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THEORY & REVIEW

ASSESSING REPRESENTATION THEORY WITH A FRAMEWORK FOR PURSUING SUCCESS AND FAILURE

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Appendix A

Definitions of Some Key Constructs in Representation Theory

Construct	Definition
Representation	A model of someone's or some group's perceptions of the meaning of some focal real-world phenomena.
Faithfulness of an information system representation	The extent to which someone or some group deems that a representation accurately and completely captures their perceptions of the meaning of some focal real-world phenomena.
Accuracy of an information system representation	The extent to which someone or some group deems that a representation correctly captures their perceptions of the meaning of some focal real-world phenomena.
Completeness of an information system representation	The extent to which someone or some group deems that a representation fully captures their perceptions of the meaning of some focal real-world phenomena.

Construct	**Definition**
Real-world phenomena	The aggregation of constituent things and their properties that exist in the real world, as perceived by someone or some group.
Meaning	How someone (or some group) interprets the real-world phenomena.
Unfolding meaning	The changes in meaning ascribed to focal real-world phenomena by someone (or some group) as a result of events that occur in the real world.
Deep structure	Those characteristics of an information system that embody someone's or some group's perceptions of the meaning of the focal real-world phenomena.
Information system script	An ordered string of meaningful symbols that provides descriptions of the focal real-world phenomena that an information system is intended to represent.
Information system grammar	A set of constructs and rules to combine the constructs to generate scripts that provide representations of someone's or some group's perceptions of the meaning of some focal real-world phenomena.
Information system language	The set of all scripts that can be generated via an information system grammar to represent all domains in which the grammar might be applied.
Hereditary property	A property of a thing as well as its components (e.g., mass).
Emergent property	A property of a thing that has some relationship with the properties of its components but is not possessed by its components (e.g., a work group's level of cohesion).
External event	An event that occurs in a system by virtue of the actions of things in the environment of the system on things in the composition of the system.
Internal event	An event that occurs to the components of a system by virtue of the action of the system's transformation laws.
Well-defined event	An event where the subsequent state can be predicted based on the prior state.
Ill-defined event	An event where the subsequent state cannot be predicted based on the prior state.
Representation model	An account of the relationships between the set of constructs that exist in an ontological model chosen to characterize real-world phenomena and the set of constructs provided in an information system grammar.
State-tracking model	An account of the conditions an information system must satisfy if it is to continue to provide a faithful representation of the meaning of its focal real-world phenomena as these phenomena experience changes of state (events).
Good-decomposition model	An account of the conditions an information system decomposition must satisfy such that it best conveys the meaning of its focal real-world phenomena.
Construct deficit	The situation that arises when a construct exists in an ontological model chosen to characterize real-world phenomena that has no mapping from any modeling construct in an information system grammar.
Construct redundancy	The situation that arises when two or more modeling constructs exist in an information system grammar that map to a single construct in an ontological model chosen to characterize real-world phenomena.
Construct overload	The situation that arises when a modeling construct exists in an information system grammar that maps to two or more constructs in an ontological model chosen to characterize real-world phenomena.
Construct excess	The situation that arises when a modeling construct exists in an information system grammar that has no mapping to any constructs in an ontological model chosen to characterize real-world phenomena.
Mapping condition	A state of the information system must map to only one state of its focal real-world phenomena.
Tracking condition	An information system must faithfully track state changes that occur to its focal real-world phenomena as a result of interactions between things within the boundary of the focal phenomena (*internal events*).
External-event condition	An information system must provide a faithful representation of any change in the state of its focal real-world phenomena that arises due to the action of a thing in the environment of the focal real-world phenomena (an *external event*).

