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14. ABSTRACT

As the world becomes more interconnected digitally, even the most basic actions are producing data points that paint a picture of a society's activities and beliefs. The study of societal beliefs and actions using "big data" has been termed social physics--the study of information and idea flow relative to human behavior. Research and experimentation is required to determine if social physics can provide insight into the operating environment in ways that can be informative and even predictive for a Geographic Combatant Commander. This paper defines social physics, it explains the importance to operational planners, it proposes a method to use social physics at the GCC-level, it recommends an experiment case, and it answers the shortfalls and challenges that are associated with using social physics to help understand the operating environment.

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FUTURE WAR PAPER

Social Physics: A Tool for Operational Design

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MASTER OF OPERATIONAL STUDIES

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Introduction

Every minute throughout the world, individuals produce bits of data that tell about their activities, preferences, and even their beliefs and biases. Collectively, this information can show trends in a society. The information can be as benign and anonymous as the fact that Store A sold one unit of soda for $1.50 to one person of unknown age, gender, or ethnicity. Of course, the data can also be very intimate, but big data analysis and the science of social physics are more concerned with the benign bits of data.

[1] Everyone is producing data points*, as recent articles in publications such as *Foreign Affairs* explain.[2] Taken together the data shows trends in groups of people and the trends tell a larger story of societal interaction and the flow of goods, information, and even ideas. Studying the right big data can provide insight into societal beliefs, and this data can also be used to predict future activities of the same groups because most of the data reflects the unconscious habits of individuals. Economist Daniel Kahneman refers to conscious and unconscious thought as System 1 and System 2, respectively.[3] Automatic (or unconscious) thought is often demonstrated by how people behave, and conscious thought is represented by what individuals believe.

With the above in mind, analysts use big data and the science of social physics to track the ideas groups of people, and they have succeeded with tracking ideas in groups as large as cities. In doing so, the analyst is able to identify the actions society is taking with regard to those ideas, and researchers have been able to manipulate a group's behavior and beliefs through social physics. If true, social physics can be a powerful new tool for military planners and commanders at the Combatant Command (CCMD) level.

Overview

* Phones around the world produce data points regarding the phone's location, status, and usage. Also, data is produced by satellite television links, daily business transactions, and Internet activity.

This paper will accomplish four tasks. First, this paper defines the science and explains the importance of social physics to operational planners. Second, this paper proposes a way in which operational planners and commanders can use social physics at the theater or CCMD level. Third, this paper outlines a recommended experiment based on a recent crisis to determine the validity of social physics on planning. The results should influence future operational design and campaign planning. Finally, this paper identifies and addresses challenges and opportunities that are inherent within an experiment using digital media. In the end, this paper will have shown the value of social physics for operational design, and proposed an experiment that will either validate or disprove social physics and big data as tools for planning.

Social Physics Explained

Today's world is more interconnected by computers and personal data than ever before, and counterinsurgency expert David Kilcullen is only one recent author who warns of a future of urban threats and opportunities for militaries in such a world.[4] For example, Killcullen describes digitally, crowd-sourced counter-sniper operations in Libya where locals used Google to identify sniper locations. Coalition aircraft used these "overlays" to conduct strikes, and the locals, noting the tactical utility, adopted the method to counter pro-Qaddaffi snipers.[5] Such is the opportunity of social physics.

Social physics measures quantitative connections between information and idea flow relative to human behavior, much as energy translates to motion in traditional physics.[6] Social physicists make a compelling case that much of the data shared around the world can help predict conflict and unrest, and if Jake Kendall and Rodger Voorhies are correct, the increased use of cellular phones and other electronic devices will be the means by which much of the data is generated.[7] In that regard, MIT's Alex "Sandy" Pentland, describes the new science of social physics as the analysis of "big data", the term used for the seemingly

limitless amount data generated by individuals—regardless of a person's connectivity to the Internet.* Professor Pentland and his team of researchers have claimed that a better world can be created by the appropriate application of big data research and analysis. In fact, researchers for Data for Development (D4D), a cooperative effort between Orange, MIT, Louvain University, UN Global Pulse, and the World Economic Forum, reported in May 2013 that they had been able to use social physics to improve public health systems, transportation systems, and government transparency in Cote d'Ivoire.[8] The predictive power of this new science has very real potential for a military planner or commander.

