Enhancing Accounting Recommendation Quality:

The Joint Effects of Problem Similarity and Effortful Comparison

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ABSTRACT: We rely on research on problem similarity and effortful comparison to study why accountants' ability to develop and correctly apply relevant accounting knowledge across decision settings is constrained. In stage one of our experiment, we manipulate participants' access to base accounting problems that share with a target problem (1) relevant similar causal relations *and* several literal similarities; or (2) relevant similar causal relations only. We also manipulate instructions to compare base problems by explicitly eliciting an effortful comparison, or not eliciting it. In stage two of our experiment we ask participants to provide an accounting recommendation for the target problem. We find that participants in our accounting setting apply causal relations more correctly when *deprived* of literal similarities, and still more correctly when they exert effort to compare the base problems. More importantly, we find that the incremental benefit of comparison is greater when base problems are literally similar, and the incremental benefit of depriving participants of literal similarities is greater when they do not compare base problems. This is the first study that documents the joint effects of problem similarity and effortful comparison on accounting recommendation quality.

Keywords: *literal vs. relational similarity; comparison and advice; accounting causal relation; knowledge representation; activity-based costing/management.*

Data Availability: *The data are available from the authors upon request.*

I. INTRODUCTION

Empirical accounting and knowledge management research (Argote et al. 2003; Nadler et al. 2003; Douglas 2002; Lev 2001, 7; Argote and Ingram 2000; Argote et al. 2000; Osterloh and Frey 2000) and the professional literature (Read and Thibodeau 1999) converge on the conclusion that knowledge is the most strategically important intangible source of sustained competitive advantage, corporate value, and economic growth. The importance of knowledge for decision-making is best understood when considered in relation to information: "[I]nformation becomes knowledge based on the capacity to make information meaningful. Often an individual's or group's previous experience with a problem, product, or customer provides an important added dimension of understanding. Simply stated, what may be mere information to one person may be knowledge to another person who can put it to productive use. It is the capacity to act that differentiates knowledge from information" (Douglas 2002, 73).[1]

For information to become knowledge, individuals must have the ability to develop, from previous experiences, appropriate knowledge representations—or a framework or model—to guide problem solution (Holland et al. 1986, 12). Psychology research findings suggest that when accountants encounter new problem situations, they do not tend to spontaneously bring to bear to the decision-making task previous experiences that share only relevant knowledge which they would value on hindsight (see Reeves and Weisberg 1994 for a review), even though this is a requisite core competency for making high-quality accounting judgments and decisions (Arnold and Sutton 1997; Ashton and Ashton 1995).

Recent psychology studies show that making an effortful comparison of problem

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[1] Knowledge management research distinguishes among data, information, and knowledge. Data are the basic building blocks of communication, while information is data in a meaningful context. In turn, information differs from knowledge in that the former is a flow of messages, while the latter is created by that very flow, and is anchored on the abilities, beliefs, and commitment of the person who holds it (Nonaka and Takeuchi 1995, 58-59).

situations to highlight their similar and dissimilar features offers an effective mechanism for developing an appropriate knowledge representation; that is, one that includes causally relevant problem features for future application.[2] The expected outcome of this effortful comparison is the abstraction of a relevant causal relation and its application across decision settings (Gentner et al. 2003; Kurtz et al. 2001; Ferguson and Forbus 1998; Gentner and Medina 1998; Gentner 1989). Further, there is common agreement in this literature that individuals represent problem features in terms of attributes (i.e., concrete or abstract properties of objects), and relations (i.e., links that define the causal relationship between two or more attributes when considered in combination) (Medin et al. 1993, 257; Goldstone et al. 1991; Medin et al. 1990).

We rely on research on problem similarity and comparison to examine why accountants' ability to develop and correctly apply relevant accounting knowledge across decision contexts is constrained. Specifically, we investigate the individual and joint effects of problem similarity and effortful comparison on accountants' ability to abstract a relevant causal relation and apply it to a different accounting setting. The ultimate goal of this study is to help accountants improve the quality of their recommendations.

Previewing our experiment in a managerial accounting setting to illustrate attributes and relations, consider two different companies, each of which manufactures a single, standard product. Because these companies share an abstract cost attribute (e.g., they both manufacture a "low-cost-to-make" product), and an abstract causal relation (e.g., "low-cost-to-make" products are causally related to low manufacturing overhead expenses), they exemplify a *literal* similarity match. In contrast, and extending our cost-accounting example, consider on one hand a manufacturing company whose product mix consists of a high proportion of "unique" products

[2] The defining characteristic of effortful comparison is that it involves an alignment process whereby multiple examples that are partially understood are compared to make key components of meaning more salient and relations more evident. This alignment process leads to deeper understanding of the problems and development of a sophisticated knowledge representation (Kurtz et al. 2001, 420).

relative to their "standard" products, and on the other hand, an online apparel retailer whose customer mix consists of a high proportion of "high-cost-to-serve" customers relative to their "low-cost-to-serve" customers. In this case, these two companies share a relevant abstract causal relation (e.g., the manufacturer's unique products are causally related to high manufacturing overhead expenses in the same way that the online retailer's high-cost-to-serve customers are causally related to high selling and administrative expenses[3]), but they share few or no concrete or abstract attributes. Thus, these companies exemplify a *relational* similarity match.

In this study we conduct a two-stage between-subjects experiment to examine the separate and joint effects of similarity between various accounting problems (hereafter base problems) and a new problem (hereafter target problem), and of elicitation of effortful comparison of the base problems on the quality of accountants' recommendations, while holding constant the total amount of information provided. In the first stage we vary problem similarity as either literal or relational. Participants in the literal similarity condition received various base problems that share implicitly a relevant causal relation with the target problem and maintain a one-to-one attribute match. Participants in the relational similarity condition received various base problems that also share the relevant causal relation with the target problem, but do not maintain the one-to-one attribute match. Further, we either explicitly elicit effortful comparison of the base problems (i.e., identification of their similarities and differences, and written articulation of an overall main principle that captures the essence of the problems taken together), or do not elicit such comparison and instead ask participants to provide advice for each base problem separately.

[3] This description is extracted from real-life examples of companies that are increasingly discriminating between their profitable and unprofitable customers. For instance, a recent Associated Press article refers to unprofitable customers as those who "tie up a salesworker but never buy anything, or who buy only during big sales. Or customers who file for a rebate, then return the items." Brad Anderson, chief executive of Best Buy, indicates that "What we are trying to do is not to eliminate those customers, but just diminish the number of offers we make to them." The article also describes an investment firm that found that one customer with a portfolio of $500,000 was tying up three financial advisers almost full-time with requests for help and information. In this case, the firm asked him to go elsewhere (Freed 2004).

Importantly, participants were not informed in advance that their memory for the base problems would be tested in a subsequent task, nor of the nature of the subsequent task related to the target problem. In the second stage participants assume the role of a business consultant who is asked to recommend ways to improve a client's revenues. Our design randomized experimental treatments, and controlled for the potential effects of cost accounting system knowledge on performance. Also, we hold constant the amount of information provided between the literal and relational similarity conditions to rule out information overload as a potential explanation for our results (Turetken and Sharda 2004; Hwang and Lin 1999; Chewning and Harrell 1990; Schick et al. 1990).[4] Our dependent variable is the quality of accountants' recommendations in the target problem.

The experiment produced the counter-intuitive result that accountants apply causal relations more correctly when *deprived* of literal similarities, and still more correctly when they exert effort to compare the base problems. Our findings reveal a reason why accountants are constrained when transferring knowledge across settings: literal similarities hamper their ability to abstract causal relations from prior experiences to new target accounting problems. Similar *causes* matter more than similar *facts*. More importantly, we find that the incremental benefit of effortful comparison is greater when the base problems are literally similar, and the incremental benefit of depriving participants of literal similarities is greater when they do not compare the base problems. That is, by examining both mechanisms in combination, we demonstrate that their effectiveness in enhancing accounting recommendation quality is greater when conditions for the abstraction of a relevant causal relation are least favorable.

Our study extends prior accounting research in several important ways. First, this is the first study that we know of that documents the joint effects of problem similarity and effortful

[4] Information overload occurs when, owing to limited information processing capabilities, a decision maker is unable to cope with exponentially increasing amounts of information (Chan 2001).

comparison on accounting recommendation quality. Second, with a few notable exceptions (Gentner et al. 2003; Thompson et al. 2000; Loewenstein et al. 1999), prior studies focus exclusively on individuals' ability to abstract principles from previous experiences, but do not examine the *application* of the abstract principles across settings. Third, our results are consistent with the notion of "less is more:" depriving accountants of literal similarities allows them to construct a knowledge representation that contains a relevant abstract causal relation for correct application to new problem settings. Taken together, our study and findings contribute to the growing body of research that examines factors that hinder or facilitate accountants' ability to identify, develop, and apply relevant accounting knowledge for decision-making (e.g., Vera-Muñoz et al. 2001; Vera-Muñoz 1998).

Finally, prior studies ask individuals to make inferences about new problem situations by invoking familiar problem settings that have well-understood, and often experimenter-provided, solution strategies (e.g., Bassok et al. 1998; Gentner et al. 1997; Sherwin 1999; Marchant et al. 1993). In contrast to prior studies, we simulate a real-life accounting setting that requires an effortful comparison of *partially* understood base problems (i.e., their solution strategies are neither provided nor elicited) to make more salient the relevant accounting causal relation shared by the problems (Gentner et al. 2003, 394; Kurtz et al. 2001; Ferguson and Forbus 1998).

We organize the remainder of this paper as follows. In Section II we use cognitive psychology research to derive predictions for the joint effects of problem similarity and effortful comparison of base problems on accounting recommendation quality. We describe our experiment and results in Sections III and IV, respectively. Section V summarizes, discusses implications, and provides possible directions for future research.

II. HYPOTHESES DEVELOPMENT

In this study we examine whether problem similarity and effortful comparison of base problems separately and jointly affect the quality of accounting recommendations. We focus on

the following two interrelated stages of analogical transfer: (1) matching (or mapping) between the base problems and the target problem; and (2) causal relation abstraction (or induction), which arises from the matching process (Reeves and Weisberg 1994, 381; Ross and Kennedy 1990; Gentner, 1989; Holyoak and Thagard 1989; Holland et al. 1986; Holyoak 1985).[5] To guide and organize our discussion, we summarize graphically in Figure 1 the constructs examined and our research hypotheses.

[Insert Figure 1 here]

Problem Similarity and Matching Process

At the center of the matching process is the role played by the similarity, literal or relational, between the base and target problems. *Literal* similarity is said to occur when the base and target problems match in terms of both attributes (i.e., properties of objects, both concrete and abstract) and relations (i.e., links that define the causal relationship between two or more attributes when considered in combination). In contrast, *relational* similarity is said to occur when the base and target problems match primarily in terms of relations (Tsoukas 1993, 337; Holoyoak and Thagard 1989; Gentner 1983, 159). In this case, the base problems share a relevant abstract principle or relation with the target problem, but few or no concrete or abstract attributes.

