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From representation via planning to action: An extension of Egon Brunswik's Theory of Probabilistic Functionalism

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Abstract

Scholz (in press) proposes how Brunswik's lens model can be extended to account for planning of sustainable transitions of complex system. In this commentary, an alternative extension is proposed, according to which planning is seen as a process that unfolds in three steps. The first step can be understood with a model construction lens: A planning team builds a representation, that is, a model of a (distal) complex system. In a second step, modeled with a planning lens, the team contrasts its representation of the system with possible alternative states, and simulates how the is-state could be transformed into an ought-state. In a third step, modeled with an implementation lens, the team selects and implements a set of actions, thereby leaving the "imaginary space" (Konrad Lorenz) and entering the real world.

Keywords: lens model; probabilistic functionalism; planning; complex systems; group processes

Cognition comprises perception and action, or more precisely, action control. When we grasp a coffee mug, we continuously coordinate perception and action during this process. Conceptualized in the Kantian dualistic heritage, some objective reality is mentally represented, and this representation steers our behavior in an attempt to modify this reality to serve our goals, needs, and desires. While the mug was initially on the table, it will ultimately be at our mouth so that we can drink. The human species made a step of tremendous importance in its history when our ancestors could decouple representation and action. This decoupling allowed for nothing less than, as Konrad Lorenz (1943) put it, *handling in the imaginary space* (orig.: “Hantieren im Vorstellungsraum”), that is, performing mental operations instead of physical operations. Planning is, at bottom, mental simulation. An objective reality is mentally represented, that is, a model of reality is constructed. Within this representation, mental operations are performed, the outcomes of these “actions” are simulated in the “imaginary space”, and among the resulting outcomes the most desirable one is identified and selected. Subsequently, a decision has to be made whether or not one wants to proceed from mind to muscles, that is, from mental operations to real actions.

In the target paper of the present commentary, Scholz (in press) proposes how Brunswik’s (e.g., 1952) *theory of probabilistic functionalism* (TPF) can be used to conceptualize and to aid planning in teams. After having laid out the basic principles of TPF (in his Section 2), and after having linked it to current biophysical and neurological models of visual perception (Section 3), Scholz discusses—based on his rich experience in urban, regional, and industrial planning, gained through numerous case studies that he and his colleagues conducted—how TPF can be used to understand and to support planning teams’ endeavors to cope with the cognitive challenges of rapid sustainable transitioning (Section 4). In Sections 5 and 6, Scholz evaluates and discusses his approach. The target paper is laudable and deserves attention. It makes two important novel contributions, specifically, it builds two bridges. First, it links TPF to contemporary visual perception research, thereby not only filling a gap in Brunswik’s own work (who, as Scholz points out, largely ignored biological aspects), but also a gap in visual perception research (that largely ignored the psychology of Egon Brunswik). Second, Scholz expands TPF to planning, thereby focusing on an area, namely action, that Brunswik was well aware of but did not pay as much attention to as he did to perception. Conversely, it seems fair to say that theoretical and practical approaches to planning have, so far, not paid much attention to Brunswik’s framework of psychology.

In the present commentary, I present and discuss two extensions of the lens model. The first extension has been proposed by Leary (1987) and will be introduced next. In a second step, I propose how Leary’s idea can be even further extended to better cover the issue of planning. I do not claim that these two extensions are contradicting anything Scholz said. But even if these extensions were perfectly in line with his ideas, they may still be useful to better understand and appreciate his contributions. Third, after having presented those extensions, I will encourage both conceptual and empirical work that pits the ideas presented in Scholz (in press) and in the present commentary against each other.

