Developing Interfield Nomological Nets

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Abstract

As behavioral research has expanded in Information Systems and other scientific fields, researchers are recognizing that construct proliferation increases the difficulty in identifying the nomological networks of constructs pertaining to any given research question. An Inter-Nomological Network uses semantic analysis to systematically identify, categorize, and predict relationships among the constructs that define the combined cognitive interest of behavioral scientific fields. Researchers can thereby identify concentrations in behavioral research around similar phenomena related to human experiences that transcend field boundaries, and that may in fact have common cognitive underpinnings. Interfield theory development is supported by discovery of nomological relationships between scientific fields. Preliminary results demonstrating confirmatory, exploratory, and interfield research applications are presented.

1. Introduction

As behavioral research has expanded in many fields, researchers are recognizing that multiple scientific fields have an interest in explaining different aspects of the same phenomenon. But at the same time, researchers are realizing that it is impossible to find and incorporate all knowledge about specific constructs, related linguistic concepts, and the nomological nets they form within a single field, much less across academic boundaries. As a consequence, finding and developing theories which transcend the boundaries of academic fields is impeded by our limited ability in construct discovery. This research addresses two related problems; 1) that understanding of the nomological relationships of constructs published in the large volume of behavioral research across fields has become virtually impossible, and 2) that interfield research is currently encumbered by the difficulty of discovering, reconciling and applying numerous conceptually similar constructs from related fields, particularly when the constructs may have different names.

Truly transformational research is more likely to result when researchers step outside their own inherited terminology silos and form collaborative relationships that allow them to investigate intransigent problems in novel ways [4]. The basic units in scientific inquiry have been described in a variety of ways including disciplines, fields, domains, paradigms, and research programs [1]. As a matter of terminology, we adopt the term academic *fields* and for the purpose of this research, we do not distinguish between scientific fields and disciplines nor do we attempt to settle what the proper analysis of the basic units of science. We assert that scientists decide what items to group into a field and assert that theory development across field boundaries can be mutually beneficial. In this research, we consider scientific fields to consist of:

> *"A central problem, a domain of items taken to be facts related to that problem, general explanatory factors and goals providing expectations as to how the problem is to be solved… and concepts, laws and theories which are related to the problem"* [10, p. 44].

This research outlines a new line of inquiry, the Inter-nomological Network (INN) that will enable researchers to systematically identify, categorize, and predict relationships among the constructs that define the combined cognitive interest of behavioral scientific fields. Thus we emphasize the theoretical overlaps and agreements among related fields rather than differences. In addition, the reconciliation of constructs within, and across disciplines, addresses aspects of what Lyytinen [31] refers to as data poverty, which limits the scope and salience of IS research as well as other behavioral fields. The Inter-nomological Network will potentially contribute to breaking down disciplinary barriers as researchers gain a better understanding of the dispersion of

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behavioral constructs and the theoretical discourses formed around them across disciplines.

When Cronbach and Meehl [6] introduced their enormously influential concept of construct validity, the linchpin of the concept was the nomological network, envisioned to serve the dual functions of 1) providing implicit definitions of constructs based on their related constructs, and 2) generating the very design underlying construct validity itself through evaluation of a network of meaning vs. empirical data [3]. The concept of the nomological network also underpins Benbasat and Zmud's [2] argument for an IS core identity and research on IS theorizing [16, 17].

Unfortunately, the nomological network has been considered problematic in regards to validity claims. For example, Lissitz [30] stated that:

"…there are few traces of the nomological network idea in current validity theory [20, 35]. However, it is an interesting historical fact that even though the core of their theory was defective from the outset, several peripheral aspects of their theory actually did survive, and in fact, are largely constitutive of the construct validity doctrine as it exists today" (p. 137).

This current research is founded on the belief that nomological networks provide a foundation for consolidating and comparing theories within and among fields. The difficulty in comparing nomological nets arises due to construct proliferation during which items and constructs measuring the same phenomenon are given different names.