Construct	Definition
Sequencing condition	An information system must faithfully record the *sequence* in which external events occur in its focal real-world phenomena.
Determinism condition	Given a set of external (input) events that occur in some focal real-world phenomena, an information system decomposition that represents the phenomena is good only if the events enacted in the information system are either *external events* or *well-defined internal events*.
State variable	An information system representation of a property of some thing in the real world.
Minimality condition	An information system decomposition is good *only if* all subsystems and systems in the information system that represent user perceptions of the meaning of the focal real-world phenomena have no redundant state variables (i.e., state variables that are never needed during the life of the information system to represent user perceptions of the meaning of states or events in the focal real-world phenomena).
Losslessness condition	An information system decomposition is good *only if* it preserves every *hereditary property* and every *emergent property* in its focal real-world phenomena.
Maximum-cohesion condition	A subsystem of a decomposition is maximally cohesive if its output state variables (those whose values are changed by internal events) cannot be partitioned based on a partition of its input state variables (those whose values are changed by external events.
Minimum-coupling condition	A decomposition has minimum coupling if and only if, for all subsystems of the decomposition, the number of external events occurring in each subsystem of the decomposition is less than or equal to the number of external events occurring in any other decomposition that has the same and equally cohesive subsystems.

Appendix B

Literature Review Procedures

Step 1: Paper Identification

We started our review by identifying published research that referenced RT. We first debated which papers were the seminal papers that described the original theory. We agreed upon three: Wand and Weber (1990, 1993, 1995). Using Harzing's (2010) publish-or-perish tool, we obtained a total of 1,022 records of papers citing these three papers by July 2013.

To scope our review, we decided each paper in our sample should pass a minimum level of quality. We used two heuristics. First, we determined that each paper should itself be cited at least once according to Harzing's publish-or-perish tool. Eliminating uncited papers resulted in a list of 770 paper records, which still included duplicates for those papers citing more than one of the three seminal works. The removal of duplicates (53) and the removal of records of papers written in a language other than English (42) resulted in 675 records. Second, because some years may elapse before papers are cited (Allen et al. 2009), we followed suggestions to apply different thresholds for papers outside a five-year window (Straub and Anderson 2010). By consensus, we decided that any paper published over five years earlier (i.e., before 2009) required a minimum of 10 citations to be considered impactful. In contrast, we did not place a minimum limit on citations for papers published during or after 2009 (other than the original requirement of at least one citation).

We identified 202 records of papers published before 2009 with less than 10 citations. To ensure this threshold would not lead to Type-II errors, each of us reviewed these 202 records. We felt some of these papers might still be impactful in the years to come. Through a voting process in which a paper required at least one vote to be considered relevant, 29 of these 202 records were deemed relevant, while the rest were removed. We also added some papers that at the time of data collection were forthcoming or in-press (and have since appeared as publications). These steps resulted in 502 records of potentially relevant papers. We then sought to obtain the 502 papers. We were unable to locate six papers. The remaining 496 papers were included in our analysis.

All papers were processed to enable full-text search. The full-text search allowed us to identify the part of each paper that cited the theory and to determine whether the paper was actually engaging with RT or simply citing it in a cursory manner or for purposes unrelated to our study (e.g., referencing the foundational papers simply to support definitions of "ontology" but not engaging with the RM, STM, or GDM in any way). Following this process, one of us identified 162 papers that cited the seminal works in a cursory manner or for purposes completely unrelated to our aims. Another of us then analyzed the 162 papers and confirmed their lack of relevance. We thus considered 334 papers for categorization.

Step 2: Paper Categorization

We next categorized the 334 papers using the categories shown in Table B1. We hired a postdoctoral researcher who had completed a Ph.D. using RT to complete the coding. We explained the categories to him and conducted two pilot tests to evaluate the quality of his coding. With each pilot test, we compared his coding with our own. Where inconsistencies arose, we continued to clarify the categorization scheme over three iterations until his coding and ours indicated we had consensus.

During categorization, the coder identified some papers he viewed as irrelevant to our study (e.g., papers citing the seminal papers but referring to RT simply as an example of an ontology). One of us subsequently reviewed these papers to check for lack of relevance. As a result, 22 papers were removed, which resulted in a final set of 312 papers to code.

To ensure coding reliability, we employed a second postdoctoral researcher familiar with RT to independently categorize a random sample of 52 papers (just over 16% of the 312). We then compared the reliability of the two coders' work based on percentage agreement and Cohen's (1960) Kappa. Kappa understates agreement when a specific category is used rarely. This problem occurred with two coding categories (where Kappa was <0.05). In both cases, however, the percentage agreements remained high (> 92%). Moreover, when these two categories were excluded, the overall average Kappa was 0.69. Values of 0.61 to 0.80 are considered substantial (Landis and Koch 1977). Thus, the coding appeared to be reliable.

