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Title: An Integrated Framework for Theories of Individual Attitudes Towards Technology

Keywords: Theory building; theory integration; framework; relevance; individuals.

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An Integrated Framework for Theories of Attitudes Towards Technology

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Abstract

The IS discipline addresses the confluence of people and technology. A substantive sub-field of IS research explores individual attitudes and behaviours towards IT. Well known related theories include Task technology Fit (TTF), Technology Acceptance Model (TAM), Unified Theory of Acceptance and Use of Technology (UTAUT), Cognitive Fit, Expectation Disconfirmation (particularly as applied to IS-service quality measurement), and Computer Self-Efficacy. Close examination of these theories reveals three main concerns. First, the nature and scope of the theories mostly “black box” (or omit) the IT artifact. The second, related issue is that no appropriate mid-range theory is developed to contribute to disciplinary progress and to serve the needs of our practitioner community. Third, leading theories are overlapping but incommensurable. We address these problems by proposing a theoretical framework that harmonizes these attitudinal theories, and shows how they can be specialized to include the relevant IS phenomena. The framework is useful for assessing and ensuring the integrity of theory, and can be employed to develop actionable and specific mid-range theories of attitudes and behaviours and behaviours towards technology.

Keywords: Theory building; theory integration; meso-theory; specialization; framework; relevance; attitudes; individuals.

Introduction

General theories of individual attitudes towards technology, though representing a relatively small part of the full body of Information Systems (IS) research, according to some surveys [1, 2], are well-known and include some of the most highly cited theories in the IS discipline[1]. These theories include Task-Technology-Fit (TTF) [3, 4]; the Technology Acceptance Model (TAM) [5, 6], the Unified Theory of Acceptance and Use of Technology (UTAUT) [7], Cognitive Fit [8], Cognitive Dissonance and Expectation Disconfirmation [9, 10], and Computer Self-Efficacy [11]. However, on close examination, these theories are frequently competing, over-lapping and poorly integrated. Further, they are highly generalized, to the point that they do not provide useful and actionable insights for practitioners. These concerns are exacerbated by the somewhat casual way in which the theories are adopted and adapted by IS researchers, in particular, by the widespread practice of freely modifying and recombining elements from different theories. These concerns and casual practices tend to yield ambiguous and even contradictory results that inhibit disciplinary progress.

The influential social science theorist Dubin [12] discusses the issue of integrating and combining theories. He notes that social science theory has not "added up" (by combining multiple theories) in the same way as theory in the physical sciences. As well as supporting interdisciplinary research, he argues that "an important source of intradisciplinary advance is the ability to add pieces of knowledge together" (p. 237). He argues that for theories to be combined, they must be contiguous, i.e. "the boundary of [the] domain [of a theory] is contiguous with the boundary of the domain of the other theory addressing a slightly different analytical problem" (p. 234). The framework that we develop in this paper follows this recommendation for intradisciplinary progress by demonstrating that theories of individual attitudes to technology are contiguous and can be integrated based on logically consistent principles.

In this paper we present an integrated view of influential and widely-cited theories of attitudes and behaviours towards technology and offer a guide for IS researchers wishing to use this integrated view to develop new theories. The contribution of this paper is theoretical and conceptual. We note that each of these theories have been operationalized many times in different contexts. It is not our intention to propose an integrated operationalization or measurement model (in fact, we will argue later that such an endeavour is unrealistic). We do, however, demonstrate how our framework can be used to develop new theories in such a way that they are commensurate and combinable.

To help set the scope of this paper, we emphasize that the paper discusses a topic that might be termed meta-theoretical, i.e. it discusses theory about theories. We discuss topics of theory construction and integration, and properties of theories and constructs. The paper is *not* an empirical research methods paper.

The remainder of the paper is structured as follows. The next section discusses the notion of theory and the paradigmatic assumptions of the paper; it discusses "grand theory" versus specialized theory; it introduces leading attitudinal theories; and it presents three concerns with the current status and usage of these attitudinal theories in Information Systems research. We then show the development of the integrated theory framework from a small set of first principles. Following this, we show that our theory framework is sufficiently expressive to encompass the major IS theories discussed above. We then demonstrate how to use the integrated theory framework to generate new and original mid-range theory of

[1] For example, the TTF, TAM, UTAUT and Computer Self-Efficacy all occur in the top ten "most cited" articles from MIS Quarterly http://www.misq.org/skin/frontend/default/misq/pdf/MISQStats/MostCitedArticles.pdf

attitudes towards information systems. The paper closes with a discussion and outlook to future work.

Theoretical foundations

Theory and paradigmatic assumptions

While we assume that a theory is a social construction developed and shared by groups of researchers [13, 14], we share the implicit view that there is a separation between real world phenomena and theoretical concepts. A further important assumption underpinning this paper, is that the phenomena being studied and the components of the theory that represent them, can be clearly defined, classified, and separated from each other, and their context. These same boundaries and definitions allow the components of theories to be combined in a systematic way. Theories can be considered as sets of propositions that relate concepts or constructs, bounded by a specified context [15]. Theories may exist for different purposes, among them explanation [16]. Theories that explain provide causal explanations of a phenomenon and testable hypotheses [15, 16]. A representation relationship relates the theoretical level of constructs and propositions to the level of variables and hypotheses: variables represent constructs, and the hypotheses that relate variables to one another are derived from the propositions that relate constructs [15].

A similar conceptualization of theory (and similar terminology) is used by Weber [13] who defines the phenomena of research enquiry as "someone's perceptions of facts in the real world – the existence of things, the properties these things possess, the states these things experience, and the events these things undergo…The subset of phenomena in the world that the theory is intended to cover is called its domain." (p. 5), [13]. We note that this definition embeds a separation between the "real world" and perceptions or representations of the world. Theories are separate from, but represent the real world: "Theories provide a representation of someone's perceptions of how a subset of real-world phenomena should be described…. By theory, I mean a particular kind of model that is intended to account for some subset of phenomena in the real world. " (p. 5), [13].

"Grand" Theories and Specialized Theories

Theories can exist at different levels of generalization[2]. Gregor calls the most general level grand theories [16]. These are relatively unbounded in space and time. In contrast, mid-range or "meso" theories have a more limited scope. Gregor leaves further discussion of theory generality as a potential area for further work [16]. In the remainder of this article, we use the term *Grand Theory* to refer to a general theory that must be specialized to develop useful IS theory about specific IS phenomena of interest. We offer a definition of mid-range theories, for our discussion, as "*theories that are sufficiently specialized as to include characteristics of IT-specific phenomena (e.g. the IT artifact*[3]*) explicitly in their nomological net*".

[2] By "generalization" here, we refer to the extent of the scope and boundaries of the theory, as described in detail by Dubin (1978) 12. Dubin, *Theory Building*1978, New York: Free Press. pages 125-142. We do *not* refer to the issues of generalization of a sample to a population, as discussed by Seddon and Scheepers 17.

Seddon, P. and R. Scheepers, *Towards the improved treatment of generalization of knowledge claims in IS research: drawing general conclusions from samples.* European Journal of Information Systems, 2012. **21**(1): p. 6-21., and Lee and Baskerville 18. Lee, A. and R.L. Baskerville, *Generalizing Generalizability in Information Systems Research.* Information Systems Research, 2003. **14**(3): p. 221-243..

[3] This is similar to Benbasat and Zmud's discussion of the IT artifact and its nomological net, and their notion of errors of exclusion 19. Benbasat, I. and R. Zmud, *The identity crisis within the IS discipline: Defining and*

When Dubin [12] considered the progress of disciplinary development, he noted that this can occur in two ways, either by expanding the scope of theories from other disciplines, or by making them more bounded and specific. He notes that "historically, in a given discipline, there is no certainty whether the models employed will be ones of small domain or ones of large domain in the initial phases of development of the discipline…In what direction the model building goes probably does not make any difference to the development of a scientific discipline" [12]. Dubin is therefore equivocal about the extent to which theories need to be highly generalized, seeing value in both extending boundary conditions (increasing generalizability) and in increasing context specificity.

The work of Merton [20] has been influential in conceptualizing the level of theory that is appropriate for a discipline. Building on Merton's work, Weber [13] notes the primary theories used by a discipline ought to be 'middle-range' (or 'meso-level') theories. On the one hand, such theories avoid 'narrow empiricism'. On the other hand, they avoid being so general in their coverage that it is difficult, if not impossible, to test them empirically. Meso-level theories often have value because they link the micro-level world and macro-level world in a discipline. However, Weber qualifies this, noting that "in spite of the wide acceptance of Merton's idea within many disciplines, the precise meaning of 'middle-range theories' remains problematic" (p. 16), [13].

In IS, Weber [13, 21] argues that the appropriate level of theorizing can be determined by the choice of the phenomena of enquiry. "If researchers are seeking to articulate a new theory, their first concern should be the choice of the focal phenomena. They must select focal phenomena that their colleagues ultimately will deem to be important, either because the focal phenomena's importance is readily apparent, or the argument the researchers provide to support the importance of the focal phenomena is compelling [21]. The focal phenomena must also be conceived at a level that allows a meso-level theory to be formulated." (p. 25), [13].

Theory specialization, construct specialization and construct operationalization

We briefly clarify an important distinction between theory specialization, construct specialization and construct operationalization. Construct operationalization is the process of developing accurate and appropriate measures for a theoretical construct without changing it, for example, the process of scale and item development [22]. Theory specialization involves the addition of more specialised constructs in the nomological net of the theory or the replacement of general constructs with such specialized constructs. Construct specialization is the sub-typing of a construct.

These notions are frequently confused or conflated, partly because it is often necessary to do both. In the example of the TAM that we will develop in more detail in the next section, the construct "Ease of Use" is *operationalized* with questions that include: "I would find <….> useful in my job" and "I would find it easy to get <….> to do what I want it to do". Inserting a specific technology into the gaps in these questions *operationalizes the construct* in a more specific context, but it does not *specialize the theory or the construct*. The constructs in the theory do not change.

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communicating the disciplines core properties. MIS Quarterly, 2003. **27**(2): p. 183-194.. However, it is not as prescriptive. Our definition can include anything agreed by the community as a phenomenon of interest.

The theory can be made more specialised by, for example, adding more specialised constructs to the nomological net of leading attitudinal theories. If we continue with the TAM-based example, we might hypothesise that delivering an essential application required by employees as a mobile app that can be accessed on their own smart phone or tablet using a bring Your Own Device (BYOD) model will increase perceptions of the ease of use of the application. We might hypothesize, specifically, that employee perceptions of device compatibility and device integration increase perceptions of ease of use in this context. We might add new constructs for “perceived device compatibility” and “perceived device integration” into the nomological net of the theory as antecedents to perceived ease of use. This would represent *theory specialisation*, as two constructs that are very specific to the phenomenon of study (use of a mobile application in a work-related BYOD context) have been added. They are more specialized because they cannot be applied to as many phenomena as “ease of use”. Specialization is therefore a reduction in the set of phenomena to which a property is applicable, by the imposition of more restrictive boundary conditions.

If we continue with our example of the mobile application, we might also consider that our new constructs “perceived device compatibility” and “perceived device integration” were sub-types, or *construct specializations*, of a general “fit” construct that represents interactions between perceptions of the artefact itself, and the user’s context of use, and the user’s personal and cognitive characteristics. The new constructs have much more narrow boundary conditions, but fall within the general scope of “fit”.

Finally we need to *operationalize* the generalized perceived ease of use construct for the study context (without changing it), for example “I would find <this mobile application> useful in my job”

In summary, a grand theory theory can be specialized into a mid-range theory by adding new constructs or replacing general constructs with specialized ones. Mid-range theory building will frequently involve more than one combination of theory operationalization, theory specialization, and construct specialization. In our example, the TAM (constructs) are operationalized by including the technology context in existing constructs like Perceived Ease of Use (without changing them) and specialized by adding new and more focussed constructs as antecedents to ease of use. These new constructs (as it happens) are also construct specializations, as they are sub-types of a generalized “fit” construct. Both theory and construct specialization, as well as operationalization may be used in various combinations to develop new theories.

Many of the terms used in this paper are used in many different contexts with different definitions. To avoid confusion, we briefly define some key terms.

