Improving Audit Judgment and Decision Making With Dual Systems Cognitive Model

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This article proposes a dual system cognitive reasoning model to enhance audit judgment and decision making. The model is built on the fact that the total cognitive capacity of an individual comprises two systems of reasoning—System 1 that is unconscious, associative, implicit, more emotional and less controlled, and so forth; and System 2 that is conscious, explicit, deliberate and rule-governed, and so forth. The benefits of the proposed model that integrates these two complementary and compensatory systems are first illustrated with an example in audit planning, and second explained how the model could overcome the deficiencies of heuristics specifically in an audit context.

Keywords: dual cognitive systems, audit judgment and decision, heuristics

Introduction

Auditors are expected to be rational and objective when they formulate audit opinions. However, auditors are affected by the same emotions, heuristics, biases, and other behavioural traits as all other people. These characteristics could seriously jeopardize the provision of balanced audit judgment and opinion. As history and the recent 2007-2008 global financial crisis have vindicated, creditability of unqualified audit opinion is professionally questionable in cases of corporate scandals and surprised corporate failures. Audit decision and judgment are particularly susceptible because, unlike finance and economics, there are still no equivalent theories to guide optimal or “correct” solutions.

It is not that these concerns have not been addressed. There have been behavioral auditing studies on judgment and decision making—how they are affected by human heuristics, biases and other behavioural traits. Ashton (1974) was the first to conduct a research study that systematically analysed auditor’s judgment. However, it is only after Kahneman and Tversky’s (1973) work on availability, representativeness, and anchoring-and-adjustment heuristics that behavioral auditing began to flourish. As explained in more details in the section of literature review, the past studies have three common features generally. First, there is no psychological or cognitive explanation on how the heuristics noted affect audit judgment and decisions. Second, suggestions to remedy or mitigate these heuristics are effort-inducing mechanisms (e.g., documentation and counter-explanation), assuming that conscious efforts alone could overcome these behavioural traits. Third, these studies do not attempt to find a psychological or cognitive solution for an essentially a psychological or cognitive problem.

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Unlike previous studies, we offer a cognitive solution for a cognitive problem to improve audit judgment and decision making. Our solution is based on the fact that we humans do have two systems of reasoning. Researchers (e.g., Epstein, 1994; Sloman, 1996; Kahneman, 2003; Evans, 2008) have suggested that human reasoning has dual aspects: sometimes people make quick and effortless choices, often based on previously established heuristics. Other times, people make effortful and analytical decisions by thorough application of theories, rules and logic. Intuitively, the properties of these two systems are complementary and compensatory. Accordingly, we propose a model that integrates these complementary and compensatory properties to ameliorate audit judgment and decision making. Specifically, we explain how the model works with an example of audit planning, and how the model would overcome the deficiencies of using availability, representativeness, and anchoring-and-adjustment heuristics in decision making and judgment.

The remainder of the paper is organized as follows. We first explain how the heuristics of availability, representativeness, and anchoring-and-adjustment could have unfavourable impact on auditors’ judgment and decisions, followed by discussions of recency and dilution effects. We then introduce the properties of the two systems of reasoning put forward by cognitive scientists, referred to System 1 and System 2 hereon in the article. Against this background, we propose and illustrate with examples an easily implemented dual systems cognitive model. We conclude our paper with a few directions for future research in a new frontier of behavioral audit research.

**Literature Review**

Many of the studies in behavioral auditing are based on the availability, representativeness, and anchoring-and-adjustment heuristics put forward by Kahneman and Tversky (1973). In the following paragraphs, we explain each of these three heuristics, and how auditors could make less than optimal decisions with each of these three heuristics.

**Heuristics**

Heuristics are “mental” shortcuts people commonly use to help making decisions or forming judgments, particularly when facing incomplete information or complex problems.

People use availability heuristic when they “assess the frequency of a class or the probability of an event by the ease with which instances or occurrence can be brought to mind” (Tversky & Kahnman, 1974, p. 1127). Schwarz (2004) had a similar opinion: judgment can be based on both the content of accessible judgment-relevant information and the subjective ease with which this information comes to mind. When an auditor is asked what the minimum sample size is, how often the magic number of 30 comes up as the answer? The number 30 is the minimal sample size proposed by many textbooks, and consequently many auditors simply use 30 as the sample size, without going through the process of determining the confidence level, tolerable and expected errors, and so forth in working out the minimum sample size. As more and more auditors are using 30 as the minimum sample size, it becomes so popular that it becomes a generally accepted “doctrine” among auditors. Consequently, the magic number of 30 is readily accessible in the memory and is the first answer that comes to an auditor’s mind.

