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Cognitive Decision Process: The Context of Auditors' Diagnostic Reasoning

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ABSTRACT

Based on a cognitive psychology framework, this article provides an insight into how auditors perform diagnostic reasoning tasks through an analytical review (AR) process. AR refers to the diagnostic process of identifying, investigating, and resolving unexpected fluctuations in account balances and other financial relationships in financial statements. Auditors performing AR typically follow four distinct components of a diagnostic, sequential and iterative (DSI) process, namely: mental representation, hypothesis generation, information search, and hypothesis evaluation. Through the DSI process, auditors are able to recognize and detect errors and irregularities in financial statements for the purpose of presenting a true and fair view of financial reporting, with the intention of communicating quality and reliable economic information of an enterprise to users.

ABSTRAK

Berdasarkan rangka kerja psikologi kognitif, rencana ini memberi pemahaman tentang bagaimana para juruaudit melaksanakan tugas taakulan diagnosis melalui proses kajian semula beranalisis (KSB). KSB ialah proses diagnosis untuk mengenalpasti, menyiasat dan menyelesai ketidakstabilan luar jangka imbangan akaun dan lain-lain perhubungan kewangan dalam penyata kewangan. Lazimnya juruaudit melaksanakan KSB mengikut empat komponen berasingan dalam satu proses diagnosis, jujukan dan lelaran (DJL) yang merangkumi perwakilan mental, penjanaan hipotesis, pencarian maklumat dan penilaian hipotesis. Melalui proses DJL, juruaudit dapat mengenali dan mengesan ralat dan kewujudan keadaan luar biasa dalam penyata kewangan demi untuk memaparkan satu laporan yang benar dan saksama dengan harapan dapat menyebarkan maklumat ekonomi yang berkualiti dan boleh dipercayai bagi sesebuah entiti perusahaan untuk kegunaan para pengguna.

INTRODUCTION

Financial reporting provides information about business enterprises that is useful for the decisions of individuals and groups external to the business, including investors, creditors, suppliers, customers, labour unions, financial analysts, and regulatory authorities (Financial Accounting Standards Board, 1978). The types of information are governed by bodies such as the Securities and Exchange Commission and the Financial Accounting Standards Board. For the purpose of enhancing confidence in the reliability of the information in financial reporting, the reports are required to be audited by independent public accounting firms (auditors).

This paper discusses how auditors use diagnostic reasoning to recognize and detect the errors and irregularities in a company's financial reporting through the analytical review (AR)[1] process in order to achieve a fair presentation of economic information about an enterprise. In this respect, this paper takes a cognitive orientation based on grounded psychology theory. This paper has three sections. The first section provides an overview on AR as a diagnostic-inference process; the second section describes a comprehensive framework for AR and the final section presents the conclusion.

AR AS A DIAGNOSTIC-INFERENCE PROCESS

Audit AR involves identifying and determining the cause of unexpected fluctuations in account balances and other financial relationships. Following Libby (1985), AR is characterized as a diagnostic-inference process. Blocher & Cooper (1988) find that auditors performing AR typically follow four distinct components of diagnostic inference: mental representation, hypothesis generation, information search and hypothesis evaluation. That is, auditors initially recognize unusual fluctuations in a company's financial statements by acquiring and evaluating relevant problem information (mental representation), subsequently generating potential causes for the observed unusual fluctuations (hypothesis generation), and finally searching for and evaluating information relevant to those causes (information search and hypothesis evaluation). These four components along with the ultimate outcome of the diagnostic process, a decision about subsequent audit actions, are shown in Figure 1.

As the AR process is also sequential (Blocher & Cooper, 1988; Biggs, Mock & Watkins, 1989), the auditors must acquire sufficient information to identify an unexpected fluctuation before generating potential causes for the fluctuation and seeking out and evaluating information relevant to those causes. As the auditor may reperform the diagnostic-inference process which involves the four components mentioned above, the AR process can be further characterized as iterative. For example, after obtaining and evaluating information pertaining to a particular hypothesis, the auditor may decide that it does not describe an unexpected fluctuation and, thus, would generate additional hypotheses.

The next section presents a comprehensive framework for AR, based on the four components of a diagnostic, sequential, and iterative (DSI) process: mental representation, hypothesis generation, information search, and hypothesis evaluation.

