Critical Thinking and the Unbearable Lightness of Karl Friston's Active Inference Framework and the Complex Adaptive Systems Model of the Mind

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According to Elizabeth Ismail (2024), the state of critical thinking [CT] is "a chaos of mushy definitions and curricula" (Possin, 2017). Wait, that's a quote from *me*! So I guess I better agree with it. But let's see what else.

Ismail laments that there is no single definition of CT that is widely accepted—no universally embraced description that transcends particular disciplines and cultures. She finds instead a multitude of definitions of CT.

Her proposed cure for CT's profusion of definitions and pedagogies and lack of effective means of assessment is to provide it with a "theoretical framework—a foundation that justifies and enhances our approaches to fostering critical thinking" (all quotes are from [Ismail, 2024] unless otherwise noted).

Before I critique the "theoretical foundation" Ismail says the *lack* of which explains CT's ills and the *use* of which would cure them, let me first question the very premise of her diagnosis.

Is lacking a single, universally accepted definition a problem, and one that's unique to CT? It would appear not: A quick search on the Internet for "What is science?" reaps a wide variety of definitions (see Appendix A), some of which are quite tangential to our mainstream understanding of what science is. Perhaps this partially explains the tangents people take in the name of doing science, e.g., astrology, homeopathy, the anti-vaccination movement, and paranormal studies. But even if you ask *legitimate* scientists what they think science is, you usually get an outdated version of Karl Popper's view, which doesn't much account for science and how scientific hypotheses are justified (Nisbett [2015, p. 261] concurs).

The history of philosophy is littered with attempts to define science and pseudoscience (the Demarcation Problem), e.g., (Popper, 1959), culminating recently in, e.g., (Pigliucci and Boudry, 2013; Pigliucci, no date; Hansson, 2021)—still to no avail.

Would arriving at a single, universally accepted definition of science help? Well, that's a silly question, since no such (theoretical) definition is possible. Science is a

vague concept in the sense that it lacks necessary and sufficient conditions. *Most* concepts are vague. In fact, vagueness, i.e., the *lack* of necessary and sufficient conditions, is one of the rare *non*-vague concepts.

But just because science is a vague concept does *not* mean it's *subjective*—viz., a mere matter of opinion or taste. Baldness and hairiness are vague—there is no magic hair the removal of which distinguishes them. But it is not a mere matter of taste which is which. Despite there being a fuzzy area of indeterminacy between them, clear cut cases are just that.

And so it is with CT, albeit some would strongly disagree: According to Johnson and Hamby (2015), for example, "There has not been, so far as we know, any argument that 'critical thinking' is not definable, though the discrepancies and differences in the many definitions that have been offered might well suggest that very conclusion to an outsider" (p. 421). And to *this* "insider" as well! Besides their ad hominem with calling any opponent an "outsider," Johnson and Hamby have committed the fallacy of appeal to ignorance: they see no reason for believing there is *not* a definition of CT (a la necessary and sufficient conditions); therefore, there *is* or *probably* is or *possibly* is such a definition. Furthermore, they have lost track of the burden of proof, especially given that enumerative induction overwhelmingly favors their opponent. "But we will proceed on the assumption that 'critical thinking' is definable" (p. 421), they say. Well, I'm afraid that I can't join them in that *mere* assumption (2016a).

So, while CT is vague, it is not subjective—although some folks seem to treat it that way, e.g., those who proclaim that "All thinking is critical thinking."

In light of this, let's take a look at one account of CT, which happens to be mine:

> CT is the practice of requiring, assessing, and giving cogent reasons for one's beliefs, values, and actions, in keeping with the goals of pursuing the truth and avoiding error. *Cogent* reasons are ones that meet the ARS conditions of cogency: *Acceptable* premises or reasons for one's conclusions, viz., one has more reason to believe them true than to not believe them; *Relevance*, viz., their truth would increase the probable truth of the conclusion or position they are offered to support; and *Sufficiency*, viz., their truth would make the conclusion at least probably true.
>
> One is thereby *disposed* to apply these cogency conditions, to *reflect* upon and assess the justification or evidence for one's beliefs, values, and actions and those of others.
>
> CT thereby involves various elemental CT skills, some of which are presupposed in order to evaluate the cogency of arguments and criticisms, e.g.:
>
> - Identifying arguments, as distinct from mere assertions, descriptions, and explanations

- Analyzing arguments, into premises, conclusions, and sub-arguments
- Taxonomizing arguments, as inductive or deductive, so as to apply the appropriate Sufficiency condition of cogency
- Critically reviewing definitions and clarifying concepts involved in the contents of arguments
- Evaluating the use and abuse of language in argumentation
- Evaluating and constructing cogent arguments
- Identifying violations of the ARS conditions, including classic informal fallacies

> Ultimately, one is disposed to assemble these competencies so as to construct and assess extended argumentation such as found in debates and position papers (Possin, 2002b). One is thus able to determine which position on an issue has the most cogent reasons in its favor, and the fewest cogent criticisms plaguing it, compared with known alternative positions, i.e., which position on an issue is the most rational to believe, value, or act upon, while being willing and disposed to change positions if another becomes more rational to adopt.

