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Updating the Philosophy of Middle-Range Theories: Implications for IS

Completed Research Paper

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Abstract

Merton's concepts of middle-range theories (MRTs) and grand theories (GTs) are widely mentioned in information systems (IS) theorizing literature. On one hand, numerous IS authors claim that MRTs are common in IS or that design science theories are MRTs. On the other hand, others report that too much focus is placed on GTs (instead of MRTs) in IS. Moreover, MRTs and GTs have acquired a normative role in IS. Given such disagreements and the normative role of MRTs and GTs, there is a need to examine what Merton's GT and MRT are. The aim of this paper is to start such a discussion by providing an interpretation of Merton's GT and MRT. We contest many IS views on Merton. We also suggest that Merton's MRT should be revised and clarified to account for developments in natural sciences and the philosophy of science.

Keywords: Grand theory, middle-range theory, mid-range theory.

Introduction

Robert Merton is one of the most influential sociologists of all time. "Even his enemies admit that Merton is the founder of the sociology of science" (Knorr Cetina 1991 p. 523). It is reported that Merton's most important contribution is the idea of middle-range theories (MRTs) and how they differ from grand theories (GTs) (Hedström & Udehn 2009). Merton's concepts of MRT and GT have also found their way into numerous seminal information systems (IS) articles on IS research or theorizing. For example, Kuechler and Vaishnavi (2012) report that Merton's "mid-range theories are common in IS" (p. 402). Grover and Lyytinen (2015) suggest that "most published IS theory" that "constitutes the main theoretical body of the field's knowledge ... is mid-range" (p. 271).

There is also a possibility that Mertonian concepts normatively influence the IS community in terms of what type of theory is regarded as acceptable. For example, Hassan and Lowry (2015) claim that "any productive and socially relevant research ... should remain, in terms of the abstraction, in the middle range" (p. 12). As another example, Gregor and Hevner (2013) note that "design theories are special theories or theories of the middle range" (p. 340). This raises the question of whether an acceptable design theory can be something other than an MRT. Some editors and reviewers have similar views. For example, a senior editor at *MIS Quarterly* required us to "develop a mid-range contribution" (MISQ 2018-RA-15367).

There are also fundamental disagreements in IS on what MRTs actually are. For example, one set of IS scholars regards MRTs as having limited scope (Gregor 2006 p. 616; Clemons et al. 2009 p. 11). Other

IS scholars note that "theories of the middle range should not be confused with the range ... of a theory..." (Hassan & Lowry 2015 p. 8). To give another example, Weber (2012) states that the precise meaning of MRT is problematic (p. 16). If this really is the case, then how can IS authors be so certain that (a) MRTs are common in IS (Kuechler & Vaishnavi 2012) or that (b) design theories (Gregor & Hevner 2013) are MRTs? Moreover, while many state MRTs are common in IS (e.g., Kuechler & Vaishnavi 2012; Grover & Lyytinen 2015), Hassan and Lowry (2015) "conclude that too much theoretical work is based on grand theory or an awkward point between middle-range and grand theory" (p. 11). A final example of fundamental disagreements concerns the role of GTs in IS. Gregor and Hevner (2013) are skeptical regarding the possibility and usefulness of GTs in IS, while Watson (2001 p. vii) and Weber (in Gregor 2006) call for GTs in IS.

All this raises the question of what Merton's MRT and GT actually are. In this paper, we offer *an interpretation* of Merton's MRT and GT. We first review IS accounts of MRTs in light of Merton's MRT. We then review the philosophical assumptions of Merton's MRT, which we find wanting. We outline a proposal for a new dynamic classification of theories that revises Merton's taxonomy. Our taxonomy goes beyond middle range toward small, narrow, very narrow, and unique ranges.

Merton on MRT/GT and IS Views on MRTs

This section discusses some influential IS papers on GTs and MRTs. Many influential authors note that either IS theories or design science theories are MRTs or are mainly MRTs (Gregor & Hevner 2013; Groover & Lyytinen 2015). For example, Kuechler and Vaishnavi (2012) are certain that "SDT [a directive design theory] and DREPT [Design-relevant explanatory/predictive theory] are both, by definition, mid-range theories" à la Merton (p. 395). Moreover, numerous IS authors refer to Merton's MRT in terms of theory development and claim to have engaged in MRT theorizing (e.g., Boonstra & Offenbeek 2018 p. 9; Burton-Jones & Volkoff, 2017 p. 473; Carroll & Swatman 2000 p. 239). Next, we discuss some IS views on MRTs. It is important to note that philosophical and historical papers in particular require subjective interpretation. For example, it could be possible that IS scholars studying Merton give different meaning to some terms than we do. All these IS papers have made numerous contributions, and any criticism we provided (even if correct), does not negate the many other merits of these IS papers or of Merton.

Merton's MRT is unclear. Weber (2012) states that the precise meaning of MRT is not clear (p. 16). It is a common complaint (especially in sociology) that Merton's conceptualization of MRT was "rather vague" and "ambiguous" (Hedström & Udehn 2009 p. 27), and "it is clearer what middle-range theory should not be, than what it is" (Geels 2007 p. 629). Boudon (1991) states that "it has sometimes seemed hard to see what Merton had in mind when he coined his famous notion of the" MRT (p. 519). Lazarsfeld states that MRT is "an important notion, but I do not know how to define it" (ibid p. 519). We agree with these views, although we see that Merton provided statements that allow us to have a rough grasp of his MRT. Merton separated MRT from GT. For Merton (1958), GTs (or general theories) are "total systems of sociology theory," "master conceptual schemes," and "all-embracing theory" (p. 45–48) that explain all social phenomena (ibid 1968b p. 39) or cover "the full scope of sociological knowledge'" (ibid 1968b p. 66). Such GTs would be "general enough to treat all phenomena of interest to sociology" (Hedström & Udehn 2009 p. 27). A good candidate for a general theory might be Bentham's version of utilitarianism because it holds for "every action whatsoever; and therefore not only of every action of a private individual but of every measure of government" (Bentham 1789 Chapter 1, Section 2). For Merton (1968), current GTs were too abstract and remote, and he stated that sociology needs theories with a narrower scope, which he called MRTs.

