(A Computer simulation)

1. Introduction

While pondering about stepping out of my home, the westward winds of March turned into the southern gusts of September. Strangely enough, during this long time, I started missing some good rides on the streets. I enjoyed these rides but maybe my fading memory of the streets and routes made me feel it this time. You know driving is only possible by placing trust on those who are riding alongside you. It is very surprising that we place our lives in the hands of others – of course, they do the same too. The most interesting fact about this arrangement is that it has worked - you reach home safely, way more often than not. In reality all the drivers in traffic are taking individual judgements about how fast to move and which lane to move on. Even where there is no one guiding a person on how to drive, there are very few accidents in total and you're home every day. The National Highways Authority of India reports yearly the number of accidents that occur on highways. The rate for the year 2019 – 2020 was about 17 accidents per 100,000 vehicles. [1]India's accidents rate lies very close to the global average. For a safety officer in India it might be a bit scary that Indian roads have slipped lately in the rankings but for people like us, it is very reassuring that people around us can drive well. The fact that 99,966 drivers of the 100,000 are able to reach home safe is something remarkable. Random strangers being able to take a good judgment collectively is very puzzling. This is a case of excellence emerging from ordinary people.

Such examples lie very close to our life experiences but we have far long ignored them. In retrospection we find many examples in which the crowd or a group has achieved something surprising. There is something intriguing and mystical about the crowd's performance in decision making. You can only wonder about the reason behind this startling performance of crowds, what makes them good and how you can harness this power in your own life. Utilizing scepticism as our primary tool, this work has been produced in search for answers and empirical proofs for some ever-present questions about crowds. The discussion starts with a test of a group's performance, then tackles some conventional beliefs and moves on to presenting a possible answer for this phenomenon before exploring some real-life implications of the work.

The work revolves around a computer simulation programmed for this very purpose. In the simulation, a group of individuals is created whose main aim is to tackle a problem. For simplicity sake they are to choose between two possible answers out of which one answer is right. Each individual takes an independent decision. All individual decisions are aggregated and the solution with highest number of votes is determined as the group's decision.

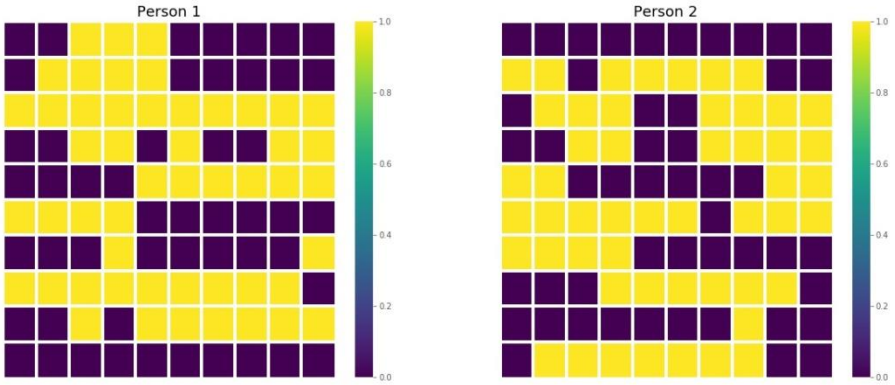
Individuals of a group have a skill-level representing the information they posses relevant to solving the problem. In this simulation, the skill–level is determined by a value called ***'proficiency'.*** The higher the proficiency, the more skilled the person in the simulation the more likely he is to make the right decision. If for instance the simulation was looking at the decision of playing a correct tennis stroke at an instance, the skill level represented by ***proficiency*** would represent how good they are on average at selecting the right shot. Each individual also has different pieces of relevant information known as areas of specialization. Take for example Rafael Nadal who plays better on clay than on hard surfaces. He would have more pieces of information required for playing a correct stroke on clay

[1] "Road Accidents in India". *Ministry of Road Transport and Highways of India, Research Wing*, 2018. Accessed on 21 September, 2020.

surfaces than on hard surfaces. In this sense, each individual has a different combination of information with them. This system as a whole represents an ideal group which is diverse (due to the different pieces of information), independent (individuals take their own decisions and is decentralized (which has no central authority). [2]

This brings us to the actual working of the simulation. Consider all the information relevant to solving a problem to be represented by a hundred blocks. As discussed earlier, each person has a different skill-level and so would have the information in a certain number of these blocks. The number of blocks he would have is dependent upon the proficiency of the person. Also people know different pieces of information and specialize in certain areas. So, each individual has a different combination of blocks that he knows.

Figure 1: Sample Areas of Specialization of Individuals



The figure shown above represents two sample people of the group. The hundred blocks represented here as mentioned earlier represents all relevant information in tackling a problem. The lightened squares in the figure represent the information that a person knows while the darkened squares represent those that a person does not know. As seen in the figure each person has a different set of specializations. A group consists of a number of these people with different specializations. A random number between 1 and 100 is generated. The block at this serial number is looked at for every person in the group.