By studying big data, experts in social physics and big data analysis have accurately predicted social and environmental phenomena such as disease, ethnic conflict, panic, financial fluctuations, and even individual behavior and belief changes.[9] Researchers have also solved complex problems with relative ease, including a contest sponsored by the Defense Department's Advanced Research Projects Agency (DARPA) called the "Red Balloon Challenge." The Challenge was to find ten red balloons that had been tethered around the United States. The team with the fastest time won $40,000. Professor Pentland's team "used social network incentives to build a worldwide organization and accomplish the difficult task in only a few hours."[10] The purpose of the DARPA challenge was to investigate new, innovative ways of solving time-critical tasks such as search-and-rescue operations or other time-sensitive crisis response operations. The possible implications for future campaign design and contingency planning seem clear.

Since social physics can support operational design and operational art as part of the future of war, both operational design and operational art must be defined for use in this paper. Operational design "is a process of iterative understanding and problem framing that

* Even non-connected individuals produce data, if they interact with connected persons. For example, store purchases provide data that can be analyzed, even though the individual concerned does not "actively" contribute to the production of the data.

supports commanders and staffs in their application of operational art with tools and a methodology to conceive of and construct viable approaches to operations and campaigns."[11] Operational art "is the application of creative imagination by commanders and staffs—supported by their skill, knowledge, and experience."[12] With both in mind, social physics seems a natural tool to assist in understanding the environment prior to contingency planning.

As noted, predictive science might lure systems theorists into the belief that social physics, with the power of the interconnected world, will be better able to predict or plan for future conflicts. However, social physics is not a panacea for future warfare or politics because societies are in fact hyper-connected, open systems. An open system means that any energy introduced into the system changes the system, and the changes cannot be predicted with accuracy. Social physics can assist military operational planning by informing operational design and operational art to allow planners to better understand "wicked" or complex problems that may produce future conflict, but social physics will not solve the problem.[13] Thus, without experimentation, the military will not know how helpful social physics can be at helping to understand future problems.

Social Physics and Operational Planning

Ideas are the seeds of change and innovation and military planners at the operational level must anticipate, respond, or react to change. Therefore, logic would dictate that operational planners would benefit from understanding the flow of ideas in their Area of Operations (AOR). As outlined above, operational planning consists of at least two parts that are germane to this paper, operational design and operational art. Both of these components of planning can be informed by better understanding of the interactions of people within an AOR. If the character of future war is as driven by ideas, ideology, and non-state actors as some think-tanks predict, operational planners would benefit from understanding the origins and flow of these ideas. Like physicists, planners can observe the flow of energy through the

system. In this sense, flow not only means the movement of energy in a specific direction but also the quantifiable changes to the energy. Thus, if insurgents, terrorists, or other non-state actors use ideological and psychological manipulation to achieve their political goals, it would benefit the operational planner to understand the ideas at the root of popular response to their activities. Understanding in this context would incorporate knowledge of the target audience, the origin of threatening ideas, the impact of the idea flow, and the possible future psychological state of the audience. Such understanding can only benefit the operational planner at the CCMD level and it would better support the commander's aims.

As with any tool applied to war, the public will have reservations. Moreover, other governments and international organizations such as the United Nations (UN) will have similar reservations about the use of big data to wage war or intervene in local conflicts because of the possible threat to sovereignty and the impact on human rights. These are serious and relevant concerns; therefore, the experiment would have to take the concerns into account to determine success or failure. In addition to the above, social physics will also meet resistance as a concept and planning tool within the military. Commanders and their staffs will balk at any increase in personnel or equipment requirements that do not meet the immediate needs of the combatant command. The experiment must likewise take internal resistance within the military into account. Without painting too rosy a picture, proponents of social physics must demonstrate that planners and commanders would be able to identify indicators of instability and develop Phase Zero operations that would promote stability.

Experimenting with Social Physics

To understand the contribution that social physics can make with regard to future operational design, one would need a "real" crisis to study *ex post* as a type of control group. This control group should be a recent, localized crisis that generates adequate data for

analysis. The expectation is that the "control" will validate the use of social physics and big data to inform operational design and planning at the Combatant Command level.

