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# Three Studies Examining the Potential for Relational Reasoning to Enhance Expertise in Complex Audit Domains

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# THREE STUDIES EXAMINING THE POTENTIAL FOR RELATIONAL REASONING TO ENHANCE EXPERTISE IN COMPLEX AUDIT DOMAINS

by

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# ABSTRACT

This dissertation consists of three studies that explore the potential for relational reasoning to advance research on the facilitation of expertise in complex audit domains. Study One seeks to explicate the potential that theory and methods from relational reasoning and associated research have to advance the audit expertise research stream. The implications for future research on facilitating auditing expertise are discussed in synchrony with future research questions, including whether or not such strategies will be effective in domains with more than minor relational complexity. Studies Two and Three experimentally examine the use of metacognitive skills intended to enhance relational knowledge, which is considered to be a fundamental component of domain expertise. Study Two investigates the effects of alternate forms of prompting for analogical comparison and Study Three explores the impact of combining analogical comparison with direct instruction on discerning the relational structure of a domain. The results of Study Two do not support the expected positive effects of the analogical comparison interventions. Implementation of effective interventions to prompt the comparison requires further research. Additionally, the results of Study Three do not support the hypotheses, by conventional standards. However, there is some evidence of positive effects associated with the analogical comparison intervention. This dissertation contributes to the literature on audit expertise by describing how relational reasoning can play a role in advancing research in this stream and by providing some preliminary information regarding the effectiveness of specific implementations aimed at enhancing relational knowledge.

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# TABLE OF CONTENTS

STUDY TWO: AN EXPERIMENTAL INVESTIGATION OF INTERVENTIONS TO

IMPROVE KNOWLEDGE TRANSFERABILITY BY ENHANCING ANALOGICAL

# LIST OF FIGURES

# LIST OF TABLES

# GENERAL INTRODUCTION

This dissertation includes three studies that explore the potential for insights from relational reasoning literature to advance research on audit expertise, and in particular the facilitation of expertise in complex audit domains. Audit practitioners are responsible for many tasks that require complex judgments to be made (Trotman 2011). The quality of these judgments has a significant impact on individual engagement audit quality on a micro scale and the value of the audit function on a macro scale. Many of these judgments necessitate the integration and comprehension of many pieces of information (Griffith 2017), which is directly impacted by the extent of expertise obtained by practitioners. It follows then, that the facilitation of greater expertise, earlier in the careers of auditors, is in the interest of audit firms as well as various other stakeholders.

Relational reasoning involves the discernment of meaningful patterns within an information stream and has been determined to be vital to expert performance (Dumas et al 2013). Further, much of the knowledge learned through training or experience in auditing must be adapted before it can be applied in future circumstances, and knowledge that is more relationally structured has been shown to be more readily applied in a flexible manner. Despite this, little research based on relational reasoning literature in psychology has been performed by audit researchers. This dissertation discusses, and experimentally examines, how relational reasoning theories might be used to advance the audit expertise research stream, particularly as it pertains to finding effective methods to foster expertise among novice practitioners.

**Study One: Facilitating Audit Expertise Through Enhancing Relational Reasoning**

Study One seeks to explicate the potential that theory and methods from relational reasoning and associated research have to advance the audit expertise research stream. While the study discusses literature from psychology, it differs from a traditional literature review. Literature reviews are restricted in scope and relatively constrained in nature to summarize a specific theory or narrow research stream. This study focuses on how theory from the core area of relational reasoning as well as closely related areas, in conjunction with methods from the naturalistic decision making paradigm of psychology, offer prospective strategies to facilitate expertise in audit domains. Also included is a discussion of how the nature of the audit environment impacts the study of expertise in audit domains. In order to lay out the context, a brief history of audit expertise research is offered as well as a description of aspects of the audit environment that suggest relational reasoning strategies would be beneficial. This is followed by a discussion of the main tenets of the relational reasoning paradigm of psychology and then by a summary of the scant research in accounting that is based directly on these theories. Subsequently, the implications for future research on facilitating auditing expertise are discussed in synchrony with future research questions, including whether or not such strategies will be effective in domains with more than minor relational complexity.

**Study Two: An Experimental Investigation of Interventions to Improve Knowledge Transferability by Enhancing Analogical Encoding**

Study Two experimentally examines the potential for effortful analogical comparison during task experience to improve audit knowledge transferability. Analogical comparison is regarded as an effective method of providing an understanding of domain principles in order to foster

more transferable knowledge (Gentner & Colhoun 2010; Goldstone, Day & Son 2010). However, research in cognitive psychology provides evidence that people tend not to perform these effortful comparisons unless specifically prompted to do so. The purpose of this study is to examine the potential of effortful analogical comparison to foster the abstraction of domain schemas that are more relationally structured. Predictions suggest that this is a multi-faceted problem involving a lack of awareness, understanding, and motivation. An experiment was conducted that employs the analogical comparison intervention, varying the form of the comparison prompt in order to determine the contribution of each of the aforementioned issues to the "failure to compare" problem, and thus provide insights regarding methods to overcome the failure to compare.

The results of Study Two do not support the expected positive effects of the interventions. Hypotheses that the interventions will enhance schema abstraction and knowledge transfer are not supported. There is reason to believe that effortful comparison does affect relational knowledge acquisition, but that the interventions, as designed herein, are not sufficient to enhance the comparison process.

Study Two contributes to the audit expertise literature by providing insight on a potential deterrent to the development of expertise in audit domains. In addition, the study has implications for audit practice concerning the facilitation of expertise via training in the metacognitive skill of analogical comparison.


**Study Three: Accelerating Audit Expertise by Training Novices to Represent Domains as Experts Do**

Study Three examines the impact that metacognitive skills aimed at discerning the deep

structure of domains can have on knowledge structure and transfer. Specifically, this study examines how analogical comparison and an explicit focus on the deep structure of domains can lead to the abstraction of more structurally-based and flexible domain schemas. This flexibility is essential for the knowledge transfer required in many audit domains. Further, it is posited that these two skills are not substitutes for each other, but rather that a focus on the deep structure of problems can enhance one's analogical encoding as the two dimensions operate separately, and can have a synergistic effect.

An experiment was conducted in a task setting related to the audit of valuations in order to assess the respective impacts of the analogical comparison and deep structure prompts on schema abstraction and knowledge transfer. In spite of substantial theoretical support, experimental results do not support the hypotheses, by conventional standards. However, there is some evidence of positive effects associated with analogical comparison. Potential explanations for the results and suggestions for future research are discussed within the study. This research contributes to the audit expertise literature by introducing two techniques for facilitating the encoding of knowledge that is more transferable, which is essential in the promotion of audit expertise.

## Overall Contribution

This dissertation contributes to the literature on audit expertise by describing how relational reasoning can play a role in advancing research in this stream, which has become essentially dormant, and by taking steps in examining the effectiveness of specific strategies aimed at enhancing relational reasoning in audit domains. The immediate goal of the dissertation is to motivate others to take up the challenging work of mapping out the requisite knowledge

4

associated with complex audit domains and to discover effective methods of fostering knowledge

transfer between and within individuals, with the ultimate goal of assisting audit practitioners in

implementing such methods.

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# STUDY ONE: FACILITATING AUDIT EXPERTISE THROUGH ENHANCING RELATIONAL REASONING

## Introduction

Practitioners in the audit industry must make many judgments in completing audit tasks, some of which are quite complex (Trotman et al. 2011). The quality of judgments, as part of individual audit tasks, collectively have a significant impact on the overall quality of an audit, and potentially on the value of information reported to stakeholders. These judgments require the integration and comprehension of many pieces of information (Griffith 2017), some provided during the course of a particular audit, and some not. The ability to integrate information provided in the course of an audit both internally, and with external information, is directly impacted by the level of expertise possessed by the audit practitioner. Therefore, it is in the direct interest of audit firms, and the indirect interest of other stakeholders, including clients, to ensure that auditors acquire the requisite expertise as they progress through their careers.

The purpose of this paper is to elucidate the potential that theories and methods from relational reasoning and associated research have for informing and advancing audit research on fostering expertise within complex audit domains. Unlike traditional literature reviews, which tend to be narrow in scope, with the objective of summarizing a body of literature, this study focuses on the core ideas of the relational reasoning paradigm, in conjunction with some ideas and research methods from other relevant paradigms, in the context of the audit environment and how they can help to advance research on audit expertise. Thus, the scope herein is somewhat less constrained, which is deemed necessary to convey the cross-section of related theoretical perspectives. Additionally, the audit research based directly on theory from the relational

reasoning paradigm is scant, and there is minimal consideration of the extant literature reviews on relational reasoning in psychology. The contribution of this study is to explicate the potential effectiveness of these theories and methods specifically in audit domains that require complex decisions and cognitive flexibility.

Driven by increasing complexity in the business environment as well as advances in technology and policy, the audit profession is undergoing a period of rapid change in which audit processes are being redesigned and methods of further automating routine tasks are being explored. The fundamental changes suggest that auditors will need greater expertise in a broader range of areas, and likely will need to develop this expertise earlier in their careers (Bratten et al. 2013; Brown-Liburd & Vasarhelyi 2015; PWC 2015; Cohn 2017; Mizar 2018). Therefore, methods of improving the facilitation of expertise among auditors are arguably more important now than ever, and academics have the ability to influence change through advancing research on audit expertise.

There is an extensive history of research in the area of audit expertise. However, since its peak in the 1990s, this stream has slowed considerably and there is much work left unfinished, particularly along the lines of how to foster individual expertise in complex domains. One particular areas of psychology research that appears fruitful for complex decision environments like many of those found in auditing is relational reasoning, which utilizes relational patterns. Relational patterns exist in many domains not at the featural level, although sometimes in addition to the featural level, but at level of the relational structure between domain features, i.e. relations between knowledge elements such as individual concepts. The audit environment is comprised of many domains that contain underlying relational patterns due to factors including the purpose of for-profit entities; accounting standards; incentive structures; measurement

methods; and human nature, but also a considerable amount of variation between instances at the surface level. Because of this surface level variation, knowledge acquired through past experience must often be adapted in order to be useful for inference about current instances. In domains such as these, an adaptive form of expertise, characterized as having a focus on knowledge transferability (Hatano & Inagaki 1986; Barnett & Koslowski 2002), is critical. Therefore, research on facilitating expertise in audit domains should seek not only to aid novices in acquiring knowledge, but in ensuring that the knowledge is encoded in a manner that renders it transferable to new domain instances with underlying similarity. Relational reasoning has the potential to serve as the critical mechanism necessary to foster knowledge transfer.

Extensive research on relational reasoning has linked it to expertise (e.g. Dunbar 2001; Day & Goldstone 2012; Chi & VanLehn 2012; Dumas et al 2013; Goldwater & Schalk 2016), described it as a fundamental aspect of general cognition(e.g. Holyoak & Thagard 1997; Hofstadter 2001; Gentner & Colhoun 2010; Halford, Wilson, Phillips 2010; Dumas et al 2013; Alexander 2016; Alexander et al 2016a), and suggested it can theoretically integrate intuitive and intentional (or analytic) systems of cognitive processing (i.e. system 1 and system 2 thinking) (Halford et al 2010; Alexander 2016).

One of the most significant challenges to acquiring extensive knowledge of relational patterns (which is the basis for expertise) is the distraction caused by irrelevant surface details during the encoding of domain knowledge to memory, which interferes with relational reasoning primarily during the retrieval and mapping subprocesses (Day & Goldstone 2012). Techniques such as analogical comparison (Alfieri et al 2013) have shown potential at overcoming this problem in psychology experiments and provide a promising avenue for handling the same challenges in audit domains. However, questions remain as to their effectiveness in environments

9

with significant relational complexity, such as complex audit tasks.

There has been some audit research in fields that are tangential to relational reasoning, such as systems thinking (e.g. Brewster 2011; O'Donnell & Perkins 2011) and general pattern recognition (e.g. Bedard & Biggs 1991; Brown & Solomon 1991; Hammersley 2006), and audit research has concluded that the assessment of relational patterns is vital to making high quality judgments in many audit domains (Griffith 2017). Notwithstanding this, very little research in auditing, or the broader field of accounting, has been directly informed by research from relational reasoning and related paradigms, such as those of transfer and similarity.

Audit researchers have the opportunity to move forward in the relatively quiescent stream of audit expertise research by utilizing insights from relational reasoning research in psychology to facilitate a more adaptive form of expertise which is appropriate for many audit domains. In addition, opportunity exists in embracing varying research methods, in addition to the traditional behavioral experiments, such as those found in cognitive task analysis (Crandall et al 2006), which is also recommended in the relational reasoning paradigm of psychology (Alexander et al (2016a).

The remainder of this paper provides background information on expertise research in auditing and the nature of the audit environment, a summary of the tenets of relational reasoning research from psychology, a summary of accounting research directly informed by the relational reasoning paradigm, and implications for research on audit expertise motivated by relational reasoning research theories and methods, including methods based on ideas from cognitive task analysis. Specific future research opportunities pertaining to applications of general relational reasoning research in auditing, innovations in knowledge elicitation and representation, variation in training and simulation, training in metacognition, and issues associated with distributed

expertise and deskilling are also discussed.

## Background

Audit practitioners engage in many tasks that require significant judgments to be made (Nelson & Tan 2005). The quality of these judgments is impacted by the level of expertise previously obtained by the practitioners involved and the outcomes of such judgments can have a significant effect on audit quality. Additionally, the audit profession appears to be entering into a period of rapid change associated with routine tasks being automated and audit processes being redesigned. There is also pressure for audit firms to make use of contemporary technologies in audits. This signifies a future audit environment in which practitioners will be required to possess a higher level of expertise (or at least sufficient proficiency) in a wider range of domains and to do so earlier in their careers (Bratten et al. 2013; Brown-Liburd & Vasarhelyi 2015; PWC 2015; Cohn 2017; Mizar 2018).  For example, in order to responsibly make judgments in the areas of valuation and advanced data analytic methodologies, audit practitioners will need sufficient expertise in these peripheral domains. This is not an implication that auditors must become masters of all task domains associated with completing a sophisticated audit.  However, auditors will need to possess sufficient knowledge related to these other areas to communicate with specialists, understand associated risks, interpret outcomes, and fulfill responsibilities which are mandated by auditing standards. In short, the demands of the modern audit environment require an accelerated path to expertise in core audit domains and, at minimum, proficiency in an expanding scope of task domains that are becoming, or will likely become, more critical to the provision of audit opinions. Thus, fostering expertise among audit practitioners may now be

more important than ever.

A related challenge created by increased complexity and automation in audit practice is the risk of deskilling throughout audit practice, as this is inversely related to practitioner expertise (Arnold & Sutton 1998). Another way to think about deskilling is to conceive of all knowledge required to complete a task linked into a complex knowledge structure (a mapping of the entire system of knowledge). The more of this knowledge that is automated, and thus is not necessarily required by the practitioner to complete the task, the larger the 'holes' in the practitioner's existing knowledge structure (mental model) are likely to become. The less of the total knowledge possessed by the practitioner, the greater the amount of systematic relations between knowledge components that will also be absent, and this can lead to serious problems in comprehension of interactions among inputs and outputs of the task.

*A Brief History of Expertise Research in Auditing*

Expertise research in the auditing literature has an extensive history. A significant amount of work was performed in the 1980s and 1990s in what has been termed the 'expertise paradigm' (Frederick & Libby 1986; Libby & Luft 1993). For reviews that capture much of this history, see Bedard & Chi (1993); Bouwman & Bradley (1997); and Bonner (2008). Libby & Luft (1993) created a model of the antecedents and consequences of knowledge (ACK) which includes relations between experience, ability, knowledge, and performance[1]. Other factors such as effort, motivation, and environmental factors are also discussed, but excluded from the model. Models in Libby & Tan (1994) expand on this by explicitly recognizing that the relations among these

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[1] The ACK is based heavily on prior work by Bonner & Lewis (1990), Bonner (1990), and Frederick (1991), as well as others.

variables would not be consistent across all tasks, due to differences in task structure and learning environments. Hammersley (2011) appended the ACK by explicitly including epistemic motivation in a model of Planning Stage Fraud Risk Assessment and Audit Program Modification. The majority of expertise research follows the expertise paradigm initially outlined by Frederick & Libby (1986) and subsequently elaborated upon in Libby & Luft (1993). Essentially, the literature has focused on attempting to understand, or reverse engineer, expertise in auditing by looking at differences between experts and novices and attempting to ascertain the determinants of such expertise (e.g. Bonner & Lewis 1990; Bonner 1990; Bedard 1991; Bedard & Mock 1992; Libby & Luft 1993; Tan & Libby 1997). Additionally, areas such as knowledge structures (e.g. Choo & Trotman 1991; Frederick 1991; Tubbs 1992; Frederick, Heiman-Hoffman, Libby 1994; Bedard & Graham 1994; Nelson, Libby, and Bonner 1995; Bonner, Libby, and Nelson 1997; Bierstaker, Bedard, and Biggs 1999; Curtis & Davis 2003), knowledge acquisition (e.g. Waller & Felix 1984; Bonner & Walker 1994; Wynder & Luckett 1999; Earley 2001; O'Donnell 2003; Borthick, Curtis, and Sriram 2006; Smedley & Sutton 2007; Rose, McKay, Norman, Rose 2012), abilities (e.g. Bierstaker & Wright 2001; Bradley 2009), characteristics of experts (Abdolmohammadi & Shanteau 1992; Kent, Munro, and Gambling 2006), pattern recognition (e.g. Bedard & Biggs 1991; Brown & Solomon 1991; Hammersley 2006), task differences (e.g. Abdolmohammadi & Wright 1987; Bonner 1994; Libby & Tan 1994; Tan & Kao 1999; Tan, Ng, and Mak 2002), expert systems (e.g. Steinbart 1987; Murphy 1990; Vinze et al 1991; Ragothaman, Carpenter, and Buttars 1995), computational models (e.g. Biggs et al 1993; Peters 1992; Wright et al 2004), as well as analogical reasoning and knowledge transfer (e.g. Biggs, Messier, and Hansen 1987; Marchant 1989; Marchant et al 1993; Thibodeau 2003; Magro & Nutter 2012) have been investigated to varying extents. A trend toward

13

investigating industry expertise took hold in the 2000s as a natural offshoot to the more general expertise literature (e.g. Wright & Wright 1997; Solomon, Shields, and Whittington 1999; Taylor 2000; Low 2004; Moroney 2007; Moroney & Carey 2011).

Much of the research on expertise in auditing has focused on examining the nature of expertise within audit domains, with particular interest in differences between experts and novices. However, there has been less research on how to foster expertise in auditing despite calls by prominent researchers (Bedard & Chi 1993, Nelson & Tan 2005).[2] Bedard & Chi (1993) provided an edifying discussion regarding expertise in audit settings. Mentioned in the paper is the importance of knowledge structure, deep features in knowledge structures, and a lack of audit research directly examining these issues. Additionally, a call for further research on training for expertise is made. Nelson & Tan (2005) characterize the expertise paradigm as focusing on the interactions between knowledge and tasks and also state the importance of investigating the process of knowledge acquisition that leads novices toward expertise in auditing domains, and how little of this research had been performed. This paper seeks to motivate and inform research in this area of facilitating the acquisition of expertise by novice auditors with a specific focus on accomplishing this through improving relational reasoning by auditors.

*The Nature of the Audit Environment and the Need for Relational Reasoning*

Domain Stability

Domain stability refers to stability underlying the relationships between elements of the specified domain and it follows that domain stability should moderate the relationship between

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[2] Some notable exceptions since Bedard & Chi (1993) include Bonner & Walker (1994); Wynder & Luckett (1999); Earley (2001); Borthick, Curtis, and Sriram (2006); Brewster (2011); and Rose, McKay, Norman, and Rose (2012).

experience and knowledge. Kahneman & Klein (2009) refer to this phenomenon as high versus low validity environments and suggest that high validity environments (stable domains) can lead to intuitive expertise as the causal structure of the environment can be learned through experience. They posit that skilled intuition (expertise) can only occur in domains of sufficient regularity that provide appropriate situational cues.

> "We describe task environments as 'high-validity' if there are stable relationships between objectively identifiable cues and subsequent events or between cues and the outcomes of possible actions." Kahneman & Klein (2009, p.524).

Kahneman & Klein (2009) refer to environments of sufficient predictability as high-validity environments and assert that many professional environments meet this criterion. They also state that high validity environments are not meant to be thought of as void of uncertainty, only that there exists sufficient regularity such that patterns exist and can be inferred by experts. In other words, validity and uncertainty can coexist.

> "Validity and uncertainty are not incompatible. Some environments are both highly valid and substantially uncertain. Poker and warfare are examples. The best moves in such situations reliably increase the potential for success." Kahneman & Klein (2009, p.524).

Low validity environments, on the other hand are extremely noisy. They are considered too complex and unstable for even trained, experienced practitioners to be able to perform well. Stock market prediction has been given as an example of such a domain (Kahneman & Klein 2009). In contrast, the practice of medicine is given as an example of a high-validity environment, as there are stable relationships within the environment, even though there remains considerable uncertainty.

The studies of expertise in the expert performance paradigm of psychology involve fairly stable environments. Many tasks in the auditing environment may be relatively more dynamic.

However, for most there are still perceivable, underlying patterns caused by the nature of business operations, the incentives of managers, the structure of double entry accounting and GAAP, etc. In references to analytical procedures, for example, PCAOB AS 2305 section 2 states: "Analytical procedures are an important part of the audit process and consist of evaluations of financial information made by a study of plausible relationships among both financial and nonfinancial data." The stability of the environment is due to the stability of these relationships between instances. The guidance goes on to state: "A basic premise underlying the application of analytical procedures is that plausible relationships among data may reasonably be expected to exist and continue in the absence of known conditions to the contrary". This implies an assumption of stable relationships.

In highly stable domains, which can be characterized as having sets of strict constraints (such as fixed rules in the example of games) and little variation between instances, a routine form of expertise may be sufficient. Many of the classic expertise studies and those in the expert performance paradigm have examined domains such as chess (e.g. Chase & Simon 1973), as well as music and sports (Ericsson, Krampe, and Tesch-Römer 1993), which adhere to this characterization. While games and songs may differ, they are subject to set constraints (such as rules in games or notes, keys, and scales in music) that do not vary between instances. Additionally, much of the expertise in fields such as sports and music is related to psychomotor skills, for which a routine type of expertise may be ideal. On the other hand, in domains that are very unstable, expertise is likely not plausible as extreme variation, or apparent randomness, will make recognition of current states or prediction of future states nearly impossible. However, there exists a space on the domain stability continuum in which there is enough underlying structure to render expertise plausible, but enough variation between instances that existing

knowledge must be adapted to be used. In other words, these domains are moderately stable, but

exhibit significant variation. These domains are where an adaptive form of expertise is

paramount and the practice of auditing, in addition to several other accounting settings,

comprises many such domains.


Adaptive Expertise and Knowledge Transferability

Routine expertise is characterized as an ability to solve familiar problems quickly and easily,

whereas adaptive expertise (as articulated by Hatano & Inagaki 1986) entails being able to

transfer existing knowledge for use in solving novel problems within a domain (Holyoak 1991;

Barnett & Koslowski 2002; Moser-Mercer 2008). From an audit expertise perspective,

Bouwman & Bradley (1997) express that routine expertise would benefit from a knowledge base

that contains a very large number of schemas, as essentially each problem encountered by a

routine expert would be solved by the application of an existing schema in memory that fits the

parameters of the current problem. They echo Hatano & Inagaki (1986) by stating that adaptive

expertise is "based on a deeper conceptual understanding of the task domain".

The audit environment consists of numerous tasks that require knowledge learned from

training or previous work experience to be adapted before it can be applied to similar situations.

For example, an audit task learned at one client may differ on several dimensions, with varying

levels of relevance, at another client. Similarly, an audit task performed at a client may be

different at the same client in a subsequent period due to internal or external changes. Thus,

knowledge transferability is important in the generation of expertise in auditing and research

associated with relational reasoning offers methods to enhance the transferability of such

knowledge. The flexibility of auditors' mental models can potentially be augmented by

17

improving their relational knowledge, both domain-specific and of certain types of general knowledge categories, and their ability to use such knowledge.

*Summary of Research on Relational Reasoning and Associated Topics*

Relational reasoning has been associated with expertise (e.g. Dunbar 2001; Day & Goldstone 2012; Chi & VanLehn 2012; Dumas et al 2013; Goldwater & Schalk 2016), described as foundational to general cognition (e.g. Holyoak & Thagard 1997; Hofstadter 2001; Gentner & Colhoun 2010; Halford, Wilson, Phillips 2010;  Dumas et al 2013; Alexander 2016; Alexander et al 2016a), and even suggested as integrating intuitive and intentional (or analytic) systems of cognitive processing, also referred to as system 1 and system 2 thinking (Halford et al 2010; Alexander 2016). Modern neuroscience has demonstrated a strong link between relational reasoning and activity in the pre-frontal cortex (PFC), which is associated with higher order reasoning, and suggests that relational reasoning is fundamental to higher cognition (Krawczyk 2012). Dumas et al (2013, p.392-393) refers to relational reasoning as "central to human cognition" and a "hallmark of expert performance", and based on a review of research regarding relational reasoning, derives four manifestations of relational reasoning which include analogy, anomaly, antinomy, and antithesis. Analogy involves the identification of structural similarity between multiple objects or domains. Anomaly is described as the recognition of the departure from an expected pattern. Antinomy is the perception of incompatibility between otherwise reasonable components of an information set. Antithesis involves identifying informational elements or concepts as direct opposites. Alexander (2016) delineates the ideas of relational thinking and relational reasoning by stating that both involve the recognition of relational

patterns within streams of information, but that relational thinking is more intuitive (akin to system 1 thinking) whereas relational reasoning is effortful and necessary for higher cognition (akin to system 2 thinking).

Analogy, or analogical reasoning, is by far the most commonly researched of the four manifestations, indicating its overall importance. From the perspective of research on knowledge transfer, Day & Goldstone (2012) similarly state the importance of analogical reasoning to the knowledge transfer field, by stating that transfer research has been largely shaped by theories from analogical reasoning and their associated symbolic process approaches to cognition. Expertise has been strongly associated with the recognition of patterns in both psychology and auditing research (Kahneman & Klein 2009; Brown & Solomon 1991; Hammersley 2006). However, it is also widely accepted that it is the patterns in the deeper, relational structure of problem domains that are most critical for inference, as well as expertise (e.g. Gentner 1983; Chi & VanLehn 2012; Richey & Nokes- Malach 2015; Bedard & Chi 1993; Christ 1993; Vera- Munoz, Kinney, and Bonner 2001). This deeper knowledge of domain relations improves not only the comprehension of individual instances or cases, but also the transfer of knowledge to new instances. Analogical reasoning is one of the prime mechanisms by which knowledge of relational patterns is used to make inferences about new instances or domains with structural similarity. It is commonly described as consisting of (at least) four distinct component processes, albeit under slightly differing terminology. These processes include: 1) Retrieval; 2) Mapping; 3) Transfer (inference); and 4) Schema abstraction (learning) (Gentner & Colhoun 2010; Holyoak 2012).

Retrieval consists of obtaining existing knowledge from long term memory (the source analog) that has potential relevance to understanding the current situation or problem in working

memory (the target analog), based on the cues of the current situation. Mapping is a process in which the correspondences between the elements (i.e. the objects and relations) of sources and potential targets are assessed in order to establish how suitable the source analog is for making inferences about the target. Transfer includes using knowledge of the source analog, and its level of correspondence with the target analog, to make inferences about the target analog regarding elements potentially missing from the target representation. Schema abstraction is the fourth stage of analogical reasoning. The process of reasoning between analogs augments existing knowledge of the source by integrating information from an associated target analog. Thus, the process leads to evolution of the existing schema. Although the majority of research regarding relational reasoning has been performed in the area of analogical reasoning, Grossnickle et al (2016) provides evidence that component processes used in analogy may also be used in the other manifestations of relational reasoning.[3]

An important and enduring early theory of analogy is Gentner's (1983) Structure Mapping Theory (SMT), which provides a description of analogy as the mapping of one domain (analog) to another based on the level of structural alignment between the two. Two principles underlie this mapping process. The first principle regards the aligning of objects (concepts) within a domain, as well as the relations between the objects, with the explicit recognition that not all elements within a domain have equal relevance for making inferences and that relations tend to be more important than objects (and particularly object values). The second principle is referred to as 'systematicity', which formally states that "A predicate that belongs to a mappable system of mutually interconnecting relationships is more likely to be imported into the target than is an

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[3] Grossnickle et al (2016) uses the component processes as described in Sternberg's (1977) model of analogy, which include encoding, inference, mapping, and application. Although the terms and process descriptions are somewhat different, the fundamental, underlying ideas of mapping between knowledge in memory and the data stream of a current problem space in order to make an inference or derive an answer are essentially the same.

isolated predicate" (p.163). In essence this suggests a preference for relations over objects and object values, higher order relations (as "higher order predicates enforce relations between lower order predicates"; p.162), and networks of deep, interconnected relations.

Relational reasoning, knowledge evolution, and ultimately expertise development are impacted by the level of understanding of the deep relational structure of domains. A significant impediment to developing this understanding is the distraction created by surface level details, as the surface features of a problem tend to lead to recall of other problems or instances that include the same features, often impeding the recall of other problems or instances that include a similar relational structure to the present problem (Ross 1987; Reed 1987; Gentner, Ratterman, and Forbus 1993). Day & Goldstone (2012, p.154) summarize the issue as such:

"By far the most robust finding involves the influence of the concrete surface similarities between cases. Although psychologists view structural similarity as the critical component in meaningful, productive knowledge transfer, research has repeatedly shown that it is the surface commonalities between cases that are more often the driving force in determining whether transfer actually occurs."

The idea that structural similarity is more important for inference than surface similarity does not only rest on psychological theory. Gentner et al (1993) found that participants provided with a target story were primarily reminded of previously given stories that matched on surface similarity despite the fact that they rated the inferential power of structurally similar stories greater than that of stories with only surface level matches. The impact of surface similarity occurs chiefly in the stages of retrieval and mapping, in spite of a general awareness regarding the importance of relational structure (Day & Goldstone 2012). It follows that the impacts in the early stages of retrieval and mapping are likely to cause detrimental downstream effects in the stages of inference and abstraction. The distraction of surface features can potentially lead to failure to retrieve or map similar analogs, incorrect retrieval or mapping of analogs, as well as

undue burden on working memory, especially in cases where surface details are not at all relevant for comprehension. Chi & VanLehn (2012) suggest that the cause of this phenomenon is the relatively greater perceptibility of surface features compared to that of relational structure. Thus, if attention is not explicitly given to the relational structure of a domain during training, or on the job experience, the schemas abstracted will likely contain less of the relational structure.

Surface level features such as business lines, specific products, geographic markets, people performing assessments, et cetera, will vary between task instances. However, key underlying structural patterns due to factors such as the nature and mission of for profit entities, accounting standards, incentive structures, measurement methods, and human nature can be expected to remain fairly stable. Thus, much information contained in the relational structure of schemas gained from past experience can be used to generate inferences in future instances of a task, or potentially even distinct, but related tasks. In fact, the assessment of such relational patterns is critical to the quality of judgments in many audit domains (Hammersley 2006; Griffith 2017).

The fundamental importance of relational reasoning, as discussed above, implies that it may be the key to enhancing, or accelerating, paths to expertise in a complex decision environment such as auditing. Instructional strategies that have been shown to benefit transfer include analogical comparison (Gick & Holyoak 1983; Catrambone & Holyoak 1989; Gentner Lowenstein, and Thompson 2003), self explanation (Chi, Bassok, Lewis, Reimann, and Glaser 1989; Renkl 1997; Chi 2000), principle identification (Chi & VanLehn, 2010; VanLehn & Chi, 2012), stressing mastery over performance goals (Bereby-Meyer, Moran, and Unger-Aviram 2004; Bereby-Meyer & Kaplan, 2005), and relational priming (Spellman, Holyoak , and Morrison 2001; Estes & Jones 2006; Bliznashki & Kokinov, 2010). Further, Alexander et al (2016a) suggests that relational reasoning itself is a directly teachable skill. Similarly, Chi &

VanLehn (2012) suggest direct intervention aimed at training novices to represent problems as experts do, i.e. by 'seeing' the deeper relational structure.

Regarding the measurement of individual relational reasoning ability, Alexander et al (2016a) lists multiple methods to do so, which may be useful in examining changes in such ability over time as well as determining the impact of that ability to the development of expertise, particularly in complex domains such as auditing. The various measures include psychometric measures, naturalistic observational techniques, and cognitive interviews. A psychometric test of particular interest is the recently developed test of relational reasoning (TORR) (Alexander et al 2016b; Dumas & Alexander 2016), which allows for the measurement of relational reasoning and is purported to be applicable in the measurement of the four distinct manifestations of analogy, anomaly, antinomy, and antithesis.

In addition to examining similarities, differences, and underlying processes associated with the four manifestations of relational reasoning and devising improved methods of measuring relational reasoning, current research seeks to explore individual differences in relational reasoning abilities (Kubricht, Lu, and Holyoak 2017; Grossnickle et al 2016); the construct of relational categories (Gentner & Kurtz 2005; Goldwater & Schalk 2016) and the integration of relational reasoning with causal reasoning (Lee & Holyoak 2008; Colhoun & Gentner 2009; Holyoak, Lee, and Lu 2010; Rottman, Gentner, and Goldwater 2012); and ideas from systems thinking and systems science (Goldstone & Wilensky 2008; Day & Goldstone 2011; Goldwater & Gentner 2015), with some studies crossing over the boundaries between these, e.g. Rottman, Gentner, and Goldwater (2012). The merging of ideas from research paradigms that engage in the study of traditional relational reasoning and those that involve a systems perspective is a natural fit and it is worth noting that ideas from systems thinking and systems science can also

inform research on facilitating expertise through relational reasoning in auditing and other accounting domains.[4]

An area of research that may be particularly relevant to audit domains is the convergence of relational reasoning and causal reasoning, as many complex audit tasks require empirical knowledge of the world that consists largely of causal relational structures (e.g. client acceptance, analytic testing, and complex estimates). Holyoak, Lee, and Lu (2010) provides a theoretical integration of analogical reasoning and Bayesian causal reasoning, essentially acknowledging that causal relations are *special*, and not just special cases of the general class of higher order relations. This revised theory is a more general version of prior theories of causal reasoning in that it is posited to be applicable in domains with high uncertainty and relational richness. At the heart of this theory is empirical evidence that causal relations impact the component processes of analogical reasoning (and presumably the other manifestations of relational reasoning) in ways that deserve singular recognition. Lee & Holyoak (2008) provide evidence that in structures that include causal relations, the associated causal knowledge, particularly in cases with multiple causes that include both positive (generative) and negative (preventive) polarity, has a greater impact on mapping than overall structural similarity. The theory also predicts that in cases which include preventive causes, the patterns of inference will vary with the directionality of the cause (i.e. prediction vs. attribution). The theory also addresses issues related to strength of causal relations and causal discounting.

There is some disagreement about the mechanics of the integration of causal and analogical reasoning. Gentner and colleagues (Colhoun & Gentner 2009; Myers & Gentner 2017) disagree

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[4] The terms 'systems thinking' and 'systems science' may be used interchangeably, thought of as variations on a theme, or even contrasted by different scholars and practitioners. Generally they tend to be considered as similar ways of thinking about the world, but with different applications (Cabrera et al 2008; Midgley 2008). The commonalities between the two are referred to herein as a systems perspective.

with the theory of Holyoak and colleagues discussed above, stating that the processes can be

explained by existing theory of analogical reasoning and that the influence of causal knowledge

occurs as part of an evaluation process post-mapping. The debate seems to be as of yet

unresolved, but the integration of causal reasoning with analogical (or the more general

relational) reasoning appears to be an area with great potential in understanding, representing,

and facilitating expertise in audit domains. Other interesting aspects of causal relations have also

been recently examined, for example competition among causal relations (Powell et al 2016) and

sequential causal learning and transfer (Lu, Rojas, Beckers, and Yuille 2016), and their potential

to inform our understanding of expertise in audit domains is another avenue for future

exploration.


*Summary of Relational Reasoning Research in Accounting*

Based on the assumption that research in a particular domain of accounting has some

potential to generalize to other domains, and due to the very scant amount of relational reasoning

research in audit, research from other areas of accounting, e.g. tax, are also included in this

section. There has been little research in accounting domains that investigates relational

reasoning, and that research has focused exclusively on analogical reasoning. Further, the

findings from these studies provide mixed evidence. In an early study on analogical reasoning in

an audit setting, Marchant (1989) suggests that experts and novices utilize analogy as a strategy

similarly or differently depending on the situational circumstances, further proposing that both

will use analogy in unfamiliar situations, but experts will rely on domain specific knowledge in

familiar situations. Building on this research, and moving into a tax setting, Marchant and

colleagues (Marchant, Robinson, Anderson, and Schadewald 1991; 1992; and 1993) collectively suggest that analogical reasoning does not increase with greater experience (expertise) in a domain.

In a more recent study, Magro & Nutter (2012) find that, consistent with theory, decision makers with greater domain experience will make use of analogical reasoning significantly more so than decision makers with less domain experience. Further, the difference between these findings and those of the tax setting research by Marchant and colleagues is thoroughly explained as being due to design issues within those studies, namely the experience differential of the participants, task structure, and overall difficulty level of the target cases. Similar to Magro & Nutter's (2012) claims about Marchant and colleagues' work in the tax research, the design and conclusions of the Marchant (1989) audit study are similarly susceptible to significant criticism. Based on the 'transfer paradigm' of Gick and Holyoak (1980; 1983), in which participants are typically given a case that serves as a potential solution (the source analog) to a problem with structural similarity, but in differing contextual circumstances (the target analog), Marchant's (1989) study arguably entangles the classic transfer paradigm with the use of existing knowledge (or beliefs) about empirical frequency. Source analogs in the classic transfer paradigm act as transferable knowledge available for the participants; they are not expected to contradict existing domain knowledge that is relevant to the target analog. The source analog in the 'performance condition', one of the two conditions of Marchant's (1989) study, may contradict existing knowledge possessed by experienced practitioners about the likelihood of different hypotheses. Participants are offered a different example in each of the two conditions, both offering plausible hypotheses to be applied to the target analog, but with one known to be more likely. In the 'timing condition' which offers the more likely hypothesis as a source analog,

experts select this more often than not as the potential solution, similar to the experts in the control condition which received no source analog. This is interpreted in the paper as the experts not using analogical reasoning, but instead relying on domain knowledge to solve the problem. However, the knowledge applied by the experts involves knowledge of the statistical properties of causal relations gained from prior real world experience in situations with similar structure but differing surface features. Applying this knowledge to the target case is in fact an example of analogical reasoning, and possibly other manifestations of relational reasoning. It is exactly this type of deep relational knowledge that the present paper suggests needs to be imparted to novices, or that that they may be able to learn more efficiently on their own if properly trained.

Thus, a reinterpretation of the findings from Marchant (1989), in conjunction with the prevailing evidence from Magro & Nutter (2012), seems to suggest that greater domain experience has the potential to lead to improved relational reasoning within accounting domains. Further, it is posited herein that this is due to greater and more sophisticated knowledge of relational structures obtained through mostly implicit learning over a larger experience set. Additionally, from the viewpoint of accounting education, Hanson & Phillips (2006) provide evidence that introducing an accounting subject via the use of analogy enhances subsequent learning of the topic.

Systems thinking, and related fields such as dynamical systems, are largely concerned with mapping systems, physical and abstract, both formally (e.g. in computational models) and in the knowledge structures of humans. This has direct relevance to, and arguably is simply another form of, relational reasoning, as systems thinking involves symbolic representations of concepts connected by relations, and these relations are often higher order, such as causal relations. In an auditing context, systems thinking has been introduced through the Strategic Systems Auditing

(SSA) approach (Bell, Marrs, Solomon, and Thomas 1997; Peecher, Schwartz, and Solomon 2007) which involves recognizing auditee entities as complex adaptive systems and seeking to adjust thinking in, and the associated methods of, auditing accordingly.[5]

Using the system dynamics in business approach of Sterman (2000), Hecht (2005) provides evidence that training in systems thinking can improve performance in an internal controls assessment task by enhancing the causal structure of mental representations. Brewster (2011) finds similar results in an analytical procedures task and further demonstrates that the improved mental representations can lead to reduced load on working memory. O'Donnell & Perkins (2011) provide evidence that using causal loop diagrams derived from systems thinking principles led to better perception of diagnostic relevance of accounts with inconsistent patterns and improved recognition of misstatement risk. Additionally, in a complex estimates task, Bucaro (2015) shows that even a relatively simple systems thinking intervention can significantly impact auditors' understandings of process complexity, and that this understanding leads to improved judgments regarding material misstatement.