Scope and MRTs. IS discussions on GTs and MRTs suggest that Merton's account contains an idea of theory scope (Clemons et al. 2009 p. 11; Gregor 2006; Kaufman & Tsai 2009 p. 184). Others seems to disagree: "The concept of the theories of the middle range should not be confused with the range or level of analysis of a theory..." (Hassan & Lowry 2015 p. 8). They maintain that "Presumably, the wider the range of the theory's application, the more generalizability it offers and the stronger the theory...This level of analysis of theories is not to be confused with the quest for grand theories or the building of middle-range theories" (ibid p. 9). Are MRTs and GTs then about the scope and generalizability? Hedström and Udehn (2009) are certain that Merton's implicit idea is that theories can be separated by

their scope or range. We agree with this interpretation. For example, Merton (1968 p. 68) notes how MRTs are "sufficiently abstract to deal with the differing spheres of social behavior and social structure" and "deal with delimited aspects of social phenomena" (p. 39–40). In other words, regarding scope, a GT is about "all phenomena of interest" (in a discipline). For example, a theory that explains all sociological phenomenon is a GT in sociology, while MRTs "deal with delimited aspects". Merton gave the theory of deviant behavior as an example of an MRT. A theory that explains only deviant behaviors (Merton's example) but no other sociological phenomena is an MRT. Put differently, a theory that explains deviant behavior does not explain all behaviors (in which case it would be a GT) but just those "with delimited aspects" of a social phenomenon, namely deviant behavior. It therefore seems that the scope of an MRT is narrower than that of a GT. It is important to note that our interpretation assumes that a GT is about "all phenomena of interest" *in a discipline* (e.g., sociology, IS). We have this assumption because we suggest the interpretation that Merton's GT/MRT is connected to the discipline or branches of knowledge. For example, for Merton, a GT in physics is the same as a GT in sociology. Also, as mentioned above, in his GT (and MRT) examples Merton sometimes refers to a scientific discipline or branches of science (e.g., sociology or sociological knowledge). Of course, other formulations of GT/MRTs could be provided that are not related to a discipline or branches of science.

According to Hedström and Udehn (2009), "the larger the set of phenomena or types of phenomena a theory explains, the more general it is". Therefore, GTs should be more general in scope than MRTs. Hassan and Lowry (2015) suggest that "the wider the range of the theory's application, the more generalizability it offers and the stronger the theory" (p. 9). If this claim holds (and Hedström & Udehn's interpretation of scope is correct), then GTs are more (1) generalizable than MRTs and are therefore (2) stronger than MRTs. We suggest that Merton would have accepted (1) but not (2) for the reasons we just gave. We accept (1) but reject (2). We suggest that being "more generalizable" does not necessarily make a theory stronger, particularly when we take into account the accuracy of an explanation.

Are reference theories by definition MRTs or GTs? According to Grover and Lyytinen (2015), "By mid-range (or middle-range) theorizing, we denote an enactment of a family of epistemic scripts that adapt or borrow (Whetten et al. 2009) grand(er) social theories originating within reference disciplines, such as economics, psychology, and sociology" (p. 271). Two questions arise here. Are MRTs related to (1) theory borrowing and (2) borrowing from GTs? To start with the latter, GTs (per Merton) are all-encompassing theories. Grover and Lyytinen (2015) did not explain what "grand(er)" is. However, their definition of MRTs is "consistent with, although somewhat different in meaning from, Merton's original definition." (p. 274). We suggest that what Grover and Lyytinen (2015) refer to as "grand(er)" (p. 271) is different and not consistent with what Merton means by GTs. One reason is that the borrowed (reference) theories (i.e., theories that are borrowed from other disciplines and applied in IS) may already be middle range (à la Merton) in their original fields. For example, IS security researchers commonly use criminology or health psychology theories that may already be middle-range (and not grand), for example, a theory that explains deviant behaviors (but not all sociological behaviors). For instance, IS security researchers applying neutralization theory or deterrence theory (Siponen & Vance 2014) are applying MRTs if (and only if) these theories are regarded as explaining deviant behaviors (and not all behaviors). Of course, IS researchers can also use GTs as reference theories, but our point is that not all reference theories used in IS are GTs.

We propose the interpretation that "grand" for Grover and Lyytinen (2015 p. 271) refers to the perceived scientific status of the theory. To our understanding, a key aspect of Merton's GT and MRT is the scope of the theory. Of course, GTs (or MRTs) may also have high status (according to someone or some criterion).

Regarding theory borrowing, Kuechler and Vaishnavi (2012) are certain that "a logical case can be made that most IS theories are mid-range, since IS is an applied discipline with a history of drawing from more fundamental disciplines." (p. 402). By mid-range, they refer to Merton's MRT (ibid p. 402). It is important to separate three claims: (1) most IS theories are MRTs, and that has to do with (2) "drawing from more fundamental disciplines," and (3) the belief that IS is an "applied discipline." We briefly consider these claims next.