Our solution to this hurdle lies in the recognition of the linguistic structure of a majority of behavioral constructs. Because the human subject must determine the semantic meaning of the questionnaire items in a construct, similarity among items and constructs becomes accessible through computational content analysis techniques [18, 24, 29]. One such technique, Latent Semantic Analysis (LSA), is based on a belief that "strings of words must somehow be able to represent and convey both verdical and hypothetical information about our inner and outer worlds; otherwise, language would not be very useful" [24, p. 7]. LSA works for a number of tasks, including document retrieval, thesauri construction, inter-language translation, essay grading, text summarization, video summarization, and knowledge clustering and extraction [29]. In a number of studies, LSA's ability to extract latent meaning in language has been found to approach, and even outperform humans in tasks such as, paragraph-to-paragraph coherence, evaluation of student knowledge, language translation, and high-school standardized tests [21, 24].

LSA starts by using a sufficient sample of domain literature and creating a very sparse term-document matrix containing a weighted count of how many times a word (term) *i* appears inside a document *j*. After appropriate preparation (weighting, normalization, etc.), this matrix is decomposed using Singular Value Decomposition (SVD), a mathematical algorithm similar to a factor analysis, with the result being a *semantic space* in which every word and every document is represented by dense vectors. In LSA, two or more external texts are projected into the existing semantic space and focus is on the cosines between those texts. In LSI, an external text (or a query) is projected into the existing semantic space, and the most similar documents that went into the creation of the semantic space are retrieved in search-engine fashion.

Two problems stand in the way of using LSA as the theory of meaning required to implement Cronbach & Meehl's [6] nomological network idea. First, LSA requires a semantic space, the "engine" of LSA within which language understanding is embedded, that can understand the complexities of behavioral research.

No such semantic space exists. Second, because the nomological network must work at the construct level and the construct measurement item level, texts related to these levels should be used to create the aforementioned semantic space. However, LSA semantic spaces based on short text units are known not to have the synonymy and polysemy detection features common in other semantic spaces [37].

We introduce the Inter-Nomological Network (INN) as a reproducible approach to creating nomological networks for any behavioral science field.

1.1. Exemplar: Discovering construct items

Constructs are unobservable theoretical entities containing specific human experiences which underlie observed measurements [9]. The meaning of the construct is represented to the subject in the form of the set of words in the measurement items. Therefore analysis of semantics provides a method to compare constructs within and between disciplines. Construct measures must be interpreted in the context of their immediate nomological network, not by individuals, but by the larger community of researchers [8, 7]. However, constructs measuring identical categories of human experience exist across different fields, making discovery and mapping of nomological nets difficult, because both disciplines and subgroups within disciplines adopt different construct terminologies and names for constructs. New findings in one subfield are often unnoticed and do not translate into changes in other subfields [8]. For example, Larsen [26] found 19 differently named versions of the ease of use construct in the adoption literature alone. Only by collecting, reconciling, and validating these constructs can researchers understand the current bodies of knowledge in their fields as well as how these bodies of knowledge relate to other fields. To understand the constructs, we must understand the inter-construct relationships. Currently, the scientific community has no available tool to enable the collaboration and validation necessary to accomplish such a task.

Therefore, we propose an Inter-Nomological Network (INN) analytic tool, grounded in the Latent Semantic Analysis technique, to support discovery and mapping of nomological nets.

Within the IS field, application of the INN analytic technique to a sample of the literature pertaining to quantitative studies such as Diffusion of Innovation [38] or Technology Acceptance [12, 44], would provide probabilities of instances in which multiple constructs with different names measure the same latent construct. The INN tool would verify semantic similarities among specific constructs. The construct synonymy probability is evaluated based on a comparison of the text of the items in each construct.