Literal similarity matches between base and target problems are highly accessible, as they can be indexed in memory by attributes or object descriptions, by relations, or by both. However, literal similarity is not very useful for analogical transfer because there is too much overlap between and among the problems' attributes and relations to discern what is relevant. For analogical transfer to occur, decision makers need to be able to apply concepts or strategies that have deep, meaningful relational structures, rather than superficial features or attributes.

[5] Analogical transfer also encompasses encoding of a familiar problem or problems (i.e., from the base domain), and encoding of a novel problem (i.e., the target domain problem).

Research suggests that base and target problems that are relationally similar facilitate the development of appropriate knowledge representations that include relevant common principles or relations that can then be abstracted and applied to new problem situations.[6] Simply said, relational similarity facilitates analogical transfer better than literal similarity because the shared features of relationally-similar problems are sparse enough to allow discerning what is relevant, and thus, make more salient the embedded relational structure common to a class of problems.

Abstraction of Accounting Causal Relation

In general, when individuals encounter a new problem situation, they do not tend to spontaneously remember previous examples that share only relevant principles or causal relations which they would value on hindsight (Reeves and Weisberg 1994). Instead, individuals tend to remember previous examples that share irrelevant problem features (Gentner et al. 1993). Recent psychology studies, however, show that making an effortful comparison of various examples to highlight their similar and dissimilar features facilitates abstraction of common principles or relations.[7] This is because effortful comparison involves an alignment process that leads to a deeper understanding of the problems and development of a sophisticated knowledge representation by making key components of meaning more salient and relations more evident.

For example, recent studies that investigate how graduate business students, executives, and consultants acquire negotiation skills (Gentner et al. 2003; Thompson et al. 2000; Loewenstein et al. 1999) find that participants who are asked to compare two short cases (i.e., "derive an overall principle by comparing two cases") are significantly more likely to develop a common solution strategy (e.g., contingent contracts) and to successfully apply it to a subsequent

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[6] See for example Chen (1996); Gentner et al. (1993); Clement and Gentner (1991); Holyoak and Thagard (1989); Holyoak and Koh (1987), experiment 2; Ratterman and Gentner (1987); Gentner and Landers (1985); Holyoak (1985).

[7] For example, see Gentner et al. (2003); Kurtz et al. (2001); Gregan-Paxton and Cote (2000); Thompson et al. (2000); Gentner and Namy (1999); Ferguson and Forbus (1998); Gentner and Medina (1998); Schwartz and Bransford (1998); Loewenstein et al. (1999); Gentner et al. (1997); Forbus et al. (1995); Ferguson (1994); Reeves and Weisberg (1994); Medin et al. (1993).

face-to-face negotiation task, relative to participants who are not asked to compare (i.e., "provide advice to the protagonist in each case").[8] Simply stated, effortful comparison can lead to focusing on the key similarities and differences between the problems and to abstracting out the common features that are causally relevant for transfer (Gentner et al. 1997; Gentner 1983).

However, with the few notable exceptions mentioned above (Gentner et al. 2003; Thompson et al. 2000; Loewenstein et al. 1999), prior studies focus almost exclusively on the abstraction of the common features from the base problems; thus, prior research does not allow inferences about how individuals *apply* the common principles or relations across decision settings. More importantly, prior studies have not examined the joint effects of problem similarity and comparison, even though both mechanisms are naturally occurring in accounting decision-making settings. As discussed next, we argue that the incremental benefit of comparison on recommendation quality is better understood when examined in juxtaposition to problem similarity, and vice-versa.

Research Hypotheses

Based on the findings from the lines of research on problem similarity and comparison, we argue that explicitly eliciting an effortful comparison of base accounting problems offers an effective mechanism to assist accountants in identifying which features of the problems are causally relevant and which are irrelevant for transfer. This effortful comparison effect on accountants' ability to abstract and correctly apply a relevant causal relation should occur only when the accounting problems are literally similar (i.e., when they share a relevant causal relation and maintain a one-to-one attribute match). There should be no effect of effortful comparison on accounting recommendation quality when the base accounting problems are

[8] These studies, however, illustrate the standard base-to-target matching paradigm used in prior analogical studies. This is because participants received intentional encoding instructions that made them explicitly aware (whether intentionally or unintentionally) that their memory for the base problems and their common solution strategy would be subsequently tested in a target negotiation study.

relationally similar. This is because relationally similar problems should make the relevant causal relation salient, so that even accountants who are not asked to compare the problems (e.g., instead they are asked to provide advice for each problem separately) should be able to abstract from them the common relational structure for application to the new problem. To test these arguments, we propose the following hypotheses:

H1a: When prompted with various base accounting problems that are literally similar to a target accounting problem (i.e., they share a relevant causal relation and maintain a one-to-one attribute match), accountants who are asked to compare the problems will apply more correctly a relevant causal relation when making accounting recommendations, relative to accountants who are not asked to compare the problems.

H1b: When prompted with various base accounting problems that are relationally similar to a target accounting problem (i.e., they share a relevant causal relation), explicit elicitation of an effortful comparison of the problems will not be related to the accountants' ability to correctly apply a relevant causal relation when making accounting recommendations.

Further, as discussed earlier, to extract common features that are causally relevant requires a step beyond creating a temporary match between seemingly different problems: individuals must develop a knowledge representation that is deprived of specific attributes and idiosyncratic details, and includes only common principles or relations that can be applied across different problems (Gentner et al. 2003, 394; Chen 1996; Marchant et al. 1993; Collins and Burstein 1989; Johnson-Laird 1989; Gentner 1983, 1989; Gentner and Toupin 1986).

Application of problem similarity research to our accounting setting suggests that base and target accounting problems that are relationally similar (i.e., they share a relevant causal relation but few or no attributes) offer an effective mechanism for the development of an appropriate knowledge representation that includes causally relevant problem features. This relational similarity effect should occur only when an effortful comparison of the base problems is not elicited. There should be no effect of problem similarity on recommendation quality when comparison of the base problems is elicited. This is because effortful comparison "actively" informs accountants as to which problem features are causally relevant for transfer, so that even

accountants who are prompted with literally-similar problems should be able to abstract from the base problems the relevant causal relation. To test these arguments, we propose the following hypotheses:

H2a: When an effortful comparison of various base accounting problems is not explicitly elicited, accountants who are prompted with problems that are relationally similar to a target accounting problem (i.e., they share a relevant causal relation) will apply more correctly the causal relation when making accounting recommendations, relative to accountants who are prompted with problems that are literally similar to the target problem (i.e., they share a relevant causal relation and maintain a one-to-one attribute match).

H2b: When an effortful comparison of various base accounting problems is explicitly elicited, the similarity between the base accounting problems and the target problem will not be related to the accountants' ability to correctly apply the causal relation to the target problem when making accounting recommendations.

III. METHOD

Overview

Consistent with our theoretical development, we constructed a two-stage between-subjects experiment to test our hypotheses (depicted graphically in Figure 1) in order to focus on the separate and joint effects of two factors, while holding constant the total amount of information provided: the similarity between the base accounting problems and the target problem, and whether accountants are explicitly asked (or not asked) to compare the base problems. Our primary tests examine the individual and joint effects of the two factors on the quality of accounting recommendations in the target problem. We assigned participants randomly to one of four cases representing the different combinations of the independent variables.

Participants

Twenty-three Master of Science in Accountancy students enrolled in a graduate strategic cost management course in a *Public Accounting Report* Top 10 graduate accounting program at a private university, and ninety upper-level undergraduate business students enrolled in a cost accounting course in a *Public Accounting Report* Top 5 undergraduate accounting program at the same university (PAR 2003, 7) participated in the experiment in their classrooms. We chose to use these students as participants because prior to the experiment, they had completed in-depth discussions (of homework problems, cases, and current business articles) and formal testing (i.e., exams and quizzes) of the key underlying subject matter of our experiment, namely, activity-based costing and management (ABC/ABM). This is important to ensure a homogeneous group of participants that shares a common body of declarative (factual) ABC/ABM knowledge.[9]

The total sample used for our analyses consists of 111 participants.[10] Participation in the study was voluntary. We conducted the study in two consecutive semesters during a regularly scheduled 75-minute class period, with one of the experimenters present in the classroom during the entire duration of the experiment. One of the researchers was the instructor for 88 (79 percent) of the participants, and a second instructor was in charge of the remaining 23 (21 percent) participants.

Out of the 111 participants, 93 (84 percent) were accounting majors, 16 (14 percent) were finance majors, and 2 (2 percent) were completing majors in marketing or business-science. Seventy-four participants (67 percent) were males, and 37 (33 percent) were females. The average age of the participants was 21 years (s.d. = 1.07), and their accounting experience ranged from 0 to 60 months, with a mean of 4.31 months (s.d. = 8.00). To rule out systematic

[9] See Lipe and Salterio (2000) for a discussion of advantages and disadvantages of using experienced participants for experiments.

[10] The responses of two undergraduate students to a post-experimental recall exercise were not sensible, and were dropped from all analyses. The results remain qualitatively the same when these participants are included in the sample.

differences in the participants' accounting program membership (graduate vs. undergraduate), instructor, major, gender, age, and accounting experience, we included these variables as covariates in our planned contrasts test (discussed below). Our results show that none of these variables affected the dependent variable at conventional levels; thus, they are not discussed further.

The participants received a flat compensation consisting of 10 credit points (10 percent) towards their total points in the final exam for the courses they were enrolled in. In addition, to encourage participants to exert high cognitive effort, they received a monetary bonus whose magnitude hinged upon the participants' performance on the two stages of the experimental phase and on recall exercises completed in a debriefing questionnaire (discussed below).[11] The average monetary compensation was $7.13 (s.d. = $1.24), ranging from a minimum of $4.00 to a maximum of $9.00.

Case Materials, Procedures, and Tasks

We collected the data in two parts: the experiment (part one), and the post-experiment (part two). Part one was structured in two sequential stages; in the first stage we manipulated our independent variables, and in the second stage we collected data to construct our dependent variable and covariate for hypotheses testing. We provided the materials in three serially numbered envelopes, one each for each stage of part one, and the third one for the post-experimental questionnaire. We instructed the participants to open one envelope at a time, to write down their starting and ending times for each task, and to proceed through the tasks at their own pace. After completing the first stage, the participants were asked to put all the materials back in the envelope before proceeding to the second stage. A key feature of the experiment is that participants were not made aware in advance that their memory for the base accounting problems would be tested in a subsequent task, nor were they informed in advance of the nature

[11] The participants were not told in advance that they would have to complete a recall exercise.

of the subsequent task related to the target problem.

