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RESEARCH

Concepts and Reasoning: a Conceptual Review and Analysis of Logical Issues in Empirical Social Science Research

Qingjiang Yao[1]

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Abstract

A substantial number of social science studies have shown a lack of conceptual clarity, inadequate understanding of the nature of the empirical research approaches, and undue preference for deduction, which have caused much confusion, created paradigmatic incommensurability, and impeded scientific advancement. This study, through conceptual review and analysis of canonical discussions of concepts and the reasoning approaches of deduction and induction and their applications in social science theorization by philosophers and social scientists, is purported to unveil the logical nature of empirical research and examine the legitimacy of the preference of deduction among social scientists. The findings note that conceptual clarity as the foundation of social science research, exchange, and replication can be achieved through interdisciplinary stress of conceptual analyses to establish universal measurements and that the primacy of deduction in social sciences needs to concede to or be balanced with induction for new knowledge, more discoveries, and scientific advancement. The study recommends that institutions and researchers of social sciences invest more in conceptual analysis and inductive research through collaboration and separate efforts.

Keywords Conceptual analysis · Deduction · Induction · Hypotheticodeductive model · Falsification · Social sciences

Social science research as a thinking and reasoning activity, like natural science research, follows logical regulation (Babbie, 2021); negligence of logical principles makes research confusing and obfuscating, causing meaningless debates (Bal, 2009; Bringmann et al., 2022; Chaffee, 1991; Wittgenstein, 1922/2007). Such debates are oft-seen in social science research; so, clarifying logical principles involved in social science research is necessary to design studies, exchange findings, encourage

✉ Qingjiang Yao
qyao@lamar.edu

[1] Department of Communication & Media, Lamar University, P.O. Box 10050, Beaumont, TX 77710, USA

innovative studies, and advance the field (Locke, 2007; Locke & Latham, 2020; Woiceshyn & Daellenbach, 2018). This study revisits and reviews the fundamental concepts of logic (specifically, conceptual analysis and the reasoning approaches of deduction and induction) and analyzes their application in social science research by reviewing canonical discussions of philosophers and social scientists, and recommends social scientists invest more time and energy in conceptual analyses and inductive research to build the foundation of social science studies and communication, advance social science research, and forward human understanding of opinion, attitude, behaviors, and social issues.

Introduction

Social sciences, roughly speaking, is the research on human behaviors, social issues, or society with methods employed by natural scientists, a definition that can be traced back to early social scientists such as Auguste Comte and Emile Durkheim (Cohen, 1994; Schlagwein, 2021). Although lately different paradigms have been applied to research on issues in society, such as functionalism, symbolic interactionism, and critical studies, empiricism or positivism is still preferred (Fetzer, 2022; Mokgohloa et al., 2021; Xin et al., 2013), which holds that theory is separated from and based on observation (Boyd & Bogen, 2021) and that knowledge is gained through experiences and senses and along the particular-general continuum (Clark et al., 2021) with objectivity in research practices (Bird, 2020). Science or social science research should be aimed at inference and generalization, have public procedures, produce probabilistic conclusions, and follow a set of rules of inference (King et al., 2021). They should be conducted objectively (value-free), systematically, and with replicability (Clark et al., 2021).

Quantitative and Qualitative Research in Social Sciences

Social science studies are often conducted with qualitative, quantitative, or mixed strategies. The debate between qualitative and quantitative researchers has been heated since the 1960s and rather intensive sometimes (King et al., 2021). Qualitative studies use smaller unrepresentative samples, measurements that are less accurate or quantifiable, and less rigid rules or procedures (intensive interviews, discussions, observations, etc.), aiming at digging deeper inside the objects and their relationships with each other. Quantitative studies, which are more dominant in social sciences, on the other hand, use large, often representative, samples with quantifiable measurements, and follow clearer and more rigorously standardized procedures. Also, qualitative research prefers inductive inference (e.g., theme analysis or grounded theory, methods to build a hypothesis or theory from qualitative data at hand; Charmaz & Thornberg, 2021; Mokgohloa et al., 2021; Veen, 2021), but quantitative research is more associated with deductive inference, preferring theoretical hypothesizing and hypothesis-testing, although some quantitative researchers also use the grounded theory method, which is usually used by qualitative researchers (Tie et al., 2019).

The qualitative and quantitative strategies, however, basically have the same assumption and underlying mechanism and follow the same logic of reference and purpose of generalization (King et al., 2021). Qualitative studies can be seen as case studies for quantitative studies, which focus more on generalization. No fundamental differences should exist between the standards for solid quantitative and qualitative studies (Mokgohloa et al., 2021; Veen, 2021).

Also, qualitative and quantitative researchers are collaborating more on mixed-method approaches, and qualitative studies are increasingly using the language of inference for generalization, from 14% in 1990 to 71% in 2019 in political science qualitative studies alone (King et al., 2021). Quantitative researchers are also called to employ some qualitative research techniques (e.g., structured interviews) to further enhance the validity of concepts and conceptual clarity (Bringmann et al., 2022), albeit concepts are often better defined in quantitative studies than in qualitative ones.

The Conceptual Confusions in Social Sciences

All scientific areas, natural or social, are constructed with concepts and based on those core ones that define an area or interact with most concepts in the area. So, the philosophical technique of conceptual analysis, also known as explication (Chaffee, 1991), is the first and constant step in all social science fields (Clark et al., 2021). Conceptual analysis builds a detailed and comprehensive definition of a concept, which should also include an empirical measurement of that concept that is developed in a process known as operationalization among social scientists. Once concepts, particularly those core ones, are sufficiently explicated, they can then connect to each other and generate patterns (propositions about relationships between or among concepts), which turn into theories if passing substantial empirical tests.

Social sciences, nevertheless, have been found full of vague concepts and careless definitions that generate confusion and meaningless debates (Bringmann et al., 2022; Locke, 2007; Wittgenstein, 1922/2007), which are also found in even humanistic or critical studies (Bal, 2009) and invite criticism of social theories and the quantitative research (Blumer, 1956). Often, researchers use a concept without conceptualization or adopt different meanings of the same concept in the same literature, thus confusing their peers (Bal, 2009). For instance, some social scientists use the term "social reality" to refer to the real social situation that exists even though people in the situation may not see it, while others use the same term to refer to the false reality that socially defines people in it. The findings of the relationship between "social reality" and other concepts, therefore, cannot be solid (McLeod & Chaffee, 2017). This is unfortunately a phenomenon prevalent among social sciences.

Psychology has been considered the most mature social science and served as the foundation of most other social sciences (Open Science Collaboration, 2015), but in a conceptual study, a group of psychologists conclude that conceptual unclarity still exists, and therefore better conceptualization needs to be conducted in almost all aspects of psychological research, from everyday concepts to statistical measures (Bringmann et al., 2022). Psychologists have found 100 or more definitions of

leadership and at least 17 definitions of mindfulness, which have caused much confusion in psychological research and scientific communications and undermined the foundation of psychological theory building (Locke & Latham, 2020). Even for a concept as important as depression, scholars find that major scales of measurement do not agree with each other, with one diagnosing much more subjects as having major depression than the other (Wu et al., 2020).

