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# Mapping the subject: The renewal of scientific psychology

Many demands are made on modern science. High among these is a clear notion of how scientific theory relates to the world, as we know it. On the one hand, science must be loyal to some domain of reality, as we already know it from common sense and daily practice. On the other hand, science has to go beyond and behind the ordinary understanding in order to find new connections and causes. Only in this way can we return with a better grasp and add new perspectives and more effective tools to our understanding. To some extent, this also leads to a correction of our usual understanding of the domain. Scientific method thus starts with the concrete and rich diversity of phenomena in the domain, makes an abstraction or reduction to a few basic concepts and models, and returns to the phenomenal world through a synthesis or construction. This procedure is well-known from physics. The first time round, the abstract and formalised concepts of physics seem to bring us far away from familiar reality. Only think of *Quantum Mechanics* and the *Theory of Relativity*. Used correctly, however, these tools bring us back to the familiar reality, and tell us things we did not know before: why things in our surroundings have the colours they have, why things are soft or hard, why the plants need sun-light, and so on. Our common sense understanding of our surroundings is deepened and enlarged, but not disproved. In physics, this is known as the *Principle of Correspondence*, and it is prescriptive for the choice of theories. In the process, of course, some of our usual and naïve ideas are being corrected, for instance that air is weightless. In this way science has indeed a critical potential. It is important to note, however, that this correction or "critique" can be integrated in an enlarged understanding of our daily life. By sacrificing the idea that air is weightless we now better understand well-known phenomena such as low pressure, pumps and balloons. After the critique order is restored. Of course, physics has caused more dramatic corrections of our ideas than the just mentioned example, *e.g.*, Isaac Newton's demonstration that movement needs no outer cause, or Nicolaus Copernicus' heliocentric model of the planetary system. But in all cases, the corrections have painlessly (except political and religious pains) been integrated in a more comprehensive understanding of the world. They have re-established our ordinary experiences in a new frame. Even outdated ideas can be understood in retrospect when their limited horizon or perspective can be conceived in the new frame. New theories do not imply loss of empirical experience; science is cumulative. Or put in other words, *good science is conservative*, in the sense that it is conserving. Natural science teaches us that only science that satisfies this demand is capable of producing *new knowledge.* Knowledge that expands our control of the material world, and in this way proves itself useful. What superficially looks like a paradox, that science must detour to find its way home, and must stay true to its home to conquer new land, is really an expression of the deep interdependence between all phenomena in the world, the phenomena of science as well as the phenomena of ordinary experience.

Today this essential understanding of science is being challenged by a different view. This is the view that good science is first and foremost useful science, *i.e.*, the so-called *pragmatic* idea of science. In this view, science is not committed to the existing sum of knowledge within its domain, but can freely pursue its goal to predict and control phenomena within some constrained sub-domain. This is done, not by violating all the formal, empirical, and methodological rules, they are keenly observed, but by choosing criteria for practical success fitting the occasion. The problem is that the choice of data and criteria becomes *ad hoc,* and this will easily lead you into circularity, as Klaus Holzkamp (1977) has shown. It also leads to a fragmentation of science. From a short-sighted motive of reaching immediate success, the method vandalises the domain.

To my eye, Daniel Robinson is a stalwart proponent of the first understanding of good science, and it is from this position he – rightly - criticises the pragmatic view dominating in contemporary psychology. He argues convincingly that psychology, as a science of human beings, must respect human nature and human existence, and therefore must include humans as political, moral and aesthetic beings in its understanding. I fully agree. A psychology that claims to have humans as its domain must *correspond* with the knowledge we already have about people. It must correspond with the knowledge expressed in our cultural history and in the human sciences, the arts, law, political science and social science. This is a *necessary* condition for psychology. But it is also evident that it is not a *sufficient* condition. If psychology is not to be just a trivial – or even diluted – reproduction or summary of the existing scientific and common sense knowledge, it must contribute something *of its own*. The contribution could be those aspects of human life, which have been underexposed by the other human sciences, our emotional life and its excesses, for instance. This choice would go well with the popular idea of what psychology is about, and would, in this sense, be a "psychological" psychology. However, we would – as

