Social Physics, Crowdsourcing and Multicultural Collaborative Research Practice in the Social Sciences: E Pluribus Unum?

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Abstract: The possibility of there being an investigator with the knowledge and ability to understand, let alone digest the data embraced by the boundaries of social scientific disciplines seems very remote. However research investigators in the human sciences might in their quest for greater validity and wider generalization in their concepts and theories, adopt a different scientific perspective in addition to its currently most prevalent hypothetico-deductive approach. The proposed approach made in the paper corresponds more to Baconian-type methods and those adopted by Darwin in his theory of evolution and involves the use of large data sets of the kind made available by the methodological approaches of social physics and crowdsourcing. The paper suggests that large data sets can be analyzed effectively in multi-disciplinary, cross-cultural collaborative research contexts, and a case study illustrating a collaborative research process is described in detail to demonstrate this point. The paper maintains that through the combined utilization of scientific approaches and large data gathering techniques made available through new technologies, it may be possible to generate comprehensively valid empirical and theoretical wholes across the human sciences.

Keywords: Social Physics, crowdsourcing, multicultural, multidisciplinary, collaborative research, social sciences.

1. Introduction

The possibility of there being an investigator who has the knowledge and ability to understand, let alone digest the data embraced by the boundaries of social scientific disciplines seems very remote. Not only has the amount of information that has become available today in general terms expanded exponentially, it has occurred to the extent that it has become impossible for any single human being to digest and use it intelligently. This has occurred in scientific and social scientific disciplines themselves such that scientists today find themselves knowing more and more about less and less (Senge,1990) as their data bases expand and greater specialization becomes imperative.

In effect, this information and data explosion alone has made any single research investigator capable of doing effective research across the human sciences beyond the realms of human capacity. In spite of this there has never before, perhaps in the history of scientific endeavor, been a time demanding generalist investigators who understand cross-disciplinary knowledge and how to use it effectively, both in developing theories and in practical implementations, than there is today. A general understanding of social scientific problems needs a movement away from its current knowledge silos, yet paradoxically such silos are becoming increasingly evident among research investigators who struggle to keep abreast of the developments in their own disciplines.

The research question the paper attempts to answer is: how can the social sciences and business research generate multidisciplinary and multicultural valid theoretical structures from generalizable data? To this end the paper aims to contribute to the social scientific methodological literature by indicating that social science research investigators should adopt a collaborative multidisciplinary and cross-cultural approach which embraces the collection and analysis of large data sets to determine communalities and theoretical structures arising from it.

The paper takes the following form. The second section gives the extra-disciplinary research problem's background by outlining the information explosion, the effect this has had on discipline specialization and the development of new sub-disciplines and the 'silo effect' on knowledge generation that this has generated. The problem of 'methodological divides' and the 'pecking order of scientific rigor,' both within and between specific human science disciplines on the possibility of multidisciplinary collaborative research is also described in this section.

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The third section discusses the practical intra-disciplinary research problem faced by social scientists who aspire to generate multi-disciplinarily-valid knowledge across the human sciences and aim at creating cross-disciplinary theoretical structures that offer practical solutions to multi-facetted social problems, brought about by intra-disciplinary problem of methodological divide. A problem that compounds the silo-generating effect arising from the information explosion discussed in the second section.

The fourth section presents a core contribution of the current paper by highlighting the author's experiences of initiating a multinational and multidisciplinary group consisting of a group of researchers combined in collaborative research across the human sciences. It is proposed that a cross-cultural, multidisciplinary, collaborative research approach can aid in counteracting the effects of the extra-disciplinary problems of the information explosion and multidisciplinary silos and the intra-disciplinary problem of methodological divides.

The fifth section of the paper considers a possible way forward in the human sciences towards the generation of valid knowledge by proposing a combination of the data gathering approaches of social physics and crowdsourcing one the one hand, with multi-national and multidisciplinary collaborative research groups on the other. It is suggested that by advocating the observational-deductive paradigm used in evolutionary biology rather than depending on the inductive hypothesis-testing 'falsificationist' approach which advocates testing of hypotheses amenable to falsification (Popper, 1992), that currently prevails in positivistic social science and, most importantly, by acknowledging the significance of qualitative data, the process of theory building and practical problem-solving could be better accomplished. The sixth and final section of the paper concludes with a brief summary of the main arguments presented.

