Auditor Confidence in Management’s Plausible Explanations

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Introduction

Using professional judgment is a central component in identifying areas where there are risks of material misstatement. Nonetheless, prior research shows that auditor decision-making is negatively affected by heuristics and biases, such as base rate and sample size neglect (Case, Fantino, and Goodie, 1999; Lovett and Schunn, 1999; Vinck et al., 2011; Pennycook and Thompson, 2016). The distortions in judgment that result from these cognitive biases often lead to insufficient evidence collection, an inappropriate audit opinion, audit firm reputation impairment, and/or costly litigation exposure. Similarly, erroneous auditor decision making can waste audit resources, unnecessarily increase audit costs, and result in dissatisfied clients. A proper auditor risk assessment is vital to first forming the prudent professional judgments necessary to avoid audit hazards. Therefore, discerning the processes and frameworks that auditors utilize to assign and reassign risk during an engagement is imperative to academics, practitioners, and standard setters who strive to understand and improve audit quality.

Unfortunately, previously developed schema for modeling risk assessment have usually modeled the process as a single-stage event and have failed to properly account for the reassignment of probabilities that occurs when certain concerns are eliminated (Allen et al., 2006). Since audit risk assessment is a recursive process that requires a reassessment when certain options are no longer a possibility, models that focus on only the initial risk allocation are of limited value. Since prior risk assessment paradigms are bounded in terms of understanding judgment, we present the Monty Hall Problem (MHP) as an alternative framework for explaining auditors’ assignment of revised probabilities when multiple sources of risk are present. Furthermore, previous frameworks for assessing audit risk have not commonly examined poor audit risk allotments as a function of erroneous probabilistic reasoning.

Furthermore, auditor judgment also brings serious concerns about insufficient levels of professional skepticism in professional practice (Nelson, 2009). In August 2013, Public Company Accounting Oversight Board (PCAOB) member Jeanette Franzel reiterated these concerns when she stated that a lack of professional skepticism in auditing was one of the main reasons for the pervasiveness of audit deficiencies and exhorted practitioners to increase their professional skepticism (PCAOB, 2013). While previous research has examined how cognitive biases and affective influences can impact professional skepticism (Anderson et al., 2004; Bhattacharjee and Moreno, 2002), the literature has not yet examined how an erroneous reallocation of probability assessments can contribute to decreased professional skepticism by overestimating the likelihood of managerial explanations. Therefore, we will utilize the MHP framework to indicate how fallacious probabilistic reasoning can lead to decreased professional skepticism and a likely increase in audit failure or inefficiency.

Despite the importance of risk assessment to the completion of a successful audit, severe risk assessment deficiencies still exist in professional practice. For instance, the PCAOB noted that firms failed to comply with one or more Risk Assessment Standards in twenty-seven percent of the audits inspected for compliance (PCAOB, 2015). Furthermore, risk assessment deficiencies were a significant component of an observation that audit opinions were not supported when issued.

Recent PCAOB and Statements on Auditing Standards (SAS) audit standards have further highlighted the importance of risk assessment in improving the effectiveness of the audit (Fukukawa and Mock, 2011, p.76). For example, Auditing Standard (AS 2110), Identifying and Assessing Risks of Material Misstatement, states that “(T) the objective of the auditor is to identify and appropriately assess the risks of material misstatement, thereby providing a basis for designing and implementing responses to the risks of material misstatement” (AS 2110, paragraph 3, PCAOB, 2010). In addition, the
Committee of Sponsoring Organizations (COSO) framework (COSO, 1992) identifies risk assessment as one of the five components of internal control, calling for assessment of the likelihood of risk and fraud in particular, in Principles 7 and 8, respectively (COSO, 2013). Thus, assessment is a recursive process that includes both identifying the nature of various risks, and estimation of their likelihood.

