Scientific Research in Information Systems: A Beginner's Guide (2nd edition)

Teaching Materials

Created by Professor Jan Recker

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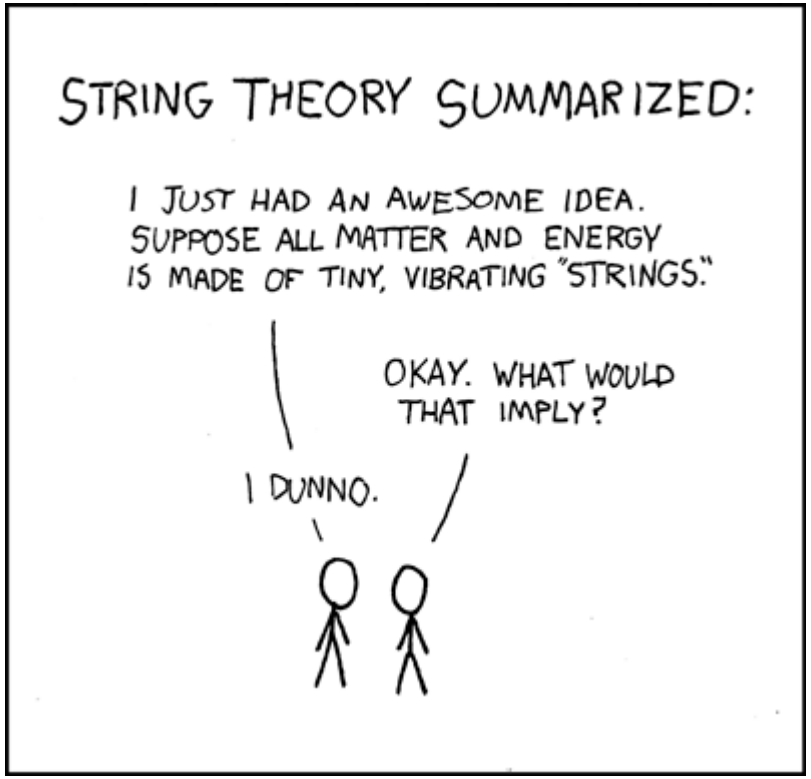
Overview

Content
Part 1: Basic Principles of Research
Part 2: Conducting Research
Part 3: Publishing Research

Chapter 4: **Theorising**

What is Theory?



What is Theory?

Warm-Up Example

- Many parents believe in the predictive power of names – a child cannot prosper unless it is hitched to the right name.

- The belief is that the right name leads to economic prosperity (ie success).

- Examples:
  - New York, 1958: Robert Lane called his baby son Winner – and later, a boy he called Loser.
  - In 2006, a man in Madrid named his Son with all the first names from the then-current Real Madrid soccer team.
  - An Indian-born Sikh cab driver in New York changed his name to Michael Goldberg.

What is Theory?

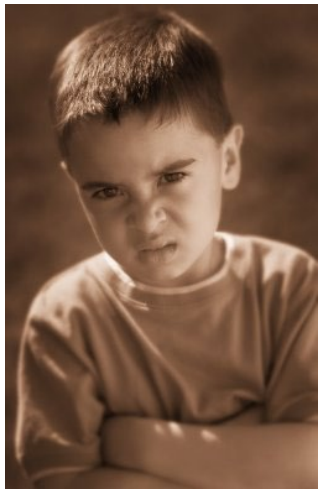
And guess what!

- A study of California birth registry data from all year since 1961 shows that indeed the name correlates with economic prosperity
  - On average, a boy called Jake will tend to earn more money and get more education than a boy called DeShawn.

- **Would DeShawn be better off if he changes his name to Jake?**

Jake

DeShawn



What is Theory?

Theory: Looking for the Reason of the discerned pattern

- The names are not the reason for the differences in education and income, they are one manifestation of an underlying reason:
  - Parents with different socio-economic status choose different names for their babies
  - The name is a *reflection* of the socio-economic status, not the *cause*.
  - Parents' socio-economic status is a good predictor of offsprings' socio-economic status

What is Theory?

Example data

- High-income boy names
  - Benjamin
  - Samuel
  - Jonathan
  - Alexander
  - Andrew
- Low-income boy names
  - Cody
  - Brandon
  - Anthony
  - Justin
  - Robert

A narrative of the analysis is included in Freakonomics
- both the book and the movie ;)

…is something we use all the time in our everyday life

“Theory”

We all use theory to construct explanations about the social world in which we live…

Which, in a way, is what researchers also try to do…

In a slightly different way, of course…

“Why do I feel unwell?”

“Why are my friends behaving oddly?”

“Why do I have to go to school?”

What is Theory?

A first definition

- A **proposed explanation of empirical phenomena**, made in a way consistent with the **scientific method**
  (a method of inquiry based on gathering *observable*, *empirical* and *measurable* evidence subject to specific principles of reasoning**)**.

- Example:
  - Theory in medicine involves trying to understand the **causes** and **nature** of health and sickness.
  - Design theory in medicine is **trying to make** people healthy.
  - These two are related but can be independent, because it is possible to research health and sickness without curing specific patients, and it is possible to cure a patient without knowing how the cure worked.

And in your work?

What is Theory?

A more formal definition

- Theory is about the connections among phenomena, **a story about why acts, events, structure, and thoughts occur**.
- Theory emphasizes **the nature of causal relationships**, identifying what comes first as well as the timing of such events.
- Theory delves into underlying processes so as to **understand the systematic reasons** for a particular occurrence or nonoccurrence.
- Theory usually is laced with a set of **convincing** and logically interconnected **arguments**.
- **Theory has implications**
  - that we may have not seen with our naked (or theoretically unassisted) eye.
  - that may run counter to our common sense.

Ref: Sutton and Staw (1995)

What is Theory?

Theory can be about explaining as well as designing

- A theory can describe, explain or predict ("make sense of") phenomena we observe
  - an account to describe, for instance,
    - Why analysts make errors in process models.
    - How top management commitment to BPM changes over time.
    - What factors contribute to successful organizational change.

