Elevating Science to Detect Unsolvable Problems

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Abstract
This article explores the systematic causes for problems in science to be effectively unsolvable. These causes are classed as problems of cognition, and problems of awareness, since, problems can't be defined or solved through conscious effort unless there is an awareness of the need for a problem to be defined, and/or awareness of the need for a solution. For this reason problems might be unsolvable not only because they are too complex to be solved through type 1 or type 2 cognitive reasoning, but also because of lack of awareness they exist. This article explores both systemic sources of lack of awareness and new techniques which might address that lack, as well as exploring the emerging science of General Collective Intelligence which promises to significantly increase capacity to address lack of collective cognitive ability.

Introduction
Humans thought consists of both type 1(intuitive) reasoning and type 2 (rational methodical reasoning) [1]. Human cognition can solve uncomputable problems through type 1 reasoning that recognizes patterns of solutions observed in the past, even where those solutions can't be computed. Human cognition can also solve computable problems through type 2 reasoning where a chain of reasoning (that is, an algorithm) exists, where the information required to evaluate that algorithm exists, and where the capacity to evaluate that algorithm exists. The newly emerging science of Human-Centric Functional Modeling [2] represents thought (concepts and reasoning) in terms of a space of concepts or "conceptual space" which the cognitive system moves through in the process of executing the reasoning with which it navigates from one concept to the next. In this conceptual space, complexity of type 1 or type 2 reasoning is defined by the distance navigated through conceptual space, multiplied by the density of concepts the reasoning must navigate through. However, problems can't be defined or solved through conscious effort unless there is an awareness of the need for a problem to be defined, and/or awareness of the need for a solution. For this reason problems might be unsolvable not only because they are too complex to be solved through type 1 or type 2 reasoning, but also because of lack of awareness.

Human-Centric Functional Modeling or HCFM represents all of human perception in terms of "functional state spaces". These functional state spaces are a significant innovation because where first person observations have always been considered subjective and therefore have often been ignored by science, functional state spaces enable all the properties of first person observation to be quantified. In functional state spaces, truth is a property that has a well-defined representation, creating the potential opportunity for the truth of any first person observations to be objectively assessed, thereby making first person observations accessible to science for the first time. Where HCFM represents cognition as moving through a conceptual space, HCFM also represents the consciousness as moving through an "awareness space". Where the magnitude of general problem-solving ability (intelligence) of the cognitive system within the domain of cognition is hypothesized to be the volume of conceptual space that can be navigated per unit time to find a solution, multiplied by the volume density of concepts the cognition must search, the magnitude of general problem-solving ability (enlightenment) of the consciousness system within the domain of awareness is hypothesized to be the volume of awareness space that can be navigated per unit time, multiplied by the volume density of awareness's that the consciousness must search. While other approaches have been used to measure and/or confirm the presence of consciousness [3], [4], [5], no other approach provides a definition that potentially serves

such a wide range of definitions from the “level of consciousness” referred to by existentialist traditions to the level of consciousness definitions used in clinical settings.

Detecting Problems that are Unsolvable Due to Lack of Awareness

According to various existentialist traditions (such as the yogic tradition) that depend heavily on defining the truth of a thing according to what that thing functions to achieve, the truth of reasoning is defined by what that reasoning functions to achieve, and the truth of an awareness is defined by what that awareness functions to achieve. Because HCFM defines all processes within a domain as consuming the same domain object as input and producing the same domain object as output, reasoning processes in the conceptual domain can only consume and produce concepts, and awareness processes in the awareness domain can only consume and produce awareness's. This suggests that reasoning (problem-solving in the cognitive domain) can only function to support or refute the truth of a conclusion. It also suggests that awareness processes (problem-solving in the awareness domain) can only function to support or refute the truth of an experience. This is a critical distinction to be aware of, because problems can be misunderstood as being in the cognitive domain (that is, they can be misunderstood as being problems of reasoning) when they are actually problems of awareness. An intuitive example is the choice to treat depression with psychological counseling involving helping the individual patient develop skills of self-analysis so they might discover the reasons why they are depressed in order to address them. Perhaps the individual’s cognition is predisposed to use type 1 reasoning to justify why they should not be depressed, and therefore in order to “solve” the problem of depression they must reprogram their brain with patterns of solutions provided to them by the psychologist. However, while type 1 reasoning is effective at bringing people to shared conclusions, in this case shared with the psychologist, it is less effective at providing detail. Such conclusions easily fall apart when inspected too closely.