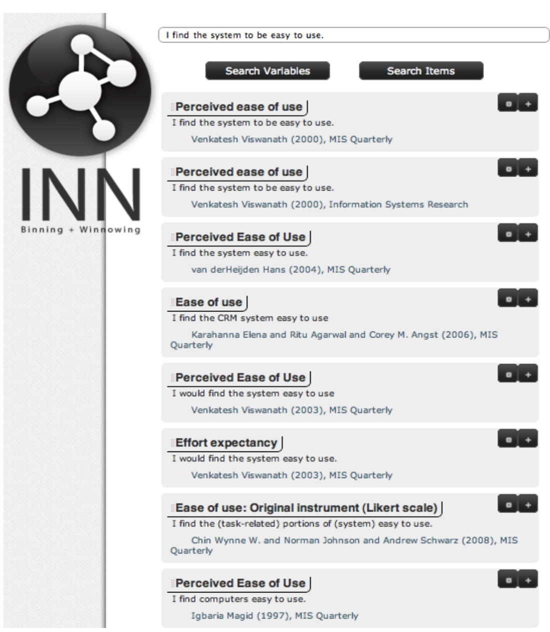

Figure 1. INN Search for *ease of use* item.

As a simple example, a pilot version of the INN was queried for a construct measurement item "I find the system to be easy to use" (Figure 1). While this example does not take full advantage of the INN construct synonymy probability features of INN, it provides the information available to a casual user, showing that the system transformed the query item into a high-dimensional vector and examined other item vectors in the system to retrieve the items most similar to the focal item.

While Figure 1 displays only the first eight items, items that could be found through keyword search for "ease" and "use," an examination of the first 40 items returned many items without those words. Of these 40 items, 27 items belonged to *ease of use* scales with names ranging from *ease of use, ease of use and training,* and *effort expectancy.* As expected, a decrease in synonymy probability is accompanied by fewer synonymous items. The remaining 13 items were related, but not synonymous. Some items were arguably identical or close to *ease of use* items even though they did not belong to *ease of use* constructs. Two *user information satisfaction* items, including "the system is easy to use" [41] were found, along with one *perceived website quality* item: "On this site, it was easy to find the information I wanted" [34]. Then some items related to *ease of use*, though not synonymous were proposed; two identical *affect* items from different articles: "Once I start working on the system, find it hard to stop" [44]. Two *perceived enjoyment* items such as "I find using the system to be enjoyable [5, 44], and finally, a *social factors* construct [44], a *facilitating conditions* construct [43], and two *usefulness* constructs [19, 22]. In all, the retrieved items all are all salient to *ease of use*, and carried different types of relationships with this focal construct.

2. An Analytic Approach: Stored Latent Semantic Analysis (S-LSA)

The theory of the INN tool is embedded in Latent Semantic Analysis (LSA). Automatic text analysis, including LSA, provides an approach to comprehending the dispersion of constructs within and among disciplines, and could potentially transform our understanding of a body of academic literature that is growing faster than human ability to comprehend. Text mining can handle large datasets and excels at providing reproducible similarities and linkages among constructs. LSA is a well-documented computational text mining technique to extract semantic meaning from text units [24, 27, 40]. LSA and similar semantic analytic techniques view meaning as "almost entirely the relations that are represented and activated by words and collections of words" [24 p 8]. LSA does not provide a 'better' technique for extracting meaning from text units; rather it provides a rigorous, reproducible, and largely automatic method for comparing meaning in large text-based datasets, making it an ideal technique for discerning cross-disciplinary inter-construct relationships.

Our preliminary research has extended LSA to examine a wide range of sizes of text units (e.g. construct measurement items) with the INN tool. By linking constructs based on their linguistic similarity, researchers can map a nomological network of the constructs within and across disciplines. These mappings will also reveal construct relationships and the theoretical or conceptual frameworks in which they are embedded.