2. Background to the problem: information deluge, specialization and methodological divides

There can be little doubt regarding the exponential increase in information as a whole and within academic disciplines in particular and through this, the development of new disciplinary areas. Although there is surprisingly little research dealing directly with this aspect, it is reasonably safe to say that the information explosion within particular disciplines, along with the discovery of different empirical problem areas that demand scientific endeavor that spring largely from this, has demarked an increasing number of new disciplines and sub-disciplines over the years. Of course it is also true to say that the founding of a particular discipline or sub-discipline, has led to new areas for information mining and, through this, its own information sourcing demands and requirements. According to a recent Berkley research project document (Lyman and Varian 2003) the storage of information (paper, film, magnetic and optical) has been expanding at the rate of over 30% per annum since 1999 and that there has been a dramatic increase from 2001-2003 in the storage of new information in every storage medium except film. The expansion in paper information from 2000-2002 was estimated as 1,634 Terabytes (a Terabyte being the equivalent of 10^{12}bytes) which requires around 788million trees to produce the world's annual paper demand.
http://www2.sims.berkeley.edu/research/projects/how-much-info-2003/. Partly as a result of this expansion in information and the need to mine new information because of the expansion of sub-disciplines within disciplines, the discipline of Economics alone now consists of around 25 sub-disciplines. Some sub-disciplines are of recent origin (e.g. Behavioral economics, Complexity economics and Bioeconomics) and in some cases fast becoming, partly as a result of burgeoning information available to them, new disciplines in their own right.

Rosvall and Bergstrom (2010) mapped more than 35 million citations between articles that appeared in around 7000 scientific journals. Their analysis of information flows between researchers worldwide showed that neuroscience has developed from being an interdisciplinary research topic to being a scientific discipline of its own and become the fifth largest field in the sciences (after molecular and cell biology, physics, chemistry and medicine). Rosvall and Bergstrom (2010, p.2) write: "Only in the last decade has this change come to dominate the citation structure of the field and overwhelm the intellectual ties along departmental lines".

Although the above data relates to science and engineering rather than the sprawling disciplines and sub-disciplines that make up the social sciences, making them much harder to plot their development, the foregoing brief analysis clearly suggests that not only has information expanded considerably recently, but this

expansion has made possible and in many cases been an important factor, in the development of new sub-disciplines within existing ones which have, in some cases, become separate disciplines in their own right.

The general trajectory of information proliferation and disciplinary expansion in the social sciences has made the possibility of social scientific research investigation extraordinarily difficult. The problem is exacerbated by the traditions of academic disciplinary exclusivity and chauvinism. This aspect is discussed in more detail in the following section.

2.1 Disciplinary discordance between and within

No scientific discipline operates free of internal divisions and external detractors. Even physics has been criticized by mathematicians for the imprecision of some of its elementary assumptions. (Spivak, 2010). The discordance between the natural sciences and social science is even more pronounced than within natural scientific disciplines per se. In this regard, Duffy, Guertal and Muntifering (1997, not paginated) suggest that: "For most natural scientists research follows a set course: formation of a hypothesis, design of an experiment, collection of experimental data, and analysis of data using a limited number of statistical techniques. Journal articles in the natural sciences tend to be short and factual, with little effort expended on justification of the methods used. By contrast in economics research experiments per se are seldom conducted. Most data are second-hand, and methods of analysis are numerous and often highly contested in the field".

Within and between the social sciences themselves discordance and disagreement run much deeper and is more widespread. Within sociology, for example, a deep seated, long established and perhaps unbridgeable (at least among the more vociferous protagonists on both sides) divide exists between positivism which maintains "…that positive knowledge is based on natural phenomena and their properties and relations as verified by the empirical sciences" (Merriam-Webster, 2016) and phenomenology, which focuses on free-of-researcher-pre-conceptualizations descriptions of phenomena as consciously experienced by an individual (Biernel and Spielberg 2015).

Within the wide disciplinary ambit that embraces the social sciences the schism is perhaps most keenly felt between economists and the other social sciences. Comte may have regarded sociology as the 'queen of the social sciences' (Turner, Beeghley and Powers, 2012) but today most academics would acknowledge (if not accept) that economics (perhaps by virtue of the fact that it is the only social science that attracts a Nobel prize and that therefore some of the best social scientific brains tend to gravitate towards it) is dominant in the 'pecking order' of the social sciences. Certainly I think that most economists regard themselves as pre-eminent in the social science disciplinary ranks and tend today to see other business science disciplines (e.g. Management) as riddled with problems of endogeneity in their explanations and limited in the validity of their findings by virtue of the small data sets generally used.

Although offered as a stepping stone towards multi-disciplinarily corroborated social science research in the case study to be described in the following section, it must be recognized that there are multifaceted and wide ranging difficulties involved in conducting multi-disciplinary and multicultural collaborative social science research. Perhaps the most prominent and tenacious 'costs' in such undertakings spring from three main sources: methodological disagreements, cultural factors and limited generalizability.