It could be that many if not most IS theories and models are MRTs (à la Merton). This we know (we argue) only by analyzing (many or most) IS theories and models one by one (Kuechler & Vaishnavi 2012 do not show such evidence). However, the fact (if it is a fact) that most IS theories are MRTs may not be necessarily linked with the issues of (2) and (3). Kuechler and Vaishnavi (2012) should make a case as to why specifically middle range level theories in IS result from the fact that IS has been "drawing from more fundamental disciplines" and that IS is an applied discipline.

We argue that basing hypotheses or propositions on reference theory—or reference theories from "more fundamental disciplines" (whatever that means)—may not be the reason we have MRTs à la Merton in IS (if we have them). Theory borrowing (e.g., the act of basing hypotheses or propositions on an existing theory) does not necessarily constitute an MRT by definition à la Merton. Why should theory borrowing and theory scope go hand in hand, for example? If one scholar "borrows" from Bentham and applies Bentham's version of utilitarianism, which is "general enough to treat all phenomena of interest" (Hedström & Udehn 2009 p. 27), to IS then this theory would be a good GT candidate. But if another scholar "borrows" from Bentham and suggests a theory based on Bentham's utility calculations that only applies to IT investments, this theory is certainly not a GT. It would not be general enough to treat all phenomena of interest to IS (just IT investments). It could, however, be an MRT. Finally, let us presume that one proposes a theory that applies only to certain IT security investments that have financially measurable consequences for online sales. Financially measurable consequences for online sales means cases where the loss of online sales is measurable and known in advance. The theory only applies in such a setting and does not account, for example, for reputational loss. For instance, an organization knows its online sales and sales are rather stable. The theory applies to cases such as a denial-of-service attack, where customers cannot buy the company's products online, resulting in certain financial losses for the company. Let us presume that one bases this theory on Bentham's utility calculations, keeping in mind that the scope of this theory is purposefully restricted, as just noted. Certainty this theory is not a GT due to its scope, and we claim that is narrower than an MRT. The aforementioned hypothetical theory examples illustrate that one could use the same reference theory to outline theories with various ranges.

What about the nature of the discipline and MRTs? We maintain that the nature of the discipline, that is, "applied discipline" or "basic science," may not go hand in hand with MRTs. However, without defining or characterizing what applied disciplines are we cannot really evaluate the claim of whether a certain conception of applied disciplines requires an MRT. Unfortunately, it is not clear to us why Kuechler and Vaishnavi (2012) regard IS as an applied discipline or what it means. But if IS is applied, then why could we not have theories with various scopes in IS? For example, we will claim later that in cancer biology (natural science) and oncology (medical research) cancer theories and treatments with all kinds of scopes are proposed and that many modern theories are far narrower than MRTs.

Should the primary theories in a discipline be MRTs? Weber (2012) claims that "Merton (1957) argues the primary theories used in a discipline ought to be middle-range" (p. 16). We offer an alternative interpretation. Merton introduced his MRT to criticize Parson's call for a theory that is general enough to capture all phenomena of interest to sociology (Hedström & Udehn 2009). Such theories Merton regarded as GTs. While Merton suggested his MRT as a critique of GTs, we suggest the interpretation that Merton (1957) recognized both GTs and MRTs as potentially valuable. Merton (1957 p. 109) noted that "there is room" for middle range and did not suggest "that only theories of middle range merit our attention." Yet he said "there is no substitute for such efforts as Parson's to develop a wide-ranging and comprehensive theory..." (Merton 1957 p. 109). As mentioned, Merton considered Parson's theory a GT, which he criticized (Hedström & Udehn 2009). Our interpretation is that Merton recognized the possibility of GTs but believed that, at least from 1949–1968, sociology was not sufficiently developed to have GTs and that GTs may come after MRTs have been developed. He noted, for example, that a GT is "a premature and apocalyptic belief. We are not ready. Not enough preparatory work has been done" (Merton 1968b p. 45). He also noted earlier that "Sociology will advance in the degree that the major concern is with developing theories adequate to limited ranges of phenomena [MRT] and it will be hampered if attention is centered on theory in the large [GT]" (Merton 1948 p. 165–6). Our interpretation is that progress is hampered if GTs receive most of the attention.

Merton also noted that MRTs differ from pure empirical generalizations, but we do not discuss this point further in this paper.

Testability, falsifiability, and axioms of GTs and MRTs. In IS, an MRT "refers to theory that has a limited scope of application and can lead to testable hypotheses in specific application contexts." (Clemons et al. 2009 p. 11). Similarly, "Middle range theory [per Merton] refers to theory that involves some abstraction, has a limited scope, and can easily lead to testable hypotheses in specific contexts" (Kaufman & Tsai 2009 p. 184). Gregor (2006) also notes easily testable hypotheses are a characteristic of MRTs (p. 616). This raises the question of whether GTs are more difficult to test than MRTs. Hassan and Lowry (2015) suggest that this is so: "In most cases, because they [GTs] are constructed from axioms, or are essentially axiomatic, grand theories are notoriously difficult to test and are not as falsifiable as Popper (1959) would encourage." (p. 7-8). Moreover, the issue of observability is noted as a problem associated with GTs: "the first problem with grand theory is its elevated level of abstraction—a level of thinking so general that practitioners cannot get down to observation and if that cannot be done, the theory itself cannot be tested" (Hassan & Lowry 2015 p. 8). It is important to separate various issues, two of which we discuss next—the difficulty of testing and Popperian falsifiability.