At the Ontario Society for the Study of Argumentation conference, in 2016, Robert Ennis presented a paper on definitions, and he included an abbreviated version of mine in a list that he called "the mainstream concept of critical thinking," along with 13 others (see Appendix B) by: Dewey, Glaser, Scriven, Paul, Ennis, Siegel, Lipman, Facione, Fisher, Hatcher and Spencer, Bailin and Battersby, Moore and Parker, Johnson, and Kuhn—all *scholars* in the field of CT. According to Ennis, these authors provide different descriptions of the same concept of CT, i.e., different "conceptions" of the same concept.

I disputed, in my commentary (2016a), Ennis' distinction between conception and concept, arguing that in fact concepts are so fine-grained as to render "conception" redundant: e.g., a triangular closed plane figure and a trilateral closed plane figure are two difference concepts despite being logically equivalent. But what I do *not* dispute about the definitions Ennis assembled is that the differences among them *do not make a difference*.

Often, what *appears* to be a significant difference is the result of the brevity of the definition—authors are forced to kick off their CT texts with a definition that would fit in a greeting card. Similarly, authors must focus on some select elements of CT more than others because a course is only a semester long or so. But there is a strong family resemblance among these mainstream definitions; and clear cut cases of outliers from them are just that. For example, a deductivist who insists that only deductively valid arguments meet the sufficiency condition for cogency; or someone who requires true, instead of acceptable, premises for an argument to be cogent; or someone whose goal in argumentation is not truth and avoidance of error but merely the persuasion of others into adopting *their* beliefs, values, or action plans; or someone who requires only metacognition, i.e., thinking about one's thinking, e.g., mere values clarification; or someone like Bloom (1956), whose account of the "cognitive objectives" of CT is often

so nebulous that it is less understandable than one's initial untutored notion of CT. Indeed, Richard Paul's teachings on CT are often guilty of this last charge too (Possin, 2017), instilling in his readers and workshop participants an unjustified confidence in their CT skills, when they have only a familiarity with Paul's jargon (e.g., 'fair-mindedness' and 'logicalness'), thereby leaving them in the same kind of embarrassing state that Paul found faculty in (1997).

So I blame *people* who *abuse* or *ignore* the mainstream notion of CT, not the lack of such a notion.

Another alternative explanation for the multitude of definitions for CT is the popular and grossly mistaken view that CT is domain-specific (e.g., Willingham, 2007). Having refuted this position elsewhere (Possin, 2016b) let me just reiterate here that the fact that "thinking is always about a subject matter" does not imply that CT is subject-matter specific. That would be as absurd as thinking that arithmetic is too, since counting is always counting *something* (so one would need different number lines to count eggs, money, and planets). The ARS conditions for cogent reasoning and argumentation are content *general*. Admittedly, *meeting* the acceptability requirement often requires subject-matter expertise, but the requirement itself applies to all domains. And similarly with the sufficiency condition: *meeting* it often requires subject-matter expertise, e.g., in statistics, but the requirement itself holds in all domains. Furthermore, the domain-specific view of CT would imply the absurd position that CT skills are *in principle non*-transferable, when they demonstrably *are*.

I think I have provided reasonable explanations, first for the *innocuous appearance* of an incommensurable multitude of definitions of CT and then also for some misguided outlier definitions of it.

So what about Ismail's proposed explanation and solution to this "problem"? Let's take a look at the theoretical foundation she would have us use, to see if it would help lead us to a universal consensus on the definition of CT, how to teach it, and how to assess one's CT skills and the disposition to implement them.

Ismail suggests that we use the "active inference framework" [AIF] to help understand CT, renamed "critical inference." This AIF approach to modeling both biological and artificial systems was offered by Karl Friston, as a model for brain processes. He insists that it is *merely* a model, a *formal description*, a way of talking—*unfalsifiable* until we claim that it actually *applies* to a system such as a neuron or neural network or a bacterium, plant, person, termite colony, ecosystem, or society (2018). Already we should be a bit skeptical: any description abstract enough to cover this range of systems can't be very enlightening. It's reminiscent of the cheap reductionism in saying "Hey, we're all just collections of particle-waves." Friston agrees that his "Free Energy Framework" *is* "deflationary" in this respect: it is "trying to reduce things to as simple a description of the way things are as you can"—all interpretations in psychology and the social sciences are just manifestations of it (Friston, 2021, 1:13 mark).