The case materials for stage one consisted of three pages, including a cover sheet with instructions, a legal-size sheet containing three short case narratives (one for each of three companies), and a response sheet. Each case narrative, in turn, consisted of a three-paragraph description of a company's business, products, customers, and operating results for a one-year period, presented in three adjacent columns of equal length (one column for each company). To avoid potential order effects, we counterbalanced the order of presentation of the three companies on the page so that each company appeared in each of the three possible column positions (i.e., left, middle, or right) with equal frequency. The counterbalancing made use of six different patterns for each of the four experimental conditions, for a total of 24 different unique orders. The patterns yielded no significant differences, and are not discussed further. Appendix 1 shows the short narratives for the three base companies presented for one of the unique orders in the relational similarity condition.[12]

The case materials for stage two consisted of two pages that included a three-paragraph case narrative about the target company, Business Forms Printing (hereafter BFP), and three questions related to the case (discussed further below). Appendix 2 shows the case narrative for BFP. After completing stage two, the participants were instructed to put all the case materials back into the envelope before proceeding to the post-experimental part. On average, the participants completed part one in 34.45 minutes (s.d. = 5.602).[13]

In part two (the post-experimental part) we asked participants to complete a debriefing questionnaire eliciting their perceptions of task difficulty and realism, familiarity with the companies portrayed in part one, and questions regarding academic background and accounting-related work experience. In addition, this section included questions intended for validation

[12] In the experiment, this material was presented on one legal-size sheet of paper.

[13] We included time to complete part one as a covariate in our planned contrasts test (discussed below). The results are not significant at conventional levels; thus, they are not discussed further.

checks (described further below).

Independent Variables

We used a between-subjects design with two variables manipulated at two levels each: the similarity (literal vs. relational) between the base and target problems, and whether participants are explicitly asked (or not asked) to make an effortful comparison of the base problems. The results of prior studies suggest that analogical transfer generally does not occur without provision of several base exemplars (Reeves and Weisberg 1994; Ahn et al. 1992; Gick and Holyoak 1983, Experiments 1-3). Thus, we used three companies as base problems.

Literal and Relational Similarity Conditions

In the *literal* similarity condition, the base and target companies share (implicitly) a relevant causal relation and maintain a one-to-one match of several abstract attributes. In this condition, one of the base companies (Mega Outfitting Company, MOC) operates in the mail order clothing business; the second company (University T-shirt Printing, UTP) is a college T-shirt printing shop, and the third one (Tailgate Party Catering, TPC) is a tailgate-party catering business. The target company (BFP) is described as a printing shop that provides business forms for various domestic and international clients, and has recently introduced a new inventory management service in an effort to increase profits.

Panel A of Appendix 3 outlines the literal similarity manipulation. Recall that an attribute could be either concrete or abstract. As shown in panel A of Appendix 3, in the literal similarity condition the three base companies and the target company match one-to-one with respect to four abstract attributes: (1) homogeneous products; (2) heterogeneous customers; (3) one-year increase in the number of customers; and (4) a one-year decrease in profits.[14]

Recall that a relation links two or more attributes causally when considered in combination. The narratives for the base companies were designed such that, when taken

[14] For all the base and target companies, sales revenues increased and prices did not change.

together, they shared (implicitly) a relevant causal relation that, in turn, could be applied to the target company. Specifically, in the literal similarity condition, all the base and target companies have "heterogeneous" customers; that is, a customer mix consisting of "high cost-to-serve" and "low cost-to-serve" customers (hereafter "low-profit" and "high-profit" customers, respectively) (Atkinson et al. 2004, pp. 145-146; Hilton et al. 2003, pp. 220-221; Blocher et al. 2002, pp. 833-835; Kaplan and Cooper 1998, 191). The low-profit customers impose more demands upon the companies' resources—ultimately reflected in the selling and administrative (S&A) expenses—than the high-profit customers.[15] For instance, the narrative for UTP describes its "low-profit" customers as follows:

> UTP's customers cannot accurately estimate the annual demand for shirts. UTP has therefore agreed to print and deliver additional reorders (min. = 2,500; max = 10,000) within 10 days. These reorders require UTP employees to handle extra production scheduling and expedited deliveries. UTP accepts returns of defective shirts, and of shirts that their customers are unable to sell in a given year. Although most of the orders are delivered by truck twice a year, UTP delivers reorders several times during the year. UTP keeps in storage orders for their smaller clients until they are needed.[16]

Despite having a heterogeneous customer mix, all of the companies use a traditional (volume-based) cost accounting system to allocate their S&A costs for pricing purposes. That is, the base companies compute the S&A rate based on estimated cost of goods sold at the beginning of the year. Although not mentioned in the case materials, using ABC would be more appropriate than using volume-based costing, because ABC would allow the companies to account for the differential costs of serving their heterogeneous customers, and thus, price their products differentially. This explains why, even though the companies' customers and sales

[15] The concepts "homogeneous," "heterogeneous," "high-profit," and "low-profit" customers were not used in the case narratives. Instead, we designed the customers' descriptions to make them implicitly consistent with these concepts.

[16] This description mirrors many real-life examples. For instance, a recent *Wall Street Journal* article indicates, "[R]etailers accustomed to selling clothes in their stores have been vexed by the complexities of Internet distribution and customer merchandise returns. Wal-Mart Stores, Inc., which sells more apparel than any other retailer in the nation, pulled clothing off its Website in 2001. While it was one of the more popular online categories, high handling costs made it infeasible" (Merrick 2003, B2).

revenues have increased, their profits have decreased. Thus, the relevant abstract causal relation shared by the base and target companies can be articulated as follows: failing to price products differentially to reflect the differential S&A costs of serving "low-profit" vs. "high-profit" customers results in a decrease in profits, even in the face of increasing customers and revenues.

In the *relational* similarity condition we designed the narratives for the base companies such that they share (implicitly) with the target company the same relevant causal relation shared by the base and target companies in the literal similarity condition. However, when taken together, the base companies do not maintain a one-to-one attribute match with the target company. Panel B of Appendix 3 outlines the relational similarity condition. As shown in panel B, we retained the industry categories of the base companies but changed some of the attributes as needed. Two of the base companies, Mega Outfitting Company (MOC) and University T-shirt Printing (UTP), had the same names as those in the literal similarity condition. The third base company is comparable to the literal similarity condition's Tailgate Party Catering (TPC), but differs in name because appropriately changing the abstract attributes suggested a corporate catering business. Consequently, we renamed the company Lambert's Corporate Catering (LCC).

Panel B shows that MOC has homogeneous products but heterogeneous customers, UTP has both homogeneous products and customers, and LCC has heterogeneous products but homogeneous customers. For instance, the narrative for UTP describes its "high-profit" customers as follows:

> UTP's two customers are able to estimate the annual demand for shirts with 99% accuracy. Therefore, UTP has not encountered requests of additional reorders or expedited (overnight) orders. UTP has agreed to deliver by truck half of the ordered shirts to both the University Bookstore and the retail chain store by the end of April, with the rest of the shirts delivered by the end of June. Finally, UTP's two customers have been able to sell all the shirts ordered in a given year; thus, UTP has not encountered returned orders. However, UTP accepts returns of defective shirts (UTP pays actual shipping charges).

The three base companies use a traditional (volume-based) cost accounting system to allocate their S&A costs for pricing purposes, and LCC and UTP use a traditional cost

accounting system to allocate production overhead.[17] Further, the two base companies that have either heterogeneous products (LCC) or heterogeneous customers (MOC) experienced a one-year decrease in profits. It follows that ABC would be more appropriate for LCC's product costs and MOC's customer costs, allowing these companies to account for the differential costs of serving (providing) their heterogeneous customers (products) and thus, price their products differentially. This explains why, even though LCC's and MOC's sales revenues and/or customers have increased, their profits have decreased. In contrast, UTP is provided as a counter-example: because UTP has both homogeneous products and customers, it experienced a one-year profit increase due to increasing customers and revenues.

Comparison and Advice Conditions

As mentioned above, we manipulated whether participants are explicitly asked (or not asked) to compare the base problems. As discussed earlier, the expected outcome of this effortful comparison process is the abstraction and application of a relevant causal relation to the target problem. At the same time, we did not expect this abstract causal relation to be noticed effortlessly by our participants; instead, we expected that to do so effectively, participants must actively align the abstract attributes of the base companies and induce their causal link through an effortful comparison process.

As shown in panel A of Appendix 4, we asked participants in the comparison condition to list as many similarities, differences, and combinations of similarities-differences as they could identify between and among the three base companies. To avoid ambiguities in interpreting the instructions, we provided participants with an example of a comparison in a non-accounting context. In addition, we asked these participants to articulate in one sentence the overall main principle that captures the essence of what they learned from the three cases taken together. As shown in panel B of Appendix 4, we asked participants in the advice condition to recommend,

[17] Production overhead is not applicable for MOC, which is a merchandising company.

for each of the three base companies separately, two possible ways in which the companies could increase their profits next year relative to the current year.

Dependent Variable and Covariate

The dependent variable is constructed from participants' recommendations as to how to improve BFP's (the target company) revenues.[18] In particular, we asked participants to recommend two possible ways in which BFP could increase its revenues, and to discuss the issues that BFP must consider as they attempt to increase revenues. We use the explanations provided by each participant to code each of their two recommendations as superior (coded = 2), average (coded = 1), or inferior (coded = 0). A response was coded as "superior" if it suggested correct application of the relevant causal relation articulated earlier. Thus, these responses indicated that BFP should increase their prices selectively (e.g., "Charge expensive customers more for the business forms"); or BFP should modify the mix of customers to increase the proportion of "high-profit" customers relative to "low-profit" customers (e.g., "Based on the results, they should target the customers who are most profitable;" "BFP could attract more customers, but would want to make sure they attract the right customers (few, high-quantity orders, good prediction of needs) because increased revenue is meaningless if you increase costs by the same amount"); or BFP should increase prices and/or quantities of business forms sold (e.g., "Charge customers a fee for non-standard quantities shipped;" "BFP can either increase the prices for small orders, or impose a minimum quantity per order").

A response was coded as "average" if it entailed recommendations aimed at decreasing costs (e.g., "Reduce manufacturing overhead;" "Implement a just-in-time system to address inventories and other costs"); increasing products or services offered (e.g., "Offer more inventory management services;" "Expand the product line into office suppliers"); or improving

[18] This is consistent with prior research that uses target problem solution as an indirect method of gauging principle abstraction from the base problems (e.g., Thompson et al. 2000; Reeves and Weisberg 1994).

efficiency (e.g., "BFP can try to increase revenues by reducing the amount of inventory they hold for its customers"). Any responses that were unrelated (or were only tangential) to the main issues described above were coded as "inferior" (e.g., "Hire a consultant to make estimates and judge customers' form needs"). The minimum score for our dependent variable (based on the participants' two recommendations) is 0 and the maximum score is 4. Two trained research assistants blind to the experimental conditions independently coded the participants' responses,[19] then met to resolve differences in coding.