2.1.1 Lack of methodological consensus among practicing social scientists

Lack of methodological consensus in the social sciences is legend and ongoing and can only be dealt with very briefly here. Its origins are multiple. Epistemological and ontological differences of opinions among social scientists have resulted in a plethora of different methodological approaches. Possibly the most far-reaching and intractable divide resides between the approaches of positivism on the one hand and phenomenology, on the other. Social scientists are sometimes persuaded by specific epistemological and ontological arguments, sometimes brought up under the traditions of one or other perspective, or sometime locked into a particular approach (usually qualitative) by a lack of mathematical/statistical knowledge and/or aptitude.

2.1.2 Cross-cultural social scientific communities-of-practice and the problem of reflexivity

An example of a cross-cultural collaborative research process is described by Easterby-Smith and Malina (1999). In this case the investigation deals with the quality of business relationships between the United Kingdom and China and constitutes a singular project. Easterby-Smith and Malina (1999) describe the reflexive process that occurred in a 'one-off' cross-cultural research project conducted by academics in the U.K and

China with homogenous disciplinary backgrounds. Jain, Hallensleben and Manger (2013) suggest that reflexivity can be considered a dialectical concept. A dialectical understanding of reflexivity includes that the implementation of reflexive structures in cross-cultural communities-of-practice which "may cause dialectic counter-movements in the shape of defensive reactions" (Jain, Hallensleben and Manger, 2013, p.9). These so-called *deflexive* defensive reactions are distinguished from reflexivity in the following manner by Jain, Hallensleben and Manger (2013, p.10): "while reflexivity produces difference, deflexivity basically means the production of identity, unambiguity and firmness by means of structural momentum and structural violence. But neither is… reflexivity merely "positive" nor is deflection/deflexivity fully "negative". Both carry "productive" and "destructive" elements. The perpetuated self-questioning and the openness invoked by reflexivity are counter-productive when it comes to the practical appliance of learning experience and new ideas, i.e. innovation. This is exactly the strength of deflexivity". When it comes to cross-cultural collaborative research the concepts of *reflexivity/deflexivity* offer a useful heuristic to describe the balance needed in such research communities of practice if, on the one hand, their cultural diversity is to be effective in opening up practitioners' creativity and the development of new bodies of knowledge reflexivity must be allowed full rein. But, on the other hand, deflexive responses are required in the sense-making, congruence-seeking and consensus knowledge building of the community.

2.1.3 Lack of generalizability of social scientific concepts and theories

There is little doubt that a major difficulty experienced by the social sciences, perhaps with the exception of Economics, is that data sets on which concepts and theoretical edifices are built are generally quite small. A good recent example of this in Economics is the research by Bloom and Van Reenen, (2007; see also Bloom et al, 2012) Economists working at Stanford University and the London School of Economics respectively, who have studied the effects of management in the performance of more than 10,000 companies in 20 countries by applying econometric methods. Although this research is wide scale and incorporates large data sets from multicultural contexts and is collaborative to an extent, it lacks a multidisciplinary and thus multi methodological validity and generalizability.

In the analysis of qualitative data, small data sets are of course the norm, but even here replication is curtailed by the fact that such data sets tend to be very small and difficult to re-engage because of this. There have been attempted solutions round this problem such as meta-analytical research and the like, but such studies are limited by their historical periodicity and the diversity of contexts they generally cover. Also, it is unlikely that a collection of relatively small samples gathered at different points in time in different contexts and used to generate a larger combination in meta-analyses, is able to produce valid up-to-date generalizations in the manner large data sets taken and analyzed at one point in time can.

3. Bridging the methodological divide: the place of multidisciplinary multinational collaborative research groups

A breathtaking example from the natural sciences of the success of small size multidisciplinary group collaborative research is presented by the Californian Institute of Technology, an institution that is now 123 years old with 57 recipients of the US National Medal of Science and 32 Nobel laureates among its faculty and alumni (Baty, 2014). There are 5 Nobel Prize winners on its current staff. Caltech's small size is considered to be the central, core reason for its fabulous global success in scientific research. Caltech's small size has made it obligatory for it to operate through interdisciplinary collaboration. An example of the interdisciplinary ethos of the institution is given by the Division of Biology (founded in 1928) which was transformed in 2013 into a new Division of Biology and Biological Engineering. This change occurred after the so-called "organic drift" of the Division of Engineering and Applied Science's bioengineering department into synthetic biology, which focused on manipulating biological materials. Of course another clear reason for its success has been its highly selective approach to recruiting the best staff available, freeing them from administrative burdens and providing them with excellent salaries, research funding and equipment (Baty, 2014).