The recent Arab Spring is a good case study in that Tunisia has arguably been the most successful country in North Africa and the Middle East to emerge from the demonstrations, protests, and political changes that were the hallmarks of the movement. Moreover, the Arab Spring in Tunisia was a social media phenomenon as a consequence of dissatisfaction and the explosion of ideas. The entire movement is a textbook example of ideas taking hold in a society, flowing throughout a region, and making substantive change quickly. Thus, the current environment can be measured from the baseline that existed prior to 2010 and the emergence of the Arab Spring. Another useful case study might be the outbreak of Middle East Respiratory Syndrome (MERS), might be a better experiment choice. The MERS outbreak began in 2012 in Saudi Arabia, and the entire Middle East experienced confirmed cases while several countries around the World experienced travel-related cases.[14] MERS surfaced in developing and developed parts of the world, meaning there is a considerable amount of relevant data for reflective analysis. Moreover, MERS is still active in the Middle East, so the utility of social physics to provide predictive analysis is also a benefit for using this crisis as an experiment.

Severe Acute Respiratory Syndrome (SARS) is another epidemic caused by a coronavirus that broke out in a highly populated, developing part of the World: Southeast Asia, in 2002.[15] The disease was contained in 2003, and the time lapse would provide enough data that can be further measured with social physics as an adequate reflective analysis. An experiment using SARS offers the possibility for numerous lessons learned, but the analysis of such large amounts of data would be difficult.

Studying either or both of the disease outbreaks (MERS and SARS) can help prevent military or political biases that might exist in the Arab Spring experiment, and the information

gained from a disease crisis would benefit nations, organizations, and even individuals to respond to or prevent future epidemics from becoming pandemics. Also, since disease is apolitical there is likely to be less concern among politicians, governments, and international organizations about the misuse of data.

Regardless of which case study is used, the experiment should have a defined formula. First, the planners and participants must seek to understand the environment prior to the crisis. To accomplish such a level of understanding, the data would have to be gathered and sorted, and the research would have to focus on the parameters identified by the initial experiment design. There would undoubtedly have to be some redesigns to the experiment parameters depending on the quality and quantity of the data, but the second step would be to use the data accumulated over a set time period to watch and learn how certain already identified ideas traveled through the designated medium. In the case of Tunisia, the activity of the populace, based on age and gender, could be identified from 2008 until October 2010. The second part of a Tunisia experiment would be to identify idea sources, how the ideas traveled through the society, and what the impact those ideas had on Tunisia and neighboring countries. In the third step, planners and analysts would follow the ideas and any changes in society from the beginning of the crisis to the present. For example, were there changes to social stratification? Was wealth or influence redistributed? Is there any indication, based on the data, that Tunisia will remain stable or become unstable for the next five years? What sort of campaign plan can USAFRICOM develop for Tunisia specifically, and for the next five years? How are regional or international actors influencing the stability of the country? Answering some of these questions will lead to an understanding of the Arab Spring and Tunisia's political and ideological state as it exists today.

This same methodology for the experiment could be used for the MERS or SARS outbreaks, and the outcome would be just as beneficial to politics, international travel,

business, and even the Combatant Commands because all of these actors have an interest in preventing epidemics and pandemics. Besides being adversely affected by disease, all of the entities listed above are often the first responders to such crises, and any advanced knowledge of, or techniques for successful response to, a major outbreak would be valuable to the international community. In the end, an experiment with social physics has the potential to predict or identify instability, and then, allows agencies, businesses, or nations to respond appropriately. Therefore, responses to crises would be more efficient and effective.

Challenges and Opportunities

There are at least four obstacles that could hinder this experiment or lead to erroneous data. First, an adequate cross-section of military and civilian planners would be required to analyze and interpret the data. In short, the experiment has to have the right personnel to determine if social physics would be useful to the average planner at a Combatant Command. Second, these analysts and planners must be trained to interpret the data without preconceived biases or other filters that might skew the data's meaning. The Defense Department can overcome both of these obstacles relatively easily by identifying the experiment as a priority and sourcing planners from all of the services and even other U.S. executive departments that are at various stages of their careers. Sourcing and training the proper personnel would also help to identify weaknesses and strengths to using social physics for operational planning.

The third challenge involves adequate resources. Since neither planners nor CCMDs have experience in social physics, either DARPA or an independent contracting company would have to provide the bulk of the resources required to run the experiment. As with the first two challenges, the U.S. Government can overcome this obstacle by establishing the experiment as its priority to understanding potentially troublesome areas. Once the US Government sets the priority, the actual entity that hosts the experiment will not matter.