Table B1. Summary of Categorization Scheme

Category	Selected Criteria
Focus and intent	What is the stated intended *research goal*? Which phenomena are the *focus of the paper* (e.g., conceptual modeling)? How does the paper *refer to the theory*? • Conceptual foundation • Test of theory • Critique of theory • Extension of theory • Reference to theory • Other Are potential *theoretical or methodological advances* an explicit or intended contribution of the paper?
Element of theory	Which *part of RT is* examined? RT as a whole (e.g., its assumptions and the three categories of structures) Representation model State-tracking model Good-decomposition model
Research method	Which *research method or approach* has been used? • Representational analysis • Survey • Laboratory experiment • Field study • Case study • Interviews • Design science • Other
Empirical evidence	What are the *results* of the study? What are the *quantity and quality* of the results (considering the *type of sample*)?

Step 3: Paper Coding

With the benefit of our broad categorization of the papers, we coded the 312 papers that used RT to determine the extent to which they engaged in the pursuit of success or failure. To identify pursuit of success, we started by listing all papers that our external coders identified (via the categories in Table B1) as reporting theoretical and/or methodological advances or extensions. To identify pursuit of failure, we started by listing all papers that our external coders categorized (again via the categories in Table B1) as referring to RT as conceptual foundation, test of theory, critique of theory, or reporting empirical evidence.

We then conducted two checks of the combined list. First, one of us reviewed each paper in the list to determine if he/she agreed that each paper reflected a pursuit of success or failure. Second, two of us reviewed the whole set of 312 papers to ensure other papers that pursued success or failure were not missing from the list. We held regular coding meetings to discuss and defend decisions until we reached consensus on the final list. The final list contained 69 of the original 312 papers. Such a small subset was expected because our aim was to assess how RT has been advanced (whether in the direction of success and/or failure). Papers that simply applied RT as is, without extending it, lay outside our review paper's scope.

Once we had finalized the list of 69 papers, we developed 16 codes to classify each paper alongside two dimensions—eight directions of pursuit and eight strategies of pursuit. Table B2 and Table B3 summarize the coding criteria. Much like the rest of the coding process, we developed these codes iteratively through group discussion until consensus was reached.

With agreed codes established, two of us independently coded all 69 papers and met to discuss, defend, and revise the coding until we reached consensus. This process took three rounds. After the first round, the average percentage agreement was 0.85 and the average Cohen's Kappa was 0.28. After the second round, the average percentage agreement was 0.93 and the average Kappa was 0.66. As noted before, Kappa is low when some categories are seldom found in the data (such as direction "B," which had a percentage agreement of 99%, but a Kappa value of 0.00). Even when these categories were included, however, the average Kappa was 0.66 (i.e., within the 0.61–0.80 range considered "substantial") (Landis and Koch 1977). Given this high level of agreement, the two of us who acted as coders then conducted one more round and resolved the remaining differences through discussion.

We highlight three aspects of our coding that have a key bearing on our results. First, as Figure 2 shows, coding the direction of pursuit requires knowledge of the theory's starting point. The starting point was not always clear, however, in each paper we reviewed. Rather than articulating what explanatory concepts RT contained, what outcomes it explained, and how it was being extended, authors frequently took the first two for granted and focused on the third point alone. This approach sometimes made it hard to code the direction of pursuit. As noted earlier, one reason for this difficulty could be that descriptions of RT have not been summarized comprehensively in one place (with the exception of Weber's 1997 out-of-print monograph), something our summary of RT above should help remedy for future research. Nonetheless, for the purpose of reviewing each paper, we simply coded the theory's starting point based on our understanding of RT and our interpretive reading of each paper.

Second, to code those papers that we believed pursued the theory's extension, we placed greater weight on papers that identified new phenomena *outside* conceptual modeling. The reason is that conceptual modeling has always been RT's primary field of application. As in assessments of research programs in other fields (Kilduff et al. 2006), we wished to weight more heavily those outward-looking papers that increased the program's empirical scope beyond its original application. Our approach is not meant to deprecate papers that advanced RT *within* the conceptual modeling field. Indeed, progress in this field has been substantial. We were simply more exclusive when coding strategies of extensions within the conceptual modeling field and more inclusive when coding papers outside conceptual modeling.