In communication studies, it is still a heavy duty to establish valid and reliable fundamental concepts to achieve the maturity of the scientific field. When studying the concept of "media effects," Potter (2012) finds that the continual clarification of this central concept is still an essential scholarly task not fulfilled yet. Many other confusions in communication research also come from malfunctioned conceptualization or operationalization of concepts, such as the dispute between the second-level agenda-setting researchers and some framing researchers, which has been largely caused by the unclear definitions of the concepts "agenda" and "frame" (Yao et al., 2020). "Agenda," a good metaphor, is accurately operationalized as the number of stories in the original agenda-setting study (McCombs & Donald, 1972). But when the agenda-setting theory was extended to its second (from objects to attributes) or the third level (to news media network agenda), the concept became vague (Yao et al., 2020). Another core concept "frame," usually conceptualized as ways of defining meanings of the texts and operationalized as rhetoric devices, patterns of message organizations, word choices, and tone (Pan & Kosicki, 1993), has also been operationalized as issue topics by some researchers, causing a concept shift (Haslam, 2016; Haslam et al., 2020, 2021). As a result of those ineffective conceptualizations and operationalizations, the salience of a story or an attribute is used in some studies as a measurement of second-level agendas but in others as a measurement of frames, thus leading to the dispute that each school claims to own the other as a part (Yao et al., 2020).

In other social sciences, international relations researcher Baldwin (1980) also finds that much theoretical controversy in research on international relations has been generated due to the unclear explication of the concept "dependence" or related concepts such as "interdependence" and "dependency" of countries. Marketing researcher Young (2008) finds that different marketing research companies, such as Ameritest, MSW, Milward Brown, Ipsos-ASI, and ARS, not only use different concepts to document campaign effects, but also measure the same concepts, such as attention, recall, motivation, persuasion, and brand linkage, in different ways, generating barriers for social science researchers and practitioners to effectively communicate, share common knowledge, and replicate studies.

Partly due to the challenge of concept clarification and measurement in social sciences and conceptual shifts or creeps (Haslam, 2016; Haslam et al., 2020, 2021), partly due to human subjects' ability to modify themselves after learning social theories, and partly due to the researchers and the journals' selective practice and bias of reporting positive findings that confirm predictions (Francis, 2012; Schimmack, 2020), social sciences' replicability has been impeded. Only about 39% of empirical studies can be replicated in psychology (Open Science Collaboration, 2015), a mature area of social science, making social sciences "harder" than the hard (natural) sciences to conduct. Identifying, defining, and clarifying concepts, particularly

core concepts, is the starting point of theory building in any field (Locke & Latham, 2020) and overcomes the paradigmatic incommensurability that segments scientists and hinders scientific advancement (Kuhn, 1996). Social scientists' undervaluing and probably unawareness of concept analysis, despite long-time calls for such emphasis (Chaffee, 1991), need to be urgently addressed again to build a solid foundation for social sciences.

The Preference of Deduction Over Induction for the Perceived Rigor

Once concepts, particularly those core ones, in each field are identified and explicated, the next step for social scientists is to build theories, namely, to identify, through reasoning, generalizable relationships between or among the concepts (Dubin, 1978; Mokgohloa et al., 2021). Human reasoning follows two logical approaches: deduction and induction (Copi et al., 2010; Hurley & Watson, 2018; King et al., 2021). Although some philosophers have proposed another approach, abduction, also called retroduction (Brandt & Timmermans, 2021; Clark et al., 2021; Kistruck & Shantz, 2022; Peirce, 1898/1992; Philipsen, 2017; Sætre & Van de Ven, 2021; Shrestha et al., 2020; Veen, 2021; a small group of scholars even differentiate abduction from retroduction, e.g., Mukumbang et al., 2021), logicians have not widely recognized it as valid. In fact, with the probable relationship between its premises and conclusions, it may also be considered a type of induction (Copi et al., 2010; Hurley & Watson, 2018).

Deduction has received much more attention than induction among logicians and therefore social scientists for its appearance of rigor (Svejvid, 2021) and has been heavily preferred by journal editors and reviewers in empirical social sciences (Locke, 2007; Locke & Latham, 2020; Woiceshyn & Daellenbach, 2018). Most quantitative research textbooks focus on the deductive approach as the "scientific method" (Brandt & Timmermans, 2021, p.191), which demands a lengthy literature review, theory-choosing, and hypothesis development (Locke, 2007; Woiceshyn & Daellenbach, 2018), but limits social scientists' theoretical imagination (Brandt & Timmermans, 2021), and impedes scientific progress (Locke, 2007). Deduction, the theoretical reasoning from known axioms, is at the heart of hypothesis-driving social science studies (Shrestha et al., 2020). Some journal editors insist so much on deduction and hypothesis-testing that they reject studies of "harking" (i.e., hypothesizing after the results are known) or promote preregistration (announcing the hypotheses before testing them), showing a lack of understanding of deduction and induction in human thinking and research (Locke & Latham, 2020). Such dominance of deduction in scientific research contributes to paradigmatic incommensurability (Kuhn, 1996) and may be led by skeptics such as Rene Descartes and David Hume, who argued that innate ideas, rather than human senses, are valid for obtaining knowledge (Woiceshyn & Daellenbach, 2018).

Induction, on the other hand, is believed to have opened the era of discovery and the scientific revolution (Kuhn, 1996) but is much underused due to overemphasis on theoretical rigor and deductive computation (Brandt & Timmermans, 2021; Svejvid, 2021). Isaac Newton was the best historical example of an inductive genius, who

explained circular motion, invented calculus, and discovered the law of planetary motion through building new concepts, experiments, and observation. Induction was also the main method used by Einstein, Darwin, Galileo, and some modern theorists in social sciences, in which theories are developed based on a large volume of data (Boyd & Bogen, 2021; Locke, 2007). Despite induction's contribution to the human scientific revolution and some social scientists' call for inductive theorization, most quantitative social scientists still pursue deductive rigor, perhaps under the undue influence of some philosophers of science such as Karl Popper, who denied induction as a reasoning approach of logic (Locke, 2007; Locke & Latham, 2020).

So, to help social scientists further understand the significance of conceptual analysis and inductive research, this study aims to answer the following research questions: how have conceptual analysis and the deductive and inductive reasoning approaches and their applications in social science theorization been discussed by philosophers and social scientists? What can social scientists learn from these discussions?

The Method of Conceptual Review Research

With the epistemological underpinnings of its purpose, this study adopts a method of conceptual review research. Conceptual review is often used by social scientists to study "abstract concepts, ideas, or theory" and is different from the oft-seen empirical research, which is based on data and hypothesis-driven (Thomas, 2021, p. 60–61). By analyzing the history of and relationships among the concepts (logic concepts in this study) discussed in the extant literature (Dreher, 2000, 2003; Xin et al., 2013), conceptual research can generate knowledge that empirical studies are unable to unveil through their data (Aven, 2018; Rosenberg-Jansen, 2022) and build the "very basis" for empirical studies, although it is harder to "sell" to journals and funding sources (Bringmann et al., 2022, p. 344). Because conceptual research is an undervalued method but is so important for clarifying social science concepts and integrating social sciences knowledge, it has been called for and practiced by pilot researchers in such areas as risk analysis (Aven, 2018), energy and humanity (Rosenberg-Jansen, 2022), psychology (Bringmann et al., 2022), tourism (Xin et al., 2013), and youth and social media (Baskaran et al., 2017).

The literature for this study is searched through Google Scholar, the author's library accumulation, peer recommendations, and citations in available articles.

Conceptual Analysis: Building the Foundation for Social Science Research

The importance of conceptual analysis, or, explication, was first discussed by philosophers such as Kant (1781/1998), and Husserl (1900/1973) and later formally studied by linguistic philosophers, who hold that language is systematically misleading and requires careful and constant analysis (Margolis & Laurence, 2022).