*Implications for Audit Research on the Facilitation of Expertise*

General Relational Reasoning

Future research can draw on theory and methodology from relational reasoning research in psychology to examine if there are useful insights that can be applied in order to foster expertise in a real world, complex domain such as auditing. Expertise in any complex domain depends on knowledge of the deep relational structure of the domain. So the primary challenge in facilitating

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[5] For excellent discussions regarding the nature of complex adaptive systems see Holland (1992) and Gell-Mann (1994).

expertise is to aid novices in improving their knowledge structures so that they include this information. From a high level view, this can be done by directly providing such knowledge to novices in a comprehensible format, or by training novices to generate these knowledge structures themselves through their own experiences by being more aware of their own cognition. Research questions pertaining to these challenges, as well as other related questions are discussed in the sections below.

Little research directly informed by relational reasoning literature has been performed in the audit expertise field. As such, there are open questions as to whether this basic psychological research will generalize to more complex domains, specifically those of interest to audit researchers.

General Relational Reasoning Research Questions

**RQ 1:** Aside from analogical reasoning, which other forms of relational reasoning (anomaly, antinomy, antithesis) are common and/or important in audit domains? Can insights from analogical reasoning research be generalized to these other manifestations?
**RQ 2:** How are the component processes of relational reasoning (i.e. Retrieval; Mapping; Transfer; and Schema abstraction) impacted by the level of relational complexity in audit task domains?
**RQ 3:** If breakdowns in relational reasoning occur among auditors in audit tasks, in which component processes do they occur and why?
**RQ 4:** Can a relational reasoning perspective of audit expertise play a role in integrating intuitive and analytic cognition (system 1 & 2) in research on audit judgment and decision making?
**RQ 5:** Can using the TORR in experimental settings provide insight on individual differences in relational reasoning and the associated effects on audit judgments and expertise development?
**RQ 6:** Is relational reasoning in audit domains primarily useful in near transfer (transfer of knowledge between instances within the same domain), or can it also be used to achieve far transfer (transfer of knowledge across domains)?
**RQ 7:** How do causal reasoning and relational reasoning interact in audit domains, which consist of more than minimal relational complexity? What are the implications of any such interactions on auditor judgments and expertise generation?

Knowledge Elicitation and Representation

One of the challenges in promoting expertise through training lies in creating, or obtaining,

the related domain knowledge. In order to directly provide sophisticated information about the

relational structure of a domain, this knowledge must be somehow elicited and represented.

For many auditing domains, there is no objectively determined, optimal solution, and thus the

'correct' way of understanding a system, completing a task, or making a decision may need to be

derived from the experts who have performed in the domains successfully, for example through

consensus (Bouwman & Bradley 1997). As the systems that make up auditing domains, the

business environment, and the world in general become increasingly complex, more work is

needed to understand how expert practitioners are making decisions (as well as the knowledge

required to make those decisions) in these domains despite complexity, uncertainty, time

pressure, competing goals, etc.  Much behavioral research in auditing follows from the Heuristics

and Biases paradigm of Kahneman & Tversky (e.g. Tversky & Kahneman 1974), which views

expertise with a skeptical eye. Assessments are often made about how humans compare to (and

fall short of) optimal judgment and decision strategies. As there are often no optimal models on

how to perform audit tasks, a different perspective may be helpful in determining how to go

about capturing expert knowledge. An alternative view is offered by the Naturalistic Decision

Making paradigm (NDM) (Klein 2008; Kahneman & Klein 2009). One of the tenets of the NDM

paradigm is that, instead of starting from formal models of decision making and examining how

practitioners' decisions compare to these models, inductive research is needed to determine how

people actually make decisions in real world environments. Alexander et al (2016a) state that

naturalistic methods are an important component of relational reasoning research. Methods

employed in the NDM paradigm vary broadly and are arguably underutilized in the audit

expertise literature.

There is a long history of eliciting expertise from practitioners in complex work environments in the field of cognitive engineering, and in the NDM paradigm more generally. Over this period, some very effective methods for knowledge elicitation have been developed under the umbrella of cognitive task analysis (CTA). According to Crandall et al (2006), knowledge elicitation, data analysis, and knowledge representation comprise the stages of CTA. A vast array of knowledge elicitation methods categorized into several classes, including interviews; observations; textual analysis; process tracing; conceptual methods; psychometric methods; and other CTA methods, are listed by Crandall et al (2006, Table 2.1 and 2.2). Militello (2001) offers a concise CTA classification scheme based on the types of representations in which the analyses result. Some existing audit research that could be categorized as CTA includes various forms of protocol analyses (Biggs, Messier, and Hansen 1987; Biggs, Mock, and Watkins 1988; Bedard & Biggs 1991; Bedard & Mock 1992; Choo 1996; Bierstaker, Bedard, and Biggs 1999) and computational models (Biggs et al 1993, Wright & Willingham 1997). Researchers should continue to learn from, and utilize, the methods of CTA to perform inductive research on expertise and decision making in auditing domains, including that which is geared toward understanding patterns of knowledge at a more elemental level.

The first step in creating knowledge representations for training purposes is specifying the domain of interest. Expertise is widely thought of as being domain specific (Ericsson, Krampe, and Tesch-Römer 1993; Klein 1997; Bonner & Lewis 1990; Bedard & Biggs 1991). For the purposes of training, domain specification is very important as it involves determining at what level the domain will be envisioned and where the boundaries are to be constructed. If the boundaries are too broad, the resulting domain will likely include too many different tasks that

may need to be examined individually. For example, the audit of complex estimates is a domain that includes many different tasks. Discussion of this level of domain may be appropriate when it relates to the entire class of tasks, such as in Bratten et al (2013). However, this may be too broad to examine the underlying expertise of these tasks due to differences in the goals of the tasks and the corresponding knowledge required to complete them. Modeling knowledge in this fashion can help us determine if auditing complex estimates (a class of tasks) should be taught as a class, in clustered subsets, or as individual tasks (e.g. valuing level 3 assets, assessing goodwill impairment, etc.). Further, where tasks are found to have significant overlap in knowledge elements, novices can be made aware of this in order to help with knowledge transfer, instead of hoping that they may arrive at this conclusion organically.

There are many innovative methods of graphically representing knowledge that are underutilized in existing research concerning audit expertise. Examples include concept maps and knowledge models (Novak & Cañas 2008; Leauby & Brazina 1998; Leauby, Szabat, and Maas 2010; Greenberg & Wilner 2015), Pathfinder network scaling (Schvaneveldt 1990; Curtis & Davis 2003; Rose et al 2007), mind maps (Buzan & Buzan 1996; Wheeldon & Faubert 2009), cognitive maps (Ackerman & Eden 2001), conceptual graphs (Sowa 1984), semantic networks (Fisher 1990), stock and flow models (Richmond 1994; Sterman 2000; Brewster 2011), causal loop diagrams (Sterman 2000; O'Donnell & Perkins 2011), and subsystem diagrams (Sterman 2000), each with their own strengths and weaknesses. These representations are useful for the facilitation, as well as assessment, of expertise. Future research should examine how best to elicit and represent these and other types of models, and how they may possibly be improved by integrating some of the ideas from multiple formats and innovating new formats. Knowledge representations to be used in order to improve knowledge structures of individuals should be as

information rich, yet as accessible as accessible as possible.[6] Research on knowledge

representations should seek methods to demonstrate the system, subsystem, supersystem (parts /

wholes) aspect by including levels so that users can see what is above and below. For example,

can knowledge be represented in three dimensional networks that allow for visualization that

depicts the parts / wholes aspect of the system (pattern) under consideration, and can more

sophisticated relational knowledge be included? For example, information that might be learned

from varied experience includes the level of variation, across instances, of relationships between

components (i.e. the statistical properties associated with the relationships); changes in the

underlying functions of the relationships; and the ranges over which different functions exist. As

experts learn this through experience they are perceiving different patterns, but they may be

incorporating the information associated with these experiences into some form of invariant

representation, which is robust to surface level changes and contains much more information

than the knowledge representations currently being created.

Thus far, the discussion of knowledge representation has been centered primarily on

graphical depictions of knowledge (i.e. knowledge visualization). Another common method to

capture and represent knowledge is in the form of decision rules (consisting of conditional and

Boolean logic, for example) databases. This is typical in the field of expert systems and involves

attempting to reduce domain knowledge to a set of rules. This method is a subfield of artificial

intelligence and notably takes the form of programmable instructions. Some examples in audit

research include computational models (e.g. Biggs et al 1993; Wright & Willingham 1997,

Wright et al 2004) and expert systems (e.g. Steinbart 1987; Ragothaman, Carpenter, and Buttars

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[6] Cognitive fit theory proposes that the correspondence between internal and external representations of a problem impact user performance, and evidence has demonstrated this in domains including accounting (Dunn & Grabski 2001; Vessey 2006).

1995; Lombardi & Dull 2016). In certain domains this may be a very useful technique, but the number of rules needed can quickly become very large in many real world domains, especially if the domain requires flexibility and adaptability, as this must also somehow be incorporated and a simple rule set does not afford this. The flexibility of rule sets can be enhanced by methods such as fuzzy logic and machine learning, in certain domains where data is available. Expert systems often contain a considerable amount of knowledge and therefore have potential as tools for the facilitation of expertise among novices. However, traditional decision rule sets are arguably not a great method for training, due to a potentially overwhelming number of rules and a lack of graphical depiction (visualization). Future research could examine how expert systems might be designed to facilitate the promotion of audit expertise in users rather than simply being repositories of knowledge that can be applied to provide expert-like answers to domain problems. This can perhaps be accomplished by providing improved interfaces for expert systems that include graphical, relation-based knowledge representation methods such as those described above; by integrating these improved expert systems with other types of artificial intelligence, such as neural networks (i.e. 'expert networks', e.g. Davis et al 1997); and by designing systems that perform simulations containing significant variation to demonstrate the statistical properties associated with relational knowledge. Additionally, more sophisticated computational modeling methods have been developed in the relational reasoning paradigm that include hybrid symbolic connectionist methods (e.g. Hummel & Holyoak 2003). The potential for such methods to model expert relational knowledge in audit domains is intriguing.

Knowledge Elicitation and Representation Research Questions

   **RQ 8:** In which audit domains, if any, do expert knowledge structures tend to converge to

similar states, as opposed to containing extreme variation?

**RQ 9:** Are there existing, underutilized methods of cognitive task analysis which are appropriate for eliciting and representing expert audit knowledge?

**RQ 10:** Can new methods of knowledge elicitation and/or representation of audit tasks be innovated?

**RQ 11:** How can the statistical properties of complex relationships be captured and represented? For example, could the belief function framework serve as a method of representing information regarding uncertainty about relationships?

**RQ 12:** Can the extent of surface level distraction typical in specific audit domains be quantified?

**RQ 13:** At what level should various audit tasks be specified in order to elicit and represent knowledge to be used for training purposes? How can boundary assessments be performed to determine what should be included in a particular knowledge model?

**RQ 14:** How can methods of audit task knowledge representation, such as including levels in hierarchical knowledge models or creating three-dimensional graphical networks, best capture the parts / wholes aspect of systematic knowledge?

**RQ 15:** Can computational models of audit tasks be improved by using contemporary models of representation, such as the hybrid symbolic connectionist models?

**RQ 16:** Can expert systems for audit tasks be improved for training purposes by integrating them with graphical representations of domain relational structure?

Variation in Experience and Simulation

There are several variations on Hatano & Inagaki's (1986) theme of adaptive expertise, including Morrison & Fletcher's (2002) cognitive readiness, and Spiro et al's (1988) cognitive flexibility theory (CFT), all of which stress the importance of a flexible form of expertise, which is proposed by relational reasoning research to be allowed by greater knowledge of relational structure of domains, and fewer surface details being encoded into memory. Additionally, these related paradigms suggest that variation in experience, including training, allows for domain novices to alter and refine their understanding of concepts and the relationships between them. The general view is that simulation is one of the most promising ways to provide that varied experience. This raises questions about if and how simulation can be used as an effective mechanism to enhance relational knowledge structures among novices in auditing.

It is widely accepted that one of the ways in which experts handle the processing of domains

with significant relational complexity is via relational chunking (e.g. Goodwin & Johnson-Laird 2005; Halford, Wilson, and Phillips 2010; Day & Goldstone 2012; Dumas, Alexander, and Grossnickle 2013). Chunking is a form of mental dimension reduction where representations are recoded into less complex versions which require fewer arguments to be processed, but which comes at a cost of easy accessibility to more granular relational structures. This is one of the primary reasons that it may be difficult (although not necessarily impossible) for experts to directly pass on their knowledge to novices. Aiding novices is quicker chunking of relational structures should allow them to sooner process overall larger systems of relations within specific audit domains. One way to do this may be to use some form of micro simulations. Perhaps domains can be broken into smaller pieces and simulations can be run with the goal of assisting novices in abstracting smaller pieces of the larger relational structure into chunks that can subsequently be integrated. In order to accomplish this it is first necessary to understand how experts in audit domains use chunking to encode domains specific knowledge. Further, this is likely best examined in a grounded manner, not beginning with pre-determined 'textbook' structures.

Simulation Training Research Questions

**RQ 17:** If complex auditing tasks are the ones most in need of this type of training, is it feasible to provide enough simulations such that a desirable level of variation can be achieved?
**RQ 18:** How might existing simulation methods be altered to make this more implementable?
**RQ 19:** Is directly providing representations including information on complex relations more effective than simulation at aiding encoding of the information to memory?
**RQ 20:** Can some form of mini- or micro-simulations that break down the total knowledge structure of an audit task into smaller relational clusters be used?
**RQ 21:** What is the role of relational chunking in a complex domain such as auditing? Can micro-simulation assist in this process?

<u>Metacognitive Training</u>

An alternative, or perhaps complementary, method to using numerous simulations in training is to train novices in certain metacognitive strategies. The importance of metacognition to expertise development is widely agreed upon (see for example Sternberg 1998; Schraw 2006; Klein 1997; Fletcher & Wind 2014). There is some precedent demonstrating the effectiveness of metacognitive training in an audit setting (Plumlee, Rixom, and Rosman 2015). However, identifying further types of metacognitive skill and examining their relative impacts on expertise development is another area that requires significant additional research in auditing domains.

A method from the relational reasoning literature that has repeatedly shown to be effective at improving knowledge transfer by promoting a focus on relational similarity, and overcoming issues with surface similarity, between domains or instances of the same domain is analogical comparison (or analogical 'bootstrapping'). Studies examining analogical comparison typically provide participants with multiple source analogs and explicitly prompt alignment and mapping between the analogs in order to direct attention to commonalities in relational structure. For a thorough review and meta-analysis on analogical comparison, see Alfieri et al (2013). In a series of studies examining analogical comparison in a negotiation setting, the benefit of comparison between multiple cases was demonstrated to be up to three times greater than providing the cases on the same page, but without explicitly encouraging comparison between them (Lowenstein, Thompson, and Gentner 1999; Thompson, Gentner, and Lowenstein 2000; Gentner, Lowenstein, and Thompson 2003). An additional advantage to training through comparison, as opposed to just providing abstract principles directly, is that the process allows novices to engage the principles in context, thus leading to greater comprehension of individual cases (Gentner, Lowenstein, and Thompson 2004). With all of the psychology research demonstrating benefits of

37

analogical comparison, questions remain about its effectiveness in real world complex decision

environments.

Comparison Research Questions

**RQ 22:** Is analogical comparison an effective method of enhancing knowledge structures
pertaining to complex decision environments? Does relational complexity act as a barrier to
knowledge structure enhancement?
**RQ 23:** Would training in analogical comparison as a metacognitive strategy be effective in
promoting a method of self-training in audit domains? If so, how would initial training best
be implemented?
**RQ 24:** If relational reasoning is a fundamental part of human cognition, why do people
appear not to perform explicit comparisons unless prompted to do so? Does this finding
generalize to auditors in audit settings, or do they perhaps receive some form of training or
experience that corrects this tendency?
**RQ 25:** What role, if any, do learning versus performance goals in audit settings play in
prompting comparison or a failure to compare?
**RQ 26:** What can be learned by naturalistic observations of the comparison process in real
audit settings?

Chi & VanLehn (2012) have characterized problems with knowledge transferability as

problems of deep initial learning and provide the theoretical foundation for a method to improve

deep initial learning by training novices to represent problems as experts do, which is by 'seeing'

the deeper relational structure. This is another metacognitive strategy which involves directly

training novices in relational reasoning skills. Chi & VanLehn (2012) state that novices are

clearly capable of perceiving surface level features, and even understanding which are relevant

and which are superficial (Chi, Glaser, and Rees 1982), but they are not as good at perceiving the

relational structure, particularly higher order relations. Although Chi & VanLehn (2012) provide

the theoretical basis for such an intervention, they do not actually attempt to implement one.

Thus, there are open research avenues about how to implement such an intervention, and

specifically how to do it in particular audit domains. Brewster (2011) provides an excellent

example, based on the field of systems dynamics, of an intervention aimed at assisting novices in

understanding a complex relational structure. However, as acknowledged in the limitations of

that paper, this type of intervention requires that the exact specifications of a particular domain

instance be mapped out ahead of time and provided to users, which is not feasible in practice.

Here it is suggested that a more general intervention geared not toward providing maps of

relational structures on a case by case basis, but training novices to 'see' these structures on their

own is likely to be more beneficial. Insights from relational reasoning research and associated

fields such as systems thinking could provide the tools necessary to implement an intervention

aimed at training novices to represent problems as experts, and in a very domain specific way.

Relational Reasoning Training Research Questions

**RQ 27:** Can insights from relational reasoning research be used to create interventions geared toward training novices to represent domains as experts do?
**RQ 28:** Can ideas from general systems thinking, as opposed to systems dynamics, be used to aid in relational reasoning based audit training interventions that do not require pre-created domain maps?
**RQ 29:** Will examination of the component processes of relational reasoning in complex audit tasks provide further insights for specific methods of training novices, at the component process level, in relational reasoning?
**RQ 30:** What impact does relational complexity of audit domains have on the feasibility of these metacognitive strategies and the methods of implementation that will be most effective?
**RQ 31:** Are relational reasoning training methods universal to all manifestations of relational reasoning, or is varied training required for different types?
**RQ 32:** What impact do the aforementioned interactions between causal reasoning and relational reasoning have on the requisite form of relational reasoning based training interventions in audit domains that incorporate causal relations?

Distributed Expertise and Deskilling

Another consideration for audit researchers is the ever expanding phenomenon of 'distributed

expertise'. Innovations in both tangible and methodological technology continue to provide new

39

ways of distributing expertise among multiple people as well as multiple sources external to the mind, such as books and machines. As an example, the inputs that go into the audit of a complex estimate might include the specialized domain knowledge of multiple people that hold multiple professional roles (e.g. auditors, valuation specialists, and actuaries), audit firm methodology, valuation professional association methodology, auditing standards, data from multiple sources, and complex calculations. Additionally, some of the subprocesses may be automated in order to bypass human cognitive capacity limitations as well as promote consistency and efficiency. It quickly becomes apparent that any person involved in the task is heavily reliant on other people and tools in accomplishing the task. This raises questions about the impact on the knowledge structures of individual experts, as no one individual has a complete understanding of all aspects of the system. This increasing distribution of expertise would seem to make processes more susceptible to error or problems with diffusion of responsibility, and individuals more susceptible to technology dominance (Arnold & Sutton 1998). As processes become more complex and the requisite expertise becomes more distributed, the proportion of the total required task knowledge understood by any individual will shrink. This can lead not only to process errors at the micro level but to deskilling of practitioners at the macro level. Recognition of this, combined with ideas discussed above, provide potential ways to mitigate these problems by mapping out the significant gaps in the knowledge structures of both novices and experts and creating training to bridge the identified gaps.

Deskilling Research Questions

**RQ 33:** How do characteristics of a specific audit task domain, such as technology used and group versus individual decision making, impact the specific relational knowledge required to complete the task?

40

**RQ 34:** How does the distribution of expertise impact the proportion of total systematic task knowledge possessed by individual practitioners? What types of measurements can be developed to quantify this?

**RQ 35:** Is the practice environment in auditing one that stresses efficiency over deep learning? If so, how does this impact expertise development, or the lack thereof?

## Conclusion

The position from several paradigms that study expertise is that expertise hinges on the recognition of patterns, and in all but the simplest of domains it is the patterns within the deeper relational structure that are important for making expert judgments. Thus, relational knowledge and relational reasoning skill, collectively, may be considered the key to expertise and there is much existing research in psychology that has been underutilized to motivate and advance research on audit expertise, particularly in the area of facilitating expertise among novices. The audit environment is unique and consists of many complex task domains. There remains some question as to whether the effects of certain strategies, demonstrated in relatively simple tasks in psychology research, will carry over to complex audit domains. The potential of such effects in intricate professional domains needs to be verified through lab experimentation. If evidence is found that the effects associated with strategies, such as analogical comparison, will hold in audit domains such as initial risk assessment, analytical procedures, complex estimates, and interpreting advanced data analytics, then methods to best deploy them in useful, real world implementations must also be devised. Additionally, strategies that remain untested but hold significant potential benefit, such as direct training in seeing the deep relational structure of domain problems, should be similarly examined. The potential for such strategies is arguably the greatest in complex environments such as auditing, and therefore, auditing is an exemplary field in which to attempt such innovation.

Advances in modeling expert knowledge of audit and related domains, including detailed knowledge of relations, through elicitation and representation, and how best to impart such knowledge to novices, also holds much potential. Further, innovative training methods including simulation and various forms of metacognition may also prove to be effective at instilling relational knowledge, and the skill to best use that knowledge, in novice auditors. Lastly, using a relational reasoning perspective to map out detailed knowledge of audit domains can allow for the identification of deficiencies in knowledge structures on an individual basis, as well as those that are typical or widespread, in an effort to combat deskilling in audit practice.

Despite a drop off from its peak in the 1990s, there are many research avenues yet to be explored in audit expertise. Most of the low hanging fruit in this area has been harvested, and much of the research suggested herein will be challenging, but these are the kinds of inquiries that offer the promise of meaningful contributions to audit practice and advances in an all but dormant research stream.

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# STUDY TWO: AN EXPERIMENTAL INVESTIGATION OF INTERVENTIONS TO IMPROVE KNOWLEDGE TRANSFERABILITY BY ENHANCING ANALOGICAL ENCODING

## Introduction

Due to changes in the audit environment, including process automation and increasing complexity of business transactions, auditors are being called upon to make more significant judgments earlier in their careers that require expertise in a broader set of domains. Calls from prominent researchers (e.g. Bedard & Chi 1993; Nelson & Tan 2005) for further examination of methods to facilitate audit expertise have gone largely unanswered. In addition, Bratten et al (2013) suggest specifically that research in promoting valuation expertise amongst auditors could help address noted deficiencies in this area. This is consistent with continued PCAOB findings of insufficiencies in auditor's assessments of goodwill impairment (PCAOB 2015a, PCAOB 2015b, PCAOB 2015c, PCAOB 2015d). Griffith (2017) suggests that auditors' problem representations of goodwill impairment assessments may contribute to the failure as auditors lack sufficient relational structures and they appear to fail to recognize how changes in one assumption may impact other assumptions. This is critical as expertise is closely associated with the amount of relational structure in mental representations and it is widely accepted that experts' mental representations of domain related problems occur at a deeper level than those of novices, which tend to be more superficial (Bedard & Chi 1993; Feltovich et al 2006; Chi & VanLehn 2012). Audit firms' interest could be enhanced by seeking out methods for facilitating greater expertise amongst their staff, and assisting them in doing so is an opportunity for academics to contribute significantly to practice.

The primary purpose of this study is to examine the potential of effortful analogical

comparison, a technique associated with the analogical reasoning paradigm, for use in structured training, or individually by auditors as a metacognitive skill, to foster the abstraction of domain schemas that are more relationally structured[7]. Expertise within a given domain may be accelerated via the abstraction of more relational-based schemas, over a given experience set, leading to greater knowledge transfer from previous experiences to future instances within the domain. A second purpose is to investigate outstanding questions surrounding the effectiveness of different implementation methods. The domain of auditing goodwill impairment assessments was chosen as the setting in which to examine the technique due to noted deficiencies in performance and the theoretical linkage to a lack of relational structure within representations of domain problems.

A variety of experiences allows the opportunity for auditors to abstract domain principles while understanding how these principles can fit into diverse contexts. This enhances knowledge transferability. However, it is not safe to assume that they will do so automatically. Research in the area of analogical comparison demonstrates that when people are given multiple, related cases to examine and instructed to compare the cases, they are more effective at abstracting domain principles (Gentner 2010; Nokes-Malach et al 2013; Holyoak & Richland 2014). However, when they are not explicitly instructed to perform a comparison their performance is diminished (Gentner, Lowenstein, and Thompson 2003). Holyoak & Richland (2014) refer to the practice of using comparison as one of the most effective mechanisms to foster cognitive readiness. However, as previously mentioned, research shows that people appear to not perform these effortful comparisons unless specifically prompted to do so. This failure to compare phenomenon is conjectured to be a multi-faceted problem. One potential explanation is that

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[7] See Appendix A for a table of key terms.

62

participants in prior studies do not spontaneously recognize the situation as a comparison situation. Another explanation may be that domain novices may require instruction about executing a conscious, effortful comparison, particularly in more complex task domains. A further possibility is that people are not motivated to perform effortful comparisons because they are not aware of the benefits of doing so.

In order to explore these prospective explanations and the effectiveness of the comparison technique in an audit setting, an experiment was conducted in a task setting involving the audits of goodwill impairment assessments and is concerned with the impact of effortful comparison on the abstraction of relational patterns among input assumptions. Three source cases were provided to afford participants, deemed to be novices in the task setting, an opportunity to abstract a particular principle regarding the relations between capital intensiveness, sales volume, and capital expenditures. Experimental manipulations include the type of comparison instruction, a simple prompt versus guided instructions which include an example, and an explanation of the demonstrated benefits of performing such comparisons, varied as absent or present. Additionally, a control condition, which contains no comparison prompt and no benefits explanation, was included in the experiment. To assess the impact of the experimental interventions, dependent measures of schema abstraction and knowledge transfer were captured.

Results do not support the expected positive effects of guided instructions and an explanation of benefits. The hypotheses that the interventions will enhance schema abstraction and knowledge transfer are not supported. However, there is some evidence that the level of effort in performing the comparisons between analogs may have a positive impact on both schema abstraction and knowledge transfer. Thus, there is reason to believe that comparison does affect relational knowledge acquisition, but that the interventions, as designed herein, are not

appropriately impacting the comparison effort or process. Curiously, there is some evidence to suggest that the guided instructions may actually have detrimental effects. One potential explanation discussed is that analogical comparisons may be performed implicitly in an idiosyncratic manner, and the guided instructions could lead some participants to utilize an unfamiliar strategy that imposes excessive strain on working memory. Future research could attempt to disentangle the results herein by examining analogical comparison in a different task context or with alternative intervention designs. Deriving the benefits from the comparison strategy may be more challenging in a complex decision environment than in simpler tasks typically used in psychology studies. Other techniques that may assist in integrating the strategy in a more complex environment, such as multiple exposures; decision aids; or learning aids, should be examined for potential improvements over the methods used in the present study.

This study contributes to the literature on audit expertise by providing insight on a potential method to aid in its facilitation. It further contributes to the literature by perpetuating the technique of analogical comparison in accounting expertise research. In addition, the study has implications for audit practice. A better understanding of the failure to compare phenomenon, including whether it is actually a failure to compare or a problem of specific comparison strategy, may lead to training interventions that utilize the skill of analogical comparison in order to foster improved knowledge transfer through more relation-based, flexible knowledge structures.

## Background

### *General Background*

There exists a substantial body of literature on expertise in audit settings.[8] However, researchers have tended to focus more on understanding the nature of expertise, and differences between experts and novices, in auditing than on how to facilitate it, despite calls to do so by prominent researchers (Bedard & Chi 1993; Nelson & Tan 2005). The auditing profession is a dynamic one and is facing what may be the beginning of some very large changes. As many of the simple, routine audit tasks are being automated, novice auditors will likely be expected to focus on making judgments in traditional risk assessment and classification audit tasks earlier in their careers than before (Cohn 2017). In addition to the more traditional audit tasks, such as assessments regarding client acceptance; preliminary analytics; inherent risk; control risk; impact of sampling risk on errors; going concern; and accounting treatments, auditors of the future may require more expertise in areas such as valuation, data analytics, and technology use. This isn't to suggest that all audit-related domains must be mastered by all auditors. Division of labor and specialization will undoubtedly continue, but auditors will need to be knowledgeable enough in these other areas to understand the risks and outcomes and to fulfill their responsibilities dictated by auditing standards. Additionally, increased communication with a broadening range of experts seems likely, and this in and of itself will require a certain level of domain proficiency.

One class of tasks in particular that has received attention regarding auditor shortcomings is the audit of fair value estimates. Bratten et al (2013) cite numerous deficiencies identified by the PCAOB regarding the audits of fair value estimates. They further posit that a significant factor in

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[8] A thorough discussion of expertise in auditing is beyond the scope of this paper. For informative reviews, see Bedard & Chi (1993), Bouwman & Bradley (1997), Nelson & Tan (2005), and Bonner (2008), and Study 1 of this thesis.

these deficiencies is a lack of valuation expertise on the part of auditors. In addition, Bratten et al (2013) suggest that insufficient training is one of the apparent causes. This is also recognized in the report by the SEC's Advisory Committee on Improvements to Financial Reporting (ACIFR) which reads "preparers and auditors will likely have to incur costs to broaden their proficiency in basic valuation matters...For instance, additional training for field auditors may be necessary as they work more frequently with valuation experts." (SEC 2008, p.29). Thus, Bratten et al (2013) specifically call for more research on promoting valuation expertise among auditors as well as more effective training methods to do so, which echoes the more general calls by Bedard & Chi (1993) and Nelson & Tan (2005).

*The Audit of Goodwill Impairment Assessments*

A specific task within the class of valuation related audit tasks is the audit of goodwill impairment assessments. PCAOB inspection reports continue to find deficiencies specifically related to auditing the inputs to goodwill impairment assessments (PCAOB 2015a, PCAOB 2015b, PCAOB 2015c, PCAOB 2015d). It is important that auditors possess the expertise necessary for gathering sufficient evidence to support the audit opinion. In other words, they may delegate some of the work to specialists, but they may not delegate the associated responsibility. Without the appropriate expertise to identify patterns underlying a given set of assumptions, auditors may fail to recognize whether the assumptions collectively indicate an unreasonable estimate (Hammersley 2006).

It is also important to understand that not all patterns are the same. Patterns can exist at the featural ("surface") level or at the underlying structural level, which includes relations between

66

features. Relational patterns are typically considered more useful for making inferences (Gentner 1983; Holyoak 2012) and as such, relational reasoning is closely linked to expertise (Chi & VanLehn 2012). For example, it is widely accepted that experts' mental representations of domain related problems occur at a deeper and more principled level than those of novices, which tend to be more superficial (Bedard & Chi 1993; Feltovich et al 2006; Chi & VanLehn 2012). Representations are considered to be more principled when they are focused more on the relations between objects within a representation than the objects themselves, or the values of the objects. In the context of auditing goodwill impairment assessments, Griffith (2017) suggests that auditors' problem representations may not be comprised of sufficient relational structure to recognize patterns among assumptions. She further finds evidence that auditors may not always attend to relational cues provided by valuation specialists. In the environment of auditing goodwill impairment assessments relationally structured representations are expected to be important, as surface level variation between task instances may be significant, but key underlying structural patterns are expected to hold. Many of the surface features, such as lines of business; geographic markets; people performing the assessment; et cetera, may change, but underlying structural patterns will exist due to factors such as the nature and mission of for profit entities; human nature; incentive structures; measurement methods; and accounting standards. It is these relational patterns that are critical for judgments regarding the reasonableness of the collective assumptions.

It is very much in the interest of audit firms to promote further expertise amongst their staff in order to mitigate audit risk and improve quality over the auditing of goodwill impairment assessments. Searching for methods that may assist auditors in fulfilling these responsibilities presents itself as an opportunity for accounting academics to contribute significantly to practice.

The purpose of this study is to examine the technique of analogical comparison, associated with the analogical reasoning paradigm, as a potential intervention that can be used in training, or by auditors on their own as a metacognitive skill, to aid the abstraction of more relationally structured domain schemas. The abstraction of more relational-based schemas, over a given experience set, may accelerate the path to domain expertise and facilitate greater transfer of knowledge gained from previous experiences to future situations.

## Theory and Hypotheses Development

### Analogical Reasoning

One of the primary mechanisms by which knowledge of relational patterns is transferred to new instances in order to make inferences is analogical reasoning (a special case of relational reasoning), which involves recognizing structural similarity in analogs.[9] There exists an extensive literature on analogical reasoning which includes many definitions of the phenomenon (e.g. Gentner 2010; Nokes-Malach et al 2013; Holyoak & Richland 2014). It is a form of induction that involves reasoning about a new problem or situation based on existing knowledge of problems or situations that appear different at the surface level, but have similar underlying relational structure. Analogical reasoning seems to be an innate part of human thinking from a very early age (Holyoak & Thagard 1997; Gentner 2010). It is generally considered to consist of four distinct stages: 1) Retrieval, 2) Mapping, 3) Transfer (inference), and 4) Schema abstraction (learning) (Holyoak 2012). Retrieval consists of selecting an analog from existing knowledge in

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[9] Category based induction (category or concept learning) is a closely related area that is relevant to the study of similarity and transfer. The primary difference between analogy and category based induction is that analogies occur between individual cases or problems, whereas category based induction involves categorical types (Lee & Holyoak 2008).

memory (the source) that is potentially relevant to understanding the current situation or problem (the target), based on the set of cues present in the current situation. Mapping involves assessing the correspondences between the elements (i.e. the objects and relations) of potential sources and targets in order to determine the suitability of the source for making inferences about the target. Transfer includes using a schema of the source analog (whether provided or existing in memory) to make inferences regarding elements that may be missing from the target representation, based on knowledge of the source and the level of correspondence between the two (Gentner 2010). Holyoak (2012 p.249) cites Bartha (2010) in stating that inference is "the fundamental purpose of analogical reasoning". The fourth stage of analogical reasoning is that of schema abstraction. Put simply, the process of reasoning between two analogs enhances the existing knowledge of the source by integrating information from a target for which the source is deemed relevant input for inference generation. Thus, the process leads to schema evolution and refinement. This final stage is where the most important connection to expertise promotion can be made and is the primary focus of the current study, as will be discussed further below.

One of the most significant early theories of analogy is Gentner's (1983) SMT, which describes analogy as mapping one domain (analog) to another based on how well their structures align. This mapping is based on two principles. The first involves the alignment of objects (concepts) and the relations between those objects within a domain, with the recognition that not all elements (particularly objects) are equally relevant and that relations are more important than objects (and especially object values). The second principle is that of systematicity, which formally states that "A predicate that belongs to a mappable system of mutually interconnecting relationships is more likely to be imported into the target than is an isolated predicate" (p.163). Essentially this suggests a preference for relations over object values, higher order relations (as

"higher order predicates enforce relations between lower order predicates"; p.162) and deep, interconnected networks of relations.

Little accounting research has utilized the analogical reasoning paradigm, but there is some evidence that experience leads to superior analogical reasoning in accounting settings, suggesting that the relational structures of the novices' domain schemas are not as developed. In a tax judgment setting, Magro & Nutter (2012) find that participants with greater experience demonstrate the use of more analogical reasoning in assessing the relevance of different tax authorities. In previous research in a tax judgment setting, Marchant and colleagues (Marchant et al 1991; Marchant et al 1992; Marchant et al 1993) did not find evidence that expertise led to greater analogical reasoning, but Magro & Nutter (2012) provide a detailed explanation of how this is likely due to design issues in the studies. In an audit setting, Marchant (1989), also found no differences in analogical reasoning between experienced practitioners and novices. However, a review of this study suggests the possibility that this is also due to design issues of the study. Marchant's study is based on the transfer paradigm of Gick and Holyoak (1980), in which participants are provided a source analog that offers a solution to a problem, given in a different context, in the target analog. Marchant's (1989) study seems to entangle the classic transfer paradigm with existing frequency knowledge. In the classic transfer paradigm, an example is given that could be a potential solution for a new problem in a different context. In this situation, the source analog becomes transferable knowledge for the participant and is not expected to contradict existing, relevant knowledge. In Marchant's study the source analog may contradict existing knowledge about the likelihood of different hypotheses. If experts (or even novices for that matter) know that one explanation is more likely than another due to empirical frequency (which is the case in the Marchant study), then using the source "analog" of the solution that is

70

known to be less likely is not representative of analogical reasoning. Analogical reasoning relies on the application of existing knowledge to new problems. Part of that existing knowledge includes knowledge of likelihoods pertaining to causal relations. The design of the Marchant study allows for significant potential demand effects, which seem to be on display in the results. Thus, the prevailing evidence from Magro & Nutter (2012) seems to suggest that greater domain experience leads to better analogical reasoning within an accounting domain, and one can infer that this is likely due to more relational structure gained through implicit learning over a larger experience set. From an education perspective, Hanson & Phillips (2006) found that using an analogy to introduce an accounting subject subsequently enhances learning of the topic. As analogy tends to force focus on the relations within a domain, this again suggests that a more relation-focused schema abstraction leads to superior domain understanding (expertise).

*Surface similarity*

One of the most significant problems discovered in research on knowledge transfer is that the surface features of a problem (or domain instance) trigger recall of other instances including those features and thus impede the recall of other instances involving similar relations to those in the present problem (Ross 1987; Reed 1987; Gentner, Ratterman, and Forbus 1993). Additionally, it is not only psychologists that view structural similarity as the most important component for transfer. In a study on story reminding, Gentner et al (1993) found that when given a target story, participants were largely reminded of previously provided stories that had matching surface similarities even though they rated the inferential power of structurally similar stories as higher than surface similarity matches. This effect of surface similarity occurs

primarily in the retrieval and mapping stages, even though people tend to be aware that relational

structure is more important (Day & Goldstone 2012). The impacts in the retrieval and mapping

stages will presumably lead to problematic downstream effects in the inference and abstraction

stages as well. Essentially, the surface details often serve as a distraction from the more relevant

relational structure. This distraction can lead to failure to retrieve or map similar analogs,

incorrect retrieval or mapping of analogs, and unnecessary load on working memory, particularly

when the surface details are entirely irrelevant. It follows that if attention is not focused on the

relations between domain objects during training or on the job learning, then the schemas learned

will contain less relational structure.

*Analogical Comparison*

One method in psychology research that has shown to be effective in promoting a better

understanding of relational structure and overcoming problems associated with superficial

surface similarity is that of analogical comparison (or analogical 'bootstrapping'). The author is

unaware of any published accounting studies using an explicit comparison technique.[10] While

the method shows positive results in psychology studies, it is unclear whether or not it will have

the same effect in a more complex, professional decision environment, or whether novices in a

familiar domain require such a prompt. Evidence is required that this strategy can remain

effective in such an environment before involving it in any real world training implementations.

Additionally, as discussed in a later section, there are open questions as to the most appropriate

way to structure interventions using analogical comparison.

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[10]). In an unpublished study, Matsumura & Vera-Munoz (2006) use a comparison intervention in an accounting setting, but due to the design of the study and dependent variable, it is unclear how to interpret their findings.