During the planning stage of the audit, risk assessment procedures are performed and initial responses to the risks of material misstatement are developed (AS 2110, paragraph 5, PCAOB, 2010). Audit risk assessment procedures include analytical procedures, as well as inquiries with management and others within the company. These procedures are necessary for making proper risk allotments, performing the appropriate quantity and quality of further audit procedures, and choosing the proper audit opinion. Analytical procedures assist auditors in identifying areas of specific risk. Inquiries may be used to gather evidence to understand potential sources that create the risk of misstatement, as well as to better measure the probability of misstatement (AS 2110, paragraph 46–55, PCAOB, 2010). Part of identifying and measuring the risk probability is determining the “likely sources of potential misstatements…by asking ‘what could go wrong?’ within a given significant account or disclosure (AS 2110, paragraph 61, PCAOB, 2010).” Risk assessment during the planning stage assists the auditor in effectively allocating resources to mitigate the probability of a material misstatement in the final financial statements. An improper risk assessment during the planning stages could, therefore, seriously impair audit quality.

For example, during the planning stage, auditors have found a potential area of misstatement. The auditors have also identified three potential causes of the misstatement, assigning equal probabilities of 0.33 to each source. After discussions, management provides a plausible explanation to remove one of the sources of misstatement. The auditors then revise their risk probabilities equally (0.50) between the two remaining sources of misstatement. However, under a Bayesian model these two potential sources of misstatement would be overstated. This paper introduces the concept of the MHP that explains the revised overstated risk probabilities that may occur during the planning stage of the audit. In addition, we discuss an alternative framework for future research that explains auditors’ assignment of revised probabilities when multiple sources of risk are present.

Our paper is organized as follows: First, we briefly discuss the relative research and present a detailed introduction to the MHP. Second, we present the traditional ‘refuted door neglect,’ an assumption found in the MHP under conditions of equal and unequal probabilities. Third, we remove the assumption of ‘refuted door neglect,’ and introduce the alternate ‘refuted explanation neglect,’ an assumption consistent with an audit planning scenario. Finally, we further generalize the traditional MHP scenario to an audit setting by removing the problems’ base assumptions, which are limited to three alternative explanations.

**Literature Review**

Research has attempted to model the auditor’s risk assessment by comparing probability theory to various belief revision models (see for example: Fukukawa and Mock, 2011; Krishnamoorthy, Mock, and Washington, 1999; and Cobb and Shenoy, 2003). In general, the results of these studies find that probability and belief revision models are interchangeable and tend to be consistent in direction. This paper introduces an alternative model that may explain auditor behavior when revising probability-based risk assessments. While the MHP had been examined in the statistical and psychology literature (see for example: Baratgin, 2009; and Granberg, 1999), it has not yet been extended to audit research.

While some risks arise from events beyond the control of the organization, accounting and auditing research has focused on risks arising from the divergent goals of principals (i.e., owners and auditors) and agents (managers). Several streams of analytical, experimental and archival research evaluate alternative monitoring mechanisms and audit procedures in an attempt to mitigate the risks and costs arising from this divergence (i.e., agency costs). This is particularly true in situations where the agent has information that is not available to the principal (Jensen and Meckling, 1976; DeAngelo, 1981; Watts and Zimmerman, 1983; Palmrose, 1984; Francis and Wilson, 1988; DeFond, 1992; Hope, Langli, and Thomas, 2012). Critical to the management of agency costs is the ability of the auditor to produce accurate initial judgments of the probability that an undesirable event has occurred in light of incomplete evidence, and to decide whether more evidence is needed during the testing phase of the audit.

A significant body of audit research has examined how auditors assess risk likelihood, including how auditor’s professional skepticism and resulting decision-making is negatively affected by heuristics and biases identified in cognitive psychology research. These biases include base rate and sample size neglect, anchoring and adjustment, and source reliability (Nelson
Cognitive psychology literature theorizes that both base rate neglect and sample size neglect are two types of extension neglect, which occurs when subjects ignore the size of a set when it is in fact relevant (Kahneman and Frederick, 2005). This article also discusses the introduction of an alternative extension neglect that we describe as ‘refuted explanation neglect.’ This form of neglect may occur during the planning stage of an audit when auditors investigating the reasons for anomalous outcomes ignore the existence of alternative explanations that management refutes. This effect reduces the apparent likelihood of remaining explanations managers have chosen not to refute (e.g., one that would reflect negatively on them), leading to premature cessation of investigation and the risk of audit failure that exceeds the auditor’s threshold.

