Second-Order Anticipatory Systems

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Abstract

This chapter introduces a new concept, the anticipatory present moment (APM) which offers a way of integrating Rosen's seminal model of the anticipatory system with post-Rosen developments in second-order cybernetics and the ontology of the present moment. The APM is a meta-model that enables systems thinking and futures thinking to be accommodated in a paradigm that transcends the contradiction between the science of systems based on evidence from the past with futures scenarios which derive from the psychology and mental models of practitioners trying to anticipate the future. As well as anticipatory systems

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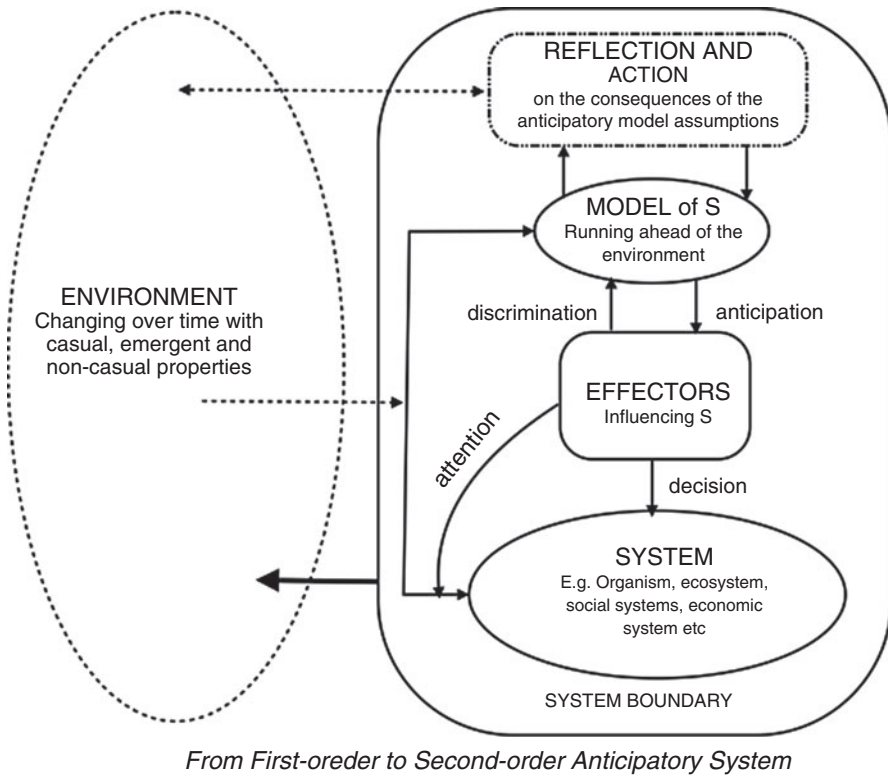e-mail: tony@decisionintegrity.co.uk

From First-oreder to Second-order Anticipatory System

Fig. 1 Second-order extension of Rosen's model

theory, the APM arises from a transdisciplinary study including the phenomenology of time consciousness, boundary critique, scenario method, reperception as induction, and multidimensionality of time. The APM provides a conceptual framework which is stimulating fresh ideas about practices which support strategic decision-making.

Introduction

The aim of this chapter is to make a case for including a second-order perspective in research into anticipatory systems. Although Rosen's foundational definition and description establishes anticipation as a system that "uses the future," his definition was based on the inclusion of a predictive model of itself and its environment (Poli – Introduction to this handbook). In an ambiguous world of action in society where

dominant conditions are increasingly complex, uncertain, and with multiple contradictions, prediction has limited validity. Hence, if anticipation as a discipline is to have value and impact, the nature of that anticipation needs to be well situated in the ambiguous world and able to contribute advantages. This requirement has been demonstrated, for example, by attempts to formulate anticipatory governance in both political and societal resilience (Fuerth and Faber 2012; Boyd et al. 2015).

Dealing with ambiguous situations necessarily involves the actor or observer. However, first-order reductionism leaves out the observer. The potential for introducing second-order cybernetics as an approach to anticipatory systems is that it includes the observer. Since anticipation incorporates the capacity to act in accord with, as well as perceive, the future (or some representation of it), then, from a second-order perspective, the state of the observer is a key factor in the functioning of an anticipatory system. This accords with the nature of second-order cybernetics (Foerster 1979; Scott 2004) the core of which is an inseparable triadic network of observer, society, and language (Muller 2016). This chapter explores the nature of that triadic network as related to the anticipatory system.

First, the first-order perspective on the anticipatory system is outlined and amplified by a second-order perspective; second, a brief description of second-order science is outlined; third, the transdisciplinary ingredients for constructing a second-order anticipatory system are proposed; and finally, a conjecture regarding the structure of a second-order system is introduced as the anticipatory present moment, APM (Hodgson 2016).

From First-Order to Second-Order Anticipatory Systems

Poli, in his review of the many forms of anticipation (Poli 2010), points out a fundamental issue in considering the nature of systems which are, in some way, able to anticipate the future. In what sense is the future there to be "made use of"? Considering this question from a second-order observer perspective requires a link between the nature of systems that function within a temporal order and the phenomenology of time consciousness: how are we aware of the future? To accommodate this question, Rosen's definition needs expanding in a way that offers the possibility of integration with the phenomenology of the present moment.