THE FRAMEWORK FOR AR

Mental Representation

Current cognitive models of behaviour, in both psychology and auditing, indicate that diagnostic reasoning is goal-driven (Newell & Simon, 1972; Anderson, Koonce, & Marchant, 1991). In auditing, the goal of AR is not fixed. That is, if AR is used for planning purposes, the goal may be to identify high and low risk areas to facilitate planning the nature, timing, and extent of other audit procedures. In contrast, if AR is used for final overall review purposes, the goal may be to assess the reasonableness of the financial statements taken as a whole. Despite the difference in the goals of AR, the DSI characterization described herein is sufficiently general to portray the AR process.

Once the auditor has identified the primary goal of AR, the task must be broken down into smaller components and sub-goals must be developed (Simon, 1973). The initial subgoal is to sufficiently comprehend the available problem information so that unusual fluctuations, if any exist, may be uncovered (Peters, Lewis & Dhar, 1989; Peters, 1990) and the diagnostic problem-solving process can proceed. This information, which includes financial and non-financial information provided by the client and other sources, is brought to bear on the goal-directed AR situation through the mechanism of a mental representation. A mental representation contains the current formulation, or understanding, of the problem situation (Sanford, 1985).

When initially attempting to understand a problem, an individual will use available information to isolate relevant declarative and procedural knowledge[2] stored in long-term memory. What is formed is a mapping between the problem information and the knowledge structures in long-term memory, resulting in an initial representation. This representation suggests not only the attention given to external information and the general and domain-specific knowledge retrieved from long-term memory, but also the manner in which such information and knowledge are evaluated (Chi, Feltovich & Glaser, 1981; Greeno & Simon, 1988). Procedural knowledge guides the manipulation of the representation in working memory as problem solving progresses. Chunking is used to store components of the representation in long-term memory, a manipulation which avoids overtaxing working memory. Although the mental representation is dynamic and changes as new information or knowledge is considered and as potential judgements are appraised, the initial representation is particularly important since it can either facilitate or inhibit the subsequent problem-solving process (Caroll, Thomas & Malhotra, 1980; Kassirer & Kopelman 1987, 1989).

In performing AR, auditors consider a large and varied amount of financial and non-financial information when formulating mental representations (Blocher & Cooper, 1988; Peters, 1990). Such representations typically also contain an expectation for the financial statement relationship under investigation. This expectation assists the auditor in identifying unusual fluctuations.

In terms of the DSI framework, the development of a mental representation provides the basis for subsequent problem solving. That is, the knowledge and information contained in the representation guides and constrains the subsequent hypothesis generation, information search, and hypothesis evaluation activities. Since AR is a sequential and iterative process, this mental representation will be revised after the auditor has generated hypotheses and then obtained and evaluated information pertaining to those hypotheses (see Figure 1).

Hypothesis Generation

If, based on the initial mental representation, the auditor concludes that an unexpected fluctuation in an account balance or financial ratio does not exist, the remaining components of AR typically need not be performed. However, if the auditor concludes that an unexpected fluctuation does exist, the next sub-goal in the process is to generate potential explanatory hypotheses or causes. By suggesting the relationships that should be present and those that should be absent if a particular hypothesis is correct, hypotheses (along with the rest of the information and knowledge contained in the mental representation) form a context within which a subsequent information search takes place.