Additionally, we measure three control variables. First, we measured participants' knowledge of appropriate cost accounting systems for decision making. As explained above, we implicitly depicted the base companies as using a volume-based cost accounting system, while instead they should have been using ABC to account for the differential costs of serving their differential customers or producing their products. Thus, we constructed a knowledge covariate from the participants' responses to the question, "Is BFP's cost accounting system appropriate for decision making? If it is, then explain why. If it is not, then explain why not and how BFP should change it," and coded them as superior (coded = 2), average (coded = 1), or inferior (coded = 0).[20]

A response was coded as "superior" if it indicated that the cost system was not appropriate and suggested the need to use cost drivers to account for the costs of customers' increasing activities, or if it pointed out that there was a problem with the current method of computing the S&A rate, and provided logical insights as to what the problem was. A response was coded as "average" if it indicated that the cost system was not appropriate and noted the increasing variety of customers, or the problems with the current S&A rate, but did not address

[19] The raters initially agreed 64.29 percent of the time on their coding of each participant's first recommendation. Cohen's Kappa (Cohen 1960), a measure for inter-rater agreement over and above that expected by chance, is 0.394 (p = 0.000). The raters initially agreed 52.68 percent of the time on their coding of each participant's second recommendation (Cohen's Kappa = 0.229; p = 0.000).

[20] We asked this question immediately before we elicited the participants' recommendations.

specifically the need to use cost drivers, as described above. A response was coded as "inferior" if it indicated that the current system was appropriate for decision making and the answer focused only on the product (which was homogeneous, and thus, not the focus of the problem), as opposed to focusing on the increasing variety of customers, or if the answer was vague and did not provide any meaningful insights. Our two trained research assistants independently coded the participants' responses,[21] then met to resolve differences in coding.

Second, although factual knowledge of ABC/ABM is assumed in this study to be above the minimum necessary for the experimental task, we measure the participants' declarative (factual) knowledge using a series of seven multiple-choice questions.[22] The mean score is 6.07 (s.d. = 0.902). Reliability test results yield a Kuder-Richardson 20 alpha of 0.11.[23] To rule out systematic differences in the participants' factual ABC/ABM knowledge as alternative explanations for our results, we include this variable as a covariate in our planned contrasts tests (discussed below). Our results show that this variable did not affect the dependent variable at conventional levels ($p > 0.10$); thus, it is not discussed further.

Finally, we used a post-experimental question to elicit participants' perceptions of task difficulty because it is possible that these perceptions are related to task performance. The question asked participants, "How difficult was it to provide a recommendation for Business Forms Printing?," using a 9-point scale with endpoints labeled "Not difficult" and "Very difficult," and a midpoint labeled "Moderately difficult." The average difficulty score in the literal similarity condition (4.89; s.d. = 1.80) is not significantly different from the average score in the relational similarity condition (5.25; s.d. = 1.60) ($p > 0.10$). Also, the average difficulty

[21] The raters initially agreed 57.14 percent of the time on their coding of each participant's response (Cohen's Kappa = 0.293; p = 0.000).

[22] This ABC-knowledge quiz was administered in the classroom several weeks prior to the experiment.

[23] The KR20 alpha is appropriate for measuring reliability when the questions are scored as either 0 or 1 for incorrect or correct answers, respectively. It is equivalent to Cronbach's alpha, which is used when individual questions can take more than two values. The KR20 alpha is sensitive to test length, with longer tests receiving a higher score; thus, the low score is likely due to the test's short length.

score in the comparison condition (4.82; s.d. = 1.59) is not significantly different from the average score in the advice condition (5.33; s.d. = 1.80) ($p > 0.10$).[24]

IV. RESULTS

Validation Checks

We collected post-experimental data to assess participants' perceptions of the cost accounting system used by the base and target companies. We used this data for various validation tests. In particular, we used four true-false questions to ask participants whether each of the base and target companies was using a traditional cost accounting system or an ABC system to assign its S&A costs (MOC, TPC/LCC, and BFP) or its manufacturing overhead costs (UTP). The average score of participants in the literal similarity condition (3.16, out of a maximum of 4; s.d. = 1.014) is not significantly different from the average score of those in the relational similarity condition (2.91; s.d. = 1.083) ($p > 0.10$). Surprisingly, the average score of participants in the comparison condition (2.84; s.d. = 1.125) is significantly lower than the average score of those in the advice condition (3.24; s.d. = 0.942) ($t = 2.015$; $p = 0.046$, two-tailed). Thus, we included the participants' scores on the True/False question as a covariate in our planned contrasts tests; the results are not significant ($p > 0.10$) and are not discussed further.[25]

We also used post-experimental data to assess participants' perceptions of whether the products and customers portrayed in the base and target companies were "homogeneous" or "heterogeneous" (as shown in Panels A and B of Appendix 3 for the literal and relational

[24] Adding difficulty as a covariate in our planned contrasts tests does not affect the dependent variable at conventional levels ($p > 0.10$), and is not discussed further.

[25] Further, we correlated the total scores on the four True/False questions (minimum = 0, maximum = 4) and the scores on our covariate collected in the experimental stage (i.e., participants' ability to determine whether BFP (the target company) is using an appropriate cost accounting system for decision making; minimum = 1, maximum = 3). Our results show a significant and positive correlation (Pearson = 0.219; $p = 0.021$), thus suggesting that participants who are able to correctly identify whether the cost-accounting system used by BFP is appropriate for decision-making are also more likely to correctly identify whether the base and target companies are using a volume-based vs. an ABC system. These results also provide support for the consistency of the participants' responses between the experimental and post-experimental stages.

similarity conditions, respectively). We asked participants the following question: "For each of the four companies you read about, please indicate below whether the company's *products* generate similar or different demands for activities (and therefore, activity costs) within the company. Also, indicate below whether the company's *customers* generate similar or different demands for activities (and therefore, activity costs) within the company. Use an S for similar, and a D for different." We coded each of the participants' eight responses as 1 if correct, and 0 otherwise.

We ran four separate binary logistic regression models (one for each of the three base companies and one for the target company) to regress the participants' responses regarding the nature of the products against the problem similarity variable (literal vs. relational). We ran another four binary logistic regression models to regress the participants' responses regarding the nature of the companies' customers against the problem similarity variable. Our results show that, in general, participants perceived the companies' products as "similar" when they were implicitly described as homogeneous in the narratives, and as "dissimilar" when they were implicitly described as heterogeneous in the narratives.[26]

Importantly, for BFP (the target company), our results show that in the literal similarity condition, the proportion of participants who correctly identified BFP's products as being "similar" (72.7 percent) is not significantly different from the proportion of participants in the relational similarity condition who correctly identified BFP's products as being "similar" (71.4 percent) (Wald-statistic = 0.023; p = 0.879). Also, in the literal similarity condition, the proportion of participants who correctly identified BFP's customers as being "dissimilar" (81.8

[26] For example, as shown in Panel A of Appendix 3, in the literal similarity condition, the narrative implicitly depicts UTP's customers as being "heterogeneous," while in the relational similarity condition (Panel B, Appendix 3) the narrative implicitly depicts UTP's customers as being "homogeneous." Our binary logistic regression results show that the proportion of participants in the relational similarity condition who identified UTP's customers as being "similar" (82.1 percent) is significantly higher than the proportion of participants in the literal similarity condition who identified UTP's customers as being "similar" (47.3 percent) (Wald statistic = 13.735; p = 0.000). In the interest of brevity, the logistic regression results for the other base companies are not shown here.

percent) is not significantly different from the proportion of participants in the relational similarity condition who correctly identified BFP's customers as being "dissimilar" (83.9 percent) (Wald-statistic = 0.087; p = 0.768). Taken together, these results provide support for the effectiveness of our problem similarity manipulation.

Descriptive Statistics and Tests of Research Hypotheses

Panels A and B of Figure 2 show graphically the mean recommendation scores (out of a maximum of 4) for the effortful comparison and problem similarity variables, respectively, and Panel A of Table 1 shows the mean recommendation scores in table format by cross-classification condition. As shown on Table 1, the highest mean score is for participants in the relational similarity condition who were explicitly asked to compare the base companies (cell 4 mean = 2.89; s.d. = 0.875), and the lowest mean recommendation score is for participants in the literal similarity condition who were asked to provide advice to each base company separately (cell 1 mean = 2.11; s.d. = 1.219). Univariate comparisons of the marginal means shown in Table 1 show that the mean recommendation score of participants in the comparison condition (mean = 2.79; s.d. = 0.986) is significantly higher than the mean score of participants in the advice condition (mean = 2.33; s.d. = 1.106) (t = 2.306; p = 0.023, two-tailed). The mean recommendation score of participants in the literal similarity condition (mean = 2.40; s.d. = 1.180) is not significantly different from the mean score of participants in the relational similarity condition (mean = 2.71; s.d. = 0.929) (t = 1.557; p = 0.122, two-tailed).

[Insert Figure 2 and Table 1 here]

Recall that H1a predicts that when prompted with various base accounting problems that are literally similar to a target accounting problem, participants who are explicitly asked to compare the problems will apply more correctly a relevant causal relation when making accounting recommendations, relative to participants who are not asked to compare the problems. Panel B of Table 1 presents the results of our planned contrast to test H1a. The results show that,

for participants who were prompted with literally-similar problems, the mean recommendation score of those in the comparison condition (cell 2 mean = 2.68; s.d. = 1.090) is significantly higher than the mean recommendation score of participants in the advice condition (cell 1 mean = 2.11; s.d. = 1.219) (t = 2.385; p = 0.010, one-tailed), even after controlling for the participants' cost accounting system knowledge. This result supports H1a.

H1b predicts that when prompted with various base accounting problems that are relationally similar to a target accounting problem, explicit elicitation of an effortful problem comparison will not be related to the participants' ability to correctly apply a relevant causal relation when making accounting recommendations. Our results show that, for participants who were prompted with relationally-similar problems, the mean recommendation score of participants in the comparison condition (cell 4 mean = 2.89; s.d. = 0.875) is not significantly different from the mean score of those in the advice condition (cell 3 mean = 2.54; s.d. = 0.962) (t = 1.286; p = 0.204, two-tailed), even after controlling for the participants' cost accounting system knowledge.[27] This result supports H1b.

Recall that H2a predicts that when an effortful comparison of the base accounting problems is not explicitly elicited (i.e., the advice condition), participants who are prompted with base accounting problems that are relationally similar to a target accounting problem will apply more correctly the relevant causal relation when making accounting recommendations, relative to participants who are prompted with literally similar problems. Panel B of Table 1 presents the results of our planned contrast to test H2a. The results show that, for participants in the advice

[27] Our full ANCOVA model (not shown here to conserve space) that regresses the participants' recommendation scores against our independent variables and covariate shows a significant main effect for causal-relation abstraction (elicited (comparison) vs. not elicited (advice)) (F = 6.372; p = 0.013, two-tailed), a marginally significant main effect for problem similarity (literal vs. relational) (F = 3.079; p = 0.082, two-tailed), and a significant effect for the cost accounting system knowledge covariate (F = 3.902; p = 0.051, two-tailed). In a linear regression model that mirrors our ANCOVA model, the coefficient for the cost accounting system knowledge covariate is positive and significant (b = 0.227; t-statistic = 1.975; p = 0.051, two-tailed). This result indicates that higher scores on the participants' cost accounting system knowledge are positively associated with higher recommendation scores. An augmented ANCOVA model that includes an interaction term shows no significant interaction between our independent variables (p > 0.40).

condition, the mean recommendation score of those in the relational similarity condition (cell 3 mean = 2.54; s.d. = 0.962) is significantly higher than the mean recommendation score of participants in the literal similarity condition (cell 1 mean = 2.11; s.d. = 1.219) ($t = 1.829$; $p = 0.037$, one-tailed), even after controlling for the participants' cost accounting system knowledge. This result supports H2a.