- Great examples:
  - Lauren Slater: "*Opening Skinner's Box: Great Psychological Experiments of the Twentieth Century*". Norton & Company, 2005.
    - Causes of drug addiction, bystander intervention, cognitive dissonance, the neural basis of learning

What is Theory?

Theory can be about explaining as well as designing

- A theory can be used to guide the design of artefacts
  - E.g., in education: **Progressive Learning**
  - Assumption: Humans are *social animals*.
    - (an organism that is highly interactive with other members of its species to the point of having a recognizable and distinct society)
  - Theoretical premise: *Humans learn best in real-life activities* with other people.
  - Design implication:
    - Teaching materials should not just provide reading and drill, but also real-world experiences and activities that centre on the real life of the students.
    - Key design principle: *Learning by Doing*!

What Theory is Not

- *Data*: sets of evidence, observations, or arguments do not make up theory.
- *Idiographic*: an explanation of a single situation or phenomenon, in whatever detail, is not theory.
- *Description* or *prediction:* classifications or occurrence claims still operate at the observational, empirical level only.

What Theory is Not

- *Design:* The construction of an artefact, however novel and useful it may be, in itself is not theory.
- *Self-perpetuating*: Theory is not and should not be an activity that is an end in itself.
- *Universal*. Theories, while striving for comprehensiveness, have their share of limitations in the form of leading assumptions and boundary conditions.

Levels of Theory

High-Level Theories

Focus on trying to explain how and why the world is ordered

What makes up organizations?

Mid-Range Theories

Focus on trying to explain some general aspect of social behaviour

Why do girls achieve higher educational qualifications than boys?

Low-Level Theories

Focus on trying to explain a specific aspect of social behaviour.

Why do I always fall asleep in math lessons?

Theory

Comes in a variety of shapes and sizes…

Some Guidelines around Theory Levels

If you understand the basic principles of **High-level** theories you will find it easier to understand other types of theory.

→ This is because **Mid-range** and **Low-level** theories are often based on the principles underpinning **High-level** theories.

↘ High level theories are usually known by their more-common label of "**Perspectives**"

↙ A "perspective", for our current purposes, is simply a way of looking at and understanding the world or social constructions within it.

→ Different researchers, working within different perspectives, construct different theories about the nature of that world…

And in Information Systems?

Types of Theory

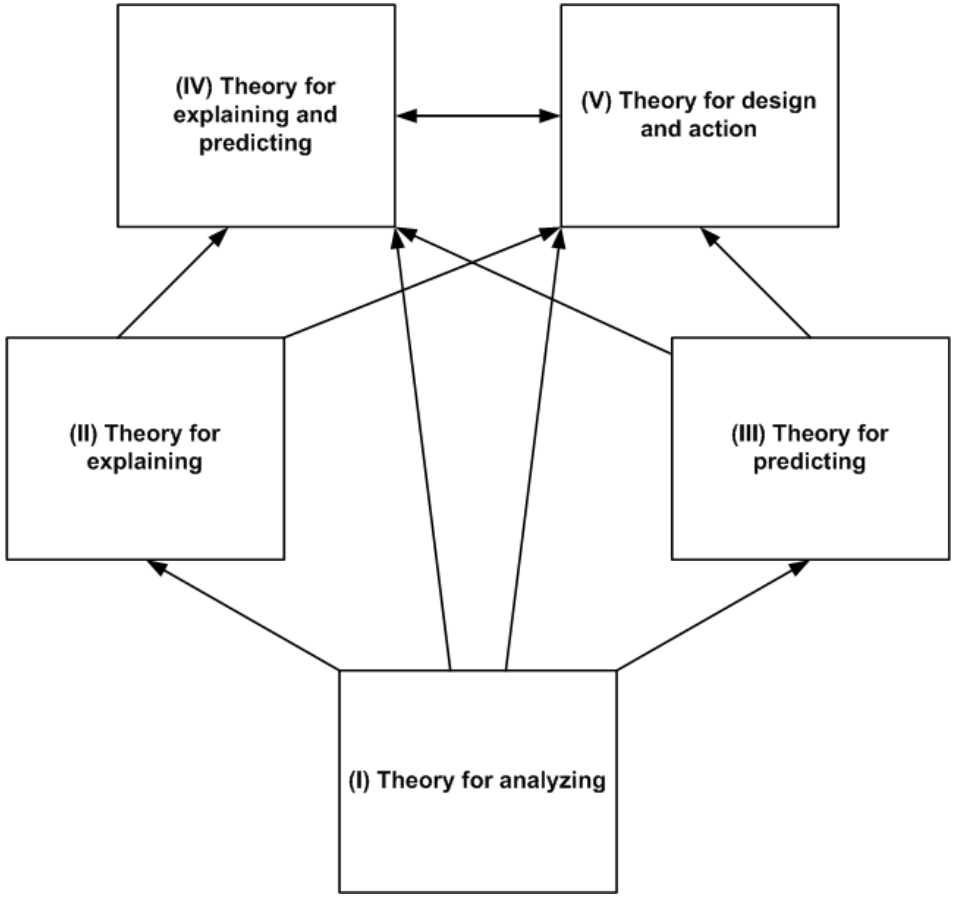
I. Analyzing and describing – What is?

II. Understanding – How and Why?

III. Predicting – What is and what will be?

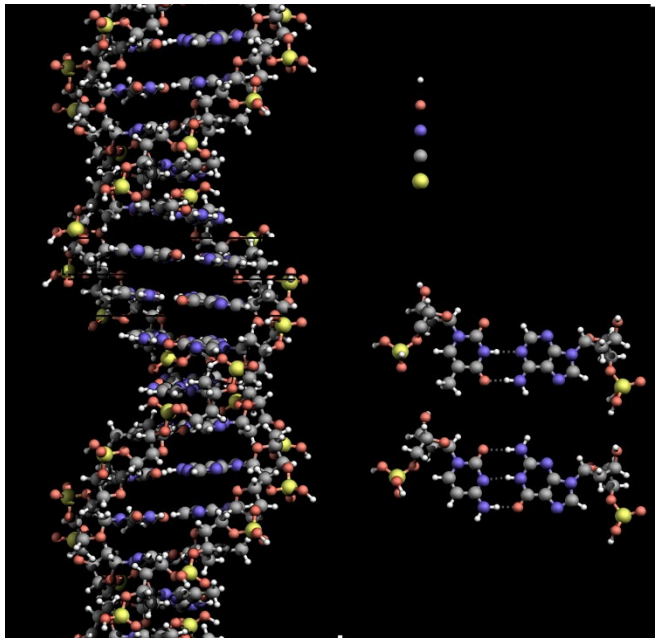
IV. Explaining and predicting (“traditional theory”) – What is, how, why, and what will be?