A necessary aspect of an anticipatory system is feedback in which effects are causes. A feedback loop will feed into the present of system information regarding past behavior of the system, which clearly can be of value in adjusting its present behavior. However, if the only information feeding back into the system is from the past, then it does not sufficiently meet the criteria for an explanation of anticipation. It is necessary that the system is able to adapt its behavior also incorporating information from the future. The simple term Rosen (1985) used for this additional loop is *feedforward*. The conventional interpretation of this feature is that the system operates with models of possible futures that go beyond those constructed simply from past information.

An analogy to feedforward in phenomenology is Husserl's (1991) notion of *protention*. This is a property of consciousness which anticipates as a lived

experience a range of "what next?" which he distinguishes from imagination. The link with Husserl's model will be described on page 6.

Rosen's idea that an anticipatory system is one which contains an internal predictive model of itself and its environment goes beyond a reactive system based solely on feedback. Reactive systems can only respond to changes that have already happened and for effectiveness depend on a repeated environment or context. In contrast an anticipatory system not only responds this way but is in addition continually sense-making in the present and taking into account futures that have not yet happened.

A second-order development of the anticipatory system includes as part of the system an observer who is able to reflect and act on the consequence of anticipatory model assumptions. This opens up the possibility of creativity and acausal factors entering into the decisions of the system.

Figure 1 presents an extended version of Rosen's anticipatory system. In the diagram, S stands for system, which may be an individual organism, an ecosystem, or a social or economic system. At first view, S is an ordinary non-anticipatory dynamical system. M represents a model of S. In Rosen's account (1985), the behavior of S is considered to be taking place in conventional real time. The behavior of M, however, is taking place in a time variable which goes faster than real time. This means that after a fixed interval T, then M will have proceeded further along its behavioral trajectory than S. In this way, the behavior of M predicts the behavior of S; by looking at this stage of M at time T_1, we get information about the stages that S will be in at time T_2. M and S are set up to interact in specific ways. Suppose system M is equipped with a set E of effectors which allow it to operate either on S itself or on the environmental inputs to S, in such a way as to change the dynamical properties of S. The whole system will now be adaptive such that prospective future behaviors determine present changes of state. Anticipation would require the further property that M can discriminate between desirable and undesirable states and can change the dynamics of S in a way to avoid the undesirable region as well as cope with mutual possible trajectories in the future.

If S is a planning system, then we can make further propositions from this model. To be anticipatory beyond adaptability, the system needs to be open to interactions that enable M to be revised and extended beyond inherited experience (feedback), and the system needs M to be able to reframe and re-perceive its advance running in the light of an anomalous situation that is not yet experienced (feedforward). There is also the question as to whether, without openness to information from the future and in some sense "guessing futures," the system is fully anticipatory in an impredicative world in which time may be richer than simply a linear "block time" future.

From a second-order perspective, the case can be made that such anticipation is facilitated by the reflexive nature of an observing system which is able to ask itself what its view of the future is. In first-order science, the notion of anticipation is problematic due to what has been summarized as "the zeroth commandment" that future states cannot affect present changes of state. In second-order science, the nature of time and causality is open to reframing, and so the possibility of a theory of anticipation is more plausible. ("The idea of anticipation in science is controversial, because of "objective causality" pronounced in the "Zeroth Commandment": Thou
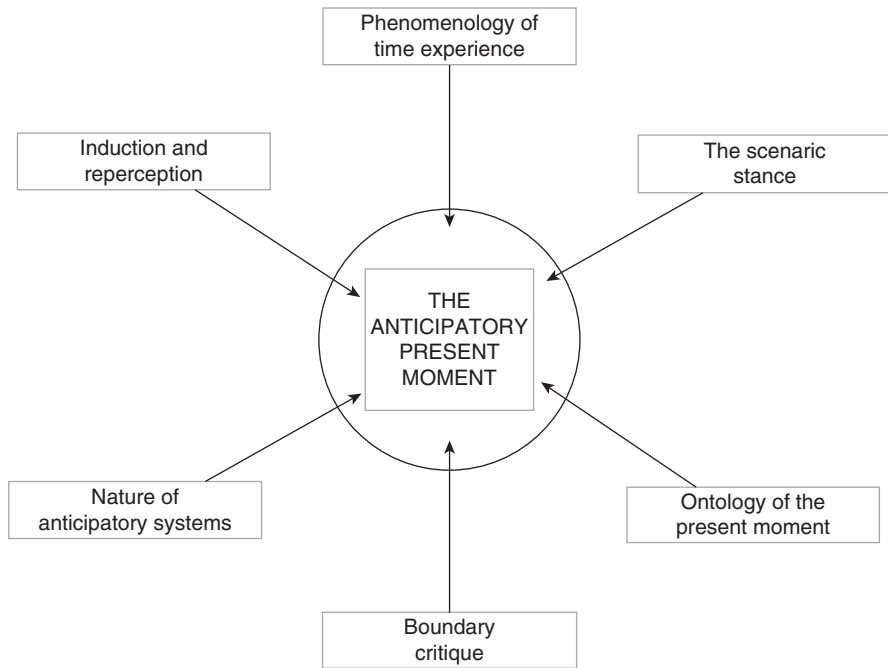
Fig. 2 Six aspects of the anticipatory present moment