To reiterate, cognition comprises perception and action. Brunswik had a clear focus on perception, which also explains why almost all the literature (including Brunswik's own writings) that discusses the lens model depicts a double lens whose left side refers to some distal stimulus (or variable) and whose right side refers to the organism's perception of that stimulus. The area between distal stimulus and proximal cues is located in the environment, and the area between the proximal cues and the perception of the object is conceived to be within the organism. Organism and environment meet each other in the lens, that is, in the sensory organs. Put differently, the sensory organs (e.g., the eye) are like gulfs through which the environment enters the organism. On the one side, the retina consists of cells built and maintained by the organism; and hence belongs to the organism. On the other side, light from the environment enters the eye and creates an image on the retina; and hence the pattern of arousal on the retina can be seen as a part of the environment.[1]

Consistent with Tolman and Brunswik (1935), Leary (1987) proposed that this *perceptual lens* can be complemented by a *behavioral lens* (Figure 1). The joint functioning of perception and behavior (or action) can then be portrayed as follows: The distal object, for instance, a coffee mug, is depicted on the very left. It is perceived through some senses whose input can be conceived of as proximal cues. The integration of these cues ultimately leads to a representation of that object (referred to as central response in Figure 1). Now the organism can do something with the mug, for instance, put it in the dish washer to have a clean room, or use it to get and drink some more coffee. Such actions, which can be seen as means to reach goals, are represented by the behavioral lens. Figure 1 can also be read from the right to the left side: The inner perception of being thirsty may lead to the goal of drinking something. A mean to reach this goal is to get some container, and so we screen the environment until we have, eventually, perceived the mug on the cupboard. Just as there are several cues the organism can use when perceiving objects, it can typically also choose among several means (e.g., drinking water from the tube) to reach a certain goal, and so the vicarious functioning of cues finds its correspondence in a vicarious functioning of means (Figure 1).

Leary's two lenses are adequate to describe daily activities such as drinking coffee. However, for more complex activities such as transforming a complex system (e.g., a city or a company) I propose to change the terminology a bit, and, more importantly, to add one more lens into the picture. The center of Leary's figure is what he called the central response of the organism. I propose to refer to it as the organism's representation (or, synonymously, the model) of some distal object. Given that the present extension is proposed to account for the planning of transitions of complex systems, I will henceforth replace the term *objects* by *systems*. Moreover, I propose to split up this representation of a system, the midpoint in Leary's figure,

[1] A provocative question may be allowed here: Where is the border? The surface of the eye, the retina, or eventually even the brain? Can the physical brain, including its activities at a given point in time, be conceived as part of the environment? And is the perception of an object located in the brain or must this perception be sharply distinguished from electric activities of the brain? (Note that the philosophy of the mind literature uses the term "qualia" to refer to a reality that cannot be reduced to physical patterns.)

into an *is* and an *ought*, and to connect these two states via a third lens which I will, henceforth, refer to as the *planning lens* (Figure 2). The *is*-state is the model that an individual or a group creates to understand a distal complex system. Typically, this model construction happens in a social context. For instance, some stakeholders may experience some dissatisfaction and initiate a process with the ultimately goal of changing the status quo. This is the context in which a planning team is assembled that typically starts by creating a model of the status quo. With the help of this model, the team may be able to convince the stakeholders that they have no reason to be dissatisfied, but this seems unrealistic. The more likely outcome is that the team, based on the problems they have identified in the model themselves, and based on its understanding of the stakeholders' goals, enters a phase in which they draft an *ought*-state.

How to find the *ought*-state and how to find the way from *is* to *ought*? There are two ways, bottom-up and top-down, which will be described next and in this order. Obviously, the planning lens can be located within the organism, here, the planning team. When the team develops various potential *ought*-states, it is "handling in the imaginary space." Based on the model of the system, which includes an understanding of how the (distal) system is functioning, the team can simulate the outcomes of various manipulations. The anticipated effects of these manipulations can be obtained via mental simulations, but if the model of the system is precise enough to be cast in program code, these simulations may also be run on a computer. There is one important difference between the means in the planning lens (Figure 2) and those in the behavioral lens (Figure 1). Whereas the former are mental operators, the latter are real actions. A manipulation in the real world will have an effect in a real world, and there may be uncertainty when it comes to identifying this effect (in complex systems, one manipulation has most likely multiple effects, and one observation is most likely an effect of multiple causes—which Brunswik in his TFP called stray effects and stray causes). In contrast, when introducing a manipulation in the planning lens, the effects are under the teams' control, but the team members may be uncertain about which effects they should assume, and whether the effects in their simulated world will match those in the real world. Hence, not only the team's representation of the present state of the system may be flawed, but also its expectations about which manipulations will lead to which outcomes. But these uncertainties involved in the planning of complex system transitions are exactly those features that invite the use of Brunswik's TPF as a framework to model these processes (with a model construction lens and a planning lens, respectively). To wrap up, all these operations are performed by the planning team in an "imaginary space". Different operations lead to different outcomes and the team, together with the stakeholders, can select which should be aimed for, that is, chosen as the *ought*-state.

