A Pattern-Oriented Approach to Health; Using PAC in a Discourse of Health

Kees P. Pieters

Abstract**—** Interdisciplinary or trans-disciplinary research is becoming more common and their importance is increasingly being recognized. However, in practice many of these efforts tend to end up in more or less isolated activities around a common theme. In many areas where it is becoming more recognized that collaboration around certain research themes is essential to understand certain phenomena, it becomes important to develop a vocabulary that all parties involved can share, and which reflects the essential concepts that are needed to grasp subject matter. This could contribute to a 'lingua democratica', a cooperative and deliberative means of cross-scientific research.

Within limits, many research disciplines can easily adapt their regular 'dialects'. For instance, biology and informatics share a common framing in mathematics and systems approaches. Likewise, some disciplines within the social sciences and humanities can find each other in certain schools of thought or theoretical frameworks. However, the gap between the natural sciences on one hand and the social sciences and humanities on the other, is quite problematic, and in part, this is due to mathematical and graphical orientation of the former, as opposed to the linguistic orientation of the latter.

This article explores the notion of patterns as means to develop a graphical vocabulary that may assist in cross-domain research that includes contributions from both the natural sciences as social sciences and the humanities. It will be clear that this is targeted for research themes that take place at the boundaries of the traditional disciplinary focus. In this article a number of patterns will be discussed and used to model a discourse on the theme of 'mental health', which is currently being recognized as being a concept at the interface of biological, psychological and social interactions..

Keywords**—** Complexity, Complex Systems, Patterns, System Theory.

I. INTRODUCTION

In the first decade of the new millennium, science is becoming more complex and more fragmented ([1]:2). The concept of 'complexity' itself has become a means to counter this fragmentation, as more and more scientific disciplines are adopting this concept to further their research. In fact, many of the more technical dialects of the 'system theories' are currently often already collected under the banner of complexity [2].

Complexity, however, is no longer a new kid on the block. The first 'wave' of complexity can probably be pinpointed in the late sixties with the successful synthesis of non-linear mathematics and computer technology. The second wave had its peak around the Millennium, for instance through the successes of the Santa Fe institute in the United States ([3],[4]). Currently the concept is taken up more vigorously in the social sciences and humanities, and increasing interest in the work of for instance Edgar Morin and Niklas Luhmann in those areas suggest that a third wave is building up there ([5],[6]). With this, complexity has certain potential to bridge some gaps between the 'two cultures' or put a band-aid or two on the injuries of the 'science wars' [7].

Of course, complexity warns us that there is not going to be something as a Grand Theory of Complexity, as concepts like 'dependence of initial premises and scale' and of course 'emergence' seem to constrain such ideas [8]. They suggest that maybe there has been good reason that science has differentiated in the way it did, as a lot of issues just need to be addressed on their own turf. However, complexity also makes a strong argument that the physical, chemical, systemic, biological percolate into the social *and the other way around*. For example, genetic expression influences the interactions of social species, and conversely social interactions and values may affect genetic coding ([5]:115). With this, complexity may support the fragile and provisional pioneering across domain boundaries, such as between biology and ethics ([9],[10]).

It is here that some attempts can be made to improve the communications across the domains; first to ensure that the various domains actually speak the same language –that at least everybody *knows* what they are disagreeing on- and secondly by opening up to the possibility that the considerable work that is done in each domain may actually prove to be valuable in others. This contribution aims to draw attention to the notion of *patterns* as a means to assist in this [11]. It will give an extended example of the use of patterns to describe a current debate in psychiatric genomics, and argues that science itself may be subject to the patterns that are introduced here.

II. PATTERNS

Design patterns were first coined by the Austrian/British architect Christopher Alexander in his 1977 book "A Pattern Language: Towns, Buildings, Construction" [12]. In this book, a few hundred architectural patterns were described, more or less formal directives on how to tackle certain (infra-) structural issues in building architecture. A 'Place to Wait' (pattern 150) is a good example of a pattern in architecture that spans bus stops and waiting rooms at a dentist or a hospital:

> *"..in any office, or workshop, or public service, or station, or clinic, where people have to wait – interchange(34), health center (47), small services without red tape (81), office connections (82), it is essential to provide a special place for waiting, and*

> *doubly essential that this place not have the sordid, enclosed, time-slowed character of ordinary waiting rooms" (*[12]*:708)*

According to Alexander, each of these specific functional forms have common underlying principles, and the best solutions that have been used throughout human history to effectively address the generic aspects of such patterns. This results in certain harmony not only for their function, but also for their place in a wider context, such as the area or building in which the pattern is implemented. Here the notion of parsimony returns into the discussion and indeed, Alexander considers the library of patterns to form a 'language' in its own right -a pattern language- that will result in the harmonious meta-structures which he observed in medieval towns and buildings.