Finally, when coding papers that sought to propose an alternative (competing) theory in direct preference to RT, we only coded extensions made to RT and not potential extensions made to competing theories. Our main reason was that such papers did not seek to advance RT primarily but rather the competing theory they discussed. We generally coded such papers in terms of direction "G"and "tests of competing theories" to reflect the basic argument in these papers that RT offered a poorer account of the focal phenomena compared to the alternative theory they used or developed.

Table B2. Criteria for Codifying Papers for *Direction* of Pursuit of Success and Failure

Direction	Coding Criteria
A	Does the paper show how existing phenomena can be explained with fewer explanatory constructs? (This category does not include studies that only examine part of the theory, such as studies that examine the effect of ontological clarity alone rather than both clarity and completeness. Rather, this category requires the explicit aim of *reduction* of RT by removing a particular construct from the theory.)
B	Does the paper show how new phenomena can be explained, or existing phenomena explained more effectively, with fewer explanatory constructs? (As with A, this category requires the explicit *reduction* of explanatory constructs.)
C	Does the paper explain new phenomena or improve explanations of existing phenomena with the existing set of constructs? (New phenomena could be explained by making creative inferences from existing constructs. Improved explanations of phenomena could be achieved through refining or improving the precision of construct definitions and associations or research procedures.)
D	Does the paper explain new phenomena, or improve explanations of existing phenomena, with the benefit of additional constructs? (Examples are new constructs that add predictive power, moderators that explain the theory's performance in different contexts, or mediators that explain the mechanism through which RT's constructs affect outcomes.)
E	Does the paper add new constructs to explain existing phenomena? (With this category, the implication is that the explanatory power of RT would be lower than currently purported to be if the additional constructs are not added. This outcome could occur, for instance, if a new construct is added to explain a counterexample.)
F	Does the paper show that even with the addition of new constructs, the explanatory power of the theory is lower than currently purported to be? (This category would include attempts to explain counterexamples through the addition of new constructs, but where the attempts do not entirely resolve the unexpected results.)
G	Does the paper show that the current set of constructs is not able to provide the explanation that the theory currently purports to offer? (This could be achieved in an absolute sense if a theoretical prediction is refuted or no evidence is found for it. It could also be achieved in a relative sense if RT's explanation of existing phenomena is shown to be poorer than that offered by an alternative theory.)
H	Does the paper constrict the theory by removing constructs and also removing phenomena or explaining existing phenomena less powerfully? (This category requires the explicit *reduction* of both the theory's explanatory constructs and the phenomena the theory purports to cover, such as particular outcome constructs.)

Table B3. Criteria for Codifying Papers for *Strategy* of Pursuit of Success and Failure

Strategy	Coding Criteria
Intension (reduction)	Does the paper reduce RT's existing set of constructs and associations? (This is equivalent to coding direction "A.")
Extension (addition)	Does the paper introduce new constructs or associations to account for new phenomena? (When judging novelty, a more exclusive stance is used to code conceptual modeling phenomena and a more inclusive stance is used to code phenomena outside conceptual modeling.)
Extension (precision)	Does the paper introduce improvements to research procedures that could increase the precision of existing explanations? (Improvements could include new measurements, methods, guidelines, and empirical approaches.)
Intension and extension	Does the paper introduce improvements to constructs and/or associations that help to improve RT's explanations? Note that improvements could vary widely from expansions/additions to contractions/refinements. (When judging novelty, we adopt a more exclusive stance when considering papers within the conceptual modeling field and a more inclusive stance when considering papers outside the conceptual modeling field.)
Identify tacit assumptions	Does the paper explicitly identify and challenge assumptions not explicit in the original works (Wand and Weber 1990, 1993, 1995; Weber 1997)? (If an assumption is identified and challenged, is the challenge only conceptual, or does the paper take steps to empirically test the challenge?)
Delineate boundaries	Does the paper propose a boundary to the theory? If boundaries are identified, are they proposed *a priori* (e.g., based on theory) or *ex post* (e.g., based on the pattern of results observed in a given study)? (Delineation of boundaries could involve adding constructs, such as moderators, to explain why RT works in some contexts, not others, or could involve adjusting RT's constructs and associations to restrict their application to certain contexts.)
Conduct contests with competing theory	Does the paper provide a description of a theory as an explicit alternative to parts of RT (e.g., an alternative ontological benchmark or model) or RT as a whole? (If competing theories are identified, does the paper develop competing predictions between RT and the other theory? If so, does the paper empirically test these competing predictions?)
Explain counterexamples	Does the paper report findings that contradict RT's propositions, hypotheses, or conjectures? (If counterexamples are identified, did the discovery occur through conceptual analysis or empirical results? Are the counterexamples followed up with empirical studies to explain the counter-example?)