If the block is lightened, like the box at serial number three (third in the top row) of Person 1, a right decision is taken by the individual. If the block is darkened, like Person 2 at the same block, a wrong decision is taken. The number of lightened squares a person possesses is equal to the proficiency of the person. As blocks equal to a person's proficiency are darkened for each person, each person has a chance equal his proficiency to give the right answer. The votes of all the individuals are aggregated and the group's decision is computed. Each group is put through a thousand of such tests and the mean performance is reported. Now that the working of the model is clear, it is our primary objective question if the crowds are actually wise. So, the next section is going to deal with this immediate question.

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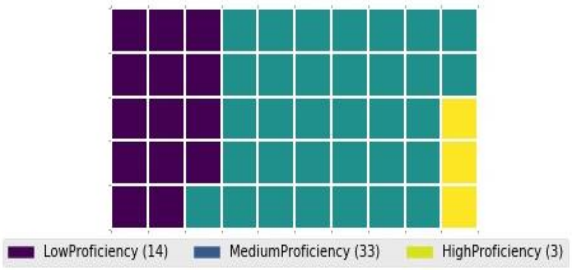
[2] Suroweicki, J. (2004). "The Difference Difference Makes: Waggle Dances, the Bay of Pigs, and the Value of Diversity." (Author), *The wisdom of crowds* (pp. 23-40). New York: Anchor Books.

2. The Power of Ordinary Groups

To uncover if ordinary groups perform well we must put our scientific skepticism to use. We could test the wisdom of the crowd to the extremes by having a very low proficiency score. An average proficiency score around 0.55 would be harsh test; because it just marginally better than a random coin toss which has a 0.5 chance of guessing the right answer. People in real- life are a lot better than random coin tosses but this test would reveal if the crowds really have something going for them. This section really asks the question if ordinary people together cultivate extraordinary abilities.

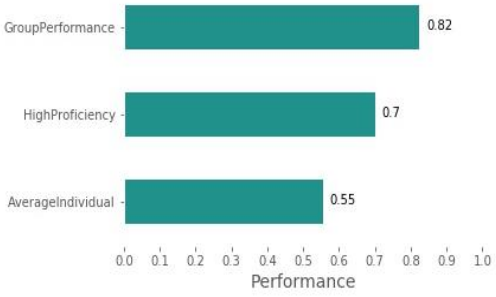
In this experiment a modest group containing fifty people is considered. To ensure that the group is diverse we will have a range of possible proficiency values with the mean proficiency being close to 0.55. Also, each individual will have diverse areas of specialization. The composition of the group is shown in the Waffle Chart. (Explain the number of people in each category)

Waffle Chart 1: Composition of a Diverse Group



The group is predominantly made up of low and medium proficient people with a small portion of high proficient people. The low proficient section has an average proficiency of 0.52 – so would have 52 lightened blocks out of a 100. The medium section has an average proficiency of 0.56 and the high section has an average of 0.66. So, the people in the medium and high sections have 56 and 66 lightened blocks respectively. The proficiencies in the group range from 0.50 to 0.70 but with an average proficiency of 0.56.

Figure 2: Performance of an Ordinary Group



The group was tested for thousand runs and the performance of individuals and the group as a whole was computed. The adjacent bar plot shows the results. The group performance at 0.81 is about 47% higher than an average individual's performance. The group as a whole performs way better than an average individual. Again, it is the group of ordinary people with a proficiency score slightly better than a coin toss that has produced such a high performance. Ordinary people just by aggregating their individual decisions were about 47% smarter. This demonstrates the extraordinary powers of a crowd.

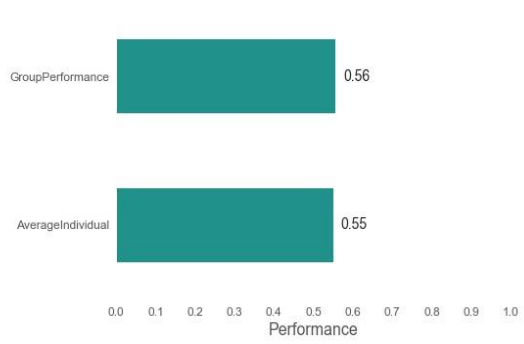
Another interesting observation from the plot is that the group outperforms even the person with the highest proficiency in the group of 0.70 . The performance of the group is about 12% better than the most skilled person in the group. Essentially it shows us that a group is greater than the individual sum of its constituent members. The group in a sense invokes synergy between its

constituent members which makes it perform even better than the most skilled-person in the group. The decision of a group is even more credible than the most proficient person in that group. Again this is a mean performance of the 1000 runs– so the group consistently outperformed each individual of the group.

It is really hard to digest that a diverse group of ordinary people – who here are assumed to be just marginally (in real-life they are far more skilled) better than a coin toss at predicting the right solution, collectively are able to come up with the right answer. It is only natural to ask what happens if the group is not diverse.

Consider a non – diverse group which is to tackle the same problem. Every person in the group has about 55% chance of taking the right decision. The performance of the group and average individual is measured over thousand runs. The results are again presented in the bar plot given below.