The fourth obstacle may prove to be the most significant—actually making sense of the enormous amounts of data that are produced by such an interactively complex system. Even focusing the experiment on only a few key ideas and their flow could lead down infinite paths with interconnected causes and effects that could occupy the time of several supercomputers, programmers, and analysts for an indefinite period of time. The final obstacle cannot be solved simply by making this experiment a priority because even if the experiment can overcome the obstacles, the actual use of social physics may prove to be unfeasible for the average CCMD. The lessons from failing could prove just as beneficial as the lessons from succeeding, though. Specifically, there are positive benefits to conducting an in-depth analysis of a known social event, like the Arab Spring's beginning and end in Tunisia, through the prism of military planning using the computing and data analysis tools available today. Nevertheless, the US Government will better understand the Arab Spring, current events tied to the Arab Spring, and the limitations of understanding big data. Failing in this experiment, as failing so often does, might also expose areas for future opportunity.

The potential failures also illustrate some of the benefits from this experiment that are not limited to military objectives. First, a wide variety of private companies could use the data analysis techniques and predictive methodologies to improve safety and security of their workers while maximizing their investments in certain countries. Second, a transparent experiment, like many of the challenges and experiments at DARPA, can dissuade many of the fears that arise when the military is associated with personal information and predictive analysis. Finally, the experiment would highlight the positive and negative aspects of social physics and big data collection in order to inform better domestic and international policies with regard to the Internet, personal information, and data storage and analysis. The last benefit can be realized without an experiment in social physics, but a well-funded,

government experiment would be of greater benefit to policy-makers and leaders than an experiment conducted by private business with different parameters.

Conclusion

Though there are challenges, the opportunities to better understand a conflict or crisis either as it happens or before are too promising to shy away from performing an experiment like the one described above. The data and the knowledge are both readily available, and once the value of social physics is understood, operational planning can either add another tool to the repertoire of campaign design, or have a sound reason for avoiding such predictive-type analysis. There will never be a definitive answer until an experiment is conducted and published, however.

Appropriate timing is key to conducting experiments and implementing social physics in military planning. There are few well-established or recognized international regulations that impair the use of Internet, big data, and social physics, so many of the challenges of using social physics for military planning are easily overcome. These agencies would help keep the experiment on the right track, but they could also use the information to draft future regulations and even help to inform treaties. Therefore, starting experimentation soon would benefit more than just the military.

Individuals throughout the world are creating millions of data points over the course of their lives, and analysis of this data is a tool for future operational planners at the Combatant Commander level to understand his or her AOR and the emergence of crises. This paper has shown how future operational art can be influenced by big data and the science of social physics, and it has provided an experiment to gain the required knowledge of using big data and social physics in future planning and problem framing. Additionally, this paper has explored some of the challenges and opportunities that could emerge from using social physics in a military capacity, and the benefits of experimentation outweigh the negative

impacts. The impact of data can be seen in ever day life in the developed world, but even developing countries are producing data at a rapid pace that can help commanders and their planners to understand future crises. The expectation is that the tool of social physics will mature to the point where combatant commanders and policy makers can work to prevent a developing crisis before the situation requires military intervention.

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[1] Jake Kendall and Rodger Voorhies, "The Mobile-Finance Revolution", *Foreign Affairs,* vol. 93, no. 2, (March/April 2014): 10.
[2] Ibid.
[3] Daniel Kahneman, *Thinking Fast and Slow*, (New York:Farrar, Straus, and Giroux, 2011), 21.
[4] David Kilcullen, *Out of the Mountains: The Coming Age of the Urban Guerrilla*, (New York: Oxford University Press, 2013), 169-231.
[5] Ibid.
[6] Ibid, 4.
[7] Jake Kendall and Rodger Voorhies, "The Mobile-Finance Revolution", *Foreign Affairs,* vol. 93, no. 2, (March/April 2014): 10.
[8] Alex Pentland, "Social Physics for a Better Life" http://www.brookings.edu/blogs/techtank/posts/2014/03/03-social-physics-better-life-pentland.
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[11] U.S. Department of Defense, *Joint Operation Planning,* Joint Publication 5-0 (Norfolk, VA: U.S. Joint Forces Command, August 11, 2011), III-1.
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[13] Ibid, 188.
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