A top-down approach, in contrast, would be less constrained by the model of the *is*-state and by the repertoire of means. Such an approach starts in some future and may be inspired by the writings of Jules Verne. Let's dream! Let's create visions, let's walk on the thin line between fantastic ideas and wild fantasies! The *ought*-states generated by such an approach will most likely appear to be more desirable compared to those generated by the bottom-up approach.

The problem may be to find operators and means that lead from *is* to *ought*, but chances are that *ought*-states generated by the top-down approach may inspire and motivate one to find means that were not in the initial behavioral repertoire. Obviously, the bottom-up approach and the top-down approach are not exclusive but may complement each other. The former focusses on the *is*-state and the means, the latter on the *ought*-state and the goals, but at the end both needs to be brought together. It may be useful, in order to make full use of the potential of a team, to follow both approaches, be it in temporal sequence or by splitting the team into subgroups, at least for a limited time during the planning process.

Independent of whether the *ought*-state has been identified via the bottom-up approach, the top-down approach, or a mixture thereof, the planning team—or someone else, based on the planning team's work—can now move forward, from the imaginary space to the real world. It is the *ought*-state and the experience made with the (mental or computer) simulations that informs the decision how to proceed, that is, which actions to implement in the real world in order to transform its present state and into a future state. Achievement could then be measured either by comparing the present state with a future state, or by comparing the ought-state with a future state. A result of such an evaluation that reflects these two different benchmarks could be: "Better than before, but not as good as envisioned and anticipated".

How are the three lenses—model construction, planning, and implementation—related to each other and how can the work of Scholz (in press) be extended in even other ways? The first lens captures how a system is represented. Different team members may find different aspects important. They may still be able to construct a model to which all can agree. Alternatively, they may not be able to find such an agreement, be it because they have unshared information that will not be communicated and revealed as such (Stasser & Titus, 1985; see also Reimer & Hoffrage, 2006), or because they cannot agree on assumptions that need to be made, on causal relationships, on extrapolations and predictions of future states, and so on. Conversely, note that the absence of any conflicts during the model construction phase does not necessarily imply that the team's representation of the system is an accurate one (Janis, 1972). As these examples show, research on group processes offers multiple insights that could be used to complement Scholz's cognitive perspective (see, e.g., Kerr & Tindale, 2004). Independently of whether groups amplify or attenuate biases of individuals, any flaws in the representation will jeopardize the planning and the ultimate success of the transition process. What is captured by the planning lens hinges on what happened during the model construction phase. Wrong assumptions and misrepresentations may lead to distorted results obtained in the imaginary space. Garbage in, garbage out. If the representation of the system is flawed, it may be hard to identify the resulting biases in the planning phase (see again, Janis, 1972). Chances are that the selection of means in the behavioral lens may be suboptimal as well and lead, in turn, to suboptimal outcomes. Note that the planning phase in Figure 2 is wider than the planning lens. Planning in the narrow sense, as captured by the middle lens, tackles the question of how to find an *ought*-state and how to get from *is* to *ought*. But planning in a wider sense is a process that also includes model construction and implementation, that is, stretches into the two adjacent lenses.