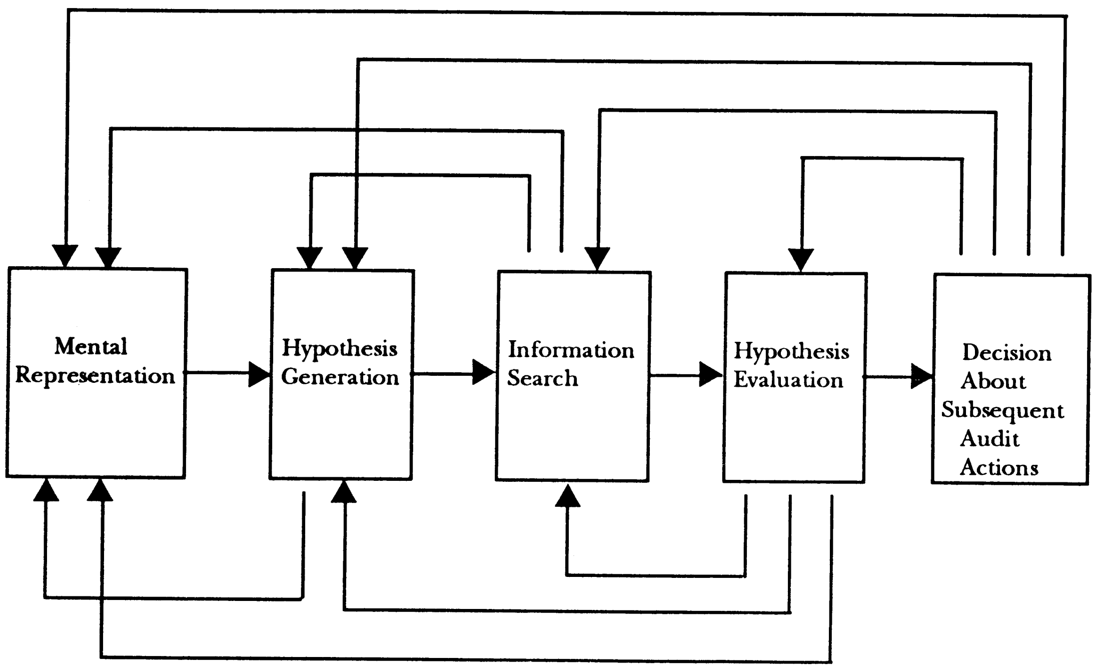
Hypotheses can be acquired from sources that are either internal or external to an individual. In terms of internal, or memory-based, generation of hypotheses, Fisher, Gettys, Manning, Mehle and Baca (1983) have developed a descriptive model of the hypothesis generation process. Their model has two stages, a memory retrieval process and a separate plausibility assessment process. In the initial retrieval stage, potential hypotheses stored in long-term memory are converted from an inactive state. Problem information (which can include single or multiple data items, previously generated hypotheses, or inherited hypotheses) is used to facilitate retrieval (Collins & Loftus, 1975). Since hypothesis retrieval is triggered by the first few information items examined or hypotheses considered, a retrieval hypothesis may be inconsistent with the remaining information not used in the retrieval process.

In the second stage of the two-stage hypothesis generation process, a (non-conscious) preliminary plausibility assessment of the activated hypothesis is made. This process is termed consistency checking and is used to evaluate the hypothesis in terms of its suitability in accounting for the information contained in the mental representation. If non-conformity occurs, the process stops and the hypothesis is discarded as inconsistent. If, however, the hypothesis survives consistency checking, the hypothesis is retrieved from the memory and incorporated into the individual's mental representation.

For hypothesis generation in AR, most studies have examined auditors' abilities to self-generate hypotheses once they inherit an initial hypothesis from an external source. Exceptions are studies done by Bedard and Biggs

FIGURE 1

The Diagnostic, Sequential, and Iterative Process of Analytical Review



(1991a) and Libby (1985). Libby demonstrates that an auditor who self-generates an initial error hypothesis in response to an unexpected fluctuation will use that hypothesis as a retrieval cue and generate other error hypotheses from the same transaction cycle. This 'cueing' effect occurs because once a particular portion of memory decreases, it facilitates the retrieval of additional information from that portion. Libby also establishes that the frequency with which errors are perceived to occur and the recency of experience affect the likelihood that such errors will be retrieved from the memory. These results were attributed to the increased strength of associations and retrieval properties in memory for frequently and recently experienced errors.

In terms of the plausibility assessment stage of hypothesis generation, several AR studies have found that experience plays a key role in this process. Libby and Frederick (1990) find that more experienced auditors generate more plausible and fewer implausible hypotheses in AR than less experienced auditors. They suggest that this occurs because as auditors become more experienced, their knowledge store of plausible financial-statement errors increases in size and the number of memory linkages to implausible errors is reduced. Bedard and Biggs (1991b) extend the Libby and Frederick study by noting that industry specific experience is a better predictor of the auditor's ability to identify the correct cause of an unexpected fluctuation than is general audit experience. Noteworthy though was the fact that the experienced auditors' ability to identify the correct cause was significantly influenced by whether the correct solution to the case was given to the auditors as an inherited hypothesis from client management. Kaplan, Moeckel, and Williams (1992) report that more experienced auditors performing AR consider non-error events to be more plausible causes (and error events to be less plausible causes) for unexpected fluctuations than do less experienced auditors. The accumulated direct experience of the more experienced auditors was cited as the factor that allows them to better understand that financial-statement errors are relatively rare in comparison with non-error events.

In terms of the DSI characterization of AR, the auditor's acquisition of a hypothesis or hypothesis set can be viewed as the refinement of the initial mental representation. That is, the auditor's representation is updated now to include one or more potential hypotheses or causes of unexpected fluctuation. Since AR is an iterative process, this representation will continue to be updated once the auditor has obtained and evaluated information pertaining to those hypotheses.

