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Exploring the Differences Between Social and Behavioral Science

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Even though social science and behavioral science are interconnected and both study behaviors, there are some noteworthy differences between the two fields at the level of scientific analysis of behavior. In this article, a definition of social science is put forward as the study of relationships between macro type variables, like culture and society, and micro type variables such as how people behave. Behavioral science, on the other hand, is the organized study of human and animal behavior through controlled systematic structure. The differences in the fields pertaining to contextual manipulation, operationalization and creation of variables are discussed. Factor analysis has been suggested as potential solution for social science research. *Model of Hierarchical Complexity* (MHC) as the potential bridge between the 2 fields is discussed. Social science can expand its social value by adapting behavioral science research models. Furthermore, behavioral science needs to expand its scope to take on social science issues.

Keywords: social science, behavioral science, factor analysis, context manipulation, operationalization

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The terms behavioral science and social science are often used interchangeably. Even though these two fields are interconnected and both study behaviors, there are some noteworthy differences between the two fields at the level of scientific analysis of behavior. In this article, a definition of social science is put forward as the study of relationships between macro type variables, like culture and society, and micro type variables such as how people behave. Social science provides a perspective structure to study social observation through social systems. Some of the major subfields within social science are cultural anthropology, history, micro and macroeconomics, political science, sociology, social psychology, personality, abnormal psychology, and psychometrics. Behavioral science, on the other hand, is the organized study of human and animal behavior through controlled systematic structure. Behavioral research has independent variables that can be directly manipulated by the experimenter. The experimenter starts by locating a framework in which to perform the experiment. When groups are used, the experimenter selects and organizes participants into groups, operates variables, and obtains measures of participant's responses. Some of the major sub fields within behavioral science are psychophysics, behavioral economics, cognitive psychology, psychobiology, and management science. The article discusses the underlying differences between the two fields pertaining context manipulation, operationalization, and formation of variables and is accompanied by the examples within the subfields of the disciplines. *Model of Hierarchical Complexity* (MHC) is discussed as a potential bridge between the two fields.

Differences in Research Design

Context Manipulation

True experiments may have four elements: (a) manipulation, (b) control for group experiments, (c) random assignment of conditions and in population studies, and (d) random or stratified selection. Manipulation and control are the most significant elements of true experiment.

Michael Lamport Commons discussed with the author and provided notes on which this article is partially based on.

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Manipulation means that something in the environment has been purposefully altered by the experimenter. Control is used to prevent outside source from influencing the study. When something is manipulated and controlled, there is higher confidence that the systematic manipulation and control caused the outcome.

"Contextual manipulation" (p. 3) is the key in behavioral research. The planned and systematic act of appropriate manipulation is the principal feature that differentiates the behavioral research from all other research strategies (Bush & Kennedy, 1985). By manipulating for participant's instructions, motivations, limitations, and reinforcement in an experimental setting, behavioral scientists can fine-tune the constraints of real-world applications (Butz & Torrey, 2006). Often the observer deliberately manipulates the context to identify the effects of these manipulation. The contexts that are altered are called independent variables. The outcomes of the experimenter's manipulations, called dependent variable, are measured.

On the other hand, controlled experiments are only one of the few numerous approaches to studying the association between variables in social science. Applied or moral reasons often restrict the use of true experiments in socials science research. Thus, even though context manipulated true experiments are ideal for detecting casual relationships, they are not always feasible for social science studies. This limits the application of research outcomes to real-world. Economics and political science are two fields within social science that relies on observation and expertise but most often not true experiment. The consequences of lack of true experiment in economics and political science is discussed next.

Economics is the branch of social science that seeks to describe factors that determine production, distribution, and consumption of goods and services. Economics is driven by the need for expertise in predicting and controlling the economy in many levels (Turner, 2013). However, expertise is not enough. Expertise is time bound and deals with the knowledge that one has now even though there are leading and lagging indicators. There is no true experiment that is, waiting for the procedure of trying, estimation, and rejection, replication, used by others in adjacent fields and the rest of it to work itself (Turner, 2013). There is often a gap between mastering the scientific concepts and understanding actual affairs in a way to predict or control them. Each financial crisis has not been anticipated by the economists. This has led to a call for restoring economics as a field, challenging its assumptions and so forth. However, these challenges soon die away because there is no alternative and the expertise of economists is still expertise and the methods such as econometrics, microeconomics, and core economic theory were stable (Turner, 2013). Economic relies on unrealistic, unverifiable, or highly simplified assumption because these assumptions simplify the proof of desired conclusions into perfect profit maximization and rational choices. All of the variables are composite (described later in the article) and does not apply to individuals until the rise of behavioral economics (Green, Rachlin, & Hanson, 1983; Rachlin, 1995).