Jerry Fodor (1974, 1983) cautioned us against ignoring the importance of the "special sciences," each with its own natural kinds, nomological relations (or lack thereof!), and explanatory powers; and we would do well to heed his warning. Unfortunately, Friston does not, beginning his research by beautifully detailing, for example, the "predictive processing" between early visual receptive field layers (2005), but now asking us to "'skip ahead' to the AIF description of human neural architecture—and its role in navigating the complexity of our cultural niche" (2018, p. 2). Thusly Friston's psychological attributions come as cheaply as his reductionism, e.g., when he says that our *brains* continuously make predictions, inferences, choices and decisions and update *their beliefs*, and that, while we may learn from the well-worn path on the lawn that many people have passed that way, that well-worn path is likewise the *lawn's learning* the same thing (Friston, 2021).

Applying the AIF to *us*, at the psychological level, involves a new language which I barely understand, but I'll try my best to translate: "we aim to confirm our internal model of the world (i.e., beliefs) while minimizing prediction error (i.e., "the brain's free energy," i.e., false beliefs) which is the mismatch between our predictions (i.e., beliefs) and what we actually experience."

The AIF is "a normative framework of how optimal inferential activity operates." Agents are "driven" to adjust their beliefs and behavior, based on new evidence or information, to realize their expectations (i.e., beliefs and experiences) via those actions. In light of this "imperative" to "minimize expected free energy" (i.e., false beliefs) about the *future*, we choose actions the expected consequences of which will "reduce future uncertainty" (i.e., false beliefs) and bring about desired outcomes. Our "inferential activity" is thus *self-organizing*, adaptive, and evolving in response to interactions within an ever-changing world, by virtue of which we can be described as "complex adaptive systems." "A CAS is any multi-component, nonlinear, interactive, and dynamical system that has the ability to adapt *in* and evolve *with* a changing environment by means of feedback loops" via sensory input and behavioral output: Basically, what I do depends on my situation, and my actions can change my situation to match my beliefs and desires.

An important characteristic of a CAS is its "criticality": when it is "highly responsive to inputs and optimal for processing information," i.e., when it is at the "edge of chaos" [perhaps 'catastrophe' would be a more apt term—a sudden shift in cognition or behavior arising from a detected small change in circumstances]. Translation: what criticality amounts to, from *our* point of view, is openmindedness—the ability to change beliefs in light of new evidence. And "self-organized criticality" is the ability to change beliefs in light of our *own* beliefs, desires, emotions, and proprioceptive states.

You might have noticed by now that the AIF for CAS takes a very Panglossian view on how we make "active inferences." We are driven to "harmoniously proportion our beliefs to the evidence," forming true beliefs and changing our beliefs so as to adapt to our environment and preferring actions that satisfy our desires. But as the last five decades of great cognitive and social psychological research has shown us, we are *by default* anything *but* so "optimal" or rational—we are prone to biased beliefs in the face

of evidence and prone to rigid beliefs in the face of counter-evidence and prone to hasty judgments in the face of sparse evidence (Ariely, 2008; Kahneman, 2011; Lehrer, 2010; Nisbett, 2015; Thaler and Sunstein, 2008; Travis and Aronson, 2007). Ismail admits that we can fail to operate at "criticality" because of stress, emotion, cognitive workload, lack of attention, or sensory overload, but promises to suggest some remedies when discussing the pedagogical implications of the AIF. We shall see.

So, is Ismail right that "interpreting our inferential activity by means of the active inference framework sheds light on its recursive and systemic nature"? In my opinion, the AIF provides not a single photon, for at least our topics. All the jargon of the AIF that is relevant to *us* as psychological subjects, and to the subject of CT more specifically, gets translated into standard folk, cognitive, and social psychology and their basic accounts of the interaction of propositional attitudes, emotions, and sensory experience and how those propositional attitudes function as causes and reasons for our behavior (or *lack* thereof). For example: "active inference…proposes a balance between maximizing information gain, while minimizing free energy; that is, between enhancing the legitimacy of our internal model while limiting surprise to avoid undesired, improbable states." Huh? Oh, you mean the goal of maximizing truth and avoiding error with respect to beliefs, values, and action plans—you know, the goals of CT! Why didn't you just say so?!