<u>Theory:</u> A theory is “a particular kind of model that is intended to account for some subset of phenomena in the real world.” (p. 5), [13]. Theories can be considered as sets of propositions that relate concepts or constructs, bounded by a specified context [15].

<u>Grand theory</u>: In the scope of the present paper, we discuss a number of theories that have been appropriated into Information Systems that contain propositions about Beliefs/Attitudes/Perceptions towards technologies. We define these as “grand theories” [16]. This is because the only boundary conditions in these theories are that they must include a technology (any technology; sewing machines, bicycles, or business process modelling methodologies work equally as well as ICTs) and its users.

Theory generalizability: Theory generalizability refers to the breadth of the scope and boundary conditions of the theory. So grand theories will have a very broad scope (for example, all users of technology), while mid-range theories will have a narrower scope with more boundary conditions (for example, all users of work-related mobile applications). We do *not* refer to the generalizability of the sample to the population [18, 23].

Construct operationalization: This is the specification of the technology or context involved in the study without changing the theoretical constructs.

Theory specialization: We call including new and more specific theoretical constructs in the nomological net of the theory, theory specialization.

Construct specialization: Specialized constructs are a sub-type of a more general construct.

Individual attitudinal theories in IS

In this section, we critique salient theories of individual attitudes to IS, in relation to three concerns that follow from the preceding discussion. Our first concern is that leading attitudinal theories are "grand theories". Our second related concern, is that the way they are used by IS researchers is insufficiently specialized to offer useful mid-range theories. Our third concern is that the theories are not integrated. Having critiqued the focal theories, we then offer two theoretical contributions; (i) we address the third concern first, extending the scope and scale of IT theories by integrating existing theories in a consistent and contiguous way. This offers options and solutions for the first and second concerns. We then (ii) show how the framework developed in this paper allows IS researchers to move from the general to the more specific by adding boundary conditions to general theories, to create novel and salient mid-range theory that is appropriate for the IS discipline. Arguably, the first task beneficially precedes the second. If researchers seek to include in a new theory constructs that derive from more than one reference theory, then there is merit in carefully considering how the two reference theories are related. Otherwise any theorising that includes "specializations" of constructs from more than one general theory will be combining them in a vacuum. In fact, researchers may not recognise that their constructs are specializations of more general constructs.

Concern 1: Leading attitudinal theories used in information systems are "grand theories"

When adopting, or borrowing, theories from reference disciplines such as social psychology, the reference theories typically have a very broad scope (frequently all people). We will argue that they (via their constructs) are frequently operationalized, but not specialized to the IS context. For example, if the construct of self-efficacy from self-efficacy theory [24] is operationalized as "judgement of one's capacity to <insert action> , we can see that Computer Self-Efficacy [11] is still very broad, and operationalizes (without changing) the generic self-efficacy concept to the IS area where it is defined as "judgment of one's capability to use a computer" (p. 192), [11].

Most theories of individual attitudes towards technology are broadly based on social psychology, including the Technology Acceptance Model (TAM) [5]; Cognitive Fit [8]; Computer self-efficacy [11]; and the UTAUT [7]. To these, we add two further high-impact theories of attitudes towards information systems, the IS-ServQual model [25], based on services marketing literature, and the home-grown (within the IS discipline) Task Technology Fit Theory [4]. We briefly review these theories, with respect to: 1) their breadth, and efficacy and use for developing specific mid-range IS theories; and 2) the degree to which they are able to be integrated into a coherent framework to support disciplinary progress and theory extension.

Concern 2: The lack of mid-range attitudinal theories in IS

In this section, we argue that the leading IS attitudinal theories we integrate are overly broad in scope in terms of the phenomena they address, and need to be specialized for phenomena that are unique to IS researchers and salient to their practitioner community.

There has been much discussion about what constitutes an appropriate focus for theories in the IS discipline. While there is no consensus on this issue, important research and opinions have proposed both a more "prescriptive" approach [e.g. 19, 26, 27], and a more "emergent" approach [e.g. 28, 29]. Amongst the "prescriptive" approaches, some have advocated for a relatively narrow definition based around the IT artifact [e.g. 19], while others have conceptualized IS more broadly as including the communication, memory (storage) and representation of information as "symbolic objects" [30, 31]. Some researchers have proposed that information systems should be conceived as socio-technical work system involving participants, information and technologies which combine to form processes and activities that are embedded in products and services [31]. The more "emergent" approach eschews any prescription of what does, or does not constitute the appropriate focus for IS theory, and argues for a pluralist approach based on a "market-place of ideas" [29].

The prescriptive recommendations are perhaps not as far apart as they appear, and differ more in emphasis than in their essential claims. Benbasat and Zmud [19], while emphasizing the importance of the IT artifact, conceptualize the IT artifact "as the application of IT to enable or support some task(s) embedded within a structure(s) that itself is embedded within *a context(s)* where the design of the artifact "encapsulates the structures, routines, norms and values implicit in the *rich contexts* in which the artifact is embedded" (p. 186). Alter's [31] work-system conceptualization also includes a *technology component*, although differing in emphasis on the context and end-customer. Our position can be considered to fall within the broader end of the "prescriptive" camp, in that we advocate that the process of specializing theories and adding additional boundary conditions to make them unique to the IS discipline will frequently involve the addition of technology components in their broader sense.

What recent "calls-to-action" have in common is an argument for greater specificity in IS theorizing – effectively, less focus on "grand theories" with broad boundaries, and more focus on the sort of mid-range theories advocated by Weber [13] that explain phenomena specific to our discipline. Considering the scope of IS research in general, Benbasat and Zmud [19] argued that the less we focus on IS-specific phenomena in our research, the less likely it is that we contribute to the principle consumer of our research which is the IT practice community. With specific reference to individual attitudinal theories, they lamented that we spend a significant amount of energy in making marginal additions to the theories we have borrowed, and many IS papers have offered only minor improvements to the TRA, and adoption models and theories. This is echoed in the criticisms of TAM-related research by Benbasat and Barki [32], which include "the diversion of researchers' attention from important phenomena…importantly IT artifact design and evaluation" (p. 212).

Existing individual belief-based theories in information systems research run the risk being characterized as "social psychology lite". Several decades of research have not expanded our knowledge greatly beyond that provided by Azjen in his Theory of Planned Behaviour (TPB)

[33]. Benbasat and Barki [32] argue that while TAM has been one of the most influential theories in IS we are still in the process rediscovering the importance of some of the aspects of the TPB, such as social influence that were not included in the TAM. In their TAM2 study, Venkatesh and Davis [34] looked back to the TRA and the TPB for extensions to the TAM model. More recently, TAM3 extended the TAM with additional attitudinal factors such as self-efficacy [35]. We will demonstrate that this occurs because the scope of the phenomena included in these theories is still too broad. Theories borrowed from social psychology were operationalized in IS contexts, but IS concepts and phenomena were not used to specialize the theories.

The original TAM model [5], and its variants and extensions, have, collectively, been cited more than 20,000 times. Davis [5] defines the concept of ease of use as "the degree to which a person believes that using a particular system would be free of effort" and defines usefulness as "the degree to which a person believes that using a particular system would enhance his or her job performance". While Davis applies the concepts to information systems, the TAM is highly generalized. There is nothing in the concepts that is specific to the IT artifact. For example, items like "I would find ... useful in my job" and "I would find it easy to get ... to do what I want it to do" may be applied to bicycles just as well as computer systems, an example of a grand theory where the *constructs* are very generalized, and by inserting a specific technology in the gap, they can be operationalized in a context, but the constructs and the theory itself does not change. When examining the immediate theoretical network into which this construct is embedded, the initial study examined actual use as a consequence but did not study any IT-specific antecedents.

Recent work on TAM [36] extends the original model to include several compatibility concepts as antecedents. However, these are also generic concepts and their measures, e.g. "Using <the CRM system> is a new experience for me", are can be shown to be operationalizations of highly general constructs (any technology could be inserted without changing the meaning of the item). IT specific either. Extensions of TAM to include source credibility and argument quality as antecedents [37] and to include perceived personalization, familiarity and trust [38], may be seen as specific to some IT characteristics of, for example, knowledge management systems or recommender systems, and are perhaps less generic than other theoretical networks examined here.

Cognitive Fit [8] is also based on social psychology; in particular, Cognitive Dissonance Theory [39]. Cognitive Fit theory is defined as "matching representation to task [which] leads to the use of similar, and therefore consistent, problem-solving processes, and hence to the formulation of a consistent mental representation" [8]. Vessey uses this concept to explain the understanding of graphically presented information, but again the concept itself is not specific to information systems. The study includes only consequences of cognitive fit (no antecedents), and no concepts specific to IT phenomena are included (i.e. no concepts that cannot be equally well applied to other, more general phenomena).

Computer self-efficacy [11] is based on Self-Efficacy Theory [24] and describes the adaptation of the generic self-efficacy concept to the IS area. Computer self-efficacy is defined as "judgment of one‘s capability to use a computer" [11]. The adaptation to the IT context again yields very generic measurement items such as "I could complete the job using ... if I had seen someone else using it before trying it myself". Only one of the items given by Compeau & Higgins [11] is specific to the IT context in that it refers to a built-in help facility, which could not be expected of bicycles, but of computer systems. The theoretical network in which the concept is embedded is also generalized rather than IT specific, containing antecedents like encouragement and support, and consequences such as anxiety and usage.

UTAUT [7], building on TAM, introduces concepts such as effort expectancy and performance expectancy. Again, these are defined without reference to IT characteristics: "Effort expectancy is defined as the degree of ease associated with the use of the system" (p. 450) and "Performance expectancy is defined as the degree to which an individual believes that using the system will help him or her to attain gains in job performance" (p.447). The measurement of these constructs includes items such as "I would find the system easy to use" and "Using the system increases my productivity" (p. 460). As with TAM, these are generalized concepts, and their measures could be applied to bicycles just as well as computer systems. In this work too, the nomological network includes only generic consequences, such as behavioural intention and use behaviour. No antecedents or other IT specific concepts are included.

IS-ServQual[4] is an instrument and not a theory in its own right, but we include it, since it is a measurement of attitudes towards aspects of an information system. IS-ServQual is based on the ServQual instrument developed by marketing scholars Parusaraman, Zeithaml and Berry [41, 42], which in turn was based on expectation-disconfirmation theory [9, 10], and psychological theories of cognitive dissonance [39]. ServQual posits that perceptions of service quality can be expressed as a gap between expected and perceived performance on a range of dimensions, including: reliability (the ability to perform the promised service dependably and accurately); tangibles (the appearance of the physical facilities, equipment, personnel); responsiveness (the willingness to help customers and provide prompt service); assurance (the knowledge and courtesy of employees and their ability to convey trust and confidence); and empathy (the caring, individualised attention provided to the customer). Once again, these dimensions are not in any way specific to any IS phenomena.

Of the prominent IS theories, only Task Technology Fit [4], which is defined as "the degree to which a technology assists an individual in performing his or her portfolio of tasks" acknowledges that the generic nature of its focal construct needs to be adapted for specific technologies: "To defend these assertions ... and to test them, requires applying the perspective to a specific task domain, at a detailed level" [3]. Based on a process model, 14 specific dimensions of TTF are identified.

In summary, we believe that this overview of major IS theories shows that current research in the IS field appears to focus mainly on consequences of the mere presence of an IT artifact, and fails to account for characteristics of specific types of IT or specific characteristics of an IT artifact. We suspect the focus on consequences may be one reason why IS research is not considered relevant to practitioners [43, 44]. There are too few specific and actionable

[4] In its original form, IS-ServQual 25. Pitt, L., R. Watson, and B. Kavan, *Service Quality: A Measure of Information Systems Effectiveness.* Ibid.1995. **19**: p. 173-187. aimed to measure the service quality provided by IS *personnel*. However, over time, and perhaps based on a misreading of the Delone and McLean IS-Success Model ten year update 40. Delone, W.H. and E.R. McLean, *The DeLone and McLean Model of Information Systems Success: A Ten-year Update.* Journal of Management Information Systems, 2003. **19**(4): p. 9-30. which included service quality (of the IS personnel) as a dimension, ServQual dimensions and attributes have been appropriated as measures of user attitudes towards the service quality of information systems, not just IS personnel.

prescriptions. For example, for a business it is not terribly insightful to know that it must increase the usefulness of an application in order to foster its use. Businesses need to know not just that a specific technology is perceived to be useful (operationalization of the "usefulness" construct by inserting the technology of interest in the appropriate place in the items measuring the construct) *but also* the specific characteristics of an information technology artifact that make it more useful. This requires additional theoretical constructs focussing on the attributes of interest. Similarly, while it is important for businesses to know that recommender systems convey trust, which may lead to an increase in a user's intention to adopt the recommendations of that agent, it is much more important and useful to know how the level of trust conveyed by an agent can be increased.