Interdisciplinary collaborative research in the social sciences is different from the ideal type presented by above example of Caltech in at least three main ways:

- Lack of methodological concensus among practicising scientists
- Cross-cultural social scientific communities-of-practice differences in values and social priorities:
- Limited generalizability of concepts and theories

The benefits of multidisciplinary collaborative research groups are more evident in disciplines comprised of the natural sciences perhaps because of the general consensus among scientists in these disciplines of what comprises scientific method (Duffy, Guertal and Muntifering, 1997). This is not to say that differences in methodology don't exist, or that such differences do not create fundamental disagreements among natural scientists. Clearly they do and perhaps are most keenly felt in the methods of evolutionary biology, where its inability to create mathematically precise explanations of natural selection and the theory's inadequacies as regards prediction of future life forms, is regarded with disfavor among Physicists and Chemists. How these problems peculiar to the social sciences might be successfully dealt with is discussed in more detail in the following section.

4. Benefits of multi-disciplinary and multicultural collaborative research: A case study of a cross cultural multidisciplinary research group

Collaborative cross-cultural multidisciplinary research in the social sciences is not only possible, but can generate enormous benefits in terms of the interdisciplinary richness of perspective and cross cultural validity of the concepts and theories utilized. This aspect is described in some detail below in relation to the author's recent experiences of directing an international multidisciplinary collaborative research group: the Strategic Foresight Research Group (SFRG) created for this purpose.

The SFRG was initiated in 2011 as a tool for research generation. Its purpose and function is to:

- Generate high quality research outputs through collaborative national and international research.
- Augment the research output.
- Offer fledgling researchers help to promote their research expertise.
- Offer junior researchers supervision for advanced degrees.
- Offer experienced international researchers the opportunity to work in collaborative research with researchers in South Africa.

A major feature of the SFRG is that it offers junior researchers both the opportunity to develop their formal research qualifications *and* to produce publishable research outputs through expert training and guidance.

The Strategic Forecasting Research Group research focuses on broadly defined strategic issues in business and other formal organizations. Multidisciplinary and multinational research projects are aimed to investigate management and organizational issues and to provide multicultural theoretical and empirical perspectives. Research by the group covers aspects of international concern such as: governance, social responsibility, responsible leadership, intercultural conflict management, research productivity, organizational citizenship, entrepreneurship, teaching and learning.

The group involves around sixteen active researchers with roughly half based overseas. The group adopts a matrix structure in the research process. Researchers take leadership roles for specific projects as they arise based on personal interest and expertise. Research is funded by local and overseas grants and through financial packages/allowances provided to individual group members by virtue of their graded research status. Research meetings are held by national (SA-based) members of the group when project-related research issues arise. Research workshops focus on communicating new multidisciplinary research ideas among national members to build collaborative research teams for particular projects, and to decide on applications for funding. Virtual workshops to decide on research outputs and collaborations for specifically targeted conferences and journals are conducted electronically as required.

Easterby-Smith and Malina (1999) identify five steps in the collaborative research process. *Harnessing networks,* the initial phase of group formation, consisting of informal meetings aimed at creating trust and communication among team members. The next phase, f*ocusing the project* defines objectives of the research and is a crucial aspect for applications for research funding. The U.K. research team, reported by Easterby-Smith and Malina, (1999) focused on the research objectives and the economic utility of the project required by the British funding agency. Chinese team members of the UK driven research project needed to modify the research proposal to show its contribution towards the Chinese economic reform process. Easterby-Smith and Malina (1999) report that at the beginning of the research collaborative process, team UK and Chinese members realized that both sides saw the other's research interest differently and attributed a "slightly less

positive, practical and commercial motives to the other national group" (Easterby-Smith and Malina 1999, p. 79). Over time it became obvious in collaboration between Chinese and UK researchers that funding agencies of each country injected a political element to the project by stipulating specific practical outcomes. A*ccessing data,* the third step in the research process brought into sharp focus the status and expertise of the researchers and their role in the research process. This differed quite markedly between the two nations and, in some instances, contradicted internal perceptions of expertise and seniority of members themselves. For example, a young female researcher was ignored by British interviewees whereas in China she was regarded by Chinese interviewees as important. Also, field-work procedures differed between the two national research groups regarding interview settings and empirical data collection procedures.

During the *interpretation* or making sense out of the data in the fourth phase, reaching a satisfactory consensus took substantial time. This was partly due to differences between the Chinese and U.K. research teams' ontologically-driven methodological approaches. U.K. researchers were interested in qualitative empirical material, while their Chinese counterparts focused more on finding similarities and associations using quantitative data. In line with Nonaka and Takeuchi (1995), Easterby-Smith and Malina (1999) explain this by 'dualistic' (search for differences), vis a vis 'holistic' (search for similarities) distinction in researcher perspectives. The interpretation phase clearly showed differences in UK and Chinese research perspectives, educational traditions and methodological perspectives. There was a need to discuss and negotiate similarities and differences in interpretations in the research teams to reach mutually acceptable consensus.