Figure 3: Performance of a non–Diverse Group



As seen in the figure, the performance of the group is almost equal to the performance of an average individual at 0.55. As individuals are not specialized, they have overlapping knowledge about the problem. Each and every person in the group is like a perfect clone of each other. Their overlapping understandings contribute to nothing more to what the group already knows but only strengthened the information already known by the group. The bits of information which are not known to the group are never explored due to homogeneity. The group has isolated itself to this unexplored information. Diversity and specialization help break this homogeneity and introduced different pieces of information to the group. So specialization and diversity are essential for a group's performance.

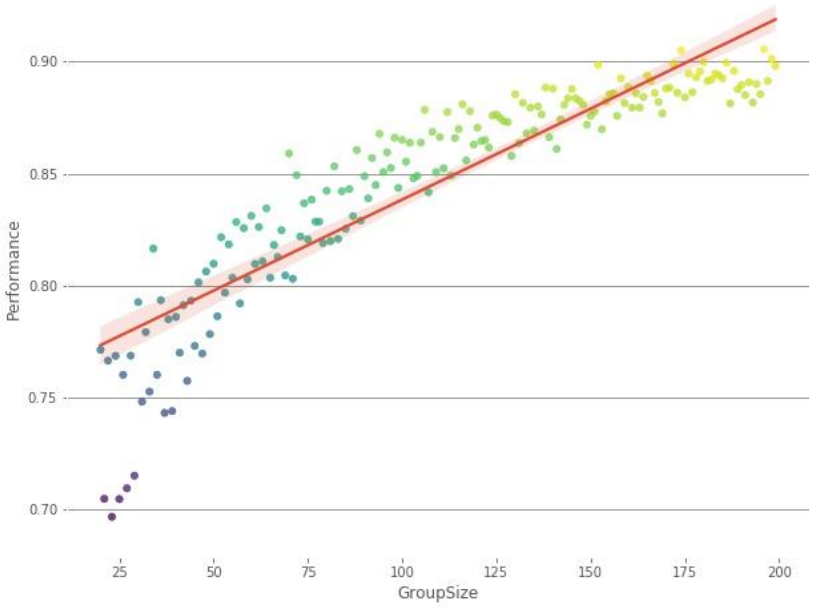
The characteristics of diversity, independence and decentralization help in maximizing the performance of a group. These traits essentially help surface the total information available at a group's disposal. The main advantage of such a group is that it effectively cuts down errors. Because individuals present a decision independently only considering the information they possess, they do not make co-related errors. Even though an error is committed by an individual, the decisions of others in group help correct this mistake. This is only possible because every individual has his own combination of information pieces. This makes it very unlikely that many people commit the same mistake. Hence group with these characteristics is able to transform itself into something that is greater than the sum of its individual members.

The success of free markets in the western world has been attributed to this a mechanism that it incentivizes. The market is very effective is cutting down bad ideas quickly. Out of the many ideas that reach the marketplace, only few are ever successful. Inefficient or ineffective ideas are quickly exit the market. In this sense by quickly rejecting bad ideas, the society as a whole arrives at incrementally better ideas. So, the group – in this case the society as a whole benefits due to cutting down bad ideas.

It is evident that a diverse group is far more intelligent than any of its individuals – even if they are highly proficient. The surprising performance of the group shown earlier was produced at a modest group size of fifty people. It is only natural that our eyes widen with suspicion at this. It could well be one particular case of a group size and maybe different group sizes perform very differently. So our discussion continues to this question - *'How does the group size affect a diverse group's performance?'*

A new diverse group is created at each size ranging from one to two hundred. The group as earlier consists of predominantly low and medium proficiency people with a few high proficiency people. The composition of each group is the same as that showed earlier in Waffle Chart 1. Each group has the same ratios of different proficiency levels. The performance of these groups as usual considered over thousand runs. The results of this computation are shown in the scatter plot below.

Figure 4: Performance of a Diverse Group at different sizes



It is important to note that the scale of the graph on the Y-axis starts at the average value of individual performance – 0.55. The graph reveals to us that the group size increases gradually with increasing group sizes. It is clear that there is a healthy relationship between performance and group size. For every additional person added to the group, the performance boosts by around 0.5% . Although group sizes only up to 200 were considered for this simulation, the general trend suggests that the performance would increase with greater group sizes. Some points at smaller group sizes around 0 to 12 shows a wide variation in performance. In this region, groups with similar sizes have largely different performances reaching about an accuracy of 0.90 at best and falling to 0.65 at worst. On an average they still follow the general trend and settle around the value of 0.77. In spite of the great variance, these small groups of people have performed consistently better than the average individual. The average performance of small group is about 40% higher than the individuals. These small groups also consistently perform better than the most proficient persons present in the groups with a proficiency of 0.70 while the average group performance is 0.77. Astonishingly, small groups also perform very well.

In practical situations it is very hard to muster a big group of people. In most real-life cases, building up a small group is quick and easily achievable. The latest findings reassure us that these small groups are also very effective in this making the right decisions. Generally speaking it is always better to bring together the biggest diverse group that can be mobilized in given situations. But we must not shy away from forming smaller groups when the situations do not permit the formation of big ones. In light of the previous discussion, it can be understood that groups are always better than individuals at taking the right decisions. In almost all cases, groups of any size are better than the most proficient individual present in the group.