Analytical philosopher Carnap (e.g., 1956, 1963) has been best known for valuing explication in scientific research and maintaining that scientific concepts must be analyzed and defined a priori by philosophers. Carnap defined explication as the logical analysis and construction to clarify a concept that is vague in daily life or the earlier stage of scientific research (1956, 1963). For most everyday concepts, explication is searching out new definitions that are clearer, simpler, more exact, and, above all, fit for a systematic structure of scientific concepts, and the more a concept is embedded into the system of scientific concepts through explication, the more productive and useful the concept is to formulate theories or laws (Yao, 2023a). Ideally, the meaning of the explicated scientific concepts is consistent with their everyday meaning as much as possible, although much clearer, measurable, and responding to the scientific system. Explication, Carnap argued, therefore, is one of the most important tasks of philosophy and science (1963).

After being challenged by Quine (e.g., 1974) and Putnam (e.g., 1962), who believed that producing a priori concepts was neither possible nor necessary, conceptual analysis has revived in recent decades, largely due to the work of Australian philosopher Jackson (e.g., 1998), who has offered the most sophisticated defense of conceptual analysis. Jackson (1998) argues that conceptual analysis is the very business to make a story in the vocabulary of daily life true in a more fundamental vocabulary, like the scientific language, by grasping the essential structures of the concepts; it is an important tool to understand the materialistic world, the foundation of categorization, the construction of meaning, and communication (Stich & Weinberg, 2001).

Conceptual analysis has been appealing to most philosophers because it justifies philosophers' work as a priori conceptual explicators, is necessary for conducting ontological reduction, and offers normative guidance. It has also been objected to by other philosophers for being aligned with naturalism and for the possibility that human intuition cannot be shared, which may be worse across cultures (Margolis & Laurence, 2022). But concepts are seen as basic units, out of which theories are built, in empirical social sciences (Dubin, 1978). Unlike the nativists who believe that concepts are innate, empiricists, to whom most social scientists belong, hold that all concepts are formed in the human mind through sensing and analyzing the world (Hume, 1748/1999, Margolis & Laurence, 2022).

Concepts, Constructs, and Variables

Epistemically, concepts are the basic unit of thoughts and statements, the mental representations/images, categorizations, and labeling of things being observed in the real world (Chaffee, 1991; Hume, 1748/1999; Fodor, 1998, 2004; Locke, 1689/1997, etc.). They have also been deemed as abilities particular to cognitive agents (e.g., Dummett, 1991) or Fregean senses/abstract objects (e.g., Peacocke, 2009). They are, as put in the words of the lexical hypothesis, the "single terms" encoded in "human transactions" in all languages to represent the most important individual differences (Mollaret, 2009, p. 316). They are the "primitive bears of intentional content" (Fodor, 1998, p. 7).

All concepts are expressed in languages and are defined by simpler concepts identified through conceptual analyses, according to the classical theory of concepts,

which is held in the highest regard among all theories of concepts (Fodor, 1998, 2004). In science, conceptual analyses are ongoing as the theories develop. Explicated concepts are the building blocks of social scientists, who identify causal relationships between or among concepts to build propositions (hypotheses) and test them into theories (Dubin, 1978), which they consider as their paramount responsibility (Kerlinger & Lee, 1999). Social science concepts are related to human reflection and society.

Constructs, as called by some social scientists, are concepts consisting of multiple dimensions (Kerlinger & Lee, 1999): for instance, "weight" is considered a concept, but "intelligence" may be called a construct and require a scale of dozens of questions to measure. All constructs or other concepts should be carefully analyzed before being used in theory building; even a simple concept can cause confusion if it is used without meticulous examination or measured in different ways: for instance, ages reported in years are found uncorrelated with those calculated with birth dates, showing that they likely refer to different concepts in human minds (Chaffee, 1991).

Variables are indicators/items to measure concepts with varying degrees or amounts (Dubin, 1978). Social science concepts, particularly constructs (Kerlinger & Lee, 1999) need to eventually develop one or more items of indicators from their conceptual meanings as their empirical measurements in a complete explication. Variables can generate new variables through calculations to measure related concepts (Yao, 2023a). Conceptual analysis or explication in social science, the process of searching for the definition of, and deriving items or variables from, the concepts, is lengthy and should be replicable (Chaffee, 1991).

It should also be noted that, as widely used as these terms (i.e., constructs, variables) are, they are still criticized by some scholars. For empirical social scientists to clearly explicate a concept, understanding these terms and the relationship among them would be necessary.

The Process of Conceptual Analysis in Social Sciences

Social scientists explicate concepts through conceptualization and operationalization (Babbie, 2021). Conceptualization, termed meaning analysis by some social scientists (e.g., Chaffee, 1991), is the process of articulating the essential meaning of concepts through the lens of the scientific system. The meaning of a concept, according to Chaffee (1991), can be defined by either distillation or list (similar to the logical terms of intension or connotation and extension or denotation respectively. See, e.g., Copi et al., 2010). Distillation is the abstract statement of the essential elements of the concept with simpler concepts in the scientific system. For instance, media dependency is a media effect that when the audience has no access to other communications on a topic it depends maximally on the mass media. In a definition by list, all concepts subordinate to the concept to be defined are listed. The concept of mass media, for example, would be better defined by list as including newspapers, books, magazines, television, radio, and films; a distillation definition is not easy to produce because it is unclear whether the "mass" refers to mass production, mass audiences, or both (Chaffee, 1991).

Operationalization is the step based on conceptualization to find measurable items of indicators that can be used to gauge the concept, which are sometimes aggregated along multiple dimensions (Babbie, 2021). Although with disagreement, many social scientists hold that finding measurable items for concepts is the completion of explication and the beginning of theory building. For instance, after conceptualizing communication privacy management (CPM) as the belief of owning and controlling one's private information within privacy boundaries, researchers continue to operationalize the concept along the dimension of privacy boundaries, privacy rules, collectives, and privacy turbulence and propose questionnaire items to measure these dimensions (Petronio & Child, 2020). Also, based on the conceptualization of empathy in design as a situated phenomenon that is affected by, internally, empathic orientation and mental processes and, externally, empathic design research and action, researchers have identified six dimensions (empathic tendency, beliefs about empathy, emotion recognition, understanding mental contents, shared feeling, and prosocial responding) and developed measurable items for each dimension (Surma-aho & Otto, 2021).

These measurable items represent an essential part of the concepts, but never the whole of them, thus inevitably leaving room for errors, which social scientists should try hard to minimize. Social science concepts are not well explicated unless reliable and valid measurements have been developed for them (Locke & Latham, 2020).

In more mature areas of social sciences, such as psychology and education, research on the operationalization of concepts has been highly valued as a major task and constituted a fundamental subfield (Nunnally, 1987). But psychologists are still unsatisfied with psychological studies or theories filled with unclear or inaccurately-measured concepts, which have hindered the development of the area (Bringmann et al., 2022; Nunnally, 1987).

Other areas of social sciences may suffer more from the lack of, or the malfunction of, conceptualization or operationalization. The dispute between second-level agenda-setting researchers and some framing researchers in the mass communication field, for instance, can be avoided if communication researchers share the same explication of the concepts of "agenda" and "frame" (Yao et al., 2020). A communication scholar has also mentioned that a concept measured inaccurately in her research nearly invalided a line of her work for fifteen years and made her aware of the significance of explication: For a long time, she studied how the concept "uncertainty," which was conceptualized as public perception of what scientists did not know about an issue, impacted the public's information use for risk judgments. She measured that concept by asking respondents about their level of uncertainty and late found that most respondents understood "uncertainty" as how much they, instead of the scientists, didn't know about the issue (Dunwoody, 2005).

A meta-analysis of 414 U.S. human-subject-related articles published in leading epidemiology journals in 1995–2018 finds that only four studies completed conceptualization and clearly defined race and ethnicity and that a majority did not complete operationalization to provide measures, showing a situation that needs to be improved (Martinez et al., 2023).