In the early nineties of the previous century, the 'Gang of Four' [13] adapted this notion for software engineering and currently it has become a common means of both designing software systems at architectural level as a means of communicating aspects of these systems with other stakeholders, such as end users of the system.

As an example, the following figure shows one of the most widely used patterns in modern software applications, and which any frequent Web surfer will use daily, called the Model-View-Controller (MVC) pattern.

MVC shows –at an abstract level- how information from for instance a database (a model) is transformed to a view that makes sense for a user, for instance a web page.

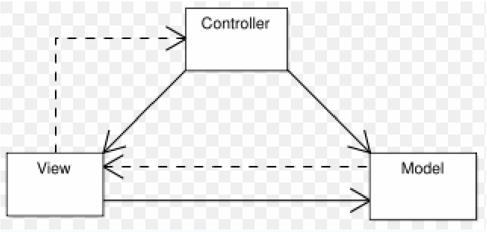
Name	**Model View Controller (MVC)**
Description	A simple diagram depicting the relationship between the Model, View, and Controller. 
Notes	Note: the solid lines indicate a direct association, and the dashed line indicate an indirect association (e.g., observer pattern). Retrieved from Wikipedia (http://en.wikipedia.org/wiki/Image:ModelViewControllerDiagram.svg)

Figure 1: MVC Pattern

The controller supervises the interaction between user and the model by monitoring user events –clicking a button or a selecting a link- and taking the appropriate actions.

For the purposes of this article, the interesting aspects of a design pattern is the fact that it shows the internal structure of the miniature system, and that it usually also describes the interfaces with which it interacts with its environment or connects to other design patterns. Certain recurrent problems are coupled to design patterns and as software engineers consistently use them in various applications, it becomes easier to understand these systems.

From the vantage point of complex systems, one interesting aspect of design patterns is that they allow themselves to be scaled at different levels of complexity. The 'A Place to Wait' pattern described earlier already demonstrates this, but in software architecture this trait becomes even more vivid. It is not uncommon that some forms or instantiations of a pattern can be built up of simpler versions of itself.

At first glance, a design pattern has close similarity to Holland's notion of 'building blocks' and indeed one could say that design patterns could be a more formal means of describing such building blocks. A building block such as 'aggregate' is almost identical to the software design pattern called 'composite', but the design pattern aims to capture such notions in a more rigid way. This way, design patterns go beyond a description or a schematic drawing, but become means to connect structures together in a coherent fashion. Alexander's description of 'A Place to Wait' can exemplify this, as the descriptions already point to other patterns (the numbers enclosed in brackets).

A design pattern typically has a name, a description and an entry that describes what problems it aims to solve. They also have a list of cross-references that usually contain alternative names for the same pattern. Software design patterns typically also have a visual layout of the software entities (objects) that make the pattern -in the classic GST paradigm of system and entities- and a description of the interfaces with the outside world. Thus a fundamental shift is introduced with respect to the classic GST paradigms, as 'vertical' relationships between sub-system and system are introduced. Basically the pattern is described in a white-box fashion, not only as a means to describe the design pattern as a system in itself, but also in order to integrate it in a larger superstructure. This is probably the most distinguishing aspect of a pattern versus a 'building-block' paradigm, as the latter does not necessarily accentuate this 'open' character of the building block.

Another distinction between patterns and building-blocks is the fact that patterns are assembled in a library, the pattern language, that aims to rigorously describe their mutual relationships. A pattern is therefore more than 'just a sub-system', but also a node in a hierarchy of patterns of increasing complexity. Contrary to the 'building block' idea, this allows its users to know the composition of the patterns, and their relationships with the others in the pattern language. It is up to the user to decide whether this internal structure is needed or not, which contributes to the notion of *information-hiding*.

One last interesting aspect of patterns is their ability to be re-used for different, but related areas, and their function as record of best-practices. This introduces a certain temporal aspect in a system, as pattern and their implementations co-evolve. A pattern gets a life-cycle that starts from its inception, and may be modified or changed until it matures into a stable pattern. It may eventually even become obsolete, as the explosion of new patterns in the software industry demonstrated when the design patterns became an inevitable hype. Many of those patterns were short-lived, and indeed there are some authors on software design that claim that the original library assembled by the Gang of Four is more than sufficient to tackle most recurrent problems in software design.