Step 4: Analysis of Results

In our final step, we prepared two summaries of the coding results to facilitate an interpretation of the literature review. First, we created detailed accounts of our coding organized by strategy of pursuits in two concept matrices (one each for pursuit of success and failure) (Tables B4 and B5). We then prepared a summary of the coding results including both strategy and direction of pursuit on a per-paper basis (Table B6).

Table B4. Concept Matrix of Studies that Report on the Pursuit of Success

Pursuit Strategy	Description
Intension (reduction)	None found
Extension (addition)	Addition of new phenomena explained: • Effective use (Burton-Jones and Grange 2013) • Software metrics (Chidamber and Kemerer 1994) • IT value measurement (Davern and Wilkin 2010) • Reduction in modeling variations (Hadar and Soffer 2006) • System volatility (Heales 2002) • Perceived usefulness and ease of use (Recker et al. 2011) • Process validity (Soffer and Wand 2007) • Data quality (Wand and Wang 1996)
Extension (precision)	Improvement of precision through: • Experimental design and controls (Parsons and Cole 2005) • Improved mapping (representational analysis) (Opdahl and Henderson-Sellers 2004; Rosemann and Green 2000, 2002; Rosemann, Green, and Indulska 2004; Rosemann et al. 2009) and improved instances of mapping specific scripts (e.g., relationships with attributes) (Parsons 2011) • Improved measurement item development (Recker and Rosemann 2010) • Use of a focused ontology (Rosemann and Green 2000, 2002; Rosemann, Green, and Indulska et al. 2004; Rosemann et al. 2009; Soffer et al. 2001) • Clarifying broad scope of underlying assumptions (Wand and Weber 2006) • New methods for measuring maximum ontological completeness and minimum ontological overlap (zur Muehlen and Indulska 2010)
Intension and Extension	Addition of constructs/relationships: • Interaction between ontological clarity and users' knowledge of the phenomena shown in a script on understanding (Burton-Jones and Weber 1999) and the functional form of the interaction (Bera et al. 2014) • Direct and moderating effects of model complexity and cognitive load on query performance (Bowen et al. 2006, 2009) • Role of information content and incidental processing in explaining perceived ease of understanding (Burton-Jones and Meso 2008) • Use of semiotics and pragmatics to improve explanations of outcomes in conceptual modeling experiments (Burton-Jones et al. 2009) • Ontological production rules for improving explanations of the effects of ontological clarity (Evermann and Wand 2005) • Learning constructs needed to explain the effects of ontological clarity on understanding (Gemino and Wand 2003) • Role of local clarity and cognitive integration in explaining the effects of ontological clarity on understanding (Gemino and Wand 2005) • Maximum ontological completeness and minimum ontological overlap to explain multiple grammar adoption (Green et al. 2011) • Contingencies when accounting for the effects of ontological clarity on understanding (complexity of the represented phenomena, quality of ontological benchmark, and knowledge of the represented phenomena) (Milton et al. 2012) • New concepts (instantiation and modality) needed to improve the usefulness and precision of UEML ontology (Opdahl et al. 2012) • New concepts (stability condition, corrective action, hierarchical analysis) to understand good decomposition (Paulson and Wand 1992) • Mediators (perceived ease of use and usefulness) and moderators (purpose, experience, role, tool, conventions, voluntariness) needed to understand the effects of ontological completeness and clarity on grammar usage (Recker et al. 2006) • Semantic processing, relationship information, chunking, context, to explain cognitive outcomes (Rockwell and Bajaj 2004) • Hierarchy of systems needed to understand the effect of ontological clarity in models of social phenomena (Rosemann and Wyssusek 2005) • Ontological distance to explain alignment, including a method to measure such distance (Rosemann, Vessey, and Weber 2004) • Role of voluntary/imposed misalignment in affecting how lack of alignment is resolved (Sia and Soh 2007) • Latent structure to explain enterprise system fit (Strong and Volkoff 2010)