H2b predicts that when an effortful comparison of the base accounting problems is explicitly elicited (i.e., the comparison condition), the similarity between the base accounting problems and the target problem will not be related to the participants' ability to correctly apply the relevant causal relation to the target problem when making accounting recommendations. Our results show that, for participants in the comparison condition, the mean recommendation score of those in the relational similarity condition (cell 4 mean = 2.89; s.d. = 0.875) is not significantly different from the mean recommendation score of participants in the literal similarity condition (cell 2 mean = 2.68; s.d. = 1.090) ($t = 0.739$; $p = 0.463$, two-tailed), even after controlling for the participants' cost accounting system knowledge. This result supports H2b.

To summarize, our results provide support for the individual and joint effects of problem similarity and elicitation of effortful comparison of base problems on accounting recommendation quality. Our results are consistent with the conclusion that effortful comparison of base problems facilitated the development of an appropriate knowledge representation that includes the relevant causal relation for application to the target accounting problem. Importantly, by examining both mechanisms in combination, we demonstrate that their effectiveness in enhancing accounting recommendation quality is greater when conditions for the development of an appropriate knowledge representation are least favorable. That is, as shown in Panel A of Figure 2, the incremental benefit of eliciting (vs. not eliciting) effortful comparison is greater when the base problems are literally similar, and as shown in Panel B of Figure 2, the

incremental benefit of prompting decision-makers with relationally-similar problems (vs. literally-similar problems) is greater when effortful comparison of base problems is not explicitly elicited.

Supplementary Analyses

In this section we report the results of supplementary analyses conducted with two objectives in mind. The first objective is to probe deeper on the robustness of our main results. The second objective is to investigate whether participants' self-reports of the usefulness of the information contained in the base company cases are associated with their recommendation quality. To accomplish our first objective, in this section we replicate our planned contrasts using a sub-sample of our participants. This sub-sample is composed of 99 participants (out of our total sample of 111) who self-reported via a post-experimental question that, when making their recommendations as to how to improve the target company's revenues, they took into account the fact that different customers may demand company activities at different levels. Thus, these participants' *ex post* self-insight is consistent with the relevant abstract causal relation implicit in the base problems; that is, "low-profit" customers cause higher selling and administrative costs to the company than do "high-profit" customers.

Panels A and B of Figure 3 show graphically the mean recommendation scores (out of a maximum of 4) of participants for the effortful comparison and problem similarity variables, respectively. The results are qualitatively similar to those shown in Figure 2 and Table 1 using the full sample. The results of our planned contrasts (not shown here) provide support for our four research hypotheses: H1a and H2a at $p = 0.003$ and $p = 0.010$, one-tailed, respectively; and H1b and H2b at $p = 0.236$ and $p = 0.499$, two-tailed, respectively.[28]

[Insert Figure 3 here]

To accomplish our second objective, we analyzed the relationship between the

[28] All four planned contrasts control for the participants' cost accounting systems knowledge, as described earlier.

participants' recommendation quality and their responses to a post-experimental question eliciting reactions as to which of the three base companies, or all of them combined, was (were) more helpful (or not at all) in providing their recommendations for possible ways to increase the target company's revenues.[29] We focus our analyses on the problem similarity variable. Table 2 shows the mean recommendation scores for the literal and relational similarity conditions, and classified by the five possible responses.

[Insert Table 2 here]

Table 2 shows that for participants who identified all three base companies as being similarly helpful for making their recommendations, the mean recommendation score of those in the relational similarity condition (3.00; s.d. = 0.756) is significantly higher than the mean score of participants in the literal similarity condition (2.00; s.d. = 1.323) ($t = 2.577$; $p = 0.015$). This finding is consistent with the argument that when the three base companies are considered together, this makes more salient the causal relation shared by them for participants in the relational similarity condition than for those in the literal similarity condition.[30]

V. SUMMARY, IMPLICATIONS, AND DIRECTIONS FOR FUTURE RESEARCH

This paper reports the results of a two-stage between-subjects experiment that investigates the individual and joint effects of similarity between various base accounting problems and a target problem, and of effortful comparison, on accounting recommendation quality. The experiment produced the counter-intuitive result that accountants apply causal relations more correctly when *deprived* of literal similarities, and still more correctly when they exert effort to compare the base problems. More importantly, we find that the incremental benefit

[29] The question read as follows: "Please mark an "X" next to the statement below that you agree the most with (please choose only one): In providing my recommendation as to possible ways in which Business Form Printing can increase their revenues over the 2001 level: Mega Outfitting Co. was the most helpful to me; Lambert's Corporate Catering was the most helpful to me; University T-Shirt Printing was the most helpful to me; All three companies were similarly helpful to me; None of the companies was helpful to me."

[30] We performed a similar analysis of the mean recommendation scores for the effortful comparison variable, but found no significant differences between the comparison and advice conditions at conventional levels.

of effortful comparison is greater when the base problems are literally similar, and the incremental benefit of depriving participants of literal similarities is greater when they do not compare the base problems. Our findings reveal a reason why accountants are constrained when transferring knowledge across settings: literal similarities hamper their ability to abstract causal relations from prior experiences to new target accounting problems. Similar *causes* matter more than similar *facts*.

Our findings are of practical importance for organizations that are increasingly focusing on knowledge as the most strategically important intangible source of sustained competitive advantage, corporate value, and economic growth. As mentioned earlier, what may be information to one person may be knowledge to another person who can put it to productive use (Douglas 2002).[31] By examining problem similarity and comparison jointly, our study demonstrates conditions under which each of these mechanisms can operate most effectively at enhancing accountants' ability to abstract a relevant accounting causal relation from information contained in various base accounting problems, and to develop a knowledge representation that can be "productively" used across accounting decision settings.

Further, prior studies suggest that, for knowledge development to occur, individuals need to invoke familiar problems that have well-understood solution strategies. In contrast, our study and findings demonstrate that accountants are able to develop new knowledge from previous problem experiences, even if they are only partially understood. Thus, we demonstrate the incremental benefits, on recommendation quality, of effortful comparison and of depriving accountants of literal similarity in a more realistic setting that is consistent with the natural ecology in which accountants normally make decisions.

[31] Consistent with this argument, Lawrence Prusak, executive director of IBM's Institute for Knowledge Management asserts: "[T]he right information to the right person at the right time is not a good algorithm for success of an organization…access to the right knowledge at the right time is much more valuable" (Hansen and Thompson 2002, 17-18).

Certain features of this study point to potential ideas for future research. First, in our experiment we examined "pure" mechanisms, comparison vs. advice. It is possible that in real-life situations, abstraction and application of a relevant principle or causal relation can also occur with "hybrid" mechanisms. However, hybrid models often develop in the absence of knowledge of the effectiveness of their components. Further, examination of "pure" types is an important precursor to examination of hybrid models. Future research, then, could examine the generality or our findings using "hybrid" models that may facilitate development of knowledge representations that include relevant principles or causal relations (see also Nadler et al. 2003 for other models of knowledge creation and transfer).

Further, the literature has identified two types of knowledge—explicit and tacit. The former is defined as "knowledge that has been captured or codified into manuals, procedures, and rules, and is easy to disseminate" (Stenmark 2000, 10). For example, knowledge of generally accepted accounting principles (GAAP) regarding fair value requirements is explicit knowledge. Tacit knowledge, on the other hand, is gained through experience, not easily made visible or articulated, and often is experienced as an intuition, a notion, insights, beliefs, or values (Ambrosini and Bowman 2001; Ancori et al. 2000; Nonaka and Takeuchi 1995). For instance, an auditor's insights as to how an entity's management develops fair value estimates and whether those estimates conform with GAAP represent tacit knowledge. In general, tacit knowledge is more challenging to transfer than explicit knowledge (Nonaka 1991). In our study, the implicit relevant causal relation that participants could abstract from the base problems could be articulated (by knowledgeable individuals), and thus, is consistent with the definition of explicit knowledge. Future research could examine the generality of our findings by addressing whether the tacit knowledge that decision-makers bring to the task interacts with explicit knowledge.

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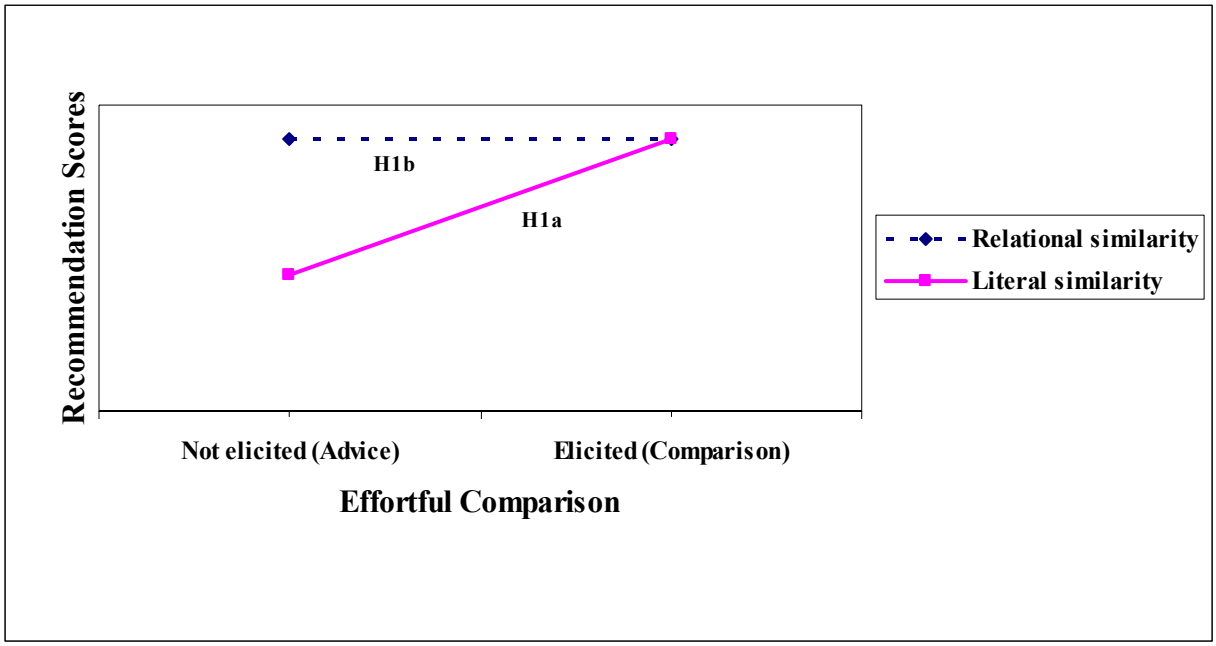
Figure 1
Predicted Effects of Effortful Comparison and Problem Similarity on Accounting Recommendation Quality[a]