Sometimes, the AIF is just unhelpful metaphor: "criticality [is] where the active and nuanced chemistry between structural representations and new evidence results in adaptive and self-organizing patterns of inference."

But sometimes, the AIF seems potentially harmful, for example to our pedagogical goal of enhancing CT skills in ourselves and others: "Rather than maintaining an orientation toward a veiled objective truth, [the AIF's] epistemological approach advances the idea that the aim 'is not to discover…justified principles…but rather *to improve our individual and shared capacity to tap into the critical potential of lived experience in a world that is unalterably characterized by flux and change'* (Kadlec, 2007, p. 12)." So now you're *giving up* on the goal of true beliefs? And wouldn't discovering and using a few justified epistemic principles from informal logic and CT help us better deal with a world of flux and change? The pedagogy suggested here by the AIF reminds me of that joke about teaching someone to swim—just throw them in the lake and, after they cut their way out of the gunny sack, they'll catch on. Similarly, Ismail says:

> Pedagogical approaches to fostering critical thinking may therefore benefit from focusing less on a restrictive set of skills or dispositions and more on … fostering … a tolerance for ambiguity and an appreciation of nuance, developing an atmosphere of diverse viewpoints; scaffolding opportunities for interactive engagement in inquiry and reflection while incorporating timely, explicit and recursive cycles of feedback; and balancing a supportive yet challenging environment that can push students to operate at the edge of their understanding [i.e., "criticality"].

These are great recommendations, except that learning to do them without first learning some of the *elemental CT skills*, such as those listed earlier in my definition, would be like training to be a marathon runner before learning to walk.

So the pedagogical advice we get from the AIF is redundant, spotty or even reckless.

Research (unassisted by the likes of the AIF) indicates that the most effective method for CT instruction is the "mixed" approach: Transferable CT skills, and the disposition to apply them, are best instilled by first explicitly introducing and explaining CT skills in the abstract, illustrating those skills by means of examples from various domains, and then having students repeatedly apply those skills in various domains while providing them feedback as to their errors, and having students practice correcting those errors until they are able to do so on their own—self-reflecting and self-correcting and practicing for a lifetime (Possin, 2016b, 2017).

Lastly, how about the AIF's advice on the assessment or measurement of one's CT skills and the disposition to apply them? According to Ismail:

> An authentic assessment of critical thinking would need to capture the evolving, contextual, and multi-dimensional aspects of inference and the continuous interaction between learning acquisition and application. Suitable evaluations would recognize that critical inference is not just about what one knows or how one thinks at a static point in time, but how one continuously adjusts, integrates, and applies thinking in a changing world. Traditional assessments… do not adequately capture this dynamism. Instead, more effective efforts may involve real-time assessment, contextual analyses, or longitudinal observations that track changes in inference or patterns of inference over time.

Ismail's position here amplifies Leo Groarke's (2021) skeptical view to an ear-piercing volume: The only true test of one's CT skills must involve one's application of those changing skills over a whole lifetime of experiences, judgments, and actions. I guess a good score on this "real-time assessment" would be living a vibrant rational life to a ripe old age. We must remember, however, that "ought" implies "can." As educators and employers, we usually have to make assessments in an hour or so. And despite the numerous faults that I have detailed in my articles on many of the commercially available CT assessment tests (mostly regarding their *interpretive validity,* with poorly worded directions and items and incorrect answer keys), they are largely still valid and reliable *enough* to detect a person's application of a significant number of important CT skills (Possin, 2020, 2014, 2013a, 2013b, 2008; Hatcher and Possin, 2021).

So, while Karl Friston is an outstanding mathematician and neurophysiologist, rather than shedding light on the nature of CT and the best way to teach it and measure it, his AIF casts more of a shadow on it all. As a theoretical foundation of our status as psychological subjects and agents and critical thinkers, the AIF is at best a distracting

variant of our folk, cognitive, and social psychology and at worst just abstract descriptions and metaphors, with a dash of notation and formulae—what Moberger (2020, p. 609) calls "obscurantist pseudophilosophy": "pos[ing] as philosophy by using arcane and quasi-technical terminology and jargon, which can easily make the most trivial claims appear profound."

Here's a parting example from Friston to illustrate: "The Gibsonian concept of 'resonance' appears to be appropriately matched to [our] complex situated activity, in which the agent's multiscale embodied neurodynamics 'resonate' with the multiscale environmental dynamics, following experiential attunement to the relevant regularities [i.e., affordances]" (2018, p. 14).