V. Design and action – How to do something?



Examples – Type I Theory

- DNA double helix
  - A model that describes the structure of the genetic instructions used in the development and functioning of all known living organisms



Do you know other examples?

Gregor's Types of Theory;
Animal Classes

Examples – Type II Theory

- ***Essence of Decision: Explaining the Cuban Missile Crisis***
  - A model that explains an account of the confrontation among the Soviet Union, Cuba and the United States in October 1962 through an organizational process and governmental politics model
  - Showed that the prevalent explanation (mutually assured destruction as a barrier to nuclear war) was unfounded.

Do you know other examples?

Adaptive Structuration Theory;
Complex Systems Theory

Examples – Type III Theory

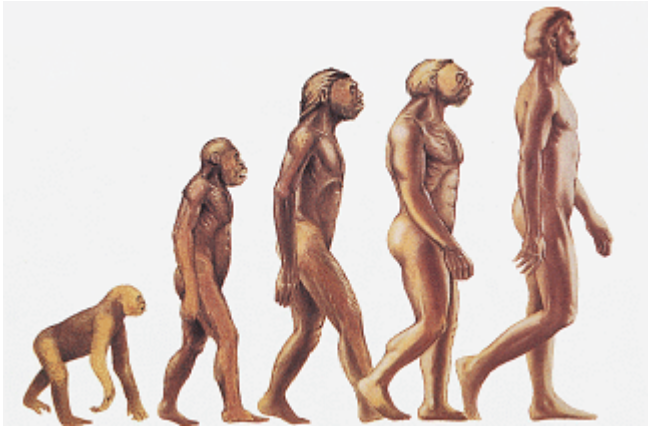
- ***Moore's Law***
  - Predicts that the number of transistors that can be placed inexpensively on an integrated circuit doubles approximately every two years.
  - Also holds (mostly) for other electronic devices, such as processing speed, memory capacity, sensors and even the number and size of pixels in digital cameras

Do you know other examples?

Organizational Size and Innovativeness
Predictive Analytics
Process Mining

Examples – Type IV Theory

- ***Theory of Evolution***
  - Explains and predicts the process of change in all forms of life over generations, by means of mutations, genetic drift and natural selection.



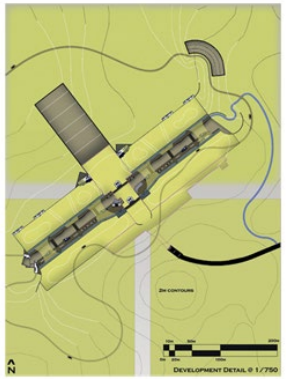
- ***Theory of Representation***
  - Models the desirable properties of information systems at a deep level and predicts consequences when these properties are not met.

Do you know other examples?

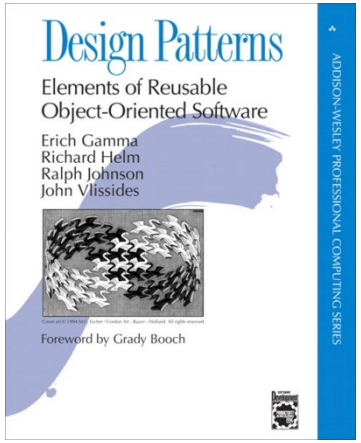
TAM, Innovation Diffusion Theory

Examples – Type V Theory

- ***Design Theory of Architecture***
  - consists of all the knowledge that the architect uses in his work, including how to select the best site and the most suitable construction materials, and advice on how to design practical buildings, up to the ease of maintenance and reparations.



- ***Gamma's Design Patterns***
  - Describes describing recurring solutions to common problems in software design.



Do you know other examples?

Progressive learning theory;
Tailorable Technology Design Theory

What are the building blocks of theory?

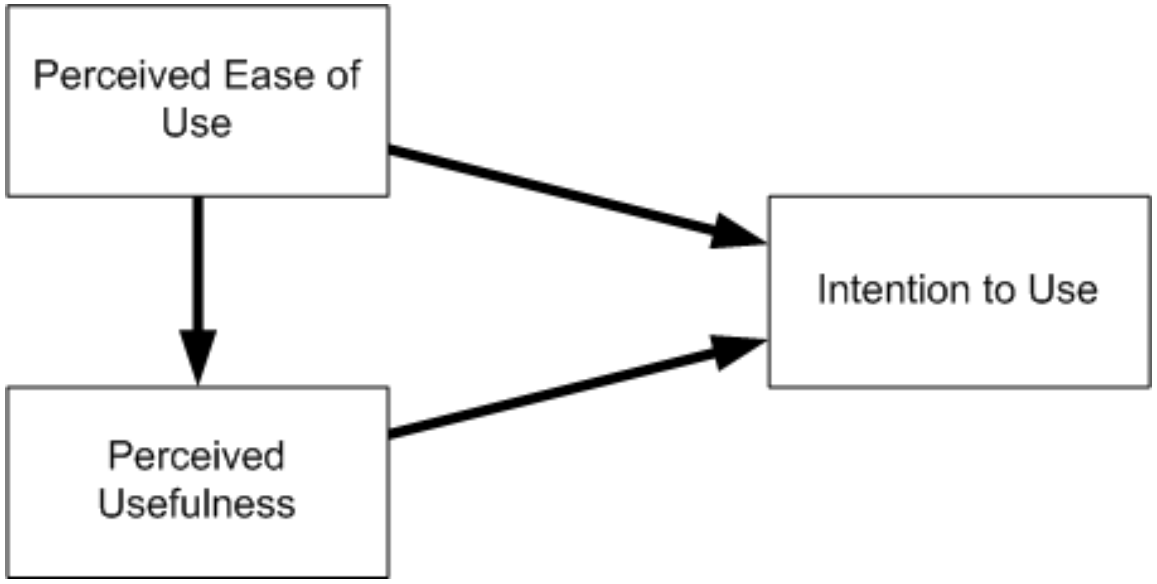
Four building blocks of Theory

- *What* (constructs),
- *How* (relationships),
- *Why* (justification), and
- *Who, Where, When* (boundary conditions)

(Whetten 1989)

Example: Technology Acceptance Model

- A theory that predicts why people intend to use information technologies:
  - Because they believe the technology will be useful to their work
  - Because they believe the technology will be easy to use.