shalt not allow future state to affect present change of state. Anticipation is almost always excluded from study at every level of system theory. The reasons for this rest on certain basic methodological presuppositions which have underlain "science" in the past few centuries: the essential basis on which "genuine scientific inquiry" rests is the principle of causality (which an anticipatory systems apparently violates); and "true objective science" cannot be argued from final cause (but an anticipatory system seems to embody a form of teleology)" (Louie 2010, p. 20).) Especially important in this view is the concept of inferential entailment in mathematics which is considered to correspond to forms of enactive relationship in biology as described in the emerging field of relational biology (Kineman and Poli, 2014) in which relational modeling emphasizes integration rather than mechanistic reduction.

Louie (2010) considers that this "information from the future" is not actually from the future but is information about self, species, and the evolutionary environment encoded in the organization of living systems. This is the idea of model-based behavior where the model can contain aspects that are speculated future states not directly derivable from past causality. Having said that, Louie (2010) also makes a strong case for the admission of the "forbidden" concept of teleology to legitimately reenter science. Discussing this in the context of the Aristotelian four causes, he points out that three of them (material, efficient, and formal) are congruent with Newtonian physics, but the fourth, final cause, is conventionally rejected. However, the Newtonian paradigm itself violates the existential nature of time and therefore

Fig. 3 Representation of
Husserl's present
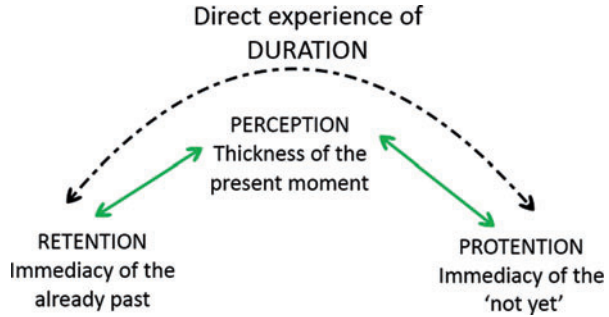
cannot be regarded as an adequate comprehensive frame for considering what is
scientifically acceptable (Smolin 2013). The extension of dimensions beyond space-
time leaves open more radical ways to consider what the future is that is being used
in anticipatory systems (Hodgson 2013).

Transdisciplinary Expansion of Second-Order Anticipation

What is time? The ontology of time in philosophy has been largely concerned only
with an ill-defined instant or with a timeless "eternal now." The question needs
broadening out. An ontology of all present moments, including past and future
states, is needed (Poli 2011). We can begin from our experience of the present, the
actual "now." What exists in the human mind is our present moment, and this can be
different according to the state of our consciousness. Our attention to the present can
be constricted with very little content, or it can be very expansive with a multiplicity
of impressions informing it. In the ordinary way, experience is of the content which
is being actualized coupled with its traces of the past and expectations of the future.
Within that personal present moment, freedom is limited by the commitments of the
past and recognition of latent patterns of potential. If the commitments are high and
the recognition is low, then the present moment is a conditioned state in which the
self has little power of choice. This is one version of the "thin" present moment. It is,
however, possible to transcend this conditioning by abandoning attachment to the
current content of the present moment, expanding the consciousness, and thereby
experiencing a larger present moment with more degrees of choice and freedom.
This is the "thick" present moment. A sentient human walker resting at the bottom of
a valley can, unlike a rock, bring to mind the destination over the hill and climb out –
still conditioned by the physical situation but exercising freedom to transcend it. This
is because the processes "inside" the walker are not wholly determined by the
contextual processes of its environment as is the case with the rock.

The present moment in some way contains aspects of the future – future in the
present. Containing the future in some existent way implies the idea that the future can
influence the present in a distinct way beyond any modeling function such as is
proposed in first-order anticipatory system theory. The status of both the present and
the future are not the same in this context as in the conventional time line of the past,

Fig. 4 A phenomenological
view of anticipation
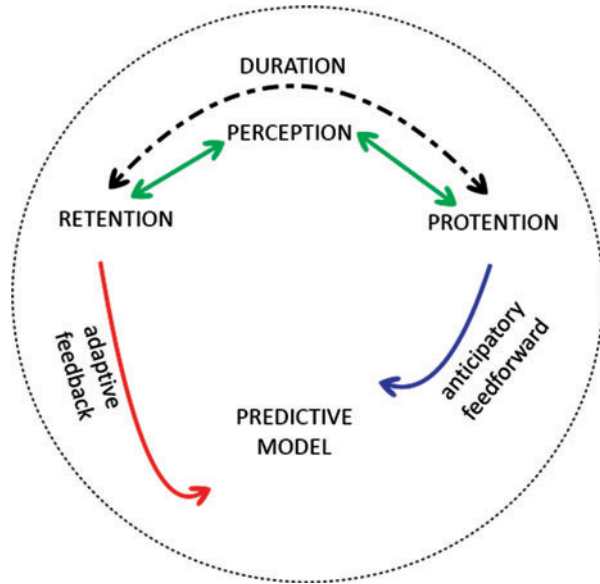
present, and future. In this alternate view, the key framing is a topological one of nested present moments of different scales of present moment. This means that what is contained in a larger present moment can be in the future of a smaller present moment. This is another way of interpreting that some "saw it coming," whereas many did not.