In other contexts and fields, the INN will reveal areas marked by heavier density of relationships, which might contain constructs related to shared human experiences that transcend field boundaries and that may, in fact, have common cognitive or epistemic underpinnings. Identifying this interfield network of constructs will further our understanding of human behavior itself. For example, use of our INN pilot version finds that the *trust* construct exists in IS, psychology, education, and nursing, four disciplines currently sampled for the INN, with the first occurrence of a trust-like construct in nursing being *social capital* which was partially defined based on "shared values, trust, mutual support, and reciprocity among people" [23, p. 217] followed by the variable *hostile mood*: *suspicious/paranoid* [39], arguably an antonym for trust.

Analogously, chemistry faced the same problem 140 years ago. Scientists attempting to understand the physical and chemical properties of elements and chemical compounds were faced with a mountain of seemingly unconnected concepts and facts [42]. The solution was Mendeleev's Periodic Table of Elements, which simultaneously classified elements and predicted the properties of missing elements. The behavioral sciences now exist in a "pre-Mendeleev" era, where true interfield research is impossible. To link behavioral constructs both within and between fields, Cronbach and Meehl's [6] nomological network idea is needed more than ever. An implementation of a nomological network should decrease the cognitive load on behavioral scientists and expand access to the numerous constructs already devised and studied, thereby reducing reinvention and allowing the field to advance realistic solutions for child and adolescent obesity prevention. The ability to effectively structure existing construct knowledge and automatically examine construct relationships is crucial to introducing real behavior change.

This line of inquiry has broad implication within IS and outside the traditional boundaries of IS. sLSA represents a new technique for identifying concepts and semantically overlapping behavioral constructs compared to approaches currently used by IS researchers. Within IS, an inter-nomological network will aid in understanding densely researched areas of IS and related disciplines which contain numerous synonymous but differently names constructs and in locating under-researched interstices that may be fruitful research areas. In addition to proposing a new approach to construct validation and integration, this project will make unprecedented amounts of theoretical information available to our contemporaries, and will facilitate interfield theory development in the behavioral sciences.

3. INN Method

Using LSA as a theory of meaning that would allow its use on constructs and construct measurement items requires solutions to two problems: First, no LSA semantic space currently exists that could serve as the theory of meaning required to develop a nomological network. Second, construct measurement items are too short to provide the text needed to build up that network of meaning. We solve the problems through a two-step process. In the first step any paper selected for inclusion in the inter-nomological network is parsed, and every paragraph in the paper used as the input into the LSA creation of a semantic space. Step two: text representing construct measurement items (statements or questions) and constructs (name, definition, and measurement items) are "projected" into that semantic space, and the n-dimensional vector for each item, which in the process has been imbued with deeper meaning, is stored in the INN database.

In our use of LSA, all paragraphs of text from selected behavioral papers (those appearing in high impact research journals that contain at least one behavioral construct) are analyzed to create a semantic space (Steps 1-4 in Figure 2), into which related texts or specific construct may be projected. Because our focus is on constructs and their measurement items, these are projected into the semantic space, but stored as a separate semantic space that is used for analysis among the constructs. The approach enables small texts to be represented by rich semantic vectors and stored for future retrieval and analysis. When creating the meta-semantic space, INN projects each construct measurement item into the semantic space as a pseudo-document [13], and stores its high-dimensionality vector into a new meta-semantic space consisting exclusively of construct measurement vectors (step 5 in Figure 2). For each meta-semantic space, precision and recall measures are calculated to detect the objectively best meta-semantic space. For each measurement item, the INN Validation system examines its own success in retrieving other items from the same scale (step 6 in Figure 2). These vectors are the INN's mathematical representation of the constructs. Relationships between constructs are then examined by calculating the cosines (as a relation of similarity) between projected target constructs and other constructs within the meta-semantic space (Step 7 in Figure 2). Larsen and Monarchi [29] summarize the mathematical approach used in the application of LSA to develop the INN.