Example: TAM

- *What* (constructs)
  - Perceived Usefulness, Perceived Ease of Use, Usage Intention
- *How* (relationships)
  - e.g., PEOU leads to PU leads to Usage Intention
- *Why* (justification)
  - e.g., principles of cognitive dissonance: humans adjust their behaviors to be consonant with their perceptions and beliefs
- *Who, Where, When* (boundary conditions)
  - not in original theory paper

Interlude: How can you contribute to theory?

- *What* (constructs)
  - Adding new constructs to TAM (such as habit, emotion, playfulness, anxiety)
- *How* (relationships)
  - Identifying new relationships (e.g., between PU and Anxiety)
- *Why* (justification)
  - Evidencing other principles for relationships (e.g., expectation-confirmation behavior)
- *Who, Where, When* (boundary conditions)
  - for different types of systems (IT-agnostic),
  - PU/PEOU influences change over time,
  - differences in gender, culture and so forth

Exercise

- Let's find a theory we are all familiar with, and dissect the building blocks.
  - *What* (constructs)
  - *How* (relationships)
  - *Why* (justification)
  - *Who, Where, When* (boundary conditions)

Nomological Nets

- Specifies the roles and relationships of nets of constructs in a theoretical model.

- We can classify constructs in relation to their purpose in our theory as *independent*, *dependent*, *mediating,* or *moderating* variables.

Nomological Nets

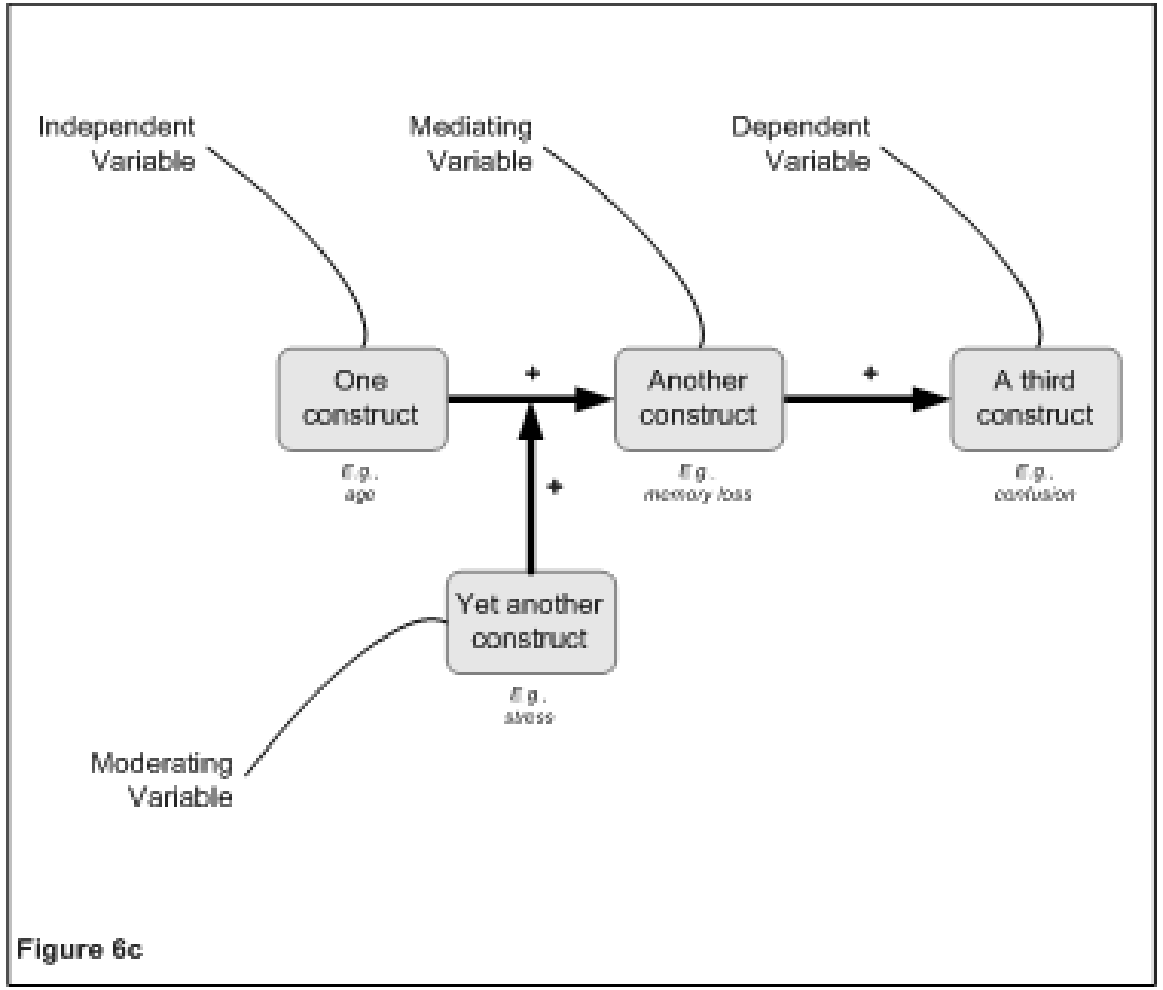
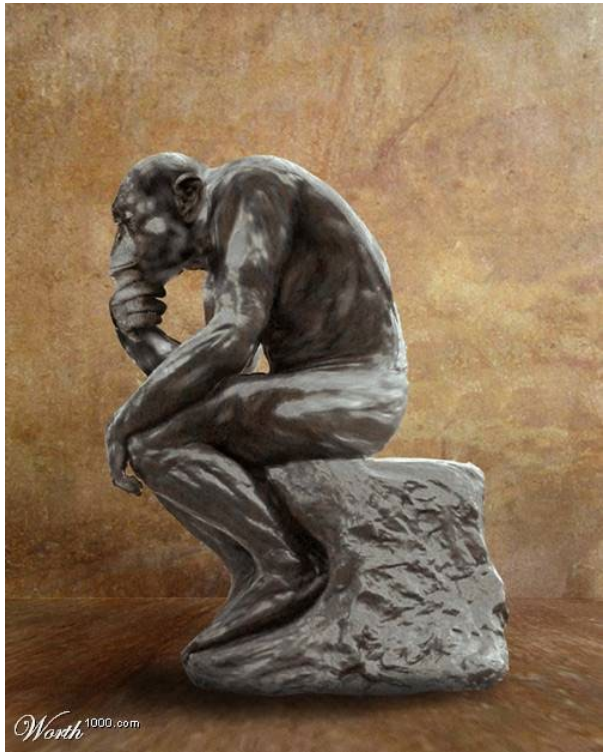