Concepts' Dimensions and Levels of Measurement

In operationalization, while the traditional theory of measurement strongly encourages measuring concepts with multiple items to reduce measurement errors (Boateng et al., 2018), lately social scientists have found that single-item measurements may be preferred for concrete concepts for the questionnaire's parsimony and economy with little sacrifice in reliability and validity, leading to a new approaches for social scientists (Allen et al., 2022; Bergkvist, 2015; Gardner et al., 1998; Verster et al., 2021). It is critical to keep the measurements of the concepts the same across the fields regardless of whether they have single or multiple items.

Complex concepts, or constructs (Kerlinger & Lee, 1999), however, may contain different dimensions, each demanding several items (Bergkvist, 2015; Gardner et al., 1998; Verster et al., 2021). Attitudes, for instance, have been identified as having three dimensions: cognitive, affective, and behavioral, each measured by several items (Eagly & Chaiken, 1993). Social scientists should be warned about the possibility that these multi-dimensions of measurements may distort the meanings of the concepts, fail to capture all aspects of the concepts, or include irrelevant items, which becomes more possible when the concepts are more abstract and cannot be detected by simple factor analysis (Locke & Latham, 2020). Constructs with loosely connected dimensions may be better studied as separate concepts measured with more precise items. Without solid operationalization and testing, the differences among items measuring a construct can lead to conceptual ambiguity.

Items for a concept are usually measured at four levels (nominal, ordinal, interval, and ratio), but the same concept would interact with the system of scientific concepts differently if it is measured at a nominal level with only information on categorization or ordinal level with information on ranking than if it is measured at an interval level with information for addition or subtraction or ratio level with a true zero point and information for multiplication or division (Babbie, 2021). Systematically explicating a concept can establish a consensus across fields regarding the most appropriate level of measurement for the items of a concept. Meanwhile, if ordinal scales, such as Likert, Guttman, Thurstone, and semantic differential, are adopted to measure the concepts, to reduce research incongruence and increase replicability, appropriate statistical procedures should be recommended to ensure consistency in research (Yao, 2023a).

Concepts' Validity and Reliability

Validity and reliability for social science concepts, particularly the core ones for a field, should also be standardized to control the loss of information in the process of explication and minimize the errors of measurement. Validity measures the accuracy of the operational definition gauging the concept. To ensure the validity of core concepts in psychology and educational research, a joint committee on standards for educational & psychological testing of the American Educational Research Association (AERA), the American Psychology Association (APA), and the National Council on Measurement in Education (NCME) (2014) classifies validity into four types (content, predictive, concurrent, and construct) and sets common standards for

measurements of core concepts shared by scholars involved in these associations. This task should also be completed by other social science organizations and scientists based on scientific discussions and debates.

For concepts that emerge in exploratory studies, content or face validity may suffice, which is judged by a group of experts who examine if the operational definition accurately and comprehensively represent the concept (Locke & Latham, 2020). Commonly used concepts, however, should have established criterion validities, which check their operational definitions against an outside criterion either concurrently (concurrent validities) or in the future (predictive validities). Constructs, especially those with multiple dimensions, should also have guaranteed construct validity (Kerlinger & Lee, 1999). High construct validity ensures that concepts interact with the system of scientific concepts (Carnap, 1956, 1963) as expected based on the literature (Locke & Latham, 2020). Social scientists use the whole process of developing a theory to develop an empirical measurement for a construct (Kerlinger & Lee, 1999) with factor analysis or structural equation modeling (also called latent variable modeling, path model, covariance structural modeling, or several other names in social sciences). Validity analysis should also guarantee that the whole concept, instead of just a portion of it, is addressed by the measurement.

To maintain sufficient measurement validity and build the bedrock for mature sciences, Clark and Watson (2019) recommend social scientists complete fifteen procedures: 1). conducting clear conceptualization; 2). creating an overinclusive initial item pool; 3). paying careful attention to item wording; 4). testing the item pool against closely related concepts or constructs; 5). choosing validation samples thoughtfully; 6). preferring one-dimensionality over internal consistency; 7). considering the hierarchical structures of personality and psychopathology; 8). co-developing scales in the context of the hierarchical structures; 9). paying attention to constructs that do not fit in the hierarchical structures; 10). solving problems with "conglomerate" constructs; 11). developing alternative versions of measures; 12). following item-response theory to check external validity; 13). emphasizing convergent and discriminant validity; 14). checking incremental validity; 15). conducting cross-method analysis.

Social science concept explication should also generally maintain high reliability, which documents how consistent the measurement is as an operational definition of the concept (therefore also called dependability, stability, consistency, or predictability; Kerlinger & Lee, 1999). Reliability essentially examines how many errors are produced simply because of a misunderstanding of the operational definition or the way of using the operational definition in different situations or across different respondents (Yao, 2023a).

The oft-used reliability coefficient, Cronbach's alpha (Hayes & Coutts, 2020), ranges from 0 to 1 and measures the internal consistency among a concept's items. Core concepts in a field should maintain a Cronbach's alpha higher than 0.9, and common concepts should have a Cronbach's alpha higher than 0.8, in the condition that their measurements contain the fewest items possible and that the items are consistent with each other and cover the complete concept, to ensure that the concepts are solidly measured and that the social scientists speak the same language (Schrepp, 2020).

For core constructs with multiple dimensions, such as attitude (Eagly & Chaiken, 1993) and openness (Gatzka, 2021), high reliability should be achieved in each dimension, although the overall reliability may not reach an excellent threshold. Also, for formative concepts, such as domain knowledge, instead of reflective concepts, such as theoretical concepts often seen in empirical studies, high alpha may not be achievable or good (Stadler et al., 2021). Systematic attention should also be paid to the exploration and discussion of emerging coefficients of reliability, such as McDonald's omega, to consistently enhance measurement reliability (Hayes & Coutts, 2020). Attention should also be paid to following the guidance on calculating validity and reliability in the testing literature.

For better explication, psychologists have recommended eight steps: 1). conceptualizing comprehensively in research; 2). explicitly discussing conceptual ambiguities and differences; 3). linking the concept to the measurement methods and justifying the methods; 4). conducting conceptual studies; 5). dedicating funds for conceptual-clarification research; 6). incorporating conceptual competence in psychological education; 7). teaching qualitative research skills (to improve conceptual validity and clarity); 8). valuing commentary studies addressing conceptual flaws (Bringmann et al., 2022).

Establishing reliable and valid measurements of concepts is the ultimate step of conceptual analysis and a fundamental task for all social scientists (Xin et al., 2013). Even qualitative social scientists are recommended to value conceptual analysis to establish concepts with high validity and reliability (Rose & Johnson, 2020), whose quantitative measurements can be easily derived based on sufficient conceptualization, and use concepts in commonly accepted manners for conceptual clarity in scientific communications.

Social scientists are recommended to deem explication as more fundamental and valuable than theory building because the maturity of a social science field is symbolized by the establishment of widely recognized standardized measurements of core concepts specific to the field. Without commonly accepted concepts and measurements, theory-building in the field would inevitably be confusing. Concepts across multiple fields of social sciences need to be explicated by those fields together to build the foundation for interdisciplinary common understanding, as what the joint committee of AERA, APA, and NCME (2014) has accomplished. Such explication should also be systematically conducted or regularly reviewed to update the necessary concept shifts due to the accumulation of knowledge or the emergence of new phenomena and avoid the unnecessary conceptual creeps that create conceptual confusion and low replication rates (Haslam, 2016; Haslam et al., 2020, 2021).

Reasoning: Deduction and Induction in Social Science Research

The undue primacy of deduction and undervaluation of induction among social scientists largely result from a lack of understanding of these two logical reasoning approaches. So, a review and analysis of the canonical discussions of deduction and induction by philosophers and social scientists is needed to address the issue.