There is an important point worth mentioning here. Small groups usually fall into the trap of encouraging a consensus. The notion of *"Can't we all get along"* is a lot stronger in smaller groups. In this way, small groups are easily swayed into one common outcome. When small groups fall into this trap, they lose all the advantages of improved group performance as shown earlier. So it becomes fundamental to encourage dissent in small groups.

Anyway, the revelation that groups perform even better than the most proficient members is a particularly counter-intuitive. In real-life situations we often rely on the most proficient of us for answers and it hard to believe that their performance can be topped by a group containing ordinary people. We will question the impact of these high proficient people in the next section, - the so called *'experts'*.

3. The Impact of Experts

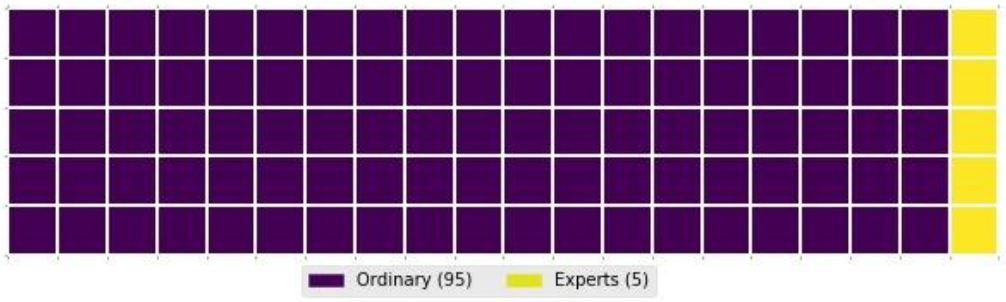
It has become a common notion that experts are usually right when it comes to business, sports and science and as a matter of fact they are usually right. Our confidence on experts truly arises from our experiences in watching these experts at work. But also regularly we see experts getting their estimates wrong. In the US presidential election of 2016, a vast majority of experts predicted an easy victory for the democrat Hillary Clinton. Proving all the experts wrong, the republican candidate Donald Trump won that election despite being heavily out-favoured. Still there is a lot of confidence built around experts. We have also seen in the earlier section that the group as a whole generally outperforms the most proficient person present in that group. Before our confidence turns into an illusion of knowledge, we must question the impact of '**experts'** on a group. In this section we will be discussing the impact of experts on an ordinary group, the performance of a group of experts and evaluating if the costs of acquiring them justify the benefits the group achieve.

Though the word 'expert' can have many contextual meanings, it usually refers to people who are extremely good at performing certain tasks. Experts are highly skilled at performing tasks and so in our simulation have a high proficiency score. There is something we must consider though before moving on. As James Suroweicki discusses in his book *'Wisdom of Crowds'*, experts usually have same the specializations of knowledge.[3] Cristiano Ronaldo is one of the most prolific scorers in the history of football and is considered to be an expert finisher. He is called an expert finisher because he can head the ball, score with either of his feet and even convert half chances into a goal. If for instance someone else is called an expert finisher; it is only fair to assume that he/she must have some or even all of these above mentioned characteristics. You are only called an expert if you are good at certain tasks. Hence, the simulation accounts for similar specialization for experts of the same kind.

Before considering the group consisting only of experts, let us examine their effect on groups which are predominantly ordinary. In this section we will consider the impact of more proficient experts and more number of experts on the performance of the group. The impact of experts on the group could be explored by tweaking the values of their individual proficiencies or by changing the number of experts in a group. A binary model consisting of only ordinary and expert people can simplify the process. To be consistent across different runs, the proficiency of ordinary people is taken to be constant. Expert proficiency on the other hand could be changed to explore the impact of theirs. The waffle chart below shows a sample structure of such as group.

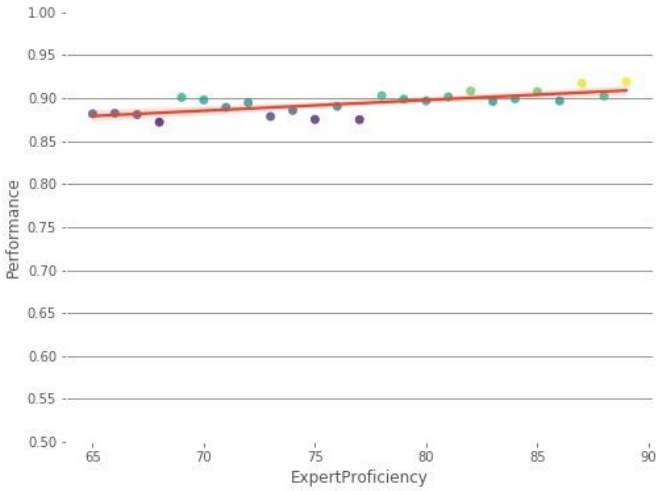
[3] Suroweicki, J. (2004). "Monkey See, Monkey Do: Imitation, Information Cascades, and Independence" (Author), *The wisdom of crowds* (pp. 23-40). New York: Anchor Books.

Waffle Chart 2: Composition of Predominantly Ordinary Group



By changing the proficiency of experts in the group, we could understand the how much the group performance is affected with changing proficiencies. A group with the same composition is run through different proficiency levels of experts ranging from 0.65 to 0.90 while keeping the number of experts constant. The group performances at different proficiency levels are stored and displayed in the graph below.