There have been a number of attempts to adopt this approach ([14],[15]), both as a means to improve communications across domains as a (interdisciplinary) modelling tool, but to date these attempts are too fragmentary and specific to address the theme of complexity. One of the problems is that design patterns have mainly been used for construction activities, but far less as a means to *analyse* complex systems. This alternative approach brings with it some methodological conundrums.

As both construction activities as analysis are complex activities in themselves, one of the consequences of any methodology of complexity is that the methodology must describe the approach itself. In true complex fashion, a methodology of complexity must be able to recursively describe itself! From this self-referential perspective, it becomes clear that a pattern library of complexity should begin with such self-referential loops, or rather its somewhat simpler precursor, feedback.

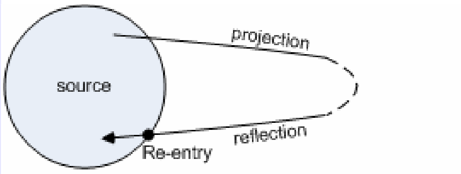
III. FEEDBACK AND SELF-REFERENTIALITY

Feedback and especially self-referentiality are an interesting test case for a pattern-oriented approach to complexity (PAC), as these mechanisms are widely used in technical areas, while the social sciences and the humanities have a long history of struggling with issues related to self-referentiality. The problem that the observer influences the observed is one of the fundamental problems of any social science ([16]:16-43). However, the equally extensive and especially practical experience attained in for instance electronics or computer science has gone largely unnoticed. Issues concerning self-referentiality are not necessarily problematic in these areas, as it is known that certain patterns in feedback loops can result in fairly stable and predictable behaviour. Obviously certain caution is still required when relocating such findings to a definitely more complex area such as the social sciences. However, they do suggest that self-referentiality, rather than being problematic *a priori*, rather *can* become problematic depending on certain conditions.

As the techno-sciences tend to communicate their experiences amongst themselves in mathematical equations, schemas, graphs and drawings, it is very difficult for more linguistically oriented domains to catch the essences of such systems. As a result, the four basic behavioural patterns of feedback - positive and negative feedback, oscillations and chaotic motion around attractors [17]- are hardly in the vocabulary of social scientists and the humanities, even though these patterns may actually be manifest in a social system. The concept of feedback is at best used in a metaphorical or colloquial fashion, leaving the 'sting' out of this concept. From a technical perspective, this omission (or quasi-omission) is remarkable, as feedback is at the heart of most complex systems. A system without feedback is usually not very complex. Besides this, natural language does not seem to be well-equipped to capture concepts such as recursion, while it does not take much effort to understand them in drawings (or mathematical equations). For these reasons, a shared vocabulary on complexity should at least include graphical representations ([18],[19]) in which feedback takes a central place.

A. Pattern of Feedback

The previous discussion on feedback and self-referentiality may already have become mind-boggling for some, so it may be helpful to introduce a pattern to assist in the argumentation. Not surprisingly, feedback itself is a pattern:

Pattern:	**Feedback**
Description	A mechanism where data from a source feeds back to it (re-entry).
a.k.a	Self-referentiality, when data that is strongly related to the identity of a source is reflected 
Notes	– Projected data are not necessarily entirely reflected. – The four basic forms of feedback are positive, negative (regenerative) feedback, oscillations, and chaotic motion round attractors. These depend on the internal structure of the source.
Expert Domains	Electronics, computer and information science, physics, cybernetics etc.

As this example demonstrates, the pattern is necessarily coarse. In technical domains, there are many more forms of often very sophisticated forms of feedback, but the four basic forms can already be very valuable for other domains. If need be, this pattern can be used as a starting point for researchers who want to delve deeper into the various instantiations of feedback. This is why the section of 'expert domains' has been included in the pattern.

At first glance, the pattern seems to be a representation such as many will include in articles and papers. However, regular graphs and pictures are usually very specific for a certain research topic, while patterns purport to have a wider potential due to the aspect of *isomorphy*, which it shares with the systems theories ([20]:33-34). Like the system theories, isomorphy is the underlying assumption that drives the claim that patterns that are well-known in one domain may actually manifest themselves in others as well. The pattern of 'orbit' can be identified at atomic scale as well as the scale of solar systems and galaxies. In this case, the pattern's isomorphy is *scale-invariant* across different levels of aggregation, as galaxies are made up of solar systems which, in turn, are made up out of atoms ([21]: 33-38). This often implicit assumption is a cornerstone in the system theories. In fact, isomorphy across different levels of complexity is the driving assumption behind modelling activities in general. A claim that an artificial neural network represents some aspects of the biological brain is based on isomorphy, and it is important to realise that this isomorphy is *substrate-neutral;* it (apparently) doesn't matter if the neural network is implemented *in silico* or in organic matter ([22]:50).