Difficulty of testing. We suggest that whether GTs are testable depends on each individual case. We maintain that there can be GTs that are difficult to test with observations and that there can also be MRTs that are difficult to test with observations. For example, a theory claiming that "all humans are mortal" could be a GT candidate. Its scope is universal. It seems to be rather well testable. Countless cases can be given where this theory holds, and it is difficult to find any evidence to the contrary. The lack of testability is hardly an issue here. If the difficulty of testing is not necessarily an MRT/GT-related issue, then what it is?

It is well known (generally speaking) that natural science theories have become more complex over time with the introduction of unobservable—called theoretical—entities (Laudan 1983). Deep-structure theoretical entities can be difficult to test with observations (ibid). However, we argue that this issue is not related to whether the theory is grand, middle range, or narrow. Theories about black holes may not be GTs, yet they might be difficult to test with observations. This is because observational access to the phenomenon is limited. There are also numerous reasons why theories in IS are not testable with observations. One reason is that IS authors use a high level of abstraction (Siponen & Baskerville 2018). Let us provide a technology acceptance model (TAM) example. Hassan and Lowry (2015) argue that TAM "is closer to being a grand theory" (p. 10). We propose an alternative interpretation. We see that TAM is an MRT rather than a GT. As mentioned, GTs explain all social phenomena (Merton 1968b p. 39) or cover "the full scope of sociological knowledge'" (ibid 1968b p. 66). GTs would be "general enough to treat all phenomena of interest to sociology" (Hedström & Udehn 2009 p. 27). It seems to us that TAM focuses on IT use, and not on *all* IS phenomena. In other words, TAM is not a theory that is "general enough to treat *all phenomena of interest to*" (Hedström & Udehn 2009 p. 27) IS. It does not aim to cover "the full scope of IS knowledge". One concern with TAM is perhaps a high level of abstraction. For example, perceived ease of use is "the degree to which a person believes that using a particular system would be free of effort" (Davis 1989, p. 320). Such constructs do not refer to any specific system features; therefore, no one knows which system features would be associated with "free effort." If practitioners want to use TAM, then TAM-based advice, such as "improve the ease of use" is unclear for many reasons (Pahnila et al. 2011; Silva 2007). One reason is that it does not tell which system features should be improved to make them easy to use or free of effort. Nor does it tell how the system features should be improved to make them easy to use or free of effort. It could be that in the TAM example, these concerns are related to the theory scope. Namely, it could be that what makes systems' features easy to use varies per application, user type, and countless other things. But then it may turn out that a theory that aims to explain all IT use or IT use in general (MRT-level theory) is rather useless in practical terms. Perhaps numerous theories that have narrower scopes than MRTs are needed (they do not aim at explaining all IT use phenomena). For example, those studying social media could propose theories of social media use or even separate theories for Facebook or Twitter use. These theories would be narrower than MRTs.

Popper's falsifiability (Hassan & Lowry 2015). Briefly, Popperian (1963) "scientific theories are universal statements" (p. 37). These universal statements are laws. Popperian "scientific law" is exceptionless, "[o]f all points in time and space (or in all regions of space and time)" (ibid p. 68). According to Popper, we propose theories tentatively. We then expose them to severe tests. Popperians have zero tolerance for anomalies (Laudan 1978). An anomaly (e.g., test failure) means that the theory has to be rejected in its current form or it has to be revised (Putnam 1974). According to Popper, "if the outcome of a test shows that the theory is erroneous, then it is eliminated" (Popper 1963 p. 313). Popperians do not try to find support for theories. Popperians believe that "if we look for positive evidence we will find only positive evidence, which is of no scientific value" (Gattei 2004 p. 461). Popperians do their best to prove theories false (Putnam 1974). Falsification "is essentially a method of elimination" (Popper 1963 p. 313). Now, what is the problem with Popper's falsification? It is well known that scientists do not necessarily reject a theory when it faces anomalies (Kuhn 1962; Laudan 1978). For example, Lakatos (1970) claimed that all theories are "born falsified" and that they float in the "ocean of anomalies" (p. 135). Moreover, scholars often try to find positive evidence for their theory (Putnam 1974). Finally, the existence of Popperian true exceptionless laws in physics is questionable (Cartwright 1983), let alone in social sciences. Without such laws, falsification, as formulated by Popper, becomes problematic. We suggest that we should not associate Popperian falsification with any theory applications in IS, including MRTs.

The Philosophy Behind Merton's MRT and a Proposal for an Updated Classification

In this section, we examine some aspects of Merton's MRT in more detail. This review led us to prose a first sketch of a new dynamic taxonomy.

Have Developments in Science Moved Far Beyond the Middle Range Level?

We suggest the interpretation that a key influence for MRTs (for Merton) was a development in natural sciences. In Merton's time, sociologists developed GTs because classical philosophers (e.g., Hegel, Kant) developed GTs (Merton 1968). Sociologists also looked toward physics as a role model and believed that grand, all-encompassing theories exist in physics (ibid). Merton (1968) saw physics (and other natural sciences) developing narrower theories than GTs, and he referred to these narrower theories as MRTs. We argue that Merton (1957, 1968) was correct in assuming that science (generally speaking) developed and became specialized through theories that were more narrow than grand. However, he did not explicitly note that (at least some) sciences have progressed from GTs not only to the MRT level but to far narrower scopes.