Incidentally, if one is looking for a naturalistic theoretical foundation for our status as psychological subjects with developing representational states that function as explanatory reasons for our actions (and, coincidentally, for what AI would have to have in order to *share* that status with us), I recommend the brilliant work of Fred Dretske (1981,1988). The irony is that the CAS paradigm is purely descriptive and at most predictive and thereby inert of explanatory powers—it *needs*, well, a *theoretical foundation*, to power the self-organization and adaptive capacities of the systems it claims to model. Dretske's account of how representational content provides a "structuring cause" (1988, 2004) of self-organization via evolution and learning is just what CAS needs (see [2021, 1:13 mark] where Friston *admits* such a need).

But even *this* addition would shed no light on the nature of CT and how best to teach it and assess it; nor *should* it be *expected* to. That's *our* job!

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Appendix A: Definitions of Science

Any system of knowledge that is concerned with the physical world and its phenomena

and that entails unbiased observations and systematic experimentation. In general, a science involves a pursuit of knowledge covering general truths or the operations of fundamental laws. (Britannica.com)

Our knowledge of the natural world and the process through which that knowledge is built. The process of science relies on the testing of ideas with evidence gathered from the natural world. Science as a whole cannot be precisely defined but can be broadly described by a set of key characteristics. (Undsci.berkeley.com)

Science is a rigorous, systematic endeavor that builds and organizes knowledge in the form of testable explanations and predictions about the world. (Wikipedia)

Knowledge or a system of knowledge covering general truths or the operation of general laws especially as obtained and tested through scientific method. (Merrian-webster.com)

Science is the pursuit and application of knowledge and understanding of the natural and social world following a systematic methodology based on evidence.
Scientific methodology includes the following:

Objective observation: Measurement and data (possibly although not necessarily using mathematics as a tool)
Evidence
Experiment and/or observation as benchmarks for testing hypotheses
Induction: reasoning to establish general rules or conclusions drawn from facts or examples
Repetition
Critical analysis
Verification and testing: critical exposure to scrutiny, peer review and assessment.

(Sciencecouncil.org)

The study or knowledge gained through careful observations and experiments is called science. It is basically a systematic approach or attempt to understand about the physical world, nature and natural phenomena in as much details and depth as possible. A man makes experiments and takes observations. It uses the observation and experimentation to describe and explain about the nature and its natural phenomena. Science explores, experiments, and predicts from what we see around us. It unravels the secrets of nature. (Scienlycom)

Appendix B: Definitions of Critical Thinking

Active, persistent, and careful consideration of any belief or supposed form of knowledge in the light of the grounds that support it and the further conclusions to which it tends. (Dewey 1933, p. 9)

The ability to think critically ... involves three things: (1) an attitude of being disposed to consider in a thoughtful way the problems and subjects that come within the range of

one's experiences, (2) knowledge of the methods of logical inquiry and reasoning, and (3) some skill in applying those methods. (Glaser 1941)

Critical thinking is the intellectually disciplined process of actively and skillfully conceptualizing, applying, analyzing, synthesizing, and/or evaluating information gathered from, or generated by, observation, experience, reflection, reasoning, or communication, as a guide to belief and action. (Scriven and Paul 1987)

Critical thinking is reasonable reflective thinking that is focused on deciding what to believe or do. (Ennis 1987)

A critical thinker is one who is appropriately moved by reasons. (Siegel 1988, p. 32)

Skillful, responsible thinking that is conducive to good judgment because it is sensitive to context, relies on criteria, and is self-correcting. (Lipman 1988)

Purposeful, self-regulatory judgment which results in interpretation, analysis, evaluation, and inference, as well as explanation of the evidential, conceptual, methodological, criteriological, or contextual considerations upon which that judgment is based. (Facione 1990, Table 1)

Critical thinking is skilled, active interpretation and evaluation of observations, communications, information, and argumentation as a guide to thought and action. (Fisher and Scriven 1997, p. 20)

The practice of identifying, having, and giving good reasons for one's beliefs, values, and actions, given one's goals of truth and avoidance of error. (Possin 2002a)

Thinking that attempts to arrive at a judgment only after honestly evaluating alternatives with respect to available evidence and arguments. (Hatcher and Spencer 2006, p. 1)

The careful examination of an issue in order to reach a reasoned judgment. (Bailin and Battersby 2010)

The careful, deliberate determination of whether we should accept, reject, or suspend judgment about a claim, and the degree of confidence with which we accept or reject it. (Moore and Parker 2014)

The articulated judgment of an intellectual product arrived at on the basis of plus-minus considerations of the product in terms of appropriate standards (or criteria). (Johnson 2014)

[Reasonable] inquiry and argument. (Kuhn 2015, p. 47)