People use representativeness heuristic when they judge probabilities “by the degree to which A is representative of B, that is, by the degree to which A resembles B” (Tversky & Kahnman, 1974, p. 1124). Suppose an auditor is asked which audit client would have a higher probability of exceeding the tolerable
material misstatement of five million in accounts receivable: A or B? A is a technology company; B is a finance company. C is a commercial bank and its accounts receivable misstatement is 4.8 million. An auditor would tend to pick B because B resembles C more than A does. B and C are completely different entities, with different credit policies and management. There is no reason why B is expected to have a material misstatement similar to that of C, even though both of them belong to the same industry. As illustrated by the example, a limitation of using representativeness heuristic is the failure of taking individual characteristics and uncertainty into consideration.

People use anchoring-and-adjustment heuristic when they “make estimates by starting from an initial value that is adjusted to yield the final answer. The initial value, or starting point, may be suggested by the formulation of the problem, or it may be the result of partial computation. In either case, adjustments are typically insufficient” (Tversky & Kahnman, 1974, p. 1129). For example, an auditor is initially asked whether a typical accounts receivable sample size for a global financial institution is greater or less than a randomly selected number say 500. Subsequently, the auditor is asked to estimate the account receivable sample size for an equivalent financial institution. The auditor would tend to have an estimate close to 500 on either side, displaying an anchoring effect on the 500 and an under-adjustment. It has been suggested that people use the last data point in the series as a mental anchor, and then adjust away from that anchor to take account of the major features of the series. As adjustment is typically insufficient, their estimation is biased (Harvey, 2007).

Having explained how auditors may make suboptimal decisions with availability, representativeness, and anchoring-and-adjustment heuristics, we can discuss some of the studies on the subject matter. A bit out of date, but Shanteau (1989) had reviewed over 40 studies of heuristics and biases in auditing literature. Most of them had investigated representativeness heuristics, with fewer studies on availability or anchoring-and-adjustment heuristics. Generally, while heuristics can be efficient in making decisions, use of heuristics also make auditors vulnerable to biases, errors and inconsistencies that cause their decisions to deviate from normative or statistical principles (e.g., Libby, 1981; Ashton, 1982).

There are researchers who interpreted the same availability, representativeness, and anchoring-and-adjustment heuristics proposed by Kahneman and Tversky (1973) from a different perspective: recency effect is one; dilution effect is another. We explain these two effects in turn.

**Recency Effect**

Recency effect is not significantly different from anchoring-and-adjustment heuristic proposed by Tversky and Kahnman (1974). Recency effect results when individuals overweight the latest piece of information received. In the language of anchoring-and-adjustment heuristic, the latest information received is the anchor, and is assigned the greatest weight compared to previous information received. The weight assigned could be suboptimal. In contrast, a primary effect results when an individual anchors an initial belief and maintain that belief in spite of subsequent relevant evidence.

There have been various interpretations of the recency effect.

Hogarth and Einhorn (1992) were the first to develop a model to explain the recency effect. Synthesizing past psychology literature, Hogarth and Einhorn (1992) developed the “belief-adjustment model” and provided evidence supporting the existence of order effects in human judgment in the context of step-by-step (SbS) strategy and end-of-sequence (EoS) strategy. In both strategies, a prior belief or judgment (viz. an anchor) is first formulated, which is revised on the basis of new evidence. Step-by-step (SbS) strategy revises the initial
judgment (the anchor) every time after each new piece of evidence is received. End-of-sequence (EoS) strategy revises the initial judgment only once when all evidence have been received and aggregated. Recency effect occurs when inappropriate highest weight is assigned to the latest evidence received, as in the case of Tversky and Kahnman (1974)’s anchoring-and-adjustment heuristic. Relative to EoS strategy, SbS strategy is more vulnerable to recency effect because of the order of processing. Taking a different perspective, Emby (1994) discussed the same phenomenon of recency effect as framing and presentation mode effects—sequential frame where information is considered sequentially, or simultaneous frame where information is considered simultaneously. It can be appreciated that, from the perspective of these studies, recency effect is neither cognitive nor psychological but procedural.