Robinson observes - have to face sharp competition from the arts, literature and drama, which we could hardly rival. We would also have to compete with psychiatry and modern neuroscience; and we might perhaps find it difficult to argue just what it is we can offer that could not just as well be supplied from others. We could take up the challenge from the biologically oriented sciences and promote ourselves as the science that bridges the gap between on the one side the humanities and social sciences and on the other the physical and biological sciences. Of course, any scientific psychology must bridge this gap, since it must correspond with what we know about the human being from all these fields of science. But we are still talking about the necessary conditions for developing psychology, and necessary conditions are not sufficient conditions.

To develop and justify a psychological scientific discipline, it is required – besides meeting the demands of correspondence and relative independence in relation to other disciplines – that a *method* is developed. First of all this means that you have to find relevant fundamental concepts, which can be the basis for the reductions and abstractions necessary if we shall return to concrete reality with a deeper and more comprehensive understanding than we had at the starting point. It is not enough that we say something true and well-known, it should also be true and *new*. To put it short: Psychology shall not only be "psychological", it shall also be *scientific*. And here we seem to get little help from Robinson.

We may still get some help, though, albeit in an indirect and ironical way. When Robinson brings out a psychological sub-discipline that should serve as a methodological ideal, he chooses *psychophysics*! This seems inconsistent with his instructions about how to start psychology as a political, moral and aesthetic discipline – Robinson's "Begin here!" With psychophysics we are far from Robinson's *pixis* and totally embraced by his *doxa*. More than any other psychological sub-discipline or tradition, psychophysics is exemplary of the input-output paradigm, which is Robinson's scapegoat number one. The reason psychophysics can serve as a methodological ideal, after all, may be this. It is the only psychological sub-discipline, which is methodologically well-established and, at the same time, does no violence to its subject matter or sub-domain. Psychophysics catches just that aspect of our relation to the world where the input-output paradigm is well-placed, and where – a rarity in psychology – there is *correspondence between method and domain*. So, why not indeed, say: "Begin here!"

If we do that, we may construct a method where we step by step include more of the domain and, step by step, correct and expand the method. An analogy from physics would be Albert Einstein's development of the *Theory of Special Relativity*. The methodological procedure here was first to describe in detail the well-established classical case and then introduce the smallest possible correction that is consistent with the new observations of the progression of light. Only this extremely conservative procedure made it possible to reach a consistent theory which included both the new and the old concepts – the latter now as a special case – and from which radically new knowledge could be derived, *e.g.*, the now famous equivalence between mass and energy.

Actually, Einstein's example was my own inspiration to pursue my project. It had in fact psycho-physics as its starting point and was motivated by a concern about psychology's general crisis, quite similar to that of Robinson (Mammen, 1983). Independently my colleague in Copenhagen, Niels Engelsted, undertook a parallel project motivated by the same concern, but with biology as a starting point (Engelsted, 1989a; 1989b, 1992). Presumably, it is no accident that we reached very similar conclusions. But more about that later.

In *classical psychophysics* our senses are studied as "transducers", that is, input-output devices, where the *input* is physical stimulation of the sense organs. In the psycho-physical experiment, the input is combined with an *instruction* to the subject participating in the experiment. The instruction asks the subject to focus on a certain dimension or quality in the input, and forces the subject to choose between a few reactions, defined in advance, the *output*. The questions asked are usually of a relatively simple kind, for instance, "Are the two presented tones of different volume?" The reactions allowed are often answers of the Yes/No type. The input can be quantified in physical-chemical units of measure, but the output is not quantified. The psychophysical laws and curves - Weber's Law, equal loudness contours, the ROC curves of Signal Detection Theory - are all, via constructed mathematical models, about equivalence relations in the input set. They are about what subsets of the total input set are equivalence classes, in the sense that input elements in the same class with the same instruction give the same output. The laws and curves describe *quantitative invariants in the input set*. In mathematical language the laws and curves tell us about the inverse images of a constant output from a function or mapping defined by the instruction.