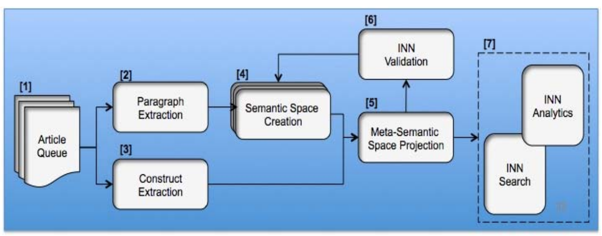

Figure 2. High level INN architecture

The INN core is based in the LSA method and enables similarity detection across behavioral constructs. The underlying idea of LSA is that the aggregate of all the word contexts, in which a given word does and does not appear, provides a set of constraints that determines the similarity of meaning of words and sets of words [24]. Thus, when two terms occur in contexts of similar meaning – even in cases where they never occur in the same passage – LSA represents them as having similar meaning. LSA theory concerns itself with the transformation of words and passages into meaning. This method of analyzing texts using relatively simple mathematical techniques can yield conclusions comparable to those of human experts, in a time- and resource-efficient manner [24]. In fact, research has found that LSA can perform some meaning-based tasks as well as humans, and LSA has been found to capture up to 90% of the agreement human experts share among themselves [25].

In this research we describe the preliminary results of LSA use to examine texts ranging from single words up to sentence level texts that function as construct measurement items. In creating the semantic spaces for LSA, paragraph-level texts or larger are first necessary for proper synonymy and polysemy detection. Once a proper semantic space has been created, LSA has been shown to work for analysis of text units from document-size down to word-size.

4.1. Challenges to Nomological Networks: Synonymy and Polysemy

Synonymy (differently named identical constructs) and polysemy (identically named dissimilar constructs) problems are rampant because different people are less than 20% likely to express the same idea using the same words [29]. For instance, Larsen [28] found that in one research area, 83 construct categories were measured using 948 different scales, and a high proportion of the research papers employing these constructs did not build on the existing similar scales but rather relied on creating new ones. In fact, our own examination of preliminary data found that of 11,505 constructs collected from seven journals (one each in psychology, business, two in education, and three in nursing), 9,400 uniquely named constructs existed, and of these 8,670 (92%) were used only once, and 9,112 (97%) were used only once or twice. This suggests that a large proportion of research is likely to recreate existing scales under new names, and in all likelihood, unknowingly replicate existing research under the auspices of novel research.

5. Interfield Theory Development

Phenomena involving information technologies and the information accessed via technologies are the subject of study in many disciplines. Importantly, many of the phenomena and objects of study in IS are also of concern in other disciplines. Readily visible examples include the adoption of technology, the effect of information on decision-making, the ability of information to alter consumer choice and behavior, and the increase in comprehension from spatial information. Although the institutional, structural and epistemic differences among multi/ inter/ and transdisciplinary research endeavors are interesting and potentially fruitful avenues of research, this research highlights the potential for development of interfield theory [10].

Interfield theories bridge two fields of science and are "likely to be generated when two fields share an interest in explaining different aspects of the same phenomenon and when background knowledge already exists relating the two fields" [10, p. 43].

Interfield theories make the relationships between fields explicit and several types have been identified. In addition to identification of causal linkages and specification of physical location and physical nature of entities or processes identified in another field [10], we assert that interfield theories may be generated based on the overlap of nomological networks between fields which have developed constructs to measure observables related to a phenomenon held in common.

We now provide an example which demonstrates the efficacy of the INN in identifying synonymous constructs in nomological networks derived from the same base theory. We then present an example of the future potential of the INN in advancing our comprehension of human health protective behavior.

5.1 INN tool: A confirmation example

Behavioral research relies on a set of constructs that are sometimes specific to the domain of inquiry. Other constructs reliably cross domains and learning about their nomological networks can distinctly improve the knowledge base of a discipline. *Social influence* is a construct of interest to almost all behavioral disciplines due to the emergence of social media, and research on the construct proliferates in multiple fields. A researcher interested in constructs relationship to other human behaviors will find more than 140,000 articles containing the words in that specific order in Google Scholar, with little ability to examine which other constructs have been evaluated against social influence, even should the researcher have encyclopedic knowledge of all synonymous construct names. Research in the social sciences is now being characterized as theoretically scattered, fragmented, and chaotic [32]. Only within small research "silos" are researchers aware of a small proportion of existing research that is directly applicable to their own, often research that extends the same theory or cites a related theory. For example, a researcher interested in obesity might have no trouble finding psychological literature on outcome expectancies related to exercise avoidance, but might be unaware of a separate nursing literature on illness uncertainty that relates to a similar question.