Political Science is about: (a) the organizations of government, (b) the examination of political activity, and (c) political behavior. Political scientists rely heavily on media reports, usually print media, as the basis for data on important facets of politics and policy issues (Woolley, 2000). The record for analysis—whether media reports, government documents, private papers, or prior scholarly work— is a rough coding of true events that is often incomplete and driven by personal biases. Rarely do we know with confidence the true universe of events; hence, it is difficult to identify precisely the selection mechanisms of a record-coding process. Commonly, there is another layer between the original record and scholarly data coding. This coding layer involves the creation of periodical indexes for nonscholarly purpose. Index record coding results in error and instability biases (Woolley, 2000).

Operationalization

Operationalization is the process of strictly defining variables into potentially quantifiable factors. It is important to define the variables in such a way to facilitate a precise imitation of a research process. Most social scientists use operationalization as a part of the controlled method of observation and psychometrics. The observations and coding schemes are checked for reliability. However, the concerns with operationalization arises when social scientists

deal with complex stimuli and concepts that are not often directly measurable, observable and almost never manipulable by the experimenter. For example, Goffman (1959) argued that individuals take on roles and act on to present the most favoring impression to their audience. He further argued that individuals are concerned with how others view them. He called this "impression management." However, in his presentation of self in everyday life, rarely did he operationalized concepts such as shame or measured behavior such as "face work" or role taking. This lack of operationalization questions the validity of his research conclusions.

Unlike social science, operationalization in behavioral research is direct observation of the behavior and stimulus properties. Measurements often involve turning conceptual variables into measured variables. Measurement variables are the numbers that represent conceptual variables (Stangor, 2014). For example, laundry instrument is used as a means to score a person's stage of decision making. Laundry instrument is based on the MHC (Commons, Li et al., 2014). To score a person's stage of decision making, the participants are asked to decide whether a piece of stained clothing gets cleaner or remains dirty depending on different factors, like whether it is cleaned with hot water or cold water. The instrument is made up of a number of tasks for each stage. Participants are given problems in the ascending order of stage and can only advance to the next stage after correctly answering the three tasks in a row. The laundry assessment is cross-culturally and cross species valid measure of decision making (Upadhyaya, Giri, & Commons, 2015).

Construction of "Good" Variables

To construct an independent variable to be a good predictor, all the scales should be unidimensional. This means that the items in a scale for one variable should measure one and only one notion or measurement at a time. It is important for the items within a variable to be unidimensional because if the items within a variable are multidimensional, there is no way of telling which part of the variable is predictable. This defeats the usefulness of multidimensional regression.

Construction of Variables in Social Science

Almost all social science variables obtained through statistical analysis are composite and not based on fundamental courses. Composite variable is created by combining two or more individual variables, called indicators, into a single variable. Each indicator alone cannot provide adequate information, but altogether they can represent more complex concepts. As composite variables are not unidimensional, it is hard to use them as either dependent or independent variables and understand what they mean. Metaphors or categories are created to express imprecisely what they might mean. Use of composite variable can (a) alter the position of dependent variables (b) cause changes in statistical significance, produce overreduction, or loss of information analyses in interpreting the composite variables itself to the relationship with the outside world (Song, Lin, Ward, & Fine, 2013). As composite variables may not be easily decomposed into simpler variables, they easily combine with other variables resulting in low corrected r^2. Problematic interpretation of composite variables within the field of social science is discussed next.