The technique of analogical comparison involves providing multiple examples and then explicitly encouraging alignment and mapping between the examples in order to focus attention on commonalities in underlying structure. This strategy has been shown to lead to the abstraction of schemas that focus more on the deep relational structure of a domain (Alfieri et al 2013). An early example of this phenomenon occurs in Gick & Holyoak (1983) where transfer was improved when participants compared two superficially unrelated analogs, as opposed to only being provided with one source. Catrambone & Holyoak (1989) provided evidence that using more than two sources for comparison further improves transfer. In a series of studies involving training business students in negotiation (Lowenstein, Thompson, and Gentner 1999; Thompson, Gentner, and Lowenstein 2000; Gentner, Lowenstein, and Thompson 2003), the benefit of comparison between two cases was shown to be approximately three times greater than providing the same two cases on the same page but without prompting a comparison between them.

A particular type of comparison, referred to as analogical encoding (Lowenstein et al 1999; Kurtz, Mao, and Gentner 2001; Gentner et al 2003) is different from comparison involving traditional analogical reasoning. Traditional analogical reasoning refers to a process of learning about a target analog by utilizing existing knowledge from a source analog that is in a different domain or context, and is well understood. In contrast, with analogical encoding the purpose of the comparison is to learn about a new concept or domain by comparing multiple instances within the same domain. Thus, the mapping is not from a well understood analog to a less well understood analog, but serves as a multi-directional source of illumination about the similarities and differences of the analogs under comparison, which promotes attention to structural similarities. This in turn leads to a more abstract schema of the common structure, with less

encoding of idiosyncratic, contextual details, allowing for greater transfer of knowledge to new

domain instances (Lowenstein et al 1999; Gentner et al 2003; Gentner et al 2004). In other

words, encoding more abstract schemas allows for greater flexibility in their application and less

inert knowledge that is entangled with superficial detail which hinders its retrieval from memory

(Gentner et al 2003; VanLehn & Chi 2012). Another benefit of analogical encoding, as opposed

to merely providing the principles directly, is that it allows for better comprehension of the

principles by providing opportunities to engage them in context, within cases (Gentner,

Lowenstein, and Thompson 2004). This is in line with the widely held view that variation in

experience within a domain leads to a more adaptive form of expertise (Hatano & Inagaki 1986;

Holyoak 1991; Barnett & Koslowski 2002; Hoffman et al 2014 Ch.5). Despite the prospective

benefits of the comparison technique, its potential to be advantageous to high level decision

makers in real world domains remains unknown.


*The "Failure to Compare" Phenomenon*

Research on comparison in cognitive science demonstrates that people are capable of

performing comparisons if they are guided in doing so, and even if they are merely prompted.

However, research also suggests that if participants are not prompted to perform a comparison,

they tend not to, even if individual cases are provided side by side on the same page (Lowenstein

et al 1999; Thompson et al 2000; Gentner et al 2003). Thus, there appears to be a 'failure to

compare' phenomenon in much of the analogical reasoning research. Comparison is generally

considered to be an important part of problem solving, categorization, analogical reasoning,

judgment, decision making, and general cognition (Gentner & Colhoun 2010; Goldstone, Day,

and Son 2010). For example, models of both memory and categorization rely on similarity between new stimuli and representations in long-term memory (Goldstone, Day, and Son 2010). It seems then that comparisons must take place, even if entirely subconsciously. According to contemporary views in cognitive neuroscience, the human brain is thought to operate essentially as a Bayesian prediction machine. The brain does not just passively receive stimuli, it continuously predicts incoming stimuli, compares to the stimuli received and makes adjustments to behaviors, as well as mental models and memory, based on the prediction errors (Clark 2013). While the specifics of the physiological operations of the brain are still debated (and perhaps always will be), there is significant evidence to support this view. The relevance to the discussion herein is simply that this position suggests that comparisons are continuously being made at the most fundamental levels of cognition. So the question remains as to why participants in the analogical comparison studies do not seem to perform them innately. In addition to introducing the comparison technique to the accounting literature as a potential intervention for training purposes,  this study explores potential causes of the failure to compare phenomenon in order to determine how best to implement the comparison intervention. It is posited below that this is a multi-faceted problem.

One potential explanation is that participants don't recognize the situation as a comparison situation. People may compare cars when shopping by drawing a comparison of features, or evaluate potential jobs by creating a pros and cons list. Thus, we know that adult humans are certainly capable of performing effortful comparisons, at least of some sort. In an accounting context, practitioners may choose an accounting treatment based on similarity between the current transaction and others known from previous experience or examples from guidance. Perhaps people recognize that comparison is necessary for some scenarios, for example those in

which a choice must be made, but not in others, such as situations that involve learning.

Therefore, one possible explanation is that novices are entirely capable of performing

comparisons in the analogical reasoning settings, but it does not occur to them to do so. It is

posited herein that a simple prompt to perform a comparison will result in the abstraction of

more structurally based schemas through the analogical encoding process, which in turn allows

for greater knowledge transfer.

    H1a: Novices who are provided a simple prompt to perform a comparison across multiple
cases with similar underlying structure will abstract more structurally based schemas than those
who receive no prompt to compare.

    H1b: Novices who are provided a simple prompt to perform a comparison across multiple
cases with similar underlying structure will demonstrate greater knowledge transfer than those
who receive no prompt to compare.

    If learners are fully capable of performing effortful comparisons, and need only to be

instructed to do so, then a simple prompt to perform a comparison would be all that is necessary

to receive the full benefit of analogical encoding. Another potential explanation is that domain

novices may require some guidance in executing a conscious, effortful comparison, particularly

in more complex task domains such as accounting and audit contexts. In other words, even in the

face of an explicit prompt to perform a comparison, without any guidance on how to do so,

novices may perform a less effective comparison, which in turn will result in less effective

schema abstraction and subsequent transfer. In a review and meta-analysis of comparison

studies, Alfieri et al (2013) did not find type of instruction, which they classified as prompted or

guided, to be a moderator of the comparison effect. They speculate that this may be due to the

type of instruction being confounded with the amount of detail included in the cases. Alfieri et al

(2013) posit that guided instruction may be necessary in rich cases that include irrelevant details,

whereas for simpler cases, a mere prompt to compare might be sufficient, and suggest that this

should be examined in future research. As the motivation of this study is to facilitate expertise in

real world auditing domains by identifying interventions for training in effortful analogical

comparison, the domains of interest are rich in detail, much of it superficial. The position of

Alfieri et al (2013), that more guided instruction should lead to a greater benefit from analogical

encoding in more complex domains, is furthered herein.

H2a: Novices who are provided guided instructions on performing a comparison across
multiple cases with similar underlying structure will abstract more structurally based schemas
than those who receive only a simple prompt to compare.

H2b: Novices who are provided guided instructions on performing a comparison across
multiple cases with similar underlying structure will demonstrate greater knowledge transfer than
those who receive only a simple prompt to compare.


Another possible factor leading to ineffective analogical reasoning due to lack of effortful

comparison is that novices, while capable of performing effortful comparisons even in context

rich domains, are not motivated to do so because they are not aware of the potential benefits.

Thus, informing participants of the benefits of performing a comparison should lead to an

increase in motivation to do so. This understanding should lead to greater use of the comparison

technique, even without an explicit prompt to perform such a comparison.

H3a: Novices who are informed about the benefits of comparison across multiple cases with
similar underlying structure will, through the increased use of comparison, abstract more
structurally based schemas than those who receive no such information.

H3b: Novices who are informed about the benefits of comparison across multiple cases with
similar underlying structure will, through the increased use of comparison, demonstrate greater
knowledge transfer than those who receive no such information.

Note that such an intervention includes an implicit hint that comparison on the task should be

performed, but there is no explicit instruction to do so. Thus, improved performance due to such

an intervention provides evidence that the problem may not be explained by prompting alone; the problem is more complex. As the failure to compare is deemed to be a multi-faceted problem, these interventions are not expected to be substitutes for each other. The combination of the guided instruction and benefits explanation interventions should therefore produce a greater effect than either on their own.

H4a: Novices who are provided guided instructions on, and informed about the benefits of, performing a comparison across multiple cases with similar underlying structure will abstract more structurally based schemas than those who do not receive both interventions.

H4b: Novices who are provided guided instructions on, and informed about the benefits of, performing a comparison across multiple cases with similar underlying structure will demonstrate greater knowledge transfer than those who do not receive both interventions.

Taken together, the above hypotheses suggest that failure to compare is not simply due to a lack of effort or motivation, but stems from a multi-dimensional lack of understanding of the technique of conscious, effortful comparison.

## Method

### *Experimental Design and Task*

In order to test the hypotheses stated above, an experiment was conducted that employs a 2 (prompt type) X 2 (benefits explanation absent vs. present) design, with an additional control condition. Experimental materials were developed by the researcher who has substantial knowledge and experience in valuation task settings. The materials were subsequently revised based on feedback from pre-testing, and the explanation of discounted cash flow valuations, at the beginning of the experiment, was reviewed by a valuation expert with over 20 years of experience. A summary of the revisions can be found in Appendix B.

<u>Case Materials</u>

The experimental instrument contains multiple cases concerning the audit of valuations related to goodwill impairment assessments. The task setting involves the utilization of deep underlying principles but also varies greatly at the surface level between different entities. Additionally, it is a task that may be performed or evaluated by people in various accounting roles. Further, it is a task that is often performed at least partially by valuation experts but relied upon by others. Thus it is an area in which the promotion of expertise among domain novices is important. Before receiving the case materials, participants are provided with a brief primer on valuations using the discounted cash flows method.

The instrument includes four short cases; three source cases and one target case. Each source case includes information concerning a fictional company's background and any changes in cash flow projections, as well as the auditor's conclusion regarding the cash flow assumptions. After reading the source cases, participants were asked to either list similarities and differences between the cases (intervention conditions) or to articulate central ideas about each case individually (control condition). Differences between conditions are discussed further in the independent variables section below. Subsequently, participants read the target case, which includes similar information regarding company background and changes in cash flow projections, but in this instance they were not provided with a conclusion as to the validity of the assumptions. All four cases were designed such that they include a common principle embedded within them, as discussed below in the dependent measures section. Thus, this is considered an example of near transfer, between instances of a task. The cases also contain varying surface level details. See Appendix C for a table of the specific elements embedded in the cases. Following the target case, participants were asked to answer questions concerning the valuation

and cash flows of the company in the target case. More details are included in the dependent measures section below. Subsequent to the dependent measure questions, participants were asked to answer other questions pertaining to comparison effort and motivation, control variables, attention checks, and demographic information, which are discussed below. The full experimental instrument is included in Appendix F.

Comparison Design

Alfieri et al (2013) list several variables related to comparison treatment design. Following is a discussion of the relevant design choices. First, the key principle to be abstracted from the cases was not provided, as the participants are supposed to derive this during the comparison process. Second, the features and relations of the problems are not explicitly labeled as such. Participants must also derive these from the cases. The intent is not to examine merely how to train on a particular subject matter, but on a method of thinking. Third, the comparison asks for similarities and differences. Asking for similarities only is thought to be beneficial to learners in situations where differences are not relevant, due to decreased cognitive load (Alfieri et al 2013). However, in many real world audit tasks, differences between instances may be quite important, and the study is motivated by promoting expertise, which involves training people to apply methods that will be beneficial in their natural work environments. Additionally, the increased cognitive load caused by searching for similarities and differences makes for a better test of the comparison effect. It is for these reasons that both similarities and differences were included in the comparison prompts. Fourth, there is no explicit cue to transfer knowledge from the source cases to the target case, thus any transfer is spontaneous.

Other design choices were made to add some complexity in order to create a more powerful

testing scenario. The relevant feature values were not the same in all cases. For example, source one and two are described as capital intensive industries, and source three is not. Sources two and three are determined to have all reasonable assumptions, but source one does not. Finally, some of the surface features of the target case were shared with one of the source cases that did not share the same outcome as the target case.

*Independent Variables*

To test the hypotheses above, comparison prompt type was manipulated as a simple prompt to compare or a prompt that includes an example as more guided instruction. An explanation of the benefits of performing effortful comparisons is manipulated as present or absent. Additionally, a control condition includes no instructions to perform a comparison or explanation of the benefits of comparison in order to serve as a benchmark. Language included in the control condition which prompts the participants to engage the case materials is as follows: "Consider what is going on in Case A. Briefly articulate any central ideas or principles demonstrated in the case." This is language repeated separately for cases B and C.

Comparison Prompt Type

The simple prompt to perform a comparison versus the guided instruction serves as the basis to examine within task differences related to type of instruction.[11] In the simple prompt,

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[11] Alfieri et al (2013) refer to two classes of instruction, prompted and guided. However, this is a complex construct and the classification rules, as described, are somewhat ambiguous. They state that "In general, *guided* instructions directed learners to search for more specific features and/or relations across the cases, whereas *prompted* instructions were more general and asked learners to simply search for similarities and/or differences" (emphasis in original, p.98). Additionally, they state that "type of instructions was coded as either *prompted* or *guided* to reflect the degree to which learners received instructional guidance toward the common features and/or unifying

participants receive the following instructions. "Think through the similarities and differences between the previous cases (A, B, and C). List as many similarities, differences, and combinations of similarities and differences (where two items are similar but different from the third) as you can identify." They are also asked to "Briefly articulate any central idea(s) or overall principle(s) demonstrated by the cases taken together". In the guided prompt, participants receive the same instructions as in the simple prompt and are additionally provided with an example of the comparison process.[12] In the control condition, no comparison prompt is included and in order to similarly engage participants with the case material, they are instead asked to "Consider what is going on in Case [X]. Briefly articulate any central ideas or principles demonstrated in the case". H1 predicts that a prompt to perform an effortful comparison will result in better schema abstraction and knowledge transfer than no prompt, as in the control condition. H2 predicts that the guided instructions will result in greater schema abstraction and knowledge transfer than the simple prompt.

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concept/procedure" (emphasis in original, p.94/97) and that "These cues serve to make the search for commonalities much more focused" (p.98). What they have described as a dichotomy for purposes of analysis is in fact a continuum. The simple prompt manipulation used herein fits the description of *prompted* per Alfieri et al (2013), and the example manipulation fits the guided classification, albeit adapted for the purposes of the task design. The example provided serves as a form of additional comparison guidance when contrasted to the simple prompt. A demonstration of how the process is performed serves to focus participants more on the cues (features and relations) of the case by delineating some cues in the example.

The objective of this task is for participants to learn a specific principle that must be abstracted from the cues in the cases. Therefore, providing or strongly hinting at the features of the valuation cases could be detrimental in that it essentially provides the principle. While this may be desirable for certain task domains and particular objectives, it is not in the present circumstance. The goal of the study does not concern the mastery of material, but the effects of using specific reasoning strategies. Therefore guidance in instruction is manipulated as a worked-through simple example of the comparison process. Future research can continue to delineate varying effects of differing types of instruction in order to examine the classification of levels of guidance in comparison instruction and whether they are best represented as a dichotomy or continuum.

[12] The example used is adopted from Matsumura & Vera-Munoz (2006). It includes the provision of some similarities, differences, and combinations of similarities and differences between three sports.

<u>Benefits Explanation</u>

In the conditions where the benefits explanation is present, participants receive the following explanation of the benefits of performing a comparison. "Research has demonstrated that comparing the similarities and differences of multiple cases not only aids in understanding the relevant similarities and differences between the cases, but also has the benefit of facilitating the development of more abstract, principle-based mental models of the cases.  This has further been shown to be beneficial beyond just providing the more abstract principles directly because the comparison process also allows for interpretation of the principles within the context of individual cases."  The explanation was included immediately before the prompts to engage the material (comparisons or control condition). H3 predicts that the presence of an explanation of the benefits of performing a comparison will result in greater schema abstraction and knowledge transfer than its absence, and H4 predicts that the additive effect of the benefits explanation and guided instructions will result in the greatest level of schema abstraction and knowledge transfer.

*Dependent Measures*

<u>Schema Abstraction</u>

In order to measure the process variable of schema abstraction, participants were provided the information elements from the target case (D) and asked to choose the "pieces of information from the case that you think were important in indicating whether or not a change should be made to StrollCo's valuation".[13] Informational elements are classified as 1) directly connected to the structure used to infer that the valuation should decrease ; 2) related to the valuation overall, but not directly connected to the inferential structure; and 3) superficial details not relevant to the

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[13] Information elements and their classifications are displayed in Appendix D.

decision of whether or not the valuation should be revised. The hypotheses predict that the schemas abstracted in the intervention conditions will be more structural in nature. In other words, they will contain more relations and the relevant concepts and attributes connected to those relations, and fewer superficial surface level details. Therefore, the coding scheme is comprised of two components, a 'positive portion' and a 'negative portion'. Each portion consists of a four-point scale, and the dependent measure is the sum of two, resulting in a seven point scale. The positive portion is designed to acknowledge participants' inclusion of informational elements related to the principle necessary for inference, described above. Responses were coded as a 4 if all elements directly connected to the structure of the principle are included in the response. They were coded as a 3, 2, or 1 if two, one, or none of the elements related to the structure of the principle are included, respectively. The negative portion of the measurement is designed to capture the amount of superficial surface detail that is included in the response. A greater number of superficial details included in the response indicates a less 'skeletal' abstraction of the inferential structure. The inclusion of no superficial surface details and the entire principle indicates that the schema structure was encoded cleanly during engagement with cases A – C and was applied to case D with the realization that this was the information directly suggestive of a required valuation decrease. The coding is structured such that responses with fewer superficial surface elements received higher scores. Responses with three or more such elements were coded as zero for the negative component. Responses with two, one, and zero superficial elements were coded as 1, 2, and 3, respectively. The sum of the positive and negative portions ranges from 1 to 7, with higher scores indicating a more structural schema abstraction.[14, 15]

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[14] An alternate measure was constructed on a five-point scale in which the negative component was similarly

<u>Knowledge Transfer</u>

The principle to be abstracted from the source cases can be articulated simply as: A capital intensive company, that wishes to increase sales volume, will require additional capital expenditures in the future beyond those required to maintain the current level of sales volume.

A demonstration of knowledge transfer necessitates applying this knowledge to the target case by recognizing that the relational pattern in the target case is inconsistent with this principle. To measure this transfer, participants were specifically asked: "Based on the assumptions used in estimating the valuation for StrollCo, which includes all available information as of the valuation date, do you believe the projected capital investment and upkeep expenditure cash flows should be revised upward (increase), be revised downward (decrease), or stay the same?". Responses were captured on a fully labeled, seven-point, bi-polar scale ranging from "definitely revised downward" to "definitely revised upward", and centered on "stay the same". As stated above, if sales volume for a capital intensive company is projected to increase in a valuation estimate, then capital expenditures must also be projected to increase above levels to maintain the current sales volume, to some extent, regardless of capacity. As such, higher scores on the assessment scale are considered more accurate and provide evidence of improved knowledge transfer from the source cases to the target case. In order to avoid creating a demand effect by only asking about one specific aspect of the case and thus drawing attention to its importance, the dependent

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created, but on a three-point scale instead of four-point. The positive component was constructed by coding as a 3 those responses that include all elements directly connected to the structure of the principle to be abstracted, coding as a 2 responses that include some of the components (i.e. one or two), and coding as a 1 the responses that include none of the relevant elements. The coding scheme for the positive portion is similar to that used in Gentner et al (2003) and Gentner et al (2004). Results from this scale were very similar to those obtained via the seven-point scale. As such, the seven-point scale is used as the primary measure for reporting results in order to keep the overall scale length consistent with the dependent measure of transfer.

[15] Informational elements categorized as related to the valuation overall, but not directly connected to the inferential structure, are not included in the calculation and thus are treated as neutral, neither increasing nor decreasing participants' scores.

measure was embedded within similar measures inquiring about projections for revenue, materials and labor expenses, operating expenses, and research and development expenses.

*Additional Measure Related to Comparison Effort*

As a supplemental measure of the effect of the comparison manipulation participants were asked "When answering the questions regarding Cases A, B, and C, to what extent did you actively compare the cases to each other?" These self-assessments of comparison effort provide information regarding not only how effective the prompt to compare is, but also the extent to which participants that were not prompted to compare did so anyway. Responses were provided on a five-point, unipolar, fully labeled scale ranging from "Did not compare" to "Compared Extensively".

*Control Variables and Attention Checks*

Additional control measures include self-assessments regarding perceived case difficulty ('difficulty') , motivation to perform a comparison ('comparison motivation'), and overall motivation to complete the study ('motivation). The responses were provided on a five-point, unipolar, fully labeled scale ranging from "Not at all…" to "Extremely…". Demographic information including gender, age, undergraduate major, college GPA, number of accounting and finance classes taken, and number of years of accounting or finance work experience, were also collected. Attention check questions inquiring as to whether participants were specifically asked to perform a comparison and the nature of the task were included in order to assess effort and comprehension.

Participants were undergraduate accounting students recruited from an Intermediate II financial accounting course. Participants were recruited by an email sent from the course professor and were provided extra credit for completing the study. The study was completed online via Qualtrics with a median time to complete of 48 minutes. A total of 122 participants completed the experiment. Median age and work experience of participants is 22 years old, and 0 years, respectively. Thus, the participants appear to be representative of the population of novice audit practitioners. Alfieri et al (2013) find no evidence that experience level moderates the effect of comparisons and that the technique can be productive with various levels of domain knowledge. As the current study examines the facilitation of expertise, domain novices are deemed to be ideal subjects. To serve as an effective test of the theory, the task should be somewhat challenging, and the task complexity is tailored to the experience level of the participants. The task is designed such that the participant population should be able to perform well with sufficient effort, but it is not so easy that experimental interventions will not be helpful in assisting them. Further, as the purpose of the study is to employ an intervention that will foster the abstraction of knowledge, using students will result in a cleaner manipulation as they are likely to be more homogenous in domain knowledge than those with more practice experience.

## Results

In order to better understand any potential effects of the experimental interventions on the dependent measures, data were collected on several variables, as discussed above, that were considered to have a potential impact on the dependent variables. These measures were included as covariates in ANCOVA models and where they were found to have a significant impact, at the

conventional level, on the dependent variables, they were left in the final models. Of the 122 participants that completed the study, 10 did not pass one or both of the attention check questions and thus are excluded for the reported results. Including these observations in the analysis does not have a substantive impact on the conclusions drawn from the results.
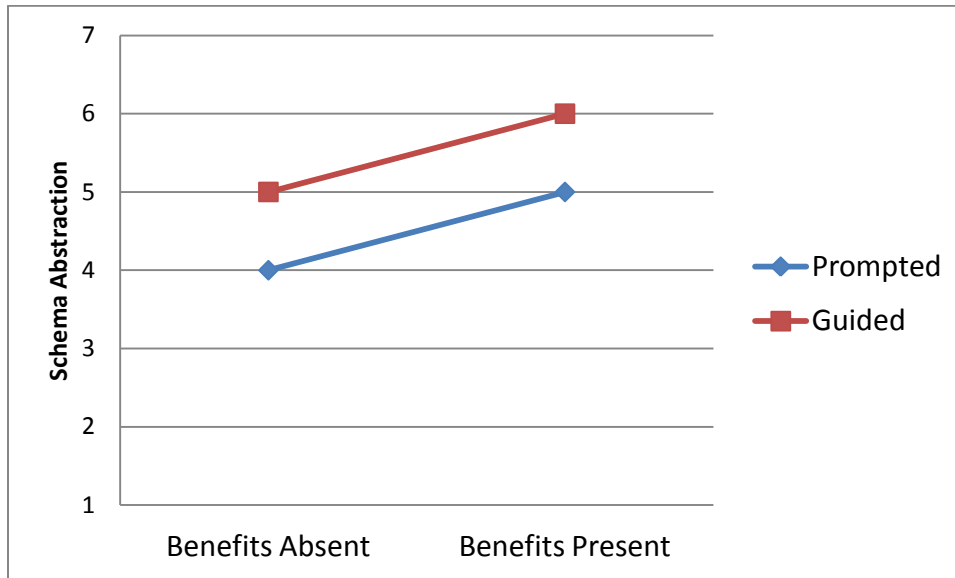
*Schema Abstraction*

Descriptive statistics for the schema abstraction dependent measure are displayed in Table 1 Panel A. Predicted and actual values are displayed in Figures 1 (Panels A and B) and 2 (Panels A and B), respectively. H1a predicts that a comparison intervention containing only a simple prompt to compare will lead to greater schema abstraction than no prompt to compare (the control condition). However, the mean for the control condition (5.05) is greater than that of the simple prompt condition (4.81). As the direction of the means is opposite what was predicted, H1a is not supported. In order to test hypotheses H2a, H3a, and H4a, an ANOVA was performed to examine the effects of the various interventions on schema abstraction.

H2a predicts that a comparison intervention with guided instructions will be more effective at facilitating schema abstraction than a simple prompt to compare. Descriptive statistics show that the overall mean of the guided instruction conditions (5.02) is greater than that of the simple prompt conditions (4.81), but ANOVA results, displayed in Table 1 Panel B, show that the difference is not significant ($p = 0.445$). As such, H2a is not supported.

H3a predicts that the inclusion of an explanation of the benefits of comparison will be more effective than no explanation. Overall, the means of the conditions which include the benefits explanation (5.02) are greater than those which do not (4.83). However, results from the ANOVA show that the difference is not significant ($p = 0.467$), thus H3a is not supported.

88

Additionally, H4a states that the additive effect of the guided instructions and benefits explanation combined is expected to be greater than all other conditions. While the mean of the guided instructions / benefits explanation condition (5.21) is greater than all others, ANOVA results show that the interaction is not significant ($p = 0.514$) and therefore H4a is not supported.

Panel A: Predicted Effect on Schema Abstraction Without Control Condition



Panel B: Predicted Effect on Schema Abstraction With Control Condition
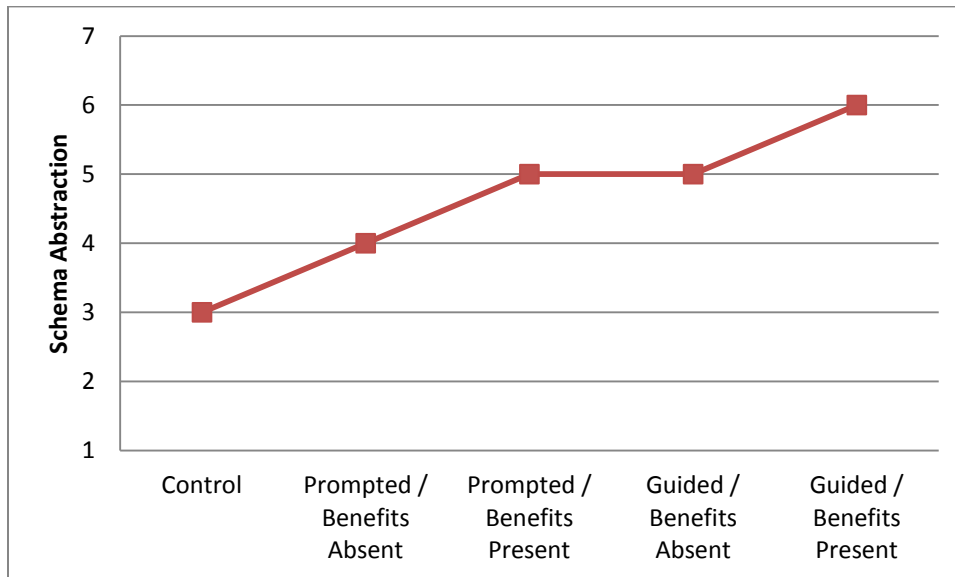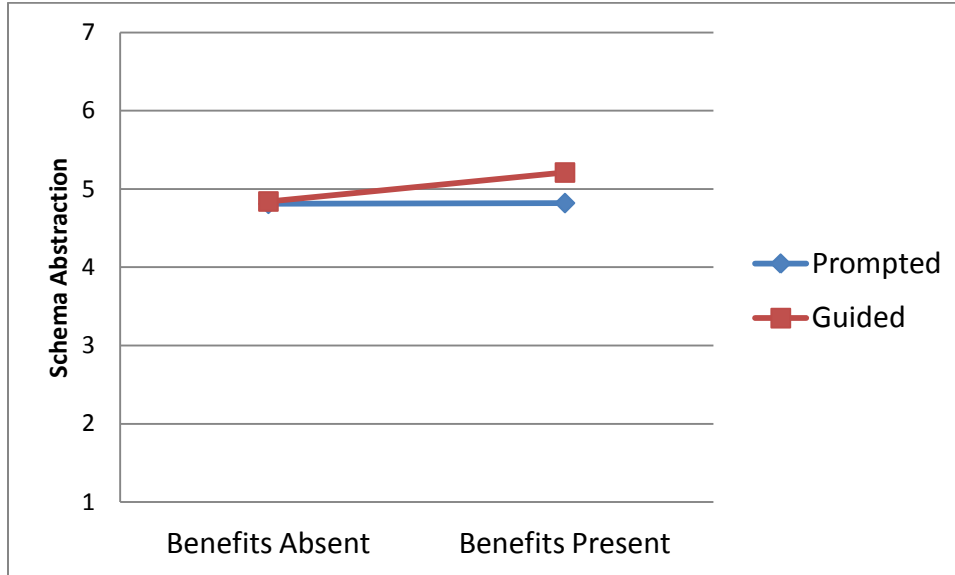


**Figure 1: Study Two Predicted Effects on Schema Abstraction**

Panel A: Actual Effect on Schema Abstraction Without Control Condition



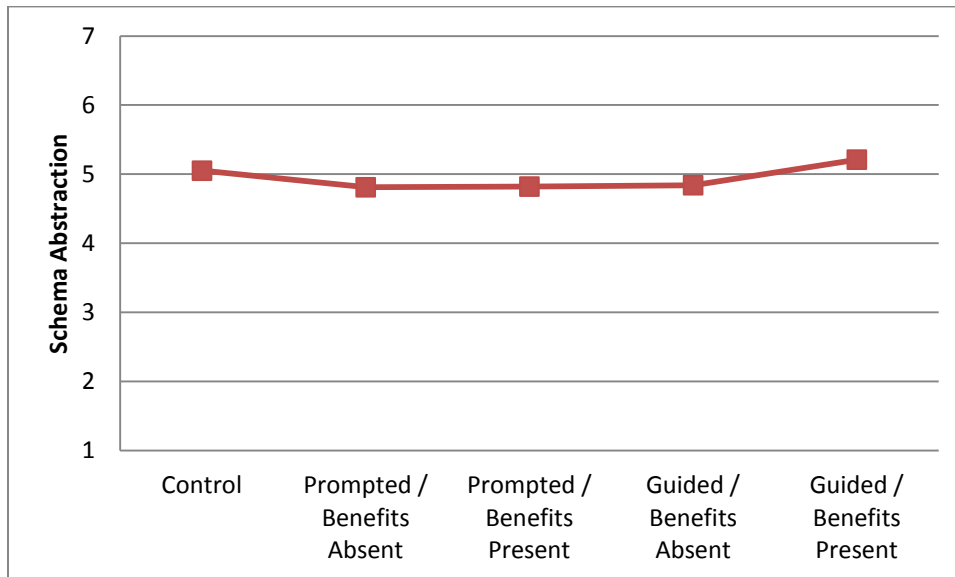Panel B: Actual Effect on Schema Abstraction With Control Condition



**Figure 2: Study Two Actual Effects on Schema Abstraction**

**Table 1: Study Two Results for Schema Abstraction**

| Panel A: Descriptive Statistics for Schema Abstraction[a] Means (Standard Deviations) | | | |
|---|---|---|---|
| | **Benefits[c]** | | |
| **Comparison Type[b]** | **Absent** | **Present** | Total |
| **Prompted** | 4.81 (1.33) n=21 | 4.82 (1.40) n=22 | 4.81 (1.35) n=43 |
| **Guided** | 4.84 (1.28) n=25 | 5.21 (1.25) n=24 | 5.02 (1.27) n=49 |
| **Total** | 4.83 (1.29) n=46 | 5.02 (1.32) n=46 | |
| **Control[d]** | 5.05 (1.05) n=20 | | |

| Panel B: ANOVA results for Schema Abstraction | | | |
|---|---|---|---|
| **Source of Variation** | **df** | **F-Statistic** | **p-value** |
| Comparison Type | 1 | 0.59 | 0.445 |
| Benefits | 1 | 0.53 | 0.467 |
| Comparison Type*Benefits | 1 | 0.43 | 0.514 |
| Residuals | 88 | | |

[a] Schema Abstraction measures information deemed to be important to the decision of target case valuation revision. The measure is constructed on a 1 to 7 scale.

[b] Comparison was manipulated as a simple prompt or guided instructions

[c] Benefits explanation was manipulated as present or absent

[d] Control condition includes no comparison prompt and no benefits explanation

*Transfer of Knowledge from Source Cases to Target Case*

Descriptive statistics for the knowledge transfer dependent measure are displayed in Table 2

Panel A. Predicted and actual values are displayed in Figures 3 (Panels A and B) and 4 (Panels A

and B), respectively. H1b predicts that a comparison intervention containing only a simple

prompt to compare will lead to greater knowledge transfer than no prompt to compare (the

control condition).However, the mean for the control condition (5.40) is greater than that of the

simple prompt condition (5.29). As the direction of the means is opposite what was predicted,

H1b is not supported. In order to test hypotheses H2b, H3b, and H4b, an ANOVA was

performed to examine the effects of the various interventions on knowledge transfer.

H2b predicts that a comparison intervention with guided instructions will lead to greater

knowledge transfer than a simple prompt to compare. Descriptive statistics show that the overall

mean of the guided instruction conditions (4.88) is lower than that of the simple prompt

conditions (5.23). As the direction of the means is opposite what was predicted, H2b is not

supported.

H3b predicts that the inclusion of an explanation of the benefits of comparison will lead to

greater knowledge transfer than no explanation. Overall, the means of the conditions which

include the benefits explanation (4.96) are greater than those which do not (5.13). As the

direction of the means is opposite what was predicted, H3b is not supported.

H4b states that the additive effect on knowledge transfer of the guided instructions and

benefits explanation combined is expected to be greater than all other conditions. However, the

mean of this condition (4.75) is in fact lower than all other conditions. Therefore, H4b is not

supported. This finding is rather curious in light of the fact that this condition had the highest

mean on the schema abstraction measure. The pattern of means was essentially the opposite of

those on the schema abstraction measure. The conditions including guided instructions and

explanation of benefits resulted in lower means than those with a simple prompt and no benefits

explanation, respectively. The implications of this will be addressed further in the discussion

section.

Panel A: Predicted Effect on Knowledge Transfer Without Control Condition
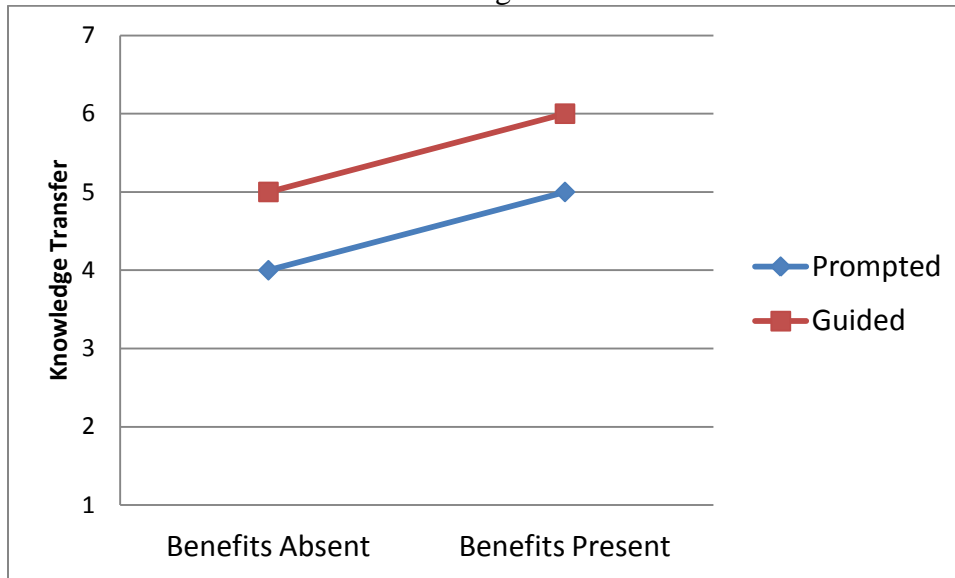


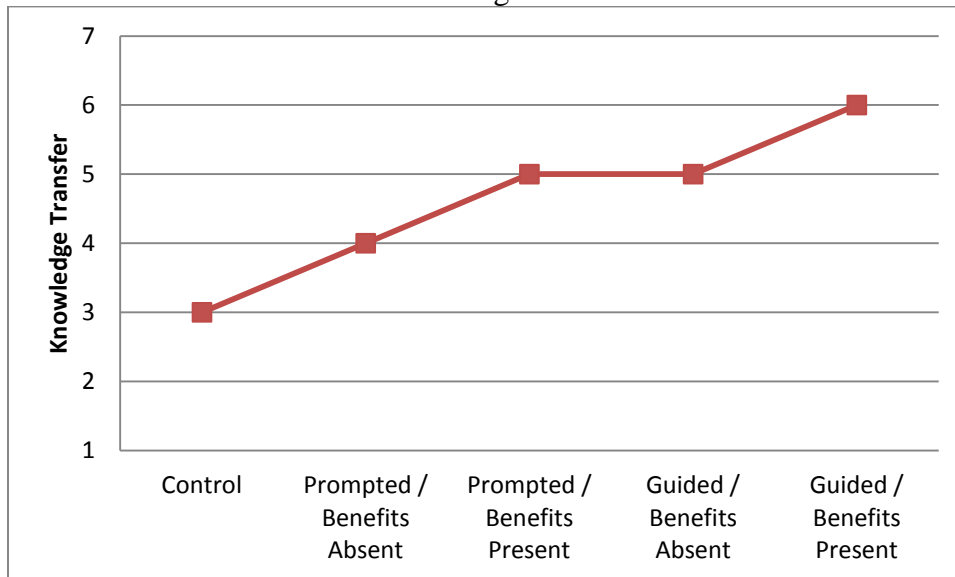Panel B: Predicted Effect on Knowledge Transfer With Control Condition
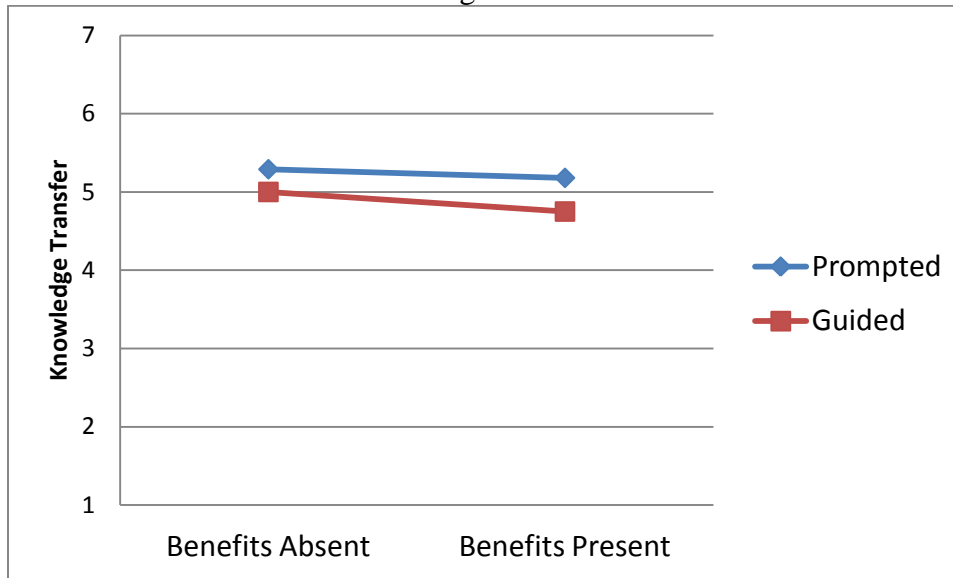


**Figure 3: Study Two Predicted Effects on Knowledge Transfer**

Panel A: Actual Effect on Knowledge Transfer Without Control Condition



Panel B: Actual Effect on Knowledge Transfer With Control Condition
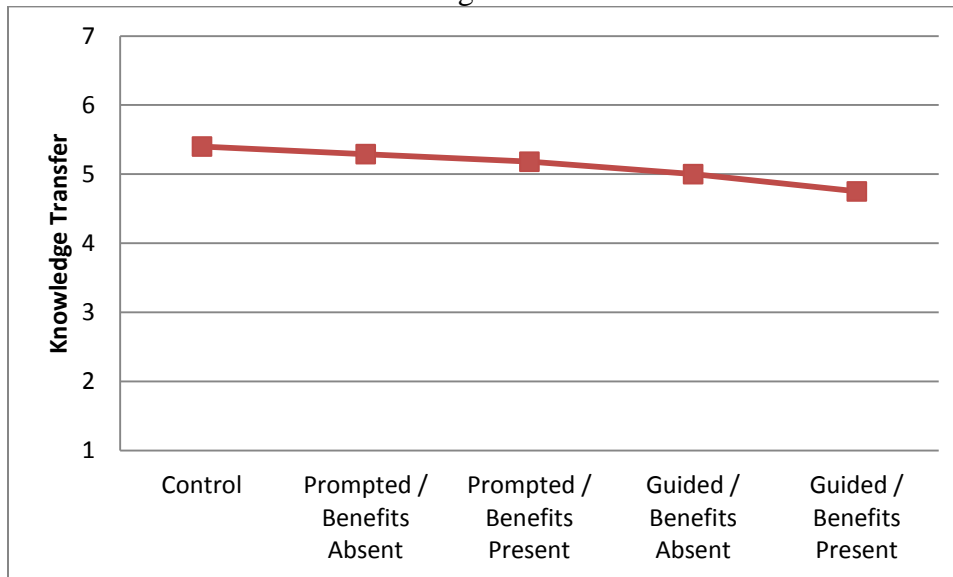


**Figure 4: Study Two Actual Effects on Knowledge Transfer**

**Table 2: Study Two Results for Knowledge Transfer**

| Panel A: Descriptive Statistics for Knowledge Transfer[a] Means (Standard Deviations) | | | |
|---|---|---|---|
| | **Benefits[c]** | | |
| **Comparison Type[b]** | **Absent** | **Present** | Total |
| **Prompted** | 5.29 (0.90) n=21 | 5.18 (1.18) n=22 | 5.23 (1.04) n=43 |
| **Guided** | 5.00 (1.19) n=25 | 4.75 (1.57) n=24 | 4.88 (1.38) n=49 |
| **Total** | 5.13 (1.07) n=46 | 4.96 (1.40) n=46 | |
| **Control[d]** | 5.40 (1.27) n=20 | | |
| **Panel B: ANOVA results for Knowledge Transfer** | | | |
| **Source of Variation** | **df** | **F-Statistic** | **p-value** |
| Comparison Type | 1 | 1.91 | 0.171 |
| Benefits | 1 | 0.49 | 0.485 |
| Comparison Type*Benefits | 1 | 0.08 | 0.779 |
| Residuals | 88 | | |

[a] Knowledge transfer measures the application of the principle to be abstracted to generate inference in a new case. It is measured on a 1 to 7 scale.