In the fifth, *writing and dissemination* phase of the research process team members decided "that all data collected on the project should be considered equally the property of every member" (ibid., p. 81). Deep insights of the qualitative empirical data obtained by a Chinese and U.K. researcher enabled them to publish in prominent refereed journals. Also, a number of articles were published with differing co-authorships reflecting the substantive collaborative effort in the research process.

The Easterby-Smith and Malina (1999) phases of the UK-Chinese collaborative research process is used to classify the SFRG research project processes in Table1.

Table1: National and multinational research collaboration: specific phases, descriptors and research outputs (Adapted from Coldwell and Fried, 2014).

National and multinational research collaborative teams	**Phase 1: Harnessing networks**	**Phase 2: Focusing research project**	**Phase 3: Accessing data**	**Phase 4: Interpretation**	**Phase 5: Writing and dissemination**	**Phase 6: Research outputs**
South Africa (Founding institution with national multidisciplinary research team consisting of: accounting, auditing, governance, finance, economics, marketing, management and HRM)	Interdisciplinary foundations of network built on: i) Personal contact. ii)Academic and research interest iii) Research group formation	Projects arose from mutual research interests and commonalities in research focus	Group research division of labor responsibilities in: i) Data collection instrument, ii) Sample design and iii) Data administration and collection and capture.	Project leaders of specific research project interpret the data from data analysis	Writing of research product conducted by project leader. Project group members involved in secondary research and project 'housework' e.g. editing. referencing and formatting	National and international conferences and national and international journal articles with different management science foci.
South Africa-Canada	Network from i), ii) and iii) arising from a specific conference meeting in Johannesburg	Specific project arose from conference paper presentation	Project group Division of labor based on expertise i) ii) and iii)	Three project collaborators, 2 in SA and 1 in Canada	Collaboration between SA and Canada project members	Project currently in sample acquisition and accessing data stage

UK, South Africa-Germany	Network from i), ii) and iii) arising from Summer School originally held in Chemnitz	Specific project arose from visiting professorship (Open University, Milton Keynes) and Summer School in Chemnitz	Group Division of labor based on expertise i), ii) and iii)	Project collaborators consisting of two members, 1 in Germany and 1 in SA	Collaboration between SA and German researchers	Conference papers and international journal article
South Africa-Sweden	Network from i), ii) and iii)	Specific project arose from invitation to write a chapter in Knowledge Management research handbook book	Group Division of labor based on expertise i), ii) interest and iii).	Project collaborators 1 in Sweden and 1 in SA	Collaboration between SA and Swedish researchers	Chapter in book
South Africa-United States of America	Network from i), ii) and iii) arising from meeting at a conference in Johannesburg	Specific project arose from conference paper presentation	Group Division of labor based on expertise i), ii) interest and iii).	Project collaborators 1 in USA and 3 in SA	Collaboration between SA and USA researchers	Conference paper and International journal articles
South Africa-New Zealand	Network from i), ii) and iii) arising from an invited personal visit to SA during sabbatical leave	Specific project arose from invitation to contribute a chapter in a book on corporate social responsibility	Group Division of labor based on expertise i), ii) and iii).	Project collaborators consisted of 1 in SA and editor of book in New Zealand	Collaboration between SA researcher and New Zealand Editor	Chapter in book
South Africa – United Kingdom	Network arose from i), ii) and iii) PhD supervisor of a research group member. SA conference. Personal visit to SA and meeting of UK professor. Invitation to join UK research group. UK conference	Projects arose from supervision of doctoral degree of one member of the research Group and conference papers	Group Division of labor based on expertise i), ii) and iii).	Multiple projects' collaboration 4 SA and 1 in UK	National and international collaboration between SA and UK	Conference papers national and international journal articles
South Africa-Israel	Network arose from ii) Academic and research interest	Project arose from article publication in an international journal on a research topic of mutual interest	Group Division of labor based on expertise i), ii) and iii).	Project collaborators 3# in South Africa and 1 in Israel (currently not a member of the SFRG)	Collaboration between SA and Israel researchers	Project temporally suspended

Table I clearly indicates that the SFRG has been successful in conducting collaborative research that is culturally sensitive and multidisciplinary. Recently the South Africa-Israel has had to be suspended for political

reasons. 'Multidisciplinary' in this context means disciplines that are all within the general ambit of business studies and commerce. Differences between research methods employed by, for example, accountants and financial management researchers are quite distinct from those adopted by Management and Human Resources Management, particularly regarding the importance of qualitative data. 'Multicultural' in this context generally refers to research projects located in the specific countries involved. However, the principle of multicultural research collaboration and its practical possibility are clear from the recent research work of the SFRG involving different countries. For example, collaborative work involving researchers based in Germany, Sweden, South Africa and the United States of America, led to a research outputs (Coldwell and Fried, 2012) and (King, Joosub and Coldwell, 2013) that were multidisciplinary and cross-culturally aware.