IQ tests has been highly touted as the predictor of academic achievement and 18 states already administer the single shot IQ test to determine whether a child is gifted or not. The problematic use of IQ test is that it assumes all students with same IQ have similar educational needs. However, the fact that many other factors contribute to learning and real-world success, from active learning to intrinsic motivation, grit, and self-regulation and outside support and encouragement is not taken into consideration. Furthermore, the construction of four variables that composite the IQ test is not effective enough in predicting the performance. The interaction between these four variables are unclear. Studies have found better predictive of academic achievement other than IQ. Duckworth and Seligman (2005) found self-discipline, $r(196) = .67$, to be a better predictor of academic achievement (GPA in college) than IQ, $r(196) = .32$. Alloway and Alloway (2010) found that IQ accounted for a very small portion of unique variance to learning outcome. Rather, they found working memory at the start of formal education to be a better predictor of later academic achievement, $r(96) = .54$. *Order of*

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Hierarchical Complexity was able to explain a great deal of the variance in difficulty of the IQ item, with the correlation being $r(99) = 0.66$ (Commons, Featherston, & Chen, 2015). When including the second factor of rareness of an items as a second independent variable, the $r = .66$ went up to $r = .778$. The study also demonstrated the flaw in the structuring of IQ tests.

Social Psychology is the study of how individual's thoughts; perceptions and behaviors are influenced by the actual, imagined or implied presence of others. A common pattern among social psychologists is to study how quickly individuals yield to the pressure of authorities' prompts provided by their social environment (Damico, 1982). Asch (1956) conducted an experiment on conformity to investigate the extent to which social pressure from majority could influence an individual to fit in. He reported that on average about one third of the participants went along with the incorrect responses on the critical trials reported by the confederates (Asch, 1956). Later, Milgram conducted an experiment on obedience to see the extent to which participants followed the dictates of an authority figure to shock a person who was "purported" to give wrong answers, over 65% of the participants who were to act as teachers proceeded to the highest voltage. Milgram (1963) concluded that people comply either out of fear or out of the desire to seem obliging. Thereafter, the concept of conformity was highly sensationalized and touted as an innate characteristic in all human beings (Baumeister & Leary, 1995). However, conformity is a composite variable. Unlike behavioral science, the composite variable of conformity did not identify the key variable of stage of the person measured outside of the experiment. Furthermore, there were some behaviorally defined independent variables such as whether the participant could see the purported student or not. Stage is absolute. Stage works outside of laboratories unlike the periods.

For the composite variable to work well, all components should be substitutable and, meet three conditions. First, all the variables should have more or less the same importance from a scientific point of view. Second, all components should occur with similar frequency and third, they should have a similar sensitivity to treatment. However, frequently, hard, and occasional variables are combined with less severe or more frequent variables. As a result, more frequent variable will condition the frequency of the outcome. It is impossible to identify what is causing what within the composite variable. Traditionally, most measures are the composites of multiple things going on. There is little worry about colinearity among variables, that is, many of the variables have correlations with other variables. It is proposed that complicated predictors may be largely accounted for by examining the interactions among the variables. Interaction terms are multiplicative. For example, consider the Body Mass Index (BMI). It consists of x_1 = weight; and x_2 = 1/height, that means there is an interaction between weight and height that is x_1/x_2. Equation 1 is the simplified form of linear regression:

$$\begin{aligned} y = {} & \beta 0 + \beta 1x1 + Y. \\ & + \beta mxixj + Y. \\ & + \beta nx1x2x3 + Y. \\ & + \beta ox1x2x3 + Y. \\ & + \beta px1x2x3x4 + Y. \\ & + \beta qx1x2x3x4x5 + Y. \end{aligned}$$

Then the two way interactions follow. Next the three way interactions follow and so on. Each additional interaction is simply added to previous terms. Equation 2 is the actual multiple regression equation with all the interaction terms:

$$\begin{aligned} y = {} & \beta 0 + \beta 1x1 + \beta 2x2 + \beta 3x3 + \beta 4x4 \\ & + \beta 5x5 + \beta 6x6 + + \beta 7x1x2 + \beta 8x1x3 \\ & + \beta 9x1x4 + \beta 10x1x5 + \beta 11x1x6 \\ & + \beta 12x2x3 + \beta 13x2x4 + \beta 14x2x5 \\ & + \beta 15x2x6 + \beta 16x3x4 + \beta 17x3x5 \\ & + \beta 18x3x6 + \beta 19x4x5 + \beta 20x4x6 \\ & + \beta 21x5x6 + \beta 22x1x2x3 + \beta 23x1x2x4 \\ & + \beta 24x1x2x5 + \beta 25x1x2x6 + \beta 26x2x3x4 \\ & + \beta 27x2x2x5 + \beta 28x2x3x6 + \beta 29x3x4x5 \\ & + \beta 30x3x4x6 + \beta 31x4x5x6 \end{aligned}$$