Concern 3: Leading attitudinal theories are not integrated

In social science, there is only ever inductive evidence of theory generalizability – a mounting body of evidence is needed. Such a body of evidence usually requires repeated studies using the same theory in different specializations and operationalizations which are then combined and evaluated using meta-analysis techniques. However, a reluctance to conduct and publish replication studies, and a lack of any coherent approach for inter-relating, aligning, extending, or comparing theories has resulted in a comparatively weak body of evidence for many IS theories. In 1978 Dubin lamented the "relative indifference to facts" in the social sciences [12]. This has hardly changed in thirty five years. We have a great deal more data, but no consistent basis for integrating and comparing it to develop strong "weight of evidence" arguments.

In social psychology, the TPB has been evaluated in a meta-analysis based on 161 studies [45]. This makes us more confident in the TPB, but does not constitute "proof" of theory generalizability. Unfortunately, studies of this nature are both rare, and very difficult to carry out in the IS field – there simply are not enough studies available that have used the same operationalization of key constructs to carry out statistical meta-analyses.[5] This is partly a result of the wide-spread practice by IS researchers of modifying constructs; using the same construct name but measuring it differently; and freely mixing and matching constructs and items from different theories. For example, many TAM researchers modify the TAM constructs, or use only a partial set of the original items, to measure Perceived Usefulness or Perceived Ease of Use [e.g. 46, 47, 48]. Interpretational confounding, where constructs are called by the same name but measured with different items or indicators, is also widespread. For example, the construct "information quality" is widely used in theories of attitudes towards technology and technology quality, including the IS-Impact Model [49], the IS-Success Model [40], and the e-Qual instrument [50], among others. All of these have different measures and nomological nets. Specific items (questions) are also mixed and matched between constructs, for example the IS-Impact model includes two TAM indicators of Ease of Use as measures of System Quality. The impact of this relatively unstructured modification and recombination of constructs and items is that systematically integrating theories based on an accumulation of empirical studies (for example, by using quantitative statistical meta-analysis or Bayesian statistical techniques [51] is very difficult, as it is very unclear which studies can be included. Our integrated framework can provide a reference point for researchers wishing to combine elements from multiple theories. This allows novel theories to be developed, their scope and boundaries to be clearly defined, and the new theory to be connected to existing theory in a systematic way.

[5] This may change with the launch of the new journal "AIS Transactions on Replication Research." The very launch of the journal in 2014 indicates the absence of such studies in the past.

A number of previous studies exist which combine one or more of these theories. For example, the UTAUT [7] included a comprehensive review and integration of theories of individual adoption of technology. Authors of major theories have themselves called for greater integration, for example, Goodhue [52] wrote "Anyone who knows my work will not be surprised that I have suggested that task- technology fit is …a key construct between TAM and performance impacts. *Perceived task-technology* fit is a key predictor of perceived usefulness….*Actual task-technology fit* is a key moderating variable between utilization and performance impacts" (our emphasis). Dishaw and Strong [53] developed an integrated model that combined the Task Technology Fit model with the TAM model, and found their combined model has better explanatory power than either of the theories evaluated individually. Many TAM extensions have been developed, to include other theories of individual attitudes and behaviours (for example) self-efficacy [35] and trust [54].

However, systematic bottom-up empirical integration and comparison of a full range of attitudinal theories is precluded, among other things, by practical considerations: the complexity of the resulting model[6]; the prohibitive number of items that would need to be included in a questionnaire; and the corresponding requirement for an exceptionally large sample size. This is lamented by Bagozzi [56], who comments on empirical attempts to extend and integrate acceptance models: "The study of technology adoption/acceptance/rejection is reaching a stage of chaos, and knowledge is becoming increasingly fragmented with little coherent integration. A good example is the recently proposed unified theory of acceptance and use of technology (UTAUT, [7]). The exposition of UTAUT is a well-meaning and thoughtful presentation. But in the end we are left with a model with 41 independent variables for predicting intentions and at least eight independent variables for predicting behaviour… The IS field risks being overwhelmed, confused, and misled by the growing piecemeal evidence behind decision making and action in regard to technology adoption/acceptance/rejection. What is needed is a unified theory about how the many splinters of knowledge cohere and explain decision making." (p. 245). This is echoed by Benbasat and Barki, who (based on TAM, but the argument is equally applicable to other theories of the individual used in IS) argue that "TAM as a theory [is unable to] provide a systematic means for expanding and adapting its core model…[and] efforts to "patch up" TAM…have not been based on solid and commonly accepted foundations, resulting in a state of theoretical confusion and chaos." [32].

Accordingly, we have taken an approach based on argument from first principles[7]. Researchers could always revert to the foundational studies, such as those discussed above, to develop integrated models, but this would obviate any evidence that had been accumulated subsequently. In conclusion, we claim that a systematic historical *empirical* integration of

[6] Empirical integration and comparison would require identifying and removing overlapping constructs and then collecting data (or conducting a meta-analysis on previously collected data) for all the theories, variations, and extensions. This is impractical. For example, Lee et al.,55. Lee, Y., K. Kozar, and K. Larsen, *The Technology Acceptance Model: Past, Present, and Future.* Communications of the AIS, 2003. **12**(article 30): p. 752-780. found twenty one different constructs that had been used to extend the TAM alone.

[7] By first principles, we mean the form of argumentation, in the tradition of philosophy of science from Aristotle and Descartes, which states certain foundational assumptions about the world that we believe to be true, and then develops other arguments from them. In this case, we assume the three basic tenets, described in Figure 1, to be true. These form the nucleus of our framework.

general theories of attitudes towards technology is impractical and unrealistic. Integration, if it is to occur, must be at a conceptual and theoretical level.

An Integrated Framework of Grand Theories of Individual Attitudes Towards Technology

The following section develops an integrated framework of Grand Theories of individual attitudes towards technology. It is intended to systematize the extension and combination of theories and to guide researchers in the development of new specialized IS theories (illustrated in the next section). In clarification of the notation in our framework, we observe that the theories we integrate are usually depicted as causal diagrams, which typically proceed from left to right, with antecedents on the left followed by their consequences on the right. In Section 1 we have argued that as IS researchers, we need to focus on the IS-specific phenomena/artifacts. The review of theories in the introduction has shown that much of IS research with a focus on the individual deals with consequences of the IT artifact, not antecedents. Hence, the specific characteristics of the IT artifact are generally missing from the left-hand side of causal models. As we have demonstrated in the introduction, this part of a theory is frequently under-specified or entirely omitted in IS research.

Our integrated theory framework is based on two fundamental principles:
1. IS research is located at the intersection of humans, tasks (or contexts) and IT phenomena/artifacts, "the application of IT [by a human] to enable or support some tasks embedded within a structure that itself is embedded within a context" [19].
2. Because we are concerned with theories of the individual, our framework is based on the foundational psychological idea that perceptions cause beliefs, which in turn cause attitudes and give rise to intention and subsequent behaviour [57]. Thus, following the general logic of Fishbein and Ajzen’s theories of attitude formation, as we move from "left to right" in causal diagrams, we expect to see perceptions, beliefs, and subsequently attitudes [57].

The first principle is initially represented by three concepts in an initial model (Figure 1). Humans are generically represented by their cognitive characteristics (centre sphere Figure 1). This includes background knowledge and reasoning procedures. While Benbasat and Zmud [19] separate the task from the context, we collapse the two in order to achieve some parsimony (top sphere Figure 1) and to not detract from the focus on the IT artifact. Perceptions of the IT artifact (bottom sphere Figure 1) are characterized primarily through its affordances, i.e. actions a human can perform with it, on it, or to it. Other, non-functional characteristics may also be added and subsumed under this construct. We emphasize the point that all three concepts are psychological concepts; they are perceptions of the IT phenomena and perceptions of the task. It is these perceptions that matter and cause in part any consequent behaviour.

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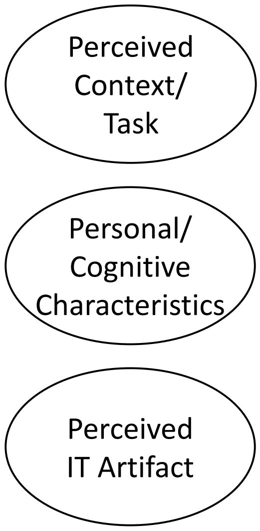

Figure 1: Three foundational concepts of IS behavioural research

Our first principle above suggests that IS research is located at the intersection of the concepts in Figure 1. We now model this intersection and represent it as interaction terms between the three concepts. We can combine them in four different ways:

1. **Perceived IT Artifact × Personal characteristics**: The interaction between artifact and personal characteristics allows us to examine issues such as whether a knowledge management system provides information that is relevant to the user or whether the reasoning of an automated system is understandable to the user.
2. **Perceived IT Artifact × Perceived task**: The interaction between artifact and task characteristics allows us to examine issues such as the usefulness of an IT system for the task it is used for, or to examine whether different systems lead to different performances on task.
3. **Perceived task × Personal characteristics**: The interaction of these two concepts does not contain any IT specific concepts and thus falls outside the scope of IS research, as it would lead to an error of exclusion [19].
4. **Perceived IT Artifact × Perceived task × Personal characteristics**: This three-way interaction allows the richest study of context-situated use of an IT artifact by a particular type (or even a particular instance) of individual. For example, it allows us to examine whether an expert system provides reasoning procedures that are useful to domain experts for a certain task.

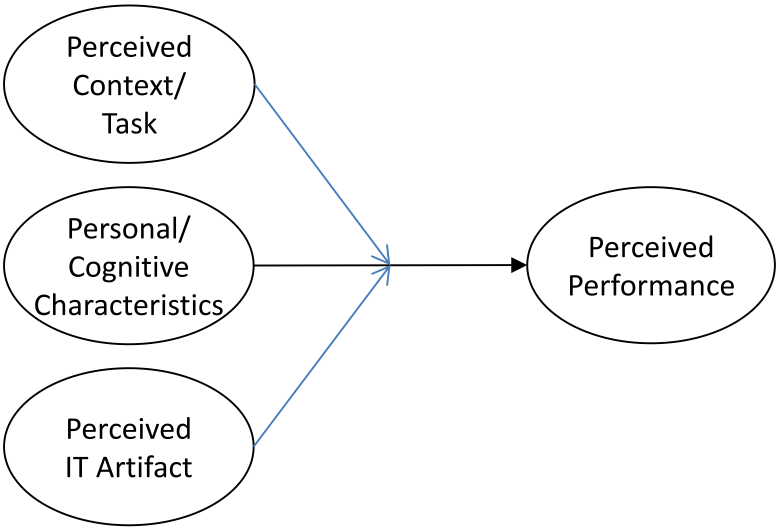

Figure 2: Typical notation for interaction effects

Typically, interaction terms are modelled in the form shown in Figure 2 [e.g. 7], and one of the interacting variables may be called the moderator of the relationship between the other interacting variable and the consequence. In essence, Figure 2 is about "fit". There is widespread confusion over modelling "fit" and "difference" scores in information systems research. In this study, we draw on Polites et al. [58][8], who identify "aggregate" constructs (that are a mathematical function of their dimensions) and "profile" constructs (which represent a set of discrete combinations of various levels of their dimensions) as fundamentally different from other forms of model constructs [58]. With regard to "fit" Venkatraman [59], offers a number of conceptualizations, including "fit as moderation", or interaction between the variables of interest to determine their combined effect on a dependent variable; and "fit as matching", which examines the theoretical difference between two variables without requiring consideration of the effects on a subsequent criterion variable. While these conceptualizations were developed for an organizational strategy context, and thus use a different unit of analysis to the theories in our study, the conceptualizations of fit are nevertheless informative. As we are interested specifically in the interaction term, we make it explicit. We reify[9], i.e. "make as a thing", this concept as Perceived Fit, shown in Figure 3. Notice that the arrows connecting the three antecedents to fit are not of a causal nature. Hence, we do not draw them as solid lines, but as dashed lines. It would be wrong to assert that perceptions of the IT artifact cause perceived fit. Instead, as the perceived fit is a construction of the interaction of the three antecedents, it is appropriate to assert that perceived fit *is a mathematical function of* perceptions of the IT artifact, perceptions of the task and personal characteristics. To make a simple analogy, the sum of two numbers is not caused by them, but is a function of them. In the same way, a gap score between expectations and perceptions is calculated as a function of the two measures, not a

[8] Polites et al. (2012) offer a more nuanced taxonomy of types of constructs than we are able to represent here. It is also more detailed than we require for our discussion. However, their distinction between two types of "calculated" constructs - aggregate constructs (the result of an algebraic function of their dimensions) and profile constructs (expressed as scores on a series of dimensions which cannot be meaningfully aggregated to a single score) – and causal constructs is fully congruent with our argument.