The pattern of 'orbit' also makes clear that one cannot simply reposition a certain phenomenon from one area to another; an orbit at atomic scale behaves quite differently than one at the level of a solar system. Besides this, the scale-invariance of isomorphy also provide the *limitations* of patterns; most patterns will be limited to a certain range in which the isomorphy holds.

The pattern of feedback will thus return in many forms and guises in the following argumentation on the concept of the 'lingua democratica'. The version of PAC used here extends an example pattern library [11] that builds on John Holland's 'framework of complexity' [23].

IV. TOWARDS A LINGUA DEMOCRATICA

The various ways in which scientific disciplines adopt certain concepts may all serve a purpose. A concept such as 'competition' is used somewhat differently in biology than in game theory or sports, where it is closely related to a 'winner takes all' strategy, rather than being a collection of interactions of organisms that addresses the problem of selective pressure (survival).

These differences become important when theories move beyond the boundaries of a certain knowledge domain and enter a friction space with others. The friction between biological explanations of human behaviour has met severe criticism in the social sciences and the humanities and the other way round ([24],[25]).

From the perspective of complexity, these controversies demonstrate the problem of how knowledge attained in one domain can be used to advance knowledge in another. One precursor of complexity thinking, general systems theory (GST) [20], quickly fell apart in mathematical, social, organisational and other dialects that currently hardly overlap in the way the pioneers had envisioned. Some concepts are used in all these domains in a more or less similar fashion, but descriptive models are hardly shared. In retrospect, the predisposition of mathematics and logic that was still dominant at the time when GST was developed probably already spelled out that this would be inevitable. It is highly unlikely that the social sciences and humanities can use mathematical rigor for their own enterprises in the same way as is possible in the 'hard' sciences. The 'granularity' of formal languages is simply too high for such areas. Besides this, formal systems often host implicit assumptions, such as the absence of ambiguity and the existence of crisp distinctions between symbols. These do not necessarily translate to 'real' systems, as for instance natural language demonstrates ([26]:123-126). As a result, there is a limit to the 'scale-invariance' in which modelling tools such as mathematics can be applied. This has been very strikingly demonstrated in software engineering, an area which is very much based on formal systems, that had to resolve to graphical means of representation such as design patterns at a certain level of complexity. This can also be seen in other engineering disciplines (also see [27]:48-50).

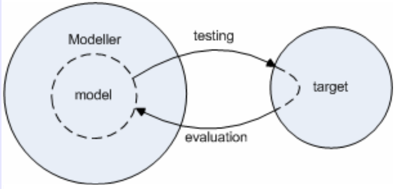
Such problems of definition already surface at a very elementary level. In some technical domains definitions of 'information' often assume a quality of 'meaning' . However, this 'meaning' cannot be understood as being the same as 'meaning' in the way it is used in the humanities. It is therefore not surprising that sciences that dedicate themselves to understanding the nature of (human) knowledge need a more refined vocabulary to address this issue, as here the idea of information as being 'meaningful data' is clearly incorrect ([28],[29]:53). This aspect becomes more important since 'knowledge' is becoming a theme at the interface of technology and society [30].

Graphical representations such as patterns tend to combine 'information-hiding' of assumed details with highlighting of certain essences, *but not more than that.* The big difference with the system theories is that patterns do not necessarily aim do fully describe a system, but rather lay down a few essential characteristics of such systems that interact with each other. Depending on scope and aim of the modelling activities, one can concentrate on a coarse model with relatively few patterns, or work towards a more detailed model that can eventually be transformed to a more or less complete system. On the other hand, patterns aim for certain consistency through the pattern libraries, a concept that has never been consciously deployed and developed in the system theories. The 'evolution' of (design) patterns in software engineering also demonstrates its democratic tendencies. Pattern libraries are not prescriptive or static, but the community of users guide their evolution, their lifecycles and the 'niches' in which they are effective [21]. This allows them to become more dynamic than, for instance, 'theories' which often tend to have a more conservative nature. Patterns in many ways are more 'streetwise' than theories are. For these reasons, patterns should be seen as being distinct –but not opposed to- from both system theories and 'regular' scientific theories, as they more closely resemble the 'building block' idea that Holland proposed for analysis of complexity ([23]:34).