[b] Comparison was manipulated as a simple prompt or guided instructions

[c] Benefits explanation was manipulated as present or absent

[d] Control condition includes no comparison prompt and no benefits explanation

*Supplementary Analyses*

Dichotomized Knowledge Transfer Measure

In an attempt to further disentangle the results from noise in the data, some additional tests were performed. The knowledge transfer measure regarding capital expenditures was dichotomized into correct (greater than or equal to 5 on the scale, or revise upward) or incorrect (less than 5 on the scale, or revise downward) to remove some potential noise in the excess variation. Proportions of correct and incorrect responses are presented in Table 3. The results are largely similar to those from the scaled measure. The conditions with the guided instructions and benefits explanations fare worse than those with the simple prompts and no benefits explanations, respectively. One difference is that the simple prompt conditions now outperform the control condition, but not significantly. A logistic regression (not tabulated) shows no significant effects of the interventions.

**Table 3: Study Two Results for Dichotomized Knowledge Transfer Measure**

| Proportions of Dichotomized Responses on Knowledge Transfer Measure[a] | | | | | |
|---|---|---|---|---|---|
| | Control | Prompted / Benefits Absent | Prompted / Benefits Present | Guided / Benefits Absent | Guided / Benefits Present |
| Incorrect | 30% | 19% | 27% | 36% | 42% |
| Correct | 70% | 81% | 73% | 64% | 58% |
| [a]The knowledge transfer measure is dichotomized as correct (greater than or equal to 5 on the scale, or revise upward) or incorrect (less than 5 on the scale, or revise downward). | | | | | |

Overall Valuation Revision Measure

As previously discussed, this study was designed in order to demonstrate the potential of

interventions to assist in schema abstraction and transfer of knowledge related to a specific principle, or set of relations. The interventions were not designed to enhance knowledge about valuation assessments overall. This is a complex task, training in its overall completion would require significantly more instruction, time, and effort beyond the level of implementation in the present laboratory study. However, the task is the environment in which the interventions are implemented and therefore insights may be gained by examining how participants performed on the overall task, in total and between conditions.

Before responding to the knowledge transfer measure of capital expenditure projections, participants were given a chance to respond about potential revision to the overall valuation. They were asked specifically: "Based on the assumptions used in estimating the valuation for StrollCo, which includes all available information as of the valuation date, do you believe the overall valuation should be revised upward (increase), be revised downward (decrease), or stay the same?" Responses were elicited on a fully labeled, seven-point, bi-polar scale ranging from "definitely revised downward" to "definitely revised upward", and centered on "stay the same". Note that consistent with the pattern of relations in the principle to be abstracted in the target case, the overall valuation should be revised downward. Therefore, in contrast to the aforementioned dependent variables, lower scores on this scale suggest greater performance.

An ANOVA was performed using the valuation revision measure as a dependent variable. Results are shown in Table 4 Panel B. Not surprisingly, due to the noise in the measure, an odd pattern emerged. Similar to the knowledge transfer dependent variable, the main effects of guided instructions and benefits explanation do not appear to be beneficial. The overall mean of the guided instruction conditions (4.22) is greater (worse) than that of the simple prompt conditions (4.02). As shown in Table 4 Panel B, this difference is not significant (p = 0.486).

Additionally, the overall mean of the benefits explanation present conditions (4.24) is greater (worse) than that of the benefits explanation absent conditions (4.02). This difference is also not significant (p = 0.453).  On this measure, however, the simple prompt / benefits explanation absent condition fares the best (3.52), although a t-test shows that it is not significantly better than the control condition (3.80) (p = 0.267). Additionally, there is a significant disordinal interactive effect such that the benefits explanation improves performance in the guided instructions conditions, but hinders performance in the simple prompt conditions. Further, performance in the simple prompt / benefits explanation absent condition (3.52) is better than performance in both the guided instruction / benefits explanation absent (4.44) and simple prompt / benefits explanation present (4.50) conditions. This is again suggestive that in addition to not providing significant benefits to schema abstraction or knowledge transfer, the guided instruction and benefits explanation interventions seem to be detrimental to overall task performance. Potential implications of these findings will be addressed in the discussion section below.

**Table 4: Study Two Results for Valuation Revision Measure**

| Panel A: Descriptive Statistics for Valuation Revision[a] Means (Standard Deviations) | | | |
|---|---|---|---|
| | **Benefits[c]** | | |
| **Comparison Type[b]** | **Absent** | **Present** | Total |
| **Prompted** | 3.52 (1.25) n=21 | 4.50 (1.30) n=22 | 4.02 (1.35) n=43 |
| **Guided** | 4.44 (1.39) n=25 | 4.00 (1.64) n=24 | 4.22 (1.51) n=49 |
| **Total** | 4.02 (1.39) n=46 | 4.24 (1.49) n=46 | |
| **Control[d]** | 3.80 (1.54) n=20 | | |

| Panel B: ANOVA results for Valuation Revision | | | |
|---|---|---|---|
| **Source of Variation** | **df** | **F-Statistic** | **p-value** |
| Comparison Type | 1 | 0.49 | 0.486 |
| Benefits | 1 | 0.57 | 0.453 |
| Comparison Type*Benefits | 1 | 5.77 | 0.018 |
| Residuals | 88 | | |

| Panel C: Follow-Up T-test | **T-statistic** | **p-value[e]** |
|---|---|---|
| Prompted/Benefits Absent vs. Control | -0.63 | 0.267 |

[a] Valuation revision measures performance on the overall valuation task. It is measured on a 1 to 7 scale, with lower scores representing greater performance.

[b] Comparison was manipulated as a simple prompt or guided instructions

[c] Benefits explanation was manipulated as present or absent

[d] Control condition includes no comparison prompt and no benefits explanation

[e] Reported p-values are the one-tailed equivalent based on unadjusted alphas

Comparison Effort

The measure of self-reported comparison effort was also analyzed as a dependent variable in order to determine if the interventions had any impact on the measure. This is of particular interest because a potential explanation for the lack of results of the comparison interventions is that participants are exhibiting significant comparison effort innately, without needing to be prompted. It is possible, for example, that accountants receive training or experience that instills in them a greater tendency to perform comparisons in accounting related tasks. Descriptive statistics, displayed in Table 5 Panel A, show that overall the participants in the simple prompt conditions reported the highest mean (3.89) for comparison effort. In contrast, the overall mean for the guided instruction conditions is 3.53. Results of an ANCOVA, displayed in Table 5 Panel B, show that the guided instructions appear to have a nominally significant detrimental effect on comparison effort (p = 0.066).[16] The overall mean of the benefits explanation present conditions (3.76) is greater than that of the benefits explanation absent conditions (3.63), but the difference is not significant (p = 0.427). There is also a nominally significant disordinal interactive effect such that explanation of benefits improves comparison effort in the guided instruction conditions, but not in the simple prompt conditions (p = 0.076). Interestingly, within the benefits explanation absent conditions, the simple prompt (3.95) results in higher reported comparison effort than the guided instructions (3.36). Implications of these findings are addressed in the discussion section.

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[16] As shown in Table 5 Panel B, covariates in the ANCOVA model include measures of motivation to perform comparison specifically and overall motivation to complete the study, as discussed in the control variables subsection of the methods section above. These measures were included in the final model as they were shown to have a significant association with comparison effort.

**Table 5: Study Two Results for Comparison Effort Measure**

| Panel A: Descriptive Statistics for Comparison Effort Measure[a] Means (Standard Deviations) | | | |
|---|---|---|---|
| | **Benefits[c]** | | |
| **Comparison Type[b]** | **Absent** | **Present** | Total |
| **Prompted** | 3.95 (0.74) n=21 | 3.82 (0.80) n=22 | 3.89 (0.76) n=43 |
| **Guided** | 3.36 (1.08) n=25 | 3.71 (1.12) n=24 | 3.53 (1.10) n=49 |
| **Total** | 3.63 (0.97) n=46 | 3.76 (0.97) n=46 | |
| **Control[d]** | 3.70 (0.92) n=20 | | |

| Panel B: ANCOVA results for Comparison Effort | | | |
|---|---|---|---|
| **Source of Variation** | **df** | **F-Statistic** | **p-value** |
| Comparison Type[e] | 1 | 3.46 | 0.066 |
| Benefits[e] | 1 | 0.64 | 0.427 |
| Comparison Type*Benefits | 1 | 3.23 | 0.076 |
| Comparison Motivation | 1 | 44.01 | <0.001 |
| Motivation | 1 | 4.86 | 0.030 |
| Residuals | 86 | | |

[a] Comparison effort measures the self assessed levels of effort expended on comparing the source cases. It is measured on a 1 to 5 scale.

[b] Comparison was manipulated as a simple prompt or guided instructions

[c] Benefits explanation was manipulated as present or absent

[d] Control condition includes no comparison prompt and no benefits explanation

[e] Results include the covariates motivation to compare

## Discussion

In reviewing the results, some trends are worth noting. Contrary to predictions, there is some evidence that the guided instructions may actually be detrimental relative to a simple prompt to compare or even no prompt to compare (as in the control condition). In testing the impact of the interventions on the knowledge transfer dependent variable (Table 2), the means of the guided instruction conditions suggested worse performance than the means of the simple comparison prompt and control conditions. Similarly, in the dichotomized capital expenditure measure (Table 3), the simple comparison prompt conditions outperformed the guided instruction conditions. In the measure of the perceptions regarding potential revision of the valuation overall (Table 4), both guided instruction conditions performed worse than the simple comparison prompt / benefits explanation absent condition. In addition, both guided instruction conditions performed worse than the control condition. On the measure of self-reported comparison effort, the guided instruction intervention appeared to have a detrimental impact versus the simple comparison prompt(Table 5). Additionally, participants in the guided instruction / benefits explanation absent condition reported noticeably lower effort than those in the simple comparison prompt / benefits explanation absent condition. The exception is the schema abstraction measure, in which participants in the guided instruction / benefits explanation present condition perform the best, but again not significantly so.

Although most of these differences are not significant, when taken together, these results bring to mind an intriguing question as to whether or not the guided instructions may actually have a detrimental impact. One potential explanation for why such a phenomenon might occur is that novices may have varying strategies of how they perform comparisons naturally, and the simple prompt to compare spurs them to perform a comparison however they would normally do

so. In contrast, the guided instructions may lead them to perform the comparison in a particular way that they are not used to, which in turn could result in an excessive toll on working memory, or decreased effort. Future research could examine whether different implementations of guided instructions have more success.

Another curious finding is that multiple measures show the combination of guided instructions and explanation of benefits present improving performance over either alone (Tables 1 and 4). This may be merely due to noise in these measures, but an alternative explanation is that the simple comparison prompt leads novices to perform a comparison the way that they normally would, which perhaps they are doing anyway in the control condition. Inclusion of the guided instructions may cause an excessive toll on working memory, or decreased effort, if this method is different than the individuals' "natural" way of comparing stimuli. Including the benefits explanation in addition to the guided instructions may motivate them to work harder and thus somewhat improve performance over the provision of guided instructions alone. A similar effect could happen with the inclusion of the benefits explanation without the guided instructions in that it causes novices to get stuck thinking about the "right" way to perform the comparison, essentially creating pressure to do so, but without instruction on how to do so. Thus the introduction of the guided instructions in addition to the benefits explanation helps them better accomplish what they are now trying to do, but due to the toll on working memory, the combination is still not as good as the simple prompt alone or the control condition.

It is interesting that the interventions seem to have little impact on comparison effort (Table 5). This suggests that prompting novices to perform effortful comparisons may be somewhat elusive. Performing effortful comparisons in such situations may be an innate strategy for certain individuals more so than others. Future research could examine potential determinants of

whether or not individuals perform effortful comparisons as a strategy in contexts in which they are novices as well as how better to guide those who do not into doing so.

The lack of effect of the benefits explanation is particularly surprising. Of the eight conditions included in the pre-test (which consisted of a larger design including a third independent variable), the three conditions which included the benefits explanation had the best transfer scores. In the present study, the benefits explanation is not presented until after the participants read through the cases once. Thus, it is possible that presenting the benefits explanation before the initial reading may increase its effect, as participants may not engage with the cases as diligently when going through them the second time, particularly as this is a somewhat challenging task.

Perhaps the failure to compare phenomenon is an artifact of the laboratory in which simple tasks, structured in a certain way, benefit from conscious comparison whereas more complex tasks do not due to cognitive overload. There is not enough evidence herein to suggest that, but future research should delve into whether these results are simply due to noise in the measures, whether they indicate possible boundary conditions for the comparison strategy investigated in psychology studies, or whether this strategy requires more practice. Future research could further examine the comparison strategy in a different task setting within accounting, or in the same task setting, but with a different population. Studies could also examine the impact of alternative interventions to prompt comparisons or interventions aimed at other strategies, aside from comparison, that may lead to improved schema abstraction, knowledge transfer, and in turn greater expertise.

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# STUDY THREE: ACCELERATING AUDIT EXPERTISE BY TRAINING NOVICES TO REPRESENT DOMAINS AS EXPERTS DO

## Introduction

The environment of external auditing is one that necessitates regular judgments by practitioners. The quality of these judgments may ultimately be associated with audit effectiveness, efficiency, and innovation and will be affected by the level of expertise that practitioners possess. Therefore the study of expertise in audit settings is an important research avenue, and there is much existing literature on the subject. Notwithstanding, audit researchers have tended to focus on understanding expertise in audit domains, rather than on how to foster it, in spite of calls to do so (Bedard & Chi 1993; Nelson & Tan 2005).

Both psychology and auditing research has linked expertise to pattern recognition (Kahneman & Klein 2009; Brown & Solomon 1991; Hammersley 2006), but research also notes that patterns can take different forms and researchers have converged on the idea that expertise is dependent on understanding patterns in the deeper, relational structure of problem domains (e.g. Gentner 1983; Chi & VanLehn 2012; Bedard & Chi 1993; Christ 1993; Vera-Munoz, Kinney, and Bonner 2001). Relational knowledge of domains improves understanding of individual instances but also in the transfer of knowledge to new, slightly different instances due to the knowledge being less inert. In numerous domains, including in many audit tasks, expertise is contingent on being able to transfer knowledge from one instance to another, with some level of variation between instances. In audit tasks such as analytical procedures; preliminary and other risk assessments; auditing goodwill impairment assessments as well as other complex estimate and classification tasks; and advanced data analytics, relational knowledge included in problem representations will likely be a significant factor in the quality of audit judgments. Thus, the

abstraction of schemas comprising the relational structure of domains may help enhance knowledge transferability, and in turn, audit expertise.

One example of a task that the Public Company Accounting Oversight Board (PCAOB) has repeatedly found deficiencies in among practitioners is auditing of goodwill impairment assessments (PCAOB 2015a, PCAOB 2015b, PCAOB 2015c, PCAOB 2015d). In an experiment involving this task setting, Griffith (2017) demonstrates that in circumstances involving higher risk, auditors can benefit from a cue regarding relations between assumptions. It is suggested therein that this effect may derive from insufficient relational structure in auditors' problem representations which prevents them from recognizing the relational pattern among the set of assumptions. Additionally, there is evidence that auditors do not always attend to the relational cues when provided, which is indicative that they may not understand the importance of the relations in comprehending the overall problem domain.

Improving relational reasoning by audit practitioners may be accomplished by enhancing the relational knowledge that they possess in relevant domains as well as their general ability to engage in relational reasoning. The purpose of this study is to investigate training interventions that have the ability to improve relational reasoning on the part of auditors by fostering the abstraction of mental representations (schemas) that consist of greater relational information. Mental representations that are more relation-based tend to be more flexible and therefore allow for greater knowledge transfer. One of the most common findings in knowledge transfer research is that surface level (superficial) similarity between domains or instances within a domain often has significant negative effects on knowledge transfer (Ross 1987; Reed 1987; Gentner, Rattermann, and Forbus 1993). Chi & VanLehn (2012) suggest that this phenomenon occurs because surface features of a domain are directly perceivable, whereas the systems of relations

115

are often not.

Analogical comparison is a process that involves comparing analogs that share commonality in relational structure. This process has the effect of highlighting the relational structure and has been shown in psychology literature to promote analogical encoding, or the abstraction of more relation-based schemas that include fewer superficial details, which in turn leads to greater knowledge transfer (e.g. Gick & Holyoak 1983; Catrambone & Holyoak 1989; Loewenstein et al 1999; Kurtz, Mao, and Gentner 2001; Gentner, Loewenstein, and Thompson 2003, for a thorough review see Alfieri, Nokes-Malach, and Schunn 2013).

Chi & VanLehn (2012) provide the theoretical foundation for another training intervention aimed at improving what they term deep initial learning, which similarly involves a focus on the 'deeper' relational structure of domains. They speculate that experts have come to 'see' the deeper structure through vast experience, and in order for novices to begin to see it they must advance to considering interaction cues (relations). They further suggest that novices receive explicit instruction in consciously representing problems as experts do, which would be based on the deeper structure. The intention in this study is to undertake an initial effort at implementing the intervention for which Chi & VanLehn (2012) have provided a theoretical position.  Day and Goldstone (2012) also stress the importance of discerning deep structure and recommend that for educational purposes removing all extraneous detail from learning examples will assists in focusing learners on the relational structure. However, from the perspective of developing professional expertise in a real world domain such as auditing, where most learning will occur on the job, this solution is not feasible. Therefore, a more realistic solution is to train auditors in the skill of seeing beyond irrelevant surface details in order to focus on the deeper structure of domains.

This study examines the potential of these two interventions, analogical comparison and explicit training on seeing the deep structure of domains, to be implemented as training in metacognitive skills. Further, it is posited that these two skills are not substitutes for each other, but that seeing the deep structure of individual instances will moderate the effect of analogical encoding, as they operate in different ways. By representing domains in a more systematic way, based on the deeper structure, should lead to a better understanding of the individual instances and additionally, the individual representations should be constructed in a more alignable format. This should allow the comparison process to be more effective in promoting the abstraction of more flexible schemas.

To test the predictions that the interventions will lead to improved schema abstraction and greater knowledge transfer, an experiment was conducted using a 2 (comparison absent or present) X 2 (Deep Structure Prompt, 'DSP', absent or present) design, in a task setting involving the audit of valuations related to goodwill impairments. In the comparison present conditions, participants were prompted to assess the similarities and differences between three source cases, which contain a common principle. In the comparison absent condition, participants are prompted to assess each case individually, although all three cases are presented side by side on one page, allowing the opportunity for comparison, in all conditions. In the DSP present condition, participants were provided with an intervention which provides instruction on how to represent domains as systems of concepts, attributes, relations, and higher order relations. In the DSP absent condition, the prompt was not included as part of the experiment, but was included post experiment, in order to keep overall time consistent.

The dependent measure of the schemas abstracted from the source cases was based on which informational elements, from a target case, participants designated were important to their

117

decisions about whether or not the overall valuation in the target case should be revised. The dependent variable of knowledge transfer was measured as participants' responses to a question regarding whether or not the capital expenditures projection in the target case should be revised, as the principle to be abstracted from the source cases involves the relations between sales volume and capital expenditures. An exhibition of knowledge transfer requires application of the principle to be abstracted from the source cases to the target case through recognition that the pattern of relations between assumptions in the target case is not consistent with the principle.

Despite substantial theoretical background for the hypothesized outcomes, results from the experiment do not provide support for the predicted effects of the interventions on schema abstraction or knowledge transfer. Notwithstanding a lack of significant support for the hypotheses, there is some evidence for the potential of the interventions. Conditions that received only the comparison intervention tended to display better performance across nearly all tests, albeit mostly not statistically significantly greater. The conditions receiving the DSP prompt performed better than the control condition on the knowledge transfer measure, which is deemed to be the most precise measure in the study, but worse on other measures; thus, the results for this intervention are mixed. As expanded upon in the discussion section, additional research is necessary to demonstrate the potential that these techniques offer for expediting audit expertise.

This study has important implications for the development of expertise in audit practice, other areas of public accounting, and perhaps other accounting domains. The nature of public accounting is such that practitioners work with many different clients over time. This setting provides the opportunity for practitioners to develop significant expertise in a range of tasks and general business principles. Theory suggests that an accelerated path to expertise can be fostered by a conscious focus on the deeper principles of the domains. By learning to represent domains

118

as systems of relations, and by consciously focusing on comparisons between experiences gained on the job, practitioners can acquire more flexibly applied knowledge by encoding to memory the deeper elements of the domain and fewer of the irrelevant surface features, which serve as significant distracters to recall of useful knowledge from memory. The small, positive impact of the comparison intervention in this study suggests that similar, and likely greater, effects could be achieved through the use of a full scale, perhaps more longitudinal, training implementation. The more mixed results of the DSP intervention may indicate that a different format, greater exposure, or both may be required to instill in novices the skill of recognizing the deeper structure of domains.

This research also contributes to the literature on expertise in auditing by introducing two techniques for facilitating the encoding of more transferable knowledge. There has been significant research on examining the nature of expertise in accounting, but less research on how to better create it. Chi & VanLehn (2012) layout a framework for interventions intended to train in seeing the deeper structure of problem domains. This study is a first step in examining methods to implement such an intervention.

## Background

The audit environment consists of many instances in which significant judgments must be made. Moreover, the public accounting profession is at the precipice of considerable change. Many routine audit tasks are being redesigned and automated, and it follows that novice auditors will be expected to perform further up the value chain earlier in their careers. More complex judgments involving risk assessments, complex estimates, and other classification audit tasks

will be undertaken by auditors earlier in their careers than in previous generations (Cohn 2017). In addition to conventional complex audit tasks including, for example, various risk assessments, future audit professionals will need to make judgments involving diverse areas such as valuation and advanced data analysis.

These judgments are impacted by the level of expertise possessed by practitioners and may be associated with audit effectiveness, efficiency, and innovation. Thus, there is good reason to examine expertise in audit contexts and there exists a prodigious literature on the subject. However, researchers have focused more on understanding expertise in auditing than on how to facilitate it, despite calls to do so by prominent researchers (Bedard & Chi 1993; Nelson & Tan 2005). Bedard & Chi (1993) provided an informative treatise on the construct of expertise in audit settings from a cognitive science perspective. They discuss, among other things, the importance of knowledge structure, deep relational features in knowledge structures, and a lack of direct evidence on the issue in auditing research. Further, they call for more research on training and the facilitation of expertise. Nelson & Tan (2005) provide a more recent, and concise, review of the audit expertise literature, and summarize the expertise paradigm as focusing on knowledge and task interactions. Nelson & Tan (2005) further discuss the importance of understanding the knowledge acquisition process that leads novices to become experts in auditing domains, and how little of this research has been performed.

Expertise has been closely linked to pattern recognition in psychology (e.g. Simon 1992; Kahneman & Klein 2009) as well as auditing (e.g. Brown & Solomon 1991; Hammersley 2006), and many tasks in auditing require inferences based on recognition of patterns. It has been documented in various contexts that auditors often have difficulty with such pattern recognition (Bedard & Biggs TAR 1991; Bierstaker et al 1999), that this is impacted by, among other things,

120

the domain knowledge possessed by the auditors (Brown & Solomon 1991; Hammersley 2006), and that interventions can assist auditors in improving such pattern recognition (Earley 2001; Griffith, Hammersley, Kadous, and Young 2015; Plumlee et al 2015). It is important to articulate that not all patterns take the same form. The representation of a complex domain will consist of various types of elements. Theories involving domain representation (e.g. Minsky 1974; Gentner 1983; Johnson-Laird 1983; Novak & Cañas 2008; Doumas & Hummel 2012) typically include some form of objects, attributes, and relations, although the terminology and exact descriptions may vary widely. These representation theories also tend to state or imply that the relations in the representation are more important than the representation objects for making inferences. Scholars of expertise across many paradigms converge on the idea that expertise is dependent on an understanding of the deeper, relational structure of problem domains (e.g. Gentner 1983; Chi & VanLehn 2012), as opposed to focus on the surface features that are often irrelevant and less useful for making inferences based on existing knowledge. This has also been recognized in auditing research (Bedard & Chi 1993; Christ 1993; Vera-Munoz, Kinney, and Bonner 2001). Similarly, knowledge transfer is linked to abstracted schemas of the deep structure of domains. Thus, in many domains, expertise is contingent upon the transferability of knowledge, which in turn is conditioned on having abstracted sufficiently deep and flexible knowledge structures. Encoding of surface features into domain schemas can hinder the ability to recall these schemas when presented with stimuli that differ on the surface level features but are similar on deeper, more meaningful dimensions (Day & Goldstone 2012).

In an analytical procedures task setting, Brewster (2011) finds that participants guided to take a systems-based view of a domain develop mental models that contain more relational information linking pieces of evidence to each other and to management assertions. These

121

improved mental models are shown to improve performance on the analytical procedures task and Brewster (2011) calls for more research on methods of training to improve systems thinking in audit settings.

Citing deficiencies identified by the PCAOB related to fair value auditing tasks, Bratten et al (2013) postulate that a lack of valuation expertise amongst auditors is an important factor in such deficiencies and suggest that training could serve as a potential remedy. They call for more research on promoting valuation expertise among auditors as well as more effective training methods to do so. The need for further auditor training in this area is also recognized by the SEC in the report by the Advisory Committee on Improvements to Financial Reporting (ACIFR) which reads "preparers and auditors will likely have to incur costs to broaden their proficiency in basic valuation matters...For instance, additional training for field auditors may be necessary as they work more frequently with valuation experts." (SEC 2008, p.29).

A particular task, within the broader class of auditing fair value measurements, in which the PCAOB has continued to find deficiencies on the part of auditors is that of auditing goodwill impairment assessments (PCAOB 2015a, PCAOB 2015b, PCAOB 2015c, PCAOB 2015d). In a task setting involving auditing goodwill impairment assessments, Griffith (2017) finds that in higher risk situations, auditors benefit from a relational cue concerning the collective assumptions and suggests that this effect arises as auditors' problem representations of the task may not be comprised of sufficient relational structure to recognize patterns among the assumptions. She finds evidence that auditors may not always attend to relational cues provided by valuation specialists, suggesting that auditors may not recognize the importance of the relations between domain elements. Griffith (2017) also suggests that benefits could be derived from using decision aids and training methods that promote understanding the relationships

between assumptions, including training in systems thinking, as this may help develop problem representations and pattern recognition skills.

More research is needed on fostering expertise in auditing tasks and expertise has been closely linked with knowledge structures rich in relational information. Knowledge of relations within a domain aids in understanding individual instances and in transfer of knowledge to new instances, due to knowledge being less inert[17]. In task environments such as analytical procedures; preliminary and other risk assessments; auditing goodwill impairment assessments as well as other complex estimate and classification tasks; and advanced data analytics, relational knowledge included in problem representations may play a key role in the quality of audit judgments. There may be substantial variation amongst surface features such as lines of business; geographic markets; people performing the assessment; et cetera, but key relational patterns can be expected to remain fairly consistent due to factors such as the nature and mission of for profit entities; human nature; incentive structures; measurement methods; and accounting standards. Recognition of these relational patterns is often critical to judgments regarding the reasonableness of the collective assumptions.

Dumas et al (2013 p.392) describe relational reasoning as "the ability to recognize or derive meaningful relations between and among pieces of information that would otherwise appear unrelated" and Alexander (2016 p.1) describes the "intentional harnessing of pattern recognition to drive higher levels of human learning and performance." Relational reasoning is widely regarded as central to human cognition and essential for expertise in any domain, and may be more important than ever in the information age (Dumas et al 2013). This is especially true in

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[17] The inert knowledge problem is concisely summarized by Gentner et al (2003, p.393) as "a failure to access prior examples that would be highly useful if retrieved". Thus, the problem arises from a failure to recall known patterns from memory, typically because dissimilar surface features, which are easily perceptible, impede such recall.

settings as complex as the contemporary audit environment. There are many task domains in auditing that could benefit from improved relational reasoning on the part of auditors. Enhancement of relational reasoning by audit practitioners, particularly novices, may be accomplished by increasing relational knowledge within specific domains as well as general relational reasoning ability. This study seeks to investigate the potential benefits of training methods that can improve auditors' relational reasoning by facilitating the abstraction of more relation-based schemas and explicit training in the strategy of thinking in terms of systems of relations. The interventions used herein have potential applications across public and other accounting settings. Drawing on multiple paradigms related to expertise, and in particular the analogical reasoning paradigm, this study tests the potential of two methods for fostering expertise in auditing. Additionally, methods are utilized that aren't constrained by requiring the use of pre-constructed decision aids or problem representations. Brewster (2011) notes that a limitation of the approach used in that study is that it requires pre-determined systems diagrams for every individual instance within a task domain; a requirement that is not feasible in practice. Other studies such as Bradley (2009) and Plumlee et al (2015) provide evidence that training in metacognitive skills may have benefits in audit tasks. The training methods, discussed further below, that are used in the current study aim to promote a metacognitive skill of explicitly comparing systems of relations that combines the abstraction of more domain-specific relational knowledge and the domain general strategy of thinking in terms of systems of relations.

**Theory and Hypotheses Development**

*Surface Similarity and Deep Structure*

In understanding the nature of deep structure, it is useful to conceive of domains as systems and the knowledge representing the domains as knowledge systems, typically construed as consisting of nodes (e.g. objects or concepts), relations between nodes, and even relations between relations, as well as systems connected to or nested within other systems. Goldwater and Schalk (2016, p.15), for instance, state that relational concepts "comprise knowledge systems" and "form coherent systems of interconnected concepts". This is a common depiction throughout various cognitive science paradigms (see, for example, Gentner 1983; Hummel & Holyoak 2003; Cabrera, Colosi, and Lobdell 2008; Novak and Cañas 2008; Chi & VanLehn 2012). However, thinking in terms of systems does not seem to be something that all people do inherently well. Rottman, Gentner, and Goldwater (2012) found that social science (psychology, sociology, and economics) students clustered various domains based on content (i.e. surface features), whereas students of the physical sciences (primarily physics and integrated science) sorted based on various types of causal systems (i.e. relational structure). Whether this abstract understanding of causal systems is due to the education received in physical science courses (i.e. repeated exposure to various systems), is somewhat innate and systems thinkers tend to be drawn to physical sciences where the systems are more apparent, or some combination of the two remains to be seen. However, this finding suggests that auditors, as former social science students, likely require explicit instruction in how to construe a domain in such a way.

In a review of expertise literature, Richey & Nokes-Malach (2015) identify what they refer to as the key features of robust knowledge; these features are listed as deep, connected, and coherent. In order to understand what deep structure is, it may be helpful to first understand what

it is not. Chi & VanLehn (2012, p.178) offer a description of surface features as "literal objects, concepts, or entities explicitly described in a problem statement". In contrast to surface features, Chi & Van Lehn (2012) offer examples of deep structure found throughout the literature which include rules (explicit and abstract), schemas, stories, mental models, and relations between objects. This last example offers perhaps the most concise and abstract way to envision the deep structure. Put simply, the surface features are the objects (concepts) within the system, and the deep structure consists of the object roles and relations between objects. Additionally, not all relations are of the same type. Distinctions have been made between first-order relations and higher-order relations, with higher order relations being those that take at least one relation as an argument. According to Gentner's (1983) structure mapping theory (SMT), in mapping knowledge systems from one to another, there are preferences for relations over objects, higher-order relations over first-order relations, and systems of connected relations[18]. Similarly, Day & Goldstone (2012) discuss the discerning of deep structure by emphasizing the structure of representations (relations) over the contextual features (nodes) that are not relevant to the structure. In returning to the terms of expertise, this is essentially what Richey & Nokes-Malach (2015) allude to in their mention of deep, connected, and coherent features of expert knowledge. Further, VanLehn & Chi (2012) link adaptive expertise to a metacognitive strategy of focusing on domain principles, which are embedded in the relational structure[19].

In an audit context, Brewster (2011) and Griffith (2017) discuss the importance of understanding relations in an analytical procedures and goodwill impairment assessment task, respectively. Understanding of the relational structure becomes very important as it is necessary

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[18] This preference is known as the systematicity principle. For a more thorough explanation, see Gentner's (1983) description of structure mapping theory.

[19] Adaptive expertise is described as expertise that can be transferred to novel problems (Hatano & Inagaki 1986; Barnett & Koslowski 2002). In other words, existing knowledge can be adapted so that it is transferable.

to infer how changes in a variable, or combination of variables, may impact other variables that are, or should be, part of the assessment. Further, it is difficult to overstate the importance of knowledge adaptation and transfer in auditing contexts, as no two instances within a domain will be exactly the same. In domains such as auditing, where significant variation may occur between instances within a task domain, expertise is contingent upon knowledge transferability. It follows then that relation-based schemas, combined with skill at relational reasoning are required for expertise in these audit tasks.

## *Problems Related to Surface Similarity*

One of the most common findings in research on knowledge transfer is that surface similarity has significant, often negative, impacts on transfer (Ross 1987; Reed 1987; Gentner, Rattermann, and Forbus 1993). Chi & VanLehn (2012) offer an explanation for this phenomenon as surface features often being directly perceivable, whereas elements of the deeper structure are not. Thus, the perception of surface features has a tendency to lead to recall from memory of situations with similar surface features and impede recall of situations with similar relational structure but dissimilar surface features. Chi & VanLehn (2012) further state that knowledge transfer can be thought of as two distinct sets of processes. The first process is initial learning of domain related knowledge and the second is the application (or reuse) of that knowledge. It is conjectured that the fundamental problem in knowledge transfer is a lack of deep initial learning. Holyoak & Richland (2014) similarly state that "analogical transfer is ultimately limited by the learner's understanding of the source domain". This is in line with the views laid out above in that if peoples' knowledge structures related to a domain consist primarily of, or are cluttered by,

surface features from the specific instances through which they gained the domain knowledge then it cannot be easily transferred to new instances with different surface features, even if the underlying structure is similar. Thus, Chi & VanLehn (2012) reframe what is commonly referred to as the 'failure to transfer' problem as a 'lack of deep initial learning' problem. This is also offered as an explanation of why the failure to transfer knowledge is so common in research on analogical reasoning, whereas successful transfer has been found more commonly in the categorization paradigm. Traditionally, the domains used in categorization consist merely of features, whereas research on analogical reasoning is focused on mapping relations, meaning that a deep initial learning is not as necessary in categorization as it is in the more complex domains of analogical reasoning. Chi & VanLehn (2012) discuss several methods that have been discovered which cultivate deeper initial learning of domains, including analogical comparison, self-explanation, and identification of solution step principles. Due to its tight coupling with the transfer literature and focus on relational structure, analogical comparison is the method of most interest in the present study.

*Analogical Comparison and Encoding*

Analogical comparison, a process that involves comparing structurally similar analogs which tends to highlight their relational commonalities, has been shown to be effective at enhancing knowledge transfer through the promotion of more abstract domain schemas (e.g. Gick & Holyoak 1983; Catrambone & Holyoak 1989; Gentner, Loewenstein, and Thompson 2003, for a thorough review see Alfieri, Nokes-Malach, and Schunn 2013). The process leads to analogical encoding, which is the abstraction of schemas that include more of the relational structure and

fewer idiosyncratic surface features (Loewenstein et al 1999; Kurtz, Mao, and Gentner 2001; Gentner et al 2003). In traditional analogical reasoning, a domain that people understand well is used to explain another domain that is less well understood. This process differs from learning via traditional analogical reasoning because it does not require a well understood domain that can be transferred to the new domain. Thus it can be an ideal method for novices to learn about a new domain by comparing multiple instances, or cases and is more appropriate for the purposes of promoting expertise (i.e. guiding novices to be experts) within one domain, which is the primary motivation herein. This procedure is also theorized to lead to a bootstrapping process in which relation and principle based schemas provide a better framework to understand new experiences within the domain which will in turn lead to further analogical encoding (Gentner et al 2003). Analogical comparison interventions typically consist of first providing multiple analogs, which serve as source examples of the domain, that share similarity in relational structure, but consist of different surface features. Next the process of mapping between the source analogs is encouraged via prompting in order to focus novices on the structural similarities, and often differences, between the analogs (Alfieri et al 2013).

Analogical comparison is closely associated with the analogical reasoning paradigm[20]. Little accounting research has utilized the analogical reasoning paradigm[21], and the author is unaware of any published accounting studies using an explicit comparison technique.[22] Existing research on analogical encoding, and comparison more broadly, tends to focus on using the technique in the presentation of educational or training materials. However, it is proposed herein that this

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[20] Informative reviews of the analogical reasoning paradigm are presented in Holyoak (2012) and Gentner & Colhoun (2010).

[21] Notable exceptions include Marchant (1989); Marchant, Robinson, Anderson, and Schadewald (1991); Hanson and Phillips (2006); and Magro and Nutter (2012).

[22] Matsumura and Vera-Munoz (2006) is an unpublished accounting study that uses comparison. However, based on aspects of the hypotheses and experimental design, the results of the study are difficult to interpret.

technique be taught as a metacognitive skill so that auditors in practice can construct schemas in long term memory that consist of fewer surface details, and thus will be more flexible for use on future engagements.

In summary, analogical encoding aids in the transferability of knowledge by fostering re-representation of schemas as more relation-based, which help to overcome the inert knowledge problem. These abstract schemas are flexible in use and are not highly entangled with surface level features that impede recall from memory in situations with different surface features. The focus on the structure of the domain knowledge leads to its being more easily recognized in future instances that share the structure.