In Fig. 2, the present moment of a system is represented by a circle of which a time span is a diameter. In present moment theory, the future exists: but it does not exist within a small conditioned "thin" time slice. It exists in a greater "thick" time slice. Our future is not-yet-now for us, but it is already present as a latency. We cannot say that the future is "in" the future in a linear sense. What we can say is that an event that will occur in our future is already present in a larger present moment. The notion of present moment also implies sentience. This may be of differing degrees depending on the level of reality in focus.

The conjecture made here is that a systemic structure of a second-order anticipatory moment can be constructed from the integration of the following six aspects depicted in Fig. 2.

The anticipatory present moment, APM, brings together the following perspectives:

1. The phenomenology of time experience (Gell 1992)
2. The scenaric stance toward the future (Ogilvy 2011)
3. The ontology of the present moment (Hodgson 2013)
4. Boundary critique as a second-order notion (Midgley 2000)
5. The nature of anticipatory systems (Rosen 1985)
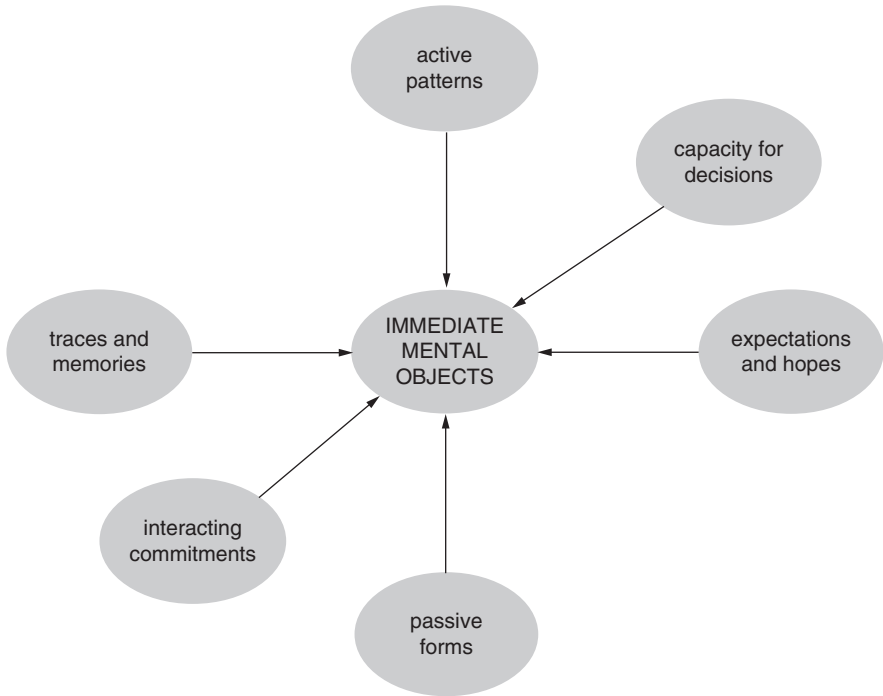6. Meta learning through varieties of reperception (Wack 1985)

Fig. 5 The experience of the present moment, after Bennett (1966) and Hodgson (2013)
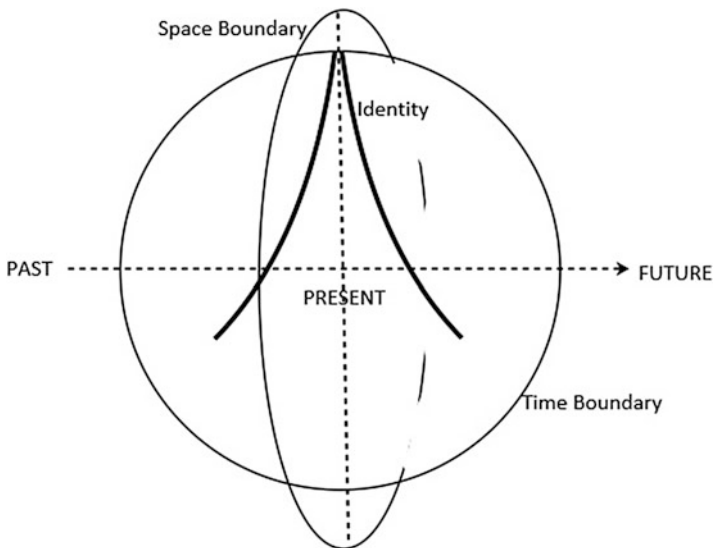

Fig. 6 Boundary critique with time in addition to space

These aspects are described briefly in the following sections.