How does the present framework of the three lenses relate to the ideas presented in Scholz (in press)? Even though the sequence of three lens models is not visually displayed in the target article, one may argue that integrating his ideas into the framework presented in this commentary (and vice versa) would be easy. Space constraints did not allow for a more detailed conceptual analysis to verify or refute this suspicion. But apart from such a conceptual analysis, this question might also be treated as an empirical one. Scholz looks back at 21 large scale case studies, involving 97 planning teams, about 1300 master students and 2000 practitioners. These numbers are impressive and indicate how much effort and how many man-years went into all those activities. Scholz (in press) also points out that "As the above studies focused on sustainable transitioning of cases and not on how planning groups function, unfortunately no detailed data are available that provide in-depth information about the presence, functioning, and impacts of the proposed principles of TPF" (p. xx). While the requirements of planning groups working on real cases may not allow for experimental work, it may not be too hard to start in the lab and on a small scale. I would like to encourage Scholz and other scholars to conduct empirical research along the lines of what Scholz (in press) proposes in his section 5.3. One could, for instance, let several groups of Master students, who function as planning teams, work on the same case, but in isolation of each other. Prior to their planning activities, the groups could receive a different training, that is, they could be equipped with different theoretical frameworks and different tools. Another group of Master students could observe and document the processes that unfold in the different experimental conditions and, if such data can be obtained, eventually also evaluate their achievements. In one experimental conditions, groups could be familiarized with TFP only, in another condition with standard planning techniques only, in a third condition with the link between TFP and planning as proposed by Scholz (in press). Finally, if Scholz comes to the conclusion that the framework presented in this commentary is sufficiently different from his own framework, and if he finds it worth further investigations, he could implement a condition that allows one to determine which is more useful for (the training of) planning teams. The same can of course be said for other proposals of how to extend this work (e.g., made by other commentators).

The goal to create and to have a sustainable future is something we can all agree on. But the devil is in the details, and people may disagree what sustainability entails and how to reach such a desired state. I close this commentary with a double-question. The first part is inspired by the warnings of the Club of Rome and various environmentalist movements: "Can we afford to continue with our way?" When considering the depletion of the planet's resources, the answer should be a resounding "No." But what is the alternative? "Can we afford to stop that way?" It seems many people are not willing to reduce their living standards substantially. In view of this dilemma, planning the necessary transitions into a sustainable future is indispensable and hard at the same time, in particular during a political climate of "alternative facts" in which even climate change is occasionally denied. I wish Scholz and his colleagues all the best with their attempts to help planning teams to navigate through these mine fields.

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Figure 1: Extension of the lens model to behavior (Figure and caption taken from Leary, 1987, p. 123).

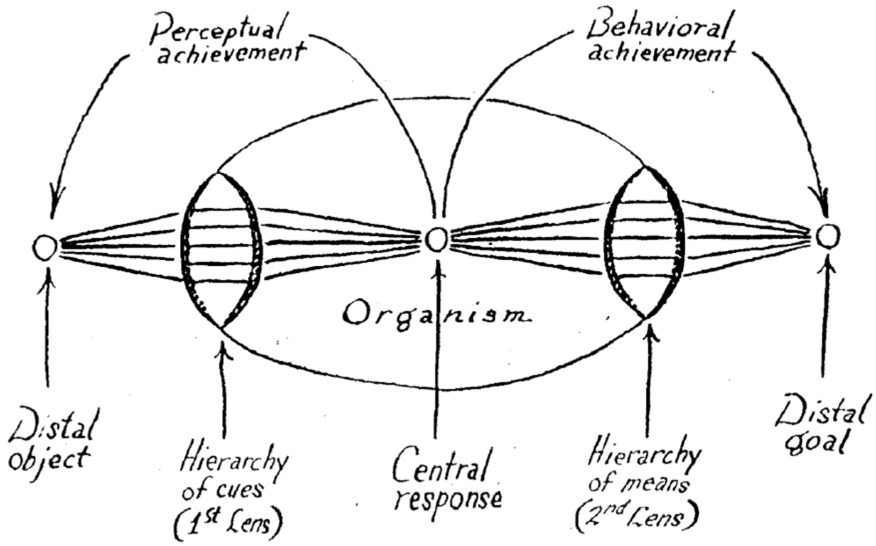

Figure 2: Extension of the lens model to planning.