[9] By "reify" we mean that we include an explicit construct in our model to represent the interaction function. We clarify this, because inappropriate reification is often considered to be a fallacy (for example http://en.wikipedia.org/wiki/Reification_(fallacy)).

consequence of them. We use dashed arrows to signify such relationships. Perceived fit as moderation is measured as a mathematical function, typically as difference or indicator product scores. We find that gap or fit measures are frequently mis-conceptualized as causal. For example, in the Task-Technology-Fit model presented by Goodhue et al. [4], (the level of) fit is modelled as being caused by (the levels of) task characteristics as well as being caused by (the levels of) technology characteristics. This is clearly not the case; the (level of) fit may be a function of both of these, but not caused by them

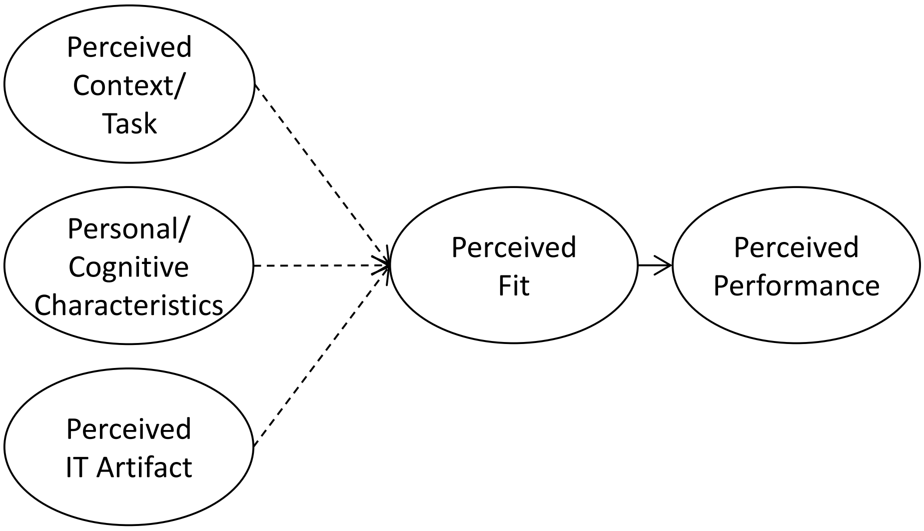

Figure 3: Reifying the interaction shown in Figure 2 as Perceived Fit

As a next step, we recognize that subjective perceptions frequently differ from objective reality. Experimental researchers recognize this and include manipulation checks in their experiments [60] to ensure that the objective characteristics of a task or artifact are actually perceived. Perceptions of the IT artifact are caused (in part) by the actual characteristics of the IT artifact. This is not necessarily a perfect causal relationship, because people may not be aware of actual characteristics, or, less commonly, may perceive characteristics that do not actually exist. Similarly, the perceptions of the task and context are caused (in part) by the actual characteristics of the task and context. This too is not a perfect relationship. These additions to our model are shown in Figure 5.

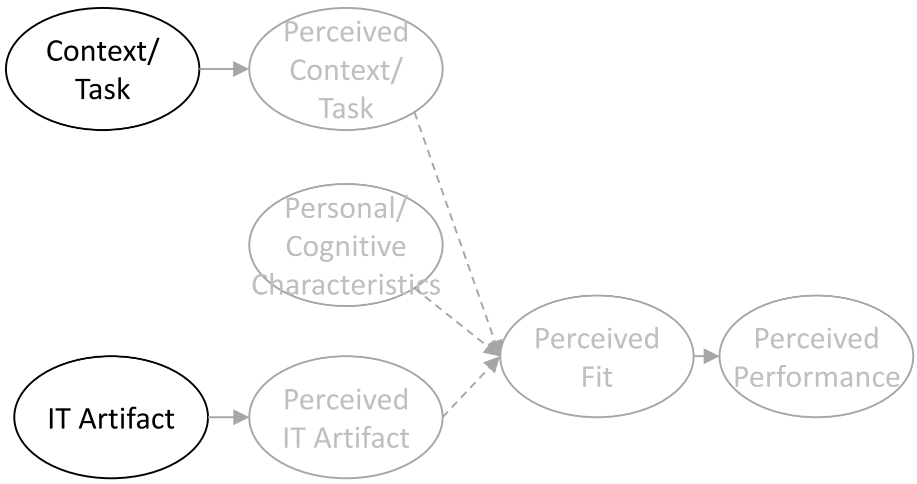

Figure 5: Perceptions differ from reality (new constructs at this stage highlighted, constructs from earlier stages of the model are greyed out).

Finally, a person‘s perception of fit may not match the actual fit and, similarly, a person‘s perception of performance may not match her actual performance, although we expect them to be strongly correlated. For example, the degree to which a system is a good fit for someone’s mental models and style of work could be evaluated experimentally (as actual cognitive fit) and might be different to the extent to which the person believes the system is a good fit for them. Similarly, a person might believe that she performs well at the task, while in fact her performance is poor compared to others. We thus add the Fit and Performance concepts to our template as shown in Figure 6. Experimental evaluations of cognitive fit and performance may, and are likely to, differ from measures of perceptions of performance that are elicited by questionnaires or similar means.

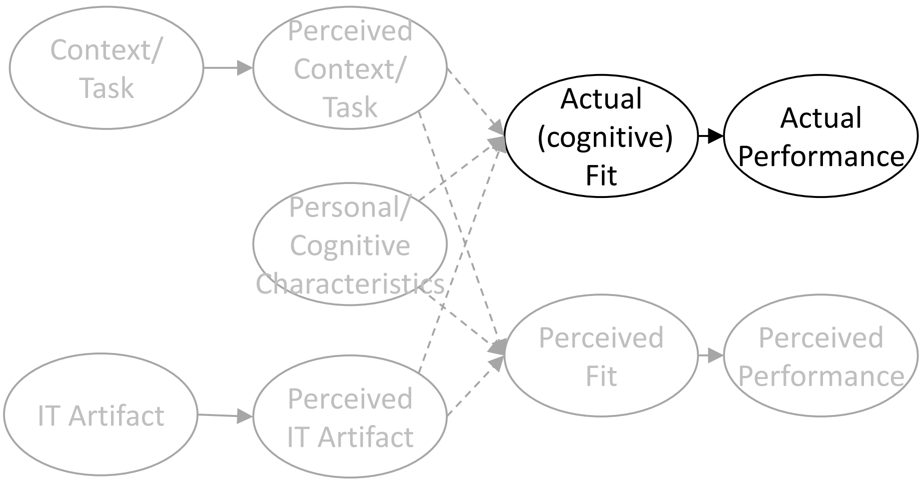

Figure 6: Adding actual fit and performance (new constructs at this stage highlighted, constructs from earlier stages of the model are greyed out).

Figures 3 to 6 represent the perceptions of the IT artifact interacting with perceived task and personal characteristics in the form of fit. A second type of interaction is that of differences. Cognition and the mental model that are part of the personal characteristics concept may give rise to certain predictive beliefs called expectations, and to normative beliefs about what should or ought to happen. We clearly separate these two types of beliefs; it is possible to believe the world ought to be in a certain state, but not to expect the world to be in that state, and vice versa. These beliefs may interact with both the perceived task and perceived IT artifact in that they can be confirmed or disconfirmed [9, 10]. However, the interaction of expectations and perceived task is not relevant to IS research, as it is not an IS-specific phenomenon. Thus, we extend the template using the concept of a perceived gap between expectations and perceptions. This perceived gap, together with the perceived fit, causes evaluative beliefs, which in turn may lead to attitudes [57]. This final model is shown in Figure 7. Similar to our definition of fit, gap is a reified interaction concept, and thus it is *not caused* by perceptions of the IT artifact and predictive and normative beliefs, but is *a function of* these concepts. Again, it is measured in its functional form, e.g. through difference scores [61], or product indicators [62, 63].

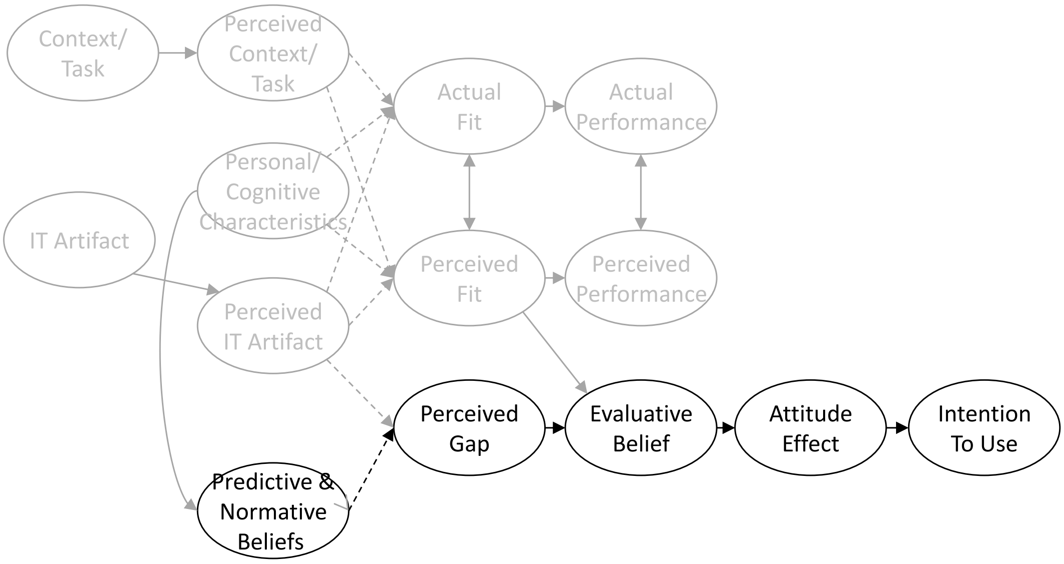

Figure 7: Adding expectations and gaps (new constructs at this stage highlighted, constructs from earlier stages of the model are greyed out).

There are important features of our theory framework that we wish to draw attention to. First, we note that Figures 6 and 7 contains two types of arrows between concepts. The solid arrows in the diagram represent standard causal relationships. The causal relationships on the right hand side of the diagram have been examined in detail by extant IS literature. For example, we can say that the perceived gap between expectations (predictive beliefs) and perceptions *causes* evaluative beliefs about the IT artifact. The dashed arrows in the centre of the diagram are different and do not represent causal relationships. For example, it makes no sense to say that predictive or normative beliefs cause a perceived gap. Instead, these arrows indicate mathematical *functional relationships*: We say that a perceived gap is a function of both predictive or normative beliefs and perceptions of the IT artifact[10] As with perceived fit, the concept is measured as a mathematical function, e.g. as an indicator product [62, 63] or a difference score [61]. Confounding in diagrams has been argued to be at the root of some long-running disputes in IS [65] and it is important that researchers clarify the semantics of any diagram, as we do here.