Merton notes that "The principal basis of advancing sociological theory today consists, I believe, in much the same modest and limited development of ideas which occurred in the early modern period of other sciences, from natural history to chemistry and physics" (Merton 1957 p. 109). What are these examples that Merton used as inspiration? Merton (1968) states that:

> The seminal ideas in such theories [MRT] are characteristically simple: consider Gilbert on magnetism, Boyle on atmospheric pressure, or Darwin on the formation of coral atolls. Gilbert begins with the relatively simple idea that the earth may be conceived as a magnet; Boyle, with the simple idea that the atmosphere may be conceived as a "sea of air"; Darwin..." (p. 448).

What we want to highlight is that Merton's examples of scientific MRTs outside of sociology were hundreds of years old, such as the theories of Gilbert (1544–1603), Boyle (1627–1691), and Darwin (1809–1882). Two observations are important here. First, the scientific outlook of science was different then (1544–1800) than it is now. Second, many modern natural science theories are very different than theories dating back hundreds of years. For example, cancer research has developed far beyond MRTs (all kinds of cancers) to "type-specific" and "subtype-specific" theories. Following Merton's own logic

in regard to the development of successful science, we should seriously reconsider his grand/MRT classification, which we indeed do next.)

Have Developments in Science Moved Far Beyond the Middle Range Level?

We outline a new proposal for a dynamic classification of theories to replace Merton's GT/MRT classification (Table 1). In our proposal, the levels include grand, wide range, middle range, small range, narrow range, very narrow range, and unique. Of these levels, grand, wide range, small range, narrow range, and very narrow range are new in IS and sociology (to our understanding). As mentioned, Merton's MRT was inspired by developments in natural science. To keep with Merton's "logic", we also use examples from natural sciences. More precisely, we use cancer biology examples to justify the claim that cancer biology (a natural science) has developed beyond MRTs. Hippocrates' humoral theory, a GT, once explained all medical concerns from cancer to melancholy (Sudhaker 2009). Then came cancer MRT, which explained not all medical diseases but all cancers. Up to the eighteenth century, cancer research theories were mainly MRTs aimed at explaining cancers in general. For example, the contagion cancer theory first proposed in 1649 suggested that cancer was a contagious disease. To prevent the spread of cancer, patients should be isolated. Such MRTs made sense because different mechanisms and treatments for different types of cancers were unknown; therefore, only middle range-level theories about cancer could be expected. What Merton (1957; 1968) did not mention in his writings on MRT was that such evolution in science did not stop at the middle- range level. By and large, success in cancer research has been the result of narrower scopes. For example, when it was realized that different cancers had different dynamic mechanisms, cancer research followed up and narrower cancer type-specific explanations were sought. However, cancer research did not stop at the type-specific level. In addition to IS examples, we also provide "deviant behavior" examples, as one of Merton's own examples of an MRT was the theory of deviant behavior.

Table 1. Classification of theories: grand, wide range, middle range, small range, narrow range, very narrow range, and unique

Level	Cancer examples	Deviant behavior examples	IT use and IS security examples
Grand	Hippocrates' humoral theory	Bentham's utilitarianism	May not currently exist
Wide Range	No known	Habit by Verplanken and Orbell	May not currently exist
MRT	Trauma theory, Contagious cancer theory, Lymph theory	Deviant behavior (e.g., control balance theory by Tittle; economic theory of crime by Becker)	TAM, UATUT, and most studies of IS security behavior
Small Range	E.g., lymphomas	Serious crimes, minor crimes, cyber crimes	Theories for social media use, non-malicious IS security policy violations
Narrow Range	Non-Hodgkin and Hodgkin	Hackers; Internet scammers	Theories for password memory
Very narrow range	B cell, T cell	Organized Internet scammers; one-man business of Internet scammers	A theory of Facebook use and theory of Twitter use

Extremely narrow range	Systemic marginal zone, extranodal marginal zone, follicular, mantle cell, diffuse large B-cell, mediastinal large B cell and Burkitt	One-man Internet scammers in Nigeria	Habit development in Facebook use
…	Diffuse large B cell subtypes: Activated B cell type Germinal center type	One-man Internet scammers desistance in in Nigeria	-
Unique	Primary brain lymphoma	Mass murder in Auschwitz, one mass murder by person X	A case study of Microsoft operating system design failure in Windows XP

GTs: We suggest the interpretation that GT aims to "explain all the observed uniformities of social behavior" (Merton 1968 p. 448). To transfer this characterization from sociology to IS means that GT aims to explain all the observed uniformities of behaviors in IS. Next, we outline our first proposal for a dynamic classification. Term *explanandum* (plural *explananda*) refers to a phenomenon that is to be explained (Hempel & Oppenheim 1948). *Explanans* (plural *explanantia*) explains the *explanandum* (ibid).

Wide-range theory: This is a new level existing between middle-range and general. Wide scope (and other scope types) is perhaps best understood by giving examples. For example, Bas Verplanken's formulation of habit theory (Verplanken & Orbell 2003) can be seen as a wide-range theory but not as a general (i.e., grand) theory (of course, other habit theories could be proposed that are at a different level). It is not a "unified theory" to "explain all the observed uniformities of social behavior" (Merton 1968 p. 448). This is because wide-range theory explains only habit (and not non-habitual behaviors). We do not call Bas Verplanken's habit theory an MRT because it does not focus on certain types of behaviors (e.g., deviant behavior) but rather on habitual behaviors in general. In addition, protection motivation theory (PMT), a frequently used theory in IS security, may not be an MRT according to our terminology but a wide-range theory, provided that it explains all IS security behaviors (assuming a threat), health behaviors (assuming a threat), and safety behaviors (assuming a threat). This is somewhat Boss et al.'s (2015) account of PMT, which can be seen as a wide-range theory. Wide-range theories cover two or more types of middle-range phenomena.