H1a: Novices who are prompted to compare multiple, structurally related analogs will abstract more structurally based schemas than those who do not.

H1b: Novices who are prompted to compare multiple, structurally related analogs will demonstrate greater knowledge transfer than those who do not.

*Deep Structure Intervention*

Chi & VanLehn (2012) provide the foundation for another method to improve deep initial learning. They speculate that one of the primary differences between novices and experts is that experts can 'see' the deeper (relational) structure of a problem and novices cannot. They state that novices are quite good at 'seeing' surface features, and even determining which are relevant and which are merely superficial (Chi, Glaser, and Rees 1982). However, in order to perceive the

130

deeper structure, they must advance to considering the interaction cues (relations) between the features and the relations between the interaction cues (higher order relations). They propose that "experts can 'see' the underlying principle or deep structure of a problem because they can derive the higher order cues based on the *interactions* of the surface features" (p.183, emphasis in the original). Based on findings from studies 7 & 8 in Chi, Glaser, and Rees (1982), Chi & VanLehn (2012) posit that experts are better at seeing process cues (i.e. relations), or interactions between surface features, and novices see more entity cues (i.e. objects, concepts). Therefore, they suggest instruction that prompts an explicit focus on interaction among relevant surface features as a way to help novices perceive the deep structure of the domain. In other words, they suggest directly teaching novices to consciously represent problems as experts have learned to do (probably subconsciously) over time. They further posit that transfer is largely based on the perception of second order cues, which consist of relations between first order cues (i.e. higher order relations from SMT). Day and Goldstone (2012) also stress the importance of discerning deep structure and suggest, from an educational perspective, that one of the most impactful ways to improve focus on relational structure is to remove extraneous details from learning materials. From the perspective of developing expertise in a professional domain such as auditing, where much of the learning will occur on the job, this is not a practicable solution. Therefore, a potentially more effective solution is to directly train auditors in the skill of seeing past the irrelevant surface details and focusing on deeper structure. This is similar to VanLehn & Chi's (2012) idea stated above that adaptive expertise is linked to the metacognitive skill of focusing on domain principles.

H2a: Novices who receive instruction in perceiving the deep structure of a problem will abstract more structurally based schemas than those who do not.

H2b: Novices who receive instruction in perceiving the deep structure of a problem will demonstrate greater knowledge transfer than those who do not.

*Enhancing Comparison*

There is significant evidence that analogical comparison can lead to superior schema abstraction, but also that surface features can be a distraction that serves to obscure the deeper relational structure. If novices are distracted by surface features of domains, comparison may still lead to a shallower abstraction than its potential. The analogical comparison process works by forcing a conscious alignment of analogs which highlights the common relational structure during encoding. This is accomplished by focusing on similarities (and sometimes differences as well) between analogs because it is the deeper relational structure that is most similar, while most of the differences are superficial. Therefore, if people are already primed to think in terms of systems (i.e. concepts, relations, and higher order relations), this should ease the alignment and encoding process.  One reason for this easing is that in order to perform a quality alignment, the domain needs to be represented in an alignable format. It should not be assumed that people can easily translate domain representations into such a format without instruction. Providing instruction on how to see the deep structure simultaneously provides instruction on how to translate a domain into an alignable format. This should allow for a superior alignment, and thus comparison, process. Another associated reason is that relational reasoning requires significantly

more working memory than feature based reasoning (Halford, Wilson, and Phillips 1998; Waltz, Lau, Grewal, and Holyoak 2000). Mentally translating domain knowledge into a system-like format can reduce cognitive load. This was demonstrated by Brewster (2011) using the systems dynamics paradigm. The deep structure intervention will lead to improved representation of the individual analogs and the comparison intervention will then prompt abstraction of a cleaner (more "skeletal") schema. In other words, the deep structure prompt intervention is expected to moderate the effect of the comparison intervention on schema abstraction and subsequent knowledge transfer.

H3a: Novices who receive instruction in perceiving the deep structure of a problem followed by a prompt to compare multiple, structurally related analogs will abstract more structurally based schemas than those who receive either intervention alone.

H3b: Novices who receive instruction in perceiving the deep structure of a problem followed by a prompt to compare multiple, structurally related analogs will demonstrate greater knowledge transfer than those who receive either intervention alone.

## Method

### *Experimental Design and Task*

To test the above hypotheses, an experiment with a 2 (analogical encoding) X 2 (deep structure prompt) between participants design was conducted. Materials used in the experiment have been revised based on results and comments from pre-testing. A summary of these revisions can be found in Appendix E. The instruments used in the experiment contain multiple

cases regarding the audit of company valuations used in goodwill impairment assessments. The task setting was chosen as it is an example of a task that involves the utilization of deep underlying principles but also varies greatly at the surface level between different entities. Additionally, it is a task that is often performed at least partially by valuation experts but relied upon by others. Thus it is a domain in which facilitating expertise development for novices, including auditors, is imperative.

Following the standard structure in comparison studies, the instruments contain three source cases and one target case. Embedded in all four cases, in slightly different forms, is a common structured principle as well as several varying surface level details.[23] The common principle embedded in the source cases can be expressed as: A capital intensive company, that wishes to increase sales volume, will require additional capital expenditures in the future beyond those required to maintain the current level of sales volume.[24]

Experimental materials were separated into three packets, enclosed in three separate envelopes. Participants were instructed to complete the packets in order, and put away the contents of each packet before moving on to the next. The first packet included general instructions, a brief primer on discounted cash flow valuations, the respective interventions, and the three source cases. In the deep structure prompt present conditions, participants are presented with this intervention before the source cases. In the deep structure prompt absent conditions, the intervention material is presented at the end of the study so as to keep the completion time consistent. In all conditions, participants were provided, and prompted to engage with, three source cases which comprise the training materials from which a common principle can be

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[23] See Appendix C for a table of the specific informational cues embedded in the cases.
[24] This holds regardless of current capacity as sales growth will carry on into perpetuity unless specifically shown as otherwise. Even if expansion of capacity is not required by production increases, the increases in production volume will "use up" current capacity more quickly and capital will need to be replaced sooner.

derived. The source cases were presented on the same page. Each source case includes information about the background and changes in cash flow projections regarding a fictional company as well as an auditor's conclusion regarding the cash flow assumptions. After reading the source cases, participants were asked to either list similarities and differences between the cases (comparison present intervention conditions) or to articulate central ideas about each case individually (comparison absent conditions). Differences between conditions are discussed further in the independent variables section below.

The second packet contained the target case, which shares the same principle as the source cases mentioned above, in order to test knowledge abstraction and transfer. If participants have better learned the principle of interest from the source cases, they should make better inferences regarding the target case. The target case contains information regarding information about a fictional company's background and changes in cash flow projections, similar to the source cases, but in this case participants were not provided with a conclusion as to the validity of the assumptions. In order to engage participants with the target case material, participants were next asked to assess whether or not the target valuation should be revised, and were given a free response question which asks which information from the case was important to the decision of whether or not to revise the valuation.

The third packet contained the schema abstraction dependent measure, which asked participants to choose, from a list of all informational elements from the target case, which were important in the valuation revision decision. Following this, participants were asked to answer questions concerning potential revisions to particular cash flows of the company in the target case. The knowledge transfer dependent measure is embedded in this section. More details are

included in the dependent measures section below. Subsequent to the dependent measure questions, participants were asked to answer other questions pertaining to comparison effort and motivation, control variables, attention checks, and demographic information, which are discussed below.

<center>*Independent Variables*</center>

<u>Analogical Comparison</u>

To examine the impact that analogical comparison has on schema abstraction and knowledge transfer, the construct was manipulated as present or absent. In the present condition, immediately before reading the source cases, participants were instructed that "Research has shown that comparing the similarities and differences of multiple cases has the benefit of facilitating a better understanding of the relationships between elements within the individual cases. The questions following the cases will be related to the similarities and differences between them so it will be helpful to consider these when reading the cases". After participants were presented with the three source cases, they were asked to compare the similarities and differences between the cases. They were also asked to "briefly articulate any central ideas or overall principle(s) demonstrated by the cases taken together". In the absent condition, participants were asked what is going on in each individual case, and to "briefly articulate any central ideas or principles demonstrated in the case". As the source cases were all presented on the same page, participants had the opportunity to compare the cases in all conditions, but only in the comparison present condition were they prompted to do so.

<center>136</center>

<u>Deep Structure Prompt</u>

To investigate the predicted effect that training to better represent ('see', in the parlance of Chi & VanLehn) the deep structure has on schema abstraction and knowledge transfer, a deep structure prompt (DSP) was manipulated as present or absent. In the present condition, participants were provided with an intervention aimed at instructing in how to represent domains as systems of concepts, attributes, relations, and higher order relations. The ideas for the intervention were drawn from the propositions made by Chi & VanLehn (2012) as well as Gentner's SMT. The example used was adapted from Hummel & Holyoak (2003) and is often used in cognitive science. The situation involves what is commonly referred to as a 'love triangle' and is well suited for use in the current study as it includes concepts, attributes, first order relations, and higher order relations. Additionally, the scenario is one that can be easily understood without any specialized domain knowledge. It is worth noting that Chi & VanLehn's (2012) suggestions are geared toward a classic problem solving paradigm that involves domains such as math and physics problems. They do, however, reconcile this with the analogical reasoning paradigm. Their suggestion was somewhat adapted for an analogical comparison task in an accounting setting. The differences are primarily related to terminology, and more importantly, the nature of the first and higher-order relations. For example, they state that a common higher order relation in problem solving tasks is "equal to" (i.e. a relation of equivalence) whereas a common higher order relation in domains concerned with empirical knowledge of the world is "causes" (i.e. a causal relation). Therefore, the overall intervention suggestion was utilized in the present study, albeit in terms more familiar to the analogy paradigm. They further suggest that in problem solving transfer situations, it is primarily the second order cues that promote transfer. However, in many, if not most, real world tasks, the first

order cues (relations) are important as well. See the full intervention in the experimental instrument included in Appendix G.

*Dependent Measures*

Schema Abstraction

The purpose of this study is to examine the effect that metacognitive skills aimed at discerning the deep structure of domains can have on knowledge structure and transfer. To measure the impact on knowledge structure, participants' schemas related to the overall valuation decision are measured. After reading the cases, participants were asked to assess whether or not the overall valuation should be revised. Specifically they were asked: "Based on the assumptions used in estimating the valuation for StrollCo, which includes all available information as of the valuation date, do you believe the overall valuation should be revised upward (increase), be revised downward (decrease), or stay the same?" To measure the abstraction of schemas derived from the source cases, the informational elements from the target case were given to the participants and they were asked to mark an X next to each item in the appropriate column demarcating it as "Not Relevant", "Somewhat Relevant", or "Important" in indicating whether or not a change should be made to StrollCo's valuation.[25] The intention is to assess the importance of the capital expenditure principle in the overall schema related to the task and decision.

The informational elements are classified as either 1) directly related to the principle used to conclude that a decrease in the valuation is appropriate; 2) related to the overall valuation, but

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[25] Information elements included in schema measure are displayed in Appendix D.

not directly to the principle used to infer the needed change; and 3) superficial features not directly related to the conclusion regarding the potential valuation revision. It is predicted herein that schemas abstracted in the conditions including interventions will consist of greater relational structure. This should be evidenced by the inclusion of elements that are connected by relations which together form the principle needed to infer that the valuation should be revised downward. Put simply, the schemas should include more elements that are attached to the relational structure of the capital expenditure principle and fewer that are not, i.e. fewer surface level details.

In order to capture both of these dimensions, the response coding scheme consists of two components, a 'positive component' and a 'negative component'. Both components consist of a four-point scale, and the sum of the two comprises the dependent measure. Informational elements that are marked as "important" are used to create the dependent measure. The positive component is intended to measure participants' inclusion of those informational elements which are directly related to the principle used for inference in the task. Responses were coded as a 4 if all elements directly connected to the structure of the principle are included in the response. They were coded as a 3, 2, or 1 if two, one, or none of the elements related to the structure of the principle are included, respectively.[26]. The negative component is intended to measure the quantity of superficial surface detail that participants include in the responses. A less 'skeletal'

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[26] An alternate measure was computed in which the negative component was constructed in a similar manner, but on a three-point scale. The positive component was created, also on a three-point scale, by coding responses including all elements directly connected to the structure of the capital expenditure principle as a 3. Responses including one or two of these elements were coded as a 2, and those including none were coded as a 1. This positive component coding scheme is similar to that used in Gentner et al (2003) and Gentner et al (2004). Those studies did not include a negative component to the measure, and thus the measure created herein is seen as a potential improvement over those measures of schema abstraction. These two components sum to a five-point scale and results obtained from this measure were very similar to those on the seven-point scale (correlation between the measures is 0.94). Thus, the seven-point measure is reported as the primary measure so as to maintain consistency of scale length between the dependent measures of schema abstraction and knowledge transfer.

abstraction of the principle is indicated by the inclusion of a greater number of such surface level

details. The presence of all elements directly related to the principle and the exclusion of all

irrelevant surface details suggests that the encoding of the appropriate schema took place.

Responses with fewer superficial surface elements received higher scores in the coding of the

negative component. If three or more such elements were included as important, then

participants received a 0 for the negative component of the measure, as they have included as

important several items deemed not relevant to the decision. If two, one, or zero superficial

elements were included as important, then the negative component was coded as 1, 2, or 3,

respectively. The sum of the positive and negative components ranges from 1 to 7, with higher

scores suggesting the abstraction of a more structural, relation-based schema.[27]


### Knowledge Transfer

In order to evaluate the transfer of knowledge, related to the capital expenditures principle to

be abstracted, from the source cases to the target case, participants' judgments about the validity

of capital expenditure projections are measured. A demonstration of knowledge transfer requires

the application of this principle in the capital expenditure cash flow assessment through

recognition that the relational pattern of the assumptions in the target case is not consistent with

the capital expenditures principle. Participants were specifically asked: "Based on the

assumptions used in estimating the valuation for StrollCo, which includes all available

information as of the valuation date, do you believe the projected capital investment and upkeep

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[27] Certain elements of information were categorized as being potentially relevant to the valuation overall, but not connected to the structure of the capital expenditure principle directly. Therefore, they are not part of the pattern used to infer that the valuation should be revised, and are excluded from the calculation, in effect being treated as neutral, neither increasing nor decreasing schema abstraction scores.

expenditure cash flows should be revised upward (increase), be revised downward (decrease), or stay the same?". Responses were captured on a fully labeled, seven-point, bi-polar scale ranging from "definitely revised downward" to "definitely revised upward", and centered on "stay the same".

As previously mentioned, increases in sales volume projections for a capital intensive company require associated increases in capital expenditures in order to, at a minimum, maintain capacity at a level above that required for current sales volume. As such, evidence of greater knowledge transfer is provided by higher scores on the judgment scale. Asking this question alone may result in providing a strong hint, or creating a demand effect, regarding the importance of the principle. To avoid this, the dependent measure was included in the midst of similar measures. These masking questions are similarly structured but capture judgments about potential revisions to cash flows related to revenue, materials and labor expenses, operating expenses, and research and development expenses.

*Additional Measure Related to Comparison Effort*

Self-assessments of comparison effort were collected as a supplemental measure of the effects of the interventions on comparison effort, as well as to provide information regarding the extent to which participants that were not prompted to compare did so anyway. Specifically, participants were asked "When answering the questions regarding Cases A, B, and C, to what extent did you actively compare the cases to each other?". Responses were provided on a five-point, unipolar, fully labeled scale ranging from "Did not compare" to "Compared Extensively".

*Control Variables and Attention Checks*

In order to control for potential individual differences and better define the relationship between the independent and dependent variables, several measures were collected as control variables. These include perceptions of case difficulty ('difficulty') and overall motivation ('motivation). Responses for these measures were captured on fully labeled, five-point, unipolar scales ranging from "Not at all…" to "Extremely…". Also included is certain demographic information comprising gender, age, undergraduate major, college GPA, number of accounting and finance classes taken, and number of years of accounting or finance work experience. Questions regarding the nature of the task and whether participants were explicitly asked to perform a comparison were incorporated as assessments of attention and effort.

*Participants*

Participants were recruited from undergraduate auditing classes via email from the course professors, and were awarded extra credit for participating in the study. The study was administered during class time and the author was present at all data collection sessions. The participants were randomly assigned to experimental conditions. A total of 107 participants completed the experiment with a median completion time of 36 minutes. Median age and work experience of the participants is 22 years and 0.25 years, respectively, and 52% are male. Alfieri et al (2013) find no evidence that experience level moderates the effect of comparisons. The technique has been shown to be productive with various levels of domain knowledge. As the current study is motivated by the promotion of expertise, domain novices seem ideal subjects. Specifically, using student participants allows for a manipulation that is cleaner due to the level

of domain knowledge likely being relatively more homogeneous than would be in practitioner participants. The difficulty of the task is intended to be challenging to the participant population, but such that they should be able to perform proficiently with sufficient effort.

## Results

### *Control Variables and Comprehension Checks*

To clearly delineate any effect of the interventions on the dependent variables, the control variables discussed above were initially included in the models. Where they were deemed to be significant at the conventional level, they were left in the models, as presented in the results tables. Non-significant covariates were removed from the final models. A total of eight participants failed one or more of the attention checks and were therefore excluded from the results. However, there is little impact on the results, and qualitatively the conclusions are similar, whether or not these participants are included.

### *Schema Abstraction*

Descriptive statistics for the dependent measure of schema abstraction are displayed in Table 6 Panel A. Predicted and actual values are shown in Figure 5 (Panels A and B). In order to test the hypotheses related to schema abstraction, an ANCOVA including the significant covariate of time to complete the study was performed. Results are shown in Table 6 Panel B. In regard to the abstraction of schemas from the source cases, H1a predicts that novices who receive a prompt to compare multiple structurally related analogs will abstract more structurally based schemas than

those who do not. The overall mean for the comparison present conditions (5.04) is greater than the overall mean for the comparison absent conditions (4.78). However, as shown in Table 6 Panel B, this difference is not significant ($p = 0.385$). Thus, H1a is not supported. The difference in means occurs primarily in the DSP absent conditions with the mean of the comparison present / DSP absent condition (5.24) being greater than the mean of the comparison absent / DSP absent condition (4.83). However, a t-test between these conditions shows that the difference is not considered significant by conventional standards ($p = 0.155$, one-tailed).

H2a state that novices who receive instruction in perceiving the deep structure of a problem will abstract more structurally based schemas than those who do not. However, the overall mean for the DSP present condition (4.78) is less than the overall mean for the DSP absent condition (5.04). As the direction of the means is opposite what is predicted, H2a is not supported.

H3a predicts that novices receiving instruction in perceiving the deep structure of a problem, followed by a prompt to compare multiple structurally related analogs will abstract more structurally based schemas than those who receive either intervention alone. As the mean for the comparison present / DSP present condition (4.83) is the same as the comparison absent / DSP absent condition (4.83) and less than the comparison present / DSP absent condition (5.24), H3a is not supported.

Panel A: Predicted Effect on Schema Abstraction
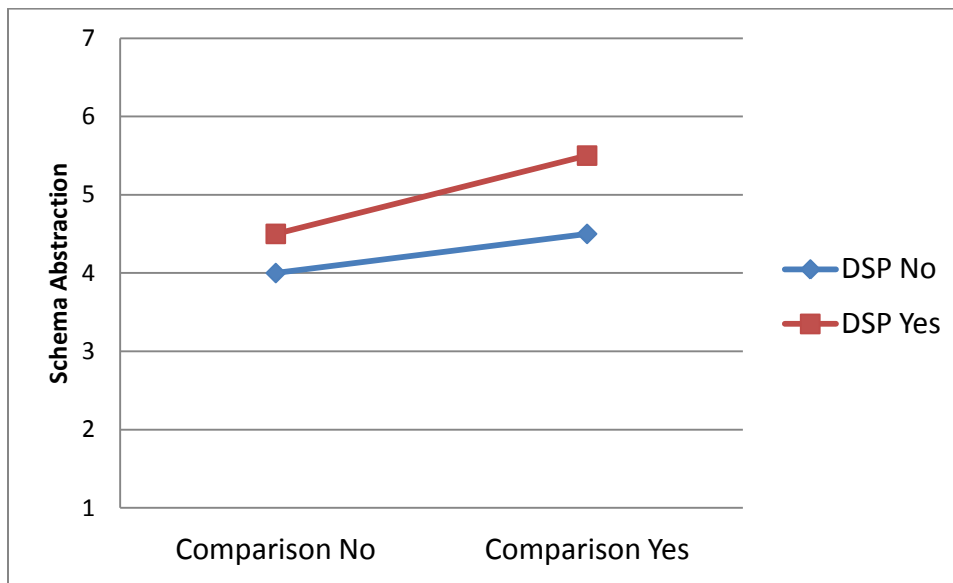


Panel B: Actual Effect on Schema Abstraction
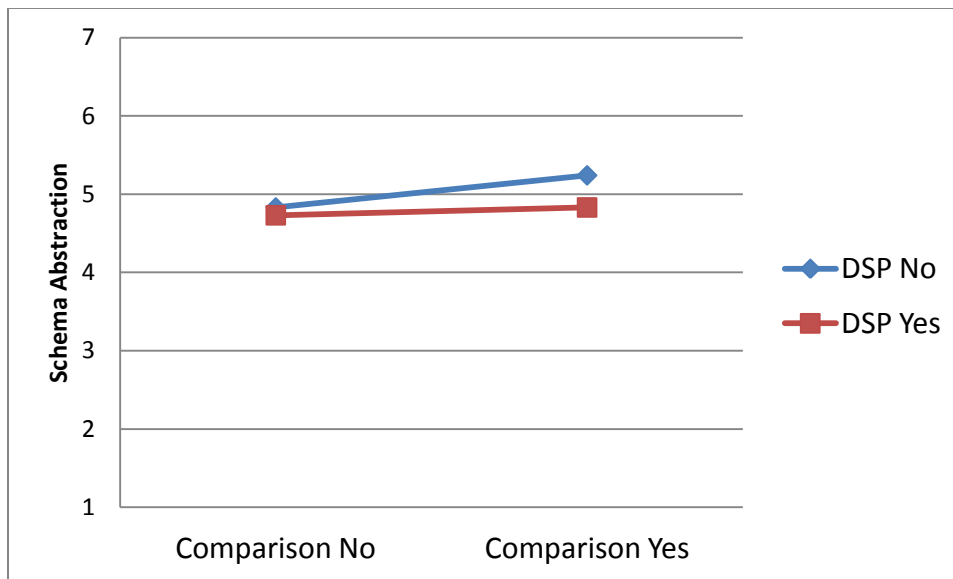


**Figure 5: Study Three Predicted and Actual Effects on Schema Abstraction**

**Table 6: Study Three Results for Schema Abstraction**

| Panel A: Descriptive Statistics for Schema Abstraction[a] Means (Standard Deviations) | | | |
|---|---|---|---|
| | **DSP[c]** | | |
| **Comparison[b]** | **Absent** | **Present** | Total |
| Absent | 4.83 (1.49) n=24 | 4.73 (1.54) n=26 | 4.78 (1.50) n=50 |
| Present | 5.24 (1.27) n=25 | 4.83 (1.66) n=24 | 5.04 (1.47) n=49 |
| **Total** | 5.04 (1.38) n=49 | 4.78 (1.58) n=50 | |

| Panel B: ANCOVA results for Schema Abstraction | | | |
|---|---|---|---|
| **Source of Variation** | **df** | **F-Statistic** | **p-value** |
| Comparison[d] | 1 | 0.76 | 0.385 |
| DSP[d] | 1 | 0.91 | 0.342 |
| Comparison*DSP | 1 | 0.32 | 0.572 |
| Time to complete | 1 | 4.47 | 0.037 |
| Residuals | 94 | | |

| Panel C: Follow-Up T-test | **T-statistic** | **p-value[e]** |
|---|---|---|
| Comparison present/DSP absent vs. Comparison absent/DSP absent | -1.03 | 0.155 |

[a] Schema Abstraction measures information deemed to be important to the decision of target case valuation revision. The measure is constructed on a 1 to 7 scale.

[b] The comparison prompt was manipulated as absent or present

[c] The Deep Structure Prompt was manipulated as present or absent

[d] Results include the covariate of time to complete the study

[e] Reported p-values are the one-tailed equivalent based on unadjusted alphas

*Transfer of Knowledge from Source Cases to Target Case*

Descriptive statistics for the knowledge transfer dependent measure are displayed in Table 7

Panel A.[28] Predicted and actual values are shown in Figure 6 (Panels A and B). In order to test

the hypotheses related to schema abstraction, an ANCOVA, including the significant covariates

of time to complete the study and number of finance classes taken, was performed. Results are

shown in Table 7 Panel B. Similar to the prediction concerning schema abstraction, H1b predicts

that novices who receive instruction in perceiving the deep structure of a problem will

demonstrate greater knowledge transfer than those who do not. The overall mean for the

comparison present conditions (5.22) is greater than the overall mean for the comparison absent

conditions (5.00). As shown in Table 7 Panel B, this difference is not significant (p = 0.293).

Therefore, H1b is not supported. The difference in means occurs primarily in the DSP absent

conditions with the mean of the comparison present / DSP absent condition (5.28) being greater

than the mean of the comparison absent / DSP absent condition (4.74). A follow-up t-test

between these conditions shows that the difference is nominally significant (p = 0.065, one-

tailed). This result provides some modest evidence of an effect of the comparison intervention on

knowledge transfer, when compared to the control (comparison absent / DSP absent) condition.

H2b states that novices who receive instruction in perceiving the deep structure of a problem

will demonstrate greater knowledge transfer than those who do not. The overall mean for the

DSP present conditions (5.20) is greater than the overall mean for the DSP absent conditions

(5.02). As shown in Table 7 Panel B, this difference is not significant (p = 0.408). Therefore,

H2b is not supported. The difference in means occurs primarily in the comparison absent

conditions with the mean of the comparison absent/ DSP present condition (5.23) being greater

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[28] The number of observations for the control (comparison absent / DSP absent ) condition is one less than in the other tests, as one participant did not respond to the knowledge transfer dependent variable question.

than the mean of the comparison absent / DSP absent condition (4.74). A follow-up t-test between these conditions shows that the difference is nominally significant ($p = 0.087$, one-tailed). This finding yields modest evidence of an effect on knowledge transfer, from the DSP intervention, when compared to the control (comparison absent / DSP absent) condition.

H3b predicts that novices receiving instruction in perceiving the deep structure of a problem, followed by a prompt to compare multiple structurally related analogs will demonstrate greater knowledge transfer than those who receive either intervention alone. While the mean for the condition including both interventions (5.17) is greater than that of the control (comparison absent / DSP absent) condition (4.74), it is not greater than the comparison present / DSP absent condition (5.28) or the DSP present / comparison absent condition (5.23). Therefore, H3b is not supported.

Panel A: Predicted Effect on Knowledge Transfer
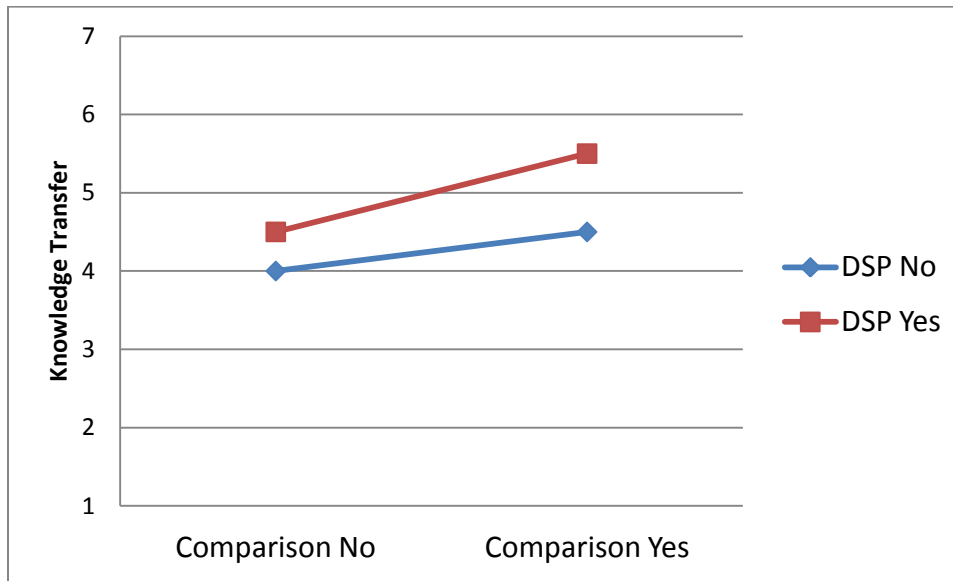


Panel B: Actual Effect on Knowledge Transfer
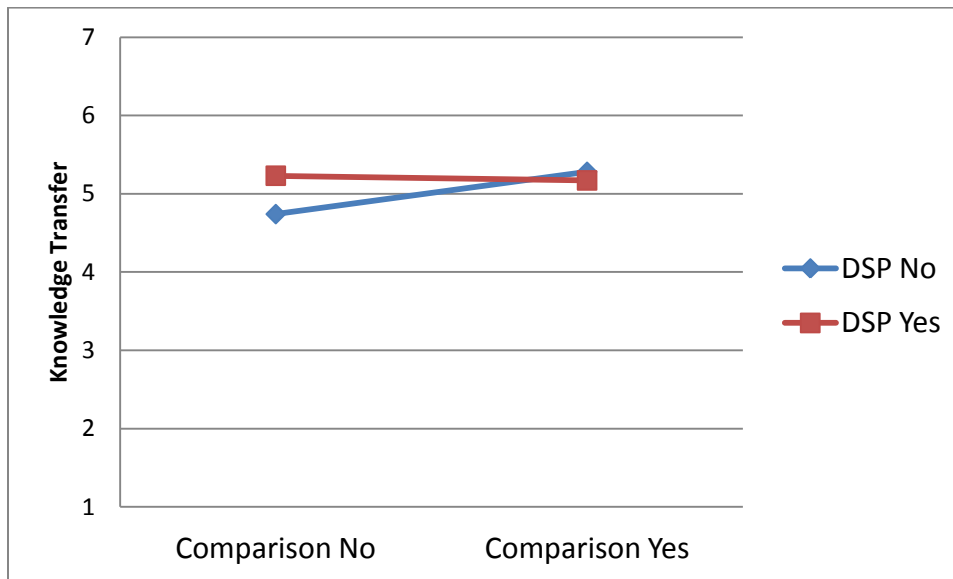


**Figure 6: Study Three Predicted and Actual Effects on Knowledge Transfer**

**Table 7: Study Three Results for Knowledge Transfer**

| Panel A: Descriptive Statistics for Knowledge Transfer[a] Means (Standard Deviations) | | | |
|---|---|---|---|
| | **DSP[c]** | | |
| **Comparison[b]** | **Absent** | **Present** | Total |
| Absent | 4.74 (1.45) n=23 | 5.23 (1.03) n=26 | 5.00 (1.26) n=49 |
| Present | 5.28 (0.94) n=25 | 5.17 (0.92) n=24 | 5.22 (0.92) n=49 |
| **Total** | 5.02 (1.23) n=48 | 5.20 (0.97) n=50 | |

| Panel B: ANCOVA results for Knowledge Transfer | | | |
|---|---|---|---|
| **Source of Variation** | **df** | **F-Statistic** | **p-value** |
| Comparison[d] | 1 | 1.12 | 0.293 |
| DSP[d] | 1 | 0.69 | 0.408 |
| Comparison*DSP | 1 | 2.37 | 0.127 |
| Time to complete | 1 | 8.18 | 0.005 |
| Number of Finance Classes | 1 | 6.79 | 0.011 |
| Residuals | 92 | | |

| Panel C: Follow-Up T-tests | **T-statistic** | **p-value[e]** |
|---|---|---|
| Comparison present/DSP absent vs. Comparison absent/DSP absent | -1.55 | 0.065 |
| Comparison absent/DSP present vs. Comparison absent/DSP absent | -1.38 | 0.087 |

[a] Knowledge transfer measures the application of the principle to be abstracted to generate inference in a new case. It is measured on a 1 to 7 scale.

[b] The comparison prompt was manipulated as absent or present

[c] The Deep Structure Prompt was manipulated as present or absent

[d] Results include the covariate of time to complete the study and number of finance classes taken

[e] Reported p-values are the one-tailed equivalent based on unadjusted alphas

*Supplementary Analyses*

Dichotomized Knowledge Transfer Measure

As the knowledge transfer dependent measure is considered to be the most precise in capturing the transfer of the principle of interest, and the pattern of means across the conditions shows the control condition as being lower than the other three, further analysis was performed. The knowledge transfer measure was dichotomized such that scores were coded as a 1 if they were greater than or equal to five (suggesting the correct response that capital expenditures should be increased) and a 0 otherwise. Table 8 shows that the control condition has the lowest proportion of correct scores. Logistic regression (not tabulated) was performed on the dichotomized variable. The comparison intervention independent variable was shown to be a nominally significant, positive predictor ($p = 0.082$, one tailed) of knowledge transfer.

**Table 8: Study Three Results for Dichotomized Knowledge Transfer Measure**

| | **Proportions of Dichotomized Responses on Knowledge Transfer Measure[a]** | | | |
|---|---|---|---|---|
| | Comparison absent / DSP absent | Comparison present / DSP absent | Comparison absent / DSP present | Comparison present / DSP present |
| Incorrect | 42% | 24% | 31% | 25% |
| Correct | 58% | 76% | 69% | 75% |
| [a]The knowledge transfer measure is dichotomized as correct (greater than or equal to 5 on the scale, or revise upward) or incorrect (less than 5 on the scale, or revise downward). | | | | |

Overall Valuation Revision Measure

Prior to the collection of the primary schema and knowledge transfer dependent measures, participants responded to a question about potential revision to the overall valuation.

Specifically, they were asked: "Based on the assumptions used in estimating the valuation for StrollCo, which includes all available information as of the valuation date, do you believe the overall valuation should be revised upward (increase), be revised downward (decrease), or stay the same?" Responses were elicited on a fully labeled, seven-point, bi-polar scale ranging from "definitely revised downward" to "definitely revised upward", and centered on "stay the same". In evaluating the pattern of relations in the target case, it should be clear that in keeping with the capital expenditure principle the company's valuation should be revised downward. Therefore, in contrast to the aforementioned dependent variables, lower scores on this scale are considered to be more accurate and imply greater performance on the task. This scale measures overall valuation task performance, which includes more dimensions than just knowledge transfer. However, it was analyzed as a possible source of additional insight. An ANOVA was carried out on the valuation revision measure, the results of which are presented in Table 9 Panel B. Descriptive statistics, presented in Table 9 Panel A, show that the overall mean for the comparison present conditions (3.57) is less (better) than the overall mean for the comparison absent conditions (3.74). As shown in Table 9 Panel B, this difference is not significant (p = 0.460).

The overall mean for the DSP present conditions (3.78) is greater (worse) than the overall mean for the DSP absent conditions (3.53). ANOVA results in Table 7 Panel B, show that this difference is not significant (p = 0.263). Thus, no significant main effects or interaction are found. The result that stands out is that the mean for the comparison absent / DSP present condition (3.96) is worse than those of the other three (as lower numbers are better). Potential implications of these findings will be addressed in the discussion section below.

**Table 9: Study Three Results for Valuation Revision Measure**

| Panel A: Descriptive Statistics for Valuation Revision[a] Means (Standard Deviations) | | | |
|---|---|---|---|
| | DSP[c] | | |
| Comparison[b] | Absent | Present | Total |
| Absent | 3.50 (1.22) n=24 | 3.96 (1.04) n=26 | 3.74 (1.14) n=50 |
| Present | 3.56 (1.00) n=25 | 3.58 (1.06) n=24 | 3.57 (1.02) n=49 |
| Total | 3.53 (1.10) n=49 | 3.78 (1.06) n=50 | |

| Panel B: ANOVA results for Valuation Revision | | | |
|---|---|---|---|
| Source of Variation | df | F-Statistic | p-value |
| Comparison | 1 | 0.55 | 0.460 |
| DSP | 1 | 1.27 | 0.263 |
| Comparison*DSP | 1 | 1.02 | 0.316 |
| Residuals | 95 | | |

[a] Valuation revision measures performance on the overall valuation task. It is measured on a 1 to 7 scale, with lower scores representing greater performance.

[b] The comparison prompt was manipulated as absent or present

[c] The Deep Structure Prompt was manipulated as present or absent

Comparison Effort

In order to determine if the interventions had an impact on participants' self-reported responses of comparison effort, the measures were analyzed as a dependent variable in an ANCOVA model. The results are shown in Table 10 Panel B. Interestingly, the variable of gender was a significant covariate, with males being more likely to report higher comparison

effort. As such, the variable was included in the final model to control for this variance.

Descriptive statistics, displayed in Table 10 Panel A, show that the participants in the

comparison present conditions reported the highest overall mean (3.51) for comparison effort. In

contrast, the overall mean for the comparison absent conditions is 3.02.  Not surprisingly, the

comparison intervention had a significant positive impact on comparison effort (p=0.003).

Interestingly, the overall mean for the DSP present conditions (3.14) is less than the overall

mean for the DSP absent conditions (3.39), although the ANCOVA results show that the

difference is not significant (0.243). However, the greatest difference occurs within the

comparison present conditions as the mean of the comparison present / DSP absent condition

(3.68) is greater than that of the comparison present / DSP present condition (3.33). These results

suggest that perhaps the effort required in understanding the DSP intervention may be leading

participants to reduce effort in other areas, such as the analogical comparison.

**Table 10: Study Three Results for Comparison Effort**

| Panel A: Descriptive Statistics for Comparison Effort[a] Means (Standard Deviations) | | | |
|---|---|---|---|
| | DSP[c] | | |
| **Comparison**[b] | **Absent** | **Present** | Total |
| Absent | 3.08 (1.02) n=24 | 2.96 (1.18) n=26 | 3.02 (1.10) n=50 |
| Present | 3.68 (0.85) n=25 | 3.33 (0.92) n=24 | 3.51 (0.89) n=50 |
| **Total** | 3.39 (0.98) n=49 | 3.14 (1.07) n=50 | |

| Panel B: ANCOVA results for Comparison Effort | | | |
|---|---|---|---|
| **Source of Variation** | **df** | **F-Statistic** | **p-value** |
| Comparison[d] | 1 | 9.08 | 0.003 |
| DSP[d] | 1 | 1.38 | 0.243 |
| Gender | 1 | 7.13 | 0.009 |
| Comparison*DSP | 1 | 1.96 | 0.164 |
| Residuals | 93 | | |

[a] Comparison effort measures the self assessed levels of effort expended on comparing the source cases. It is measured on a 1 to 5 scale.

[b] The comparison prompt was manipulated as absent or present

[c] The Deep Structure Prompt was manipulated as present or absent

[d] Results include the covariate of gender

## Discussion

The technique of effortful comparison between analogs within a domain has been shown to lead to analogical encoding, which assists in the abstraction of more structurally based schemas and aids in knowledge transfer to analogous situations (Loewenstein et al 1999; Kurtz, Mao, and Gentner 2001; Gentner et al 2003). Chi & VanLehn (2012) posit that instructing novices in how

to 'see' the deep structure of problems can help them in representing the problems as domain experts do. This improved representation of individual problems, in conjunction with an effortful comparison across analogs should lead to improved schema abstraction and knowledge transfer over either intervention alone. In other words, if novices first represent problems more on the deep structure than the superficial surface details, this should positively moderate the effect of the comparison. However, this high level speculation regarding 'seeing' the deep structure does not give specific guidance in how such training might be implemented and the author is unaware of any studies that have attempted to implement Chi & VanLehn's (2012) suggestion. Thus, this study is somewhat exploratory in nature.