Deduction: from the General to the Particular and Let the Theory Guide

Deduction is defined by Aristotle (1984) as the inference from the general to the particular. Although he discussed both deduction and induction, he focused on deduction and developed his syllogism, which even now still represents deduction. Meticulous rules guide syllogism reasoning and guarantee the validity of the conclusion; a violation commits a fallacy (Yao, 2023c). The Aristotelian syllogism dominated the Greek and the medieval era, influencing Europe so significantly that some scientists believe if it wasn't for such domination, some scientific revolutions might have come earlier (Kuhn, 1996). Skepticism philosophers such as Hume and Kant reinforced the preference for deduction in the social sciences (Locke, 2007).

Deduction takes a more rigid and precise form when converging with mathematics, starting with Boole (1952/2012) and Gottlob Frege (Peacocke, 2009). Boole initiated the algebra of logic and revolutionarily built an algorithm system that can be applied to an unlimited amount of deductive argumentations, denote the underlying structure of logic, and calculate the logical propositions with help of algebra techniques. The Boolean algorithm was later developed into a binary system of deduction in computer science and inherited by Tarski (1946/1996), who framed a system of equations to calculate the logic relations. Frege, on the other hand, to fulfill Leibniz's (1666/1989) idea of "universal characteristic", created the system of arithmetic notations for formal logic, a language of pure thought. Instead of turning logic into algebra as Boole did, Frege reduced mathematics to logic in an arithmetic form that can solve all mathematic problems. The Fregean tradition is inherited by Whitehead and Russell (1956) and most modern logicians.

Popper (1959, 1963, 1982) further recognized deduction as the only valid way of thinking, reasoning, and scientific inquiry and defined a deductive statement as true if and only if when all the truth contained in the statement as a conclusion has been transmitted from the premises, which means, a deductive inference is valid if and only if no counterexample exists. This is the philosophical foundation of his falsification model (Yao, 2023c).

Today, although the *Oxford English Dictionary* still defines deduction as "in logic, inference by reasoning from generals to particulars; opposed to induction," logicians have included more types of methods of inference into deduction by defining a deductive argument as one whose premises support the conclusions in the way that it is impossible (as opposed to improbable in induction) for the premises to be true and the conclusions to be false (Copi et al., 2010; Hurley & Watson, 2018). For instance, a popular textbook lists five types of typical deductive arguments: arguments based on mathematics (e.g., $1+1=2$), arguments from definitions (e.g., it is a book; so it can be read), categorical (Aristotelian) syllogism (e.g., all men are mortal; Socrates is a man; therefore, Socrates is mortal), hypothetical syllogism (e.g., if it rains, the floor will be wet; it rains; therefore, the floor must be wet), and disjunctive syllogism (e.g., the flower is either red or blue; the flower is not blue; therefore, the flower must be red; Hurley & Watson, 2018).

The Deductive Models of Scientific Inquiry

Although deduction is believed to generate no new knowledge and constrain discovery (Kuhn, 1996), it has attracted most scientists with its form of rigor and precision

(Locke, 2007; Locke & Latham, 2020; Svejvid, 2021; Woiceshyn & Daellenbach, 2018). Some deductive models of scientific research have been oft-cited in social sciences (Locke, 2007).

Popper's Falsification Model

Believing the impossibility of objectively drawing patterns from single facts without theoretical intervention and the inevitability of all scientific inquiry starting with a system of theoretical assumptions (Locke, 2007; Woiceshyn & Daellenbach, 2018), Popper (1959, 1963) held that theories, or any general statements, could be logically never proven but only disproven when even one counterevidence appeared. Falsifiability was the only difference between science (e.g., Einstein's theory of a new universe) and non-science (e.g., Karl Marx's theory of history, Sigmund Freud's psychoanalysis, and Alfred Adler's individual psychology), and falsification was the only way to test and disprove theories (Locke, 2007; Woiceshyn & Daellenbach, 2018). So, for Popper (1963), scientists' responsibility was to deduct hypotheses from existing theories and search for opposite cases to falsify these hypotheses; hypotheses that could explain many phenomena and survive multiple times of falsification tests would be good theories (Locke & Latham, 2020; Woiceshyn & Daellenbach, 2018).

Popper's falsification method could easily reject many established theories with just one piece of counterevidence. His student, Imre Lakatos, proposed a Methodology of Scientific Research Programs (MSRP) to improve the tolerance of the falsification method (1978). Lakatos' MSRP classifies a theory's contents as central theses (hard core) and peripheral theses (auxiliary hypotheses). Disproving the auxiliary hypotheses does not falsify the theory but improves it by enhancing its predicting capabilities. A theory is only falsified when its hard core is disproved. Meanwhile, Lakatos, unlike Popper (whose subject of examination was normally a single theory), liked to think of theories as a sequence that shared the same hard core.

Although most social scientists have accepted falsifiability as a criterion to differentiate science from non-science, few have adopted falsification as a model of theorization. First, the techniques of statistical analyses widely used by social scientists are not designed to search counterevidence for falsification. Second, falsification is theoretically impossible because it requires first the validation of its evidence, which also demands falsification and turns the process into "an infinite regress" of falsification of falsification. Third, confirming something not true does not really advance science (Locke, 2007, p.869). Falsification has also been a goal of attack by philosophers and scientists leaning toward the Duhem-Quine thesis, who hold that hypotheses can be tested never individually but only possibly holistically as a science or even knowledge overall due to the challenge of differentiating analytical statements from the synthetical ones (Szatek, 2020).

Carl Hempel' Deductive-Nomological (D-N) Model

Based on Mill's (1843/2011) theory of scientific explanation that takes the explicandum (i.e., the explanandum, the thing to be explained) as a logical consequence

of the explican (i.e., the explanan, the thing that explains), Hempel (1965) developed the deductive-nomological (D-N) model. It contains three elements: (1) One or more law-like statement(s) as the premise, stating that factor x causes factor y; (2) a statement of the antecedental happening of x; (3) a deductive conclusion about the consequential happening of y. The model is deductive because the explicandum needs to be the logical consequence of the explican and nomological because at least one "law of nature," a universal law that describes a class of phenomena, needs to be the premise. It is thus also known as the covering law model (Fetzer, 2022).

The D-N model has also been criticized because it assumes a universal law that is impossible to validate. Toulmin (1953), following Wittgenstein (1922/2007), rejected universal laws as a prerequisite for explaining human behaviors and argued that Charles Darwin's theory of evolution had no such law to guide data collection and theoretical articulation. Kuhn (1996) pointed out that historical studies need no law-like statements. Furthermore, Hume (1748/1999) argued that no evidence would be available for the future validity of universal laws. The model, O'Shaughnessy (1992) maintains, explains only the relationship and time order of the necessary causations but not the third-factor effects, the sufficient causations, and the "why" behind the relationship. Despite its dominant reputation in sciences and social sciences, Gunnell (1975) argues, the model is deficient and seldom applied in research practice.

The Hypotheticodeductive (H-D) Model

The hypotheticodeductive (H-D) model, called deductivism by Popper (1959), emerged in physics studies in the 17th century and has become a major model, or, "the official doctrine," for scientists and social scientists (Locke, 2007, p. 872). O'Shaughnessy (1992) summarizes it in eleven steps: (1) interested in an issue and collecting perceptual experiences; (2) sorting out perceptual experiences under the guidance of existing knowledge; (3) when challenged to sort out perceptual experiences into the existing knowledge system, research problems emerging; (4) generating hypotheses to solve these problems; (5) hypotheses, based on existing knowledge, formulated into a tentative theory or model; (6) a procedure (e.g., an experiment) designed to test the tentative theory; (7) data collected to test the hypotheses; (8) verification with statistical tests; hypotheses withstanding the testing (the 9th step) elevated as laws or formal theories (the 10th step) and the foundation to explain other phenomena (the 11th step). These eleven steps can be condensed into six stages: domain image, problem identification, speculative hypothesis, tentative model, test preparation, and testing (O'Shaughnessy, 1992).