Perhaps the individual’s cognition is predisposed to use type 2 reasoning to justify why they should not be depressed, and they must reprogram their brain with reasoning algorithms provided to them by the psychologist. However, type 2 reasoning is often very ineffective at bringing people to shared conclusions. Rather than coming to the conclusion their psychologist was hoping to lead them towards, the individual might just as soon find reasons to become more depressed.

On the other hand, one might just as easily choose to treat depression with guided meditative practices that instead of trying to solve a cognitive problem with vague or unpredictable reasoning that might not reliably lead to a solution, attempts to solve a problem of awareness. This problem of awareness might be shifting the focus of the awareness to gratefulness, acceptance, or other experiences, as opposed to bringing the cognition to understand the reasons for gratefulness, or acceptance, where that shift might have more reliable outcomes. This is a hypothetical example that has not been tested experimentally, but the point is not to make any claim regarding the effectiveness or lack thereof of psychological therapy, mindfulness meditation, or any other practices. The point is simply to identify these two different perspectives.

Problems in the cognitive domain can be divided between type 1 thinking requiring a recollection of patterns, and type 2 thinking requiring a recollection of facts and reasoning, but these recollections are not required to be retrieved from the individual’s memory in order for problems to be solved. Perhaps because of this lack of awareness, one fundamental challenge with detecting problems in science that are not reliably solvable through current thinking might be overcoming the tendency to confuse memory with intelligence. In other words, decisions regarding whether or not problems are unsolvable with a given set of reasoning might be more effectively justified using written decision-trees that can be validated step by step without having to accept any claim from memory that is assumed to be

"obvious" to those deemed subjectively to be "intelligent". Such value judgments might effectively make certain categories of problems unsolvable because reasoning can't effectively be challenged.

In addition, another challenge with science is to confuse intelligence with awareness. One of a number of glaring historical examples of such lack of awareness was the rejection by the medical community for decades of hand washing as a means of preventing the death of newborns from infection [6]. This example is particularly poignant because the consequences were so severe (death), because the victims were so vulnerable (newborn babies), because the suggested interventions took so little effort comparatively (hand washing), and because those efforts were resisted so strenuously (doctors at the time were reportedly offended at being told to wash their hands). While it might appear this was a problem of intelligence and therefore a problem in the domain of cognition in that better information (a theory of the existence of germs) would have solved the problem by allowing doctors to accept observations from experiments showing that hand washing saved lives, it might also be seen as a problem of awareness and therefore a problem in the domain of consciousness. Because a more general solution might be to develop an approach that enables individuals to search their awareness for all categories of candidate problem definitions or solutions, and that allows the fitness of solutions in solving problems to be objectively determined, so that problems could then be solved through leveraging solutions observed to work, even where the mechanisms by which those solutions work are unknown. A more general solution would also include enabling individuals to more reliably recognize where such candidates don't exist, and where such candidates are required to solve problems, particularly where those problems are important.