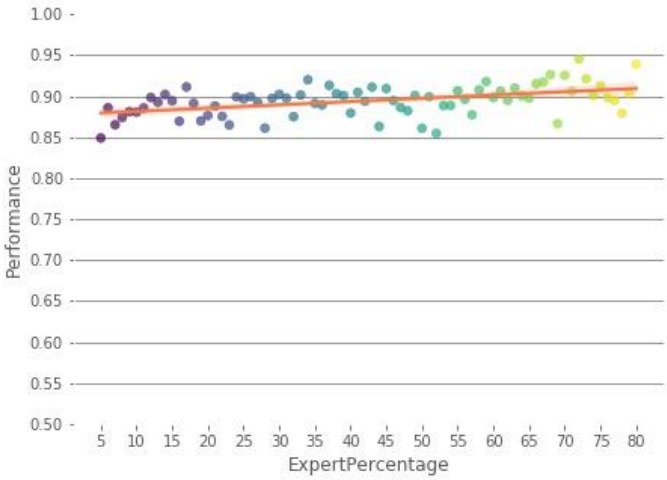
Figure 5: Performance of a Group at Different Expert Proficiencies



At first sight it is clear that as the expert proficiency increases the performance of the group improves. It is true that as you take in better experts into a group, the performance of the group improves. This is because the total information available with the group increases with an increase in the proficiency of the experts. You can also observe that the line is reluctant to rise. The line is very flat and does not change much. In fact a 40% change in the Expert Proficiency causes only a 4% change in group performance. Better experts do have a positive impact on the group performance but the impact is marginal. If better experts have a limited impact on the group, how much impact does more number of experts have?

Again in an intuitive sense, higher number of experts must improve the group performance. The question here is, *if an increase in quality is not very effective in boosting group performance, is quantity effective?* The number of experts could better be presented as the percentage of group size. In this case, a new group is created with the expert percentage ranging from 5 to 80. The performance of each group is then estimated through thousand runs. The figure below represents the impact of higher expert numbers in a group.

Figure 5: Performance of a Group at Different Expert Percentages

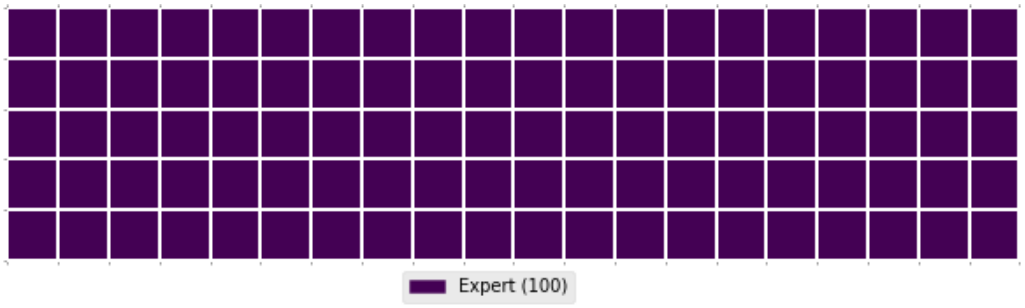


First estimates from the graph are against our common notions. The line here too shows reluctance to rise. Even when the expert percentage is as high as 80% did not help the group performance by much. In this case, a 1500% change in the expert percentage caused only a 3% change in the performance. More number of experts marginally improves the performance of the group as a whole. In this awakening we realize that better experts and even more experts do not help the group as much as our instincts say they do.

In this almost counter–intuitive realization, it is good to look for possible reasons for this happening. As already discussed earlier, the experts do have an concentrated overlap of knowledge amongst themselves. This overlapping knowledge does not help contribute to the group as a whole. It makes the group more confident in what it already knows but gives it no chance of getting the unknown right. As more experts join the group, only marginally new information is being added to the group and so the performance only improves marginally. So acquisition of better or more experts may not as effective in presenting a good decision. One question that may have been in the background of your mind is – *"How does a group of only experts perform?"*

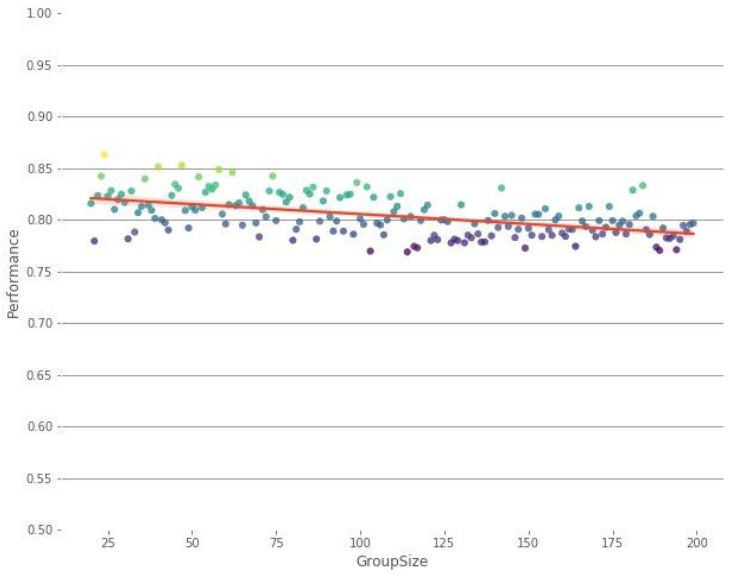
Only a group of experts could answer how they would perform . The composition of the group as shown below is purely homogenous. Experts with proficiencies ranging from 0.65 to 0.80 are considered in the group to maintain a skill-level diversity. The average diversity is maintained at 0.76 .