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Construction of Variables in Behavioral Science

There are just two fundamental variables in behavioral science, (a) Order of Hierarchical Stage and (b) Value. The behavioral science variables are unidimensional. This is aided by submitting the items in a proposed scale to a factor analysis. Any item that load on only the first factor is then selected and also run what is called a Rasch (1980) Analysis. A Rasch Analysis tests for the unidimensional ordering of items. It does not guarantee that there are not more dimensions making up the single scale. However, it does mean that the scale items are transitive.

$$\text{If } A > B, B > C \text{ then } A > C$$

The *r* in behavioral research is fairly high. for example, Commons, Goodheart, and Dawson (1997) by means of Rasch analysis found that, *Order of Hierarchical Complexity* of a given task forecasted the stage of a performance, the correlation being $r = .91$.

Li, Commons, & Zeqing (2016) led a study to see whether six variables were related to criminal behavior or not. These variables were scaled scores on unidimensional measurements of lying, anger, depression, attachment, impulsivity, and social perspective taking stage scores. As it turned out, the various interaction among these measures were predictive of how many crimes were committed and the severity of these crimes. Traditional social science and psychometrics testing would not have been able to see what the components of these interactions were. Stronger models account for individual variables. Independent variables can be treated in behavioral science and broken down into directly measureable things. Behavioral scientists try to run some form of experiments: single subject experiment, quasi-experiments rather than just have descriptions. In the study of criminality, the quasi-independent variable included social-stage-of-perspective taking that affects the number of crime a person does rather than using composite variable of education. Quasi-independent variable such as anger, stage of helper person is better than using class, education, or income which former are quasi-independent variables and not composite variables.

Factor Analysis as the Possible Solution for Social Science Studies

Almost all psychometric tests have been developed using factor analysis. Factor analysis places item into groups. Each item in the same group is highly related. This requires sharp identification of uniqueness and similarity of variables. This helps to choose useful factors and items for a study. Every item will have a factor loading after factor analysis. The factor loading is the correlation between the item and the factor. The higher the factor loading of the item, the more it represents the factor. Having a factor loading of .7 or higher is a good rule of thumb in factor analysis. In behavioral science studies, the items are chosen based on this rule. If a second factor explains a great deal of the variance, one needs to look at the items to see what they are measuring. If they seem to cohere, a new scale needs to be made. It is tested by giving it out again and doing a factor analysis to make sure that there is only one big factor. That second factor has to be Rasch tested to make sure it is unidimensional l and has no items with big infit errors bigger than 1.9. This is repeated for the third and other factors if they explain a great deal of the variance.

Table 1 is a Rasch Analysis of possible boundary crossings. It should be noted that none of the infit errors are above 2.0. None of the items fall off the scale. This means that the scale is unidimensional. The Rasch scale of perceived seriousness of boundary excursions (a) supports the progression of severity and (b) should not be taken as an absolute index of severity. These estimated values are based on relatively small sample size. The scale of perceived harms and unprofessional behaviors are not scaled actual harms. It is important to note that over 94% of the boundary items fell on a single dimension of perceived seriousness of boundary issue. This result may be contrasted with our suggested previous factor analysis that suggested three clear factors. The single scale makes sense in describing the severity of all boundary excursions. The scale is linear and smoothly continuous. This continuity supports the "slippery slope" notion. There are no breaks or jumps indicating a "bright line" between (a) boundary excursions, (b) boundary crossings, and (c) boundary violations. This further under-

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Table 1
Rasch Analysis of Possible Boundary Crossings