The influence of the H-D model can be seen from its popular presence. Based on John Dewey's (1910/1997) analysis of reflective thinking, Kerlinger and Lee (1999) described it in four steps: problem-obstacle-idea, hypothesis (a conjectural or tentative proposition) derivation from experiences, reasoning (testable consequences deduction from the hypothesis), and testing the consequences. A recently published textbook summarizes the model (named "the process of deduction") in six steps: theory, hypothesis, data collection, findings, hypothesis confirmed or rejected, and revision of theory (Clark et al., 2021).

Although with its domination as representative of deduction in sciences, the H-D model is not essentially deductive or rigorous. It combines the D-N model (in hypothesis derivation) and falsification model (in testing) and therefore inherited flaws of both. It still requires unverifiable law-like statements to derive hypotheses, whose validity can never be proven. In the testing step, it is converted into falsification ("p → q; ¬q, and therefore ¬p") if the counterevidence ("¬q") is supported by statistical analysis based on p-values, which, nevertheless, suffers from the criticism of the Duhem-Quine thesis (Szatek, 2020) and other questions (Locke, 2007). Or, it turns into abduction or retroduction if the hypothesis is supported ("p → q; q, and therefore probably p"; Brandt & Timmermans, 2021; Clark et al., 2021; Kistruck & Shantz, 2022; Peirce, 1898/1992; Philipsen, 2017; Sætre & Van de Ven, 2021; Veen, 2021), which is a form of deductive fallacy.

In fact, an "abductive experimentation methodology" is recently proposed to tackle "grand challenges," which is essentially a repeated process of the H-D model and has seven steps: assembling current knowledge, generating hypotheses, deducing testable intervention, collecting data, confirming or falsifying propositions and generating new hypotheses, re-deducing testable intervention, collecting and analyzing data (Kistruck & Shantz, 2022). O'Shaughnessy (1992) cites the great discovery of Columbus to illustrate the invalidity of abduction in the H-D model: Columbus followed the deductive model rigorously but incorrectly concluded that he landed on India; his failure to support his hypothesis, however, should not be used to reject the theory of round earth. The H-D model only helps to make quick and often short-lived theories (Locke, 2007), but its domination, limitation, and the myth around its deductiveness have to be addressed to further scientific research (Foxall, 1986; Woiceshyn & Daellenbach, 2018).

In sum, this review of canonical discussions of deduction and deductive models of scientific inquiry reveals that deduction has not been instrumental in scientific research as oft perceived (Locke, 2007; Locke & Latham, 2020). Its assumption of the covering laws and the myth of rigor around the deductive models have increased paradigmatic incommensurability in sciences (Kuhn, 1996), clouded the vision of scientists and journal editors and reviewers (Svejvid, 2021), and hindered scientific communication and advancement (Woiceshyn & Daellenbach, 2018). The scientific revolution has come out of not deduction but induction (Gunnell, 1975; Kuhn, 1996; Locke, 2007), and social scientists are recommended to understand their deductive research method more fundamentally for conducting studies that are more meaningful and useful.

Induction: from the Particular to the General and Let the Data Speak

Induction, defined by Aristotle (1984) as "an argument from the particular to the universal," was first promoted by the Epicurean philosophers. Based on their medical practices, the Epicurean philosophers saw induction as the only instrument to reveal the laws of nature if the listing of the members of a class examined both similar and different facts (Locke, 2007; Locke & Latham, 2020; Woiceshyn & Daellenbach, 2018). The Aristotelian definition has been followed by later logicians such as Mill (1843/2011), who defined induction as "the operation of the

mind by which we infer that what we know to be true in a particular case or cases will be true in all cases that resemble the former in certain assignable respects" (p. 345). Even nowadays, the *Oxford English Dictionary* defines induction as "the process of inferring a general law or principle from the observations of particular instances (opposed to the deduction)."

Late logicians, however, have extended the definition of induction also. Carnap, for example, called all non-deductive reasoning induction (1956, 1963). Popular textbooks also hold that the only characteristic of induction is that its conclusions are not logically guaranteed by premises, which only provide evidence to increase the probability of the conclusions happening (Copi et al., 2010; Hurley & Watson, 2018). Abduction (Brandt & Timmermans, 2021; Kistruck & Shantz, 2022; Peirce, 1898/1992; Veen, 2021) or retroduction (Mukumbang et al., 2021) is then included with this definition; also included are predictions, arguments from authorities, arguments based on signs (e.g., reasoning that there should be a sharp curve when you see a sharp curve sign on the interstate), and some causal inferences (e.g., Mill's five methods. Copi et al., 2010; Hurley & Watson, 2018).

Francis Bacon is widely considered the most prominent advocate of induction (Locke, 2007; Locke & Latham, 2020; Woiceshyn & Daellenbach, 2018). He criticized the dominating deduction, whose conclusion was contained in its premises, as a tool of argumentation and useless for scientific searching for new findings (Bacon, 2000). The scientists' only hope, he said, was in induction, which he illustrated with three methods to identify causal relationships in phenomena. Bacon (2000) is deemed the founder of the theory of experimental methods, and his listing tables of presence and absence inspired Mill (1843/2011) to create the five methods. Darwin (1897) acknowledged that his evolution theory work was based on the use of "the true Baconian method." Induction proponents learn from experiences, identify patterns, generate hypotheses, and project findings into similar situations in other places or times (Yao, 2023b).

The earliest attack on induction came from the Stoicism philosophers in their debate with the Epicureanism philosophers. The Stoicism philosophers criticized induction as invalid, because it allowed human beings to infer from phenomena in their experiences to those outside of their experiences, and as impossible, because a partial listing of the members of a class was insufficient and a complete listing infeasible.

The most severe attack, however, came from Hume (1748/1999), who proposed the famous problem of induction and maintained that people could not reason, even just probably, from repeated instances that they had experienced to other instances that they had not experienced, no matter how many repeated instances people had experienced. Induction was a function of human beings' internal mechanism to generate associations of the repetitions and make expectations of the instances that they had not experienced. Although critical to their survival, human expectations generated through such a mechanism were invalid. Hume's criticism of induction has cast huge doubt on the empiricism description of the procedures of scientific research, which is inherited by Russell (1946) and Popper (1959), who both rejected induction completely.

Despite the harsh criticism, induction is still cherished as valuable, called for by social scientists who pursue meaningful scientific advancement (Locke,

2007; Locke & Latham, 2020; Woiceshyn & Daellenbach, 2018), and used prevalently without being realized. The statistical analyses pervasively used by scientists, including social scientists, are essentially inductive, inferencing from a sample (the particular) of assumedly independently and identically distributed (iid) instances (parametrically or nonparametrically, depending on the data distribution) to the population (the general) with a probability at a certain level of confidence (95% by default).

Fisher (1955) maintained that the invention of statistics had made induction as strict as, if not more than, deduction with three factors: first, the introduction of mathematics to statistics leads to more exact calculation of the observed data; second, the advance of the experimental method generates better data for observation and calculation; third, the establishment of statistics provides a more sophisticated understanding from a sample to the population. He criticized deduction as only revealing the implications contained in the axioms and exalted induction, together with observations, as the approach to new human knowledge. When social scientists apply advanced statistical models such as structural equation models, hierarchical linear models, and multivariate time series models to depict the complex relationships (patterns) among events in the samples and project those relationships into the populations, few notice the inherent inductive nature of these statistical models (Yao, 2023b).