Panel A. Predicted Effects of Effortful Comparison (H1a and H1b)



Panel B. Predicted Effects of Problem Similarity (H2a and H2b)

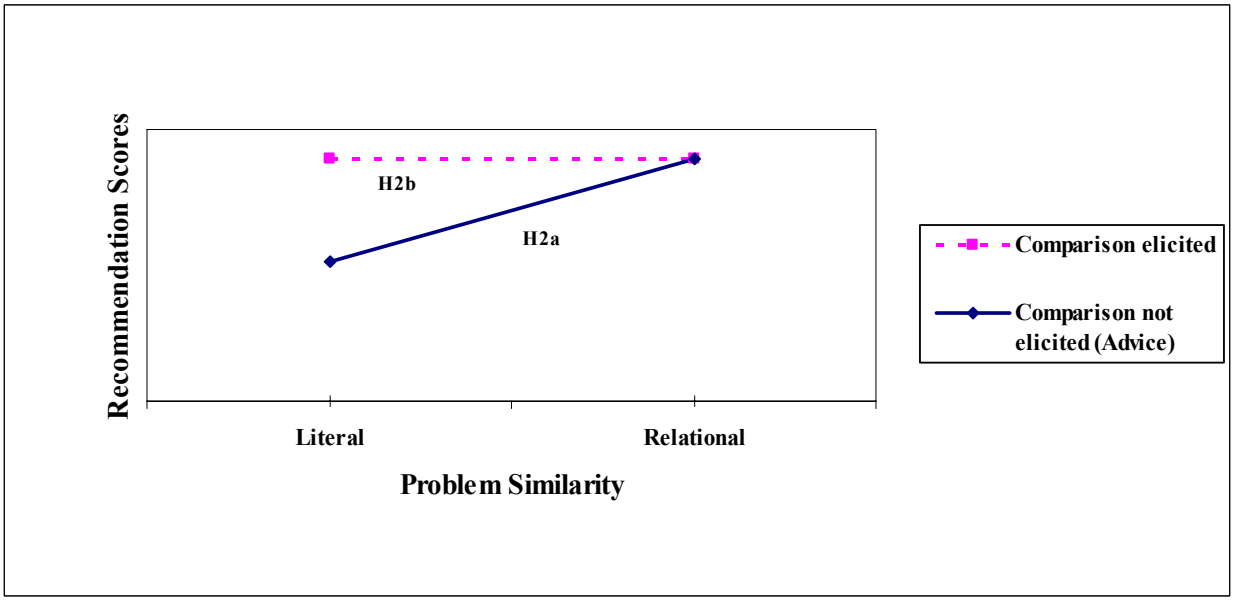


Figure 1
Predicted Effects of Effortful Comparison and Problem Similarity on Accounting Recommendation Quality[a]

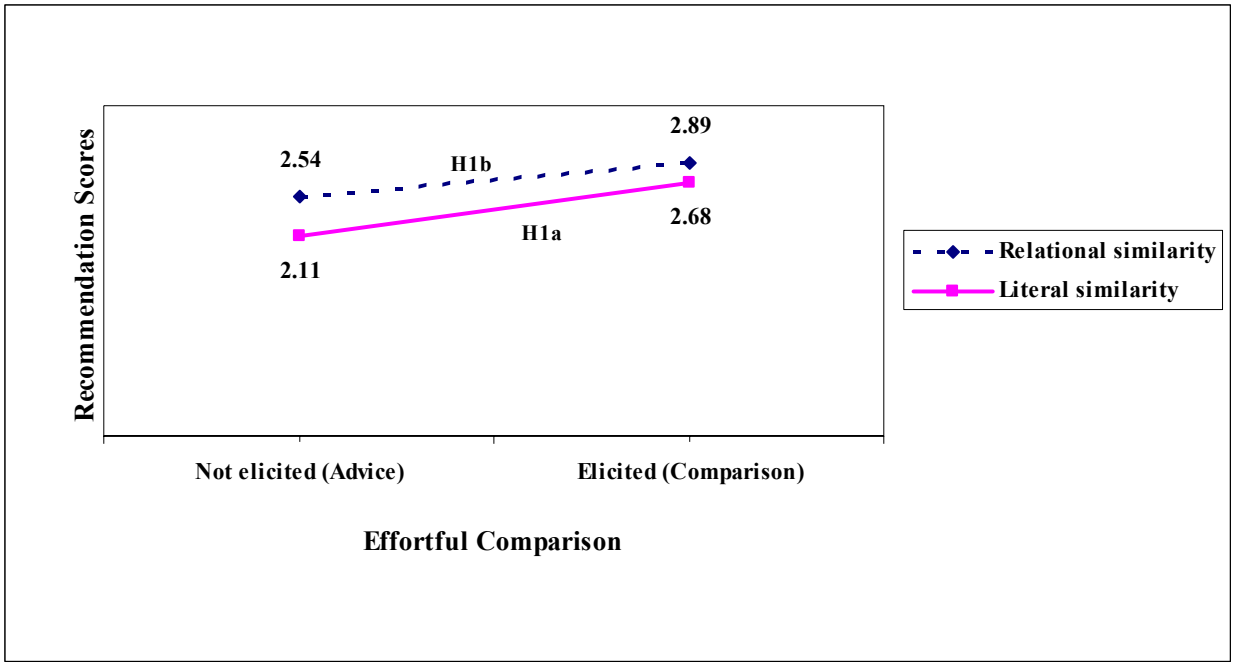
[a] Participants in the literal similarity condition were prompted with three base problems and a target problem that share (implicitly) a relevant causal relation and maintain a one-to-one attribute match. Participants in the relational similarity condition were prompted with three base problems and a target problem that share the relevant causal relation but do not maintain the one-to-one attribute match.

Participants in the comparison not elicited (advice) condition were asked to provide two recommendations each for each of the three companies depicted in the base problems as to how to improve the companies' profits in year *t*, relative to year *t – 1*. Participants in the comparison elicited condition were asked to write down similarities and differences between and among the three base companies, combinations of similarities and differences, and to articulate the overall main principle that captures the essence of what they learned from the three base companies taken together.

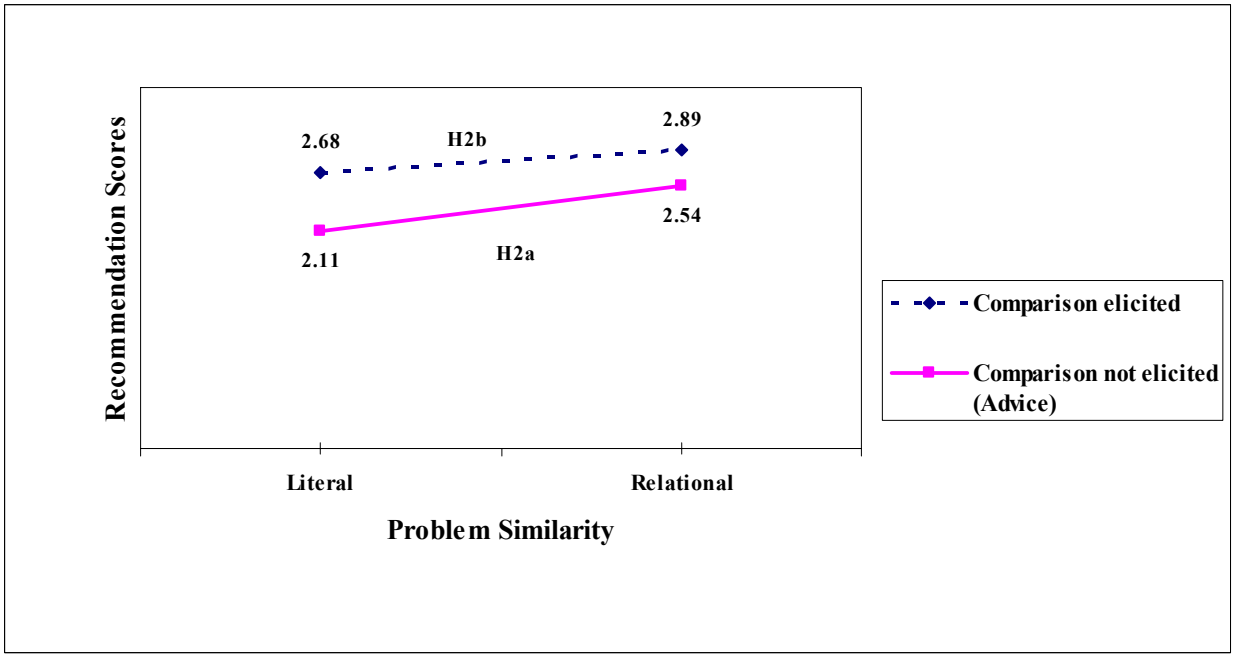
The dependent variable is constructed from participants' recommendations as to how to improve the target company's revenues.