Information Search

Once a plausible hypothesis (or set of hypotheses) has been generated, the auditor's next sub-goal in the DSI process of AR is an information search, aimed primarily at uncertainty reduction. That is, the auditor searches for information until relatively certain about the cause-effect relationship at hand (Biggs et al., 1988). In this information search process, the content of the mental representation is important since it contains not only factual information relevant to the problem situation, but also procedural knowledge that provides guidance on conducting the search (Anderson et al., 1991). Like hypotheses, information to support or refute a particular hypothesis can be obtained internally from long-term memory or from external sources such as the client, the audit team members, workpapers, and industry data sources.

Psychology research suggests that when searching for information relevant to hypotheses, individuals typically focus on only one possible hypothesis and ignore information relevant to alternative hypotheses (e.g., Taplin, 1975; Major, 1980). Shaklee and Fischhoff (1982) note that such a truncated-search strategy, in which the individual clarifies the role of one hypothesis without proceeding to consider other hypotheses, is appropriate only when there are two mutually exclusive hypotheses. If there are multiple potential hypotheses that may not be mutually exclusive, this truncated-search strategy poses considerable risk (Klayman & Ha, 1987). A truncated-search strategy is analogous to the confirmation bias in which individuals tend to seek out or rely heavily on confirmatory, rather disconfirmatory, information when testing hypotheses (Wason & Johnson-Laird, 1972).

Shaklee and Fischhoff identify two other possible search strategies that individuals can follow when searching for information relevant to a hypothesis set. Individuals can perform a serial search that involves clarifying the role of one hypothesis is before considering others. Alternatively, individuals can perform a parallel search by seeking out information about all possible hypotheses before making any causal judgements. From their experimental investigation of the relative prevalence of these three search strategies, Shaklee and Fischhoff find that a greater proportion of individuals follow the truncated-search strategy than follow serial- or parallel-search strategies. That is, individuals who suspect that a hypothesized cause is involved in an event prefer to learn additional information about that hypothesis rather than learn about other potential hypotheses that also might have influenced the event. Such behaviour was noted to have important implications for the effectiveness of problem analysis, since the foregoing information search could have easily indicated that another cause(s) was relevant to the analysis.

In the AR domain, experience appears to affect auditors', information search strategies. Biggs et al. (1988) find that audit managers take a 'managerial' or parallel-search approach to information acquisition, while audit seniors take a 'follow-the-instruction' or serial-search strategy. The authors suggest that audit managers appear to have well-developed knowledge structures that allow them to focus on acquiring information to understand the client, the nature of business, and any potential business problems. Lacking well-developed knowledge structures, audit seniors spend more time acquiring the minimum amount of information to perform the AR task as outlined in the case instructions. Similar results were obtained by Kaplan and Reckers (1989). They report that while less experienced auditors primarily seek information confirming an initial hypothesized cause (i.e., follow a serial- or perhaps truncated-search strategy), more experienced auditors also seek information about causes other than the initial hypothesized cause (i.e., follow a parallel-search strategy).

Also within AR, Waller and Felix (1987) demonstrate that, consistent with a parallel-search strategy, auditors generally consider information pertaining to a hypothesized cause to be as important as information pertaining to other causes. Interestingly, though, auditors' causal judgements were affected to a greater extent by the information supporting other causes. Church (1991) reports that as auditors become more committed to their initial hypotheses, they attach more importance to confirming evidence. This result may suggest that increased commitment causes auditors to employ serial- or truncated-search strategies.

In terms of the DSI model of AR, the auditor's search for information to confirm or disconfirm a particular hypothesis or set of hypotheses leads to additional modifications of the auditor's mental representation. The type of information obtained by an auditor, as well as the information search strategy, are important since they influence how auditor's mental representation will be updated during the subsequent hypothesis evaluation phase of AR.

Hypothesis Evaluation

The next sub-goal in the auditor's DSI process of AR involves evaluating the validity of the current hypothesis (hypotheses) in light of the information in the mental representation. This section presents a discussion on the algebraic-updating hypothesis evaluating models which have been tested empirically within the AR domain.