MRTs: MRTs of health behavior explain all health behaviors. Deviant behavior is an MRT that explains all deviant behavior. One of the most influential concepts in IS security is Straub's (1990) concept of computer abuse, which could be another example of an MRT. Straub (1990) defines computer abuse as "the unauthorized and deliberate misuse of assets of the local organizational information system by individuals" (p. 257). D'Arcy et al. (2009) termed the same concept "computer misuse," while Siponen and Vance (2010) introduced the term "information security policy violations." We see these theories as MRTs. They are aimed at explaining all IS security behaviors or computer abuse behaviors. Computer abuse (Straub 1990), computer misuse (D'Arcy et al. 2009), or IS security policy violations are generic in the sense that they do not distinguish between different types of insecure behaviors (Siponen & Baskerville 2018). For example, they do not examine how password selection is different from locking a computer. In addition, theories that explain the mechanisms or treatments of all cancers

are at this level. Up to the eighteenth century, such views dominated cancer research. Therefore, virtually up to the eighteenth century, all cancer theories were MRTs.

Small-range theories: These can be understood by comparing them with MRTs. Small range theories focus on narrower *explanandum* than MRTs. A theory that tries to explain all kinds lymphomas (one type of cancer) could be a small-range theory. It certainly does not endeavor to explain all cancers. A small-range theory is needed when there are *explananda* that seem to belong to higher-level theories, but the higher-level theories cannot explain the *explananda* accurately enough. For example, this level of cancer theory was introduced in the nineteenth century when it was realized that different cancers have different mechanisms. When it is realized that IS security behaviors have different *explanans*, then these different *explanans* may be divided into small-range theories. For example, computer abuse (Straub 1990) could be divided into malicious and non-malicious (Willison & Warkentin 2013). In IT use, an MRT could be a theory that aims to explain all social media use. It is narrower than a theory proposed to explain all IT use or IT use in general.

Narrow-range theories: These could be necessary when there are *explananda* that seem to belong to higher-level theories but the higher-level theories cannot adequately account for them. For example, non-Hodgkin and Hodgkin are two types of lymphomas. Two narrow-range theories are required when these two types have different *explanans*. Non-Hodgkin and Hodgkin lymphomas have different *explanans* and require different treatments (Bödör & Reininger 2016, Kuppers et al. 2012). Similarly, a theory for password behavior could be a narrow-range theory (Woods & Siponen 2018).

Very narrow theories: For example, the *explanans* for non-Hodgkin lymphomas are not the same. Non-Hodgkin lymphoma can be divided into B-cell and T-cell types. Moreover, the B-cell type alone can be divided into a number of different sub-categories (Bödör & Reiniger 2016). A theory about Facebook use and a theory about Twitter use, if they would exist, could be IS examples of vary narrow theories. An example of extremely narrow theories could be theories to explain diffuse large B-cell lymphoma (Bödör & Reininger 2016). This is a B-cell lymphoma that can be even further classified as activated B-cell type or germinal-center type based on genetic and immunohistological differences. This narrowing continues, and cancer research has progressed to such narrow levels of theorizing that we have run out of categorization words to describe the narrowing.

Unique theories: Primary brain lymphoma is a unique subtype of diffuse large B-cell lymphoma that has a specific disease manifestation confined to the central nervous system and that has a specific treatment modality (Kortel & Schlegel 2013). Even outside of cancer research, lower-level theories may be necessary. Consider Merton's example of a "deviant behavior" MRT in which small-range theories could be used to theorize about serious crimes and mass murder, but mass murder in certain contexts could be different than in others. For example, mass murder in Germany during WR II may have a set of *explanans* that are not explained by small-range theories about mass murder; therefore, we may have to narrow the scope even more. Obviously, the mass murder in the concentration camps in Germany is linked to a higher-level theory of the holocaust in Germany, as the former could not happen before the latter. However, closer scrutiny may reveal that mass murder in Auschwitz may have some *explanantia* (e.g., situational characteristics) that are different than when explaining the holocaust in general. Finally, an even more specific level of theories may be needed. For example, different mass murders by single persons can have different *explanantia* and therefore require specific theorizing. In IS, examples of unique theories include case studies on unique cases. For example, it is known that the Microsoft operating system Windows XP has numerous security issues and that Microsoft did many things to fix it. A case study of the Microsoft operating system design failure in Windows XP could be a candidate for this level of theorizing.

Why do we need scopes narrower than GTs and MRTs?

Akers and Sellers (2004) define scope as follows: "The scope of a theory refers to the range of phenomena which it proposes to explain" (p. 6). They state that "a theory that accounts only for the crime of check forgery may be accurate, but it is obviously very limited in scope. A better theory is one which accounts for a wide range of offenses, including check forgery" (p. 5). The preference for a theory that captures a wide range of offenses is close to MRT in terms of deviant behavior. A check forgery theory is too specific to be regarded as an MRT (Merton's own example was deviant behavior). So,

