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Tunnel Vision: A Problem in Academics

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Inspiration is just as important to scientists as it is to artists. Einstein's theories of special relativity were famously drawn from his boyhood question, "What would riding upon a beam of light be like?" Archimedes came to his famous eureka moment, and uncovered the principle of buoyancy, in a bath. Without moments of inspiration like these, humanity would not have made the progress that it has. Taking a broad view of the world has historically been a large part of the academic world; however, there is still a constant struggle with academic tunnel vision. When one becomes obsessed with a singular field, failure to recognize the potential applications of the problems, methods, ideas, and inspirations from other fields becomes an even greater possibility.

Tunnel vision is a common phenomenon in which an individual becomes so focused on a single or handful of objects that they cease to notice anything but those objects. A famous case of this occurrence is known as "The Invisible Gorilla."[1] Two researchers, Christopher Chabris and Daniel Simmons, examined a potential downside of over-focusing. Participants were told to count the number of times a basketball was passed during a short video clip. In the middle of the video a research assistant, for a few moments, hopped across the screen in a gorilla suit. Afterwards, the participants were asked if they noticed anything strange during the video. Surprisingly, very few people noticed the gorilla because they were too focused on counting the passes.

This issue extends into the academic world as well. Imagine that you are researching solutions for a specific problem. Naturally, you would use all of the relevant available tools in your discipline to solve it, but what if the problem stubbornly refuses to be solved? You could spend hours trying to break down the problem, create simplified models, and research similar material without making much headway. Even after every available methodology has been exhausted, an answer may still not be apparent or largely applicable. Better solutions may exist, but it is possible that they do not exist solely within the constraints of a single academic discipline. Thus,

1 For more information on this subject see http://www.theinvisiblegorilla.com/.

it is often helpful, if not necessary, to couple a strong understanding of a singular field with the tools, methodologies, and inspirations from several other academic disciplines. Graph theory offers an excellent example of how biology and math have interacted in such a manner.

The "travelling salesman" problem is a straightforward one: find the quickest[2] way to visit all of the vertexes, i.e. cities, on a graph in a cycle without revisiting any one of them. Given the wide range of practical applications that instances of this problem have, it would be nice if we could compute the optimum solution quickly; however, this problem, and many like it, is famous for its computational inefficiency.[3] For a graph of n vertexes, than there are $n!$ possible orderings to visit the vertexes in.[4] Thus, the time required to compute the shortest route quickly becomes unmanageable, and can easily consume more time than the worst solution itself.

Alternatively, non-deterministic algorithms can give us answers quickly, but we must sacrifice the total accuracy of the solutions to do so. Finding algorithms whose approximations are consistently as close as possible to the true solution is a major field of research in mathematics and computer science. Typically, these methods and their resulting approximations draw deeply from various areas of mathematics such as graph theory, geometry, and combinatorics. Mathematics, however, does not have a monopoly on the provision of powerful problem solving tools. In his Ph.D thesis, Marco Dorigo created a very powerful biology-inspired approximation algorithm. He explored the behavior of ants as a possible solution to the traveling salesman problem.[5]

He found that ants, when searching for food, deposit pheromones on the ground to mark their path. Ants, having a finite amount of pheromones, coat longer paths with less pheromone than they do shorter ones. Thus, the next time an ant has to find food, it will search[6] for the strongest

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2 Quickest is used as one of the many possible measures of the least-costly way of traversing a graph. Formally, we're looking for the Hamiltonian circuit with the least amount of weight.

3 Such problems make up the set known as NP-Complete.

4 This is the overall complexity bound of the problem. In several special con straint systems this can be reduced by small to very large factors.

5 *Ant Colony Optimization* by Marco Dorigo and Thomas Stützle is recommended for more information.

6 The selection is made pseudo-randomly. The ants aren't "bound" to the strongest pheromone deposit, but rather choose it with a greater probability.

pheromone deposit and follow that path. Since this path is now getting coated again, it becomes more and more likely that the following ants will choose that route.

Even though this simulation seems fairly basic it has been proven that, in several somewhat restricted cases, the optimal solution can always be found.[7] Now I pose the question: Would this algorithmic procedure have existed without multidisciplinary interactions? One could argue that, for example, an Artificial Intelligence researcher could have found a similar solution without inspirations from biology. However, it would be hard to overlook the fact that artificial intelligence itself is a field that has deep connections to cognitive science and psychology.

Seeing this underlying structure of academic fields, and how interconnected they actually are, is an important step in correcting academic tunnel vision. Since the bases of every academic field are deeply tied to each other, the problems, questions, and solutions drawn from them will be linked in a similar fashion. Therefore, a multidisciplinary approach should be taken when attempting to solve them, as it will address the many facets of the problem. By looking at science with a liberal arts philosophy, a vast wealth of experiences, methods, and much more can be added to our academic arsenal. When paired with a strong mastery and passion for a specific study, or handful of studies, truly amazing things can happen. After all, econophysics, biochemistry, pharmacology, and many other fields would not exist if researchers had not overcome their tendencies towards tunnel vision.

7 These conditions bar us from making a "P = NP" claim.