2014; Golembewski et al, 2010) which amount to a set of reminders of what one can do to move a design process forward. The difference between the design method cards and music method cards is that the OS cards serve as reminders of improvisational approaches whereas the design method cards typically consist of known procedures for finding out or analysing information. The OS cards are not much use for data gathering but are useful prompts for changing meanings of the given conditions. In effect they amount to a method for attempting improvisation with a view to creativity. On the surface this could look like “planned spontaneity”⁸. However, since the conditions the musician faces when drawing the OS card are so complex and unconnected to the method card, the effect works and the oxymoron is avoided.

Taking product-orientated industrial design as a typical of the design genre, we notice routine methods matter because substantial parts of the problem or task are familiar: humans, common needs, well-known materials, well-known situations. Looking at music, virtually the entirety of the “problem” is not familiar other than the stock of instruments available and the tropes of the different musical genres. If design is mostly brick, music is mostly mortar. Music is plastic, fluid and insubstantial. McAdams (2004) describes the methods of the composer Reynolds which bears this out. Reynolds is the master of virtually every rule constraining the development of the work. If rational methodologies as used in design are to have any value in something as plastic as music, some artifice on the part of the composer/performer is required. What makes it difficult to import a methods approach into music from design is that one is *declaring* a parameter fixed whereas in design fixed parameters are *imposed*. Designers don’t have pretend to respect the givens of a case. They are required to. When a musician fixes a parameter, it is an act, acting “as-if” and as such carries less force. It might be interesting to have a set of rules or a self-imposed dogma but that does not make it as compelling. Personally compelling perhaps, but less compelling than the necessities imposed by budgets, consumers and production processes that are the grist for the designer’s mill. It could be that what music producer, Eno, brought to various artists’ work was a bit of a commitment to listen to his ideas in the hope they would bring forth the creativity and originality sometimes absent in a *carte blanche* situation (the self-indulgent, overlong album is a common result of too much freedom). In another field of art, painting, the near total lack of constraints might be a reason for why abstraction can be unsatisfying: it has no obligation to look like anything we recognise and seems too easy. An example from drama (admittedly not music) indicates that a performer can find constraints useful for improvisation:

“One way that practitioners will hold the uncertainty during improvisation is to create constraints around the number of parameters they are working with. Dramaturg Clare Grant describes how, while teaching improvisational performance, she will focus on “patterns of possibility” and then use these to create a set of tight parameters that will “allow the inexperienced people to fly.” In her opinion, the “tighter the base is, the greater the

⁸ David Bowie used the Eno/Schmidt OS cards on the the 1979 album *Lodger*. One proposed title for the recording was *Planned Accidents* (Buckley, 2000, p.305). Ironically, that suggested title was not oblique at all whereas the chosen title *Lodger* eludes obvious interpretations and that adds to its potential interest. Was the lodger Mr. Eno?

freedom.” During improvisation, tight parameters will act to channel (but not block) the rhythmic flow of her students’ performances.” (Costello, 2018, p. 68)

It might be too much of a stretch to say designers find “constraints useful” other than in the most basic sense that they are useful to satisfying the client’s wishes. That said, in the early stages of ideation, some constraints (self-imposed) can guide the improvisation and give it structure.

The title of this article is “Problem solving in design and music”. We promised at the start to consider approaches to problem solving in music and in design in relation to creativity and the linked concept of improvisation. In so doing we hoped to bring forward the essential artistic and creative aspect of design that distinguishes it from engineering (natural science concerns) and management (social science concerns).

In design, designer reflects on a process in action (Schön, 1983) while in music performance, skilled musicians focus their attentions on the effect of their actions. This is because they are focusing on a process that they have planned (e.g. the performance) and continue carry it out in action sequences in order to organise a complete performance. By juxtaposing the two creative activities of design and music we have shown that they both rely on improvisation as the motor of creation, but apply them in almost symmetrically opposite ways, with art being used to solve problems in design and problems being used to create art in music.

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