Figure 6c

Theorizing

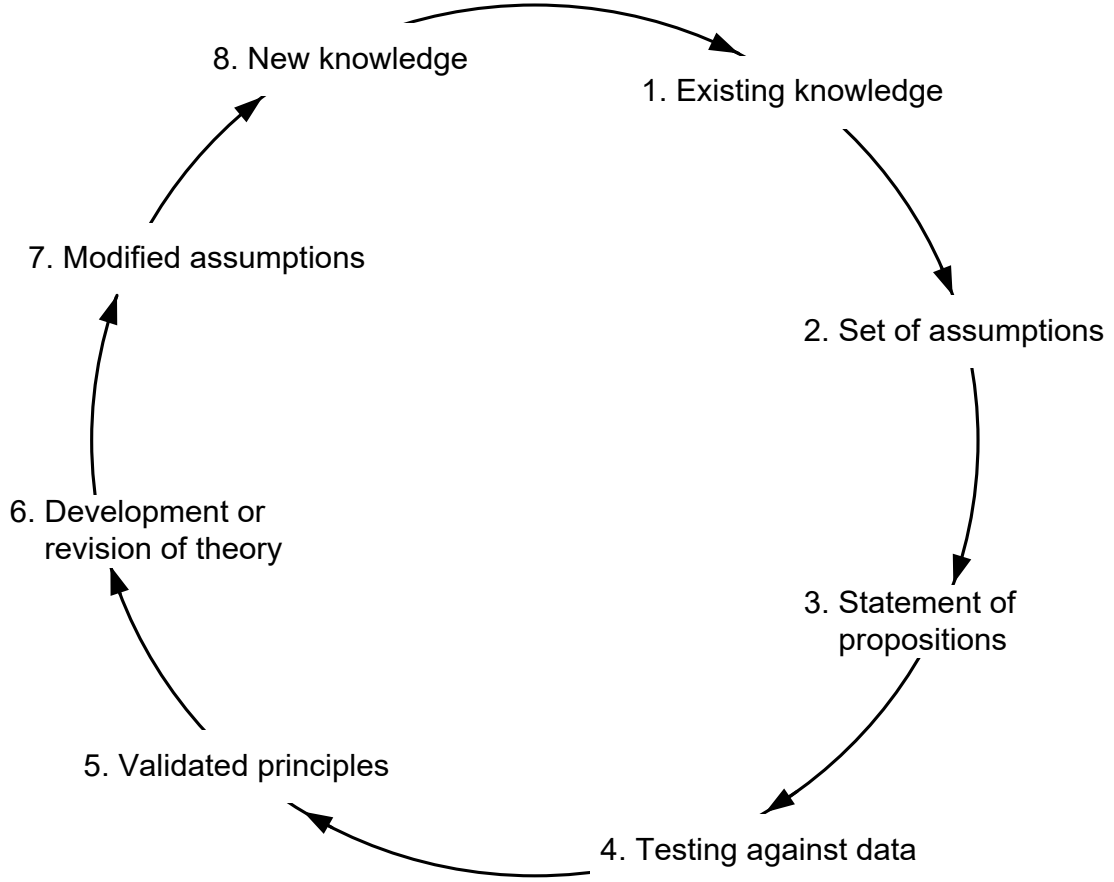


The most important Principles about Theorizing

- Theory is always an **simplification**
  - it should not be more complex than the phenomenon to be investigated

- A strong theory is an **idealization**
  - the idea of free competition in markets
  - the idea of a rational human decision-making

The General Nature of Theorizing



Theorizing – Basic Principles

- Theorizing is the application or development of theoretical arguments to make sense of a real account (e.g. an observed phenomenon).

- Can be **inductive**, **deductive** or **abductive**.

- Can be dependent on data analysis, creative thinking, inspiration, or good luck.

How To Theorize – an Example

- Start with an observation.
  - For example, think about being in college. You're in class, and the guy next to you - who is obviously a football player - says an unbelievably dumb thing in class. **So you ask yourself: Why?**
- *Football players are dumb.*
- This is a theory.
- It is not a very good one, but it is a start. What would make it better?

This material draws liberally from Lave & March,
An Introduction to Models in the Social Science
(some changes have been made)

Generalization and Explanation

- One thing would be to make it a little more **general**. Theories that are too narrow and specific are not very interesting, even if they are correct.

- Theories should be about **classes of things** (Volkswagen cars), not the things (my New Beetle) themselves. If we abstract further, we can find more general **kinds of classes** (cars in general) than specific types of classes (only Volkswagen cars).

- So, we could say:

- *Athletes are dumb.*

Generalization and Explanation

- *Athletes are dumb.*

- This statement is about a class of people (athletes) rather than a specific type of athlete (a football player). That's more general. That's good.

- But the theory still has **no sense of process**, of **explanation**. It says, athletes have this property of being dumb, and that's why they ask dumb questions. Dumb begets dumb. That's descriptive (how) but not explanatory (why).