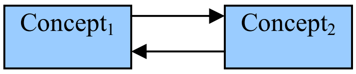
As a result, patterns may demonstrate their strength for a 'lingua democratica' across various knowledge domains. In fact, they seem to be good candidate for a 'pidgin language' that Nowotny, Scott and Gibbons see as becoming more necessary in the socially contextualised 'Mode 2' environment in which science is progressing [31].

V. RECURSIVE METHODOLOGY

As was mentioned earlier, a methodology of complexity should be able to describe the methodology itself. As PAC basically is a 'game' of puzzling with various patterns, the methodological recursion of PAC thus is a continuous 'communication' between modeller and subject matter (target):

Pattern:	**Modelling**
Description	A process of interaction between a model and a target.
a.k.a	crafting, experimental method
	
Expert Domains	Craftspeople, experimenters, empirical science

This recursion is clearly derived from the previous pattern of feedback. In terms of design patterns, it is a process that is inherited from the previous pattern. In other words, the patterns describes the methodology that uses this pattern! Actually, the above pattern is one of many that return in various guises in different scientific disciplines. Replace 'model' with 'system', 'testing' with 'output', 'target' with 'environment' and 'evaluation' with 'input', and immediately the classic paradigm of technical systems emerges ([32]:3). Many areas of computer and software science will also immediately recognise the pattern in their own work, when 'model' is replaced by 'algorithm' or 'strategy' and 'target' becomes 'problem domain'. This suggests that the pattern of modelling is one instantiation of a more abstract pattern, which is called *symbiont* [11].

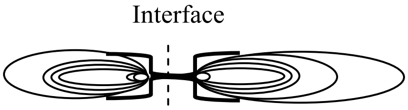
Pattern:	**Symbiont**
Description	A stable association between dissimilar concepts
a.k.a	Gestalt (when one concept stabilises the other around equilibrium states and vice versa)
	
Notes	The implicit acknowledgement of feedback in symbiont means that this pattern can display all the interaction processes of feedback.

This somewhat more abstract level consists of concepts (post-structuralist philosophers might prefer signs ([26]:38-41)) that interact with other concepts in a certain context, the modelling environment (which could be a theory). Note here, that due to their claim to correspondence across different levels of complexity, these patterns somewhat blur the distinctions between science and philosophy. Scientific theory and experiment are described as a form of feedback, which is well-known in the technical domains, and it is known how this form of feedback behaves. Therefore it also allows a window of understanding what the experimental method can reveal and what not.

A. Hourglass Pattern

Design patterns pay quite a bit of attention to interfaces, which often translates in other areas to boundaries [33]. These interfaces are often surprisingly complex, and play an important role in issues concerning 'identity', 'self', 'emergence' or 'inside-outside' perspectives. Interfaces and boundaries influence the interactions between an actor and the media in which an actor can express itself, such as its environment. In fact, as modelling tools have become more sophisticated, gradually more and more is known on the complexity of actor-environment interactions in general [34]. Usually, as in boundaries, interfaces appear to increase the selectivity of projection and reflection –engineers may speak of 'filtering'-, but it is becoming more widely recognised that these interfaces may have more complex properties. Research of complex systems has suggested that these interfaces may sometimes demarcate the transition point from one state to another, where the 'edge of chaos' keeps a delicate balance between order and disorder [3]. Likewise, the social theorist Bruno Latour considers a (material) object to have certain agency ([35]:63). This has also been observed in technological artefacts, which beget the characteristic of polypotency, which means that an artefact (object) can interact in many more ways with its environment than just its function ([36]:81). A hammer can be used to drive in nails, but it can also bruise thumbs. Such emergent and transitory phenomena seem to occur especially at these interfaces ([27]:38, 50-53). As these interfaces, despite their internal complexity, usually manifest themselves quite clearly, they normally have a distinct name. In terms of PAC, they correspond with a *concept;* an *interface concept.* As a rule of thumb, any concept that one immediately understands, and yet is hard to capture in a crisp definition is likely to be an interface concept.