The problem of reflexivity in the interpretation phase of collaborative research work discussed earlier in the paper is contained to a significant extent in the Strategic Foresight Research Group (SFRG) in at least three specific ways.

1. The research collaboration performed by the SFRG is *multinational* and involves at its present level of development collaboration between South African, German, Swedish, Canadian American, British. New Zealand, Australian and Israeli - based academics.
2. The research projects conducted by the SFRG are *on-going*, with completed projects being replaced by completely new ones or derivatives of older ones. Different projects do not necessarily involve the same academic personnel from the same countries and,
3. The research team combines researchers across a wide spectrum of the Management discipline and includes Accountants, Auditors, Marketers and specialists in Management, HRM, Finance and Governance.

Disciplinary diversity and multiculturalism of the research meant that various perspectives emerged, and although particular individuals led particular projects in line with their disciplinary emphases, the common goal of publishable products ensured that overall consensus was achieved.

The multi-disciplinary and multicultural collaborative research process in the SFRG clearly shows that the reflexive process among researchers is overridingly a positive one, where differences in disciplinary perspectives, methodological approaches and cultural and educational backgrounds have blended to generate bodies of new knowledge. Despite this, extant social scientific research is hampered the lack of generalizability of its findings and emanates from the small-scale of the data bases often used. The following section discusses this aspect in more detail.

5. A methodological way forward? The place of large data sets in social science investigation: social physics and crowdsourcing

Evolutionary theory was partly developed from a large series of acute flora and fauna observations made by Darwin who writes: "During some part of the day I wrote my journal and took much pains in describing carefully and vividly all that I had seen and this was good practice". (Darwin, 2009, p. x).

Such observations led to the development of Darwin's theory of natural selection, although it is also suggested that Darwin had already the notion that species gradually became modified and that it had 'haunted' him (Penny, 2009) before his observations were able to corroborate this in any systematic way. But before these 'haunting hypothesis' were merged with his observations and classification of large scale biological data, it was observation pure and simple similar to that Popper (1963. p.46) ridicules: "The belief that we can start with pure observation alone, without anything in the nature of theory is absurd; as may be illustrated by the man who dedicated his life to natural science, wrote down everything he could observe, and bequeathed his priceless collection of observations to the Royal Society to be used as inductive evidence". The approach to scientific discovery recommended by Popper (1992) is quite different and emphasizes an ex- ante, hypothesis-testing method used in positivistic social scientific research. However, it is proposed that the large data set, observational approach advocated by Darwin could provide the basis on which the social sciences can produce valid generalizable knowledge and dissolve the methodological divide.

Although mixed methods are becoming more prominent research tool, they are still hampered by the fact that they tend to deal with relatively small data sets and are limited to a mono-cultural and mono-disciplinary

perspectives. However the current paper suggests that through the initial accumulation of large data sets of the kind made available by methodological approaches of social physics and crowdsourcing, it is possible to use both quantitative and qualitative approaches in subsequent analyses to generate comprehensively valid empirical and theoretical wholes. This approach would also require 'discipline bridging' of the kind suggested by de Kok (2013). In this regard de Kok (2013. p.12) states: "Real understanding between academics from different disciplinary backgrounds requires the translation of each other's concepts (Bevan, 2000) and 'active attempts at clear communication' (de Kok, Hussein and Jeffery, 2010). The onus is on social scientists to use language and concepts that can render their ideas accessible and thus engage scholars from other disciplines". And, one might add, scholars with diverse cultural perspectives.

Such large data sets could be regarded as providing the quantitative, non-verbal 'bread crumbs' (Pentland, 2014) of human behavior through recent developments in social physics, while the qualitative, verbal 'loaves' arising from large data sets would emerge from 'crowdsourcing'. Thus large data sets, Social Physics and crowdsourcing are seen as methodological alternatives that present an opportunity for valid research across the social sciences, while at the same time providing large scale data for collaborative research teams to generate comprehensively valid accounts of social scientific phenomena. Also, to attend to intercultural differences in the application and meaning of specific social scientific concepts, such collaborative research teams would be comprised of multi-national scholars.