A second important feature is the level of generality of the theory integration framework. The framework is, in the terms of our discussion, an integrated view of "grand" theories of IS. For example, the general concept of the IT artifact is very broad, and is neither measurable nor immediately operationalizable. What is measurable with respect to individuals is not the artifact, but properties or perceived affordances of the artifact. Hence, the phenomenon that needs to play a role in individual theories of perceptions, attitudes and behaviours towards IT is not the IT artifact as a "black box" but its properties or characteristics [12, 13]. This is analogous to the natural sciences. For example, Newton's law deals not with objects, but with their mass and distance, i.e. properties. Thus, the framework can be used as a basis for

[10] Although we have emphasized that this is not an operational model, relationships and constructs of this nature would likely be operationalized as formative variables 64. MacKenzie, S., P. Podsakoff, and N. Podsakoff, *Construct Measurement and Validation Procedures in MIS and Behavioral Research: Integrating New and Existing Techniques.* MIS Quarterly, 2011. **35**(2): p. 293-334., or profile variables 58. Polites, G., N. Roberts, and J. Thatcher, *Conceptualizing models using multidimensional constructs: a review and guidelines for their use.* European Journal of Information Systems, 2012. **21**(1): p. 22–48..

developing specific and consistent theories which include specific properties of the IT artifact under investigation. Similarly, there are no generic tasks that are studied, but specific tasks that an IT artifact can be used for and that a researcher might be interested in. Once these two general concepts are specified as concrete phenomena that can be evaluated, the rest of the theory follows. For example, the specific kind of performance is usually determined by the task and the evaluative beliefs are beliefs about a certain characteristic of the IT artifact.

Third, our framework specifically supports not only perceptions, but potentially enables those to be triangulated with and compared with alternative measures of cognitive fit and performance (for example, experimental, or process tracing). This is to ensure not only relevance in terms of coverage of an IS specific phenomena, but also actionable outcomes for practitioners. As we indicated in the introduction section, it is not sufficient to show that beliefs cause attitudes and subsequent usage, but practitioners need to know how to vary objectively given characteristics, either of task or IT artifact, to affect those beliefs. This is in contrast to many of the foundational theories in IS, as we discussed earlier. We believe it is this area of the framework to which IS researchers ought to pay increased attention. While computer scientist and engineers deal with the IT artifact and psychologists deal with perceptions and beliefs, the IS researcher‘s focus should be on the linkage between the two.

Fourth, our framework maintains rigorous distinctions between psychological concepts and objectively present concepts “in the world”. This has implications both for theory as well as for measurement. Psychological concepts such as an individual’s beliefs and perceptions are truly latent; that is they are unable to be observed directly [66]. They need to be measured by self-reports, usually by means of questionnaires. This is not the case for objectively present concepts such as performance or fit. These need to be measured by observation, typically by experiment. Further, this distinction encourages the researcher to attend to the specific nature of their theory and how it should best be evaluated. For example, is it the perceived fit, or the actual fit that should play a role in the theory? The next section shows how this framework is sufficiently expressive to capture core IS theories as instances. Following that, we show how the framework can be used to generate new theory.

Integrating existing theories

In this section we show how existing IS theories with a focus on individual attitudes and behaviours fit into our framework. We do this to demonstrate two points. First, it demonstrates that our framework is effective in integrating leading IS theories with a focus on the individual. Second, we demonstrate that the theories we examine are theoretically commensurable i.e. they are based on the same set of assumptions or “first principles” (these assumptions are the two principles we introduced in the previous section to develop our framework). We show the examples by highlighting the relevant concepts in our framework based on Figure 7.

We begin with the Technology Acceptance Model (TAM). TAM includes the concepts "Perceived Ease of Use", "Perceived Usefulness" and "Intention to Use". These are all psychological variables, best characterized as beliefs about properties of a technology artifact. For example, perceived ease of use is measured by an item worded "I would find ... easy to use" which asks respondents about their beliefs with respect to the ease of use of an artifact (although in the initial paper by Davis [5], subjects are asked about hypothetical usage situations, so that rather than perceptions, the instrument actually measures expectations). As we had indicated earlier, TAM itself makes no mention of specific IT characteristics, and hence its constructs fit at the right hand side of our framework. Figure 8 highlights where concepts covered by TAM fit into the template. The TAM constructs Perceived Usefulness and Perceived Ease of Use are evaluative beliefs.

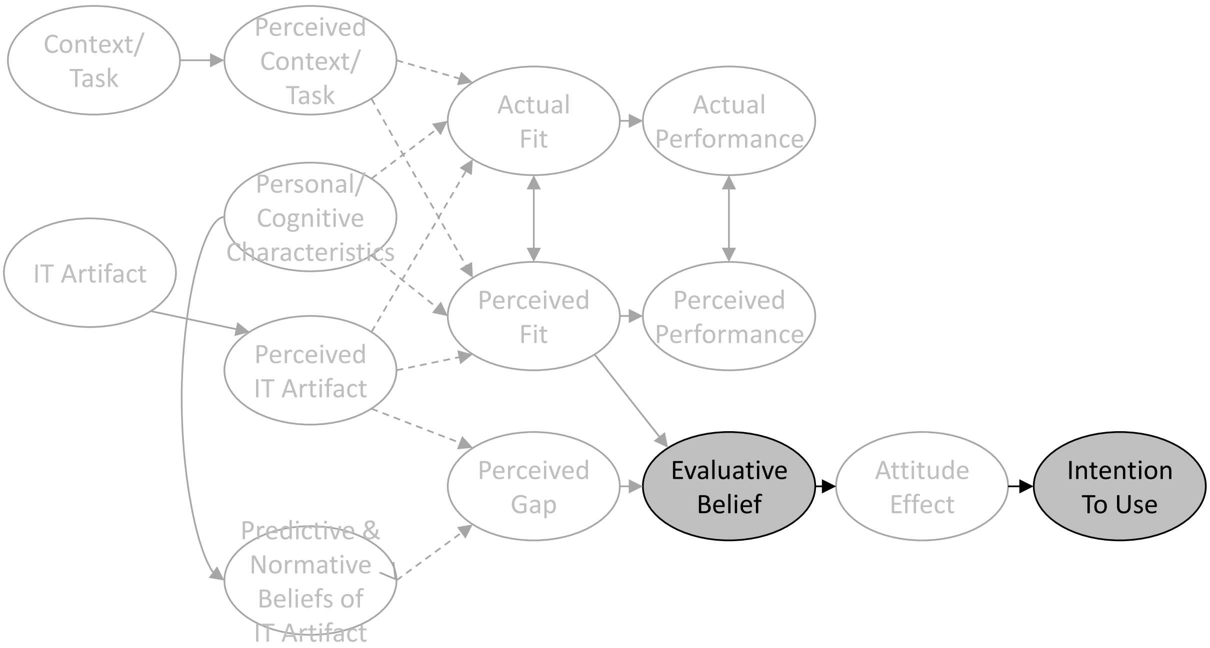

Figure 8: TAM in the Theory Framework

The second example is the Unified Theory of Acceptance and Use of Technology (UTAUT) [7], which uses concepts such as performance expectancy, effort expectancy, social influence, facilitating conditions and a number of personal characteristics. Personal characteristics are instances of our concept "Personal/Cognitive Characteristics". In UTAUT these are moderated by gender, age, experience and voluntariness of use. The latter moderators are however unlike our personal/cognitive characteristics. In fact, Venkatesh et al. (2003) scarcely theorize about these moderators but include them based on previous findings. Hence, we suggest that UTAUT fits in the same part of the framework that TAM does (Figure 8).

Cognitive Fit [8] is defined as "matching representation to task [which] leads to the use of similar, and therefore consistent, problem-solving processes, and hence to the formulation of a consistent mental representation" (p. 221). Cognitive fit is clearly an example of our fit concept, and Vessey examines the performance consequences of this fit. Hence, cognitive fit can be placed on the framework as shown in Figure 9.

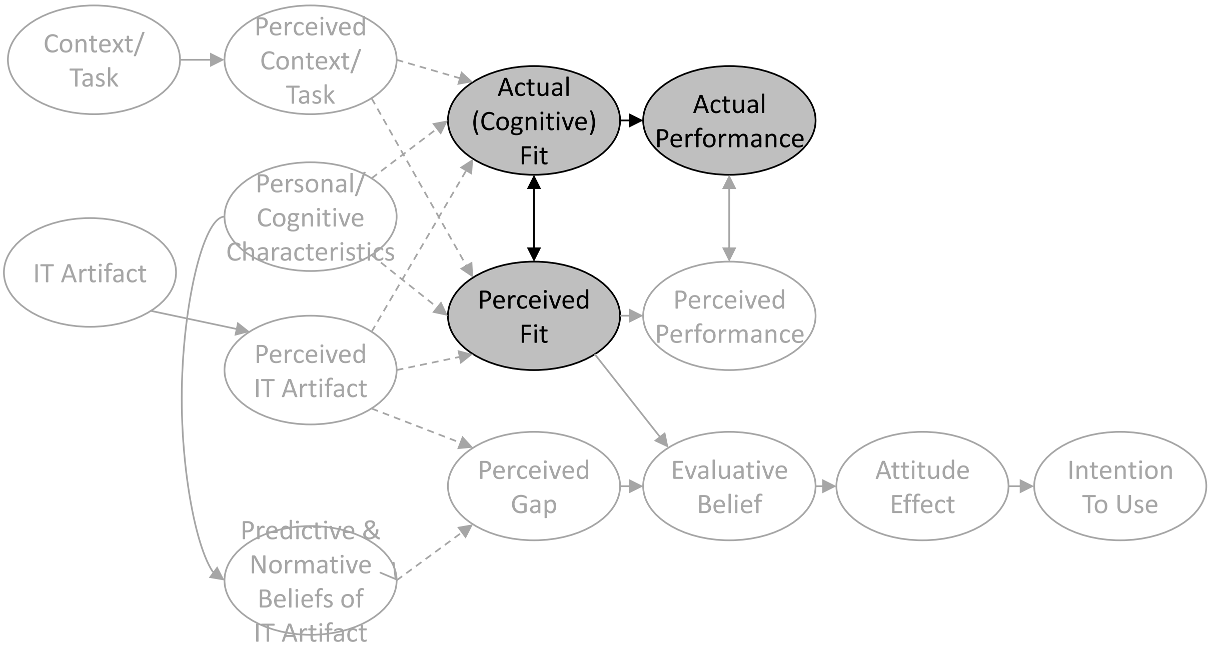

Figure 9: Cognitive Fit in the Theory Framework

Computer self-efficacy [11] is the adaptation of the generic self-efficacy concept to the IS area and is defined as "judgment of one‘s capability to use a computer." (p. 192). We argue that this is the perceived fit of the personal or cognitive characteristics with the task characteristics. The IT artifact is scarcely theorized and is only generically included. Self-efficacy is thus perceived fit, primarily of personal characteristics and perceived task. The self-efficacy is argued to ultimately lead to affect and usage. We show this in Figure 10. As stated earlier in our foundational concepts, the interaction of perceived task and personal characteristics is considered to be outside the scope of information systems research.