The pattern corresponding with an interface concept is called the hourglass pattern. An object á la Latour can be considered to be the locus, or bottleneck, of multiple processes that run through it [37]:

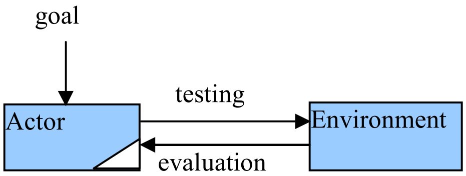
Pattern:	**Hourglass**
Description	An interface provides a locus of multiple processes that run through it.
a.k.a	interface can be called 'locus' or 'bottleneck'
	
Notes	The interface can demarcate 'inside' from 'outside', but also mediate, or be intermediary between different domains

The complexity of for instance 'inside-outside' interactions often leads to some confusion. Technically oriented people usually concentrate on specific problems which they aim to solve by creating artefacts. This usually requires an instrumental, causal, or functional focus, which may obfuscate the polypotency of these artefacts and can result in a limited awareness of the wider consequences of such artefacts in a societal or natural environment ([36]:76-83). For instance, the people who pioneered the Internet will probably have had no clue about the social impact that this technology would have

[38]. It would seem that many interface concepts, such as ‘health’, ‘genius’, ’beauty’, ‘consciousness’ or ‘intelligence’, therefore deserve a collaborative approach due to the sheer complexity of their multi-faceted nature. Metaphorically speaking, such an interface can be likened to the mouth of a river flooding into an ocean at flood tide; there are all kind of dynamic flows and interactions, and experiments can only capture a few of them.

B. Convergence-Inducing Process

Many actor-environment interactions are variants of a feedback pattern called convergence-inducing process. This pattern is widely known and used in various domains associated with computational intelligence, and includes problem solving approaches such as genetic algorithms and (the learning phase of) neural networks.

Pattern:	**Convergence Inducing Process**
Description	An actor samples its environment by an iterative cycle of testing and evaluation until a certain goal criterion has been met.
a.k.a	Global Search, Problem Solver
	
Notes	The actor typically maps the evaluated variables with the goal function and typically contains a *securing mechanism* that stores high-ranked variables, which are used for further evaluation.
Expert Domains	Computational Intelligence, Cybernetics

For the social sciences and the humanities, this pattern could be interesting because it may help to explain some similar processes of convergence in a societal setting.

A somewhat funny (or disturbing) example was given in a Dutch newspaper recently, when a journalist observed that Hollywood actresses are starting to look more and more alike ever since plastic surgery and Botox have become a commonplace means to change one’s appearance [39]. Such dynamics between certain values in a social domain and individual social actors have an uncanny resemblance to a convergence-inducing process, in which the diversity amongst a population is reduced by the availability of certain goal-directed actions, such as plastic surgery. These dynamics usually reinforce the values that are aimed for, and so the process amplifies itself.

Again I would like to stress that these patterns do not aim to provide theories for such phenomena –that is up to the domain experts-, but rather that these patterns may demonstrate that various scientific domains may have more in common that is often presupposed.

VI. Patterns in Psychiatric Genomics

The patterns that were introduced in the previous sections will be applied in an extended example that was informally presented at the WSEAS International conference on Information and Automation in Prague in March 2009. This example is based on an article from psychologist Ingrid Baart and publicist Marjan Slob from the medical centre of the Vrije Universiteit in Amsterdam, called “From determining genes to complex networks: On the geneticisation of mental illness” [40].

This article draws attention to changes in the concept of ‘mental health’ in research in psychiatric genomics. This research area traditionally followed a perspective of causality from genes to ‘mental health problems’, at least those which are known to have a hereditary component. It is currently becoming more and more accepted in the scientific community that ‘mental health’ –or health in general [41]- is very hard to grasp and rather takes a place in a complex network, which includes biological and environmental aspects and social values. By now, it has become clear that some people who are genetically more at risk of developing certain mental health problems, such as psychoses, depression or schizophrenia, may never experience these problems, because certain social influences may determine whether the ‘tipping point’ [42] where the risk is effectuated is never reached. Stress, personality, lifestyle and other factors may contribute to the development of a mental health problem.

In terms of PAC, ‘mental health’ can be considered an interface concept that adheres to the hourglass pattern. It is not surprising that psychiatric genomics deals with such an interface, as it will be quite clear that biological processes interact with, amongst others, social, ecological and psychological ones. For one, it may be obvious that what is considered a ‘mental health problem’ in one culture, may be a sign of divinity in another [43]. This *cultural* aspect is not a trivial one, for it determines how an individual with certain symptoms is accepted and treated in a society or a group; they may be stigmatised as ‘patients’ having an ‘undesirable’ trait in the Western world, while they might become highly respected spiritual leaders in another.

Baart & Slob make a strong argumentation for a more inclusive view on ‘mental health’, as even the more subtle differences between various forms or categories of ‘mental health problems’ become more differentiated and blurred as science progresses and ‘nature versus nurture’ becomes ‘nature *and* nurture’ ([40]:25).