The origin of the term 'social physics' is attributed to Auguste Comte in his book "Philosophie positive" (2009). However, a recent adaptation has come through the work of a physicist Ball (2004) in his book entitled: "Critical mass". Ball (2004) regards a people as human particles which are then studied in computer simulations. Critical mass is regarded as the statistically averaged behavior of human particles which taken together with large data set observations, offer a critical mass typology of aspects of human behavior. Not unsurprisingly, Ball has met with some fierce criticism from, in particular Fuller (2005), an American sociologist who regards the idea of social physics as an affront based on a defunct reductionist (i.e. inappropriately reducing complex phenomena to simple ones) conception of social science that died in the late 19 th century. Despite this and other attacks on the 'reductionist' assumption of regarding humans as atoms or molecules, a recent more sophisticated revitalization of the idea that the study human behavior 'en masse' can help develop theories of behavior from large data sets has been presented by Pentland (2014). Pentland (2014) suggests that human ideas of 'common sense behavior' are developed in our social interactions and the social ideas and notions that arise from our social networking behavior. New technology such as that afforded in the widespread use of smart phones and the internet, have led to a digital stream of 'bread crumbs' that can be studied and analyzed. Pentland (2014) suggests that it is possible to discover patterns of information exchange in social networks without knowing its detailed content, that inform on specific social behavioral patterns that allow accurate predictions to be made of probable specific human behavior. Pentland (2012) suggests that social physics helps understand how ideas flow from one individual to another through social learning to create norms in behavior and shows how new ideas are adopted and transformed into changes in social behavior. Pentland (2014) also suggests that the traditional social sciences (perhaps with the exception of Economics) have always tended to be data poor and have not been able to make valid generalizations and predictions. Social physics by accessing large data sets is better able to deal with a wide spectrum of social issues. Whatever ones views on reductionist explanations of Social Physics, there is little doubt that the use of large data sets can improve the accuracy of social scientific research and through the widespread use of modern technology (currently mainly in the Western world but with increasing preponderance in the developing world) among large groups of people, it becomes possible to trace and analyze digital streams (social 'bread crumbs') to offer widely corroborated basic social data.

If social physics offers the quantitative, non-verbal 'bread crumbs' of social behavior on a wide scale, it might be said that crowdsourcing can offer the qualitative verbal 'bread' from the study of large scale data sets. Howe (2006, p.1) succinctly indicates how crowdsourcing originated: "Technological advances in everything from product design software to digital video cameras are breaking down the cost barriers that once separated amateurs from professionals. Hobbyists, part-timers, and dabblers suddenly have a market for their efforts, as smart companies in industries as disparate as pharmaceuticals and television discover ways to *tap the latent talent of the crowd.*"

Crowdsourcing can be regarded as a multi-functional technique for: soliciting mass informants' views of solutions to specific problems, suggest innovative ways forward and describe widely held attitudes and

perceptions and knowledge discovery through information (Brabham, 2008; 2013). The immediacy of crowd sourced information allows the researcher to gather rapid data turnaround on a large scale with high generalizability and validity potentiality. Of course this is not to suggest there are not potential disadvantages and difficulties in crowdsourcing information of which information quality, research confidentiality and response reliability, are considered the most serious (Stoyanova, 2010).

Page (2000) suggests that the diversity of the information garnered is a core advantage of crowd-sourced material. Page (2000) has suggested from experiments conducted that diversity can and often does trump ability. Under certain conditions, a random selection of crowd-sourced problem-solvers outperforms a collection of the premier experts in the specific field largely because of the homogeneity of their thinking. Experts were found to be better at finding solutions than the crowd but only with regard to highly focused problems. Von Hayek (1945) perhaps was the first to note that every person has an advantage of others because of the uniqueness of their personal experiences and information and that this information has potential benefits to society.