The results from the experiment do not support the predicted effects of the interventions on schema abstraction or knowledge transfer. However, there are some patterns worth noting. On the schema abstraction dependent measure, the knowledge transfer dependent measure, and the supplementary, dichotomized knowledge transfer measure, the comparison present / DSP absent condition demonstrates the best performance. The main effect of the comparison intervention is not significant on any of these measures, by the conventional standard, but a t-test on the knowledge transfer dependent measure shows that performance in the comparison present / DSP absent condition is nominally significantly greater than that in the control (comparison absent / DSP absent) condition. This is particularly promising as this measure is considered to be the most precise measure of what the study is trying to accomplish, which is to improve the transfer of knowledge based on understanding of structural patterns. Additionally, the comparison intervention variable is a nominally significant predictor in the model for the dichotomized measure of knowledge transfer. Based on these collective results it appears as though the

comparison intervention has some positive effect on schema abstraction and knowledge transfer although the present study may not have enough power to detect it. Future research could focus on refining the comparison intervention, and possibly using it in a more comprehensive (i.e. longitudinal) manner. Repeated exposure to the process may enhance its effect.

Results regarding the DSP intervention are more mixed. On the knowledge transfer dependent measure, which again is deemed to be the most precise measure, performance in the comparison absent / DSP present condition is nominally greater than that in the control condition in a t-test. However, on the schema abstraction measure, there is no evidence of improved performance over the control condition. In the supplementary analysis of the overall valuation decision, the comparison absent / DSP present condition was noticeably worse than the other conditions. Further, the comparison absent / DSP present condition resulted in the lowest score on the measure of self-reported comparison effort. Based on the nominally improved performance on knowledge transfer, there is reason to suspect that the method has potential for positive effects, but the intervention may require substantial retooling. The current form of the DSP intervention is undeniably exploratory. Future research studies should examine alternate forms of interventions to highlight the structural nature of domains. Research has suggested that training interventions are most effective when the content is domain specific (e.g. Hoffman et al 2014 Ch.14). The DSP intervention in the present study was intentionally not domain specific in order to be a stronger test of the intervention's generalizability and, more importantly, to avoid internal validity problems associated with providing additional domain-relevant information to participants in select conditions. Perhaps future studies could find a solution to relax the strength of the test constraint and move closer to a domain specific intervention without compromising

internal validity.

Future research could also consider using a different task, or the same task with a different population. Upon reviewing the open ended responses, it became apparent that many of the participants did not fully understand the task. This was demonstrated by the use of speculative information not included in the case and projected into the future in a manner that suggests they did not comprehend that all future projections are included in the valuation, despite the instruction on discounted cash flow valuation at the beginning of the instrument. Although the task was intended to be challenging, it is possible that the lack of familiarity with the task served as a distraction to many of the participants, leading to excessive cognitive burden. It is also possible that the DSP prompt, combined with the challenging task led to cognitive overload or reduced effort on the part of participants. Attempts at testing a similar intervention with a simpler corresponding task may help to alleviate this problem. Also, similar to the suggestion related to the comparison prompt, a more comprehensive intervention that involves repeated exposure to the technique, including multiple examples, may improve the effect derived from the DSP intervention.

Another area worth exploring is the effect of different forms of educational conditioning in conjunction with the DSP prompt. This study was administered in an educational environment, during class time at a university, and the participants may have thought of it as an educational task. It is possible that the population of participants in the present study are not accustomed to completing cases as a significant part of their curriculum, and the task in the study somehow conflicts with the mode of thinking to which they are accustomed in such an environment.

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# GENERAL CONCLUSION

This dissertation includes three studies aimed at advancing audit expertise research by using theories pertaining to relational reasoning and associated methods. Study One summarizes the core ideas of relational reasoning theory in the context of how these ideas can aid progress in audit expertise research, and in particular in the under-researched area of expertise facilitation in audit domains. Extant accounting research that utilizes theory from the relational reasoning paradigm is scant and the findings appear to be mixed in regards to their consistency with the theory and findings from psychology. However, upon closer examination, these deviations seems to be explainable and do not seem to contradict psychological theory. Additionally, Study One discusses research methods that may demonstrate synergy with the goal of fostering audit expertise as well as specific research opportunities. Studies Two and Three experimentally investigate interventions with the potential to enhance expertise development in novice auditors through certain metacognitive strategies centered on the improvement of relational reasoning.

Study Two examines whether analogical comparison, a method shown in psychology research to enhance knowledge transferability through leading domain novices to focus on relational similarity between problems, can be effective as a tool to facilitate expertise development in complex decision domains such as those encountered in auditing. Additionally, the study explores open questions in psychology research regarding why novices require prompts to perform effortful comparisons, and how best to implement such interventions. Prior research in psychology demonstrates that prompting analogical comparison has positive effects on schema abstraction and knowledge transfer, but results of this study suggest that implementing such an intervention in a complex decision task may be difficult. While the interventions seemed to be ineffective in such an environment, self-reported comparison effort did have a positive

impact on results, which is in line with theory.

Study Three investigates the potential of another intervention, aimed at training novices to represent problems as experts do (the deep structure prompt, or 'DSP'), to improve schema abstraction and knowledge transfer, as well as interactively improve the effect of analogical comparison. Results of the study exhibit improved performance in the comparison conditions from that in Study Two, due to changes made to the intervention based on the results of Study Two and pre-testing for Study Three. However, the effects of the DSP were more mixed with a slight positive impact on knowledge transfer, which is deemed the most precise measure of the study, but no evidence of improved schema abstraction. Additionally, the DSP only condition resulted in significantly lower self-reported comparison effort than the comparison only condition.

Taken together, studies two and three suggest that comparison effort is associated with improved schema abstraction and knowledge transfer but that prompting such effort in tasks with even moderate relational complexity may be difficult. More generally, the studies demonstrate that implementing interventions intended to facilitate expertise, through improved relational reasoning, in complex decision domains is somewhat elusive, and that efforts to do so will require careful consideration of how to aid novices in managing the burden placed on working memory by the relational complexity present. However, they also show that there is reason to be hopeful that interventions with this goal can be implemented successfully and that continued research in this area will be rewarded with such an outcome.

Although further research is needed, the studies contribute to our understanding of how such interventions may be used to foster expertise in audit domains, particularly that of analogical comparison. Despite the fact that results are mixed, there is some evidence showing that effortful

relational reasoning can improve the transferability of knowledge and the practical implication is that if the interventions can be improved to appropriately prompt this, then real world, domain specific training implementations can be created to foster expertise development in domain novices. Overall, this dissertation discusses how theory from relational reasoning research, in conjunction with various research methods, provides a path forward in the audit expertise research stream, particularly as it pertains to the goal of facilitating expertise development. It further takes steps down this path by providing experimental results regarding the efficacy of certain methods when implemented in a task with more than minimal relational complexity. Future research can continue down this path by investigating how different implementations and greater exposure may improve effectiveness of the interventions, as well as the impact of other factors such as variation in individual relational reasoning ability.

# APPENDIX A: TABLE OF KEY TERMS

| | |
|---|---|
| Analogical reasoning | A form of induction that involves reasoning about a new problem or situation based on existing knowledge of problems or situations that appear different at the surface level, but have similar underlying relational structure. In other words, using knowledge about one domain to make inferences about a different domain that shares some level of relational structure. |
| Analogical comparison | Involves providing multiple examples and then explicitly encouraging alignment and mapping between them in order to focus attention on commonalities in underlying structure. This has been shown to lead to the abstraction of schemas that focus more on the relational structure of a domain. |
| Analogical encoding | A special case of analogical comparison in which the purpose of the comparison is to learn about a new concept or domain by comparing multiple instances within the same domain. This is in contrast to general analogical comparison which typically uses cross-domain reasoning in the tradition of analogical reasoning. |
| Failure to compare | A phenomenon in which participants in laboratory studies tend to exhibit greater knowledge transfer when specifically asked to perform a comparison between multiple provided cases, suggesting that this may not be occurring in conditions without the specific prompt. |

# APPENDIX B: STUDY TWO REVISIONS BASED ON FEEDBACK FROM PRE-TESTING

| Changes | Description |
|---|---|
| Simplification of design | The design of the study was simplified by focusing on a reduced set of conditions. The original design included another dimension involving comparison priming. |
| Changed measure of knowledge transfer | Based on feedback regarding the original transfer measure, it was clear that in addition to the effect of transfer, the measure also captures other factors, particularly those of how well participants understand the valuation task and how much speculative information participants included. This was evident as participants' responses on the measure scale often did not line up their written free responses. As the purpose of the study is to aid in the abstraction of a specific principle, and not the far more complex task of overall valuation, a more precise measure was included to specifically capture whether or not participants had abstracted the desired principle. The original transfer measure, inquiring as to whether or not the overall valuation should be revised, remains in the study primarily as a means to set up the free response question about which information is important. It is, however, analyzed and discussed in the supplementary analysis section. |
| Changed the subject pool | The pre-test was completed by 199 participants that were enrolled in an introductory managerial accounting class. Overall task performance on the pre-test was lower than expected.  Although the task is intended to be challenging, it was deemed that the population was not appropriately matched to the task. As such, upper level accounting students were reasoned to be a better fit. |
| Minor changes to cases | Cases were simplified slightly by removing some extraneous detail and the setting was revised to the audit of valuations instead performing valuations.  The substance of the cases was, however, substantively unchanged. |
| Refinement of instructions and DCF explanation | Further revisions included refinement of the instructions and greater detail in the explanation of discounted cash flow valuations. |

# APPENDIX C: CASE INFORMATION ELEMENTS

|                              | Source Cases               |                                  |                        | Target Case                       |
| ---------------------------- | -------------------------- | -------------------------------- | ---------------------- | --------------------------------- |
| Information Elements         | Case A                     | Case B                           | Case C                 | Case D                            |
| Industry                     | High end Smartphone manufacturer | Moderately priced car seat manufacturer | IT consulting firm | Moderately priced stroller manufacturer |
| Base region                  | Northeast                  | Midwest                          | Northeast              | Mid-Atlantic                      |
| Sales regions                | N. America, Europe, Asia   | North America & Europe           | North America          | North America                     |
| Sensitive to general economy? | Yes                      | No                               | Yes                    | No                                |
| State of economy             | Improving                  | Improving                        | Improving              | Improving                         |
| Market size                  | Increase                   | Flat                             | Increase               | Flat                              |
| Market share                 | Flat                       | Increase                         | Increase               | Increase                          |
| Sales volume                 | Increase                   | Increase                         | Increase               | Increase                          |
| Cost of sales                | Increase                   | Increase                         | Increase               | Increase                          |
| Operating expenses           | Increase                   | Increase                         | Increase               | Increase                          |
| Research & Development       | Flat                       | Flat                             | Flat                   | Increase                          |
| Capital intensive industry   | Yes                        | Yes                              | No                     | Yes                               |
| Capital expenditures         | Flat                       | Increase                         | Flat                   | Flat                              |
| Capital upkeep               | Flat                       | Increase                         | Flat                   | Flat                              |
| Initial valuation            | Management                 | Management                       | Management             | Management                        |
| Assumptions reasonable?      | No                         | Yes                              | Yes                    | No                                |

# APPENDIX D: CASE ELEMENTS INCLUDED IN SCHEMA MEASURE

| Element | Classification |
| --- | --- |
| Sales volume is projected to increase | Connected to Principle |
| Raw materials and labor costs are projected to increase | Neutral |
| StrollCo is headquartered in the Mid-Atlantic region | Superficial |
| StrollCo's sales market is North America | Superficial |
| The reason for the valuation is a goodwill impairment assessment | Superficial |
| Other operating expenses are projected to increase | Neutral |
| StrollCo's production requires significant capital | Connected to Principle |
| Research and development costs are projected to increase | Neutral |
| The initial valuation is performed by management | Superficial |
| Capital investment and upkeep expenditures are projected to remain flat | Connected to Principle |
| StrollCo is privately owned | Superficial |
| The type of products that StrollCo sells | Superficial |
| StrollCo's products are popular with younger parents | Superficial |
| StrollCo's market share has increased over the past couple of years | Neutral |

# APPENDIX E: STUDY THREE REVISIONS BASED ON FEEDBACK FROM PRE-TESTING

| Changes | Description |
| --- | --- |
| Comparison manipulation | The comparison prompt was simplified by removing an example comparison that was included in pre-testing. Additionally, participants were prompted before reading the cases that they would be asked to compare them, whereas in pre-testing they were instructed to perform a comparison only after reading the cases. |
| DSP manipulation | Changes to the DSP intervention included some minor wording changes as well as the addition of bolded print to highlight certain key sections of the text. |
| Measure of knowledge transfer | Based on feedback regarding the original transfer measure, it was clear that in addition to the effect of transfer, the measure also captures other factors, particularly those of how well participants understand the valuation task and how much speculative information participants included. This was evident as participants' responses on the measure scale often did not align with their open ended written responses. As the purpose of the study is to aid in the abstraction of a specific principle, and not the far more complex task of overall valuation, a more precise measure was included to specifically capture whether or not participants had abstracted the desired principle. The original transfer measure, inquiring as to whether or not the overall valuation should be revised, remains in the study primarily as a means to set up the free response question about which information is important. It is, however, analyzed and discussed only in the supplementary analysis section. |
| Minor changes to cases | Cases were simplified slightly by removing some extraneous detail and the setting was revised to the audit of valuations instead performing valuations. The substance of the cases was, however, substantively unchanged. |
| Refinement of instructions and discounted cash flows explanation | Further revisions included refinement of the instructions and greater detail in the explanation of discounted cash flow valuations. |

**APPENDIX F: STUDY TWO EXPERIMENTAL INSTRUMENTS**

**Explanation of Research and Discounted Cash Flow Explanation – All Conditions**

You are being invited to take part in a research study. Whether you take part is up to you. The purpose of this research is to study judgment and decision making in an audit setting. The study consists of hypothetical cases related to the valuation of companies. You will be asked to read some information and answer questions that will take about 30 minutes of your time. You will also answer a few demographic questions at the end. **It is important that you answer each question in a serious and thoughtful manner.**

Your professor has agreed to offer extra credit, in the amount of 1% of your total grade, for participation. If you do not wish to participate or are under 18 years of age, an alternate assignment of comparable time and effort will be provided for students who wish to earn extra credit. Your decision to participate or not participate in this study will not affect your continued enrollment or other grades in this course.

Please note that participation in this study is voluntary and **your responses will be completely anonymous**. Your name will not be associated with any data, and only aggregated data will be included in any publications or presentations resulting from this study. If you decide to participate, you have the right to withdraw your consent or discontinue participation at any time without penalty. You must be 18 years of age or older to take part in this research study. There are no anticipated potential risks associated with this study.

Upon completion of the study, you will automatically be redirected into a separate survey where you will enter your name and PID or NID, so that extra credit can be awarded to you.

If you have questions, concerns, or complaints contact Matthew Holt, PhD candidate, College of Business Administration (407) 823-4331 or by email at Matthew.Holt@ucf.edu or Dr. Sean Robb, Faculty Supervisor at (407) 823-4414. Research at the University of Central Florida involving human participants is carried out under the oversight of the Institutional Review Board (UCF IRB). This research has been reviewed and approved by the IRB. For information about the rights of people who take part in research, please contact: Institutional Review Board, University of Central Florida, Office of Research & Commercialization, 12201 Research Parkway, Suite 501, Orlando, FL 32826-3246 or by telephone at (407) 823-2901.

By clicking next you are indicating that you understand the above and voluntarily consent to participate in the research. If you would like a copy of the results of the study, please send an email to Matthew.Holt@ucf.edu with your name and address and "results requested". The results will then be sent to you when they are available.

Thank you very much for agreeing to participate.

**Important!**
Please do not attempt to complete the study on a mobile phone or other small device, as certain sections may not display correctly.

Once you begin the study, please finish it all in one sitting. Do not close your browser and attempt to complete it later.

This study has multiple sections. For each section, you will be given instructions. It is important that you read the instructions and materials carefully, and consider your responses thoughtfully.

All responses are anonymous. After completing the survey you will be provided with a link to a separate survey in which you will provide your name and PID or NID, so that extra credit can be awarded.

Click next if you wish to continue and participate in the study.

Thank you very much for your participation!

On the following pages, you will be given some hypothetical cases to read. The cases concern the auditing of company valuations used in goodwill impairment assessments. The valuations are based on the discounted cash flows method. This is an example of the type of complex estimates that auditors need to understand in order to support their opinion on the financial statements.

Below is a brief and simple explanation of a discounted cash flow valuation. <u>It is important that you read and understand the explanation below, as your ability to complete the subsequent cases will be dependent on your understanding it.</u>

Essentially, a discounted cash flows valuation is done by estimating all future cash flows related to whatever is being valued, then discounting those cash flows back to the present value today, and summing them. In the context of valuing a company this entails estimating all future cash flows in and out of a company over the duration of its life. In other words, all future revenues, expenses, etc. are estimated based on all available knowledge about the future direction of the company, including growth and expansion, as of the valuation date. There are multiple existing models for creating these estimates in distant future periods, but they all work based on the same conceptual idea stated above. Thus, all of the inputs to the cash flow calculation represent assumptions about future occurrences.

Future cash flows are discounted to represent the idea that a dollar today is worth more than a dollar tomorrow. Therefore, the projected cash flows used in the short to medium term can significantly impact the valuation of the company.

---

Please select an answer regarding the following statements.

Projected cash flows in the short to medium term can have a significant impact on the valuation of the company.

○ True

○ False

---

All projected future cash flows in and out of a company are included in the valuation as of the valuation date.


○ True

○ False

**Source Cases – All Conditions**

Please read the following three hypothetical cases carefully. After reading the cases, you will be asked to answer questions about them. You will be able to refer back to the cases while answering the questions.

Case A

PortPhone, a large, privately owned company headquartered in the Northeast, manufactures smartphones for several phone companies in North America, Europe, and Asia. As part of the annual goodwill impairment assessment, management prepared a valuation of the Company as of June 30, 2017. Projected in management's valuation is revenue growth based on a belief that PortPhone could maintain its 30% market share in a growing market. The market is expected to grow as there have been recent signs of improvement in the general economy, which management expects to impact the demand for its products. Management projects that the company can significantly increase unit sales annually over the next five years. Cost increases for the component parts used in production are projected to increase in line with revenue. Additionally, operating expenses such as payroll, marketing costs, and utilities are expected to increase in line with the revenue.

Research and development expenditures are deemed to be adequate and are projected to remain at a consistent level going forward. Further, management assumes that expenditures on capital such as production space and equipment will remain consistent with current levels.

The audit manager on Portphone's engagement reviewed their preliminary valuation and informed management that certain assumptions needed to be changed. PortPhone is a smartphone manufacturer, and like most manufacturing companies, it is a capital intensive company. This is because in order to generate revenue, it requires significant physical capital, such as production facilities and machinery, to create the products that it sells.

The audit manager stated that the expected revenue growth cannot be achieved without increased investment in, and upkeep costs for, capital needed to produce the additional units.

Case B

Lil-Rides, a privately held company based in the Midwest, manufactures moderately priced child car seats for sale throughout North America and Europe. Management prepared a valuation of the Company as of June 30, 2017, as part of the annual goodwill impairment assessment. Lil Rides' management acknowledges that the general economy is improving but also states that the industry is not particularly sensitive to the economic cycle. Therefore the size of the overall market for Lil-Rides' products will not change considerably in the near term, essentially increasing at the rate of population growth in its sales regions. Lil-Rides is a growing company that has been enjoying increasing market share over the past several years. Management expects that market share will continue to increase due to strong branding of the company and therefore projects increases in revenue in the near to medium term.

Costs associated with raw materials for production and operating expenses are projected to increase in line with revenue, and this is reflected in the valuation. Lil-Rides' management concluded that the current level of research and development expenditures is sufficient and therefore they are maintained in the valuation projections. They also recognize that since Lil-Rides is a capital intensive company, significant expansion to production capacity, including space and equipment, is required in order to achieve the projected increase in sales. This is reflected in the valuation assumptions regarding capital expenditures and increases in future capital replacement costs.

The audit manager assigned to Lil-Rides reviewed the valuation and concluded that all of the assumptions seemed reasonable.

Case C

Incantnetz is a privately owned IT consulting firm based in the Northeast, and primarily serving North America. As part of the annual goodwill impairment assessment, management prepared a valuation of the Company as of June 30, 2017. Incantnetz has steadily increased their market share over the past several years by actively pursuing new clients and maintaining high performance standards that result in ongoing business from many of their existing clients. There are signs that the general economy is improving and management believes that this will lead to an increase in demand for IT consulting services. This, in conjunction with management's assumption that they will continue to increase their share of this growing market, leads them to project significant growth in revenue over the near to medium term.

In order to support the growth in revenue, management expects the costs associated with providing their services to increase. These costs predominantly include wages paid to service personnel, and other operating expenses such as marketing costs, rent, and utilities. Due to the nature of Incantnetz's operations, it is not a particularly capital intensive company. Therefore, management expects that expenditures for capital acquisition and upkeep will remain relatively flat, regardless of the company's expansion. Further, the company engages in minimal research and development and costs associated with this are not expected to increase significantly.

The audit manager assigned to Incantnetz reviewed the valuation and concluded that all of the assumptions seemed reasonable.

**Intervention – Prompted / No Benefits Condition**

Please answer the following questions about Cases A, B, and C. You may refer back to the cases to answer the questions.

Think through the similarities and differences between the previous cases (A, B, and C). List as many similarities, differences, and combinations of similarities and differences (where two items are similar, but different from the third) as you can identify.

Similarities among the cases:

Differences among the cases:

Combinations of similarities and differences among the cases:

Briefly articulate any central idea(s) or overall principle(s) demonstrated by the cases taken together.

**Intervention Prompted / Yes Benefits Condition**

Please answer the following questions about Cases A, B, and C. You may refer back to the cases to answer the questions.

Research has demonstrated that comparing the similarities and differences of multiple cases not only aids in understanding the relevant similarities and differences between the cases, but also has the benefit of facilitating the development of more abstract, principle-based mental models of the cases. This has further been shown to be beneficial beyond just providing the more abstract principles directly because the comparison process also allows for interpretation of the principles within the context of individual cases.

Think through the similarities and differences between the previous cases (A, B, and C). List as many similarities, differences, and combinations of similarities and differences (where two items are similar, but different from the third) as you can identify.

Similarities among the cases:

Differences among the cases:

Combinations of similarities and differences among the cases:

Briefly articulate any central idea(s) or overall principle(s) demonstrated by the cases taken together.

**Intervention Guided / No Benefits Condition**

Please answer the following questions about Cases A, B, and C. You may refer back to the cases to answer the questions.

You will now be asked to compare the previous cases (A – C) for similarities, differences, and combinations of similarities and differences. **For example, consider the following list: hockey, football, and snowboarding. Similarities** among the three items in the list include: (1) they are all sports; and (2) individuals use padding to protect their bodies from injury. **Differences** include: (1) hockey requires a puck, football requires a ball, and snowboarding requires a snowboard. **Combinations of similarities-differences** include: (1) hockey and football are team sports, while snowboarding is an individual sport; and (2) hockey and snowboarding are Winter Olympic sports, while football is not.

Think through the similarities and differences between the previous cases (A, B, and C). List as many similarities, differences, and combinations of similarities and differences (where two items are similar, but different from the third) as you can identify.

Similarities among the cases:

Differences among the cases:

Combinations of similarities and differences among the cases:

Briefly articulate any central idea(s) or overall principle(s) demonstrated by the cases taken together.

**Intervention Guided / Yes Benefits Condition**

Please answer the following questions about Cases A, B, and C. You may refer back to the cases to answer the questions.

Research has demonstrated that comparing the similarities and differences of multiple cases not only aids in understanding the relevant similarities and differences between the cases, but also has the benefit of facilitating the development of more abstract, principle-based mental models of the cases.  This has further been shown to be beneficial beyond just providing the more abstract principles directly because the comparison process also allows for interpretation of the principles within the context of individual cases.

You will now be asked to compare the previous cases (A – C) for similarities, differences, and combinations of similarities and differences. **For example, consider the following list: hockey, football, and snowboarding. Similarities** among the three items in the list include: (1) they are all sports; and (2) individuals use padding to protect their bodies from injury. **Differences** include: (1) hockey requires a puck, football requires a ball, and snowboarding requires a snowboard. **Combinations of similarities-differences** include: (1) hockey and football are team sports, while snowboarding is an individual sport; and (2) hockey and snowboarding are Winter Olympic sports, while football is not.

Think through the similarities and differences between the previous cases (A, B, and C). List as many similarities, differences, and combinations of similarities and differences (where two items are similar, but different from the third) as you can identify.

Similarities among the cases:

[ text box ]

Differences among the cases:

[ text box ]

Combinations of similarities and differences among the cases:

[ text box ]

Briefly articulate any central idea(s) or overall principle(s) demonstrated by the cases taken together.

[ text box ]

**Intervention Control Condition**

Please answer the following questions about Cases A, B, and C. You may refer back to the cases to answer the questions.

Consider what is going on in Case A. Briefly articulate any central ideas or principles demonstrated in the case.

Consider what is going on in Case B. Briefly articulate any central ideas or principles demonstrated in the case.

Consider what is going on in Case C. Briefly articulate any central ideas or principles demonstrated in the case.

**Target Case – All Conditions**

In the following case, you are to assume the role of an auditor. Please read Case D below and answer the following questions. You will be able to refer back to the case while answering the questions.

Case D
You have been assigned to the audit of StrollCo for the fiscal year ended June 30, 2017. Your task is to review the projections related to StrollCo's valuation prepared for the company's goodwill impairment assessment. In reviewing StrollCo's projections, you note the following:
StrollCo, a privately owned company based in the Mid-Atlantic, manufactures moderately priced strollers for sale throughout North America.

Management is aware of signs of improvement in the general economy, but recognize that their business is not impacted greatly by the general economic cycle. Thus, they assume that the overall market for their products will remain relatively flat in the near to medium term. However, management's valuation includes projections that revenue will continue to grow over the next several years due to further increases in market share as the style and branding of their products are popular with the younger generation of parents. These projected revenue increases are supported by growth in revenue and market share over the past couple of years.

In accordance with the increased production required to meet expected demand, StrollCo's management projects that raw materials and labor, as well as other operating expenses associated with the expanding size of the business will increase in line with revenue.

Management believes that in order to maintain the level of growth in market share, research and development expenditures will need to be increased, and these additional costs are included in the expense projections used in the valuation. Expenditures for capital, including machinery and building space used to manufacture the company's products, as well as replacement and upkeep of such capital, are included in the valuation and are projected to remain flat going forward.

**Dependent Measures – All Conditions**

Please answer the following questions about Case D. You may refer back to the case to answer the questions.

Based on the assumptions used in estimating the valuation for StrollCo, which includes all available information as of the valuation date, do you believe the overall valuation should be revised upward (increase), be revised downward (decrease), or stay the same?

| | Definitely Revised Downward | Likely Revised Downward | Possibly Revised Downward | Stay the Same | Possibly Revised Upward | Likely Revised Upward | Definitely Revised Upward |
|---|---|---|---|---|---|---|---|
| | ○ | ○ | ○ | ○ | ○ | ○ | ○ |

Please be thoughtful in answering the following question. Your response will help in understanding the thought process underlying your decision above regarding the valuation.

In a few sentences, please explain which information from case D was important in indicating whether or not a change should be made to StrollCo's valuation.

Please drag and drop the pieces of information from the case that you think were important in indicating whether or not a change should be made to StrollCo's valuation.

The case is displayed again below for reference.

| Items | Place items here |
|---|---|
| Sales volume is projected to increase | |
| Raw materials and labor costs are projected to increase | |
| StrollCo is headquartered in the Mid-Atlantic region | |
| StrollCo's sales market is North America | |
| The reason for the valuation is a goodwill impairment assessment | |
| Other operating expenses are projected to increase | |
| StrollCo's production requires significant capital | |
| Research and development costs are projected to increase | |
| The initial valuation is performed by management | |
| Capital investment and upkeep expenditures are projected to remain flat | |
| StrollCo is privately owned | |
| The type of products that StrollCo sells | |
| StrollCo's products are popular with younger parents | |
| StrollCo's market share has increased over the past couple of years | |

Case D

You have been assigned to the audit of StrollCo for the fiscal year ended June 30, 2017. Your task is to review the projections related to StrollCo's valuation prepared for the company's goodwill impairment assessment. In reviewing StrollCo's projections, you note the following: StrollCo, a privately owned company based in the Mid-Atlantic, manufactures moderately priced strollers for sale throughout North America.

Management is aware of signs of improvement in the general economy, but recognize that their business is not impacted greatly by the general economic cycle. Thus, they assume that the overall market for their products will remain relatively flat in the near to medium term. However, management's valuation includes projections that revenue will continue to grow over the next several years due to further increases in market share as the style and branding of their products are popular with the younger generation of parents. These projected revenue increases are supported by growth in revenue and market share over the past couple of years.

In accordance with the increased production required to meet expected demand, StrollCo's management projects that raw materials and labor, as well as other operating expenses associated with the expanding size of the business will increase in line with revenue.

Management believes that in order to maintain the level of growth in market share, research and development expenditures will need to be increased, and these additional costs are included in the expense projections used in the valuation. Expenditures for capital, including machinery and building space used to manufacture the company's products, as well as replacement and upkeep of such capital, are included in the valuation and are projected to remain flat going forward.

Based on the assumptions used in estimating the valuation for StrollCo, which includes all available information as of the valuation date, do you believe the projected revenue cash flows should be revised upward (increase), be revised downward (decrease), or stay the same?

| | Definitely Revised Downward | Likely Revised Downward | Possibly Revised Downward | Stay the Same | Possibly Revised Upward | Likely Revised Upward | Definitely Revised Upward |
|---|---|---|---|---|---|---|---|
| | ○ | ○ | ○ | ○ | ○ | ○ | ○ |

Based on the assumptions used in estimating the valuation for StrollCo, which includes all available information as of the valuation date, do you believe the projected materials and labor costs cash flows should be revised upward (increase), be revised downward (decrease), or stay the same?

| | Definitely Revised Downward | Likely Revised Downward | Possibly Revised Downward | Stay the Same | Possibly Revised Upward | Likely Revised Upward | Definitely Revised Upward |
|---|---|---|---|---|---|---|---|
| | ○ | ○ | ○ | ○ | ○ | ○ | ○ |

Based on the assumptions used in estimating the valuation for StrollCo, which includes all available information as of the valuation date, do you believe the projected capital investment and upkeep expenditure cash flows should be revised upward (increase), be revised downward (decrease), or stay the same?

| | Definitely Revised Downward | Likely Revised Downward | Possibly Revised Downward | Stay the Same | Possibly Revised Upward | Likely Revised Upward | Definitely Revised Upward |
|---|---|---|---|---|---|---|---|
| | ○ | ○ | ○ | ○ | ○ | ○ | ○ |

Based on the assumptions used in estimating the valuation for StrollCo, which includes all available information as of the valuation date, do you believe the projected operating expense cash flows should be revised upward (increase), be revised downward (decrease), or stay the same?

| | Definitely Revised Downward | Likely Revised Downward | Possibly Revised Downward | Stay the Same | Possibly Revised Upward | Likely Revised Upward | Definitely Revised Upward |
|---|---|---|---|---|---|---|---|
| | ○ | ○ | ○ | ○ | ○ | ○ | ○ |

Based on the assumptions used in estimating the valuation for StrollCo, which includes all available information as of the valuation date, do you believe the projected research and development cash flows should be revised upward (increase), be revised downward (decrease), or stay the same?

| | Definitely Revised Downward | Likely Revised Downward | Possibly Revised Downward | Stay the Same | Possibly Revised Upward | Likely Revised Upward | Definitely Revised Upward |
|---|---|---|---|---|---|---|---|
| | ○ | ○ | ○ | ○ | ○ | ○ | ○ |

197

## Additional Measures – All Conditions

Following are some additional questions pertaining to the previous cases. There are no 'correct' answers, but please answer thoughtfully.

When reading or answering questions related to case D (the last case about StrollCo), were you **reminded** of any of the previous three cases (A-C)? If so, which one(s) and of what specifically were you reminded?

[ ]

Did you find any of the information in the previous three cases (A – C) **relevant** when answering case D? If so, which information?

[ ]

When answering the questions regarding Cases A, B, and C, to what extent did you actively compare the cases to each other?

| Did not Compare | Compared Slightly | Compared Somewhat | Compared Considerably | Compared Extensively |
|:---:|:---:|:---:|:---:|:---:|
| ○ | ○ | ○ | ○ | ○ |

To what extent were you motivated to perform a comparison between cases A, B, and C?

| Not at all Motivated | Slightly Motivated | Somewhat Motivated | Considerably Motivated | Extremely Motivated |
|:---:|:---:|:---:|:---:|:---:|
| ○ | ○ | ○ | ○ | ○ |

You're almost done!

Please answer the following additional questions about completing the cases.

How difficult were the four cases to complete?

| | Not at all Difficult | Slightly Difficult | Somewhat Difficult | Considerably Difficult | Extremely Difficult |
|---|---|---|---|---|---|
| | ○ | ○ | ○ | ○ | ○ |

How motivated were you in responding to the case questions overall?

| | Not at all Motivated | Slightly Motivated | Somewhat Motivated | Considerably Motivated | Extremely Motivated |
|---|---|---|---|---|---|
| | ○ | ○ | ○ | ○ | ○ |

Were you specifically asked to compare similarities, differences, and combinations of similarities and differences between cases A, B, and C in the instructions included with those cases?

○ Yes

○ No

What was the task being performed in the cases?

○ Valuation of accounts receivable

○ Valuation of companies for goodwill impairment assessment

○ Valuation of other intangible assets

○ Valuation of inventory

**Demographic Questions – All Conditions**

Please answer the following questions about yourself.

How old are you?

What is your gender?

○ Male

○ Female

○ Prefer not to answer

What is your major?

○ Accounting

○ Economics

○ Finance

○ Integrated Business

○ Management

○ Marketing

○ Real Estate

○ Non-Business

What is your overall GPA?

How many accounting classes have you taken?

How many finance classes have you taken?

How many years of accounting or finance related work experience do you have?

## Closing – All Conditions

If you care to provide any feedback about the study, please feel free to do so below. Thank you again for your participation.

Responses to this study are anonymous. You will now be redirected into a separate survey in order to collect your name and PID or NID, so that you can receive extra credit.

# APPENDIX G: STUDY THREE EXPERIMENTAL INSTRUMENTS

**Paper 3 Instrument – Control Condition**

University of Central Florida
**EXPLANATION OF RESEARCH**

Title of Project: **Accelerating Audit Expertise by Training Novices to Represent Domains as Experts Do**

Principal Investigator: Matthew Holt

Faculty Supervisor: Steve Sutton

You are being invited to take part in a research study. Whether you take part is up to you. The purpose of this research is to study judgment and decision making in an audit setting. The study consists of hypothetical cases related to the audits of goodwill impairment assessments. You will be asked to read some information and answer questions that will take about 30 minutes of your time. You will also answer a few demographic questions at the end. **It is important that you answer each question in a serious and thoughtful manner.**

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Please note that participation in this study is voluntary and your responses will be completely anonymous. Your name will not be associated with any data, and only aggregated data will be included in any publications or presentations resulting from this study. If you decide to participate, you have the right to withdraw your consent or discontinue participation at any time without penalty. You must be 18 years of age or older to take part in this research study. There are no anticipated potential risks associated with this study.

If you have questions, concerns, or complaints contact Matthew Holt, PhD candidate, College of Business Administration (407) 823-4331 or by email at Matthew.Holt@ucf.edu or Dr. Steve Sutton, Faculty Supervisor at (407) 823-5857. Research at the University of Central Florida involving human participants is carried out under the oversight of the Institutional Review Board (UCF IRB). This research has been reviewed by the IRB. For information about the rights of people who take part in research, please contact: Institutional Review Board, University of Central Florida, Office of Research & Commercialization, 12201 Research Parkway, Suite 501, Orlando, FL 32826-3246 or by telephone at (407) 823-2901.

By turning the page and continuing with the study, you are indicating that you understand the above and voluntarily consent to participate in the research. If you would like a copy of the results of the study, please send an email to Matthew.Holt@ucf.edu with your name and address and "results requested". The results will then be sent to you when they are available.

Thank you very much for agreeing to participate.

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At the end of the third packet there is a page for your name and student ID. Upon completion of the study, please write your name and student ID, remove the page, and hand it in separately.

**Begin Section One**

On the following pages, you will be given some hypothetical cases to read. The cases concern the auditing of company valuations used in goodwill impairment assessments. The valuations are based on the discounted cash flows method. This is an example of the type of complex estimates that auditors need to understand in order to support their opinion on the financial statements.

Below is a brief and simple explanation of a discounted cash flow valuation. **It is important that you read and understand the explanation below, as your ability to complete the subsequent cases will be dependent on your understanding it.**

Essentially, a discounted cash flows valuation is done by estimating all future cash flows related to whatever is being valued, then discounting those cash flows back to the present value, and summing them. Cash inflows, such as from sales, and cash outflows, such as for expenditures will net against each other. **Thus, increasing projected cash inflows increases the estimated valuation, while increasing cash outflows decreases the estimated valuation.**

All of the inputs to the cash flow calculation represent assumptions about future occurrences. In the context of valuing a company this entails estimating all future cash flows in and out of a company over the duration of its life. In other words, all future revenues, expenses, etc. are estimated based on all available knowledge about the future direction of the company, including growth and expansion, as of the valuation date.
There are multiple existing models for creating these estimates in distant future periods, but they all work based on the same conceptual idea stated above.

Future cash flows are discounted to represent the idea that a dollar today is worth more than a dollar tomorrow. Therefore, the projected cash flows used in the short to medium term have the greatest impact on the valuation of the company.

Please select answers to the following statements.

Projected cash flows in the short to medium term can have a significant impact on the valuation of the company.

_____True

_____False

All projected future cash flows in and out of a company are included in the valuation as of the valuation date.

_____True

_____False

205

Please read the following three hypothetical cases carefully. The cases concern auditors reviewing company valuations used in annual goodwill impairment assessments. After reading the cases, you will be asked to answer questions about them. You may use the included blank sheet of paper if you choose, and you will be able to refer back to the case while answering the questions.

## Case A

PortPhone, a large, privately owned company headquartered in the Northeast, manufactures smartphones for several phone companies in North America, Europe, and Asia. As part of the annual goodwill impairment assessment, management prepared a valuation of the Company as of June 30, 2017. Projected in management's valuation is revenue growth based on a belief that PortPhone could maintain its 30% market share in a growing market. The market is expected to grow as there have been recent signs of improvement in the general economy, which management expects to impact the demand for its products. Management projects that the company can significantly increase unit sales annually over the next five years. Cost increases for the component parts used in production are projected to increase in line with revenue. Additionally, operating expenses such as payroll, marketing costs, and utilities are expected to increase in line with the revenue.

Research and development expenditures are deemed to be adequate and are projected to remain at a consistent level going forward. Further, management assumes that expenditures on capital such as production space and equipment will remain consistent with current levels.

The audit manager on Portphone's engagement reviewed their preliminary valuation and informed management that certain assumptions needed to be changed. PortPhone is a smartphone manufacturer, and like most manufacturing companies, it is a capital intensive company. This is because in order to generate revenue, it requires significant physical capital, such as production facilities and machinery, to create the products that it sells.

The audit manager stated that the expected revenue growth cannot be achieved without increased investment in, and upkeep costs for, capital needed to produce the additional units.

## Case B

Lil-Rides, a privately held company based in the Midwest, manufactures moderately priced child car seats for sale throughout North America and Europe. Management prepared a valuation of the Company as of June 30, 2017, as part of the annual goodwill impairment assessment. Lil Rides' management acknowledges that the general economy is improving but also states that the industry is not particularly sensitive to the economic cycle. Therefore the size of the overall market for Lil-Rides' products will not change considerably in the near term, essentially increasing at the rate of population growth in its sales regions. Lil-Rides is a growing company that has been enjoying increasing market share over the past several years. Management expects that market share will continue to increase due to strong branding of the company and therefore projects increases in revenue in the near to medium term.

Costs associated with raw materials for production and operating expenses are projected to increase in line with revenue, and this is reflected in the valuation. Lil-Rides' management concluded that the current level of research and development expenditures is sufficient and therefore they are maintained in the valuation projections. They also recognize that since Lil-Rides is a capital intensive company, significant expansion to production capacity, including space and equipment, is required in order to achieve the projected increase in sales. This is reflected in the valuation assumptions regarding capital expenditures and increases in future capital replacement costs.