For the purposes of this article, it is interesting to see that such an inclusive approach is apparently not easily achieved ([40]:12-13). The different scientists who are currently –either enthusiastically or with severe reluctance- collaborating in interdisciplinary approaches related to mental health problems –such as biologists, psychiatrists, psychologists and sociologists- have to adjust the vocabularies of their training and backgrounds, and have to (learn to) understand the issues and knowledge that other disciplines bring to the table. This seems to be tremendously difficult, and some will prefer to omit the contributions of the others and even sometimes deem them irrelevant. This, of course, is exactly what an interface does; it provides certain closure. However, most interfaces are not completely closed and allow process to flow through them. The hourglass pattern may intuitively point out one of the problems associated with interface concepts such as mental health, as 'inward' and 'outward' perspectives tend to 'deflect' against the locus of the hourglass and cause a sort of causal reflection of the observations. This is understandable, as closure (filtering, information hiding) is a structural characteristic of an interface. One of the most straightforward manifestations of such a deflection is the 'laboratory condition', which *aims* to filter environmental conditions in order to better study subject matter. With an interface concept however, such filtering may cause a narrow view on the theme under investigation. One cannot study 'health' without an understanding that this concept is socially contextualised.

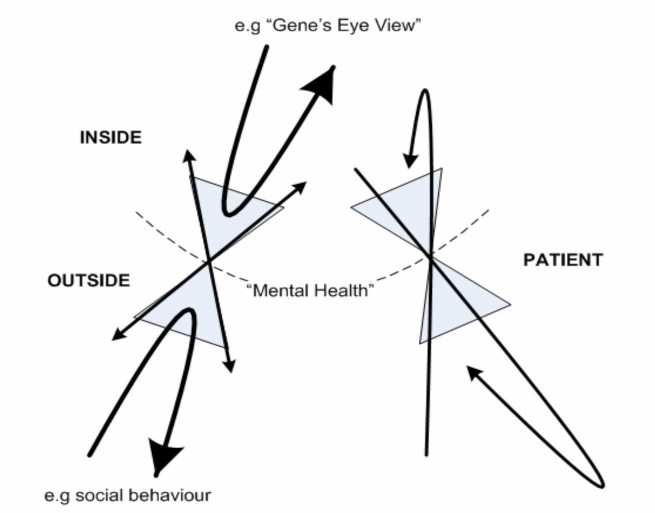


Figure 2: Causal Reflection at Interface

In figure one, a few possible processes at the interface called 'mental health' is given. The 'causal reflection' of inside-outside perspectives at the is only one possible manifestation at the interface. Figure one also shows a possible perspective of a patient[1], who is ultimately aware of these continuous dynamics, as s/he is the only one who experiences both (or all) sides of the interface ([40]: 13-14). As a result, the theories or models that aim to address the interface concept will be perfectly valid, in the sense that they precisely record the deflected processes, and the data corresponds perfectly with them (maybe after filtering the 'noise' or 'irregularities'), but *all* the perspectives may fail at the *interpretation* of the data if the other perspectives are not taken into account. A gene's eye view on 'mental health' will therefore provide accurate data, but will only address certain aspects of the concept of 'mental health'. Only a more inclusive approach that incorporates the contributions from the other perspectives on 'mental health' can provide such a helicopter view, which can span the 'complex network' around the theme of mental health. In this light, it is interesting to see that *endophenotypes* are being positioned more and more in-between genotype and mental disorder ([40]:20). These endophenotypes appear to limit the 'interpretative gap' between genes, symptoms and the concept of mental health.

However, another pattern complicates the research. As was mentioned earlier, an interface concept such as 'mental health' includes social and cultural values, and these feed back to the theories and the models that are being made, and the implicit assumptions that drives the research efforts. Researchers may for instance see a 'problem' that needs to be 'cured', and this biases the theories that are formed, the experiments that are selected and the *assumptions* that are developed *and maintained*. This has been widely recognised in areas of psychology ever since the Rosenhahn experiments in 1972 ([44],[45]). But even at a more subtle level –and this is probably where most problems surface-, some evident forms of brain damage may *cause* people to become socially successful, as for instance Antonio Damasio has reported ([46]:62-67). As it is extremely rare these people are hospitalised, a bias in research is formed that tends to focus on *a priori* 'problematic' cases.