Extending the MHP to Audit Research

Below, we use the MHP, a well-known decision-making problem, as an accessible illustration of this effect in settings with alternatives having equal and unequal probabilities, extending the MHP to audit research. A significant body of theoretical and experimental research on decision-making has investigated the MHP but has not proposed an alternative extension neglect assumption. We demonstrate how the information asymmetry between the host and contestant, and the host’s selective disclosure of information about alternatives corresponds to the relationship between managers and auditors. We conclude that if auditors are subject to effects similar to those seen in experimental settings outside of auditing, there is a ‘refuted explanation effect’ in an audit setting that may potentially lead to an increased rate of audit failure.

The MHP and ‘Refuted Door Neglect’

The risk assessment scenario encountered by an auditor during the initial planning stages of an engagement is comparable to the dilemma facing a contestant on the popular television game show Let’s Make a Deal (originally hosted by Monty Hall). The series premiered in the U.S. but was later introduced in several countries throughout the world. In the program, the host presents the contestant with three closed doors and indicates that one of the doors conceals a new car while the other two doors conceal lesser prizes (i.e., goats). Each door has an equal likelihood (1/3) of hiding the vehicle. The host, unlike the contestant, has knowledge regarding whether a goat or car is behind each individual door. The contestant is initially provided the opportunity to win the car by selecting a door, which remains closed. After hearing the selection, the host then opens either the remaining door (assuming the door selected conceals a goat) or a door chosen at random from the two remaining options (assuming the door selected conceals the prize). Lastly, the contestant is permitted the option of switching his or her selection to the other unopened door. In order to maximize the probability of winning the vehicle, one must make an agonizing decision: what is the likelihood that my initially selected door conceals the car? (Baratgin, 2009). This dilemma is commonly known as the MHP or three-door problem (Krauss and Wang, 2003).

The instinctive, but erroneous reply supplied by many novice participants is: “Stay, since there is an equal likelihood that the car is behind either of the two closed doors” (Gill, 2010). However, a contestant in the three-door scenario can actually double his or her likelihood (2/3 instead of 1/3) of choosing correctly by switching doors. Further, the switching advantage increases as the number of total doors and doors concealing goats increases, provided that the selected door and one other door remain closed. The likelihood of winning by switching with N total doors and N-1 goats shown by the hosts is (N-1)/N (assuming each door has an initially equal likelihood of concealing the car).

Vos Savant (1997) demonstrates this phenomenon by prompting readers to visualize a MHP with a million doors: “Suppose there are a million doors and you pick number one. Then the host, who knows what is behind the doors and will always

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1 Extension neglect occurs when individuals ignore the size of a set in a situation where evaluating the size of a set is relevant. Examples include base rate neglect and sample size neglect. Base rate neglect occurs when individuals, if presented with generic base rate information and case-specific information, ignore the former while focusing on the latter. For instance, even though only an insignificant percentage of students become professional football players, parents of a gifted student athlete may erroneously think their child has a high likelihood of getting into the NFL even though very few student athletes achieve that level of success. Sample size neglect occurs when individuals infer stronger conclusions than warranted from a small information sample or infer less than warranted from a larger sample of information. For instance, an individual may believe that a higher variance in a small sample (n=8) of a population than in a population with a larger sample size (n=300) indicates that there is more variation in the former population.
avoid the one with the prize, opens them all except door number 777,777. You would switch to that door pretty fast. Wouldn’t you?” Since the likelihood of initially selecting the door concealing the car is infinitesimal (1/1,000,000), the vehicle has an exceptionally high likelihood (999,999/1,000,000) of being concealed behind one of the other 999,999 doors. If another door is hiding the vehicle, then the host will clearly indicate that door by leaving it unopened.

One can easily intuit the benefit of switching in this million-door scenario. However, the same principle applies in any three-or-more door scenario where each door has an equal initial likelihood of concealing the vehicle since the host is likely to be providing the contestant with a superior filtered option based upon private information. Another intuitive explanation (referencing the three-door problem) is provided by Simmons:

If I am the contestant and my strategy is to always stick with my initial choice, then the probability that I win is 1/3.
If my strategy is to always switch, then the probability that I lose is 1/3, since I lose only if the car is behind the door I first choose. As I either win or lose every time I play, the probability that I win using the switching strategy is 2/3 (Granberg, 1999).