Waffle Chart 3: Composition of the Expert Only Group



So, in order to base our findings on general trends and add surety to them, group performances of the expert group is considered over different sizes. A new group of experts with the same average proficiency at a given group size is created and the performance is computed.

Figure 6: Performance of Expert Group at different Group Sizes



The results come as quite a surprise. The performance of the group shows a decreasing line. The scale of the graph starts from the average value of expert proficiency of 0.76 instead of zero so the decrease looks exaggerated. With each additional person in the group, the performance decreases at a rate of about 0.05 and so the loss of performance is very low. In percentages, for an 88% increase in group size the performance reduced by about 4.7%. The group achieves higher performances at smaller sizes but it is also important to consider the proficiency of an individual which as mentioned

earlier is around 0.76. So the group as whole does not perform much better than any individual. It is interesting to understand the reason behind the incompetence of bigger expert groups.

The performance of a group in the simulation is entirely dependent upon decisions taken by individuals. Examining closely these individual decisions my reveal some insights on to the performance of the group of experts. Think of the below heat map as the superimposition of individual specializations shown in the earlier discussions. The confidence at each piece of information is represented in this heat map.

Figure 7: Confidence at Different Blocks in Expert Group

The figure shows the pieces of information that the experts-only group specializes in. The heat map reveals an important observation about this group - the central squares in the grid are brightly lit in yellow representing about a hundred percent confidence of making the right decision in these areas. On the other hand, the blocks in green have relatively lower confidence rates of around seventy. Finally, the blue blocks have very low confidence rate of about forty percent. The group has lower confidence in getting these blocks. The experts due to their tendency of having knowledge of the same kind make the group less effective. The most important point here is that as experts are concentrated sources of knowledge and hence are not very effective in helping the group take decisions. Experts of the same kind contribute to the group by giving similar opinions. This is the reason behind the disappointing performance of the experts.

These insights may help clear some misconceptions we possess about experts. Experts have a low positive impact on the performance of a group. Considering the additional costs of acquiring, hiring or consulting a number of experts or more skilled-experts is almost always not justifiable by the improved performance of the group. Additionally, even if experts are considered, it is not desirable to take many of them. The most important takeaway is that a diverse ordinary group with low to medium proficient people outperforms even the experts (from the graph of different expert percentages). The reason behind the group of experts not performing as expected is due to the concentration of knowledge. It is true that too many cooks spoils the broth.

The success of the scientific community lies in its readiness to publish new information. Most scientists immediately publish the results of experiments and leave it to the scientific community to scrutinize, test and build-upon them. This immediate diffusion of information makes the scientific community as whole smarter in acquiring new knowledge. No wonder the rate at which the scientific community produces knowledge is out of the charts. So, in a scientific spirit we must question what happened to help the diverse group of ordinary people in its performance. The next section tries to answer this question.

4. Comparison of Different Groups

After all that we have discussed, one last comparison between groups would yield us the closing remarks for what has worked for or against them. We have considered three groups in all – the ordinary group, the diverse group and the experts group. In an effort to understand how to optimize the performance of a group let's compare these groups.

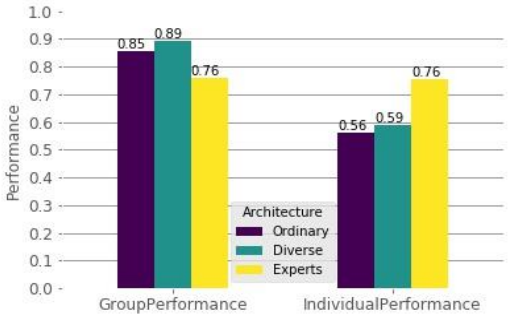
4.1 Architecture:

Individuals in both diverse and ordinary groups had completely varying areas of specialization. The only difference in these groups was that the diverse group introduced randomness to providing a range of possible values for individuals where as the ordinary group had assigned fixed proficiency values for experts and ordinary people. Contrastingly, the individuals in the expert group were all experts with varying proficiency levels but with similar areas of specialization. This represents the real-life compositions of groups if they were ever created. The *diverse group* is the closest representation of a group of actual peoples with a wide range of proficient people being present. The *ordinary group* is an idealistic version of real-life groups as it assumes that ordinary or expert has a constant proficiency level.

4.2 Performance & Confidence:

The performance of a group is informative when the performance of individual is also provided. The measure of the group's efficacy is the improvement it has shown on top of an average individual's performance. The Group and Individuals performance of these groups can help shine some light on the actual scale of difference in performance across groups. The groups with a size of hundred is created in order to compare the different group architectures. These values are shown below in the figure.

