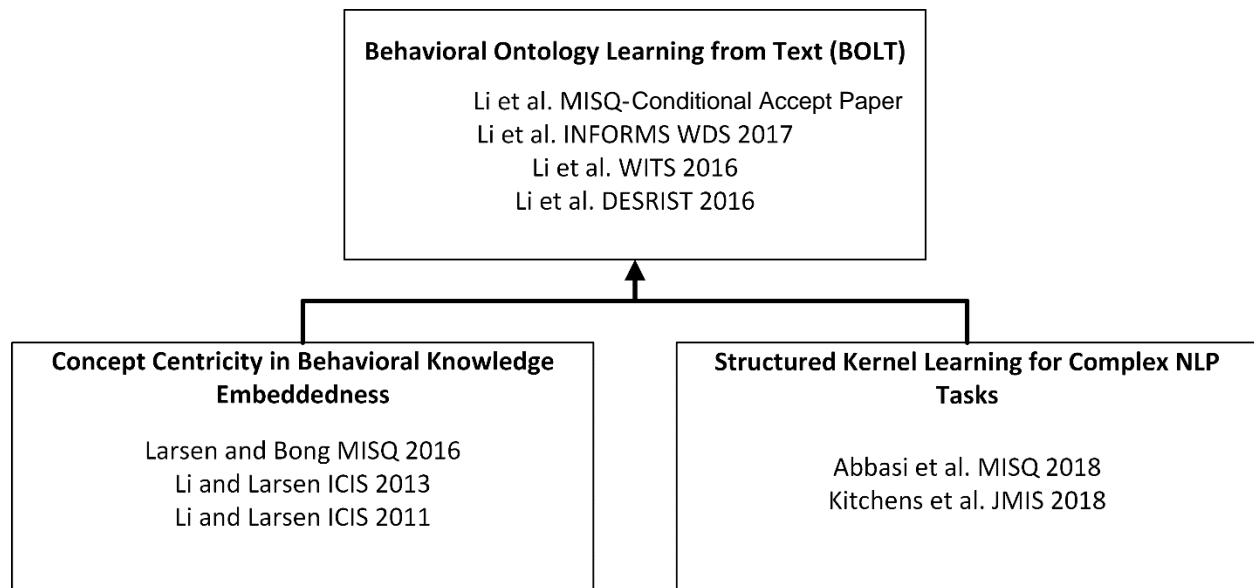




## TheoryOn: A Design Framework and System for Behavioral Ontology Learning from Text

### Summary

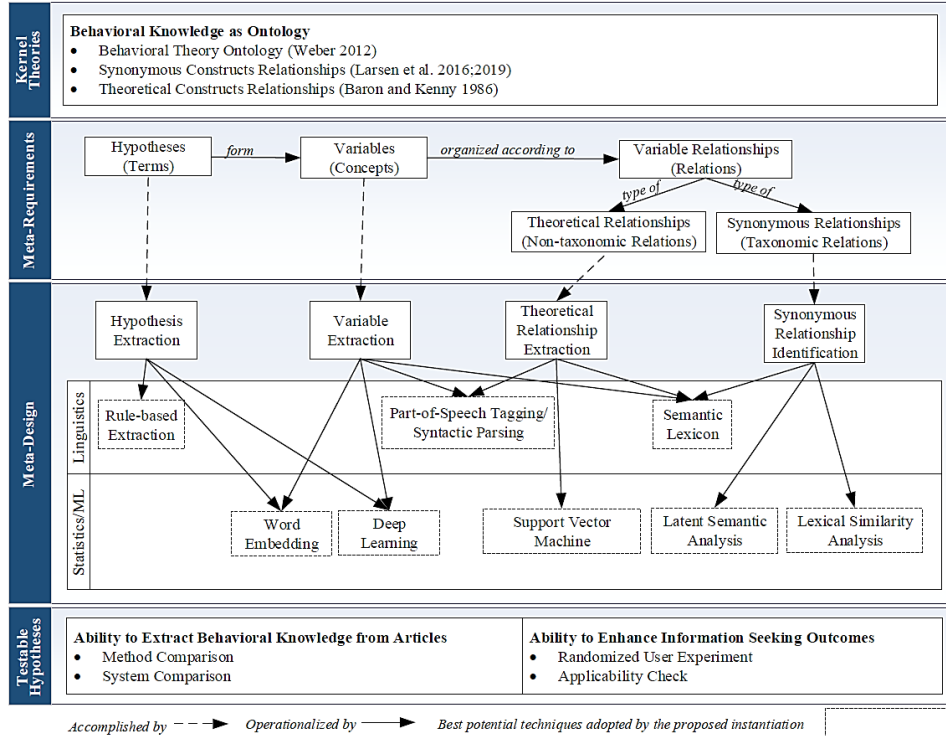
The accumulated literature base in behavioral sciences has grown beyond human comprehension, resulting in a knowledge inaccessibility problem. Studies have shown that behavioral researchers are typically able to access less than 10% of articles relevant to their theoretical lens employed. This problem has several implications, including literature fragmentation, inability to build cumulative traditions, inefficiencies in research processes, and the resulting social and monetary costs. The TheoryOn project developed a novel design framework and instantiation to unlock behavioral knowledge embedded in large-scale research articles. Figure 1 presents an overview of the key design science research thrusts related to our project.