The audit manager assigned to Lil-Rides reviewed the valuation and concluded that all of the assumptions seemed reasonable.

## Case C

Incantnetz is a privately owned IT consulting firm based in the Northeast, and primarily serving North America. As part of the annual goodwill impairment assessment, management prepared a valuation of the Company as of June 30, 2017. Incantnetz has steadily increased their market share over the past several years by actively pursuing new clients and maintaining high performance standards that result in ongoing business from many of their existing clients. There are signs that the general economy is improving and management believes that this will lead to an increase in demand for IT consulting services. This, in conjunction with management's assumption that they will continue to increase their share of this growing market, leads them to project significant growth in revenue over the near to medium term.

In order to support the growth in revenue, management expects the costs associated with providing their services to increase. These costs predominantly include wages paid to service personnel, and other operating expenses such as marketing costs, rent, and utilities. Due to the nature of Incantnetz's operations, it is not a particularly capital intensive company. Therefore, management expects that expenditures for capital acquisition and upkeep will remain relatively flat, regardless of the company's expansion. Further, the company engages in minimal research and development and costs associated with this are not expected to increase significantly.

The audit manager assigned to Incantnetz reviewed the valuation and concluded that all of the assumptions seemed reasonable.

Consider what is going on in Case A. Briefly articulate any central ideas or principles demonstrated in the case.

Consider what is going on in Case B. Briefly articulate any central ideas or principles demonstrated in the case.

Consider what is going on in Case C. Briefly articulate any central ideas or principles demonstrated in the case.

**End Section One**

**Begin Section Two**

In the following case, you are to assume the role of an auditor. Please read Case D below and answer the following questions. You may use the included blank sheet of paper if you choose, and you will be able to refer back to the case while answering the questions.

Case D

You have been assigned to the audit of StrollCo for the fiscal year ended June 30, 2017. Your task is to review the projections related to StrollCo's valuation prepared for the company's goodwill impairment assessment. In reviewing StrollCo's projections, you note the following:
StrollCo, a privately owned company based in the Mid-Atlantic, manufactures moderately priced strollers for sale throughout North America.

Management is aware of signs of improvement in the general economy, but recognize that their business is not impacted greatly by the general economic cycle. Thus, they assume that the overall market for their products will remain relatively flat in the near to medium term. However, management's valuation includes projections that revenue will continue to grow over the next several years due to further increases in market share as the style and branding of their products are popular with the younger generation of parents. These projected revenue increases are supported by growth in revenue and market share over the past couple of years.

In accordance with the increased production required to meet expected demand, StrollCo's management projects that raw materials and labor, as well as other operating expenses associated with the expanding size of the business will increase in line with revenue.

Management believes that in order to maintain the level of growth in market share, research and development expenditures will need to be increased, and these additional costs are included in the expense projections used in the valuation. Expenditures for capital, including machinery and building space used to manufacture the company's products, as well as replacement and upkeep of such capital, are included in the valuation and are projected to remain flat going forward.

Please answer the following questions about Case D. You may refer back to the case to answer the questions.

Based on the assumptions used in estimating the valuation for StrollCo, which includes all available information as of the valuation date, do you believe the overall valuation should be revised upward (increase), be revised downward (decrease), or stay the same?

| 1 | 2 | 3 | 4 | 5 | 6 | 7 |
|---|---|---|---|---|---|---|
| Definitely Revised Downward | Likely Revised Downward | Possibly Revised Downward | Stay the Same | Possibly Revised Upward | Likely Revised Upward | Definitely Revised Upward |

209

Please be thoughtful in answering the following question. Your response will help in understanding the thought process underlying your decision above regarding the valuation.
In a few sentences, please explain which information from Case D was important in indicating whether or not a change should be made to StrollCo's valuation.

**End Section Two**

**Begin Section Three**

Listed below are pieces of information from Case D. Please mark an 'X' next to each item in the appropriate column designating whether you think each piece of information was not relevant, somewhat relevant, or important in indicating whether or not a change should be made to StrollCo's valuation.

Case D is displayed again below for reference.

| Not Relevant | Somewhat Relevant | Important | |
|---|---|---|---|
| _____ | _____ | _____ | Sales volume is projected to increase |
| _____ | _____ | _____ | Raw materials and labor costs are projected to increase |
| _____ | _____ | _____ | StrollCo is headquartered in the Mid-Atlantic region |
| _____ | _____ | _____ | StrollCo's sales market is North America |
| _____ | _____ | _____ | The reason for the valuation is a goodwill impairment assessment |
| _____ | _____ | _____ | Other operating expenses are projected to increase |
| _____ | _____ | _____ | StrollCo's production requires significant capital |
| _____ | _____ | _____ | Research and development costs are projected to increase |
| _____ | _____ | _____ | The initial valuation is performed by management |
| _____ | _____ | _____ | Capital investment and upkeep expenditures are projected to remain flat |
| _____ | _____ | _____ | StrollCo is privately owned |
| _____ | _____ | _____ | The type of products that StrollCo sells |
| _____ | _____ | _____ | StrollCo's products are popular with younger parents |
| _____ | _____ | _____ | StrollCo's market share has increased over the past couple of years |

Case D

You have been assigned to the audit of StrollCo for the fiscal year ended June 30, 2017. Your task is to review the projections related to StrollCo's valuation prepared for the company's goodwill impairment assessment. In reviewing StrollCo's projections, you note the following:
StrollCo, a privately owned company based in the Mid-Atlantic, manufactures moderately priced strollers for sale throughout North America.

Management is aware of signs of improvement in the general economy, but recognize that their business is not impacted greatly by the general economic cycle. Thus, they assume that the overall market for their products will remain relatively flat in the near to medium term. However, management's valuation includes projections that revenue will continue to grow over the next several years due to further increases in market share as the style and branding of their products are popular with the younger generation of parents. These projected revenue increases are supported by growth in revenue and market share over the past couple of years.

In accordance with the increased production required to meet expected demand, StrollCo's management projects that raw materials and labor, as well as other operating expenses associated with the expanding size of the business will increase in line with revenue. Management believes that in order to maintain the level of growth in market share, research and development expenditures will need to be increased, and these additional costs are included in the expense projections used in the valuation. Expenditures for capital, including machinery and building space used to manufacture the company's products, as well as replacement and upkeep of such capital, are included in the valuation and are projected to remain flat going forward.

Please answer the following additional questions regarding the valuation

Based on the assumptions used in estimating the valuation for StrollCo, which includes all available information as of the valuation date, do you believe the **projected revenue cash flows** should be revised upward (increase), be revised downward (decrease), or stay the same?

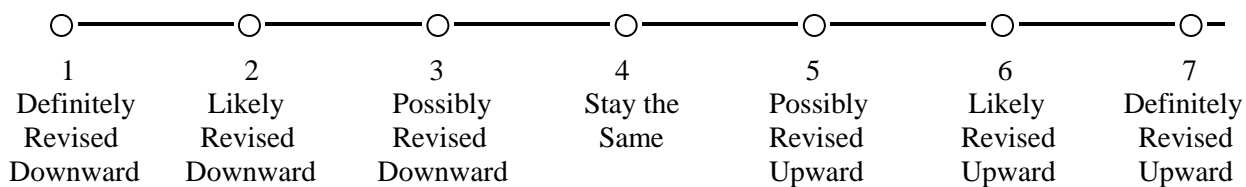| 1 | 2 | 3 | 4 | 5 | 6 | 7 |
|---|---|---|---|---|---|---|
| Definitely Revised Downward | Likely Revised Downward | Possibly Revised Downward | Stay the Same | Possibly Revised Upward | Likely Revised Upward | Definitely Revised Upward |

Based on the assumptions used in estimating the valuation for StrollCo, which includes all available information as of the valuation date, do you believe the **projected materials and labor costs cash flows** should be revised upward (increase), be revised downward (decrease), or stay the same?

| 1 | 2 | 3 | 4 | 5 | 6 | 7 |
|---|---|---|---|---|---|---|
| Definitely Revised Downward | Likely Revised Downward | Possibly Revised Downward | Stay the Same | Possibly Revised Upward | Likely Revised Upward | Definitely Revised Upward |

Based on the assumptions used in estimating the valuation for StrollCo, which includes all available information as of the valuation date, do you believe the **projected capital investment and upkeep expenditure cash flows** should be revised upward (increase), be revised downward (decrease), or stay the same?

| 1 | 2 | 3 | 4 | 5 | 6 | 7 |
|---|---|---|---|---|---|---|
| Definitely Revised Downward | Likely Revised Downward | Possibly Revised Downward | Stay the Same | Possibly Revised Upward | Likely Revised Upward | Definitely Revised Upward |

Based on the assumptions used in estimating the valuation for StrollCo, which includes all available information as of the valuation date, do you believe the **projected operating expense cash flows** should be revised upward (increase), be revised downward (decrease), or stay the same?

| 1 | 2 | 3 | 4 | 5 | 6 | 7 |
|---|---|---|---|---|---|---|
| Definitely Revised Downward | Likely Revised Downward | Possibly Revised Downward | Stay the Same | Possibly Revised Upward | Likely Revised Upward | Definitely Revised Upward |

Based on the assumptions used in estimating the valuation for StrollCo, which includes all available information as of the valuation date, do you believe the **projected research and development cash flows** should be revised upward (increase), be revised downward (decrease), or stay the same?

| 1 | 2 | 3 | 4 | 5 | 6 | 7 |
|---|---|---|---|---|---|---|
| Definitely Revised Downward | Likely Revised Downward | Possibly Revised Downward | Stay the Same | Possibly Revised Upward | Likely Revised Upward | Definitely Revised Upward |

<u>Following are some additional questions pertaining to the previous cases. There are no 'correct' answers, but please answer thoughtfully.</u>

When reading or answering questions related to Case D (the last case about StrollCo), were you **reminded** of any of the previous three cases (A, B, and C)? If so, which one(s) and of what specifically were you reminded?

Did you find any of the information in the previous three cases (A, B, and C) **relevant** when answering case D? If so, which information?

When answering the questions regarding Cases A, B, and C, to what extent did you actively compare the cases to each other?

| 1 | 2 | 3 | 4 | 5 |
|---|---|---|---|---|
| Did not Compare | Compared Slightly | Compared Somewhat | Compared Considerably | Compared Extensively |

How difficult were the four cases to complete?

| 1 | 2 | 3 | 4 | 5 |
|---|---|---|---|---|
| Not at all Difficult | Slightly Difficult | Somewhat Difficult | Considerably Difficult | Extremely Difficult |

How motivated were you in responding to the case questions overall?

| 1 | 2 | 3 | 4 | 5 |
|---|---|---|---|---|
| Not at all Motivated | Slightly Motivated | Somewhat Motivated | Considerably Motivated | Extremely Motivated |

214

Were you specifically asked to compare similarities, differences, and combinations of similarities and differences between cases A, B, and C in the instructions included with those cases?

_____Yes

_____No

What was the task being performed in the cases?

_____Valuation of accounts receivable

_____Valuation of companies for goodwill impairment assessment

_____Valuation of other intangible assets

_____Valuation of inventory

Have you previously participated in a similar study using these cases?

_____Yes

_____No

If yes, when and where?

<u>Please answer the following questions about yourself.</u>

How old are you? _____

What is your gender?

_____ Male

_____ Female

_____ Prefer not to answer

What is your major? You may mark both if you are pursuing a dual-major.

_____ Accounting

_____ Economics

_____ Finance

_____ Integrated Business

_____ Management

_____ Marketing

_____ Real Estate

_____ Non-Business

What is your overall GPA? _____

How many accounting classes have you taken? _____

How many finance classes have you taken? _____

How many years of accounting or finance related work experience do you have? _____

**When reading cases, it may help to think of each case as a system of concepts, attributes, and relations.** Concepts can be thought of as any object, event, state of being, etc. that can be designated with a label. Concepts can be general in nature, or specific instances of more general concepts. For example, 'mountain' is a general concept, 'Mount Everest' is a specific instance, uniquely identifiable with a label. Concepts can also be concrete, such as 'my dog Rover' or abstract, such as 'love'. Other examples of concepts are: 'computer', 'water', 'birthday party', 'book', 'cookbook', 'tired' and 'independent'.

Attributes are associated with particular concepts and can be thought of as properties of the concepts. Attributes often take the form of descriptors, such as 'large' or 'yellow'.

First order relations can be thought of as links between concepts. Relations link concepts into propositions, which are the smallest units of knowledge that can be considered true or false. **Often, the specific concepts of a particular case are superficial and it is the relational structure between them that is useful for making inferences about future cases.** This may be particularly true when many concepts are linked together in systematic ways. **Research shows that thinking in terms of systems of relations is how experts tend to think within their fields.**

There are also special relations, called higher order relations, which link concepts to other relations or even two relations to each other. Examples of relations that can be higher order are 'causes' or 'equal to'.

One way to think about the difference between attributes and relations is that attributes are associated with only one concept, whereas first order relations link two concepts, and higher order relations link at least one relation with a concept or another relation.

Consider the demonstration in the following simple example:



The depiction above of a system of concepts and relations makes clear what is going on in the present situation. However, **it is the structure of the relations, more so than the values of the concepts, that can make this example insightful for similar instances encountered in the future.** In the above example,

the concepts (objects) include: Bill, Mary, and Sam

the attributes (of Bill) include: male and middle aged

the first order relations include: loves and jealous

the higher order relation is: causes

In this example, it is the relations between Bill & Mary and Mary & Sam (both 'loves') that 'cause' the relation between Bill & Sam ('jealous'). Thus, 'causes' is a higher order relation that links other relations. The relational structure of this example represents what is often referred to as a "love triangle". **Understanding the systematic structure of this instance can help us understand other similar situations.** If we encounter another instance in which person A loves person B and person B loves person C, we may infer that it is likely that this causes person A to be jealous of person C. It doesn't necessarily matter who the people (in other words the values of the concepts) are, or if they are people at all. Perhaps the same scenario could be applied to other species of intelligent animal. Obviously not just any concepts will make sense in this particular relational structure. **The point is that it is often the relational structure, and not the values of the concepts, that is important for deriving knowledge that can be applied in other instances.** Therefore, the specific people and their characteristics may not be as relevant to making inferences about future instances of similar structures. Additionally, the attributes in the above example are not relevant for understanding the meaning created by the relational structure. It is possible, however, that in other types of cases, the attributes may be relevant.

Please answer the following question:

If an understanding of the structure of the previous example is gained, and we are presented with the following information, then we can predict that the relation between Alicia and Jenny might be _____.



**End Section Three**

You're done! Thank you again for participating.

To receive extra credit, remove this page from the packet, print your name and student ID in the spaces below, and turn it in separately.

Name: _____

SID: _____

University of
**Central
Florida**
**EXPLANATION OF RESEARCH**

Title of Project: **Accelerating Audit Expertise by Training Novices to Represent Domains as Experts Do**

Principal Investigator: Matthew Holt

Faculty Supervisor: Steve Sutton

You are being invited to take part in a research study. Whether you take part is up to you. The purpose of this research is to study judgment and decision making in an audit setting. The study consists of hypothetical cases related to the audits of goodwill impairment assessments. You will be asked to read some information and answer questions that will take about 30 minutes of your time. You will also answer a few demographic questions at the end. **It is important that you answer each question in a serious and thoughtful manner.**

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If you have questions, concerns, or complaints contact Matthew Holt, PhD candidate, College of Business Administration (407) 823-4331 or by email at Matthew.Holt@ucf.edu or Dr. Steve Sutton, Faculty Supervisor at (407) 823-5857. Research at the University of Central Florida involving human participants is carried out under the oversight of the Institutional Review Board (UCF IRB). This research has been reviewed by the IRB. For information about the rights of people who take part in research, please contact: Institutional Review Board, University of Central Florida, Office of Research & Commercialization, 12201 Research Parkway, Suite 501, Orlando, FL 32826-3246 or by telephone at (407) 823-2901.

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At the end of the third packet there is a page for your name and student ID. <u>Upon completion of the study, please write your name and student ID, remove the page, and hand it in separately.</u>

**Begin Section One**

On the following pages, you will be given some hypothetical cases to read. The cases concern the auditing of company valuations used in goodwill impairment assessments. The valuations are based on the discounted cash flows method. This is an example of the type of complex estimates that auditors need to understand in order to support their opinion on the financial statements.

Below is a brief and simple explanation of a discounted cash flow valuation. **It is important that you read and understand the explanation below, as your ability to complete the subsequent cases will be dependent on your understanding it.**

Essentially, a discounted cash flows valuation is done by estimating all future cash flows related to whatever is being valued, then discounting those cash flows back to the present value, and summing them. Cash inflows, such as from sales, and cash outflows, such as for expenditures will net against each other. **Thus, increasing projected cash inflows increases the estimated valuation, while increasing cash outflows decreases the estimated valuation.**

All of the inputs to the cash flow calculation represent assumptions about future occurrences. In the context of valuing a company this entails estimating all future cash flows in and out of a company over the duration of its life. In other words, all future revenues, expenses, etc. are estimated based on all available knowledge about the future direction of the company, including growth and expansion, as of the valuation date.
There are multiple existing models for creating these estimates in distant future periods, but they all work based on the same conceptual idea stated above.

Future cash flows are discounted to represent the idea that a dollar today is worth more than a dollar tomorrow. Therefore, the projected cash flows used in the short to medium term have the greatest impact on the valuation of the company.

<u>Please select answers to the following statements.</u>

Projected cash flows in the short to medium term can have a significant impact on the valuation of the company.

_____True

_____False

All projected future cash flows in and out of a company are included in the valuation as of the valuation date.

_____True

_____False

221

Please read the following three hypothetical cases carefully. The cases concern auditors reviewing company valuations used in annual goodwill impairment assessments. After reading the cases, you will be asked to answer questions about them. You may use the included blank sheet of paper if you choose, and you will be able to refer back to the case while answering the questions.

**Research has shown that comparing the similarities and differences of multiple cases has the benefit of facilitating a better understanding of the relationships between elements within the individual cases. The questions following the cases will be related to the similarities and differences between them so it will be helpful to consider these when reading the cases.**

## Case A

PortPhone, a large, privately owned company headquartered in the Northeast, manufactures smartphones for several phone companies in North America, Europe, and Asia. As part of the annual goodwill impairment assessment, management prepared a valuation of the Company as of June 30, 2017. Projected in management's valuation is revenue growth based on a belief that PortPhone could maintain its 30% market share in a growing market. The market is expected to grow as there have been recent signs of improvement in the general economy, which management expects to impact the demand for its products. Management projects that the company can significantly increase unit sales annually over the next five years. Cost increases for the component parts used in production are projected to increase in line with revenue. Additionally, operating expenses such as payroll, marketing costs, and utilities are expected to increase in line with the revenue.

Research and development expenditures are deemed to be adequate and are projected to remain at a consistent level going forward. Further, management assumes that expenditures on capital such as production space and equipment will remain consistent with current levels.

The audit manager on Portphone's engagement reviewed their preliminary valuation and informed management that certain assumptions needed to be changed. PortPhone is a smartphone manufacturer, and like most manufacturing companies, it is a capital intensive company. This is because in order to generate revenue, it requires significant physical capital, such as production facilities and machinery, to create the products that it sells.

The audit manager stated that the expected revenue growth cannot be achieved without increased investment in, and upkeep costs for, capital needed to produce the additional units.

## Case B

Lil-Rides, a privately held company based in the Midwest, manufactures moderately priced child car seats for sale throughout North America and Europe. Management prepared a valuation of the Company as of June 30, 2017, as part of the annual goodwill impairment assessment. Lil Rides' management acknowledges that the general economy is improving but also states that the industry is not particularly sensitive to the economic cycle. Therefore the size of the overall market for Lil-Rides' products will not change considerably in the near term, essentially increasing at the rate of population growth in its sales regions. Lil-Rides is a growing company that has been enjoying increasing market share over the past several years. Management expects that market share will continue to increase due to strong branding of the company and therefore projects increases in revenue in the near to medium term.

Costs associated with raw materials for production and operating expenses are projected to increase in line with revenue, and this is reflected in the valuation. Lil-Rides' management concluded that the current level of research and development expenditures is sufficient and therefore they are maintained in the valuation projections. They also recognize that since Lil-Rides is a capital intensive company, significant expansion to production capacity, including space and equipment, is required in order to achieve the projected increase in sales. This is reflected in the valuation assumptions regarding capital expenditures and increases in future capital replacement costs.

The audit manager assigned to Lil-Rides reviewed the valuation and concluded that all of the assumptions seemed reasonable.

## Case C

Incantnetz is a privately owned IT consulting firm based in the Northeast, and primarily serving North America. As part of the annual goodwill impairment assessment, management prepared a valuation of the Company as of June 30, 2017. Incantnetz has steadily increased their market share over the past several years by actively pursuing new clients and maintaining high performance standards that result in ongoing business from many of their existing clients. There are signs that the general economy is improving and management believes that this will lead to an increase in demand for IT consulting services. This, in conjunction with management's assumption that they will continue to increase their share of this growing market, leads them to project significant growth in revenue over the near to medium term.

In order to support the growth in revenue, management expects the costs associated with providing their services to increase. These costs predominantly include wages paid to service personnel, and other operating expenses such as marketing costs, rent, and utilities. Due to the nature of Incantnetz's operations, it is not a particularly capital intensive company. Therefore, management expects that expenditures for capital acquisition and upkeep will remain relatively flat, regardless of the company's expansion. Further, the company engages in minimal research and development and costs associated with this are not expected to increase significantly.

The audit manager assigned to Incantnetz reviewed the valuation and concluded that all of the assumptions seemed reasonable.

Please answer the following questions about Cases A, B, and C. You may use the included blank sheet of paper if you choose, and you will be able to refer back to the case while answering the questions.

Think through the similarities and differences between the previous cases (A, B, and C). List as many similarities, differences, and combinations of similarities and differences (where two items are similar, but different from the third) as you can identify.

Similarities among the cases:

Differences among the cases:

Combinations of similarities and differences among the cases:

Briefly articulate any central ideas or overall principle(s) demonstrated by the cases taken together.

**End Section One**

**Begin Section Two**

<u>In the following case, you are to assume the role of an auditor. Please read Case D below and answer the following questions. You may use the included blank sheet of paper if you choose, and you will be able to refer back to the case while answering the questions.</u>

Case D

You have been assigned to the audit of StrollCo for the fiscal year ended June 30, 2017. Your task is to review the projections related to StrollCo's valuation prepared for the company's goodwill impairment assessment. In reviewing StrollCo's projections, you note the following:
StrollCo, a privately owned company based in the Mid-Atlantic, manufactures moderately priced strollers for sale throughout North America.

Management is aware of signs of improvement in the general economy, but recognize that their business is not impacted greatly by the general economic cycle. Thus, they assume that the overall market for their products will remain relatively flat in the near to medium term. However, management's valuation includes projections that revenue will continue to grow over the next several years due to further increases in market share as the style and branding of their products are popular with the younger generation of parents. These projected revenue increases are supported by growth in revenue and market share over the past couple of years.

In accordance with the increased production required to meet expected demand, StrollCo's management projects that raw materials and labor, as well as other operating expenses associated with the expanding size of the business will increase in line with revenue.

Management believes that in order to maintain the level of growth in market share, research and development expenditures will need to be increased, and these additional costs are included in the expense projections used in the valuation. Expenditures for capital, including machinery and building space used to manufacture the company's products, as well as replacement and upkeep of such capital, are included in the valuation and are projected to remain flat going forward.

<u>Please answer the following questions about Case D. You may refer back to the case to answer the questions.</u>

Based on the assumptions used in estimating the valuation for StrollCo, which includes all available information as of the valuation date, do you believe the overall valuation should be revised upward (increase), be revised downward (decrease), or stay the same?

| 1 | 2 | 3 | 4 | 5 | 6 | 7 |
|---|---|---|---|---|---|---|
| Definitely Revised Downward | Likely Revised Downward | Possibly Revised Downward | Stay the Same | Possibly Revised Upward | Likely Revised Upward | Definitely Revised Upward |

Please be thoughtful in answering the following question. Your response will help in understanding the thought process underlying your decision above regarding the valuation.

In a few sentences, please explain which information from Case D was important in indicating whether or not a change should be made to StrollCo's valuation.

**End Section Two**

**Begin Section Three**

Listed below are pieces of information from Case D. Please mark an 'X' next to each item in the appropriate column designating whether you think each piece of information was not relevant, somewhat relevant, or important in indicating whether or not a change should be made to StrollCo's valuation.

Case D is displayed again below for reference.

| Not Relevant | Somewhat Relevant | Important | |
|---|---|---|---|
| _____ | _____ | _____ | Sales volume is projected to increase |
| _____ | _____ | _____ | Raw materials and labor costs are projected to increase |
| _____ | _____ | _____ | StrollCo is headquartered in the Mid-Atlantic region |
| _____ | _____ | _____ | StrollCo's sales market is North America |
| _____ | _____ | _____ | The reason for the valuation is a goodwill impairment assessment |
| _____ | _____ | _____ | Other operating expenses are projected to increase |
| _____ | _____ | _____ | StrollCo's production requires significant capital |
| _____ | _____ | _____ | Research and development costs are projected to increase |
| _____ | _____ | _____ | The initial valuation is performed by management |
| _____ | _____ | _____ | Capital investment and upkeep expenditures are projected to remain flat |
| _____ | _____ | _____ | StrollCo is privately owned |
| _____ | _____ | _____ | The type of products that StrollCo sells |
| _____ | _____ | _____ | StrollCo's products are popular with younger parents |
| _____ | _____ | _____ | StrollCo's market share has increased over the past couple of years |

Case D

You have been assigned to the audit of StrollCo for the fiscal year ended June 30, 2017. Your task is to review the projections related to StrollCo's valuation prepared for the company's goodwill impairment assessment. In reviewing StrollCo's projections, you note the following:
StrollCo, a privately owned company based in the Mid-Atlantic, manufactures moderately priced strollers for sale throughout North America.

Management is aware of signs of improvement in the general economy, but recognize that their business is not impacted greatly by the general economic cycle. Thus, they assume that the overall market for their products will remain relatively flat in the near to medium term. However, management's valuation includes projections that revenue will continue to grow over the next several years due to further increases in market share as the style and branding of their products are popular with the younger generation of parents. These projected revenue increases are supported by growth in revenue and market share over the past couple of years.

In accordance with the increased production required to meet expected demand, StrollCo's management projects that raw materials and labor, as well as other operating expenses associated with the expanding size of the business will increase in line with revenue. Management believes that in order to maintain the level of growth in market share, research and development expenditures will need to be increased, and these additional costs are included in the expense projections used in the valuation. Expenditures for capital, including machinery and building space used to manufacture the company's products, as well as replacement and upkeep of such capital, are included in the valuation and are projected to remain flat going forward.

Please answer the following additional questions regarding the valuation

Based on the assumptions used in estimating the valuation for StrollCo, which includes all available information as of the valuation date, do you believe the **projected revenue cash flows** should be revised upward (increase), be revised downward (decrease), or stay the same?

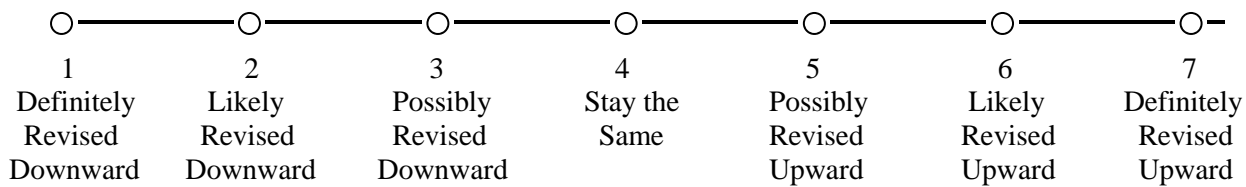| 1 | 2 | 3 | 4 | 5 | 6 | 7 |
|---|---|---|---|---|---|---|
| Definitely Revised Downward | Likely Revised Downward | Possibly Revised Downward | Stay the Same | Possibly Revised Upward | Likely Revised Upward | Definitely Revised Upward |

Based on the assumptions used in estimating the valuation for StrollCo, which includes all available information as of the valuation date, do you believe the **projected materials and labor costs cash flows** should be revised upward (increase), be revised downward (decrease), or stay the same?

| 1 | 2 | 3 | 4 | 5 | 6 | 7 |
|---|---|---|---|---|---|---|
| Definitely Revised Downward | Likely Revised Downward | Possibly Revised Downward | Stay the Same | Possibly Revised Upward | Likely Revised Upward | Definitely Revised Upward |

Based on the assumptions used in estimating the valuation for StrollCo, which includes all available information as of the valuation date, do you believe the **projected capital investment and upkeep expenditure cash flows** should be revised upward (increase), be revised downward (decrease), or stay the same?

| 1 | 2 | 3 | 4 | 5 | 6 | 7 |
|---|---|---|---|---|---|---|
| Definitely Revised Downward | Likely Revised Downward | Possibly Revised Downward | Stay the Same | Possibly Revised Upward | Likely Revised Upward | Definitely Revised Upward |

Based on the assumptions used in estimating the valuation for StrollCo, which includes all available information as of the valuation date, do you believe the **projected operating expense cash flows** should be revised upward (increase), be revised downward (decrease), or stay the same?

| 1 | 2 | 3 | 4 | 5 | 6 | 7 |
|---|---|---|---|---|---|---|
| Definitely Revised Downward | Likely Revised Downward | Possibly Revised Downward | Stay the Same | Possibly Revised Upward | Likely Revised Upward | Definitely Revised Upward |

Based on the assumptions used in estimating the valuation for StrollCo, which includes all available information as of the valuation date, do you believe the **projected research and development cash flows** should be revised upward (increase), be revised downward (decrease), or stay the same?

| 1 | 2 | 3 | 4 | 5 | 6 | 7 |
|---|---|---|---|---|---|---|
| Definitely Revised Downward | Likely Revised Downward | Possibly Revised Downward | Stay the Same | Possibly Revised Upward | Likely Revised Upward | Definitely Revised Upward |

<u>Following are some additional questions pertaining to the previous cases. There are no 'correct' answers, but please answer thoughtfully.</u>

When reading or answering questions related to Case D (the last case about StrollCo), were you **reminded** of any of the previous three cases (A, B, and C)? If so, which one(s) and of what specifically were you reminded?

Did you find any of the information in the previous three cases (A, B, and C) **relevant** when answering case D? If so, which information?

When answering the questions regarding Cases A, B, and C, to what extent did you actively compare the cases to each other?

| 1 | 2 | 3 | 4 | 5 |
|---|---|---|---|---|
| Did not Compare | Compared Slightly | Compared Somewhat | Compared Considerably | Compared Extensively |

How difficult were the four cases to complete?

| 1 | 2 | 3 | 4 | 5 |
|---|---|---|---|---|
| Not at all Difficult | Slightly Difficult | Somewhat Difficult | Considerably Difficult | Extremely Difficult |

How motivated were you in responding to the case questions overall?

| 1 | 2 | 3 | 4 | 5 |
|---|---|---|---|---|
| Not at all Motivated | Slightly Motivated | Somewhat Motivated | Considerably Motivated | Extremely Motivated |

Were you specifically asked to compare similarities, differences, and combinations of similarities and differences between cases A, B, and C in the instructions included with those cases?

_____Yes

_____No

What was the task being performed in the cases?

_____Valuation of accounts receivable

_____Valuation of companies for goodwill impairment assessment

_____Valuation of other intangible assets

_____Valuation of inventory

Have you previously participated in a similar study using these cases?

_____Yes

_____No

If yes, when and where?

<u>Please answer the following questions about yourself.</u>

How old are you? _____

What is your gender?

_____ Male

_____ Female

_____ Prefer not to answer

What is your major? You may mark both if you are pursuing a dual-major.
_____ Accounting

_____ Economics

_____ Finance

_____ Integrated Business

_____ Management

_____ Marketing

_____ Real Estate

_____ Non-Business

What is your overall GPA? _____

How many accounting classes have you taken? _____

How many finance classes have you taken? _____

How many years of accounting or finance related work experience do you have? _____

**When reading cases, it may help to think of each case as a system of concepts, attributes, and relations.**
Concepts can be thought of as any object, event, state of being, etc. that can be designated with a label. Concepts can be general in nature, or specific instances of more general concepts. For example, 'mountain' is a general concept, 'Mount Everest' is a specific instance, uniquely identifiable with a label. Concepts can also be concrete, such as 'my dog Rover' or abstract, such as 'love'. Other examples of concepts are: 'computer', 'water', 'birthday party', 'book', 'cookbook', 'tired' and 'independent'.

Attributes are associated with particular concepts and can be thought of as properties of the concepts. Attributes often take the form of descriptors, such as 'large' or 'yellow'.

First order relations can be thought of as links between concepts. Relations link concepts into propositions, which are the smallest units of knowledge that can be considered true or false. **Often, the specific concepts of a particular case are superficial and it is the relational structure between them that is useful for making inferences about future cases.** This may be particularly true when many concepts are linked together in systematic ways. **Research shows that thinking in terms of systems of relations is how experts tend to think within their fields.**

There are also special relations, called higher order relations, which link concepts to other relations or even two relations to each other. Examples of relations that can be higher order are 'causes' or 'equal to'.

One way to think about the difference between attributes and relations is that attributes are associated with only one concept, whereas first order relations link two concepts, and higher order relations link at least one relation with a concept or another relation.

Consider the demonstration in the following simple example:



The depiction above of a system of concepts and relations makes clear what is going on in the present situation. However, **it is the structure of the relations, more so than the values of the concepts, that can make this example insightful for similar instances encountered in the future.** In the above example,

the concepts (objects) include: Bill, Mary, and Sam

the attributes (of Bill) include: male and middle aged

the first order relations include: loves and jealous

the higher order relation is: causes

In this example, it is the relations between Bill & Mary and Mary & Sam (both 'loves') that 'cause' the relation between Bill & Sam ('jealous'). Thus, 'causes' is a higher order relation that links other relations. The relational structure of this example represents what is often referred to as a "love triangle". **Understanding the systematic structure of this instance can help us understand other similar situations.** If we encounter another instance in which person A loves person B and person B loves person C, we may infer that it is likely that this causes person A to be jealous of person C. It doesn't necessarily matter who the people (in other words the values of the concepts) are, or if they are people at all. Perhaps the same scenario could be applied to other species of intelligent animal. Obviously not just any concepts will make sense in this particular relational structure. **The point is that it is often the relational structure, and not the values of the concepts, that is important for deriving knowledge that can be applied in other instances.** Therefore, the specific people and their characteristics may not be as relevant to making inferences about future instances of similar structures. Additionally, the attributes in the above example are not relevant for understanding the meaning created by the relational structure. It is possible, however, that in other types of cases, the attributes may be relevant.

Please answer the following question:

If an understanding of the structure of the previous example is gained, and we are presented with the following information, then we can predict that the relation between Alicia and Jenny might be _____.

You're done! Thank you again for participating.

To receive extra credit, remove this page from the packet, print your name and student ID in the spaces below, and turn it in separately.

Name: _____

SID: _____

**EXPLANATION OF RESEARCH**

Title of Project: **Accelerating Audit Expertise by Training Novices to Represent Domains as Experts Do**

Principal Investigator: Matthew Holt
Faculty Supervisor: Steve Sutton

You are being invited to take part in a research study. Whether you take part is up to you. The purpose of this research is to study judgment and decision making in an audit setting. The study consists of hypothetical cases related to the audits of goodwill impairment assessments. You will be asked to read some information and answer questions that will take about 30 minutes of your time. You will also answer a few demographic questions at the end. **It is important that you answer each question in a serious and thoughtful manner.**

The professor for your Auditing (4651) class has agreed to offer **extra credit points** for participation. If you do not wish to participate or are under 18 years of age, an alternate assignment of comparable time and effort will be provided for students who wish to earn extra credit. Your decision to participate or not participate in this study will not affect your continued enrollment or grades in this course.

Please note that participation in this study is voluntary and your responses will be completely anonymous. Your name will not be associated with any data, and only aggregated data will be included in any publications or presentations resulting from this study. If you decide to participate, you have the right to withdraw your consent or discontinue participation at any time without penalty. You must be 18 years of age or older to take part in this research study. There are no anticipated potential risks associated with this study.

If you have questions, concerns, or complaints contact Matthew Holt, PhD candidate, College of Business Administration (407) 823-4331 or by email at Matthew.Holt@ucf.edu or Dr. Steve Sutton, Faculty Supervisor at (407) 823-5857. Research at the University of Central Florida involving human participants is carried out under the oversight of the Institutional Review Board (UCF IRB). This research has been reviewed by the IRB. For information about the rights of people who take part in research, please contact: Institutional Review Board, University of Central Florida, Office of Research & Commercialization, 12201 Research Parkway, Suite 501, Orlando, FL 32826-3246 or by telephone at (407) 823-2901.

By turning the page and continuing with the study, you are indicating that you understand the above and voluntarily consent to participate in the research. If you would like a copy of the results of the study, please send an email to Matthew.Holt@ucf.edu with your name and address and "results requested". The results will then be sent to you when they are available.

Thank you very much for agreeing to participate.

This study has three sections, which are contained in three separate envelopes. For each section, you will be given instructions, which are underlined. It is important that you read the instructions and materials carefully, and consider your responses thoughtfully. <u>After completing this section, please place this packet back in its envelope before moving on to the second section. After completing the second section, please place the second packet back in its envelope before moving on to the third section. After completing the third section please put the third packet back in its envelope, put all three envelopes back into the larger envelope, and turn in.</u>

At the end of the third packet there is a page for your name and student ID. <u>Upon completion of the study, please write your name and student ID, remove the page, and hand it in separately.</u>

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Below is a brief and simple explanation of a discounted cash flow valuation. **It is important that you read and understand the explanation below, as your ability to complete the subsequent cases will be dependent on your understanding it.**

Essentially, a discounted cash flows valuation is done by estimating all future cash flows related to whatever is being valued, then discounting those cash flows back to the present value, and summing them. Cash inflows, such as from sales, and cash outflows, such as for expenditures will net against each other. **Thus, increasing projected cash inflows increases the estimated valuation, while increasing cash outflows decreases the estimated valuation.**

All of the inputs to the cash flow calculation represent assumptions about future occurrences. In the context of valuing a company this entails estimating all future cash flows in and out of a company over the duration of its life. In other words, all future revenues, expenses, etc. are estimated based on all available knowledge about the future direction of the company, including growth and expansion, as of the valuation date.
There are multiple existing models for creating these estimates in distant future periods, but they all work based on the same conceptual idea stated above.

Future cash flows are discounted to represent the idea that a dollar today is worth more than a dollar tomorrow. Therefore, the projected cash flows used in the short to medium term have the greatest impact on the valuation of the company.

<u>Please select answers to the following statements.</u>

Projected cash flows in the short to medium term can have a significant impact on the valuation of the company.

_____True

_____False

All projected future cash flows in and out of a company are included in the valuation as of the valuation date.

_____True

_____False

**When reading cases, it may help to think of each case as a system of concepts, attributes, and relations.** Concepts can be thought of as any object, event, state of being, etc. that can be designated with a label. Concepts can be general in nature, or specific instances of more general concepts. For example, 'mountain' is a general concept, 'Mount Everest' is a specific instance, uniquely identifiable with a label. Concepts can also be concrete, such as 'my dog Rover' or abstract, such as 'love'. Other examples of concepts are: 'computer', 'water', 'birthday party', 'book', 'cookbook', 'tired' and 'independent'.

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There are also special relations, called higher order relations, which link concepts to other relations or even two relations to each other. Examples of relations that can be higher order are 'causes' or 'equal to'.

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Please answer the following question:

If an understanding of the structure of the previous example is gained, and we are presented with the following information, then we can predict that the relation between Alicia and Jenny might be _____.

Please read the following three hypothetical cases carefully. The cases concern auditors reviewing company valuations used in annual goodwill impairment assessments. After reading the cases, you will be asked to answer questions about them. You may use the included blank sheet of paper if you choose, and you will be able to refer back to the case while answering the questions.

When reading the following cases, try to understand how the concepts, attributes, and relations of the case form a cohesive system, and how the relational structure plays a key role in understanding the system.

