

Re: WISDOM of Crowds (Identify –Uare the missing data)

Source: <http://sci.tech–archive.net/Archive/sci.logic/2005–03/0619.html>

From: Immortalist (reanimator_2000_at_yahoo.com)

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feedbackdroids@yahoo.com wrote:

> > *Why is network television so awful?*
> >
> > *If you had to meet someone in Paris on a specific*
> > *day but had no way of contacting them, when and*
> > *where would you meet?*
> >
> > *Why are there traffic jams?*
> >
>
> *ILYA PRIGOGINE, who won the Nobel prize*
> *in 1997 in chemistry for the discovery*
> *of dissipative structures, is considered*
> *the father of "chaos theory." Prigogine*
> *died earlier this year after preparing*
> *this column for NPQ's Nobel laureate series...*
>
> *In large societies, we see collective motions.*
> *Accordingly, the role of individual activity*
> *is drastically reduced. Human societies*
> *could face the same evolution when tied*
> *together by networks.*
>
> *Years ago I studied traffic flows. I found*
> *that when the flow of traffic was light,*
> *each driver behaved more or less as he*
> *wanted. I called that an "individual regime."*
> *But when the flow becomes more and more dense,*
> *the characteristics of a "collective regime"*
> *take over in which everybody is pushing the*
> *other and is pushed by the other.*
>
> http://www.digitalnpq.org/archive/2004_winter/prigogine.html

See "Dietrich Braess" below;

Network logic is counterintuitive. Say you need to lay a telephone cable that will connect a bunch of cities; let's make that three for illustration: Kansas City, San Diego, and Seattle. The total length of the lines connecting those three cities is 3,000 miles. Common sense says that if you add a fourth city to your telephone network, the total length of your cable will have to increase. But that's not how network logic works. By adding a fourth city as a hub (let's make that Salt Lake City) and running the lines from each of the three cities through Salt Lake City, we can decrease the total mileage of cable to 2,850 or 5 percent less than the original 3,000 miles. Therefore the total unraveled length of a network can be shortened by adding nodes to it! Yet there is a limit to this effect. Frank Hwang and Ding Zhu Du, working at Bell Laboratories in 1990, proved that the best savings a system might enjoy from introducing new points into a network would peak at about 13 percent. More is different.

On the other hand, in 1968 Dietrich Braess, a German operations researcher, discovered that adding routes to an already congested network will only slow it down. Now called Braess's Paradox, scientists have found many examples of how adding capacity to a crowded network reduces its overall production. In the late 1960s the city planners of Stuttgart tried to ease downtown traffic by adding a street. When they did, traffic got worse; then they blocked it off and traffic improved. In 1992, New York City closed congested 42nd Street on Earth Day, fearing the worst, but traffic actually improved that day.

Then again, in 1990, three scientists working on networks of brain neurons reported that increasing the gain—the responsivity—of individual neurons did not increase their individual signal detection performance, but it did increase the performance of the whole network to detect signals.

<http://www.kk.org/outofcontrol/ch2-g.html>

The prime variable Kauffman played with was the connectivity of the network. In a sparsely connected network, each node would on average only connect to one other node, or less. In a richly connected network, each node would link to ten or a hundred or a thousand or a million other nodes. In theory the limit to the number of connections per node is simply the total number of nodes, minus one. A million-headed network could have a million-minus-one connections at each node; every node is connected to every other node. To continue our rough analogy, every employee of GM could be directly linked to all 749,999 other employees of GM.

As Kauffman varied this connectivity parameter in his generic networks, he discovered something that would not surprise the CEO of GM. A system where few agents influenced other agents was not very adaptable. The soup of connections was too thin to transmit an innovation. The system would fail to evolve. As Kauffman increased the average number of links between nodes, the system became more resilient, "bouncing back" when

perturbed. The system could maintain stability while the environment changed. It would evolve. The completely unexpected finding was that beyond a certain level of linking density, continued connectivity would only decrease the adaptability of the system as a whole.

Kauffman graphed this effect as a hill. The top of the hill was optimal flexibility to change. One low side of the hill was a sparsely connected system: flat-footed and stagnant. The other low side was an overly connected system: a frozen grid-lock of a thousand mutual pulls. So many conflicting influences came to bear on one node that whole sections of the system sank into rigid paralysis. Kauffman called this second extreme a "complexity catastrophe." Much to everyone's surprise, you could have too much connectivity. In the long run, an overly linked system was as debilitating as a mob of uncoordinated loners.

Somewhere in the middle was a peak of just-right connectivity that gave the network its maximal nimbleness. Kauffman found this measurable "Goldilocks" point in his model networks. His colleagues had trouble believing his maximal value at first because it seemed counterintuitive at the time. The optimal connectivity for the distilled systems Kauffman studied was very low, "somewhere in the single digits." Large networks with thousands of members adapted best with less than ten connections per member. Some nets peaked at less than two connections on average per node! A massively parallel system did not need to be heavily connected in order to adapt. Minimal average connection, done widely, was enough.

Kauffman's second unexpected finding was that this low optimal value didn't seem to fluctuate much, no matter how many members comprised a specific network. In other words, as more members were added to the network, it didn't pay (in terms of systemwide adaptability) to increase the number of links to each node. To evolve most rapidly, add members but don't increase average link rates. This result confirmed what Craig Reynolds had found in his synthetic flocks: you could load a flock up with more and more members without having to reconfigure its structure.

Kauffman found that at the low end, with less than two connections per agent or organism, the whole system wasn't nimble enough to keep up with change. If the community of agents lacked sufficient internal communication, it could not solve a problem as a group. More exactly, they fell into isolated patches of cooperative feedback but didn't interact with each other.

At the ideal number of connections, the ideal amount of information flowed between agents, and the system as a whole found the optimal solutions consistently. If their environment was changing rapidly, this meant that the network remained stable-persisting as a whole over time.

Kauffman's Law states that above a certain point, increasing the richness of connections between agents freezes adaptation. Nothing gets

done because too many actions hinge on too many other contradictory actions. In the landscape metaphor, ultra-connectance produces ultra-ruggedness, making any move a likely fall off a peak of adaptation into a valley of nonadaptation. Another way of putting it, too many agents have a say in each other's work, and bureaucratic rigor mortis sets in. Adaptability conks out into grid-lock. For a contemporary culture primed to the virtues of connecting up, this low ceiling of connectivity comes as unexpected news.

We postmodern communication addicts might want to pay attention to this. In our networked society we are pumping up both the total number of people connected (in 1993, the global network of networks was expanding at the rate of 15 percent additional users per month!), and the number of people and places to whom each member is connected. Faxes, phones, direct junk mail, and large cross-referenced data bases in business and government in effect increase the number of links between each person. Neither expansion particularly increases the adaptability of our system (society) as a whole.

<http://www.kk.org/outofcontrol/ch20-d.html>