The emergence of "big data" represents another opportunity for induction in social sciences, which identifies patterns without theoretical frameworks or hypotheses from an enormous amount of data created and archived with computing technology, which may not be representative (Shrestha et al., 2020). Major database companies, such as Axiom, Epsilon, and Experian, mainly provide big data analysis services and help clients to better understand their customers' lifestyles, needs, and purchasing patterns. They are behind the decisions of what advertisements or news videos people see when surfing on the internet or using social media (Shrestha et al., 2020) and perhaps what ChatGPT or Google Bard will generate to respond to your questions.

The lately popular method of meta-analyses, essentially replication with variation (Locke & Latham, 2020), is also induction, examining the same pattern across different sets of independent data to provide stronger evidence to support the hypothesis or theory predicting that pattern. Meta-analyses are used more and more by scientists. Google provides 429 million hits of "meta-analysis" in a search of mere 0.67 min in this revision in April 2023, a big increase from 46.3 million hits in 0.67 s searched a couple of years ago. Meta-analysis will be more useful if social scientists use concepts with the same explication, which will make comparisons of multiple datasets contain much fewer errors.

The Inductive Models of Scientific Inquiry

Carnap has described natural sciences as "inductive sciences" (1956, 1963), because scientists follow the process to make precise observations (the foundation of science), conduct experiments, and generalize hypotheses or theories. Inductive

researchers have also proposed models of scientific inquiry, which are, however, much less known than their deductive counterparts and urgently need attention.

George Homans's Sociological Theory-Building Model

The model (Homans, 1951) contains three steps: (1) observing how people behave in different groups; (2) conceptualizing and generalizing such behaviors; (3) including other groups to confirm or improve the concepts and generalizations. This simple early model pinpoints induction's nature of being data- or observation-based and provides the fundamental framework for later inductive models of theorization.

Hempel's Inductive-Statistical (I-S) Model

The I-S model (Hempel, 1965) has been adopted by most inductive scientists, which is a derivation and modern version of Hempel's D-N model. The I-S model just changes the law-like statement in the D-N model into a statistical law-like statement, which together with the antecedent condition statement generates the conclusion. The I-S model, although deductive in its form, is considered inductive by logicians because the truth of the premises (i.e., the statistical law-like statement and the antecedent) does not guarantee the truth of the conclusion. The statistical law-like statement, however, should state a relationship that has a high probability to happen (Hempel, 1965).

Wesley Salmon's Statistical Relevance (S-R) Model

The S-R model (Salmon, 1971) is derived from Hempel's (1965) I-S model but has a more generalized form. Instead of claiming that the statistical law-like statement should state a highly probable relationship like Hempel (1965) did, Salmon (1971) believed that the statistical law-like statement could be any set of statements as long as they could provide a basis for an inference of the probability of the conclusion happening, no matter how small the probability could be. Both the I-S and the S-R models, however, like the D-N model, suffer from finding the statistical law-like statements and cannot depict the whole process of theorization.

The Grounded Theory Method

Since the publish of the seminal book authored by Glaser and Strauss (1967), grounded theory, as a popular inductive research method, has been used by many qualitative and some quantitative researchers to generate theories from data (Tie et al., 2019). The method essentially consists of the following procedures: (1) initial coding and categorizing data from a purposive sample, (2) concurrent data generation, collection, and analysis to test the hypothesis, (3) writing memos to document the conceptualization and theorization, (4) theoretical sampling to collect more data

and saturate the categories (concepts), (5) constant comparative analysis, (6) theoretical sensitivity, (7) intermediate coding to fully develop categories by connecting sub-categories and to link categories together, (8) identifying a core category, and (9) advanced coding and theoretical integration (Birks & Mills, 2015; Mokgohloa et al., 2021). Grounded theory is an inductive research method that starts from intensive conceptual analysis and can also be used as a method of conceptualization (Charmaz & Thornberg, 2021), although operationalization to generate quantitative measurements is not a typical part of it, which makes it naturally suitable for qualitative research.

O'Shaughnessy's Inductive Scientific Exploration

O'Shaughnessy (1992) describes the inductive exploration in six steps: (1) observing and generating perceptual experiences; (2) sorting out (defining and classifying) facts collected through observation; (3) inferring (hypothesizing) to a broader category based on the facts observed and analyzed; (4) observing again to test the generalized hypotheses; (5) hypotheses withstanding tests evolving into laws or theories; (6) laws or theories becoming the basis for more scientific explanations. This model integrates the models of induction mentioned earlier and has been applied in marketing research and other social science fields.

Locke and Latham's Process for Inductive Theorization

Locke (2007) has proposed eight guidelines for developing inductive theories: (1) Start with valid philosophical axioms (which are self-evident, true, and unfalsifiable) as the base. (2) Develop a sustainable body of observations or data. (3) Formulate valid concepts (with definitions). (4) Look for evidence of causality and identify causal mechanisms through experimentation or discover lawful relationships. (5) Tie in valid concepts from other sources and theories where applicable. (6) Integrate the totality of findings and concepts into a noncontradictory whole. (7) Identify the domain and boundary conditions for the theory. (8) Make theory building a careful, painstaking, and gradual process. He recommends journal editors look for research questions, not hypotheses, in submissions.

Locke's (2007) guidelines are later specified as a nonlinear process of theorization (Locke & Latham, 2020). The theorization process includes: identifying the research domain, defining the key concepts, formulating logically relevant measures, focusing on replication with variation, integrating and presenting data in "essentialized form," identifying moderators and mediators, identifying and analyzing contradictions to inductively derived principles, connecting with other extant theories and studies in different fields, and generating guidelines for filed applications. The process has been used to develop the goal-setting theory (Locke & Latham, 2020).

Observation-based, rather than theory-driven, inductive theorization processes are guided by research questions, not hypotheses (Locke, 2007). Although inductive models are less known among many social scientists, they have been noticed by logicians and artificial intelligence (AI) computer scientists. A popular logic

textbook describes seven steps in scientific investigation (identifying the problem, developing preliminary hypotheses based on experiences and knowledge, collecting data to refine the preliminary hypotheses, formulating formal explanatory hypotheses, deducing testable consequences from the explanatory hypotheses, testing the consequences and revising the hypotheses if the test turns negative, and applying explanatory hypotheses that are heavily supported in tests as theories), in which induction is the major approach and the starting point, although part of the model resembles the H-D model (Copi et al., 2010). Induction is also considered the fundamental approach for AI to generate theories and guide its learning, as shown in the Algorithm-Supported Induction Model proposed by a group of computer scientists (Shrestha et al., 2020). The model consists of four steps, through which AI can formulate theories with machine learning and pattern detection based on big data: (1) split the data sample; (2) identify robust and interpretable patterns in Sample I; (3) formulate theory; (4) test the theory with Sample II. This model for AI theorization also starts with induction. The model also shows that patterns identified through inductive studies are still falsifiable because they can be further tested through hypothesis-testing (in step 4).

In sum, despite the criticism that induction generates knowledge about the bigger group or future based on truth gained from the particular elements of the group or the past, some scholars, particularly those with qualitative strategies or conducting behaviorism research, still tend to use inductive generalizations based on substantial analyses of behaviors of particular subjects (Clark et al., 2021; Homans, 1951). Some psychologists believe that even conceptual analysis (explication) is essentially inductive, and replications should be conducted with a variety of topics, time spans, contexts, participants, or measures in an inductive approach, just like even physics has been moved forward by induction (Locke & Latham, 2020).