Figure 2
Observed Effects of Effortful Comparison and Problem Similarity on Accounting Recommendation Quality (Full Sample = 111)[a]

Panel A. Observed Effects of Effortful Comparison (H1a and H1b)



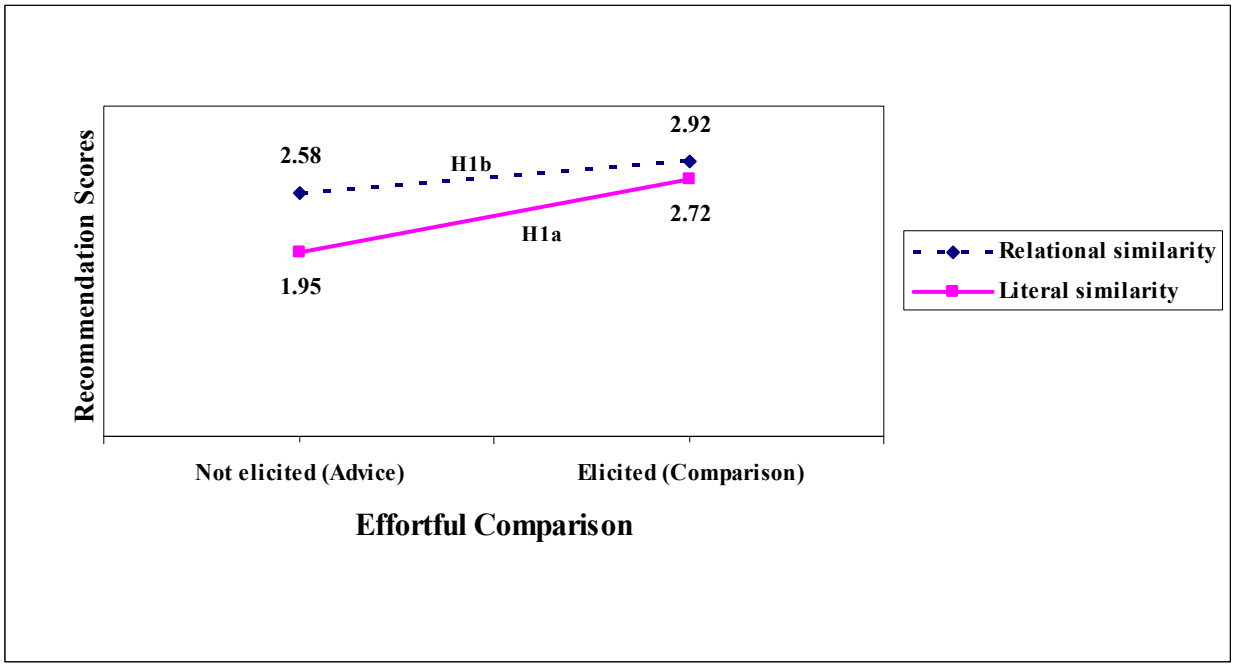
Panel B. Observed Effects of Problem Similarity (H2a and H2b)



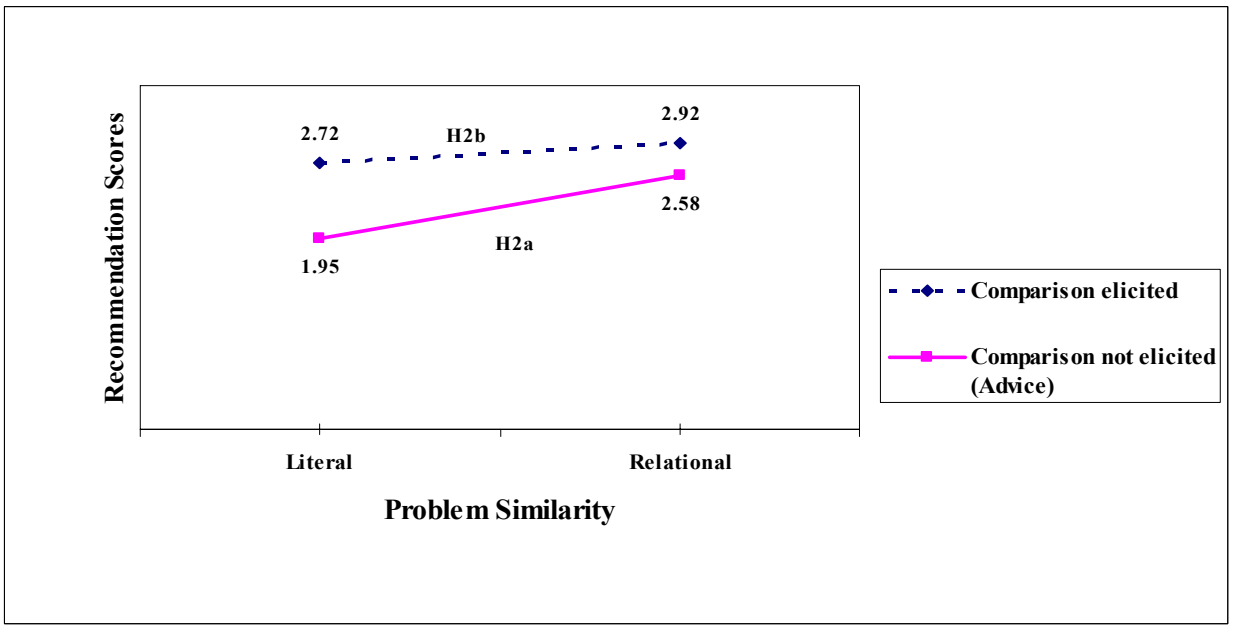
[a] See variable definitions on Figure 1.

Figure 3
Observed Effects of Effortful Comparison and Problem Similarity on Accounting Recommendation Quality (Reduced Sample = 99)[a]

Panel A. Observed Effects of Effortful Comparison (H1a and H1b)



Panel B. Observed Effects of Problem Similarity (H2a and H2b)



[a] The reduced sample is composed of 99 participants (out of the full sample of 111) who self-reported via a post-experimental question that, when making their recommendations as to how to improve the target company's revenues, they correctly took into account the fact that different customers may demand company activities at different levels. This ex-post self insight is consistent with the relevant abstract causal relation implicit in the base problems; that is, "low-profit" customers cause higher selling and administrative costs to the company than "high-profit" customers.

TABLE 1
Descriptive Statistics and Planned Contrasts (n = 111)

Panel A. Mean Recommendation Scores (out of a maximum of 4); Std. Dev. in parentheses

Problem Similarity[a]	*Effortful Comparison*[b] *Not elicited (Advice)*	*Elicited (Comparison)*	*Total*
Literal	1 2.11 (1.219) n = 27	2 2.68 (1.090) n = 28	2.40 (1.180) n = 55
Relational	3 2.54 (0.962) n = 28	4 2.89 (0.875) n = 28	2.71 (0.929) n = 56
Total	2.33 (1.106) n = 55	2.79 (0.986) n = 56	2.56 (1.068) n = 111

Panel B. Planned Contrasts

Contrast	*Mean Square*	*t-statistic*	*p-value*[c]
Effects of effortful comparison in the literal similarity condition (H1a):			
Not elicited (Advice) vs. Elicited (Comparison) (cell 1 vs. cell 2, Panel A)	5.983	2.385	0.010
Effects of effortful comparison in the relational similarity condition (H1b):			
Not elicited (Advice) vs. Elicited (Comparison) (cell 3 vs. cell 4, Panel A)	1.739	1.286	0.204
Effects of problem similarity in the comparison not elicited (advice) condition (H2a):			
Literal vs. Relational Similarity (cell 1 vs. cell 3, Panel A)	3.518	1.829	0.037
Effects of problem similarity in the comparison elicited condition (H2b):			
Literal vs. Relational Similarity (cell 2 vs. cell 4, Panel A)	0.574	0.739	0.463

TABLE 1 (continued)
Descriptive Statistics and Planned Contrasts (n = 111)

[a] Participants in the literal similarity condition were prompted with three base companies that share (implicitly) with the target company a relevant causal relation and maintain a one-to-one match of several abstract attributes. Participants in the relational similarity condition were prompted with three business companies that share with the target company the relevant causal relation but do not maintain the one-to-one attribute match with the target company.

[b] Participants who were not explicitly elicited to compare the base problems (i.e., the advice condition) were asked to provide two recommendations each to three base companies as to how to improve their profits in year *t*, relative to year *t – 1*. Participants who were explicitly elicited to compare the base problems (i.e., the comparison condition) were asked to write down similarities and differences between and among the three base companies, combinations of similarities and differences, and to articulate the overall main principle that captures the essence of what they learned from the three business cases taken together**.**

[c]

[c] One-tailed for H1a and H2a; two-tailed for H1b and H2b. The planned contrasts control for the participants' cost accounting system knowledge, constructed from their responses to the question, "Is BFP's cost accounting system appropriate for decision-making?" The responses are coded as superior (= 2), average (= 1), or inferior (= 0).

TABLE 2
Descriptive Statistics for Supplementary Analyses[a] (n = 111)

	Problem Similarity[c]	
Base Company[b]	*Literal*	*Relational*
MOC	2.50 (1.732) n = 4	2.55 (0.934) n = 11
LCC (or TPC)	2.67 (1.033) n = 6	2.55 (0.934) n = 11
UTP	2.61 (1.195) n = 18	2.33 (1.506) n = 6
All 3 companies	2.00 (1.323) n = 17	3.00 (0.756)** n = 15
None of the companies	2.50 (0.707) n = 10	2.85 (0.801) n = 13
Overall mean	2.40 (1.180) n = 55	2.71 (0.929) n = 56

** Mean recommendation scores are significantly different ($p < 0.05$, two-tailed)

[a] Cell entries in the first row indicate the mean recommendation scores (s.d.) by problem similarity condition. The second row indicates the number of participants in each cell.

[b] The participants responded to the following post-experimental question:

Please mark an "X" next to the statement below that you agree the most with (please choose only one):

In providing my recommendation as to possible ways in which Business Form Printing can increase their revenues over the 2001 level:

____Mega Outfitting Co. (MOC, the online clothing and accessories retailer) was the most helpful to me.
____Lambert's Corporate Catering (LCC, the catering business) was the most helpful to me.
____University T-Shirt Printing (UTP, the T-shirt printing shop) was the most helpful tome.
____All three companies were similarly helpful to me.
____None of the companies was helpful to me.

[c] Participants in the literal similarity condition were prompted with three base companies that share (implicitly) with the target company a relevant causal relation and maintain a one-to-one match of several abstract attributes. Participants in the relational similarity condition were prompted with three business companies that share with the target company the relevant causal relation but do not maintain the one-to-one attribute match with the target company.

APPENDIX 1
Sample Relational Similarity Narratives for the Three Base Companies Presented in Stage One[a]