Our preliminary pilot work clearly demonstrates the method's efficacy in detecting similar constructs from different disciplines to be related and different constructs from the same discipline to be unrelated. Assuming that an average paper contains five constructs, means that, slightly simplified, based on combinatorics the average paper can extend our knowledge by no more than ten relationship hypotheses. Because a priori no two constructs can be assumed to be identical, a corpus of 10,000 papers utilizing psychometric approaches to measure constructs related to health behavioral science will contain about 50,000 constructs and a maximum of 100,000 tested hypotheses. By contrast, without any method for combining identical constructs, there are over one billion untested relationships in this same body of literature. While the majority of these relationships will be nil, knowing which are not will be invaluable. Paradoxically, paper number 10,001 also containing five constructs will test no more than 10 hypotheses (for a maximum of 100,010) whereas the number of unknown relationships will increase by 250,000, leading to what we term the behavioral sciences' "Reverse Progress Problem." Essentially the "universe" of potential knowledge grows faster than all the researchers in the world can keep up with, and adding more researchers only increases the problem. This problem is directly traceable to the lacking availability of Cronbach and Meehl's [6] nomological network idea.

As a test of the pilot tool, the construct *social influence* was used in a similarity search to discover a large set of similar variables in the IS literature. When searching INN, a researcher starts with a keyword search for construct names they know, in this case bringing up a set of social influence variables from IS, found based on the definition and measurement items. We next selected a construct *subjective norm,* identified to be similar to *social influence*, and use the LSA similarity feature (Figure 3). This returns the constructs *subjective norms*, *social factors*, *peer influence, supervisor influence,* and *peer influence* to list a few that appear in research in the fields of education, health education, management, nursing, psychology and IS.

The search result (Figure 3) is as expected and serves to confirm the capability of the INN tool, as a predominance of this research cites the psychological Theory of Planned Behavior (TPB) [15] as the foundational model. Thus the constructs in the nomological nets of these studies are similar. In this case, IS has developed the nomological network surrounding *subjective norms* to a greater degree than other fields demonstrating an opportunity for constructs in the TPB nomological net in IS to be added to models and tested in other fields.

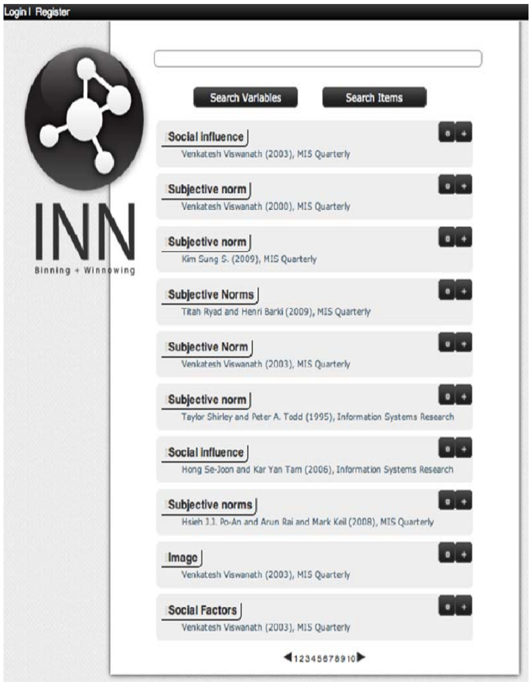

Figure 3. Construct similarity for *social influence*

We next provide two examples of the potential for use of INN for interfield theory development.