Problem Definitions and Solutions	Validation	Value Proposition
Validated Candidates Exist	Type 1 Reasoning | Type 2 Reasoning | Both	Candidate Problem Definition or Solution Solves has Unique Value
Unvalidated Candidates Exist	N/A	Candidate Problem Definition or Solution Solves has Unique Value
Validated Candidates Do Not Exist	Type 1 Reasoning | Type 2 Reasoning | Both	N/A
Unvalidated Candidates Do Not Exist	N/A	N/A

Table 1: *Categories of problem definitions and solutions for which a lack of awareness might exist.*

Addressing the Lack of Collective Intelligence in Science

The emerging science of General Collective Intelligence or GCI [7] explores how groups might be organized to more reliably solve "wicked problems" [8] which have been defined as those having a longer path through the collective conceptual space than can reliably be navigated by the group's reasoning processes. The challenge is that while scientists understand tools that significantly increase their problem-solving ability in specific areas, from anecdotal observation a tool that increases general problem-solving ability in their discipline has not even been considered by the vast majority of scientists. Many might not even understand the problem, much less this proposed solution. Therein lies the problem. The model of GCI suggests that not only is this exponential increase possible, but that there might be a well-defined path towards it. Furthermore, if a critical mass of people understand the idea of GCI, it is predicted that they might self-organize the concepts in their discipline so those concepts can be understood by the rest of the group in a way that allows GCI based collective reasoning processes to be executed, which might be used to construct the GCI itself, so that a GCI might spontaneously self-assemble when sufficient mind share is created.

Addressing the Lack of Collective Awareness in Science
Just as one might envision a hypothetical GCI platform with the potential capacity to exponentially increase a group's collective problem-solving ability, it is also possible to envision a hypothetical platform with the capacity to significantly increase a group's collective awareness. In order to define such a platform, it is first necessary to validate the theory that the behavior of consciousness can be represented within HCFM in terms of an "awareness space".

Directions Forward
The first step might be validating that level of awareness can be measured, and validate that this measurement correlates with the existence of problems that are unsolvable due to lack of awareness. Another step might be to validate the model of GCI, and to develop GCI based collaboration and decision-making tools relevant to each scientific discipline.

Conclusions
However, the underlying functional model of individual and collective cognition suggests a limit to the conceptual complexity (the product of the volume in conceptual space represented by a concept and the density of concepts in the region of that concept), that can be reliably communicated. The concept of GCI is predicted to occupy too large a volume in conceptual space for a description that is broad enough to be communicated widely to reliably be understood in sufficient detail by any individual in a different discipline, to enable that individual to apply those concepts to create the required GCI artifacts in their discipline. This predicts that no one single person can write a paper that broadly communicates a detailed understanding of GCI.

In essence, the challenge and paradox is that General Collective Intelligence, a hypothetical collective cognition that allows individuals, or intelligent agents acting on behalf of individuals, to significantly increase their capacity to conduct collective reasoning, is predicted to be a "wicked problem" that can't reliably be solved without GCI. However, rather than being a barricade, this opens a door. No one single person needs to solve the problem of broadly communicates a detailed understanding of GCI on their own. All that is required is to build mind share about what the general problem-solving ability of groups means, and how an exponential increase in that ability might be quantified as exponential, and to describe the very first small step in a process through which GCI might self-assemble.

References
[1] Kahneman, Daniel. Thinking, fast and slow. Macmillan, 2011.

[2] Williams, Andy E. "Human-Centric Functional Modeling and the Unification of Systems Thinking Approaches: A Short Communication." Journal of Systems Thinking (2021): 5-5.

[3] Bayne, Tim, Jakob Hohwy, and Adrian M. Owen. "Are there levels of consciousness?." Trends in cognitive sciences 20.6 (2016): 405-413.

[4] Koch, Christof. "What is consciousness." Scientific American 318.6 (2018): 60-64.

[5] Gamez, David. "The measurement of consciousness: a framework for the scientific study of consciousness." Frontiers in Psychology 5 (2014): 714.

[6] Best, Mark, and Duncan Neuhauser. "Ignaz Semmelweis and the birth of infection control." BMJ Quality & Safety 13.3 (2004): 233-234.

[7] Williams, A. E. (2021. Defining a continuum from individual, to swarm, to collective intelligence, to general collective intelligence. International Journal of Collaborative Intelligence, In press (2022)

[8] Williams, A.E. Are wicked problems a lack of general collective intelligence?. AI & Soc (2021). https://doi.org/10.1007/s00146-021-01297-8