**Case A**

PortPhone, a large, privately owned company headquartered in the Northeast, manufactures smartphones for several phone companies in North America, Europe, and Asia. As part of the annual goodwill impairment assessment, management prepared a valuation of the Company as of June 30, 2017. Projected in management's valuation is revenue growth based on a belief that PortPhone could maintain its 30% market share in a growing market. The market is expected to grow as there have been recent signs of improvement in the general economy, which management expects to impact the demand for its products. Management projects that the company can significantly increase unit sales annually over the next five years. Cost increases for the component parts used in production are projected to increase in line with revenue. Additionally, operating expenses such as payroll, marketing costs, and utilities are expected to increase in line with the revenue.

Research and development expenditures are deemed to be adequate and are projected to remain at a consistent level going forward. Further, management assumes that expenditures on capital such as production space and equipment will remain consistent with current levels.

The audit manager on Portphone's engagement reviewed their preliminary valuation and informed management that certain assumptions needed to be changed. PortPhone is a smartphone manufacturer, and like most manufacturing companies, it is a capital intensive company. This is because in order to generate revenue, it requires significant physical capital, such as production facilities and machinery, to create the products that it sells.

The audit manager stated that the expected revenue growth cannot be achieved without increased investment in, and upkeep costs for, capital needed to produce the additional units.

**Case B**

Lil-Rides, a privately held company based in the Midwest, manufactures moderately priced child car seats for sale throughout North America and Europe. Management prepared a valuation of the Company as of June 30, 2017, as part of the annual goodwill impairment assessment. Lil Rides' management acknowledges that the general economy is improving but also states that the industry is not particularly sensitive to the economic cycle. Therefore the size of the overall market for Lil-Rides' products will not change considerably in the near term, essentially increasing at the rate of population growth in its sales regions. Lil-Rides is a growing company that has been enjoying increasing market share over the past several years. Management expects that market share will continue to increase due to strong branding of the company and therefore projects increases in revenue in the near to medium term.

Costs associated with raw materials for production and operating expenses are projected to increase in line with revenue, and this is reflected in the valuation. Lil-Rides' management concluded that the current level of research and development expenditures is sufficient and therefore they are maintained in the valuation projections. They also recognize that since Lil-Rides is a capital intensive company, significant expansion to production capacity, including space and equipment, is required in order to achieve the projected increase in sales. This is reflected in the valuation assumptions regarding capital expenditures and increases in future capital replacement costs.

The audit manager assigned to Lil-Rides reviewed the valuation and concluded that all of the assumptions seemed reasonable.

**Case C**

Incantnetz is a privately owned IT consulting firm based in the Northeast, and primarily serving North America. As part of the annual goodwill impairment assessment, management prepared a valuation of the Company as of June 30, 2017. Incantnetz has steadily increased their market share over the past several years by actively pursuing new clients and maintaining high performance standards that result in ongoing business from many of their existing clients. There are signs that the general economy is improving and management believes that this will lead to an increase in demand for IT consulting services. This, in conjunction with management's assumption that they will continue to increase their share of this growing market, leads them to project significant growth in revenue over the near to medium term.

In order to support the growth in revenue, management expects the costs associated with providing their services to increase. These costs predominantly include wages paid to service personnel, and other operating expenses such as marketing costs, rent, and utilities. Due to the nature of Incantnetz's operations, it is not a particularly capital intensive company. Therefore, management expects that expenditures for capital acquisition and upkeep will remain relatively flat, regardless of the company's expansion. Further, the company engages in minimal research and development and costs associated with this are not expected to increase significantly.

The audit manager assigned to Incantnetz reviewed the valuation and concluded that all of the assumptions seemed reasonable.

Consider what is going on in Case A. Briefly articulate any central ideas or principles demonstrated in the case.

Consider what is going on in Case B. Briefly articulate any central ideas or principles demonstrated in the case.

Consider what is going on in Case C. Briefly articulate any central ideas or principles demonstrated in the case.

**End Section One**

**Begin Section Two**

<u>In the following case, you are to assume the role of an auditor. Please read Case D below and answer the following questions. You may use the included blank sheet of paper if you choose, and you will be able to refer back to the case while answering the questions.</u>

Case D

You have been assigned to the audit of StrollCo for the fiscal year ended June 30, 2017. Your task is to review the projections related to StrollCo's valuation prepared for the company's goodwill impairment assessment. In reviewing StrollCo's projections, you note the following:

StrollCo, a privately owned company based in the Mid-Atlantic, manufactures moderately priced strollers for sale throughout North America.

Management is aware of signs of improvement in the general economy, but recognize that their business is not impacted greatly by the general economic cycle. Thus, they assume that the overall market for their products will remain relatively flat in the near to medium term. However, management's valuation includes projections that revenue will continue to grow over the next several years due to further increases in market share as the style and branding of their products are popular with the younger generation of parents. These projected revenue increases are supported by growth in revenue and market share over the past couple of years.

In accordance with the increased production required to meet expected demand, StrollCo's management projects that raw materials and labor, as well as other operating expenses associated with the expanding size of the business will increase in line with revenue.

Management believes that in order to maintain the level of growth in market share, research and development expenditures will need to be increased, and these additional costs are included in the expense projections used in the valuation. Expenditures for capital, including machinery and building space used to manufacture the company's products, as well as replacement and upkeep of such capital, are included in the valuation and are projected to remain flat going forward.

<u>Please answer the following questions about Case D. You may refer back to the case to answer the questions.</u>

Based on the assumptions used in estimating the valuation for StrollCo, which includes all available information as of the valuation date, do you believe the overall valuation should be revised upward (increase), be revised downward (decrease), or stay the same?

| 1 | 2 | 3 | 4 | 5 | 6 | 7 |
|---|---|---|---|---|---|---|
| Definitely Revised Downward | Likely Revised Downward | Possibly Revised Downward | Stay the Same | Possibly Revised Upward | Likely Revised Upward | Definitely Revised Upward |

Please be thoughtful in answering the following question. Your response will help in understanding the thought process underlying your decision above regarding the valuation.

In a few sentences, please explain which information from Case D was important in indicating whether or not a change should be made to StrollCo's valuation.

**End Section Two**

**Begin Section Three**

Listed below are pieces of information from Case D. Please mark an 'X' next to each item in the appropriate column designating whether you think each piece of information was not relevant, somewhat relevant, or important in indicating whether or not a change should be made to StrollCo's valuation.

Case D is displayed again below for reference.

| Not Relevant | Somewhat Relevant | Important | |
|---|---|---|---|
| _____ | _____ | _____ | Sales volume is projected to increase |
| _____ | _____ | _____ | Raw materials and labor costs are projected to increase |
| _____ | _____ | _____ | StrollCo is headquartered in the Mid-Atlantic region |
| _____ | _____ | _____ | StrollCo's sales market is North America |
| _____ | _____ | _____ | The reason for the valuation is a goodwill impairment assessment |
| _____ | _____ | _____ | Other operating expenses are projected to increase |
| _____ | _____ | _____ | StrollCo's production requires significant capital |
| _____ | _____ | _____ | Research and development costs are projected to increase |
| _____ | _____ | _____ | The initial valuation is performed by management |
| _____ | _____ | _____ | Capital investment and upkeep expenditures are projected to remain flat |
| _____ | _____ | _____ | StrollCo is privately owned |
| _____ | _____ | _____ | The type of products that StrollCo sells |
| _____ | _____ | _____ | StrollCo's products are popular with younger parents |
| _____ | _____ | _____ | StrollCo's market share has increased over the past couple of years |

Case D

You have been assigned to the audit of StrollCo for the fiscal year ended June 30, 2017. Your task is to review the projections related to StrollCo's valuation prepared for the company's goodwill impairment assessment. In reviewing StrollCo's projections, you note the following:
StrollCo, a privately owned company based in the Mid-Atlantic, manufactures moderately priced strollers for sale throughout North America.

Management is aware of signs of improvement in the general economy, but recognize that their business is not impacted greatly by the general economic cycle. Thus, they assume that the overall market for their products will remain relatively flat in the near to medium term. However, management's valuation includes projections that revenue will continue to grow over the next several years due to further increases in market share as the style and branding of their products are popular with the younger generation of parents. These projected revenue increases are supported by growth in revenue and market share over the past couple of years.

In accordance with the increased production required to meet expected demand, StrollCo's management projects that raw materials and labor, as well as other operating expenses associated with the expanding size of the business will increase in line with revenue. Management believes that in order to maintain the level of growth in market share, research and development expenditures will need to be increased, and these additional costs are included in the expense projections used in the valuation. Expenditures for capital, including machinery and building space used to manufacture the company's products, as well as replacement and upkeep of such capital, are included in the valuation and are projected to remain flat going forward.

<u>Please answer the following additional questions regarding the valuation</u>
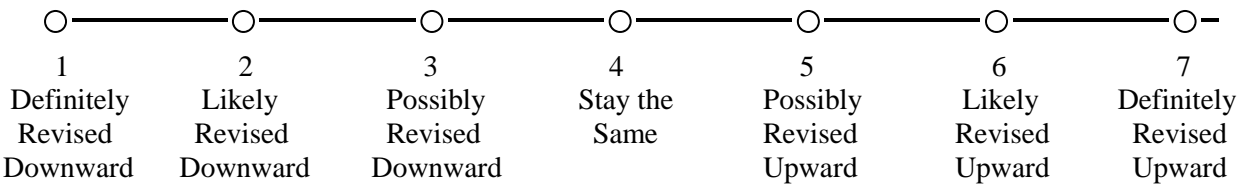
Based on the assumptions used in estimating the valuation for StrollCo, which includes all available information as of the valuation date, do you believe the **projected revenue cash flows** should be revised upward (increase), be revised downward (decrease), or stay the same?

O————O————O————O————O————O————O–

| 1 | 2 | 3 | 4 | 5 | 6 | 7 |
|---|---|---|---|---|---|---|
| Definitely Revised Downward | Likely Revised Downward | Possibly Revised Downward | Stay the Same | Possibly Revised Upward | Likely Revised Upward | Definitely Revised Upward |

Based on the assumptions used in estimating the valuation for StrollCo, which includes all available information as of the valuation date, do you believe the **projected materials and labor costs cash flows** should be revised upward (increase), be revised downward (decrease), or stay the same?

O————O————O————O————O————O————O–

| 1 | 2 | 3 | 4 | 5 | 6 | 7 |
|---|---|---|---|---|---|---|
| Definitely Revised Downward | Likely Revised Downward | Possibly Revised Downward | Stay the Same | Possibly Revised Upward | Likely Revised Upward | Definitely Revised Upward |

Based on the assumptions used in estimating the valuation for StrollCo, which includes all available information as of the valuation date, do you believe the **projected capital investment and upkeep expenditure cash flows** should be revised upward (increase), be revised downward (decrease), or stay the same?

O————O————O————O————O————O————O–

| 1 | 2 | 3 | 4 | 5 | 6 | 7 |
|---|---|---|---|---|---|---|
| Definitely Revised Downward | Likely Revised Downward | Possibly Revised Downward | Stay the Same | Possibly Revised Upward | Likely Revised Upward | Definitely Revised Upward |

Based on the assumptions used in estimating the valuation for StrollCo, which includes all available information as of the valuation date, do you believe the **projected operating expense cash flows** should be revised upward (increase), be revised downward (decrease), or stay the same?

O————O————O————O————O————O————O–

| 1 | 2 | 3 | 4 | 5 | 6 | 7 |
|---|---|---|---|---|---|---|
| Definitely Revised Downward | Likely Revised Downward | Possibly Revised Downward | Stay the Same | Possibly Revised Upward | Likely Revised Upward | Definitely Revised Upward |

Based on the assumptions used in estimating the valuation for StrollCo, which includes all available information as of the valuation date, do you believe the **projected research and development cash flows** should be revised upward (increase), be revised downward (decrease), or stay the same?

| 1 | 2 | 3 | 4 | 5 | 6 | 7 |
|---|---|---|---|---|---|---|
| Definitely Revised Downward | Likely Revised Downward | Possibly Revised Downward | Stay the Same | Possibly Revised Upward | Likely Revised Upward | Definitely Revised Upward |

When reading or answering questions related to Case D (the last case about StrollCo), were you **reminded** of any of the previous three cases (A, B, and C)? If so, which one(s) and of what specifically were you reminded?

Did you find any of the information in the previous three cases (A, B, and C) **relevan**t when answering case D? If so, which information?

When answering the questions regarding Cases A, B, and C, to what extent did you actively compare the cases to each other?

| 1 | 2 | 3 | 4 | 5 |
|---|---|---|---|---|
| Did not Compare | Compared Slightly | Compared Somewhat | Compared Considerably | Compared Extensively |

How difficult were the four cases to complete?

| 1 | 2 | 3 | 4 | 5 |
|---|---|---|---|---|
| Not at all Difficult | Slightly Difficult | Somewhat Difficult | Considerably Difficult | Extremely Difficult |

How motivated were you in responding to the case questions overall?

| 1 | 2 | 3 | 4 | 5 |
|---|---|---|---|---|
| Not at all Motivated | Slightly Motivated | Somewhat Motivated | Considerably Motivated | Extremely Motivated |

Were you specifically asked to compare similarities, differences, and combinations of similarities and differences between cases A, B, and C in the instructions included with those cases?

_____Yes

_____No

What was the task being performed in the cases?

_____Valuation of accounts receivable

_____Valuation of companies for goodwill impairment assessment

_____Valuation of other intangible assets

_____Valuation of inventory

Have you previously participated in a similar study using these cases?

_____Yes

_____No

If yes, when and where?

<u>Please answer the following questions about yourself.</u>

How old are you? _____

What is your gender?

_____ Male

_____ Female

_____ Prefer not to answer

What is your major? You may mark both if you are pursuing a dual-major.
_____ Accounting

_____ Economics

_____ Finance

_____ Integrated Business

_____ Management

_____ Marketing

_____ Real Estate

_____ Non-Business

What is your overall GPA? _____

How many accounting classes have you taken? _____

How many finance classes have you taken? _____

How many years of accounting or finance related work experience do you have? _____

**End Section Three**

You're done! Thank you again for participating.

To receive extra credit, remove this page from the packet, print your name and student ID in the spaces below, and turn it in separately.

Name: _____

SID: _____

University of
## Central
## Florida

**EXPLANATION OF RESEARCH**

Title of Project: **Accelerating Audit Expertise by Training Novices to Represent Domains as Experts Do**

Principal Investigator: Matthew Holt

Faculty Supervisor: Steve Sutton

You are being invited to take part in a research study. Whether you take part is up to you. The purpose of this research is to study judgment and decision making in an audit setting. The study consists of hypothetical cases related to the audits of goodwill impairment assessments. You will be asked to read some information and answer questions that will take about 30 minutes of your time. You will also answer a few demographic questions at the end. **It is important that you answer each question in a serious and thoughtful manner.**

The professor for your Auditing (4651) class has agreed to offer **extra credit points** for participation. If you do not wish to participate or are under 18 years of age, an alternate assignment of comparable time and effort will be provided for students who wish to earn extra credit. Your decision to participate or not participate in this study will not affect your continued enrollment or grades in this course.

Please note that participation in this study is voluntary and your responses will be completely anonymous. Your name will not be associated with any data, and only aggregated data will be included in any publications or presentations resulting from this study. If you decide to participate, you have the right to withdraw your consent or discontinue participation at any time without penalty. You must be 18 years of age or older to take part in this research study. There are no anticipated potential risks associated with this study.

If you have questions, concerns, or complaints contact Matthew Holt, PhD candidate, College of Business Administration (407) 823-4331 or by email at Matthew.Holt@ucf.edu or Dr. Steve Sutton, Faculty Supervisor at (407) 823-5857. Research at the University of Central Florida involving human participants is carried out under the oversight of the Institutional Review Board (UCF IRB). This research has been reviewed by the IRB. For information about the rights of people who take part in research, please contact: Institutional Review Board, University of Central Florida, Office of Research & Commercialization, 12201 Research Parkway, Suite 501, Orlando, FL 32826-3246 or by telephone at (407) 823-2901.

By turning the page and continuing with the study, you are indicating that you understand the above and voluntarily consent to participate in the research. If you would like a copy of the results of the study, please send an email to Matthew.Holt@ucf.edu with your name and address and "results requested". The results will then be sent to you when they are available.

Thank you very much for agreeing to participate.

This study has three sections, which are contained in three separate envelopes. For each section, you will be given instructions, which are underlined. It is important that you read the instructions and materials carefully, and consider your responses thoughtfully. After completing this section, please place this packet back in its envelope before moving on to the second section. After completing the second section, please place the second packet back in its envelope before moving on to the third section. After completing the third section please put the third packet back in its envelope, put all three envelopes back into the larger envelope, and turn in.

At the end of the third packet there is a page for your name and student ID. Upon completion of the study, please write your name and student ID, remove the page, and hand it in separately.

**Begin Section One**

On the following pages, you will be given some hypothetical cases to read. The cases concern the auditing of company valuations used in goodwill impairment assessments. The valuations are based on the discounted cash flows method. This is an example of the type of complex estimates that auditors need to understand in order to support their opinion on the financial statements.

Below is a brief and simple explanation of a discounted cash flow valuation. **It is important that you read and understand the explanation below, as your ability to complete the subsequent cases will be dependent on your understanding it.**

Essentially, a discounted cash flows valuation is done by estimating all future cash flows related to whatever is being valued, then discounting those cash flows back to the present value, and summing them. Cash inflows, such as from sales, and cash outflows, such as for expenditures will net against each other. **Thus, increasing projected cash inflows increases the estimated valuation, while increasing cash outflows decreases the estimated valuation.**

All of the inputs to the cash flow calculation represent assumptions about future occurrences. In the context of valuing a company this entails estimating all future cash flows in and out of a company over the duration of its life. In other words, all future revenues, expenses, etc. are estimated based on all available knowledge about the future direction of the company, including growth and expansion, as of the valuation date.
There are multiple existing models for creating these estimates in distant future periods, but they all work based on the same conceptual idea stated above.

Future cash flows are discounted to represent the idea that a dollar today is worth more than a dollar tomorrow. Therefore, the projected cash flows used in the short to medium term have the greatest impact on the valuation of the company.

Please select answers to the following statements.

Projected cash flows in the short to medium term can have a significant impact on the valuation of the company.

_____True

_____False

All projected future cash flows in and out of a company are included in the valuation as of the valuation date.

_____True

_____False

253

**When reading cases, it may help to think of each case as a system of concepts, attributes, and relations.**
Concepts can be thought of as any object, event, state of being, etc. that can be designated with a label. Concepts can be general in nature, or specific instances of more general concepts. For example, 'mountain' is a general concept, 'Mount Everest' is a specific instance, uniquely identifiable with a label. Concepts can also be concrete, such as 'my dog Rover' or abstract, such as 'love'. Other examples of concepts are: 'computer', 'water', 'birthday party', 'book', 'cookbook', 'tired' and 'independent'.

Attributes are associated with particular concepts and can be thought of as properties of the concepts. Attributes often take the form of descriptors, such as 'large' or 'yellow'.

First order relations can be thought of as links between concepts. Relations link concepts into propositions, which are the smallest units of knowledge that can be considered true or false. **Often, the specific concepts of a particular case are superficial and it is the relational structure between them that is useful for making inferences about future cases.** This may be particularly true when many concepts are linked together in systematic ways. **Research shows that thinking in terms of systems of relations is how experts tend to think within their fields.**

There are also special relations, called higher order relations, which link concepts to other relations or even two relations to each other. Examples of relations that can be higher order are 'causes' or 'equal to'.

One way to think about the difference between attributes and relations is that attributes are associated with only one concept, whereas first order relations link two concepts, and higher order relations link at least one relation with a concept or another relation.

Consider the demonstration in the following simple example:



The depiction above of a system of concepts and relations makes clear what is going on in the present situation. However, **it is the structure of the relations, more so than the values of the concepts, that can make this example insightful for similar instances encountered in the future.** In the above example,

the concepts (objects) include: Bill, Mary, and Sam

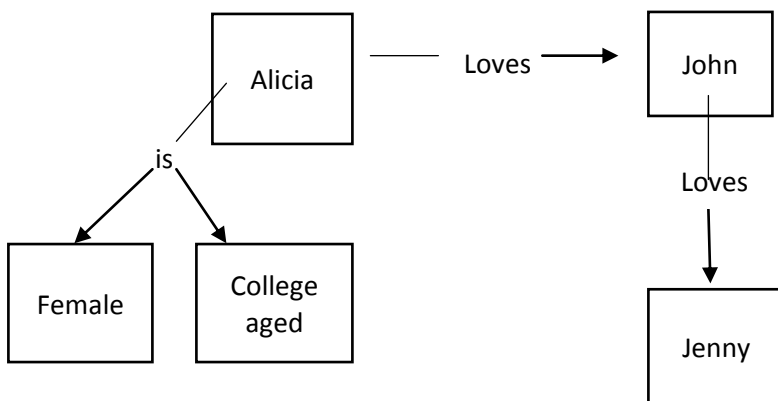the attributes (of Bill) include: male and middle aged

the first order relations include: loves and jealous

the higher order relation is: causes

In this example, it is the relations between Bill & Mary and Mary & Sam (both 'loves') that 'cause' the relation between Bill & Sam ('jealous'). Thus, 'causes' is a higher order relation that links other relations. The relational structure of this example represents what is often referred to as a "love triangle". **Understanding the systematic structure of this instance can help us understand other similar situations.** If we encounter another instance in which person A loves person B and person B loves person C, we may infer that it is likely that this causes person A to be jealous of person C. It doesn't necessarily matter who the people (in other words the values of the concepts) are, or if they are people at all. Perhaps the same scenario could be applied to other species of intelligent animal. Obviously not just any concepts will make sense in this particular relational structure. **The point is that it is often the relational structure, and not the values of the concepts, that is important for deriving knowledge that can be applied in other instances.** Therefore, the specific people and their characteristics may not be as relevant to making inferences about future instances of similar structures. Additionally, the attributes in the above example are not relevant for understanding the meaning created by the relational structure. It is possible, however, that in other types of cases, the attributes may be relevant.

Please answer the following question:

If an understanding of the structure of the previous example is gained, and we are presented with the following information, then we can predict that the relation between Alicia and Jenny might be _____.

Please read the following three hypothetical cases carefully. The cases concern auditors reviewing company valuations used in annual goodwill impairment assessments. After reading the cases, you will be asked to answer questions about them. You may use the included blank sheet of paper if you choose, and you will be able to refer back to the case while answering the questions.

**Research has shown that comparing the similarities and differences of multiple cases has the benefit of facilitating a better understanding of the relationships between elements within the individual cases. The questions following the cases will be related to the similarities and differences between them so it will be helpful to consider these when reading the cases.**

When reading the following cases, try to understand how the concepts, attributes, and relations of the case form a cohesive system, and how the relational structure plays a key role in understanding the system.

## Case A

PortPhone, a large, privately owned company headquartered in the Northeast, manufactures smartphones for several phone companies in North America, Europe, and Asia. As part of the annual goodwill impairment assessment, management prepared a valuation of the Company as of June 30, 2017. Projected in management's valuation is revenue growth based on a belief that PortPhone could maintain its 30% market share in a growing market. The market is expected to grow as there have been recent signs of improvement in the general economy, which management expects to impact the demand for its products. Management projects that the company can significantly increase unit sales annually over the next five years. Cost increases for the component parts used in production are projected to increase in line with revenue. Additionally, operating expenses such as payroll, marketing costs, and utilities are expected to increase in line with the revenue.

Research and development expenditures are deemed to be adequate and are projected to remain at a consistent level going forward. Further, management assumes that expenditures on capital such as production space and equipment will remain consistent with current levels.

The audit manager on Portphone's engagement reviewed their preliminary valuation and informed management that certain assumptions needed to be changed. PortPhone is a smartphone manufacturer, and like most manufacturing companies, it is a capital intensive company. This is because in order to generate revenue, it requires significant physical capital, such as production facilities and machinery, to create the products that it sells.

The audit manager stated that the expected revenue growth cannot be achieved without increased investment in, and upkeep costs for, capital needed to produce the additional units.

## Case B

Lil-Rides, a privately held company based in the Midwest, manufactures moderately priced child car seats for sale throughout North America and Europe. Management prepared a valuation of the Company as of June 30, 2017, as part of the annual goodwill impairment assessment. Lil Rides' management acknowledges that the general economy is improving but also states that the industry is not particularly sensitive to the economic cycle. Therefore the size of the overall market for Lil-Rides' products will not change considerably in the near term, essentially increasing at the rate of population growth in its sales regions. Lil-Rides is a growing company that has been enjoying increasing market share over the past several years. Management expects that market share will continue to increase due to strong branding of the company and therefore projects increases in revenue in the near to medium term.

Costs associated with raw materials for production and operating expenses are projected to increase in line with revenue, and this is reflected in the valuation. Lil-Rides' management concluded that the current level of research and development expenditures is sufficient and therefore they are maintained in the valuation projections. They also recognize that since Lil-Rides is a capital intensive company, significant expansion to production capacity, including space and equipment, is required in order to achieve the projected increase in sales. This is reflected in the valuation assumptions regarding capital expenditures and increases in future capital replacement costs.

The audit manager assigned to Lil-Rides reviewed the valuation and concluded that all of the assumptions seemed reasonable.

## Case C

Incantnetz is a privately owned IT consulting firm based in the Northeast, and primarily serving North America. As part of the annual goodwill impairment assessment, management prepared a valuation of the Company as of June 30, 2017. Incantnetz has steadily increased their market share over the past several years by actively pursuing new clients and maintaining high performance standards that result in ongoing business from many of their existing clients. There are signs that the general economy is improving and management believes that this will lead to an increase in demand for IT consulting services. This, in conjunction with management's assumption that they will continue to increase their share of this growing market, leads them to project significant growth in revenue over the near to medium term.

In order to support the growth in revenue, management expects the costs associated with providing their services to increase. These costs predominantly include wages paid to service personnel, and other operating expenses such as marketing costs, rent, and utilities. Due to the nature of Incantnetz's operations, it is not a particularly capital intensive company. Therefore, management expects that expenditures for capital acquisition and upkeep will remain relatively flat, regardless of the company's expansion. Further, the company engages in minimal research and development and costs associated with this are not expected to increase significantly.

The audit manager assigned to Incantnetz reviewed the valuation and concluded that all of the assumptions seemed reasonable.

257

<u>Please answer the following questions about Cases A, B, and C. You may use the included blank sheet of paper if you choose, and you will be able to refer back to the case while answering the questions.</u>

Think through the similarities and differences between the previous cases (A, B, and C). List as many similarities, differences, and combinations of similarities and differences (where two items are similar, but different from the third) as you can identify.

Similarities among the cases:

Differences among the cases:

Combinations of similarities and differences among the cases:

Briefly articulate any central ideas or overall principle(s) demonstrated by the cases taken together.

**End Section One**

**Begin Section Two**

<u>In the following case, you are to assume the role of an auditor. Please read Case D below and answer the following questions. You may use the included blank sheet of paper if you choose, and you will be able to refer back to the case while answering the questions.</u>

Case D

You have been assigned to the audit of StrollCo for the fiscal year ended June 30, 2017. Your task is to review the projections related to StrollCo's valuation prepared for the company's goodwill impairment assessment. In reviewing StrollCo's projections, you note the following:
StrollCo, a privately owned company based in the Mid-Atlantic, manufactures moderately priced strollers for sale throughout North America.

Management is aware of signs of improvement in the general economy, but recognize that their business is not impacted greatly by the general economic cycle. Thus, they assume that the overall market for their products will remain relatively flat in the near to medium term. However, management's valuation includes projections that revenue will continue to grow over the next several years due to further increases in market share as the style and branding of their products are popular with the younger generation of parents. These projected revenue increases are supported by growth in revenue and market share over the past couple of years.

In accordance with the increased production required to meet expected demand, StrollCo's management projects that raw materials and labor, as well as other operating expenses associated with the expanding size of the business will increase in line with revenue.

Management believes that in order to maintain the level of growth in market share, research and development expenditures will need to be increased, and these additional costs are included in the expense projections used in the valuation. Expenditures for capital, including machinery and building space used to manufacture the company's products, as well as replacement and upkeep of such capital, are included in the valuation and are projected to remain flat going forward.

<u>Please answer the following questions about Case D. You may refer back to the case to answer the questions.</u>

Based on the assumptions used in estimating the valuation for StrollCo, which includes all available information as of the valuation date, do you believe the overall valuation should be revised upward (increase), be revised downward (decrease), or stay the same?

| 1 | 2 | 3 | 4 | 5 | 6 | 7 |
|---|---|---|---|---|---|---|
| Definitely Revised Downward | Likely Revised Downward | Possibly Revised Downward | Stay the Same | Possibly Revised Upward | Likely Revised Upward | Definitely Revised Upward |

Please be thoughtful in answering the following question. Your response will help in understanding the thought process underlying your decision above regarding the valuation.

<u>In a few sentences, please explain which information from Case D was important in indicating whether or not a change should be made to StrollCo's valuation.</u>

**End Section Two**

**Begin Section Three**

Listed below are pieces of information from Case D. Please mark an 'X' next to each item in the appropriate column designating whether you think each piece of information was not relevant, somewhat relevant, or important in indicating whether or not a change should be made to StrollCo's valuation.

Case D is displayed again below for reference.

| Not Relevant | Somewhat Relevant | Important | |
|---|---|---|---|
| _____ | _____ | _____ | Sales volume is projected to increase |
| _____ | _____ | _____ | Raw materials and labor costs are projected to increase |
| _____ | _____ | _____ | StrollCo is headquartered in the Mid-Atlantic region |
| _____ | _____ | _____ | StrollCo's sales market is North America |
| _____ | _____ | _____ | The reason for the valuation is a goodwill impairment assessment |
| _____ | _____ | _____ | Other operating expenses are projected to increase |
| _____ | _____ | _____ | StrollCo's production requires significant capital |
| _____ | _____ | _____ | Research and development costs are projected to increase |
| _____ | _____ | _____ | The initial valuation is performed by management |
| _____ | _____ | _____ | Capital investment and upkeep expenditures are projected to remain flat |
| _____ | _____ | _____ | StrollCo is privately owned |
| _____ | _____ | _____ | The type of products that StrollCo sells |
| _____ | _____ | _____ | StrollCo's products are popular with younger parents |
| _____ | _____ | _____ | StrollCo's market share has increased over the past couple of years |

Case D

You have been assigned to the audit of StrollCo for the fiscal year ended June 30, 2017. Your task is to review the projections related to StrollCo's valuation prepared for the company's goodwill impairment assessment. In reviewing StrollCo's projections, you note the following:
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Management is aware of signs of improvement in the general economy, but recognize that their business is not impacted greatly by the general economic cycle. Thus, they assume that the overall market for their products will remain relatively flat in the near to medium term. However, management's valuation includes projections that revenue will continue to grow over the next several years due to further increases in market share as the style and branding of their products are popular with the younger generation of parents. These projected revenue increases are supported by growth in revenue and market share over the past couple of years.

In accordance with the increased production required to meet expected demand, StrollCo's management projects that raw materials and labor, as well as other operating expenses associated with the expanding size of the business will increase in line with revenue. Management believes that in order to maintain the level of growth in market share, research and development expenditures will need to be increased, and these additional costs are included in the expense projections used in the valuation. Expenditures for capital, including machinery and building space used to manufacture the company's products, as well as replacement and upkeep of such capital, are included in the valuation and are projected to remain flat going forward.

Please answer the following additional questions regarding the valuation

Based on the assumptions used in estimating the valuation for StrollCo, which includes all available information as of the valuation date, do you believe the **projected revenue cash flows** should be revised upward (increase), be revised downward (decrease), or stay the same?

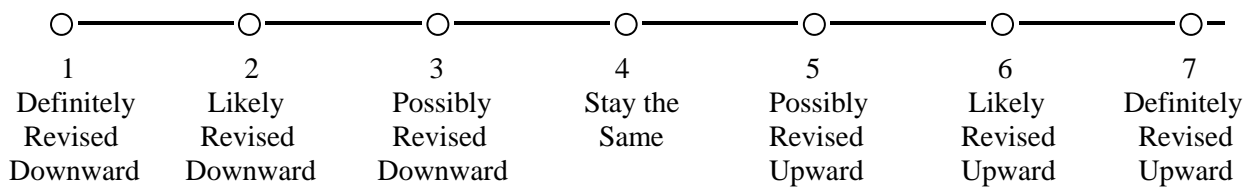| 1 | 2 | 3 | 4 | 5 | 6 | 7 |
|---|---|---|---|---|---|---|
| Definitely Revised Downward | Likely Revised Downward | Possibly Revised Downward | Stay the Same | Possibly Revised Upward | Likely Revised Upward | Definitely Revised Upward |

Based on the assumptions used in estimating the valuation for StrollCo, which includes all available information as of the valuation date, do you believe the **projected materials and labor costs cash flows** should be revised upward (increase), be revised downward (decrease), or stay the same?

| 1 | 2 | 3 | 4 | 5 | 6 | 7 |
|---|---|---|---|---|---|---|
| Definitely Revised Downward | Likely Revised Downward | Possibly Revised Downward | Stay the Same | Possibly Revised Upward | Likely Revised Upward | Definitely Revised Upward |

Based on the assumptions used in estimating the valuation for StrollCo, which includes all available information as of the valuation date, do you believe the **projected capital investment and upkeep expenditure cash flows** should be revised upward (increase), be revised downward (decrease), or stay the same?

| 1 | 2 | 3 | 4 | 5 | 6 | 7 |
|---|---|---|---|---|---|---|
| Definitely Revised Downward | Likely Revised Downward | Possibly Revised Downward | Stay the Same | Possibly Revised Upward | Likely Revised Upward | Definitely Revised Upward |

Based on the assumptions used in estimating the valuation for StrollCo, which includes all available information as of the valuation date, do you believe the **projected operating expense cash flows** should be revised upward (increase), be revised downward (decrease), or stay the same?

| 1 | 2 | 3 | 4 | 5 | 6 | 7 |
|---|---|---|---|---|---|---|
| Definitely Revised Downward | Likely Revised Downward | Possibly Revised Downward | Stay the Same | Possibly Revised Upward | Likely Revised Upward | Definitely Revised Upward |

Based on the assumptions used in estimating the valuation for StrollCo, which includes all available information as of the valuation date, do you believe the **projected research and development cash flows** should be revised upward (increase), be revised downward (decrease), or stay the same?

| 1 | 2 | 3 | 4 | 5 | 6 | 7 |
|---|---|---|---|---|---|---|
| Definitely Revised Downward | Likely Revised Downward | Possibly Revised Downward | Stay the Same | Possibly Revised Upward | Likely Revised Upward | Definitely Revised Upward |

Following are some additional questions pertaining to the previous cases. There are no 'correct' answers, but please answer thoughtfully.

When reading or answering questions related to Case D (the last case about StrollCo), were you **reminded** of any of the previous three cases (A, B, and C)? If so, which one(s) and of what specifically were you reminded?

Did you find any of the information in the previous three cases (A, B, and C) **relevan**t when answering case D? If so, which information?

When answering the questions regarding Cases A, B, and C, to what extent did you actively compare the cases to each other?

| 1 | 2 | 3 | 4 | 5 |
|---|---|---|---|---|
| Did not Compare | Compared Slightly | Compared Somewhat | Compared Considerably | Compared Extensively |

How difficult were the four cases to complete?

| 1 | 2 | 3 | 4 | 5 |
|---|---|---|---|---|
| Not at all Difficult | Slightly Difficult | Somewhat Difficult | Considerably Difficult | Extremely Difficult |

How motivated were you in responding to the case questions overall?

| 1 | 2 | 3 | 4 | 5 |
|---|---|---|---|---|
| Not at all Motivated | Slightly Motivated | Somewhat Motivated | Considerably Motivated | Extremely Motivated |

264

Were you specifically asked to compare similarities, differences, and combinations of similarities and differences between cases A, B, and C in the instructions included with those cases?

_____Yes

_____No

What was the task being performed in the cases?

_____Valuation of accounts receivable

_____Valuation of companies for goodwill impairment assessment

_____Valuation of other intangible assets

_____Valuation of inventory

Have you previously participated in a similar study using these cases?

_____Yes

_____No

If yes, when and where?

<u>Please answer the following questions about yourself.</u>

How old are you? _____

What is your gender?

_____ Male

_____ Female

_____ Prefer not to answer

What is your major? You may mark both if you are pursuing a dual-major.

_____ Accounting

_____ Economics

_____ Finance

_____ Integrated Business

_____ Management

_____ Marketing

_____ Real Estate

_____ Non-Business

What is your overall GPA? _____

How many accounting classes have you taken? _____

How many finance classes have you taken? _____

How many years of accounting or finance related work experience do you have? _____

**End Section Three**

You're done! Thank you again for participating.

To receive extra credit, remove this page from the packet, print your name and student ID in the spaces below, and turn it in separately.

Name: _____

SID: _____

# APPENDIX H: IRB APPROVALS

# Study Two IRB Approval

University of Central Florida Institutional Review Board
Office of Research & Commercialization
12201 Research Parkway, Suite 501
Orlando, Florida 32826-3246
Telephone: 407-823-2901 or 407-882-2276
www.research.ucf.edu/compliance/irb.html

## Approval of Exempt Human Research

From:  **UCF Institutional Review Board #1**
       **FWA00000351, IRB00001138**

To:    **Matthew Paul Holt**

Date:  **September 29, 2017**

Dear Researcher:

On 09/29/2017, the IRB approved the following activity as minor modifications to human participant research that is exempt from regulation:

| | |
|---|---|
| Type of Review: | Exempt Determination |
| Modification Type: | Minor changes to study design and conditions. Location change. Revised debriefing form, explanation of research, recruitment, instrument, and protocol was uploaded n iRIS. |
| Project Title: | An Experimental Investigation of Interventions to Improve Knowledge Transferability by Enhancing Analogical Encoding |
| Investigator: | Matthew Paul Holt |
| IRB Number: | SBE-17-13331 |
| Funding Agency: | |
| Grant Title: | |
| Research ID: | N/A |

This determination applies only to the activities described in the IRB submission and does not apply should any changes be made. If changes are made and there are questions about whether these changes affect the exempt status of the human research, please contact the IRB. When you have completed your research, please submit a Study Closure request in iRIS so that IRB records will be accurate.

In the conduct of this research, you are responsible to follow the requirements of the Investigator Manual.

On behalf of Sophia Dziegielewski, Ph.D., L.C.S.W., UCF IRB Chair, this letter is signed by:

Signature applied by Kamille Chaparro on 09/29/2017 02:42:40 PM EDT

IRB Coordinator

Page 1 of 1

University of Central Florida Institutional Review Board
Office of Research & Commercialization
12201 Research Parkway, Suite 501
Orlando, Florida 32826-3246
Telephone: 407-823-2901 or 407-882-2276
www.research.ucf.edu/compliance/irb.html

## Determination of Exempt Human Research

From: **UCF Institutional Review Board #1**
**FWA00000351, IRB00001138**

To: **Matthew Paul Holt**

Date: **January 19, 2018**

Dear Researcher:

On 01/19/2018, the IRB reviewed the following activity as human participant research that is exempt from regulation:

| | |
|---|---|
| Type of Review: | Exempt Determination, Category 2 |
| Modification Type: | Updated test instruments and timeline, minor revisions to explanation of research and protocol. |
| Project Title: | Accelerating Audit Expertise by Training Novices to Represent Domains as Experts Do |
| Investigator: | Matthew Paul Holt |
| IRB Number: | SBE-17-13408 |
| Funding Agency: | |
| Grant Title: | |
| Research ID: | N/A |

This determination applies only to the activities described in the IRB submission and does not apply should any changes be made. If changes are made and there are questions about whether these changes affect the exempt status of the human research, please contact the IRB. When you have completed your research, please submit a Study Closure request in iRIS so that IRB records will be accurate.

In the conduct of this research, you are responsible to follow the requirements of the Investigator Manual.

This letter is signed by:

Renea Carver

Signature applied by Renea C Carver on 01/19/2018 04:14:48 PM EST

Designated Reviewer

Page 1 of 1