Irrespective whether the bias is labeled as anchoring-and-adjustment heuristic, recency effect, or framing and presentation mode effects, the bias is common among auditors. Substantial reliance on most recent prior audit adjustments in evidential planning is a classical example of recency effect (Bedard & Wright, 1994). Auditors also suffer from recency effects when they evaluate mixed (positive and negative) evidence (e.g., A. Ashton & R. Ashton, 1988; Messier, 1992; Messier & Tubbs, 1994). All these studies considered recency effect as given (viz. no explanations are offered on how it occurs), and suggest various methods for its mitigation: documentation (Cushing & Ahlawat, 1996); decision aids (Emby, 1994; Boatsman, Moeckel, & Pei, 1997); counterexplanation (Chung & Monroe, 1999); and accountability (Kennedy, 1993). These remedies suggested are neither cognitive nor psychological solutions but mere additional conscious efforts in audit judgment and decision making. Inducing additional effort is to stimulate greater attention to, comprehension of, and recall of relevant evidence provided to subjects early in the belief-updating process, and, according to the authors of the suggested remedies, should therefore alleviate recency effect. As a specific example, Cushing and Ahlawat (1996) demonstrated clearly the benefit (reducing recency effect) of an effort-inducing mechanism (documenting the process and the evidence of arriving a judgment or opinion) in a step-by-step (SbS) strategy of judgment and decision making. In a no-documentation setting, recency effects did arise in the audit judgment subjects (experienced audit professionals) that employed step-by-step (SbS) evaluation of evidence. The recency effect disappeared when the subjects performed the documentation task.

Dilution Effect

Before we discuss dilution effect, it is worthwhile to introduce the terms diagnostic evidence and non-diagnostic evidence.

Diagnostic evidence is a characteristic associated with the presence or absence of an event or a condition. For example, relatively few errors and fraud are diagnostic evidences of an effective and a reliable internal control system. Non-diagnostic evidence is a priori irrelevant evidence. It neither supports, contradicts nor associates with the presence or absence of an event or a condition. Continuing with the previous example, the specific hardware and software platform which the internal control system is operating upon is non-diagnostic evidence.

Nisbett, Zukier, and Lemley (1981) and Tversky and Kahneman (1983) explained the dilution effect from the basis of similarity-based inference, which is not too dissimilar from the representativeness heuristic proposed by Tversky and Kahnman (1974). In the context of auditing, auditors judge the likelihood of some event by comparing their knowledge of the client (client-specific knowledge) with their knowledge of the conditions that produce the event (event-specific knowledge). The greater is the perceived similarity of the two knowledges, the greater is the assessed likelihood of the event. In the language of diagnostic evidence, the
greater perceived similarity (higher degree of representatives in Tversky and Kahnman (1974)’s language) between client-and event-specific knowledges would increase the influence of the client-specific knowledge as diagnostic evidence, which in turn increases the auditor’s perceived probability that the event would occur. The dilution effect of nondiagnostic evidence can reduce this association in two aspects: nondiagnostic evidence might reduce the influence of diagnostic evidence; or it might attenuate personal biases that produce nonregressive (extreme) decisions (Hackenbrack, 1992). Hence, dilution effect is desirable for optimal judgment and decision.

**Literature Summary**

It is worthwhile to note that all of the studies that we had reviewed do not consider the cognitive aspects of the heuristics. The researchers assume that additional conscious efforts in form of procedures (e.g., documentation, decision aids, counterexplanation, and accountability as explained earlier) would attenuate the heuristics, which might not be true. As heuristics are largely cognitive, unfavourable effects of heuristics would still exist if they are not addressed at the cognitive level.

In contrast to previous studies, we address the deficiencies of heuristics at the cognitive level. The theoretical framework of our solution is based on a real life phenomenon: humans do have two systems of reasoning.