Akers and Sellers (2004) admit that a theory of check forgery may be more accurate in explaining the phenomenon of check forgery than a wider-scope theory of deviant behavior (explaining many crimes). And yet, they still prefer a wider theory that explains "a wide range of offenses, including check forgery" over specific and more accurate theories for each crime (Akers & Sellers 2004 p. 5). What is the explanation for this? We argue that Akers and Sellers have an a priori belief that generality in a theory is better than explanatory accuracy. Is this reasonable? It depends on the goal. If the goal is not accurate explanations, then this make sense. However, if the goal is explanation accuracy, then the idea can be harmful. For example, consequences would have been serious if cancer biology or oncology would have categorically preferred generality over explanatory accuracy. In cancer biology, there are hundreds of distinct cancer theories and hundreds of treatments for different cancers. Why is this a problem? What is the problem if there are hundreds of theories for each type of crime or each sub-type of IT use? One important reason for needing theories with different scopes is explanatory accuracy. What is explanatory accuracy? We link it with *explanans*. For example, non-Hodgkin and Hodgkin are two types of lymphomas. Two narrow-range theories are required as these two lymphomas have different *explanans*. And if check forgery has a different set of *explanans* than some other forms of crime, then perhaps we should have a theory of check forgery. If two *explananda* can be adequately understood using the same *explanans*, then they are most likely about the same phenomenon. If two explananda have different *explanans*, then this is an indication that these are two separate phenomena. For example, if people have different reasons (*explanans*) for using Facebook rather than Twitter, for example, then this is a good indication that separate theorizing may be required for both. Even specific events or acts may give important information that challenge general or specific explanations. For example, in IS security, the fear of threat is suggested as an *explanans* for MRTs about "computer abuse" or the "violation of information security policies" (Siponen & Vance 2010). It is suggested that fear is a general *explanans* not just for IS behavior but also for privacy related behavior (Boss et al. 2015). Fear explains not only health behavior but also password selection, locking a computer, and even privacy behaviors. We have called such views wide-range theories. However, investigating why certain people select passwords in certain situations may lead us to realize that in a particular case, password selection is driven by other *explanans*, say a need to meet system requirements and not fear of threat. In our password case, we have not only moved the scrutiny from the "wide-range" or "middle-range" level to a narrow level (password selection), but we have moved at a unique level. We have one respondent who reports that in certain cases his password was selected to meet the system's mandatory requirements and not due to the fear of threat. If this finding (in our imaginary example) receive more support, we may not be able to claim that fear of threat explains all types of IS security behaviors and situations (Boss et al. 2015), but our results (in the imaginary example) show that in password selection, the *explanans* - fear of threat - may not affect password selection. Such anomalies may decrease the range of *explananda* of a theory. The level of generality (or scope) of the *explanans* (fear of threat) has decreased. This is also a contribution to theory. We have new information as to which phenomena the *explanans* or theory cannot explain. Unfortunately, negative results regarding a theory or its *explanans* may not be publishable in IS. If we put a premium on what explains or supports the *explanandum* and do not focus on the situations, events, or singular cases the existing *explanans* fail to explain, we lose an important tool in regard to knowledge production. In IS terminology, we do not know to what extent the theory is generalizable, in other words, what the theory can explain and what it cannot explain. In this sense, we do not know the limitations of the theory.

Studies with a narrow scope or in single settings can also be important sources for new theory development, which we discuss next. For example, by examining the password selection of one person in one situation, we may realize that the need to meet systems requirements is an important *explanans*. We may try to see if that happens beyond this particular situation and this particular person. What we are doing is some kind of vertical generalizability and horizontal generalizability. We examine whether the *explanans* can hold for other situations. That is to say, we examine, for example, if the *explanans* holds across different systems. We may come to the realization that it holds for all kinds of systems. We may believe that the *explanans* is common within the unique type of IS security behavior, password selection (*explanandum*), but we cannot know this if we do not examine it on a case-by-case basis.

Akers and Sellers (2004) suggest we should put a premium on generality. Somewhat similarly in IS, Hassan and Lowry (2015) suggest that "the wider the range of the theory's application, the more generalizability it offers and the stronger the theory." (p. 9). It would be odd to suggest categorically that cancer theories that can explain N types of cancer are less strong than those explaining N+1 types of cancer only because the range of the theory application is narrower.

Subsumption assumption of Merton

Hassan and Lowry (2015) state that "The propositions developed in building theories in the middle range are not fixated on any philosophy" (p. 13). We suggest that Merton's MRT was based on a specific philosophy. If, for example, IS scholars apply Merton's MRT to the letter, then they may also apply Merton's philosophical assumptions. Therefore, Merton's MRT assumptions should be recognized in order to understand the potential limitations of his theory. One assumption is a subsumption assumption, which according to Hedström and Udehn (2009) stems from Hempel-Oppenheim's (1948) account of deductive-nomological explanations. For this model, an explanation of a fact is a deduction of a statement (the *explanandum*) that describes the phenomenon we want to explain; the premises (the *explanans*) are scientific laws plus some initial conditions. This model is called the covering law or subsumption theory. It tries to explain a phenomenon, typically an event, by a covering law or subsuming it under a (covering) law. This model is widely criticized. Hedström and Ylikoski (2010) summarize the situation well: "[Hempel's model] is a failure as a theory of explanation." (p. 55). Even Hempel's own students regarded the deductive-nomological model as "naive" (Salmon 1989) or as having "fallen on hard times" (Kitcher 1981 p. 508). For a good overview of the key problems, see Ylikoski (2013). We highlight only one problem: "Virtually all cases of what physicists take to be bona fide scientific explanation fail to satisfy even basic requirements just articulated" (Wayne 2011 p. 831). Or as Chalmers (1993) noted regarding (Hempel's) deductive-nomological explanations, "Typical scientific explanations do not employ or need them" (p. 197). Our account (Table 1) does not have any of the standard problems associated with the deductive-nomological model (of course, our account may have other problems). What does this subsumption assumption mean in the case of Merton's MRT?