Figure 8: Comparison of different groups



The experts group fares the worst in this experiment despite having the highest individual performances. Its performance is a downgrade from the average individual performance of 0.76. The difference as already examined lies with the concentration of knowledge in that particular group. Interestingly the ordinary group with a binary architecture and the diverse group have similar performances. In close comparison the diverse group produces a slightly lower accuracy with a higher individual performance. The idealistic version of a real-life group is out performed by a closer representation of real-life. The biggest takeaway nevertheless is that these groups which resemble real-life groups perform way better than experts and their groups. These groups perform better than the person with highest proficiency present in that group. Again it is clear that the groups of ordinary people perform very well but all the credits go to something counter-intuitive - dissent. To understand visually, take a look at the next figure.

Figure 9: Confidence at each block of the Group as a whole

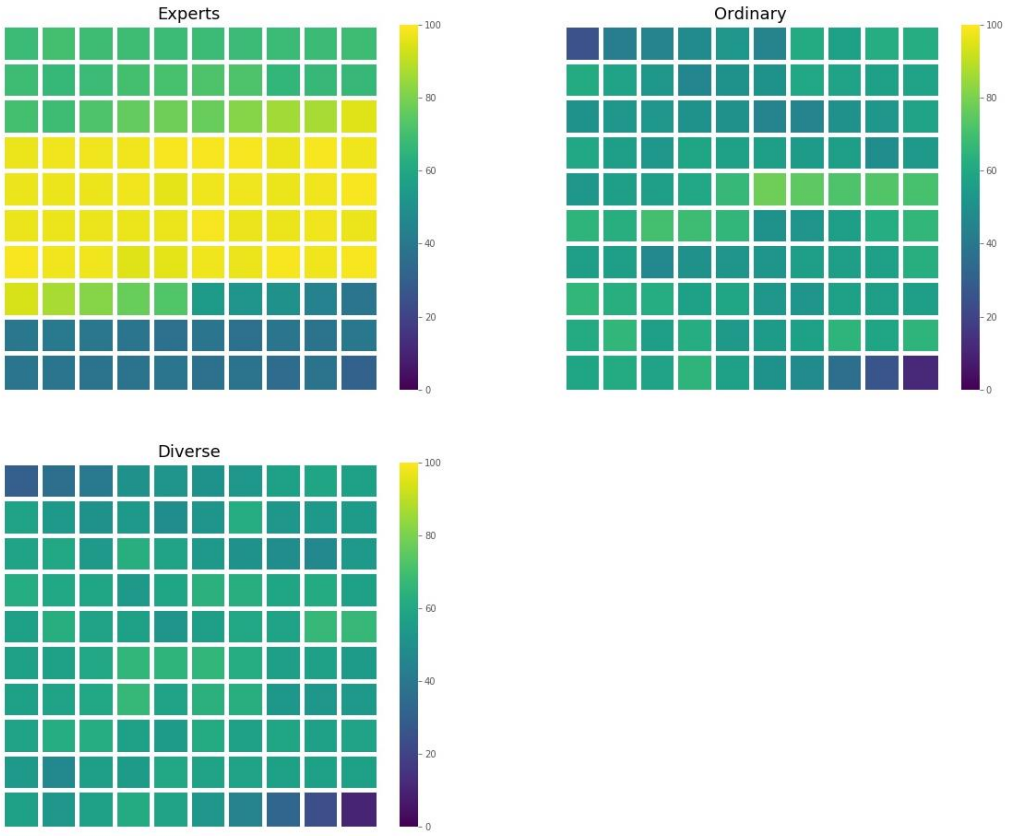
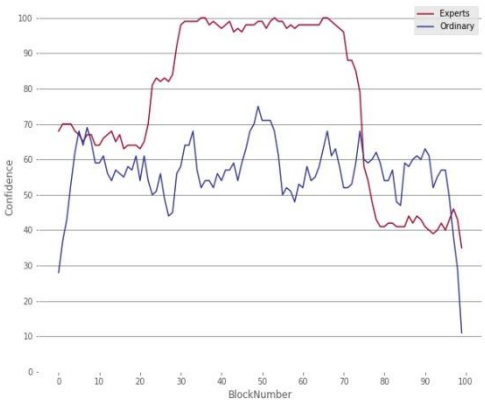


Figure 10: Confidence at different Blocks



These heat maps represent the confidence the groups have achieve at different blocks. If the group is able to muster a confidence of above 50% for a block; the whole group knows a particular piece of information and would vote correctly in the tests. It is clear from these heat maps that the confidence is extremely polarized for experts while there is homogeneity for diverse and ordinary groups. The ordinary and diverse groups however have a much lower confidence in these blocks – this is a result of dissent. These groups have a strong opposition to an idea too. Unlike experts who more or less develop a consensus – as seen by the 100% confidence in many blocks, these groups allow for variance in approach to the problem. This makes them less susceptible to the trap of consensus which discourages the existence of many perspectives. This polarization leads to an overall reduction in

information of a group. Dissent is an important feature of any successful group, and it must be encouraged. *(Israel cabinet)*

This spread out confidence in information makes the diverse groups better at taking decisions based on the known information. As a matter of fact the group of experts has the greatest sum of individual pieces of relevant information as the individual proficiency is higher. This can be seen in line plot above in which the area under the graph shows the information present with a group. The group of experts tower over the ordinary group in this matter in almost every block, yet a lack of confidence in the last few blocks costs the experts dear. It is paradoxical that even with greater amounts of information a group cannot perform well. As in real-life cases, more knowledge does not mean a smarter person.