**Two Systems of Reasoning**

There are many daily examples that we human beings have two systems of reasoning. We all might have the experience that we make decisions, come to judgments and conclusions, and come to know the solution to a problem in two different ways: sometimes as if the mind goes off to a different world and comes back with an answer; sometimes the mind really works hard to analyze information and to construct the reasoning before the answer comes about. We might also have the “eureka” experience at some point in our lives when the cause of a problem, the solution for a deadlock or a discovery suddenly dawns. Such bursts of inspiration may originate at awkward moments. Archimedes’ principle is one of the better known of these examples. In cognitive psychology, this phenomenon can be interpreted as if the mind has dual aspects: one of which conforms to the associationistic view and one of which conforms to the analytic, sequential view. Alternatively, it is possible to conceive that we humans have two systems of reasoning: one system that is associative because its computations reflect similarity structure and relations of temporal contiguity. “Don’t ask me how to define an elephant; I know when I see one” (source unknown). The other system is “rule-based” because it operates on symbolic structures (that have logical content) and variables and because its computations have the properties that are normally assigned to rules. For example, in an arithmetic calculation like $3 + 5 \times 6$, you have to follow the order of operation to come to the correct answer of 33.

Researchers have put forward these two systems of reasoning in various ways. For example, Epstein (1994) distinguished these two systems as experiential and rational, respectively: experiential in the sense that the system is holistic, affective, and associationistic; rational in the sense that the system is analytical, logical, and reason oriented. Based on past literature, Sloman (1996) reviewed the arguments relevant to the distinction and puts forward an empirical case for two systems of reasoning. Sloman (1996) also provided a summary of the properties of these two systems, which is reproduced in Table 1.

Integrating previous research, Kahneman (2003) likewise summarized and labeled two types of operations in judgments, decisions, choices, and behavior: operations of System 1 that tend to be automatic, effortless,
associative, implicit, and often emotionally charged, and operations of System 2 that are slower, consciously and deliberately monitored, and potentially rule governed. Evans (2008) reviewed a diverse set of proposals for dual processing in higher cognition in cognitive and social psychology literature, and observed that almost all authors agree on a distinction between processes that are unconscious, rapid, automatic, and high capacity (referred to by a generic and most neutral term System 1), and those that are conscious, slow, and deliberative (System 2). As another distinction of the two processes, Masicampo and Baumeister (2008) explained the differences as follows: while one process makes automatic judgments based on associative and intuitive feedback, the other process is more effortful and relies on the application of normative rules of reasoning.

Table 1

**Characterization of the Two Forms of Reasoning**

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>Associative system</th>
<th>Rule-based system</th>
</tr>
</thead>
<tbody>
<tr>
<td>Principles of operation</td>
<td>Similarity and contiguity</td>
<td>Symbol manipulation</td>
</tr>
<tr>
<td>Source of knowledge</td>
<td>Personal experience</td>
<td>Language; Generic; Formal systems.</td>
</tr>
<tr>
<td>Nature of representation</td>
<td>Concrete and generic concepts; Images; Stereotypes; Feature sets.</td>
<td>Concrete, generic, and abstract concepts; Abtracted features; Compositional symbols.</td>
</tr>
<tr>
<td>Basic units</td>
<td>Associations; Soft constraints.</td>
<td>Causal, logical, and hierarchical; Hard constraints.</td>
</tr>
<tr>
<td>Nature of processing</td>
<td>Reproductive but capable of similarity-based generalization; Overall feature computation and constraint satisfaction; Automatic.</td>
<td>Productive and systematic; Abstraction of relevant features; Strategic.</td>
</tr>
<tr>
<td>Illustrative cognitive functions</td>
<td>Intuition; Fantasy; Creativity; Imagination; Visual recognition; Associative memory.</td>
<td>Deliberation; Explanation; Formal analysis; Verification; Ascription of purpose; Strategic memory.</td>
</tr>
</tbody>
</table>

*Note.* Reproduced from Sloman (1996).

Some researchers consider these two systems are substitutes. Reyna and Ellis (1994) provided evidence to suggest intuition and heuristics are System 1 processes that usurp the effortful and analytical System 2 processes to achieve comparable results but with much less efforts. Gigerenzer and Goldstein (1996) considered System 1 processing is a fast and frugal substitute for elaborate and expensive System 2 thinking.

Interestingly, there have been no suggestions on how these two systems can be complementary. This is the contribution of our paper—we propose a practical model to integrate these two systems of reasoning. Intuitively, we believe that the properties of System 1 and System 2 are complementary and compensatory, and together they can generally improve the quality of decisions and judgments made consciously. This leads to our proposition of a dual systems cognitive model.