As the input is described using objective physical units of measure, the psychophysical laws express the exact interdependence between *objective* measures. Fechner's logarithmic law refers, of course, to a subjective measure, the magnitude of sensory experience. But in reality, this is only a transformation of Weber's Law under the hypothetical conditions of subjective equivalence and additivity of just noticeable differences. For the sake of completeness one may add that S. S. Steven's direct scaling can be transformed in the same way.

In classical psychophysics the input is relatively simple; it is defined by the *proximal* stimulation of the single sense organ, and it presupposes a rather *passive* subject. Psychophysics is, from a theoretical as well as a pragmatic perspective, a booming success. Its applications in the audio-visual industry cannot be overestimated. Psychophysics also represents a beautiful *correspondence* with ordinary experience, and with the results of other scientific disciplines, *e.g.*, physiology. But since the psychophysical laws do not refer to subjective measures – only indirectly as in Fechner's Law – you may question, after all, if it is psychology. The best way to decide this is to take a look at possible generalisations of psychophysics to more genuine psychological domains.

The closest candidate to yield such a generalisation is *J. J. Gibson's* so-called perceptual psychophysics (Gibson, 1966). Gibson's starting point is the general observation that when we move around in our usual surroundings, filled with stable objects such as streets and cars, rooms and tables, all the proximal stimulation varies as a result of the motion of ourselves or the motion of the objects. According to classical psychophysics this should result in a chaotic complex of experienced movements. Yet we experience the objects as being stable in form, size and so on. The Gestalt psychologists who succeeded the first classical psychophysicists were unable to explain this phenomenon although they introduced a plethora of ad hoc principles for the subjective organisation of complex subjective impressions. Gibson, however, did find the explanation of this so-called *constancy*. He demonstrated that it exactly matches *quantitative invariants in the complete pattern of sensory stimulation,* which result from the objects' and our own movements in the environment. In mathematical terms, Gibson found the objective invariants in the complete input set, which are the inverse images of the constant output defined as the constant experiences or perceptions. This corresponds with classical psychophysics and is a beautiful *generalisation* of this. Gibson demonstrated that the invariants in the pattern of stimulation are identical with the geometrical invariants in stable 3-D objects' so-called perspective projections on the sense organs. The invariants in the *proximal* stimulation that yield constant experiences or perceptions are exactly *the same invariants* which are produced by stable, *i.e*., constant, *distal* objects moving in relation to the subject. The function or mapping that connects experience with the proximal pattern of stimulation, and the function or mapping that connects the proximal pattern of stimulation with the distal objects are *mirror images* of each other. This is Gibson's great discovery – here formulated in relation to geometrical, visual perception, but it can be generalised to all perception.

The distal objects in the environment, and our movements in this environment, called our *ecology* by Gibson, is the key to understand our perception of the world. According to Gibson, it is these "ecological" relations a psychology of perception should study. Thus the *subjective* is again studied *indirectly*, since it is "just" a sort of mirror image of the ecology. That is why, on Gibson's view, there is no strong reason to be interested in what goes on "inside" the organism, be it feelings, or motives, or even brain processes.

Like classical psychophysics, Gibson's theory is one of psychology's success stories, and has many practical applications. It has been elaborated in very interesting ways in works of, among others, David Lee (1993) and Michael Turvey (1992). But again we may question whether this indirect approach to the subjective is genuine psychology as we want it to be. Still, Gibson's method has demonstrated that "ecology" notoriously is a road to the subjective. Or to be more precise, that "ecology" is the objective *ground* on which we should write the subjective as a *figure*. Gibson has, in any case, convincingly shown that important parts of the subjective, and the processes which mediate it, have a *distal focus*; that without an *object*, the subjective cannot be understood. What is missing in Gibson's theory is – among other things – the subjects' active and selective *choice* of objects in the "ecology". Gibson tries to do the job with a concept of the objects' so-called affordances (Gibson, 1979), but he does not succeed in explaining how they are specified in the objects' proximal mapping and hence how they are perceived. Consequently, the concept of affordance, despite the best intentions, falls outside Gibson's theoretical frame of reference.