Many areas of social sciences are still relatively young and simple, and their core concepts are not adequately explicated yet. Overemphasis on theoretical rigor and the deductive approach has prematurely established the covering laws, created paradigmatic incommensurability, and limited the area's development, as deduction has done to the scientific revolution (Kuhn, 1996). Inductive research, such as the grounded theory approach preferred by mostly qualitative researchers (Charmaz & Thornberg, 2021; Mokgohloa et al., 2021; Veen, 2021) but also some quantitative researchers (Tie et al., 2019), is the pattern identification or theorization based on data observation and well-explicated concepts and is highly recommended to social scientists to generate new knowledge, open the door for more discoveries, and ensure the prosperity of social sciences. It is also recommended that conceptual analysis and inductive research to identify patterns among well-explicated concepts are deemed as independent projects and conducted separately or by different social scientists, with the consciousness of objectivity upheld (Bird, 2020; Clark et al., 2021) and studies constantly replicated, to reduce the concern in theory-leadenness of data (Brewer & Chinn, 1994). When more inductive studies based on well-explicated concepts are conducted, deductive studies can then have better hypotheses to test.

The preference for deduction over induction among journal editors and reviewers should be changed to facilitate the call for more inductive research (Locke, 2007;

Locke & Latham, 2020; Woiceshyn & Daellenbach, 2018). Instead of working on eliminating "harking" or just promoting preregistration to pursue perfect hypotheses (Locke & Latham, 2020), social scientists should work more to explicate concepts, observe and collect data, and then explore these data, under the guidance of research questions, to identify patterns and relationships among validly and reliably measured concepts.

Discussions and Conclusions

Revisiting and reviewing basic concepts of logic (conceptual analysis and deduction and induction) and their applications in social science research as discussed by philosophers and social science theorists, this conceptual study finds that social sciences have suffered from the lack of conceptual analysis and inductive research, which institutes and researchers of social sciences need to address immediately to advance their research.

This study finds it urgent for social scientists to explicate their concepts, especially those core ones or oft-used ones in a field. Such explication can establish concepts' standardized measurements and avoid meaningless debates caused by pervasive conceptual confusions that are generated by researchers who prioritize deductive theorization over conceptual explication and inductive theorization. Ideally, the task of universalizing measurements of core concepts can be completed jointly by major research institutions like associations and journals, just like education researchers have explicated their core concepts (American Educational Research Association, American Psychological Association, National Council on Measurement in Education, 2014). Annual conferences of associations and journals of social sciences should allocate sections exclusively devoted to explicating or reviewing the conceptualization or operationalization of concepts concerning their academic missions. Universalizing measurements of all concepts enables social scientists to communicate with less conceptual errors.

Social scientists are recommended to rationalize their overenthusiasm with deductive theorization, value conceptual analysis, and engage in more research on explication. Creating and explicating a good concept can be equally significant to building a good theory in advancing a field, as evidenced in the creation of the milestone concepts such as gross domestic product (GDP), consumer price index (CPI), and intelligence quotient (IQ). In theorization research, social scientists should measure concepts with commonly used instruments, instead of creating new concepts or measurements, and document concerns or dissatisfaction with the explication of these concepts for later collective update or improvement (Bringmann et al., 2022). Each concept's explication in literature should also be comprehensively reviewed and discussed to ensure that the concept is consistent, and does not confuse, with concepts already used in the field or across social science areas. When social scientists need to analyze a concept that has no existing well-recognized measurements, intensive efforts should be first made to explicate the concept reliably and validly.

This study also debunks the myth of deductive research as rigorous, reveals the limitations of deduction as a reasoning approach in social sciences, criticizes its dominance among social scientists, and calls for more inductive social science research, following the steps of pioneer social scientists (Locke & Latham, 2020; Woiceshyn & Daellenbach, 2018). Historically, deduction has limited knowledge advancement and scientific discoveries (Kuhn, 1996). Its dominant representative in social sciences, the H-D model, is challenged with the impossibility of finding a covering law. Also, when the hypotheses are disproven, the model converts into falsification (Popper, 1959), generating little new knowledge and facing questions from the Duhem-Quine thesis (Szatek, 2020) and inductive social scientists (Locke, 2007); when the hypotheses are supported, the model is essentially abductive or retroductive (Peirce, 1898/1992), which is a logical fallacy in deduction, or, a form of induction in a broad sense.

Although associated with a lousy and lax form and lack of theoretical rigor, induction generates new knowledge, which has enabled it to initiate the era of scientific discovery (Kuhn, 1996). Induction fits into the way of human and even AI cognition (Shrestha et al., 2020). A study finds that 7th -grade students who use inductive methods to develop models gain more problem-solving skills than those who use deductive methods (Nuhoglu, 2020). Induction is also the underlying mechanism of statistical analysis, meta-analysis, and big data that have been ubiquitously used in social science research, although many social scientists are hardly aware of that. More inductive research is needed for social science areas, which are mostly young and need rapid transformation and advancement.

While both should be much more promoted, to reduce the theory-leadenness of data (Brewer & Chinn, 1994), conceptual analysis and inductive research need to be conducted independently of each other or by different social scientists, with conceptual analysis going first, the consciousness of objectivity upheld (Bird, 2020; Clark et al., 2021), and studies constantly replicated. Inductive studies based on clearly-explicated concepts can provide deductive testing with more solid hypotheses. Social scientists should also monitor the discussion around the intertwining of observational and theoretical entities in the philosophy of science and develop more procedures to mitigate data's theoretical ladenness (Boyd & Bogen, 2021; Brewer & Chinn, 1994) and maintain research objectivity (Bird, 2020; Clark et al., 2021).

Both institutions and researchers of social sciences are recommended to understand deduction and induction more, understand their strengths and weaknesses, break the stereotypes around these two reasoning approaches, and embrace induction for more new knowledge, discoveries, and breakthroughs in social sciences. Induction should be the fundamental approach to building concepts and theories in the social sciences areas; together with the emphasis on conceptual analysis and efforts to standardize concepts and their measurements in a field or even across social science areas, inductive theorization of identifying useful patterns can really break the paradigmatic incommensurability, generate long-lasting knowledge, and move social sciences forward. Deductive hypothesis testing can still be used to test and improve theories identified through inductive studies.

To conduct inductive research, social scientists are recommended to keep observing human behaviors and social lives and matters, refine and explicate concepts in

daily life into social scientific ones, generate research questions, and collect data related to the research questions to explore the relationships among the social scientific concepts. Inductive research requires social scientists to focus on conceptual analysis or categorization, measurement, data collection and analysis, pattern identification, and be moderate and open-minded about theorization. Just as Amos Tversky put it, theories "are something we should get to after we have a lot of data and we should be very careful when we suggest them" (Locke & Latham, 2020, p. 234).

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Qingjiang (Q. J.) Yao Ph.D., associate professor at the Department of Communication and Media at Lamar University, Beaumont, Texas, obtained his master's degree in philosophy with a specialty in logic from Beijing Normal University and a Ph.D. in mass communication from the University of South Carolina. His research interest lies in examining the persuasive effects of mass, digital, and social media, focusing on science and health issues. He has published in such journals as *American Journal of Media Psychology*, *Asian Journal of Communication*, *China Advertising*, *Chinese Media Research*, *Environment, Development and Sustainability*, *Environment Systems and Decisions*, *European Politics and Society*, *Journal of International Crisis and Risk Communication Research*, *Journal of Internet Law*, *Journal of Marketing for Higher Education*, *Journal of Media and Religion*, *Journal of Research in Interactive Marketing*, *Public Relations Review*, *Science Communication*, *Telematics and Informatics*, and other venues and presented for more than thirty studies at annual conferences of the International Communication Association, Association for Education in Journalism and Mass Communication, National Communication Association, and other conferences.