Mega Outfitting Company (MOC), located in the Midwest, sells moderately priced basic business casual clothing and accessories internationally. MOC has no retail outlets. Instead, MOC sends catalogs and flyers to all its customers several times a year. Customers select merchandise from MOC's catalogs or from MOC's website, which shows the same selection as the catalogs. The company purchases the clothing and accessories from dependable, high-quality suppliers. Customers place their orders by mail, by phone using MOC's toll-free phone number, or through MOC's website. Until the end of 2001, MOC used an automated phone order system. That is, customers did not speak to a person, but rather entered code numbers for selections, followed by quantity, payment information, and shipping information. At the beginning of 2002, in an effort to increase profits, MOC decided to have customer service representatives take phone orders. MOC trained its customer service representatives to provide courteous interaction with customers who order over the phone, and to patiently answer all the customers' questions. MOC also implemented a new policy whereby customers who are not completely satisfied with the merchandise receive a refund of the purchase price, though customers must pay return shipping charges. Currently, some customers place one small order once a year, others place small orders several times a year, and others place one large order once a year. Similarly, some customers order only over the phone because they want to ask the customer service representative many questions about the products. Other customers order only through the mail or the Internet. Some customers return most of the merchandise they purchase, and others rarely	**University T-Shirt Printing (UTP)**, a privately-owned local printing shop, is the exclusive supplier of Midwestern University's custom-printed annual football season t-shirts, commonly known as "The Shirt." A vendor supplies UTP with high-quality white adult-size t-shirts. UTP prints thousands of "The Shirt" every year consistent with the University's Shirt Committee's specifications of the design, colors, materials, packaging, and logos. UTP complies with all of Midwestern University's licensing requirements, including a royalty fee payable to the University. Until the end of 2001, the University Bookstore had been UTP's only client. At the beginning of 2002, in an effort to increase profits, UTP agreed to supply "The Shirt" to a retail-chain department store at a local shopping mall, located 5 miles north of the University Bookstore. The retail chain store already carries the full line of Midwestern University's licensed sports apparel. Currently, UTP sells 70 percent of the shirts to the University Bookstore, and the remainder to the retail chain store. UTP's two customers are able to estimate the annual demand for shirts with 99% accuracy. Therefore, UTP has not encountered requests of additional reorders or expedited (overnight) orders. UTP has agreed to deliver by truck half of the ordered shirts to both the University Bookstore and the retail chain store by the end of April, with the rest of the shirts delivered by the end of June. Finally, UTP's two customers have been able to sell all the shirts ordered in a given year; thus, UTP has not encountered returned orders. However, UTP accepts returns of defective shirts (UTP pays actual shipping charges).	**Lambert's Corporate Catering (LCC)** is a locally owned catering business located in a midwestern town of 500,000 people. LCC caters exclusively to local professional services firms. Clients are located within a 45-mile radius. In addition to the food orders, LCC supplies the paper goods, china, linens, glassware and silverware. Until the end of 2001, LCC had catered only tailgate parties with limited, relatively simple menus. At the beginning of 2002, in an effort to increase profits, LCC decided to expand its catering to breakfast, lunches, dinners, and cocktail receptions. LCC's menus therefore now include both standard and complex selections. Orders are placed over the phone using LCC's toll-free number. LCC trains its personnel to provide courteous interaction with clients and to patiently answer all the client's questions. Clients appreciate the personal attention that LCC provides in discussing the menu and other arrangements. LCC's clients plan their events well in advance and give LCC ample time to make catering preparations; LCC does not accept last-minute rush orders for catering. LCC employs chefs with different levels of expertise to prepare its range of simple to gourmet meals. Gourmet meals take considerably longer to prepare than simple meals, such as grilled hamburgers, hot dogs, and BBQ pork for tailgating parties. Fine cuisine menu offerings include hot hors d'oeuvres, specialty beef, chicken, and seafood selections, and specialty breads and desserts. To determine the total price of a catered service, LCC adds a 30 percent markup to the cost of the food, beverages, and catering supplies (paper goods, etc.), and charges a fixed fee per guest served. The fee per guest is computed at the beginning of each year as estimated total overhead costs (such as the

return merchandise. All customers pay actual shipping charges, whether regular or express delivery, by an international shipping company. Extra processing within MOC is required for express deliveries. New customers are more likely than established customers to place few small orders, order over the phone, and return merchandise. For pricing purposes, MOC computes the cost of good sold as merchandise cost plus freight charges. In addition, MOC computes a selling and administrative (S&A) rate to allocate selling and administrative costs for pricing purposes. This S&A rate is computed at the beginning of each year as estimated total selling and administrative costs divided by estimated total cost of goods sold. In 2002, the number of customers increased and sales revenue increased, although MOC did not change its prices. MOC's 2002 profit was lower than its 2001 profit.	The printing processes for the shirts are quite similar in terms of machines used and time requirements. For pricing purposes, UTP computes the cost of goods sold as direct materials (including the royalty fee) plus direct labor plus applied manufacturing overhead cost. The manufacturing overhead rate is computed at the beginning of each year as estimated total manufacturing overhead costs divided by estimated machine hours. In addition, UTP computes a selling and administrative (S&A) rate to allocate selling and administrative costs for pricing purposes. This S&A rate is computed at the beginning of each year as estimated total selling and administrative costs divided by estimated total cost of goods sold. In 2002, sales revenue increased, though the shirt sales price did not change. UTP's 2002 profit was higher than its 2001 profit.	cost of the cooking equipment, rental of kitchen facilities, servers' wages, and chefs' salaries) divided by the estimated number of guests served. Additional services, such as bar service and flower arrangements, are provided at an extra fee. In addition, LLC computes a selling and administrative (S&A) rate to allocate selling and administrative costs. This S&A rate is computed at the beginning of each year as estimated total selling and administrative costs divided by the estimated number of guests. In 2002, the number of clients did not increase but sales revenue increased because clients ordered a greater variety of catered events. LCC's 2002 profit was lower than its 2001 profit.

[a] In the experimental instruments all three case narratives appeared on a single legal-size sheet of paper.

APPENDIX 2
Narrative for the Target Company Presented in Stage Two

Instructions:

For this part please assume that you are a business consulting associate who works for a consulting firm. Your managing partner has asked you to assess the situation and provide recommendations for a new client, Business Forms Printing (BFP), described below.

Business Forms Printing (BFP), a Midwest printing shop, provides business forms for various companies in the US and around the world. Until the end of 2001, the company printed and shipped the forms in standard batch sizes. Customers were required to purchase in standard quantities and therefore sometimes held large quantities of inventories of their business forms. At the beginning of 2002, in an effort to increase profits, BFP introduced a new policy of shipping only what the customer requests, as frequently as the customer wants. BFP therefore now provides value to its customers by managing the inventory of business forms. Customers do not pay for ordered forms until they receive them.

Owing to the new policy, BFP asks its customers to provide a yearly forecast of the number of forms needed. However, BFP management has noticed that some customers forecast with up to 99% accuracy, while others (especially the new customers) do not forecast accurately. As a result, BFP holds rather large quantities of inventories of business forms for some of its customers, while it holds little inventory for other customers. In addition, some customers place small orders several times a year, while others place large orders a few times a year. Further, BFP encounters business form obsolescence when customers change their forms while BFP holds a large inventory of the old forms. Finally, some customers take advantage of BFP's promise to ship only what the customer requires. Therefore, BFP sometimes ships less than a full carton of forms. This requires an employee to open the carton, count out the number of forms to ship, and then package the forms for shipping.

BFP's printing processes for the various companies' forms are quite similar in terms of printing machines used and time requirements. For pricing purposes, BFP computes the cost of goods sold as direct materials plus direct labor plus applied manufacturing overhead cost. The manufacturing overhead rate is computed at the beginning of each year as estimated total manufacturing overhead costs divided by estimated machine hours. In addition, BFP computes a selling and administrative (S&A) rate to allocate selling and administrative costs for pricing purposes. This S&A rate is computed at the beginning of each year as estimated total selling and administrative costs divided by estimated total cost of goods sold. Customers pay actual shipping charges by an international shipping company. In 2002, the number of customers increased and sales revenue increased, although sales prices for the forms did not change.

APPENDIX 3
Manipulation of Problem Similarity between the Base Companies and the Target Company

Panel A. Literal Similarity

Company Name [Industry]	Nature of Business	Nature of Product(s)	Nature of Customers	One-year change in # of Customers	One-year change in profits
Mega Outfitting Co. **(MOC)** [Merchandising]	Mail order clothing company	**Homogeneous**: moderately priced business casual clothing and accessories	**Heterogeneous**: vary in terms of number of orders placed over a one-year period; dollar amount of orders placed; how the order is placed (phone, mail, or website); number and dollar amount of merchandise returned; and shipping charges (regular vs. expedited delivery)	↑	↓
University T-shirt Printing **(UTP)** [Manufacturing]	College T-shirt printing shop	**Homogeneous**: high-quality adult-size football T-shirts with Midwestern university logo	**Heterogeneous**: University bookstore, national department store chain, local bookstores, local organizations; vary in terms of size of orders placed, storage costs, ability to accurately estimate demand of T-shirts, and shipping charges (regular vs. expedited delivery)	↑	↓
Tailgate Party Catering **(TPC)** [Catering]	Tailgate party catering	**Homogeneous**: standard tailgate party catering with two similarly-priced menu options	**Heterogeneous**: Residential vs. non-residential (commercial) clients; vary in terms of number of parties catered per football season; location (in-town vs. out-of-town); how the orders are placed (over the phone or using a website); rush orders vs. regular orders	↑	↓
Target Company:					
Business Forms Printing **(BFP)** [Manufacturing]	Business forms—made-to-stock	**Homogeneous**: printing forms that use a similar printing process and machine time; inventory management service	**Heterogeneous**: vary in terms of number of orders placed over a one-year period; dollar amount of orders placed; ability to accurately estimate number of forms needed each year; dollar amount of inventory in storage; size of shipments (full carton vs. less than full cartons)	↑	↓

APPENDIX 3 (Continued)
Manipulation of Problem Similarity between the Base Companies and the Target Company

Panel B. Relational Similarity

Company Name [Industry]	Nature of Business	Nature of Product(s)	Nature of Customers	One-year change in # of customers	One-year change in profits
Mega Outfitting Co. (MOC) [Merchandising]	Mail order clothing company	**Homogeneous**: moderately priced business casual clothing and accessories	**Heterogeneous**: vary in terms of number of orders placed over a one-year period; dollar amount of orders placed; how the order is placed (phone, mail, or website); number and dollar amount of merchandise returned; and shipping charges (regular vs. expedited delivery)	↑	↓
University T-shirt Printing (UTP) [Manufacturing]	College T-shirt printing shop	**Homogeneous**: high-quality adult-size football T-shirts with Midwestern university logo	**Homogeneous**: university bookstore and national department store chain; similar in terms of ability to accurately estimate demand of T-shirts, shipping charges, schedule of deliveries over the year, no merchandise returns necessary	↑	↑
Lambert's Corporate Catering (LCC) [Catering]	Corporate catering	**Heterogeneous**: menu includes both standard and complex selections for breakfast, lunch, dinner, or cocktail party receptions; differently-priced menu selections	**Homogeneous**: local professional services firms; similar in terms of location (in-town only); how the orders are placed (over the phone only); only regular orders accepted	Ø	↓
Target company: Business Forms Printing **(BFP)** [Manufacturing]	Business forms—made-to-stock	**Homogeneous**: printing forms that use a similar printing process and machine time; inventory management service	**Heterogeneous**: vary in terms of number of orders placed over a one-year period; dollar amount of orders placed; ability to accurately estimate number of forms needed each year; dollar amount of inventory in storage; size of shipments (full carton vs. less than full cartons)	↑	↓

APPENDIX 4
Manipulation of Effortful Comparison

Panel A. Comparison Explicitly Elicited

a) Think about the similarities and differences among the three preceding business cases. In the time allotted, list as many similarities, differences, and combinations of similarities-differences as you can identify between and among the cases.

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.

Similarities among the three business cases:

Differences among the three business cases:

Combinations of similarities-differences:

b) Using only one sentence, articulate the overall main principle that captures the essence of what you learned from the three cases taken together.

Panel B. Comparison Not Elicited (Advice)

For each of the three source companies, the participants received the following instructions:

Based on the information provided above [in the preceding company description], recommend two possible ways in which [Company name] can increase their profits over the 2002 level. List first your recommendation with the highest potential for increasing profits:

Recommendation #1 (first highest potential):

Recommendation #2 (second highest potential):