Unfortunately, individuals often fail to properly respond to the MHP because they misunderstand the implications of the associated causal structure (Burns and Wieth, 2004). Repeated experimental studies indicate that only eight to fifteen percent of participants choose to switch and that this effect is immune to the number of initial incorrect doors in the scenario (Granberg and Dorr, 1998). In repeated trials, subjects increase their switching rate to an apparent plateau at fifty percent (Granberg and Brown, 1995; Herbranson and Wang, 2014), indicating that, even with experience, at least half of all participants do not perceive value in switching. The literature does however, demonstrate that repeated simulations can improve participants’ choice behaviors, although these repetitions often fail to enhance the understanding of objective probabilities (Franco-Watkins et al., 2003).

Moreover, Granberg (1999) found that there were also no significant cross-cultural differences in responses to the MHP. Regardless of their country of origin, individuals from different geographic regions were equally likely to stick with an initial option when switching would have been the optimal choice. Furthermore, the literature has found that various situational and personal factors, such as task distractions and working memory limitations, can further reduce the likelihood of correctly responding to the MHP (Tor and Bazerman, 2003; De Neys and Verschueren, 2006).

The apparent overestimation of the likelihood of the selected door when only two doors remain (1/2 rather than the correct 1/3 in a three-door game; 1/2 rather than 1/10 in a ten-door game) arises because the contestant has to reallocate the overall probability to the two remaining doors. Their reallocation is in proportion to the latter’s original likelihood (the 50:50 hypothesis). This strategy renders the original number of doors irrelevant. Franco-Watkins et al. (2003) confirm the dominance of the 50:50 hypothesis explicitly in an experiment, concluding that “participants…respond as if revealing a door creates a new problem space that is not conditional on the prior problem space” (pg 87).

However, the 50:50 hypothesis does not indicate “why” switching rates are not approximately fifty percent or higher. If the hypothesis is true, there is no reason to switch, and other psychological factors, such as avoiding regret when switching selects a goat, are likely to be influencing the participant (Granberg and Brown, 1995). Granberg and Brown (1995) also suggest that a participants’ illusion of control also explains the low switching rate. Research has found that fifty-five percent of subjects switch, after removing the illusion of control, i.e., another person selected the contestant’s door (Granberg and Dorr, 1998).

The insensitivity to the number of doors opened (i.e., doors which have been refuted as hiding a car), which we will call ‘refuted door neglect’, is consistent with the ‘extension neglect’ effect as described by Kahneman and Frederick (2005), who cite the neglect of sample size and base rates as examples. To illustrate sample size insensitivity, Tversky and Kahneman (1974) describe how students’ estimates of how often the percentage of boys born at a hospital (known to be about fifty percent) would exceed sixty percent, is unaffected by whether a hospital is small (fifteen babies per day) or large

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2 As an indicator of how difficult humans find this problem, Herbranson and Wang (2014) find that, in contrast to humans, pigeons reach optimal switching levels in a relatively short time.

3 Note that if subjects perceive the two remaining doors as having equal probabilities, they are indifferent to switching. Absent switching costs, choosing to switch does not signal that subjects perceive an advantage to doing so, i.e., that they perceive the doors’ probabilities to be unequal. However, choosing to stay put does signal they perceive no advantage to switching, i.e., that the probabilities are equal.
(forty-five babies per day). This ignores the fact that a larger sample size will significantly reduce the likelihood of extreme observations. Likewise, fixating on the original probabilities for the remaining doors ignores the existence of a new problem space that is conditional on the prior problem space. We propose that the extensive research findings of ‘refuted door neglect’ capture a new type of extension neglect.

‘Refuted Door Neglect’ With Unequal Probabilities

One constraint limiting MHP’s application is that the alternatives are assumed to have equal likelihoods for the desired attribute (i.e., hiding the car). Relaxing this assumption allows us to assess the impact of ‘refuted door neglect’ (i.e., neglecting opened doors) in more practical settings. This has a significant impact on the way probabilities are calculated. When the doors have equal probabilities, it does not matter which specific door is selected by the contestant or opened by the host, so long as the rules are followed, making the optimal strategy (i.e., to switch) not conditional on the doors selected. If the doors have unequal probabilities, the probability of winning varies with the specific doors selected by the contestant and opened by the host. As a result, calculation of the correct probabilities cannot be made with simple heuristics, but must use more complex approaches, such as Bayes’ theorem.