What we need theoretically is a relation connecting the subjects with objects in the ecology which is not just a repetition of ecology itself, being its mirror image, but which adds a new and genuine *subjective* aspect, an evaluation of the objects, *i.e.,* an addition of individual or personal sense or meaning to the objects "in themselves".

In Gibson's theoretical understanding the objects exist objectively and independent of the subjects; but to the individuals or subjects they are unequivocally specified as the inverse images of invariant patterns in the proximal stimulus, *i.e.,* patterns in the individual's *interface* with the environment. Gibson ignores, however, that the *concrete* distal objects have an infinity of qualities besides the ones that are mapped in the interface, and that these qualities are potential goals for the individuals. The *subjectivity* of the individuals is expressed in the fact that they are *intentionally* oriented towards these distal objects; even without any mediation or guidance through the interface, they are in a *search* for the objects. In Engelsted's terms (2000; see also the present volume), the animal and human subjects move in an *interspace,* which goes beyond what is specified by the proximal interface.

Gibson's objective ecology, however, does not exhaust the necessary analysis of the object side. To really understand subjectivity, and especially subjectivity at the human level, to which I now turn, we have to add something to the *objective* description of *ecology itself*. According to Engelsted, this addition is also essential if we are to understand the subjectivity of animals, but this is not important in the present discussion, which will focus on specifics of human psychology. Decisive here is the ability of humans to relate not only to the so-called *qualitative identity* of objects but also to the so-called *numerical identity* of objects. The subjective capacity, which matches this objective duality of objects' identity, I have called a *sense for the concrete* (Mammen, 1983; 1989; 1994). Let me try to explain it.

*Qualitative identity* refers to qualities that objects may share with other objects. Here I shall focus on these qualities as they are mediated in the sensory-perceptual interface between subject and object, and we may add mediation through artificial equipment as well. In the terms used above, these qualities are defined as distal inverse images of subsets in the proximal stimulus pattern. These inverse images, which are equivalence classes of objects, defined through their interface-mediated qualities, I have called *sense-categories* (Mammen, 1983). In principle, any object is contained in an infinity of different sense-categories, since the number of distinctions it holds is practically inexhaustible. All these sense-categories contain objects that

share qualities with the object in question. This means that an infinity of "sense-categorial" distinctions should be made in order to single out the object. From this follows that for a given object, which we perceive via our proximal interface, we can never in this way alone identify it as singular. We can never know if not other objects would be proximally mediated in an identical or indiscernible way. In this sense any sense-category is *infinite*.

*Numerical identity* refers to objects' – including persons' – identity with themselves, their particularity, singularity, individuality, or uniqueness, their being what P. F. Strawson (1964) called *individuals.* A set of ball-pens that look a certain way is, in the above terminology, a sense-category. Now, one of these lookalike ball-pens is mine. My ownership is not defined, however, by the qualities of the ball-pen; that claim would likely result in justified protests from owners of similar ball-pens. It is defined by the fact that this is the ball-pen, which I bought in Copenhagen last year. When I know that it is exactly this pen that I now hold in my hand, it is not based on its interface-mediated qualities, but on the fact that I have taken care of it, know where I have put it, and from where I have taken it again, what I have called my "pocketing" it (Mammen, 1993). My ball-pen is one *definitely chosen* among the ball-pens that form some sense-category, and I have therefore – in opposition to that term – called it a *choice-category* (Mammen, 1983). In this case the choice-category contains only *one object*. But a choice-category could also be other of my belongings, my family members, etc. In that case they are *finite* sets of objects or persons which are distributed in space and time, and where each object has a *history* of its own, a *trajectory* in space and time.