5.2 Development of Interfield nomological networks

Researchers' current ability to study health behaviors is limited by the lack of tools for evaluating the many studies already conducted on these behaviors and using these prior studies to predict outcomes. As an example of the potential for future development of interfield theory, we first examine human behavior in the context of development of childhood and adolescent obesity through a common construct and nomological net.

Having tripled since 1980, obesity is a serious problem among U.S. and Australian children and adolescents [36]. This problem does not end in childhood. 79% of people who were overweight at aged 10–14 years are obese adults at age 21-29 [47]. This epidemic will have long-lasting health consequences, including increased prevalence of heart disease, type II diabetes, cancer, and hypertension. Work on theories of health protective behavior holds the potential to improve our knowledge and to increase our ability to reduce obesity in the U.S. population. However, such research is mired in unintended replication and non-communication among researchers. For example, Weinstein [46] worked to integrate four theories of health protective behavior; the health belief model, the subjective expected utility theory, protection motivation theory, and the theory of reasoned action. He argued that while many reviews of theories of health protective behavior exist, these generally overlook similarities among theories. For example, he found that the four theories approached expected aversiveness of outcome using constructs like *perceived severity, negative utility*, and *negative evaluation*, where "the questions used to assess these terms are essentially indistinguishable from one theory to another" [46, p. 325]. Other variables were also held in common among the theories, such as perceived likelihood of a negative outcome, which were named *perceived vulnerability*, *perceived susceptibility*, subjective *probability*, and *expectancy*, again measured with questions or statements that were interchangeable. In the case where theory X contains construct C and theory Y contains construct C', where C' is synonymous to construct C, any discovery related to the nomological network of C' should transfer to C and vice versa. However, in practice, this transfer happens only by exception. Still, decades after Cronbach and Meehl's [6] discussion of such approaches, correlations and factor analysis represent the only methods to evaluate the synonymy of constructs. A tangible network of relationships among constructs that enable immediate examination of a construct's nomological network [8, 7], will also enable easier comparison of nomological networks within these theories. Expanding on Cronbach and Meehl's [6] thinking, we believe that once an extensive nomological network is explicated, synonymy becomes almost obvious based on measurement language as well as similarity of network ties.

Once completed, application of the INN to the constructs of the four theories identified by Weinstein, may reveal similarities to constructs in other fields (e.g. the well developed Technology Acceptance Model [11, 44] based on the TPB [15]. As semantic similarities among constructs are identified, research to test a consolidated/expanded theory can be undertaken to gain a better understanding of health protective behavior.

To examine the INN's potential for knowledge transfer between fields, we examined a small sample of articles related to mammography use intention that applied the Theory of Planned Behavior. The network in Figure 4 shows the hypothesized relationships between variables that appeared in six articles. The references in the figure are listed separately in Appendix A.