Table B5. Concept Matrix of Studies that Report on the Pursuit of Failure

Pursuit Strategy	Description
Tacit assumptions	*Challenged assumptions*: • Ontological theory provides a suitable foundation for evaluating conceptual models (Wyssusek 2006; Wyssusek and Klaus 2005); they argue that ontological theory does not offer a suitable foundation. • It makes sense for RT to use a realist ontological theory such as Bunge's (Allen and March 2006a; Ågerfalk 2010; Klein and Hirschheim 2006; Riemer et al. 2013; Wyssusek 2004); they argue that it does not make sense because such an ontological theory does not allow researchers to understand the socially constructed nature of reality and the performative (rather than just representation) functions of scripts. • Bunge's ontology has empirical support (Allen and March 2006a); they argue that there is little empirical evidence to support its use. • RT's selection of constructs from Bunge's ontology is sufficient (Rosemann and Wyssusek 2005); they argue that additional constructs are needed (such as the concept of a hierarchy of systems). • Practitioners can explicate their perception of the world into things with properties (Riemer et al. 2013); they argue that practitioners do not think this way and that any model created in this way will fail to grasp the holistic way in which actors understand the world. • RT's set of structures (surface, deep, and physical) is sufficient (Strong and Volkoff 2010); they argue that it is not sufficient and that additional latent structures need to be considered. • The one-to-one mapping process suggested by RT is sufficient (Gehlert and Esswein 2005; Guizzardi 2005); they argue that it is not sufficient because it does not account for "similarity" of mapping. • RT need only consider semantic factors when evaluating conceptual modeling grammars (such as ontological completeness and clarity) (Mendling and Recker 2007; Recker et al. 2010); they argue that these are insufficient and that pragmatic criteria should also be considered (e.g., the competence, experience, and role of the modeler, and the modeling purpose, tool, and conventions).
Boundaries	*Suggested boundaries:* • The effect of ontological clarity on an individual's ability to use a conceptual model to: ○ Understand real-world phenomena depends on the individual's prior knowledge of the phenomena (Bera et al. 2014; Burton-Jones and Weber 1999) and the measure of understanding used (as it typically influences actual understanding but not perceived ease of understanding) (Burton-Jones and Meso 2006, 2008). ○ Query a database depends on the relative complexity of the model and the effect of complexity on cognitive effort (Bowen et al. 2006, 2009), with higher complexity and effort impeding performance. ○ Recall information depends on the model's relative complexity, with benefits only apparent at higher levels of complexity (Weber 1996). ○ Detect defects in a conceptual model depends on the complexity of the represented phenomena, the quality of the ontological benchmark, the reader's knowledge of the represented phenomena, and the modeler's competence (Milton et al. 2012). • The usefulness of an ontological benchmark for reducing modeling variations depends on the type of phenomena being modeled, with different benchmarks being more useful for different types of phenomena (Hadar and Soffer 2006). • If RT is to account for social phenomena, researchers need to include additional constructs in the ontological benchmark to account for culture (Herrera et al. 2005) and the social construction of reality (Lemieux and Limonad 2011).
Competing theories	*Suggested alternative theories:* • Semantics (Rosemann and Wyssusek 2005; Wyssusek 2006) • Epistemology (Milton 2007; Wyssusek 2006) • Linguistics (Wyssusek and Klaus 2005) • Pragmatism (Ågerfalk 2010) • Cognition (Allen and March 2006a; Evermann 2005; Veres and Mansson 2005) • Event-tracking model (March and Allen 2007) • Alternative ontological benchmarks: ○ Chisholm's ontology (Milton 2007; Milton and Kazmierczak 2004) ○ Ontological works of Sowa, Brody, Tiles and Feibleman (Allen and March 2006b) ○ Unified Foundational Ontology (Guizzardi 2005) *Developed alternative predictions:* • Wand et al. (1995) compare predictions of representation theory, concept theory, and speech act theory. • Recker et al. (2007b) compare evaluations of a particular modeling grammar against two different ontological benchmarks.