Granberg (1999) investigates this using a four-door problem, with unequal probabilities of 0.1, 0.2, 0.3 and 0.4, respectively, over sixty trials. In the four-door problem, the contestant selects a door, and then the host opens two other doors, each hiding a goat. This leaves two unopened doors. The contestant must decide whether to switch or remain with their original door selection. Granberg finds that in Trial 1 only seven percent of subjects will switch, with most selecting and staying with the highest probability door. However, the proportion of contestants using a switching strategy grows to seventy-nine percent by Trial 60.

In the four-door problem where the host opened two doors to reveal a goat, the probability that a car is behind the selected door is calculated using Bayes’ formula:

\[
P(\text{Door selected has car}|\text{Doors } a, b \text{ opened}) = \frac{P(\text{Doors } a \text{ and } b \text{ opened}|\text{Door selected has car})P(\text{Door selected has car})}{P(\text{Doors } a \text{ and } b \text{ opened}|\text{Door selected has car})P(\text{Door selected has car}) + P(\text{Door remaining has car})}
\]

where ‘Doors a and b’ are the two doors opened, and ‘Door remaining’ is the remaining unopened door not selected by the contestant. This can be generalized to an N door problem where N-2 doors are opened by replacing ‘a and b’ with ‘N-2’. The estimate for the remaining door is the complement of the probability of the door selected (i.e., the two probabilities sum to 1). This contrasts with the formula that is used by most subjects when ignoring the opened doors (the ‘naïve’ formula) where:

\[
P(\text{Door selected has car}) = \frac{P(\text{Door selected has car})}{P(\text{Door selected has car}) + P(\text{Door remaining has car})}
\]

The difference in the two formulas is the first term in both the numerator and denominator. It is the probability that the opened doors are selected from those available. In an N door problem, N-2 doors are opened from N-1 options, leaving the originally selected door and one alternative door. With N-1 doors to choose from, there are N-1 possible combinations of N-2 doors, so this term becomes the probability of any specific combination, i.e., 1/(N-1). As N increases, this term 1/(N-1) decreases. Therefore, as the number of doors opened increases, the probability of the selected door hiding the car decreases.

Using Bayes’ theorem, Granberg demonstrates that the likelihood of winning the car varies widely depending on the initially selected door, and that the optimal general strategy (i.e., unconditional strategy) is to select the lowest probability door (i.e., number one), then switch. The intuition behind the optimal strategy is as follows: the contestant selects the door with the lowest probability so that the host will be eliminating doors with higher probabilities, leaving doors of higher probability than the one selected by the contestant. This increases the difference in probability between the selected door and the other remaining door. As a result, the contestant will switch to maximize the probability of winning the car.
Continuing with Granberg’s example with unequal probabilities of 0.1, 0.2, 0.3 and 0.4, selecting door one then switching yields an average probability of winning of ninety percent (vs. ten percent for sticking with number one), with a range of eighty-six to ninety-two percent depending on which two doors are opened by the host (see Table 1 Neglectful vs. Bayesian probabilities of winning). The switching strategy is generally optimal, but less advantageous when higher probability doors are initially selected. In only one of the twelve possible scenarios is it not advantageous to switch. Under this scenario, the contestant picks door four (p = 0.4), and the host opens doors two and three, leaving door one. Here, the probability of success for switching (i.e., the likelihood that door one contains the car) is forty-three percent.

When returning to the finding of ‘refuted door neglect’ described above, subjects will treat the remaining two doors as if they are a new problem. Under this scenario, participants simply re-estimate the probabilities of the remaining two doors in proportion to their original probabilities. We estimate this effect in Table 1, which presents the neglectful and actual (Bayesian) probabilities, supplementing analysis presented by Granberg (1998). The last column indicates that, in every scenario, the neglectful estimate significantly overstates the likelihood of winning a car if they stick with their door selection. Thus ‘refuted door neglect’ generates significant overconfidence in the initially chosen door, increasing the risk of loss for the contestant.