One algebraic-updating model is the Bayesian model, which posits that hypothesis evaluation follows the Bayes' rule (Edwards, Lindman, & Savage, 1963). While the Bayesian model is not generally considered to be a descriptive model of judgement, it is frequently used as benchmark of normative behaviour (Ashton & Ashton, 1988). Another algebraic-updating model is the belief-adjustment model (Hogarth & Einhorn, 1992), a descriptive belief-revision model that was developed as an alternative to the normative Bayesian model. The belief-adjustment model considers the effects of information presentation order on the judgement-formulation process and, depending on various task conditions, can predict primacy, recency, or no order effects for sequential processing of information. A third algebraic-updating model is attribution theory (Kelly, 1973). When an individual has information from multiple observations, the theory proposes that hypothesis evaluation will be based on the covariation principle. This principle suggests that an effect is attributed to the cause with which, over time, it covaries. Alternatively, when an individual has information from only a single observation, attribution theory proposes that hypothesis evaluation will be based on the use of causal schemata. Causal schemata refer to the way a person thinks about plausible causes in relation to a given effect. The discounting schema, for example, would contend that the role of a given cause in producing a given effect is discounted or reduced, if other plausible causes also are present.

While some hypothesis evaluation situations are adequately described by the Bayesian, belief-adjustment, and attribution models, other more complex situations require different hypothesis evaluation models. These are situations where a large amount of information is available, the information is piecemeal and incomplete, and subparts of the information are not independent in their implications for the hypotheses under consideration. These situations require the creation of mental representations that contain not only the available information but also elaboration and abstractions.

One theoretical framework specifically designed to handle ill-structured problem situations is Pennington and Hastie's (1988) explanation-based approach to hypothesis evaluation. Their model suggests that decision makers construct causal explanations for the available problem information and then base subsequent decisions on the causal interpretation imposed on the evidence. This process results in a mental representation of evidence that incorporates inferred events and causal connections between events. The ease with which causal explanations are developed and, thus, the decisions are made, and the confidence assessments implicit in those decisions are suggested to be a function of the manner in which problem information is presented.

Another hypothesis evaluation model suitable for ill-structured situations is belief perseverance (Ross & Lepper, 1980; Jelalian & Miller, 1984). This model predicts that when information is causally and sequentially evaluated, the information considered first has a greater impact on final judgements than the information considered later. This primacy effect is often measured by examining an individual's adherence to an initial belief about a target event, following full discrediting of the information source for that belief. This effect is noted to be greatest when the individual has previously developed a written explanation supporting the belief. The phenomenon of a stronger target-event belief after the development of a written explanation has been termed the explanation effect.

Within the AR domain, only three of these five hypothesis evaluation models — the Bayesian, attribution, and belief-perseverance — have been empirically investigated. Biggs et al. (1988) demonstrate the inadequacy of the Bayesian model as a descriptor of hypothesis evaluation in AR. Specifically, they find that auditors appear to overly adjust for the informativeness of problem data by making assumptions and conditional judgements to establish conditions under which a cause-effect relationship would appear certain, thereby showing no evidence of Bayesian reasoning.

Several AR studies have investigated the attribution model of hypothesis evaluation. Waller and Felix (1987) report that when evaluating hypotheses, auditors are sensitive to the objective covariation level in the available data, but they tend to overstate or understate this level. They also note that the ability to judge covariation is not positively related to audit experience. The later finding is consistent with psychological research suggesting that learning covariation patterns is difficult, even with substantial task experience (Holyoak & Nisbett, 1988). Also within the attribution framework, Heinman (1990) shows that auditors use the discounting schemata when performing AR. Specifically, auditors discount or reduce their initial probability assessments for an inherited hypothesis when alternatives are either provided to them or (under certain circumstances) are self-generated. Her results also indicate that auditors discount alternatives based on the number of such alternatives presented rather on than their strength (i.e., frequency). Nelson (1992) tests the interaction between the usage of the covariation principle and causal schemata. In a non-audit context, Nelson observes that when information that is highly diagnostic of a low-frequency error conflicts with equally diagnostic evidence of a high-frequency error, the low-frequency error is typically erroneously judged to be the more likely cause. This phenomenon, termed the inverse base rate effect, is consistent with prior psychological research (Medin & Edelson, 1988). Within the context of audit analytical review, however, Nelsons results indicate that the inverse base rate effect does not occur.

In terms of the belief-perseverance model, Koonce (1992) finds that when performing AR, experienced auditors who have written an explanation for an hypothesized cause assign a higher probability to that cause than do auditors who have not written an explanation. That is, the explanation effect was observed. Also consistent with this theory, Koonce finds that once auditors develop written explanations for an hypothesized cause, their beliefs in the validity of that cause appear to persevere unless the auditors are explicitly requested to counterexplain.