Pursuit Strategy	Description
	Empirically evaluated alternative predictions: • Allen and March (2006b) evaluate the effects of state- and event-based data representations that stem from Bunge's ontological view in comparison to that of Sowa, Brody, Tiles, and Feibleman. • Allen and March (2012) evaluate the effects of construct overload in representations of composites and associations on comprehension performance against theories of ternary relationships and grammar syntax.
Counter-examples	*Counterexample examined conceptually:* • The RM cannot be used to explain the quality of an enterprise architecture framework if it is not complemented with an enterprise ontology (Chen and Pooley 2009a, 2009b). *Counterexample identified through unexpected empirical findings:* • Users often perceive construct redundancy in a grammar to be unproblematic or even beneficial (Green and Rosemann 2001, 2002). • Lack of ontological clarity and completeness do not impede ARIS users; need to account for modeling purpose and role (Davies et al. 2004). • Ontological overload did not lead to predicted reductions in individuals' ease of understanding (Shanks et al. 2008), problem-solving, or discrepancy-checking (Shanks et al. 2010), or problem-solving time (Shanks et al. 2008; Shanks et al. 2010). *Empirically evaluated counterexamples:* • Conceptual modelers do not always select a combination of grammars that provides maximum ontological completeness and minimum ontological overlap (Green et al. 2011). Post-hoc interviews explain the countervailing effects of personal preferences to use text and compliance with organizational standards.

Table B6. Summary of Pursuit of Success and Failure of RT Reported in the Literature

Reference	Strategy of Pursuit of Success				Strategy of Pursuit of Failure				Direction of Pursuit	Part of theory pursued (RT, RM, GDM, STM)
	Intension (Reduction)	Extension (Addition)	Extension (Precision)	Intension & Extension	Tacit Assumptions	Boundaries	Competing Theories	Counter-examples		
Ågerfalk 2010	•	•	•	•	✓	•	✓	•	G	RM
Allen and March 2006a	•	•	•	•	✓	•	•	•	G	RM
Allen and March 2006b	•	•	•	•	•	•	✓	•	G	RM
Allen and March 2012	•	•	•	•	•	•	✓	•	G	RM
Bera et al. 2014	•	•	•	✓	•	✓	•	•	D	RM
Bowen et al. 2006	•	•	•	✓	•	✓	•	•	D	RM
Bowen et al. 2009	•	•	•	✓	•	✓	•	•	D	RM
Burton-Jones and Grange 2013	•	✓	•	•	•	•	•	•	C	RT
Burton-Jones and Meso 2006	•	•	•	•	•	✓	•	•	G	GDM
Burton-Jones and Weber 1999	•	•	•	✓	•	✓	•	•	D	RM
Burton-Jones and Meso 2008	•	•	•	✓	•	✓	•	•	D	GDM
Burton-Jones et al. 2009	•	•	•	✓	•	•	•	•	D	RM
Chen and Pooley 2009a	•	•	•	•	•	•	•	✓	E	RM
Chen and Pooley 2009b	•	•	•	•	•	•	•	✓	E	RM
Chidamber and Kemerer 1994	•	✓	•	•	•	•	•	•	C	GDM
Davern and Wilkin 2010	•	✓	•	•	•	•	•	•	C	RM
Davies et al. 2004	•	•	•	•	•	•	•	✓	E	RM
Evermann 2005	•	•	•	•	•	•	✓	•	G	RM
Evermann and Wand 2005	•	•	•	✓	•	•	•	•	D	RM
Gehlert and Esswein 2005	•	•	•	•	✓	•	•	•	G	RM
Gemino and Wand 2003	•	•	•	✓	•	•	•	•	D	RM
Gemino and Wand 2005	•	•	•	✓	•	•	•	•	D	RM
Green and Rosemann 2001	•	•	•	•	•	•	•	✓	G	RM
Green and Rosemann 2002	•	•	•	•	•	•	•	✓	G	RM