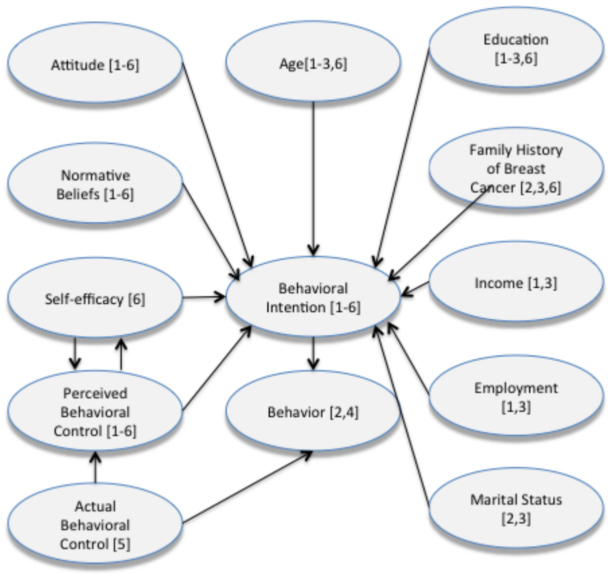

Figure 4. Mammography Use Nomological Network

If these articles had been added to the INN, the authors of these studies would have had access to hundreds of relevant IS articles that may have significantly simplified their work in developing theoretical frameworks. For example, all six studies included the construct *attitude*, a construct that Venkatesh et al. (2003) showed not to be important when their set of four independent constructs were included. *Self-efficacy* was also considered by Venkatesh et al. [44] and rejected. Access to an INN would also suggest the idea that the *effort expectancy* and *outcome expectancy* related to mammography intention might increase predictive ability. A fully developed INN would likely have changed all of these six articles. In turn, testing of constructs in the mammography context would have informed the external validity and generalizability of UTAUT and allowed expansion of the model in regards to the effect of information on behavior. While this example is consciously selected to be obvious, the literature is full of cases where only an automated tool would enable researchers to detect interfield overlaps.

6. Discussion

This research provides contributions in two areas, First, it makes a case for the importance of solving a 55 year old problem in psychology, the question of how to create nomological networks. A solution to this problem could, within a decade, transform over a dozen fields that rely on psychometric methods and build a solid interfield knowledge base that will improve knowledge about human decision making in all aspects of life. Until this problem has been solved, which Cronbach [8] so strongly believed it could, "neither the idea of implicit definition of constructs nor the idea of construct validity itself can be formulated in the absence of a theory that relates the construct to other constructs" [3, p. 1064]. The Inter-Nomological Network, building on the solid theory of meaning embedded in LSA, provides an opportunity to address the implicit network definition concept as well as the larger original concept of construct validity as formulated by Cronbach and Meehl [6].

Only by collecting, reconciling, and validating theoretical constructs can researchers understand the current state of knowledge in their fields. To understand the constructs, we must understand the inter-construct relationships. We believe that the INN infrastructure will reduce construct fragmentation by enabling consolidation of synonymous constructs within, and between fields. Mapping of the nomological networks within IS research will lead to new research questions as untested construct relationships become evident.

As behavioral constructs from other fields are added, the INN will also reveal interfield areas marked by heavier density of relationships, which might contain constructs related to shared human experiences that transcend field boundaries, and that may in fact have common cognitive underpinnings. These construct relationships may provide the foundation for the development of interfield theories. For the purpose of construct comparison, the INN has no upper bounds meaning that the eventual breadth of constructs in the INN will provide unprecedented search capability for behavioral constructs both within and among fields. We assert that as the INN is populated, the nomological nets surrounding behaviors of interest will support interfield theories which transcend academic boundaries and reveal structures and processes which are obscured by the artificial constraint of institutional disciplinarity.

Interfield research is difficult for a wide variety of reasons including institutional barriers, need for expertise in multiple fields and different research evaluation criteria. But the INN provides the potential for a foundational network of construct relationships which spans academic boundaries. Historically, IS research has emphasized the adoption, management, impact, or design of artifacts or socio-technical systems. But information systems are always a combination of technologies and some context, whether that is business, medicine, government or another domain. The idea that research on information systems is always contextualized in a domain indicates that IS research can be framed as an interfield endeavor. The role of information itself [33] and the influence of information on behavioral change, decision making, the attachment of meaning to process and artifacts and a host of other areas are fundamental object of inquiry for IS researchers. Interfield theory development seeks to determine what theoretical constructs and principles in one domain (e.g business or psychology) are present another domain (e.g. sustainability studies or ecology) and can be used to develop theory which transcends the institutional disciplinary boundary. Both of the examples of the role of information in behavioral change illustrated here is of particular interest in marketing, e-government, cognitive science, Neuro-IS [14] decision studies, sustainability [45], and medicine and suggests that construct identification and subsequent expansion of nomological nets has the potential to strengthen research. Each of these domains, and many others, represent domains where interfield theory will advance knowledge by transcending historical but socially constructed boundaries and revealing structures and relationships which underlie fundamental human phenomena.

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Appendix A: References for Figure 3.

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