As a result, the interdisciplinary research on the interface will consist of multiple instances of a convergence inducing process, which are susceptible for amplifications of such bias (most notably *confirmation bias* [47],[48]) which immediately reduces the openness to alternatives ([49]: 77). It therefore requires considerable effort for all parties involved to understand each other's contributions – and thereby putting the individual contributions, including one's own- into perspective with respect to the others. Generally speaking, especially specialists are poorly prepared for this, as interest, training, academic successes and professional closure to peers within the speciality, continuously reinforces this bias. This allows a supreme 'focus' on the processes that are deflected at the interface, but at the price of possibly being unable to understand the other contributions. The fragmentation of science that Laszlo has reported, could find an explanation in a convergence inducing process .

It is here also that reductionism can become problematic ([22]:80-83), for instance when 'mental health' is seen purely as a bio-medical phenomenon, such as often is implicitly assumed in the post-humanist movement ([50],[51]), or conversely as a purely 'social construction' [52]. At an interface, such interpretative claims are based on a too narrow view.

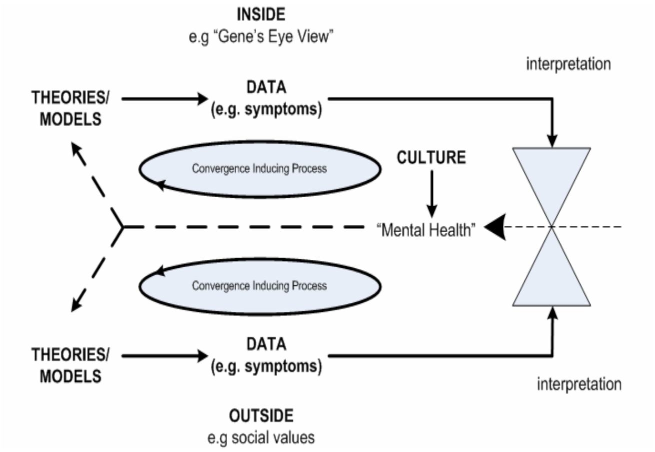


Figure 3: Convergence Inducing Process

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[1] I am aware that 'patient' is just as much biased as a concept

It would seem that science, due to the historical specialisation across various disciplines, is poorly equipped to study phenomena especially at these interfaces, and this could explain why 'nature-nurture' discussions have been so problematic in the past.

Note that it is not the intention of this contribution to be engaged in a debate on 'philosophy of science', nor to provide a 'theory' of mental health problems. The only intention here is demonstrate the use of two patterns, 'hourglass' and 'convergence inducing process', as means to model a current development in genomics research. The rather abstract, but simple visualisations aim to assist in taking a, hopefully rather neutral, 'helicopter view' on the issue of interface concepts, and show that scientific research itself may be subject to these patterns. It may also make clear that awareness of these patterns amongst participants in interdisciplinary research may help in quickly developing a vocabulary that can be shared, without it being invasive to the vocabularies of the specialist domains.

VII. CONCLUSION

As the concept of complexity is adopted in an ever wider variety of scientific disciplines, this 'power concept' has potential of engaging in inter-, trans- or even cross-disciplinary research in a collaborative fashion instead of mutual distrust. This requires 'pidgin-languages', a commonly shared vocabulary that catches the essences at the interfaces between specialist domains.

Such pidgin languages respect the fact that no-one can now everything and that every knowledge domain is necessarily restricted and biased by their internal differentiations between 'essence and details', which guide their explorations.

Although complexity suggests that fragmentation in scientific disciplines is inevitable, there may be possibilities to create 'nodes of interaction', which can bridge the no-man's land between the specialist domains. A pattern-oriented approach to complexity may become a valuable tool to assist in such efforts.

For basically a pattern is not much different than the representations that already fill scientific articles and papers. Currently these representations are used in a specific way to assist in an argumentation. However, it may sometimes be worthwhile to take a step back from the specifics of research and reflect a bit on a graph, table or drawing that has just been made. One may see an uncanny resemblance with a topic in a popular scientific book that was taken along on a holiday, or in an article glanced through in the science section of a newspaper. If so, it may just be that that graph, table or drawing might actually be a pattern.

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Ir. Ing. Cornelis (Kees) P. Pieters was born in Ede, the Netherlands in 1965, and holds degrees in electro-technical engineering and computer science. He is currently involved in a Ph. D. research in the humanities where he investigates the often problematic discourses between technology and society, most notably related to genomics research.

Besides this he conducts technical research in computational intelligence and has a one-man company dedicated to software development in this area. Further research interest is in complexity, both in technical sense as more or less philosophically.