In the field of business and specifically product innovation and marketing, crowdsourcing has been found to be especially useful. Chesbrough (2003) cites the case of Proctor and Gamble who changed their approach to innovation by crowdsourcing information on the premise that although they had 8,600 R&D scientists working for them looking for such innovations there were 1.5 million outside. Far from being a method confined to the social sciences, crowdsourcing has been used by neuroscientists. Thomas (2013) indicates that Seung of the Max-Planck Institute devised a computer game called 'EyeWire' to help map the shape of actual eye neurons. The neuron skeletons are pre-drawn and players of the game are required to color in the neurons. The hope is to produce a map of a synapse that has never been mapped before and to find out how neurons detect motion. Seung is currently writing a journal paper detailing new discoveries made from crowd-sourced material obtained from the 'EyeWire' game. Both within the natural and social sciences the advantages of crowdsourcing are becoming increasingly apparent and a respected scientific method. Buecheler et al (2010) allude to the scientific methodological potential of crowdsourcing more in a recent article on open innovation and collective intelligence. Buecheler et al (2010) refer to Malone, Laubacher and Dellarocas (2009) model which uses the genome analogy to show the different aspects of a collective intelligence (crowd sourced) task which are attributed 4 basic "genes": Who, Why, What, How.. The 'Who' aspect refers to the crowd or hierarchy to be sourced, the 'Why' refers to the incentives for doing the collective intelligence task, which are listed as money, love or glory. The 'How' refers to the structured process for obtaining the collective intelligence of the crowd and the 'What' refers to the constituent of the crowd sourced material which might be, inter alia: voting, averaging opinions/attitudes, innovative ideas, consumer behavior etc. Although not specifically included in the model suggested by Malone, Laubacher and Dellarocas (2009), the 'Where' aspect of context and culture is of particular importance in the social sciences for obtaining generalizable data in the construction of valid concepts and theories. What is clear, however, is that crowdsourcing is a scientific method that can lead to large scale data collection based either on specific 'ex- ante' hypotheses that the researcher may wish to test; or, as in the case of innovation, a means of collecting ideas from detailed crowd sourced information which, 'ex post facto', can be used to build testable theories and concepts.

In a very general sense, what social physics and crowdsourcing advocate is a movement towards large inductive data 'observations' from careful scientific work and the subsequent development of theory 'ex post hoc' and/ or 'ex ante' hypothetico-deductive process of testing particular hypotheses and away from smaller data sets used in experimental and non- experimental situations. However this is not meant to suggest that experimental and non-experimental *smaller data set* falsificationism has no place in social science. Moreover the adoption of the Darwinian approach that includes detailed observations and documentation of large scale data in the collection of social data made possible through modern technology and the methodological approaches of social physics and crowdsourcing , does not mean that hypothesis testing of sections of general findings allowed through large data sets is excluded. Large set data acquisition does not exclude piecemeal research of segments of the large scale data collected utilizing quantitative hypothesis-testing, nor does it exclude in-depth qualitative analyses 'thrown-up' by such large scale observation. In fact this was also apparent in the original theory of natural selection (Weiner, 1994). Although there is clear evidence that Darwin worked with a conjecture of a possible explanation for evolution in natural selection (Penny, 2009), Darwin also worked on Baconian-type (Hesse, 1964) premise collecting much of his flora and fauna data principles without a clearly formulated theory. It was this meticulously detailed observation that led Darwin to present hypotheses of what had been observed and later his general theory of evolution. In his use of

meticulous observation methods, Darwin's work could be said to be quite far removed from the Popper's notion of scientific knowledge creation based on 'ex ante' conjectures and refutations 'ex post hoc'. In crowdsourcing and social physics this element of collecting large scale data without necessarily having a picture of what might emerge from it as in, for example, the collection of the collective intelligences of innovative ideas sourced by neuroscientists and business organizations, can pay large dividends in social scientific research work.

6. Summary and Conclusion

This paper has suggested that multidisciplinary, cross-cultural collaborative research groups (de Kok, 2013) and the use of large data sets in the manner advocated by the approaches of social physics and crowdsourcing, can offer a way forward for social scientific research. Against the backcloth information expansion which has led to increasing disciplinary specialization and the emergence of entirely new disciplines, the idea of a research investigator(s) creating valid data *across* the social sciences is difficult to imagine. However, multicultural and multidisciplinary research is both possible in the social sciences and has been shown to be highly beneficial, despite difficulties that have emerged in its use. A major problem in social science research is its general tendency to use smaller data sets which tends to limit the generalizability and validity of its findings. Larger data sets such as those afforded through the approaches of social physics and crowdsourcing are seen as providing a possible way forward when combined with a multidisciplinary and multicultural perspective in collaborative research teams. Such large data sets could be initially analyzed through 'pure observation' with a view to extracting communalities and associations that arise from this 'ex-post facto' in the manner Darwin devised the of the theory of natural selection. It is envisaged that social scientific adaptations of this approach can only be effectively conducted through multicultural and multidisciplinary collaborative research teams. Within these larger data sets, it would also be possible to 'hive off' segments for piecemeal multicultural and multidisciplinary qualitative, quantitative or mixed methods research with a view studying smaller units of the whole in more detail. Practical implications and potential benefits of this general approach to the social sciences and business research are manifold and include: more valid theoretical structures, more generalizable knowledge and a breaking down of burgeoning disciplinary silos that seriously undermine scientific progress and innovation.

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