Input: 15 participants 6 categories								
Subject: REAL SEP.: .94 REL.: .47 . . . RANK: REAL SEP.: 2.65 REL.: 88								
Entry number	Total score	Total count	Measure	Model *SE*	Infit MNSQ	ZSTD	Outfit MNSQ	ZSTD
1	54	15	−.14	.19	1.15	.6	1.18	.7
2	46	15	.15	.19	.82	−.5	.81	−.6
3	55	1	−.17	.19	.93	−.1	1	.1
4	82	5	−1.65	.35	1.34	.7	1.28	.6
5	57	15	−.24	.19	1.21	.8	1.2	.7
6	53	15	−.1	.19	.92	−.2	.92	−.2
7	48	15	.08	.19	.81	−.6	.81	−.6
8	66	15	−.6	.21	1	.1	1.23	.7
9	45	15	.19	.19	1.37	1.2	1.37	1.2
10	77	15	−1.19	.27	1.89	1.7	2.76	2.7
11	28	14	.83	.25	.87	−.2	.7	−.6
12	32	14	.61	.22	.6	−1.1	.57	−1.2
13	30	14	.71	.23	.67	−.9	.58	−1.1
14	26	14	.96	.26	1.38	.9	1.11	.4
15	33	14	.56	.22	.75	−.6	.73	−.7
Mean	48.8	14.7	0	.22	1.05	.1	1.08	.2
SD	16.7	.5	.71	.04	.51	130	9.8	7

Note. MNSQ = mean square; ZSTD = standardized fit statistics. Miller et al. (2006).

scores the critical role of context in analysis of boundary issues.

Potential Role of Universal Models Such As MHC as a Bridge and Value and Its Discounts

Contentless and culture free mathematical models may help bridge the gap between social and behavioral science. Because they are mathematical, they are contentless, culturally and historically free. Because of their mathematical nature, they do not depend on evidence directly in their formation but only in their applicability. For example, MHC offers a standard method of examining the universal pattern of development of increasingly successful completions of tasks, which might best capture the common notion of smartness. It shows that development proceeds across general sequences of behavior. These sequences exist in every subdomain including social, interpersonal, mathematical, logical, scientific, moral, and so on (Commons, 2007). One of the major bases for this developmental theory is task examination. Each undertaking contains a series of subtasks. When the subtasks are carried out by the participant in a required order, the task in question is successfully completed. Tasks are defined as sequences of contingencies each presenting a stimulus and each requiring a behavior or a sequence of behaviors that must occur in some nonarbitrary fashion. Hence, the scoring is based not upon the context or the participant's material, but instead on the mathematical complexity of the hierarchical complexity of the information.

Order of Hierarchical Complexity (OHC) is the characteristic of the stimulus property of the task. Stage of performance is the corresponding response property. The tasks are identified as parts of sequences of contingencies, each presenting a stimuli and each requiring a behavior. The organization of actions from the adjacent next lower order from the sequence of behaviors must occur in some nonarbitrary fashion. The perceived difficulty (stage) increases with the increase of OHC. Further, tasks are quantal in nature; they are either completed correctly or not completed at all. OHC has a very strong predictive role and accounts for most of the variance, $r = .991$, task difficulty (Commons, Giri, & Harrigan, 2014). When regression analysis was run, OHC wiped out all the other factors; other factors were only the sub compo-

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nents of what OHC was measuring (Commons, Miller, Li, & Gutheil, 2012).

Models of behavioral economic models of decision making (Herrnstein, 1970; Rachlin, 1995) also may serve as an example. Value, the delay of reinforcement a changes in delay in reinforcement, may be studied both observationally in the social science and often experimentally in behavioral sciences. Value is often an operative variable in both approaches and discounting also. Recently, the change in discounting because of delay has been seen as risk that also applies to both approaches.

Claims that social science is both theoretically informed and empirically driven, committed to developing evidence-based observations, descriptions, and explanations through theoretical and empirical investigations do not hold true in the absence of true or quasi-independent noncomposite variables. Use of a psychometric scale of items having high loading on a single factor is a reasonable solution for social science studies. Other possible solution would be to adopt a contentless mathematical model of study. Social science can expand its social value by adapting behavioral science research models. Furthermore, behavioral science needs to expand its scope to take on social science issues.

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