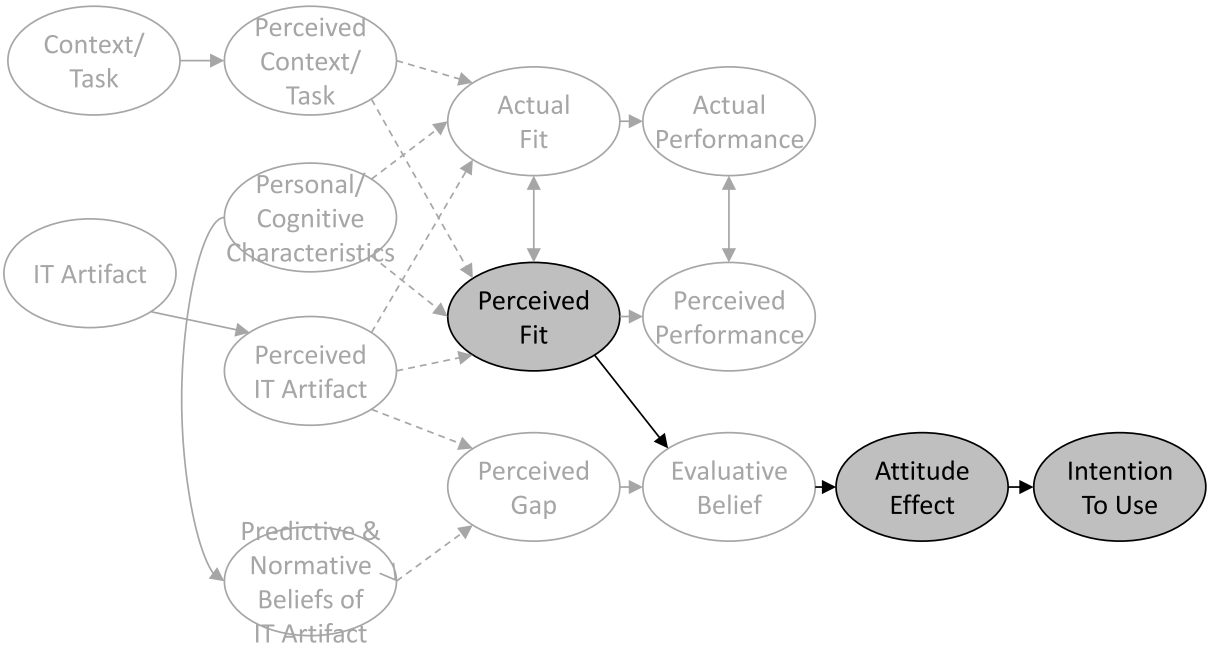

Figure 10: Computer Self-Efficacy in the Theory Framework

Next we turn to Task-Technology-Fit (TTF) theory [3, 4]. As the name implies, this is a theory of perceived fit between the perceptions of a task and the perceptions of a technological capability of an IT artifact. The authors of TTF identify 14 dimensions of this fit, which lead to an evaluative belief about the IT system. Of the prominent IS theories, only Task Technology Fit, which is defined as "the degree to which a technology assists an individual in performing his or her portfolio of tasks" [4] acknowledges that the generic nature of its focal construct needs to be adapted for specific technologies: "To defend these assertions ...and to test them, requires applying the perspective to a specific task domain, at a detailed level." [3]. Based on a process model, 14 specific dimensions of TTF are identified. Figure 11 shows TTF placed on our theory framework.

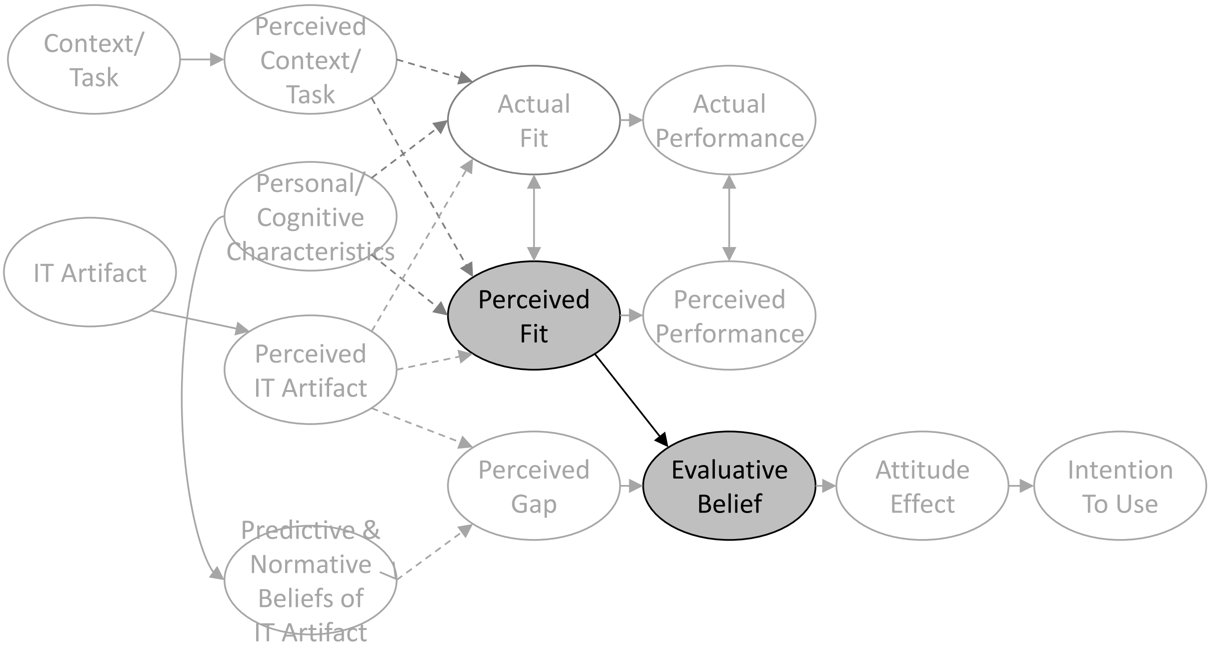

Figure 11: Task-Technology-Fit in the Theory Framework

Finally, we show how service quality can fit into this framework. Service quality originated as a difference concept [41, 67] between expectations and experience. Originally developed for the services industry, it has been adapted to the IS context by Pitt et al.[25] and has led to many debates on its properties. However, the main interest here is that the model fits into our framework as we reify the gap between expectations and perceptions. The service quality literature has few suggestions about the consequences of perceived quality, but it is not unreasonable to assume that evaluative beliefs are formed based on the gap that exists. We note also that service quality is recognized to require more specific adaptation. For example, in the original work [67] ENREF 49 Parasuraman, Zeithaml and Berry measures service quality on 14 dimensions. This was later reduced to five and the dimensionality of the concept remains a point of active debate. Figure 12 shows how service quality fits into our framework.

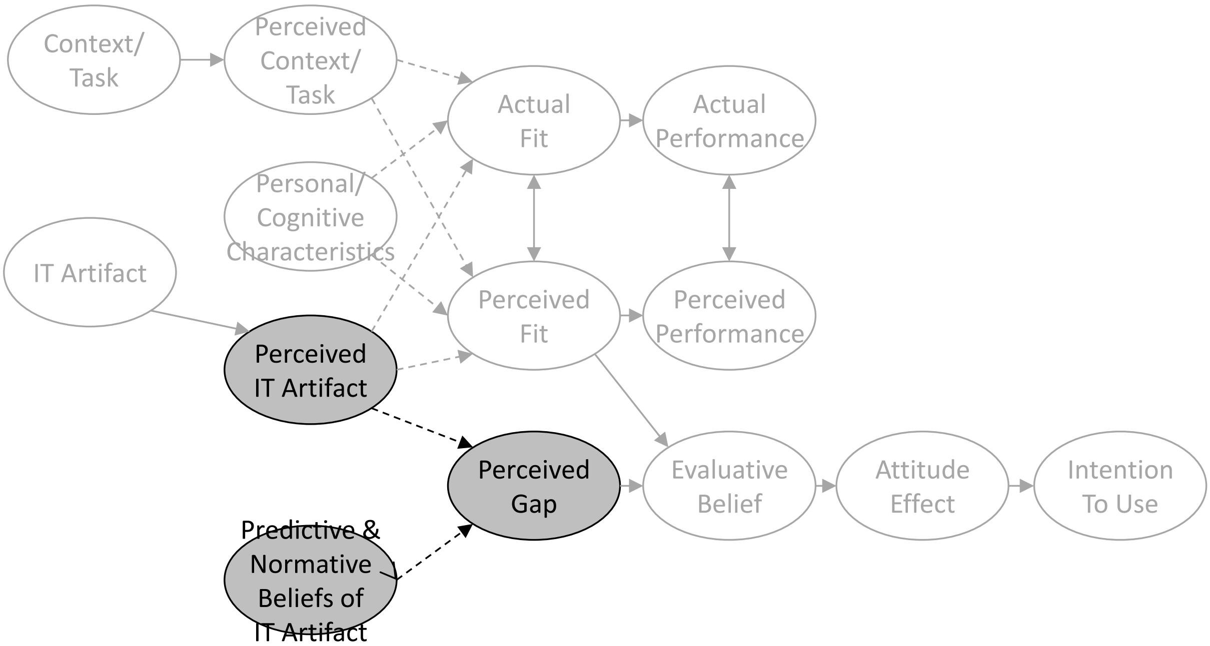

Figure 12: Service quality as an instance of the theory template

To summarize, in this section we have demonstrated that "grand" theories of the individual commonly used in information systems, with foundations in social psychology, can be integrated. We have also demonstrated that these theories are commensurable, i.e. they are not based on inherently contradictory paradigms or assumptions. This is perhaps not surprising given their common foundations. However, this view easily gets lost when IS theories are developed if it is not clear which grand theory they are specializing — the mix and match approach to theory building. Further, the extension and integration of "grand" theories is not always based on consistent principles and assumptions (our "first principles"). For example, both TAM [5] and Self-Efficacy Theory [11] were subsumed under UTAUT. Service quality has also been subsumed into other theories, notably the IS-Success model [40]. Many studies that include ServQual, or some of its dimensions, incorrectly define these as constructs, when they are gap measurements. In the next section, we illustrate how the template may be used to generate new theories.

Using the Framework for New Mid-range Theory Development - An Example

In this section, we present an example of how the theory framework can be used to yield useful, testable mid-range theories for IS researchers that are strongly grounded in existing academic theoretical research, yet provide contemporary and salient insights for practitioners. For this example, we assume the following research question: *How does social network bookmarking on news sites affect user's intentions to continue to use the news site?*

A social networking bookmark (SNB) allows site operators to offer their users an easy way to link to an article or page from their account on a social networking system. Figure 13 shows how this is implemented on the BBC news web site[11]3. With a single click, users can link to

[11] http://news.bbc.co.uk

the article from their Digg, Facebook, and other sites. Typically, this also allows their social network to see what pages or articles the user has read.

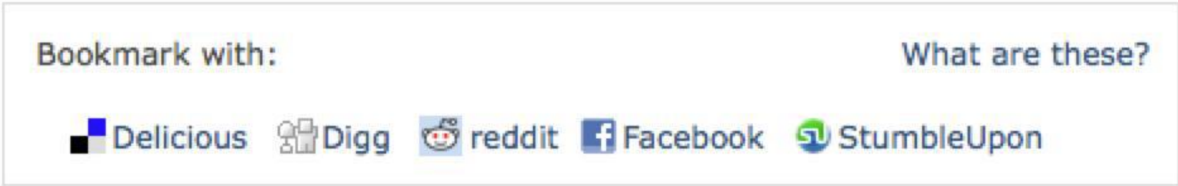

Figure 13: Social network bookmarking on the BBC news site

We now use our theory framework to develop a theory that can help answer the research question. Of course, this theory remains to be tested, which is beyond the scope of this illustration. Again, this is merely an example application of the framework. Application of our framework for new theory generation is based on two principles. First, each element of the framework can be instantiated by multiple specialized constructs (sub-types), for example, the concept 'evaluative beliefs' may be specialized multiple times, yielding different types of evaluative beliefs about multiple properties of an artifact. Second, in addition to specialization by sub-typing of existing elements in the framework, additional antecedents and consequences may be added.

We proceed from left to right through Figure 7, beginning with the IT artifact. To include the IT artifact, we cannot focus merely on the presence or absence of SNB; we must instead identify measurable properties or affordances [12, 68]. We note that the inclusion of perceptions of a task context (using SNB on a news site), and perceptions of salient characteristics of the IT artifact (SNB) in the nomological net have the effect of specializing the theory to a mid-range theory.

Examining SNB functions on different sites, one finds that they differ primarily in the number of social networks they include. The example shown in Figure 13 shows five, but other site operators offer up to a dozen. Other ways in which these differ are the placement of the bookmarks: some sites place them at the top of a page, others towards the bottom of the page, while modern browsers allow them to always float at a given position in the browser. We may, for example, assume that a floating presence is most noticeable, a top placement second most noticeable and a bottom placement least noticeable. Finally, the size of the icons may be manipulated. Thus, we include users' perceptions of the three properties in our example theory: extent of SNB (the number of options available), placement of SNB, and size of SNB. The latter two may contribute independently to a concept we may call visibility. This assumes that what a site lacks in placement can be made up for in increasing the size and vice versa. As a second step, we include a boundary condition of the perceived artifact and its perceived affordances in our example theory. In our example theory, we suggest that a higher visibility of SNB will cause a higher awareness of the extent of SNB by the site user. We suggest this may be influenced by an interaction of the visibility and the extent of SNB presence. Figure 14 shows our theory to this point.