**Figure 1:** The Nominees’ Design Science Research Related to Behavioral Ontology Learning from Text (BOLT)

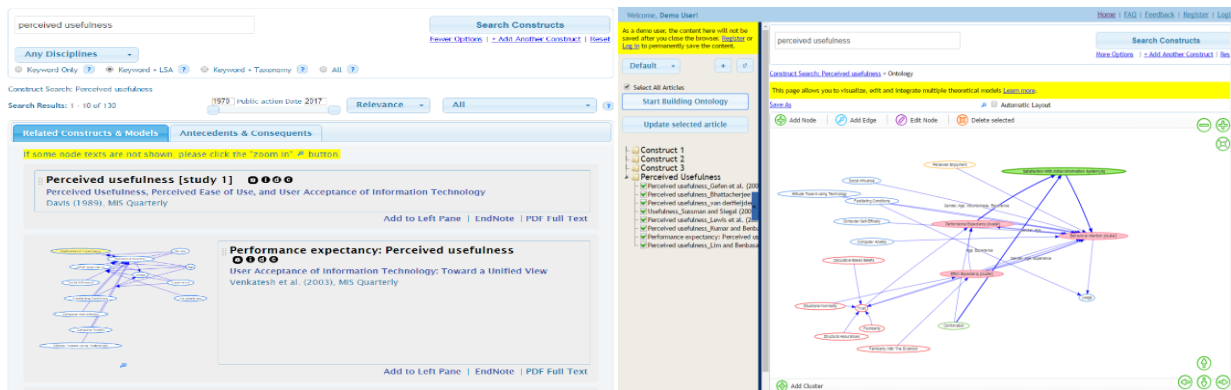
The BOLT project has generated three major design artifacts:

- **BOLT Framework:** Following the design science paradigm (Hevner et al. 2004; Walls et al. 1992), this project propose a design framework named behavioral ontology learning from text (BOLT) to identify the key objectives, tasks, exemplar techniques and evaluation solutions for disembedding behavioral knowledge. See Figure 2.



**Figure 2: Behavioral Ontology Learning from Text (BOLT) Framework**

**TheoryOn Search Engine Instantiation:** TheoryOn is an ontology-based search engine that allows researchers to directly search behavioral research articles for constructs and construct relationships, and easily integrate related behavioral theories. Figure 3 presents screenshots of the system.



**Figure 3: Screenshots of TheoryOn for Construct Search and Theory Integration**

- Multi-Stage Deep Learning Methods for Construct-Relationship Extraction:** In order to tackle the complexities of extracting behavioral knowledge embedded in articles, this project developed novel NLP methods that utilize multi-stage deep learning and tree kernel methods capable of exploiting semantic, syntactic, and communication structure.



### **End-to-End Nature of the Project**

- (1) *Iterative Design-Build-Validate-Evaluate Activities* – The design framework and NLP methods were evaluated against baseline and benchmark methods through data mining experiments. TheoryOn was evaluated against Google Scholar and EBSCO host through a randomized user study involving 52 IS and Management doctoral students, as well as an applicability check participated by ten IS professors.
- (2) *Feasibility and Value of the IT Artifacts* – The results of the user studies revealed that TheoryOn users were significantly better at retrieving relevant constructs, construct relationships and theories than standard academic full-text search engines such as Google Scholar and EBSCO host. Additionally, purely based on informal word-of-mouth, TheoryOn has already begun to see adoption by the global research community, as illustrated in the Google Analytics report and the support letters by federal funding agencies, high-tech companies and behavioral researchers.
- (3) *Design Science Insights and Contributions to IS and Beyond* – The BOLT framework and the structure kernel learning based methods are generalizable to a broader set of research domains and disciplines, including health. Moreover, as derivation of insights from unstructured data increasingly becomes a focal point, ontology learning from text-based models and methods could constitute a larger class of artifacts for tackling critical knowledge inaccessibility issues.

### **Verification**

The project is principally led and driven by university based faculty for R&D purposes.



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## **Supporting Documents:**

### Publications in Journals and Conferences

1. Li, J., Larsen, K. R., and Abbasi, A. “TheoryOn: A Design Framework and System for Unlocking Behavioral Knowledge through Ontology Learning,” conditionally accept at *MIS Quarterly*.

### Project Website Description

2. Project Website Description with Video Demos and Google Analytics Report

### PowerPoint Slide Deck

3. Li, J., Larsen, K. R., and Abbasi, A. “Unlocking Our Behavioral Knowledge Inheritance through Ontology Learning: A Design Framework and an Instantiation”

### Global Community Support

4. Support Letters from NIH, Foundation for the Advancement of Social Theory (FAST), Microsoft and IBM Research.