Merton (1968 p. 450) notes how MRTs are not derived from a general theory, although MRTs are often consistent with one general theory. Merton (1968) notes how MRTs are often subsumed under GTs, although Merton may not regard them as normative theses. Finally, Merton (1968 p. 458) notes how progress toward a comprehensive theory occurs by "gradually consolidate[ing] theories of the middle range, so that these become special cases of more general formulations." This suggests that, for Merton (1968), MRTs are "subsumed under," "consistent with," and "not inconsistent with" general theories. To summarize, we propose the following interpretation. Merton's view is that development in the sciences tends to take place mainly through MRTs that are consistent with GTs and subsumed under GTs. Later they may become special cases of GTs, which hints that the move is toward GTs that cover (subsume) MRTs as a special case.

We want to highlight that with our dynamic classification, the lower-level theories do not have to be in line with high-level theories. It could be that Merton would have also accepted this view. Numerous lower-level cancer theories (narrow range, very narrow range) are inconsistent with many of the GTs in medicine and many old middle range cancer theories. For example, Hippocrates' GT is regarded as wrong and inadequate to explain and treat cancer. More importantly, no GTs are adequate to explain—let alone help cure—all specific cancers adequately. As another example, the theory that cancer is contagious is an MRT; however, this is inconsistent with all modern cancer theories. In our

classification, lower-level theories do not have to inherit *explanans* from higher-level theories; lower-level theories do not have to be consistent with higher-level theories; and lower-level theories do not have to be special cases of higher-level theories. Our classification also allows non-cumulative development from any level toward any level and allows disunification. The future of research in each area will show whether such consolidation of MRT toward special cases of more general formulations happens. We argue that this may happen, but it could also be that none of this happens. We may later realize that a theory once regarded as unique may be part of (say) a narrow-range theory. We caution that any such development we only be aware of afterwards and that making a priori assumptions—especially if they have a normative role—could hinder the research. This means that the phenomenon in each case informs the theory level and scope, and that can change over time.

Are the categories fixed or dynamic?

Wittgenstein argues that a definition with necessary and sufficient conditions cannot be given for anything. Wittgenstein maintains that while we cannot have precise boundaries, we can still compare things. We suggest that for the classification of theories presented in Table 1 fixed definitions cannot be given—particularly for what is wide range, narrow range, and very narrow range compared to other levels—and that they vary not only from one discipline to another but also from one context to another and over time. The latter means that the status of a certain theory is not fixed permanently but may vary after numerous tests and replications. This is why we call the taxonomy dynamic. Let us give a concrete case example. Thalidomide was introduced and used to prevent morning sickness in pregnant women in the 1950–60s (Zhou et al. 2013). Unexpectedly, it had deleterious side effects, and more than 10,000 babies were born with severe limb malformations and congenital defects of the kidneys, ears, eyes, and heart (ibid). The drug was taken off the market and later, by accidental discovery, it turned out to be an effective treatment for *erythema nodosum leprosum*, establishing a new indication for the use of this drug (ibid). Its mechanisms have been extensively studied for 50 years but is still not understood, despite the fact that more than 30 hypotheses have been proposed (ibid). It is shown to inhibit blood vessel formation (angiogenesis), which is important in carcinogenesis. It decreases the plasma levels of angiogenic growth factors in myeloma patients and in lung cancer patients, and today it is used as a cancer drug in treating multiple myeloma (ibid). Variants of this drug have been formulated and are used or are under evaluation for treating different types of lymphoma, for instance (Zhou et al. 2013). This example illustrates that the scope of application of Thalidomide and the scope of its explanations have been shifting. We maintain that especially when there are no 100% deterministic laws, then the status of a theory in terms of its scope is expected to be dynamic based on ongoing tests.

Conclusions

Despite the fact that MRTs and GTs are often mentioned in IS theorizing, our review of MRTs in IS points out a fundamental disagreement on what MRTs really are and whether they common in IS. However, based on our review of MRTs in the Association for Information Systems basket of six top journals, such differences are not explicitly discussed. Moreover, numerous IS articles refer to MRT without explaining what they mean by it. Different IS scholars mean different things when they refer to MRT, which can lead to fundamental misunderstandings. As a concrete example, a senior editor at *MIS Quarterly* claimed that we are applying a GT and required us to contextualize our application of the theory so that it becomes an MRT. However, we were applying a theory of deviant behavior, which (per Merton) is already an MRT. Contextualizing an MRT theory could actually result in a theory that is narrower in scope than an MRT. This example illustrates how MRTs have acquired a normative role in IS. This can direct research towards what is believed to be MRTs. At the same time, it can also discourage research that does not meet the beliefs about MRTs. The latter situation is especially dangerous, as it can hinder progress in IS. For example, (roughly speaking) up to the eighteenth century, cancer theories were mainly MRTs aimed at explaining cancers in general. After that (generally speaking) cancer theories (explaining cancer mechanisms) and treatments become increasingly narrower, cancer type-specific and cancer subtype-specific. The history of cancer research also warns us that we should not a priori believe that theories with wider scope are stronger than theories with narrower scope. While cancer research is different from IS research, we argue that highly narrow theorizing could be successful in IS research. The practical impact may be also achieved by narrowing

the scope. We suggest that it is the decision of those who apply the theory to decide whether they prefer, for example, the accuracy or the breath of application. It is up to practitioners to decide whether they prefer broad theories that may provide less explanation accuracy or narrower theories with better explanation accuracy. We, as scientists, should provide all of these.

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