Mitigating the Impact of the MHP

While the literature documents a ubiquitous conformity to the naïve solution in the Monty Hall dilemma, several studies suggest methods for enhancing an individual’s conformity with the Bayesian reasoning model. For example, Petrocelli and Harris (2011) found that lowering counterfactual salience improved a participants’ likelihood of switching options after repeated trials. Krauss and Wang (2003) find that the manner in which the MHP is formulated and explained to an individual can foster Bayesian reasoning. The combination of a natural frequency presentation combined with a host, as opposed to a contestant, perspective was found to enhance a participants’ propensity to make the optimal decision. Likewise, Slonim and Tyran (2004) show that both competition and communication are effective in mitigating the choice anomaly resulting from the MHP. Further, Kluger and Wyatt (2004) indicate that introducing bias-free participants into a joint decision-making context is sufficient to reduce the negative impact of probability judgment errors. [see Table 1, pg 296]

While much of the research on the MHP is purely statistical in nature, the mathematical reasoning underlying the MHP has been applied in many practical contexts. Risinger and Loop (2002) find that the cognitive distortions pertaining to conditional probabilities, which impact the MHP, also lead to erroneous reasoning regarding the statistical validity of offender profiling in a court of law. Kluger and Wyatt (2004) indicate that market prices in a competitive market reflect the judgement errors pertaining to the naïve solution in the MHP when all market participants display these same individual judgment errors. Yee (2001) considers the role of security evaluations in relation to the function of cryptographic security parameters and relates the problems encountered in arriving at security metrics with the dilemma faced in the Monty Hall scenario. The study indicates that the conditional nature of probabilities in the MHP parallels the conditional nature of available information about the vulnerabilities of an operating system. Therefore, the judgmental distortions pertaining to the MHP are likely to impact decision-making in a wide variety of professional contexts.

Applying ‘Refuted Explanation Neglect’

The purpose of the above discussion was to establish the potential impact of the ‘refuted door effect’ on risk faced by the contestant. Below, we focus on how the refuted door effect applies in an audit context. Few real-world applications of the MHP findings have been proposed. As Granberg and Brown (1995) lament,

“...the two-stage decision—in which one makes a tentative decision, gains additional information, and then makes a final commitment—is very common if indeed not the rule...[However] Aside from the game-show context, it is not easy to come up with a situation in which people receive valid information about unchosen alternatives from a knowledgeable host after a tentative decision but prior to a final decision.” (pg 721, italics in original)

The above quote offers an apt description of audit settings, where external auditors must conduct risk assessments using information supplied by company’s managers. The auditor corresponds to the contestant and the manager corresponds to the host. The manager has more information than the auditor, concerning what has occurred in the organization, just as the host knows which door hides the car. When converting the game into an audit scenario, doors opened by the manager equates to a plausible but incorrect response to auditor inquiries about an anomaly. Finding the door with a car represents finding the actual reason for the misstatement, while finding goats indicate a door where a reason for the misstatement is
not found. The manager may not directly lie to the auditor when providing evidence about an explanation but is selective in the information they disclose. Managers lying to the auditor when providing them evidence can be detected when the evidence for an explanation is provided (described below). This prohibition against lying corresponds to the unambiguous information provided by opening a door.

Our model also assumes that management is rational and will not provide the auditor with evidence that fraud is occurring within the firm. Likewise, the explanation that management asserts to the auditor is logically going to be an explanation with little, if any, supportive evidence that can be obtained in a cost-effective manner (since the explanation is not true). For instance, management may conceal misappropriated funds by claiming that unique economic conditions impacting the firm are responsible for the decreased revenues. However, the auditor could easily have significant difficulty obtaining strong evidence to support that claim. An expensive market analysis would, in many situations, be required to justify the assertion. However, such an analysis would be nearly impossible for the auditors to obtain in a timely manner and would likely be considered an unjustified audit expense.

If an auditor is able to obtain evidence to prove or disprove management’s assertions in a cost-effective manner, management’s assertions (if they are concealing for fraud) are likely to require more audit effort to verify and are likely to be pursued after other more easily investigated audit possibilities have been eliminated. Therefore, in accordance with the MHP framework, risk assessments are likely to be improperly reallocated prior to obtaining evidence for management’s assertions. As a result, the likelihood of management’s assertions is likely to be overestimated.