Husserl's Model of Time Consciousness

Husserl developed his theory regarding the problem of the continuity of the perceptual present in contrast to the conventional idea that now is a "thin" present between the future and the past. Instead he saw it as a "thick" present (Gell 1992). For example, if we are listening to a note played on an instrument, we hear it as a continuous duration. When we are part way through, the sound of the first second is no longer audible. In terms of our experience, however, it is still a present tone that we are hearing. The meaning of the tone in, say, a musical work, is also evoked in relation to its future ending.

The immediate experience of the earlier part of the sound is not the same as a memory of that sound. There is a distinction between *retentions of experience* and memories of that experience. The present future of the sound is *protention* as an extended present. The idea of a knife-edge present, or a thin instant, is abandoned. Retentions are qualitatively different from memory reproductions in that they are all part of the current consciousness of the present. Protentions also contain elements of the emergent proximate future, which can be distinguished from fantasized futures. The present moment thus contains elements of conventional past and future, experienced as an extended now as in Fig. 3 (Gell 1992).

The Basic Nature of Anticipatory Systems

The phenomenology of the present as the properties of retention, perception, and protention serves to integrate anticipation in a reflexive way. It is necessary to extend the basic concept of feedback as applied in adaptive systems. A feedback loop will feed information into the present of a system regarding past relationships of the system, which has limitations of value in adjusting its present behavior to an unknown future. It is necessary that the system also has the property of feedforward in order to be able to adapt its behavior to be ready for the "not yet."

As previously stated an anticipatory system needs a way that information regarding the future can be acquired. One way is that an anticipatory system contains a predictive model of itself and its environment which enables it to make choices which are not entirely based on past information. Another way is that in some sense, aspects of the future already exist and therefore an anticipatory system can have the additional capacity to pick up information regarding the future which is neither inferential nor based on a predictive model; "using the future" could include perceiving an existent future. This requires two distinct channels of information input as shown in Fig. 4, one from the past retention side and the other from the future protention side.

The Ontology of the Present Moment

This topic is considered in some depth in my paper on the subject (Hodgson 2013). The essential features that need to be borne in mind for synthesis are recapitulated here. Poli's (2013) distinction between a thin and a thick present moment supports the idea that the present should be considered an extended duration that interfaces between the past and future, which is in contrast to it being a knife edge between the past and the future. The thickness of the present moment is related to a sense of dimensionality that is both measurable, in the sense of dimensionality in physics (Bohm 1980; Ferret 2010), and phenomenological, as in the Husserlian (1991) and Bergsonian (1910) notion of duration. Bennett (1966) extended this interpretation to six dimensions of experience: namely, traces and memories; interacting commitments; passive forms; active patterns; expectations and hopes; and capacity for creative decisions. This idea is summarized in Fig. 5.

The Structure of Boundary Critique

The notion of boundary critique in systemic intervention (Midgley 2000; Ulrich 1994) addresses problematic situations with second-order reflections on boundaries. Consideration of a present moment implicitly assumes or defines the scope of a boundary in time. Psychologically this is determined by both the duration of attention and
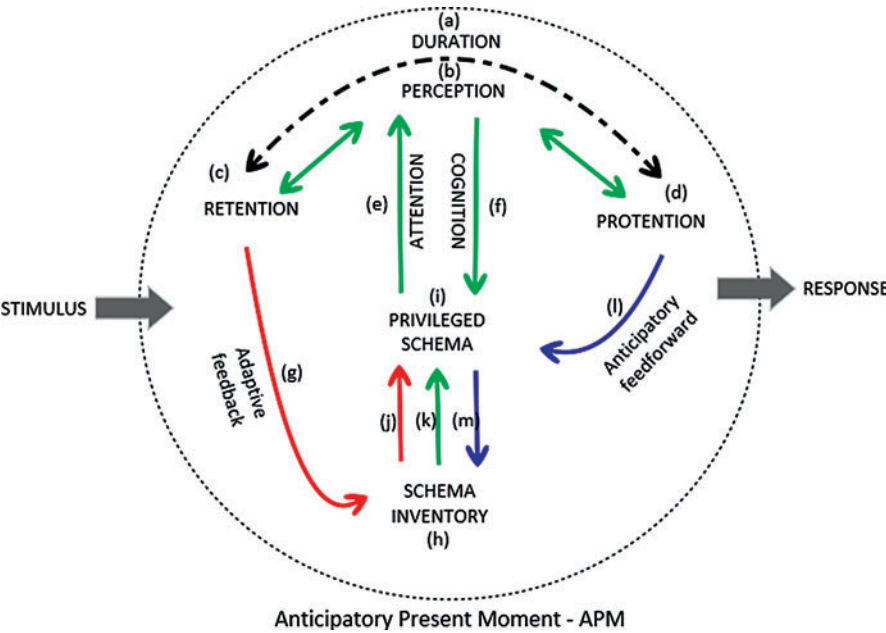