Circularity and Falsifiability

- There is also **circularity** in the example. What do we mean when we say that a person is dumb?
  - Practically speaking, it means that they consistently behave dumbly.
  - Dumbness cannot be observed or measured directly.
  - The only way we can know whether people are dumb is by what they say and do. Yet what we are trying to explain is a dumb thing that they said. So in effect we are saying that they say dumb things because they say dumb things.
- Circularity prevents theories from being **falsifiable**.
  - E.g. Rain Dance Ceremony theory*: if you perform the Rain Dance Ceremony and all the participants are pure of heart, it will rain the next day.*
- This theory is not falsifiable because if you perform the ceremony and it rains, the theory is confirmed. If you perform the ceremony and it doesn't rain, that suggests that one of the participants was not pure of heart, and again the theory is confirmed.

Explanation and Process

- A good theory has a sense of **process**. It describes a mechanism by which A makes B happen, like the way the gears in a car transfer the rotation in the engine to a rotation of the tires.

- Can we build an explanatory process into our athlete theory?

- A suggestion:

- *To be a good athlete requires lots of practice time; being smart in class also requires study time. Amount of time is limited, so practicing a sport means less studying which means being less smart in class.*

Implications and Fertility

- The focus of the theory now is a **mechanism**, not an enduring **property** of a class of people (athletes). This means that we can apply the same reasoning to other people and other situations:
- *There is limited time in a day, so when a person engages in a very time-consuming activity, such as athletics, it takes away from other very time-consuming activities, such as studying.*
- An **implication** of this theory is now that we should also observe that good musicians (who practice many hours a day) should also be dumb in class. If we don't find this, the theory is wrong.
- A good theory is general enough to generate implications for other groups of people and other contexts, all of which serve as potential tests of the theory. That is, the theory is **fertile**.

Alternative Theories

- We have conceived a potential explanation of the phenomenon by imagining the observation as the outcome of a (hidden) process.
- We may call it the **Limited Time Theory**.
- Often, we find that this is but one possible explanation:
- **Excellence Theory**
  - *Everyone has a need to excel in one area. Achieving excellence in any one area is enough to satisfy this need. Football players satisfy their need for accomplishment through football, so they are not motivated to be smart in class.*
- **Jealousy Theory**
  - *We are jealous of others' success. When we are jealous, we subconsciously lower our evaluation of that person's performance in other areas. So we think football players ask dumb questions.*

Expectations → Hypotheses

- We can use the fertility and non-circularity of all these theories to help test and choose among them.
- We need to study different contexts to see how our theories explain observations:
  - How do football players behave (or appear to behave) in class out of season?
  - Do athletes who do not look like athletes – not unusually big (like football) or tall (like basketball) or fat (like sumo wrestling) - appear to ask dumb questions?
- **Expectations** of our theories:

Question	Limited Time	Excellence	Jealousy
Football players ask dumb questions out of season?	No	Yes	Yes
Will athletes who do not look like athletes ask dumb questions?	Yes	Yes	No

A Critical Stage

- The expectations of our theory lead to testable hypotheses.

- How do you test these hypotheses?
  - E.g. in our example?

Question	Limited Time	Excellence	Jealousy
Football players ask dumb questions out of season?	No	Yes	Yes
Will athletes who do not look like athletes ask dumb questions?	Yes	Yes	No

Two Approaches to Theorizing

- From Theory to Data
  - Typically called the 'traditional' scientific process
  - You start with a theory
  - You develop a modification or an extension of it
  - Then you collect data specifically to test/falsify the predictions
    - Example: *Recker, J., Rosemann, M., Green, P., Indulska, M. (2011): Do Ontological Deficiencies in Modeling Grammars Matter? Management Information Systems Quarterly, Vol. 35, No. 1, pp. 57-79.*
  - Typical methods:
    - E.g., survey, experiment

Two Approaches to Theorizing

- From Data to Theory
  - Often equated (falsely) with inductive and interpretive research
  - You start with data, with a study of something that is 'really happening'
  - You examine whether there is no theory to explain what you observe
  - You start developing a novel theoretical account, "grounded" in the data
    - Example: *Seidel, S., Recker, J., vom Brocke, J. (2013): Sensemaking and Sustainable Practicing: Functional Affordances of Information Systems in Green Transformations. Management Information Systems Quarterly, Vol. 37, No. 4, pp. 1275-1299.*
  - Typical methods:
    - E.g., case studies, grounded theory

Practical Suggestions to Theorizing

- should be **well-argued**
  - data-inspired or (theoretical/logical) arguments-inspired
- should be **insightful**
- challenges existing beliefs and **offers a set of new beliefs**, which
- should have (**surprising) implications** that make sense

Sensemaking!

How do we know you have a good theory?

- If you have answer to the following questions:
  - Is your account insightful, challenging, perhaps surprising, and – importantly – does it seem to make sense?
  - Does it connect disconnected or disconnect connected phenomena?
  - Is your account (your arguments) testable (falsifiable)?
  - Do you have convincing evidence to support your account?

How do we know you have a good theory?

- If you have answer to the following questions:
  - Is your account parsimonious?
  - Are the arguments logical?
  - What can you say about the boundary conditions of the theory?
  - What are implications of your theory?
    ("if what you say is true then we should see/experience/witness/do the following: …")