**A Dual System Cognitive Model**

A dual systems cognitive model to generally improve the quality of judgment and decisions and specifically to attenuate the unfavorable effects of availability, representativeness, and anchoring-and-
adjustment heuristics as discussed is proposed as follows:

\[ cc = x_1S_1 \times x_2S_2 \] (1)

The total cognitive capacity of an individual, \( cc \), is made up of two components: System 1 (\( S_1 \)) and System 2 (\( S_2 \)); \( x_1 \) and \( x_2 \) are the corresponding coefficients. \( S_1 \), \( S_2 \), \( x_1 \) and \( x_2 \) are individualistic and dynamic—they are different for individuals, different under different circumstances, and they change over time. * is the two-way, compensatory and complementary interaction between System 1 and System 2. System 2 is under the conscious control of an individual; System 1 is not.

**Model Praxis**

It is very easy to implement the proposed dual systems cognitive model. First we consciously set out to make the best decision. When we think we have made the final judgment or decision, put it aside and not to think about it for a while. If time is critical, simply take a break or briefly work on other entirely unrelated matters as distractions, the more challenging the distracting tasks the better. In sum, consciously give System 1 an opportunity to work on the issue or the problem. Not thinking about the issue or the problem for a while may lead people to avoid the negative impacts of heuristics, come up with new insights, allow dilution effect to work on the issue or the problem, and may attenuate the negative influence of primacy or recency effects. There is nothing to lose, and one never knows what System 1 might bring.

The model in practice can be illustrated with the planning of substantive analytical procedures by audit manager A. Audit standards (AU 329) define analytical procedures as evaluations of financial information made by a study of plausible relationships between financial and non-financial data. Substantiative analytical procedures involve an auditor to develop an expected value (“the expectation”), and to compare the recorded value against the expectation. A tolerable difference—the absolute difference between the expectation and the recorded value that would require investigation—also needs to be defined. The expectation and the tolerable difference are critical to the success and cost-effectiveness of the substantive analytical procedures, yet their estimations are highly subjective and judgmental.

System 2 is under the conscious control of audit manager A in the sense that A can consciously control the following aspects, among others. A can consciously select the sources of data to develop the expectation: financial and operating data; budgets and forecasts; competitors’ information; and analysts’ reports. A can consciously choose the method in developing the expectation: statistical or econometric models, or simply unaided judgmental forecast. A can consciously adopt a rule of thumb such as “tolerable difference is 10% of the expectation or less”. A can also consciously allow or disallow the unconscious component of System 1 to work on the development of substantive analytical procedures by “sleeping on it”, taking a break, or just simply being distracted from the conscious thinking of the analytical procedures. This is the extent of A’s conscious control on System 1—System 1’s contributions and the timing of their coming about are not under A’s conscious control.

The two-way, compensatory and complementary interaction between System 1 and System 2 in the proposed dual systems cognitive model, *, can be explained as follows.

System 2 is responsible for selecting all the input for the substantive analytical procedures decision, and these inputs are available as potential candidates for input into System 1. However, the selection of the available input for System 2 as input for System 1 is entirely at the discretion of System 1. System 2 is responsible for all the tasks that require precision, logic and rule-compliance—the quantitative tasks that
System 1 cannot perform. The complete decision making process proposed by the dual systems cognitive model has three stages: (1) deliberation by System 2; (2) deliberation by System 1, which includes the first stage’s output as input; and (3) deliberation by System 2 as the final stage, which includes second stage’s output as input. System 2 compensates and complements System 1 in the second stage; System 2 compensates and complements System 1 in the final stage.

Mitigating Deficiency of Anchoring-and-Adjustment Heuristic (Recency Effect) and Promoting Dilution Effect

Recency effect occurs when inappropriate high weights are assigned to the latest information received. Experiencing information overload, auditors might suppress non-diagnostic evidence. Even if the non-diagnostic evidence is included in one’s cognitive process, it might not be assigned the appropriate weight because of recency effect. We hypothesize that System 1 has less chance of information overload than System 2, because it has greater capacity and that it is not involved with rule and logic. We also hypothesize that, because of its unconscious nature, System 1 has less chance of suffering from the negative impacts of anchoring-and-adjustment heuristic, and would therefore be more consistent in assigning optimal weights to factors of consideration. In other words, in a cognitive process that involves System 1, there is less chance for an auditor experiencing recency effect by not assigning inappropriate high weight to the latest information, and more chance for an auditor to realize the benefit of dilution effect by assigning appropriate weights between diagnostic and non-diagnostic evidence.