The game’s decision-making process corresponds to the recursive process of risk assessment, including the investigation of “usual transactions and events, and other risk indicators, such as amounts, ratios, and trends...” as specified in professional audit standards (AS 2110 para. 46(b)), hereafter an ‘anomaly’. If the anomaly might constitute a material misstatement in the financial statements, professional standards require an auditor to further investigate them by obtaining explanations from management along with other corroborating evidence. The auditor will cease to investigate once sufficient evidence is collected, reducing the likelihood of not detecting a material misstatement.

Consistent with practice, we assume there are generally several possible explanations for any anomaly. These can vary in nature, from changes in business conditions not requiring a financial statement adjustment, to benign errors that require a financial statement adjustment, to fraud requiring adjustment and reporting to an audit committee or owners. They also can vary in likelihood, in cases where explanations correspond to the doors with unequal probability in the MHP. The nature of the explanations and their general likelihoods (i.e., base rates) are well-known to experienced auditors and managers. The opening of a door by the host corresponds to the manager providing clear, reliable evidence concerning the applicability of that explanation to the anomaly at hand. Just as the host will not open the door hiding a car, and will only open doors with goats, the manager is selective in their disclosure, and will only refute untrue explanations rather than gather positive evidence concerning truthful explanations (the rationale for this is discussed further below).

To apply the MHP to an audit setting, we must first modify several assumptions due to differences found under a practice scenario. One apparent difference between the MHP presented here and the audit setting arises in the selection of the initial door. In the MHP, the contestant selects a door and the host opens a different door before the contestant’s second stage decision. It is vital to the effect seen in Table 1 that someone or something other than the host makes the initial door selection, and in a way that is visible to the contestant prior to the opening of the other door(s). The reason for this is that these conditions are what fixes the probability of the selected door at its’ original value, rather than update its probability as other doors get opened.4 In the audit setting, the manager (corresponding to the host) is formally responsible for providing an initial explanation to the auditor. In practice, the manager may claim they are not immediately aware of the explanations for the anomaly, particularly given that the anomaly arises from the auditor’s expectations for the value of an account, and may brainstorm with the auditor concerning these explanations. Such brainstorming may well involve use of professional guidance tools or industry standards. In doing so, the auditor would be expected to use his expertise to suggest or concur with at least one plausible explanation. The manager could then choose to not refute that one explanation but refute the other N-2 untrue possible explanations. In this way, the auditor providing or concurring with a plausible explanation is the logical equivalent of them initially selecting a door.

4 If the initial selection is made by the host, publicly or not, but before any door is opened, the contestant cannot be sure that it was made randomly from all N doors, ignoring the knowledge of which door would be opened once it was selected. This means the selected door cannot be treated as having a fixed probability by the contestant as doors are opened.
Another difference is that in contrast to the contestant selecting their initial door randomly, management will never assert the intentional error/fraud explanation. This merely reduces the potential number of asserted explanations to be evaluated by the auditor but does not affect the conditional probabilities of the asserted explanations. This is evident in an examination of Table 1; e.g., the elimination of the ability to select door one means the first three rows are not relevant but does not change the probability associated with doors two through four hiding the car. Following Bayes formula, the probability of any door hiding the car is only affected by the base rate of that door (its' probability), and the probability of it ever being opened. The probability of initial selection is irrelevant.

The objective of the auditor is to ascertain the true explanation for the anomaly, corresponding to winning the car in MHP. Assuming full elimination of uncertainty is infeasible, their objective is to reduce the risk of alternative explanations associated with intentional errors, fraud, or adjustments, to a level below their risk threshold, or a level of achieved audit risk being less than or equal to the acceptable audit risk. If this is not possible because the likelihood of alternative explanations remains above this threshold, the auditor and manager’s estimate of the likelihood of the alternative explanation becomes the baseline for establishing additional evidence needs. In this respect, the audit setting departs from the MHP in a way that makes differences in probability more important. In the MHP, the contestant is faced with a binary choice. After re-estimation of the probabilities of the remaining doors, the auditor must decide where and how much to investigate. This may be none, if the risk of alternative adjustments has not exceeded the auditor’s threshold (i.e., accepting the manager’s assertion), but will often be some additional investigation, the extent of which will be determined based on the auditor’s assessment of the likelihood of the alternative explanation.