5. Conclusion

5.1 Limitations

This simulation has been very successful in capturing underlying patterns of group dynamics. It has also been able to identify some subtle insights which can be helpful in building successful groups. Yet there are some limitations to this simulation of group dynamics.

- The implications of the findings are based upon the assumption that groups are diverse, independent and decentralized. In actual groups with people, it is very hard to achieve independence of individuals in presenting decisions. Real-life groups are very susceptible cascades, in which the decision of some people largely affects the decisions of others. In building an effective group, such like problems must be tackled.
- The work only considers only one type of experts in considering their impact. A group consisting of experts from various fields would work very differently. In view of the findings of the work, it would perform very well due to its diversity and high proficiency.

5.2 Implications

- Solutions to problems such as automobile pollution which involve costs being levied on the society as a whole can be solved using the market's wisdom. A market based solution enables decisions to be taken by individuals. The collective wisdom emerging from these individual decisions helps reach a good solution for the problem. Regulations and other command based approaches do the complete opposite by trusting few experts. These decisions are in most cases ineffective or inefficient. So, the wisdom of crowds can help reshape some public policies.

- Newer methods of voting such as Single Transferable Vote (STV) can help extract most information from an individual. Instead of a conventional voting system which asks voters to name their first preference, STV[4] asks voters to list their top preferences. As people are able to present more information into the system, an entire voting block is likely to take a better decision. These voting systems have been proven to increase voter happiness and return fair results.

- Small groups if successful in eradicating the *'curse of consensus'* are effective in taking good decisions. Any decision ranging from serious business proposals to deciding which dress suits well can be tackled by small groups. Even at the level of teams, sports or otherwise can take better decisions collectively.

Collective wisdom of a group can be utilized in any scenario which offers a group to exist; ranging from Debate clubs to top-level executive meetings. If the basic conditions of independence, diversity are met within a decentralized structure, a good decision is very likely to be taken.

[4] "Single Transferable Vote". *Electoral Reform Society.* Accessed on 21 September, 2020.

5.3 Conclusion

The document reveals some key insights of a group that can help in decision-making. These insights are universal to any group that has the characteristics of diversity, independence and decentralization – ranging from school clubs to business companies. A group powered with a diverse set of individuals with provided with basic information relevant to solving a problem can achieve great successes in reaching the right decision. The key findings of the document are -

- Groups are always better than individuals at taking right decisions and consistently outperform the most proficient member of the group.
- The bigger the size of the group the higher the chance of it taking the right decision.
- Even small groups perform way better than average individuals and may even compete with the performance of experts.
- Experts have a low positive impact on the performance of the group. The costs of acquiring experts are usually higher than the benefits of they provide a group with. If experts are to be included into the groups, it is better to have them from different fields and have few of them.
- Diverse, independent and decentralized groups in real-life are very effective in tackling decision making problems.

You could consider next time harnessing the wisdom of crowds in taking a decision. Just consider these findings while selecting such a group and way more likely than not you are going to fall in love with the crowds.

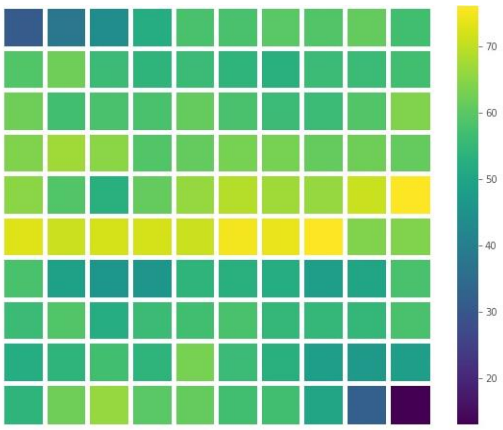
6. Additional Figures

1) Additional Figure: Expert Group - Sample Individual Specialization

The areas of specializations of individuals in the expert group

2) Additional Figure: Random Group Specialization

A group created completely with random proficiencies within the range 50 - 70



Sources

1) "Single Transferable Vote". *Electoral Reform Society*. Accessed on 21 September, 2020.
2) "Road Accidents in India". *Ministry of Road Transport and Highways of India, Research Wing*, 2018. Accessed on 21 September, 2020.
3) Suroweicki, J. (2004). "Monkey See, Monkey Do: Imitation, Information Cascades, and Independence" (Author), *The wisdom of crowds* (pp. 23-40). New York: Anchor Books.
4) Suroweicki, J. (2004). "The Difference Difference Makes: Waggle Dances, the Bay of Pigs, and the Value of Diversity." (Author), *The wisdom of crowds* (pp. 23-40). New York: Anchor Books.

Figures

Waffle Charts

Additional Figures