Good Theory – Two Contrasting Examples

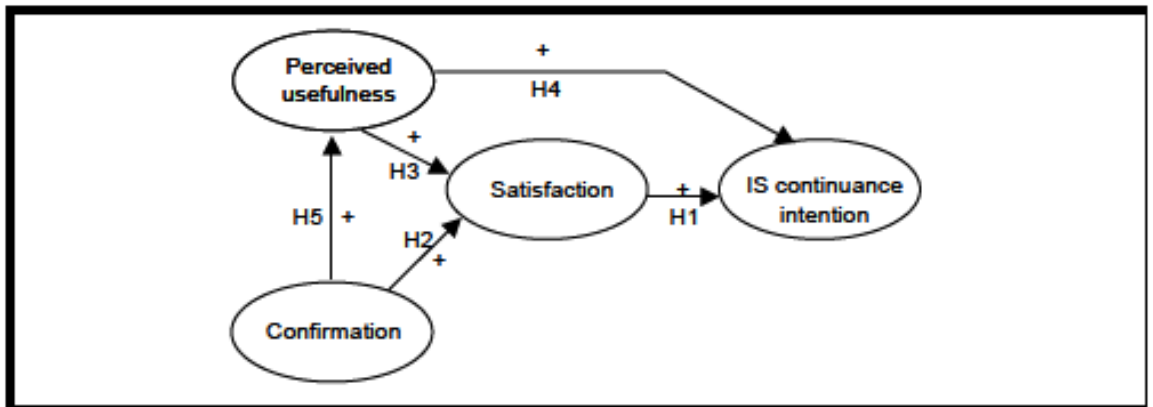


Figure 2. A Post-Acceptance Model of IS Continuance

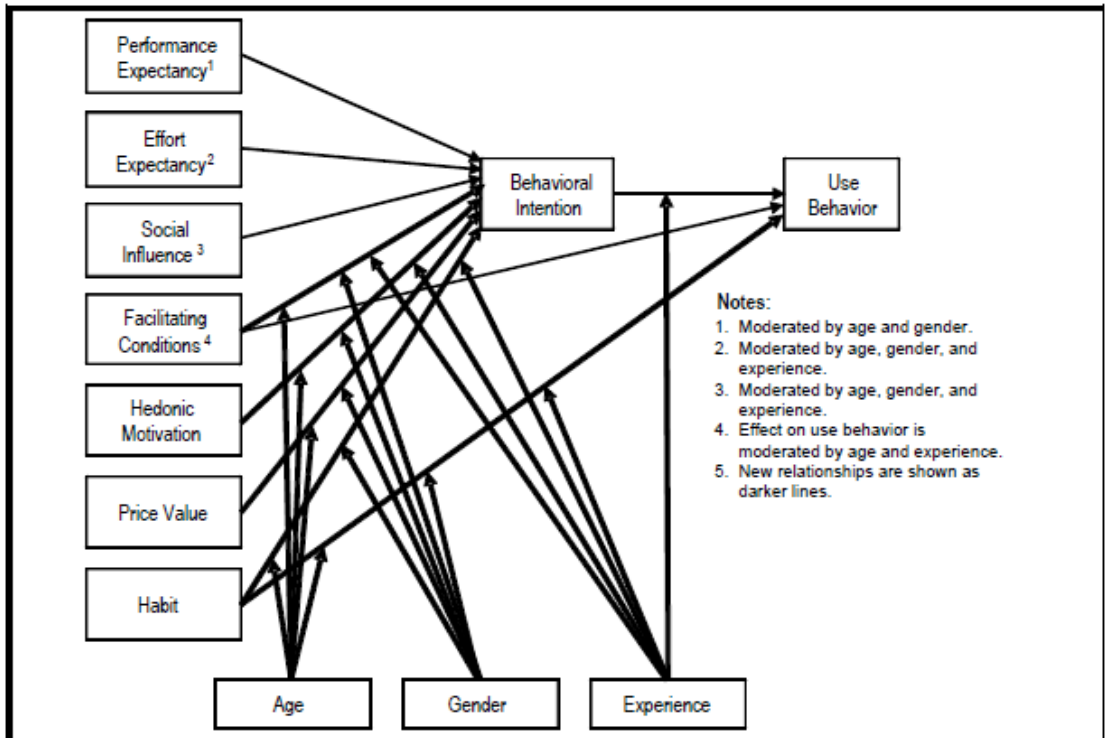


Figure 1. Research Model: UTAUT2

How do we evaluate theories?