The introduction of choice-categories, definable from trajectories in the interspace, as a supplement to the sense-categories, definable from our proximal interface with the environment, makes it possible to give a theoretical description of a *double relation* between the individual and the world, which has some remarkable characteristics:

1. The double relation *goes beyond the input-output paradigm*. This paradigm only corresponds to the sense-categories, and finds its most elaborated and valid expression in classical psychophysics. The paradigm also matches the typical psychological experiment where the environment is dramatically reduced and controlled from the outside. The conditions of the experiment is a finite "mini-world", chosen beforehand by the experimenter who himself does the job of selecting it as a choice-category from the infinite environment. In this finite "mini-world" objects can be singled out and re-identified via their sense-categories, thus yielding the illusion that choice-categories are not needed in our practical and theoretical recognition of the world. Theoretically the input-output paradigm is manifest in the *abstract functionalism* dominating cognitive psychology, and finds its prevailing metaphor in the computer-model for human cognition. As a general basis for the major part of modern psychology, however, the input-output paradigm has fatal consequences, as pointed out by Robinson.

2. The double relation not only goes beyond but is also a *generalisation of the input-output paradigm* as far as the latter – described in terms of sense-categories alone – is included *as a special case*. Thus, psychophysics and the typical experiment is included, under its special conditions. In our everyday cognition of the world sense-categories and choice-categories *interact*. Our senses help us to identify and distinguish objects within the *frame* of choice-categories defined by our practical interaction with objects in space and time. Sometimes we are "blind" to this frame, as was also mentioned above as an explanation of the seductive force of abstract functionalism. The interaction between sense-categories and choice-categories can be described in an exact way with a *mathematical model* from general topology. In this model the sense-categories are organised as a so-called perfect topology (a perfect Hausdorff-space), very similar to open intervals of measure, and the choice-categories as a discrete structure in this topology. It can be shown, that under the condition of the mathematical *Axiom of Choice* the model is complete in the sense that no other categories are needed for any division of the world. For details, see (Mammen, 1998; Mammen, Engelsted et al., 2000). Of course the model is too technical to go through here. Being an exact and indirect description of the subjective via objective category structures, the model can also be considered a generalisation of psychophysics, both classical and Gibson's.

3. The double relation also seems to include the double relation between individual and world, which according to Engelsted (2000; see also this volume) is characteristic of all animal life, in contrast to the simple proximal *interface* life of plants. The animal moves in an *interspace* with distal objects distributed in space and time to which the animal directs its intentional and selective activity, only partially mediated or guided by the interface. Where the plants live only in a local input-output relation to the environment, animals – including man – also live in a *non-local subject-object relation*, only partially mediated by local relations.

4. In its *specific human* form the double relation, as mentioned above, appears as a *sense for the concrete*, *i.e.*, a "sense" for the numerical identity of objects and for their infinity of qualities beyond the ones we presently interact with through our interface. This "sense" is the basis for our ability to attribute values to objects beyond the utility they afford (affordance in Gibson's term). It is by virtue of the – animate or inanimate - objects' *history* that value is attributed. It may be the legal value of ownership, as in the ball-pen example; but it may also be the sentimental value of objects or persons. As is well-known, we do not love our children because of their qualities, but because they are