In terms of the DSI characterization of AR, the auditor's evaluation of a hypothesis (or hypothesis set) allows him/her to appraise the likelihood that one or more previously generated hypotheses explains the unexpected fluctuation. That is, it allows the auditors to update his or her mental representation of the AR problem situation by incorporating into it an evaluation of the validity of one or more hypotheses.

Analytical Review Decision

The auditor's final sub-goal in the DSI process of AR is to make a decision about subsequent audit actions, namely to evaluate whether the primary goal of AR has been met. More specifically, the auditor renders a judgement about the validity of a hypothesized cause which, in turn, influences the auditor's judgement about the fair presentation of an account balance(s). Based on this later judgement, the auditor would then decide on appropriate course of action [e.g., perform additional AR, adjust planned substantive testing, accept the account balance(s)]. This process is illustrated in Figure 2 and described more fully below.

Once a hypothesis or hypothesis set has been evaluated in light of the available information, the auditor will have formulated a belief, or judgement, about that hypothesis. The auditing literature has suggested that when the situation requires a causal explanation, the auditor's judgement is likely to be in the form of an epistemic probability (Anderson, 1985) which concerns the degree to which the outcome is implied by the evidence and is essentially equivalent to a strength-of-belief measure. Since hypothesis evaluation in AR often involves the development of mental and written causal explanations, reasoning using epistemic probabilities appears to be relevant to this context. That is, an auditor's judgement would be a function of how well the hypothesized causal explanation accounts for the unexpected fluctuation (see Peter, 1990).

Once the auditor makes a judgement about the validity of a hypothesized cause, this judgement serves as an input to a judgement regarding the fair presentation of an account balance(s). The relationship between these two judgements should depend on the type of cause involved. More precisely, when strongly believing in the validity of a non-error (error) cause of an unexpected fluctuation, the auditor also strongly believes that the account is (is not) fairly presented.

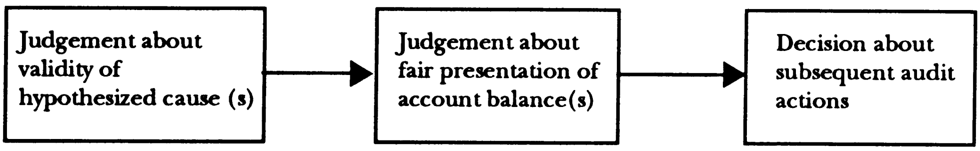
Once a judgement regarding fair presentation of an account balance(s) has been made, the auditor would then use that judgement to decide on an appropriate audit action. Compared with the relationship between judgements about a cause and a fair presentation, the relationship between judgements about fair presentation and audit action decisions is less straightforward. As the auditor is able to select numerous actions, depending on the primary goal of AR, it follows that there are different judgement thresholds at which the auditor may deem each of those actions minimally accepted (see Asare, 1992). Not only are these thresholds situation-specific, they are also a function of the auditor's loss function (Beck, Solomon, & Tommasini, 1985). Given a menu of action choices, the auditor will select the action for which his or her actual belief is greater than the threshold associated with that course of action, but less than the threshold of the next action. To the extent that no decision threshold has been met (or that a preferred decision's threshold has not been met), the auditor will return to the preceding components of AR and iterate through them until his or her judgement about fair presentation is above a pre-specified threshold.

CONCLUSION

Based on grounded psychological theory, this paper has taken a cognitive orientation and presented an overview that provides an insight into how auditors perform diagnostic reasoning through the AR process. Auditors performing this task typically perform the four components of a diagnostic, sequential, and iterative (DSI) process: mental representation, hypothesis generation, information search, and hypothesis evaluation. Through this DSI process, auditors are able to perform diagnostic reasoning to identify, investigate, and resolve unexpected fluctuations in account balances and other financial relationships present in a company's financial statements or reports. The purpose of this is to enhance confidence in the reliability of the information in the financial reporting, with the intention of achieving a fair presentation of economic information of an enterprise that is useful for the decisions of individuals and groups external to the business.

FIGURE 2

The Relationship Between Analytical Review Judgements and Decision



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ENDNOTES

1. Analytical review (AR) refers to the diagnostic process of identifying, investigating, and resolving unexpected fluctuations in account balances and other financial relationships.
2. Declarative knowledge involves factual information (e.g., sales recorded in the wrong period is a financial-statement error) while procedural knowledge entails knowing how to do something (e.g., assessing financial viability).

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