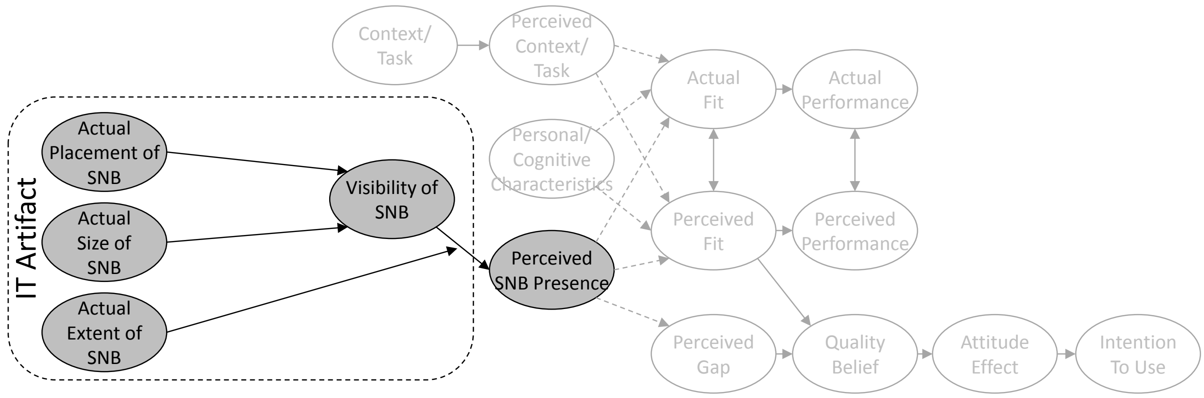

Figure 14: Social network bookmarking theory, stage 1 (new constructs at this stage highlighted, constructs from earlier stages of the model are greyed out).

An alternative to this is to maintain the separation of the three IT artifact characteristics into the perceptual sphere, as shown in Figure 15. Here, the assumption is that the use has three distinct perceptions which all contribute to a perception about SNB presence. Which of these two theories is correct must be decided empirically.

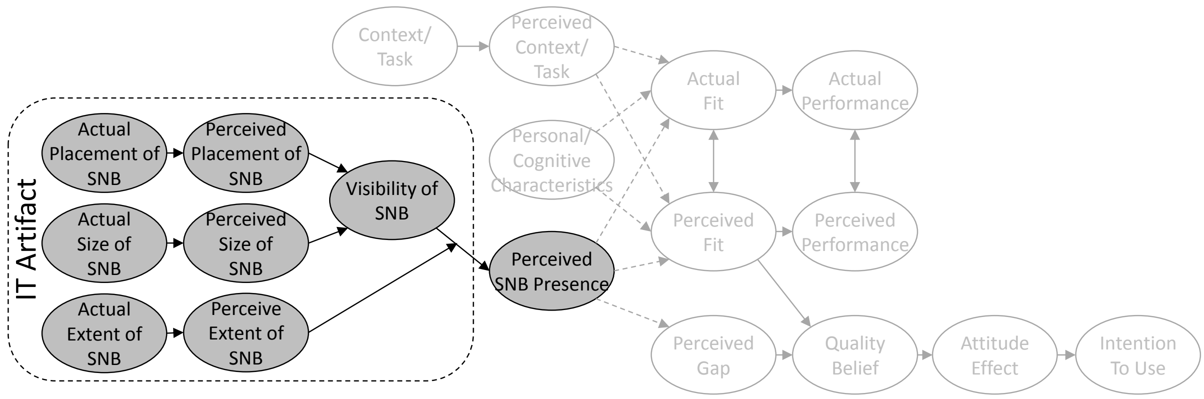

Figure 15: Social network bookmarking theory, stage 1, alternative (new constructs at this stage highlighted, constructs from earlier stages of the model are greyed out).

Next, we add the personal/cognitive characteristics of the user to our example theory, including the user‘s mental model. This may include familiarity with social networking, the extent to which the user wishes to expose her activities to her social network, communication with peers, etc. We do not aim to be exhaustive in our example theory, so we include familiarity with social networking, and the degree of extroversion from personality research. In our example, it is plausible that extroverts react differently to social networks and SNBs than introverts. Both of these concepts are measurable on a continuum and both are perceived measures. At this point, we can either continue to build an example theory around perceived fit (possibly adding task characteristics) or we can proceed with adding predictive and normative beliefs towards an example theory of perceived gap. We choose to do the latter for this illustration and propose that the degree of extroversion causes an increase in normative beliefs about the SNB that should be present on sites. Familiarity with social networks, on the other hand, may contribute to expectations about the presence of SNB that will be provided on sites, i.e. predictive beliefs. The gap model then suggests that two gaps exist. First, there is a gap between the perceived number of SNBs and the expected number of SNBs (a predictive belief). Second, there is another gap between the perceived number of SNBs and the normative beliefs about the number of SNBs. We model both gaps in Figure 15. The gaps are not perceptions, but functions of perceptions, as we pointed out previously. This is also made clear by the fact that we have used dashed lines in Figure 16, indicating not a causal, but a functional connection.

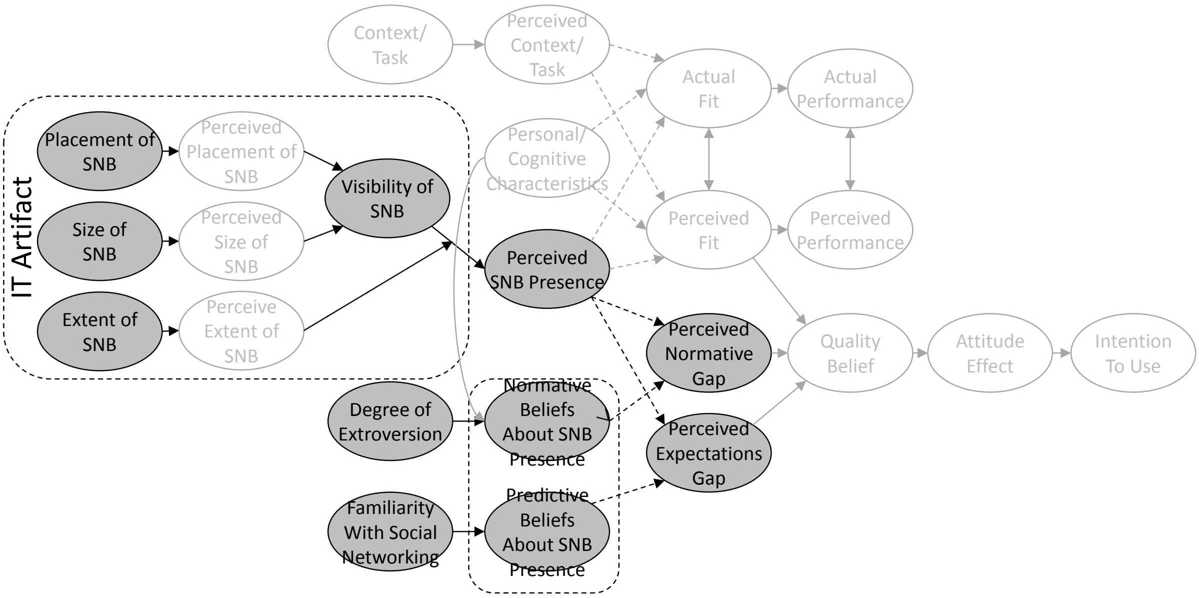

Figure 16: Social network bookmarking theory, stage 2 (new constructs at this stage highlighted, constructs from earlier stages of the model are greyed out).

Finally, we suggest that in our example theory, in accordance with previous gap theories such as expectation disconfirmation or service quality, a larger gap will cause a lower evaluation of the IT artifact. Negative evaluative beliefs will lead to a lowering of affect and a lowering of intentions to use or re-use the IT artifact. We show this in the final model in Figure 17. There are some limitations to this illustrative example. We have labelled the instance of evaluative belief as quality, while realizing that this theory will not be able to explain all of the quality beliefs. First, SNB is but one aspect of an IT artifact, and there are others, which we do not examine in this theory. Second, as can be seen from Figure 7, a second explanation of evaluative beliefs is perceived fit, usually in the context of a given task. As we do not examine tasks, task perceptions, and fit, we expect significantly less than perfect explanation of evaluative beliefs.

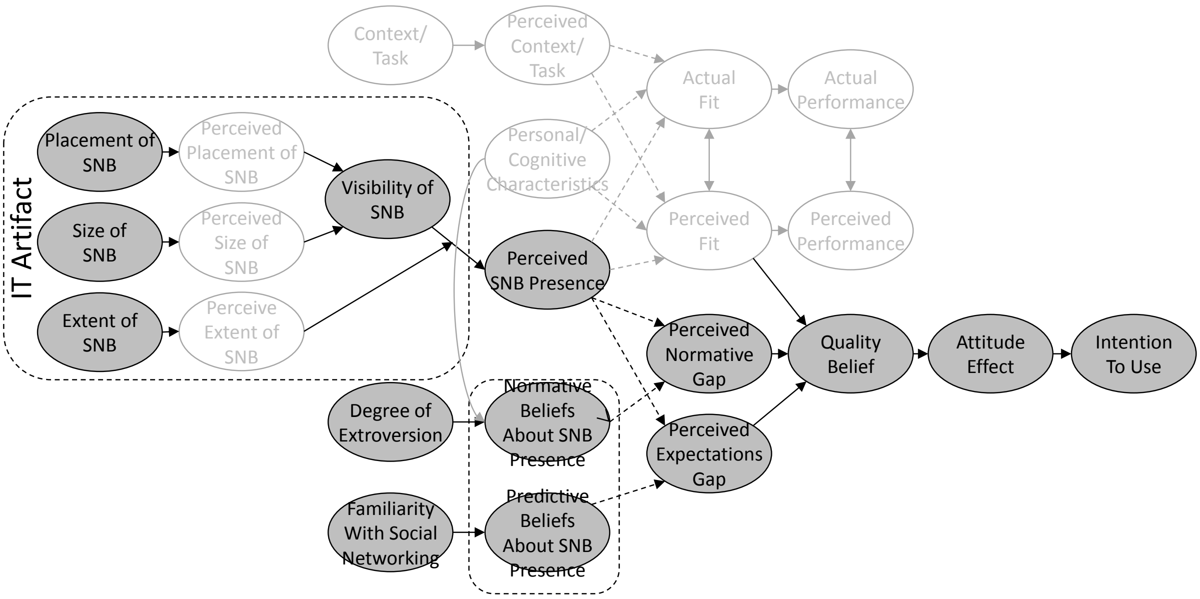

Figure 17: Social network bookmarking theory, stage 3 (new constructs at this stage highlighted, constructs from earlier stages of the model are greyed out).

To clarify the application of our meta-theoretical framework to new theory development, we offer a "marked-up" version of our new SNB theory in Figure 18, showing how it exemplifies construct operationalization, theory specialization, and construct specialization. Note that we have not added a full-set of annotations, in order to maintain the readability of the diagram.