*our* children. In fact, the ball-pen also had sentimental value because of the way it was included in the story of my life. Perhaps we are talking about the ball-pen I got as a gift from a beloved person. Our sense for the concrete is the basis for our *sentiments,* and for what A. N. Leontiev (1978; 1981) called the *personal sense*. This means that our emotional life and its problems cannot be properly understood without recognition of our sense for the concrete. But the sense for the concrete is also the basis for what Leontiev called the *societal meaning* of objects, a notion closely related to linguistic-conceptual meaning but with wider application. A coin, for instance, is not a real (valid) coin only because of its qualities, as describable in terms of sense-categories. That is, qualities which can be mediated in the proximal interface. Counterfeiters manage regularly to make their products satisfy the sense-categorial specifications for legal tender. A coin is a real coin in virtue of its history of production, its origin, *i.e.,* a trajectory in space and time which traces back to the Royal Mint. The same is true of all our cultural products or artefacts. They are what they are because of their history of production and the intentions or purposes, which their producers had in mind for their standard use. Our modern world is constituted by artefacts. We have a "sense" for them, and can acquire or "appropriate" their societal meaning due to our sense for the concrete, and under the guidance of other members of the culture. Karl Marx called this sense *"the human sense",* which means the sense for the human or cultural aspect in our world (Marx, 1973, p. 541). Archaeology demonstrates strikingly that an identification of objects' qualities and possible technical use or "affordance" is only a step on the road to identify what an artefact really *is*, that is what it was meant for. You may say that we as humans have a sense for an *historical depth* in our world that is *invisible* in terms of sense-categories. This is a sense for invisible trajectories or, in its original sense, "traditions". The Russian philosopher E. V. Ilyenkov (1977) claimed that this sense for trajectories was the basis for what we called the *ideal* or even spiritual aspect of our life. A. N. Leontiev (1982) called it a sense for the world's "*fifth quasi-dimension*", beyond the three spatial and the temporal dimension in which we can place the present objects. In my mind, this is also the key to essential features of our moral, political, aesthetic and transcendental being, which Robinson rightfully stresses (see Mammen, 1993).

5. Our sense for the concrete not only enables us to "perceive" the personal sense and societal meaning of objects, however. It also makes it possible to investigate and recognise *nature* in a radically new way, compared to the way of other animals. We can *keep* or *re-identify* a concrete numerical identical object and at the same time force or observe its qualitative changes through time. In this way we are given an extraordinary access to processes of change and development which provides us with an insight into the deep *laws* of nature. A prototypical case is Gregor Mendel who, keeping his peas under wrap, and watching their colour change, was able to discover deep laws of genetics. This is much more than just an adaptation to superficial regularities and correlation between qualities. This example demonstrates that *human concepts* not only are about qualities of objects but also have *concrete referents*. They are about both the concepts' "intension" and "extension", in a dynamical interplay, to use some terms from the Theory of Logic. This goes well with some recent results from cognitive psychologists studying our conception of objects' numerical identity and our capacity for "*indexing*" objects (Pylyshyn, 1989; 1994; 2001) and to form "*object files*" to which we allocate qualities that are not used to identify the objects (Kahneman, Treisman, & Gibbs, 1992).

6. The specific human sense for the concrete is the high road to fundamental aspects of our existence or being-in-the-world. It appears to be *an inherited species-specific character*, a basic feature of our essence or *nature*. Research on the infant's understanding of the physical world provides solid evidence, that infants well within the first year of life are indeed able to single out and track specific numerical identical objects through space and time (*e.g.*, Simon, Hespos, & Rochat, 1995; Wynn, 1992; Xu & Carey, 1996; Krøjgaard, 2002). It also seems plausible that the formation of early sentiments is related to the infant's ability to cognitively single out the mother as not just some source of "motherness", but as *this very person* (Bower, 1977, pp. 113-114). This specific character is not sufficient to make us human, but it seems to be a necessary feature. I shall not here go further into its possible evolutionary and neuro-physiological preconditions – or its pathology (see Mogensen, 1994) – just mention that no psychology interested in man's societal and cultural existence can do without a focus on the *natural and biological preconditions* for this existence.

To conclude, I fully agree with Robinson in his demands to psychology, that it should include our existence as political, moral, aesthetic and transcendental beings, if the latter means our search for a coherent understanding of the world expressed in our scientific endeavours. But I also think that no scientific psychology will emerge by saying: *"Begin here!"* This will only lead to trivial repetition of knowledge, which has already been established without the assistance of psychology. At worst, it will lead to the total dissolution and decay of science we see in social constructionism and post-modernism (*e.g.*, Gergen, 1996), today threatening the arts and the social sciences. I am sure this is not Robinson's ambition. I believe that Robinson's demands are indispensable for a future psychology, and his instructions

may serve as beacons in our quest. But we must surely begin elsewhere. [1]

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