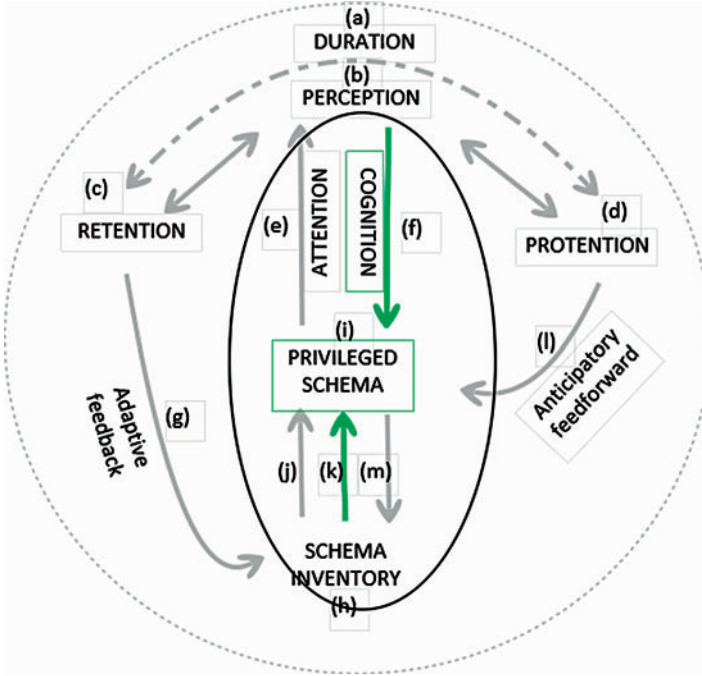**Fig. 7** The anticipatory present moment (APM)

Fig. 8 The pathway (*g*) ➔ (*j*) represents adaptive behavior that determines attention (*e*) and perception (*b*)

concern over time and the richness or variety of the content under consideration. A present moment is complex, nonlinear, and generative of emergent properties, including those influenced by the future. The boundaries of a system are defined by the limits of the knowledge that is taken as pertinent to the system in question.

In considering human systems as anticipatory systems, then, boundary critique can supply a rationale and method for supporting not only clarification of the system in question but also the present moment in which that system is being considered.

The basic representation in Fig. 6 of boundary critique by Midgley is a spatial diagram (see Fig. 6) circumscribing the domain of relevance and indicating that such a domain has a central value and identity. This is represented as the boundary of the anticipatory system. For the purposes of developing the anticipatory present moment concept, I am assuming a single boundary condition and introducing the time dimension. In this modified version, the "space" (content) of the system is represented in the plane orthogonal to the plane of the paper. The time dimension is the circle in the plane of the paper. This represents a duration with past, present, and future spread over time's arrow. Thus the boundary critique takes a space and time perspective. The significance of this is that not only do we make assumptions of boundaries of inclusion and exclusion, we also make assumptions of what is relevant in usually narrow time ranges. Put simply, without a time boundary critique, we may sacrifice the longer-term viable future to short term fixes.

Fig. 9 The pathway cognition (*f*)➔(*k*) represents the mainstream of choosing how to look at the situation

Cognition and Perception

The decision-maker is actually more than just an observer. To take a decision is to commit to some interaction with the field of the decision and "bring forth a world." An investment decision depends on financial resources in the decision system potentially at the disposal of the decision-maker. Although observing and analyzing the situation, from a systemic point of view, the decision-maker is an integral component of that decision system. Markets are reflexive to the decision-makers who participate in them (Umpleby 2007).

We need to understand both feedback and feedforward in terms of cognition and induction. As described by Holland et al. (1986), the key trigger for induction is anomaly. This is the case where inductive learning is taking place stimulated by information from the past or previous experience. This is hard enough, but the challenge of induction in the anticipatory system is dealing with anomalies that have little or no basis in information from the past. Usually we are "future blind" in this respect. Holland et al. (1986) give the example of the falling "leaf" behaving in a self-propelled way from flower to flower provoking a reinterpretation as "butterfly." But, in a world where we have never seen self-propelled plant seeds (as in the movie Avatar), how do we anticipate such and adjust beliefs and behavior accordingly?
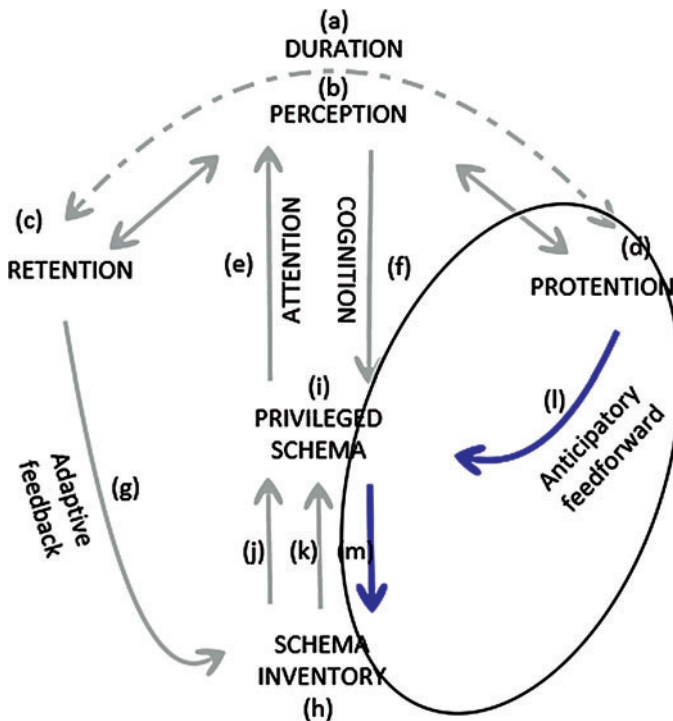
Fig. 10 The pathway anticipatory feedforward (*l*)➔(*m*) represents the way additional degrees of freedom become available to the APM. (*m*) is the enrichment of the schema inventory by the learning brought about by anticipatory feedforward, which would not occur reliant on only adaptive feedback