Mitigating Availability and Representativeness Heuristics

The ease with which events or ideas come to mind is the common factor behind availability heuristic (Tversky & Kahnman, 1974; Schwarz, 2004). For example, frequent citation and hence reporting of a particular audit procedure in the literature and media would increases its availability in memory, and thus increases its likelihood of coming to mind and being selected. “Sleep on it” would mitigate the influence of ease of retrieval because of the delayed time factor, which allows an auditor to bring other less accessible audit procedures into consideration.

A limitation of using representativeness heuristic is the failure of taking individual uncertainty and characteristics into consideration. For example, there are common features among financial institutions; but it doesn’t follow that Bank A and Bank B share similar risk characteristics, and therefore an auditor should apply similar risk weightings to the two banks for auditing planning purpose. One way for an auditor to avoid the negativity of representativeness heuristic is to put the matter aside and mull over it for a while (as circumstances allow) before the auditor makes the final decision. A break from the continuously conscious deliberation of the matter may bring other less accessible but relevant information and factors into consideration.

Conclusions and Suggested Future Directions

Mumpower (1978) suggested three questions that behavioural accounting studies might address: (1) What task variables influence accounting judgment? (2) What individual difference variables are important? (3) How do task and individual difference variables interact? Heuristics research has provided some answers to the first question, but answers to the other two questions are still wanting. Shanteau (1989) expressed the concern that there doesn’t appear to have been much progress on theory development related to heuristics and biases in behavioural auditing studies. Some twenty years later since Shanteau (1989), the situation has not improved much.
As an attempt to address these concerns, we first provide some insights to Mumpower’s (1978) second question: what and how individual variables would affect auditors’ judgment and decisions, and propose a model that can attenuate some of the issues arising from these individual variables. The individual variables that we examine are availability, representativeness, and anchoring-and-adjustment heuristics. The model that we are proposing is a dual systems cognitive reasoning model—a model that would address the shortcomings of heuristics (which are largely cognitive) from a cognitive perspective. For the theoretical underpinning for our proposed model, we refer to the evidence that we humans do have two systems of reasoning: System 1 that is unconscious, associative, implicit, more emotional and less controlled, and so forth; and System 2 that is conscious, explicit, deliberate and rule-governed, and so forth. While previous researchers either treat these two modes of reasoning as two separate and unrelated processes, or assume that heuristics can be corrected by effort inducing mechanisms without considering the cognitive aspects, we integrate these two systems of reasoning—System 1 and System 2—into a cognitive reasoning model. The model is based on the concept that the total cognitive reasoning capacity of an individual is comprised of System 1 and System 2. Since the properties of these two systems are complementary and compensatory to one another, a cognitive reasoning process that integrates these two systems would therefore generally improve the quality of and attenuate the unfavorable impact of heuristics on judgment and decision making. We illustrate the process of our model with an example of audit planning, and explain how the model could specifically mitigate the deficiencies of availability, representativeness, and anchoring-and-adjustment heuristics, and promote dilution effect.

The pursuit of understanding the impact of the dual systems of reasoning on audit judgment and decisions could open a new frontier for behavioral auditing research. A few small steps forward are suggested as directions in future research in the subject matter.

Cognitive scientists, philosophers and psychologists could provide further insights into the nature of System 1 and System 2, and their interactions in judgment and decisions. Better understanding of the formulation of heuristics—how the two systems and their interactions assign and sum weights of one’s experience over time—would further enrich audit decision and judgment models. Finally, a challenge for cognitive scientists and psychologists: Is it possible for individuals to have some conscious control on System 1, or at least, one can consciously facilitate System 1 to participate in the cognitive process?

There are many challenges in the suggested research. Various disciplines have different theoretical assumptions and research methods, and a multidisciplinary approach could lead to additional constraints. However, given the findings emerging, it is likely that such inter-disciplinary approach would contribute more to the understanding of audit judgment and decision making, over and beyond what researchers can advance within their own disciplines independently.

References