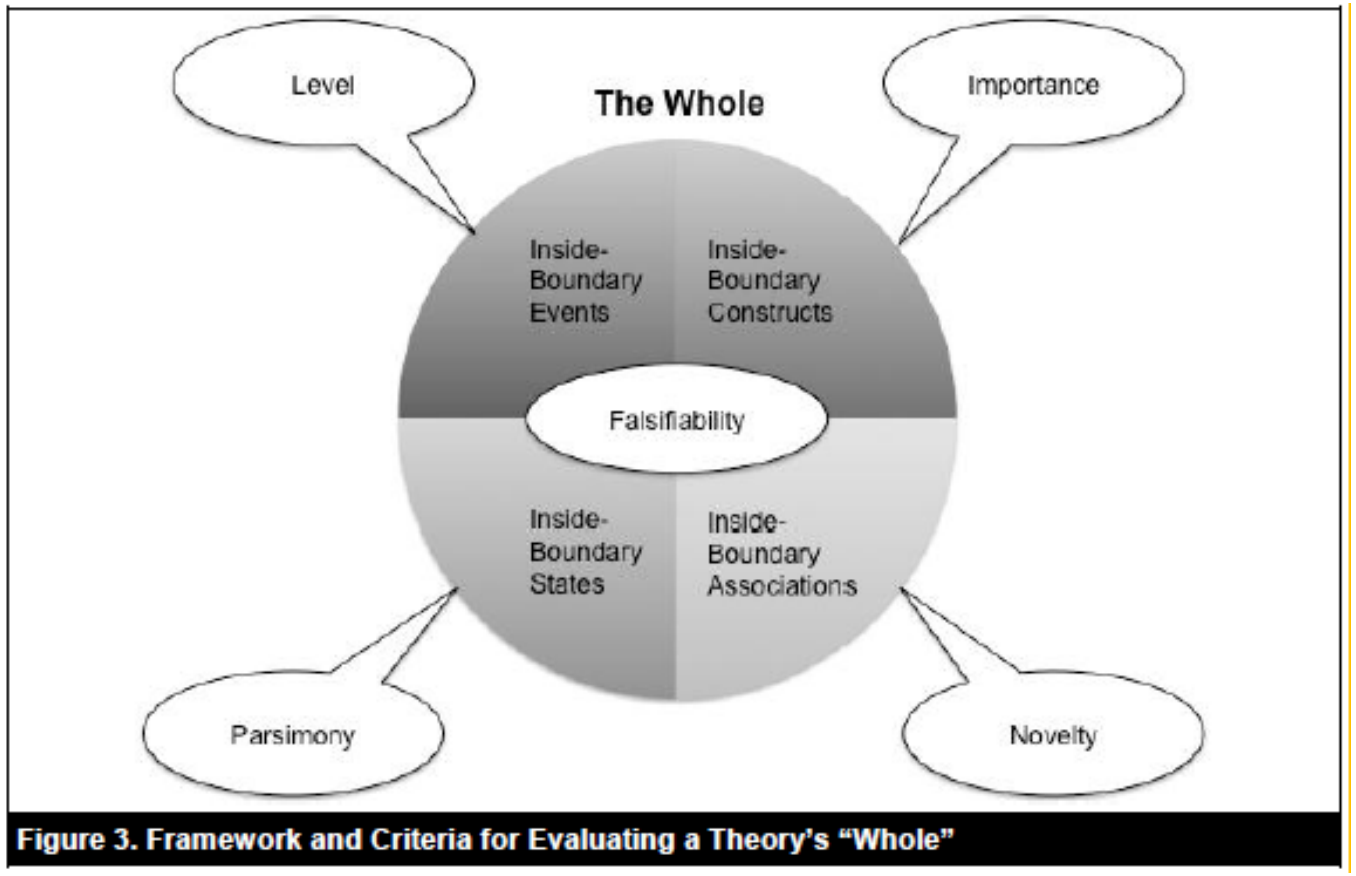


Figure 3. Framework and Criteria for Evaluating a Theory's "Whole"

Weber, R. "Evaluating and Developing Theories in the Information Systems Discipline,"
Journal of the Association for Information Systems (13:1) 2012, pp 1-30.

How do we advance theory?

- **Advance**: the further development or re-development of an existing theory
  - **Intension**: clarification/development of the set of concepts a theory uses to derive its explanation
  - **Extension**: further development to the set of phenomena that a theory explains
  - **IE**: both intension and extension

Kaplan, A. *The Conduct of Inquiry: Methodology for Behavioral Science Transaction Publishers, Piscataway, New Jersey, 1998.*

Where can I get help?

- Theories Used in IS Research (wiki page)
  - http://www.fsc.yorku.ca/york/istheory/wiki/index.php/Main_Page

- INN
  - http://inn.theorizeit.org/

Example Wiki Page - Cognitive Fit Theory

Cognitive fit theory - Theories Used i...

Problem representation, problem solving task

Concise description of theory

Cognitive fit theory was developed by Iris Vessey (1991). The theory proposes that the correspondence between task and information presentation format leads to superior task performance for individual users. In several studies, cognitive fit theory has provided an explanation for performance differences among users across different presentation formats such as tables, graphs, and schematic faces (e.g., Vessey, 1991, 1994; Vessey & Galletta, 1991; Umanath & Vessey, 1994). The theory has also been extended into the geographic information systems domain, where it has been used to explain performance differences among users of map and table-based geographic information systems on adjacency, proximity, and containment tasks (Dennis and Carte,1998; Smelcer and Carmel, 1997).

According to Vessey (1991) "matching representation to tasks leads to the use of similar . . problem-solving processes, and hence the formulation of a consistent mental representation. There will be no need to transform the mental representation . . . to extract information from the problem representation and to solve the problem. Hence, problem solving with cognitive fit leads to effective and efficient problem-solving performance."

Sources: Vessey, Iris (1991). Cognitive Fit: A Theory-Based Analysis of the Graphs Versus Tables Literature. Decision Sciences 22,(2), 219-240. and, Dunn, Cheryl, Grabski, Severin. (2001). An investigation of localization as an element of cognitive fit in accounting model representations. Decision Sciences, 32(1), 55-94.

Diagram/schematic of theory

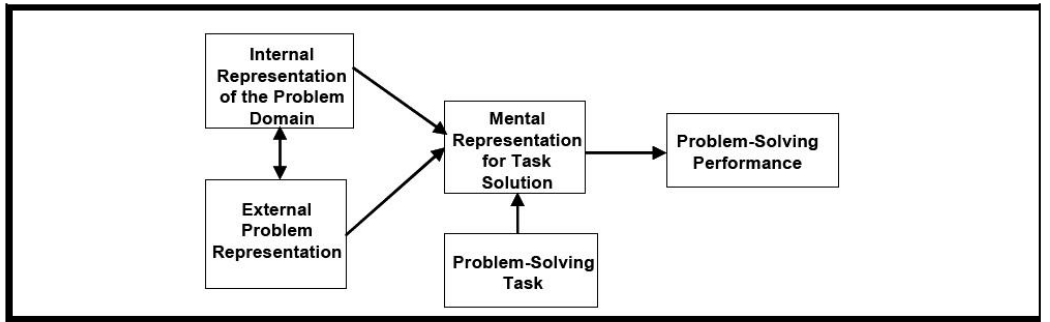


Figure 2. Extended Cognitive Fit Model

Source: Shaft, Teresa M. and Iris Vessey, (2006) "The Role of Cognitive Fit in the Relationship between Software Comprehension and Modification", MIS Quarterly, Volume 30, Issue 1, pp. 29-55.

Originating author(s)

Iris Vessey

Seminal articles

Vessey, Iris (1991). Cognitive Fit: A Theory-Based Analysis of the Graphs Versus Tables Literature. Decision Sciences 22,(2), 219-240.

Vessey, Iris, Galletta, Dennis (1991). Cognitive Fit: An Empirical Study of Information Acquisition. Information Systems Research, 2(1), 63-84.

Relevant readings (selection)

- Gregor, S. "**The Nature of Theory in Information Syste**ms," *MIS Quarterly (30:3) 2006, pp 611-642.*
- Weber, R. "**Editor's Comments: Theoretically Speaking**," *MIS Quarterly (27:3) 2003, pp iii-xii.*
- Whetten, D.A. "**What Constitutes a Theoretical Contribution?**," *Academy of Management Review (14:4) 1989, pp 490-495.*
- van de Ven, A. "**Nothing Is Quite So Practical as a Good Theory**," *Academy of Management Review (14:4) 1989, pp 486-489.*
- Weick, K.E. "**Theory Construction as Disciplined Imagination**," *Academy of Management Review (14:4) 1989, pp 516-531.*
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- Weber, R. (2012). "**Evaluating and Developing Theories in the Information Systems Discipline**", Journal of the Association for Information Systems *(13)1, pp. 1-30*

End of Chapter 4