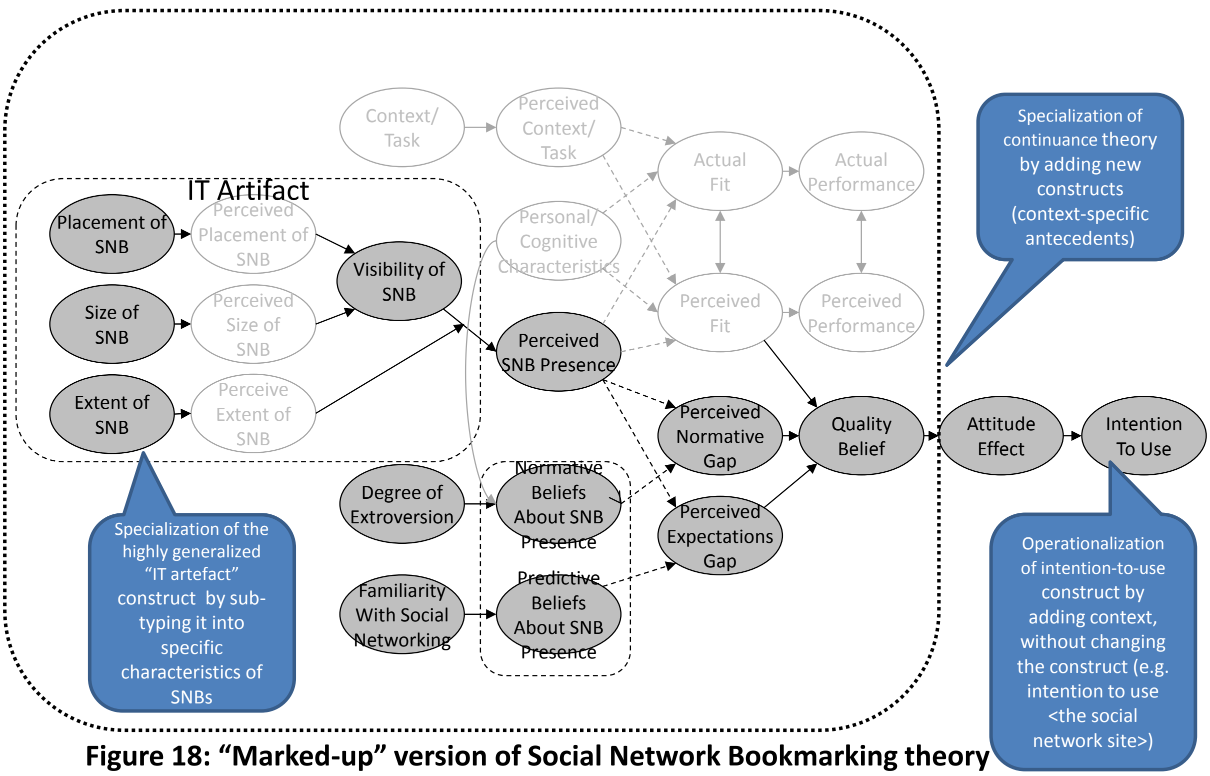

Figure 18: "Marked-up" version of Social Network Bookmarking theory

In summary, this section has demonstrated, through an example application, that the theory framework can guide the creation of new, useful, and specialized IS theories. The resulting theories are focused on characteristics of the IT artifact, and therefore located around IS phenomena of interest (steps 1 and 2, in Table 1, below). In our example, we attempt to explain how SNB features can contribute to usage intentions of a web site. This focus on the IT artifact also makes the theories practically relevant. If supported by data, our theory might tell practitioners that to increase usage intentions they need to increase visibility and extent of SNB functionality, with the visibility being a sum of placement and size of SNBs.

Table 1: Using the integrated framework to develop new theories

Step	Integrated framework construct	Task
1	IT artifact	Identify (possibly multiple) characteristics/properties that are of theoretical interest
2	Context/task	Identify (possibly multiple) characteristics/properties that are of theoretical interest
3	Perceived IT artifact (affordances)	Based on step 1, identify perceptions corresponding to characteristics of the IT artifact
4	Perceived context/task	Based on Step 2, identify individual perceptions corresponding to characteristics of the context/task
5	Predictive and normative beliefs	Identify (possibly multiple) predictive and normative beliefs about the characteristics of the IT artifact (or other phenomenon) identified in Step 1
6	Personal/Cognitive characteristics	Identify characteristics that are of interest
7	Fit **or** Perceived Fit **or** Perceived Gap	Decide whether to proceed with Fit, Perceived Fit, or Perceived Gap model (or multiple of these)
8a	(for a fit model)	Identify (typically one) performance of interest, congruent with the characteristics of the context/task identified in step 2.
8b	(for a gap model)	Identify (possibly multiple) evaluative beliefs
8c	(for a gap model)	Identify (typically one) attitude and intention

Table 1 shows a recommended process when using the theory framework. The process begins with the phenomenon of interest "in the world", typically, for theories of individual attitudes and behaviours towards technology, this will involve identification of characteristics of the IT individual, the artifact and the context/task (Figures 1 and 2). It is here that care must be taken to theorize about the IT artifact and identify interesting characteristics (properties) rather than just examine its presence or absence as a "black box" [12, 68]. The remainder of the theory development is to a large extent guided by the IT characteristics of interest, as Table 1 shows. The intention is for the researcher to decide what characteristics of the IT to focus on and what perceptions or beliefs are relevant and interesting. Following the framework guides the researcher to build theories that include the IT artifact and encourages her to construct theories that are logically consistent with the grand theories and reference disciplines, such as that provided by Fishbein & Ajzen's [57] work, which underlies, as the psychological basis, a host of IS theories and theories in related areas that focus on individual behaviour.

Discussion

In this paper, we have presented an integrated framework of "grand theories" of individual attitudes to IS, that is based to a large extent on well accepted work in psychology, but argued from first principles and applied to an information systems context. In social psychology, perceptions give rise to beliefs, which in turn cause attitudes and behavioural intentions. Our integrated theory framework is structured based on these causal links. We have described this as theory framework, rather than a theory, as it is general and aims to guide the rigorous and consistent development of specialized IS theories. Thus, here is a clear distinction between specific theories with clear boundary conditions, and the general theory framework. While the framework may be comparatively simple, the resulting theories need not be so, as shown in the previous section, due to the fact that each element of the framework may yield multiple specialized constructs of the specialized theory. In fact, we would expect theories not to be as simple as the framework, as the IS domain at the intersection of artifact, human, and task is complex, with a wide range of phenomena to be studied. While we may wish for parsimony in our aim to be easily understood, we do not believe that all of human experience can be explained by a theory with only two or three concepts.

Second, we have shown that theories contain at least two kinds of concepts and two kinds of links. Concepts such as perception and belief can be measured and may, depending on the reader‘s philosophy, be assumed to be real [69]. On the other hand we have concepts that are reified interaction terms, expressed primarily as mathematical functions, such as gaps or fit. Being mathematical functions, we suggest that these may not be real. With the two different kinds of concepts go two kinds of "links" or "arrows" in our theory. The first type are ordinary causal arrows that form the focus of any theory. However, we also introduce a different notation for constructs that are mathematical functions (e.g. gap scores or interaction terms). We urge researchers to closely attend to the distinction between causal relationships and mathematical functional relationships in their theories [65]. As pointed out above, the Task-Technology-Fit model by Goodhue et al. [4] is an example where this distinction has been neglected.

Third, our theory framework makes a clear distinction between individual perceptions and “objective” phenomena “in the world” (assuming we ascribe to this ontological and paradigmatic distinction), which are sometimes conflated [65]. By clarifying the nature of key concepts and relationships in the information systems field, we also hope to contribute to the quality of IS theory by reducing the conflation of concepts that are conceptually distinct. This separation also supports triangulation and mixed-method research, and opens up new opportunities for other techniques, such as experimental studies using neuroscience to analyse actual cognitive responses, or big data analytics to analyse actual behaviour patterns. For example, analysis of actual performance or behaviour using a cloud-based application could be compared with user attitudes and intentions towards the application, to triangulate actual usage data with popular attitudinal theories. Thus, although we have concentrated our discussion on the “left hand side” of attitudinal models, our framework also opens up possibilities for new, mixed-method studies which examine the “right hand side” – the gap between goals/intentions and behaviour. This has also been identified as a significant gap in current TAM-related research [56].

Fourth, we have shown that our integrated theory framework is sufficiently complete to allow us to express existing IS “grand theories” by means of its concepts; showing that these theories are part of the same paradigm, and are commensurable with each other, and provide a framework into which theories of individual attitudes can be sorted. This also supports researchers wishing to extend or combine theory elements, or to develop specialized theories that draw on more than one grand theory, in a way that is systematic, rigorous, and builds towards a cumulative tradition.

Implications and further research

Our paper suggests further areas of debate with regard to the desired nature of theoretical contribution in information systems. For example, if many well-cited IS theories are essentially specializing and operationalizing existing referent theories, does this really constitute a significant theoretical contribution? Have we, as Benbasat and Barki [32] lamented (with regard to TAM, but it is equally applicable to other theories in this discussion) "reinforced our knowledge of the underlying….relationships without substantially extending that knowledge"? We would argue that this is potentially the case, but with an important caveat. This argument would suggest that the only "real" theoretical contribution is an entirely new construct or concept. This is both challenging, and also frequently discouraged, as researchers are encouraged to reuse existing constructs and anchor their work in existing theory. More worryingly, the quest to simultaneously achieve both novelty and reuse has led to a large amount of theoretical confusion. This includes meaning variance in constructs, which results when new "operationalizations" of constructs bear so little relationship to the original that they cannot reasonably be claimed to be the same, and the practice of freely mixing and matching elements of various theories, such that any meaningful accumulation of knowledge is precluded. This has led Dubin [12] to suggest that "social scientists have tended to accumulate theories and theoretical models. ... The behavioural scientist tends to accumulate belief systems and call this the theory of his field" (p. 238).

We suggest that undue emphasis has been placed on the scope of IS theories, with "grand" theories with broad scope privileged over other forms of contribution. As an alternative, we suggest a more pluralistic approach that recognises other forms of contribution. For example, many IS theories have relatively low explanatory power on the dependent variable, with r^2 values of 0.5 or less. We could concentrate on improving the predictive and explanatory power of our theories for bounded, but important and wide-spread phenomena. A theory that could explain and predict a large amount of the variance in the intention to use one mobile platform with specific characteristics rather than a competing platform with different characteristics, based on manipulation of specific design properties of the mobile platform could have a multi-million dollar impact, and represent a significant theoretical contribution. While more specifically focusing on a particular technology, we note that such a contribution is still highly theoretical in nature, as even the particular technologies are abstracted into a set of more general technology characteristics.

A further implication of our study is the possibility of a genuinely cumulative tradition, as an alternative to the large number of overlapping and incommensurate studies that currently exist. One of the reasons that there are relatively few statistical meta-analysis studies in IS is that it is extraordinarily difficult to identify a sufficient range of studies that have used the same constructs and operationalization. Although historically, theories have been difficult to integrate, we anticipate, given adherence to the framework, that in the future such integration will naturally follow. Our framework offers the opportunity for disciplinary progress through meta-analysis of studies. Constructs in previous studies can be mapped to appropriate points in the framework and aggregated using quantitative meta-analysis, or vote counting techniques, depending on the exact nature of the studies selected for inclusion. This opens the possibility for advances in the discipline by aggregating and comparing previously disparate studies.

Our framework opens up a number of possibilities for further research. In particular, we suggest applications of the framework in design science and meta-analysis. According to Hevner et al. [70], design science in information systems aims to solve relevant problems in the environment, which consists of people, organizations and technology. This is achieved by an iterative process of developing and building design theories and artifacts, and justifying and evaluating them. These processes are informed by theoretical foundations and research methods. This closely echoes the call for more mid-range theory that reflects specific characteristics of IS phenomena of interest. Our framework can be used as a theoretical foundation for evaluating a design artifact, where relevant or novel affordances of the design are included in the theory on the "left hand side" as we showed in our illustration.

Another potential area for further research is the development of a richer and more expressive notation for theory modelling. The use of the same notation to represent different types of constructs and the relationships between them may be in a large part to blame for some of the confusion that exists between causal and interaction constructs. Since the development of a new notation was not the major focus of our paper, we have restricted ourselves to visualizing the distinction between causal and interaction constructs. However, future research could build on this paper, and the work of Evermann and Tate [65, 68], Polites et al. [58] and Mackenzie at el., [64], which examine issues in construct operationalization at a detailed level, to guide the development of a more precise theoretical modelling notation.

Conclusion

We have noted that most popular IS theories of individual attitudes towards technology are both poorly integrated and overly broad in scope. We have demonstrated that we can integrate such "grand theories" of attitudes to technology in a logical and consistent way. This integration supports disciplinary progress by allowing the accumulation of knowledge in a consistent manner. We can also use the integrated framework as a basis for developing new theories. A systematic application of our framework leads to discipline-specific mid-range theories in which relevant characteristics of IS phenomena "in the world" (typically an IT artifact and its intersection with individuals and tasks) form the antecedents. Hence, we argue that these theories are relevant to practitioners who are able to affect these characteristics in their practice. Researchers are encouraged to extend their theories into the intersection of technology, humans, and tasks, and thus to ensure that the developed theories that are relevant and useful to practitioners. This ensures that we, as a field, continue doing IT research that matters *and* that builds towards a cumulative tradition.

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