Stated as a paradox, the important distinction here is that anticipation needs the capacity to imagine the unimaginable and see the invisible (Toffler 1970). Entertaining multiple representations of a possible reality that has not yet happened is one way a system can become anticipatory. This is a challenge to cognitive and perceptual capabilities.

The Scenaric Stance

Ogilvy (2011) introduces the notion of the scenaric stance by which he means the simultaneous entertaining of multiple scenarios of the future that may be contradictory (e.g., both pessimistic and optimistic) and leaving room for the unknown and the creative. This frame of mind is also clearly consistent with opening to anomaly and contradiction, which can support anticipation. To practice this we need a capacity to embrace permanent ambiguity and to put our confidence in acting in the present but with a greatly enriched multidimensional experience of the present moment.

Reperceiving (Wack 1985; Burt 2010) is necessary to allow for the creative openness of our experience. This orientation accords with the "open future" that is part of the present moment concept, with this future being imagined within an enlarged (or "thick") present.

The Structure of the Anticipatory Present Moment

To summarize, the six key notions which underpin this synthesis between systems thinking and futures thinking implied in second-order anticipatory systems are:

- Multiple futures, not necessarily compatible, held in the consciousness of the present.
- Openness in that consciousness to the presence of choice and creative action.
- Capacity of the mind steady in its embrace of this openness and complexity.
- The implications of responsibility for choice in relation to the unfolding future.

These support the integrating concept of the notion of the present moment put forward here.

Figure 7 depicts the anticipatory present moment (APM). The circle represents the scale and extent of the present moment in question. It also represents the selection or identification of the relevant boundary conditions. The stimulus entering the circle on the left represents the influences of conventional causation from the past of this particular present moment. The response exiting the circle on the right represents the influence of the present moment in question on future conditions. The present moment in question is recognized as the experiential or phenomenological aspect of the self-agency of the system in question. This second-order observing self is taken to include a cognitive system represented by the components within the circle. The alphabetical tags on the diagram reference to components of the diagram to the descriptions which follow.

The different components of this diagram are labeled (a), (b), (c), and so on. These aid the referencing to the diagram in the description that follows. Subsidiary perspectives of the diagram are given in Figs. 8, 9, and 10. The main components are:

(a) Duration – the fundamental experience of time consciousness
(b) Perception – what is seen to be present
(c) Retention – the active retrospective present
(d) Protention – the immediate sense of the future
(e) Attention – the directing of interest
(f) Cognition – the mental sense-making of the moment
(g) Adaptive feedback – adjusting to information from previous experience
(h) Schema inventory – the set of mental interpretations available in the mind
(i) Privileged schema – the selected interpretation of the moment
(j) Promotion of schema from past – recovery from previous history
(k) Promotion of schema from present – immediate interpretations of current "reality"

(l) Anticipatory feedforward – alertness to information from the dimensions of the future

(m) Promotion of schema from future – innovative interpretations not extrapolated from accumulated experience – the anticipatory difference

This model can serve as a basis for interpreting reflexive decision-making. The APM thus incorporates the six threads, namely, the phenomenology of time experience, the scenaric stance, the ontology of the present moment, boundary critique, the nature of anticipatory systems, and the nature of induction and perception. The APM concept has more to it than simply the addition of these six factors; they have a dynamic interrelationship as depicted in the diagram.

Beginning with extended boundary critique, the dotted circle represents the boundary of both the system in question and the duration of the present moment. The notion of boundary critique is extended from the boundary of system space to include time span but, more than that, the span of all six dimensions of the present moment. The line is dotted to symbolize that the present moment system boundary is permeable to influences from a greater present moment within which it is contained and also subject to the judgment of the reflexive agent or subject at the heart of the system. So the concept of present moment contributes to framing the definition of the APM.

The phenomenological aspect of the APM is the experience of duration (a) which depends on the attention (e) and cognition (f) of the reflexive subject. Duration is the experience of the present as having more to it than simply the knife-edge instant between the past and the future. Attention (e) is the capacity to direct and sustain interest in the present event (Ingold 1999). Cognition (f) is the capacity to configure and interpret the experience.