Reference	Strategy of Pursuit of Success				Strategy of Pursuit of Failure				Direction of Pursuit	Part of theory pursued (RT, RM, GDM, STM)
	Intension (Reduction)	Extension (Addition)	Extension (Precision)	Intension & Extension	Tacit Assump-tions	Bound-aries	Com-peting Theories	Counter-examples		
Green et al. 2011	•	•	•	✓	•	•	•	✓	D	RM
Guizzardi 2005	•	•	•	•	•	•	✓	•	G	RM
Hadar and Soffer 2006	•	✓	•	•	•	✓	•	•	D	RM
Heales 2002	•	✓	•	•	•	•	•	•	C	RT
Herrera et al. 2005	•	•	•	•	•	✓	•	•	E	RM
Klein and Hirschheim 2006	•	•	•	•	✓	•	•	•	G	RT
Lemieux and Limonad 2011	•	•	•	•	•	✓	•	•	E	RM
March and Allen 2007	•	•	•	•	•	•	✓	•	G	RT
Mendling and Recker 2007	•	•	•	•	✓	•	•	•	F	RM
Milton 2007	•	•	•	•	•	•	✓	•	G	RM
Milton and Kazmierczak 2004	•	•	•	•	•	•	✓	•	G	RM
Milton et al. 2012	•	•	•	✓	•	✓	•	•	D	RM
Opdahl et al. 2012	•	•	•	✓	•	•	•	•	D	RM
Opdahl and Henderson-Sellers 2004	•	•	✓	•	•	•	•	•	C	RM
Parsons 2011	•	•	✓	•	•	•	•	•	C	RM
Parsons and Cole 2005	•	•	✓	•	•	•	•	•	C	RM
Paulson and Wand 1992	•	•	•	✓	•	•	•	•	D	GDM
Recker et al. 2010	•	•	•	•	✓	•	•	•	E	RM
Recker and Rosemann 2010	•	•	✓	•	•	•	•	•	C	RM
Recker et al. 2006	•	•	•	✓	•	•	•	•	D	RM
Recker et al. 2007	•	•	•	•	•	•	✓	•	G	RM
Recker et al. 2011	•	✓	•	•	•	•	•	•	C	RM
Riemer et al. 2013	•	•	•	•	✓	•	•	•	G	RT
Rockwell and Bajaj 2004	•	•	•	✓	•	•	•	•	D	RM
Rosemann and Green 2000	•	•	✓	•	•	•	•	•	C	RM
Rosemann and Green 2002	•	•	✓	•	•	•	•	•	C	RM
Rosemann, Green, and Indulska 2004	•	•	✓	•	•	•	•	•	C	RM
Rosemann, Vessey, and Weber 2004	•	•	•	✓	•	•	•	•	D	RM
Rosemann et al. 2009	•	•	✓	•	•	•	•	•	C	RM
Rosemann and Wyssusek 2005	•	•	•	✓	✓	•	•	•	D	RM
Shanks et al. 2008	•	•	•	•	•	•	•	✓	G	RM
Shanks et al. 2010	•	•	•	•	•	•	•	✓	G	RM
Sia and Soh 2007	•	•	•	✓	•	•	•	•	D	RT
Soffer et al. 2001	•	•	✓	•	•	•	•	•	C	RM
Soffer and Wand 2007	•	✓	•	•	•	•	•	•	C	RM
Strong and Volkoff 2010	•	•	•	✓	✓	•	•	•	D	RT
Veres and Mansson 2005	•	•	•	•	•	•	✓	•	G	RM
Wand et al. 1995	•	•	•	•	•	•	✓	•	F	RM
Wand and Wang 1996	•	✓	•	•	•	•	•	•	C	RM
Wand and Weber 2006	•	•	✓	•	•	•	•	•	C	RT
Weber 1996	•	•	•	•	•	✓	•	•	E	RM
Wyssusek 2004	•	•	•		✓	•	•	•	G	RT
Wyssusek 2006	•	•	•	•	✓	•	✓	•	G	RT
Wyssusek and Klaus 2005	•	•	•	•	✓	•	✓	•	G	RT
zur Muehlen and Indulska 2010	•	•	✓	•	•	•	•	•	C	RM

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