An important consideration here is the attention span of the subject. Husserl (Gel, 1992) considered this in terms of listening to a musical note lasting a matter of seconds differentiating the direct experience of hearing the sound into retention as distinct from memory and protention as distinct from imagination. The APM extends this to the range of factors in both past and future that the subject can sustain. In conventional terms, this can be related to time span capacity (Jacques 1988). In the context of systemic intervention, this span relates to the intended scope of improvement which in conventional terms is characterized as short, medium, or long term. Perception (b) is the engagement in the experience by a conscious self. Retention (c) is the presence in experience of temporally recent aspects of the currently ongoing event; note this is not the same as the reproduction of the experience in memory. Protention (d) is the counterpart to retention in the experience of anticipation of the currently ongoing event; note this is not the same as the imagination of a future.

Research into time and brain structure sheds some light on this at the neurobiological level, but the field is still unresolved. The APM implies that the time experience can range beyond the short intervals of neural impulses. The situation is summarized by Damasio (2014):

> …mind time has to do with how we experience the passage of time and how we organise chronology. Despite the steady tick of the clock, duration can seem fast or slow, short or long.

> And this variability can happen on different scales, from decades, seasons, weeks and hours, down to the tiniest intervals of music – the span of a note or the moment of silence between two notes. We also place events in time, deciding when they occurred, in which order and on what scale, whether that of a lifetime or of a few seconds. (Damasio 2014, p. 42)

In the structure of APM, the first cybernetic dynamic is the adaption to feedback (g), which is the learning cycle of adaptation. This, in itself, is not anticipation but is essential for a viable system. Adaptive feedback is the capacity of the experiencing conscious self to take heed of and adjust behavior to what has recently occurred within their present moment.

The APM structure includes the capacity to learn from past experience. This can be seen as information, as coming from the retention side of duration, which in conventional terms is characterized as adaptation, learning from history. The APM also includes the capacity to receive information from the protention side of the present moment, learning from the future. This information contains elements which cannot be derived from the past. In some current thinking about the prospective capacities of mind and brain (see, e.g., Seligman et al. 2013), this is beginning to be acknowledged.

As an anticipatory system, able to incorporate both past and future into current choice, the APM exercises the intelligent flexibility of induction and reperception. Any reflexive mind has a repertoire or inventory of schema or mental models that inform behavior at different levels. Schema inventory is the repertoire of cognitive interpretations that are available to the conscious self. The term schema refers to some organized pattern of thought or mental model that organizes categories of information and the relationships among them. The term was given prominence by Piaget and taken up by von Glasersfeld (2001) in his radical constructivism. The role of schema in sense-making also features in Weik's theory (Weber and Glynn 2006). Schema should not be understood as equivalent to blueprints within the mind that are in some way implemented. The situation is far more dynamic and plastic than that; cognition is neither wholly schematic nor wholly interactive but some hybrid of the two. The plasticity of the brain seems to be constantly active with its inventory of schema as well as enacting, through the equivalent of simulation, much wider possibilities than those currently manifest. In the APM diagram, this is represented by the relationship between the schema inventory (h) and the privileged schema (i) in action at any particular moment, selected as appropriate.

In behavior which is principally adaptive, the privileged schema will be part of an existing historical repertoire which may well be applied in a novel way but is essentially based on past experience. In behavior which is anticipatory, the privileged schema may emerge from a shock factor which has invalidated the current repertoire as ill-fitting and inappropriate. Privileged schema is the automatically or consciously selected schema that is dominant in the current interpretation. We can suppose from this model that any authentic anticipatory behavior is always arising from some anomaly that challenges the habitual way of responding to situations or taking decisions that have strong implications for the future. These anomalies may come in several forms. An example is when, in a scenario planning exercise, the reflexive decision-maker sees propositions in a scenario that contradict his or her current strategic assumptions and therefore

indicate possible future failure if not taken into account. If these scenario propositions are taken seriously enough, then a crisis of reperception is triggered. This is a nontrivial event since it almost certainly will also trigger psychological factors like denial and defensive routines (Argyris and Schon 1978) as well as entry into new opportunity space.

However, there can be internalized forms of anticipatory reperception that emerge from a more intuitive source. This can be observed externally in fields from competitive sport to entrepreneurial enterprise. A player in a ball game may have an uncanny capacity to be ahead of the game in just the right spot to make winning moves. An entrepreneur may have a hunch that something unbelievable will work against all conventional wisdom, risking with confidence seizing an opportunity overlooked or dismissed by others.

So in terms of the APM diagram, pathway cognition (f)➔(k) represents the mainstream of choosing how to look at the situation.

Conclusion

In summary, the APM reframes the anticipatory system as a second-order cybernetic system and sets the scene for new research in the discipline of anticipation related to decision-making, policy, and governance which all include the observer/actor/decider. The APM framework provides a heuristic for exploring different forms of conscious participation especially relevant to the human domain of practical affairs. These explorations include recognizing the importance of creativity in anticipatory governance, the role of the state of mind of the decision-maker in anticipation (e.g., in forms of mindfulness), and the need to stimulate reperception if the confirmation biases of entrenched belief systems are to be loosened up to better embrace the presented complexity and uncertainty of the world.

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