The interest of the manager may be to avoid disclosing the truth. The reasons for this vary depending on the nature of the true explanation and the particulars of the evidential gathering process. Avoiding these communications with the auditor may be self-serving or rational for the organization. If the true explanation is intentional error or fraud, or any other error that the manager does not want to acknowledge, then they will avoid confirming it, and will assert another explanation to be true. If the true explanation is benign, such as cost increasing due to a shortage in commodity markets, then the manager would assert this, and auditor direct confirmation of this using positive audit evidence would be the simplest solution. In contrast to the MHP, gathering positive evidence to support an explanation in the audit setting may not be the appropriate strategy due to the relative cost. For example, if the cost transaction stream during the period of the anomaly has a high volume and value, the performance of additional substantive tests such as tracing costs to documentation and verification with vendors might be very time-consuming, leading to delays and significant expense. It may be more efficient for the manager to assert this as the true explanation but provide support for it by refuting alternative explanations, until the risk of these alternatives falls to acceptable levels. To generalize this, we assume that obtaining positive audit evidence to support any explanation is much more expensive than refuting it or other explanations. Given the important role played by management’s collaborative explanations in audits, and the cost of confirming them with positive audit evidence, the refutation of alternative explanations is a common, cost-effective strategy to reduce risk.

A final difference between the MHP and audit context is the ending of the game. In the MHP, the contestant gets to learn immediately whether they won the car or not. In audit contexts, the feedback mechanism is delayed and much less reliable. Auditors only learn if their decision was incorrect if the true explanation was subsequently discovered by some other means. This strongly limits the cues that would facilitate learning over repeated audits.

**The Estimated Impact of ‘Refuted Explanation Neglect’ in Audit Settings**

We now use the prior analysis presented in the paper to estimate the impact of refuted explanation neglect in three audit scenarios:

1. Three equally likely explanations exist: one would require a material adjustment to the financial statements, while the other two would not.
2. Five explanations with unequal probabilities exist: one would require a material adjustment to the financial statements, while the others would not.
3. Five explanations with unequal probabilities exist: one would be indicative of intentional error or fraud, while the others would not.

Our objective is to estimate the overconfidence that auditors would have in the explanation asserted by the company’s management. This overconfidence may lead the auditor to accept the manager’s asserted explanation when they should not,
or perform fewer follow-up investigatory procedures than are warranted. This leads to a level of risk that exceeds the auditor’s risk threshold and the potential to fail to discover an error or fraud if it exists.

1. **Three Equally Likely Explanations, One Requiring a Material Adjustment.**

In this scenario, there are three explanations for a material expense anomaly that are equally likely: the first explanation arises from the business setting and does not require an audit adjustment. The prices for a key part spiked for a three-month period due to problems in the supply chain affecting the entire industry. The second explanation is that there has been a change in the mix of products sold at the industry level, toward products with higher costs. The third arises from an accounting systems’ programming error that may have overstated the amounts recorded as expense. If true, this latter explanation would require an accounting adjustment that would materially affect earnings levels and might affect managerial compensation.

Positively confirming the extent of supply chain price impacts would be very time-consuming. Both management and the auditor agree about the explanations’ natures, likelihoods and costs. The manager asserts that the first explanation is true, and refutes the second by providing clear, reliable evidence that there was no change in the mix of products sold. The manager does not address the third explanation. What is the probability that the third explanation is the truth?

The existence of three equally likely explanations allows us to use the MHP analysis presented in the section above. The manager has asserted the first explanation and ruled out the second explanation leaving the third as a possibility. Previous findings concerning the MHP suggest that the auditor will act as if the refuted explanation never existed, and treat the two remaining explanations as equally probable. The MHP analysis indicates that, given equal probabilities, the manager will not refute their own assertion and cannot refute the truth. There is a 0.33 likelihood that their assertion is true, and a 0.67 likelihood that the third explanation is true. This results in a 0.50 - 0.33 = 0.17 level of overconfidence in the asserted explanation.

2. **Five Explanations of Varying Likelihood, One Requiring a Material Adjustment.**

This scenario extends the previous example in two ways: there are now five explanations, and they do not have equal risk probabilities, requiring the use of Bayes theorem. Table 2 presents the results of the analysis. We assume for the purpose of discussion that the explanation with the lowest possibility of error, number one, is the only explanation that will result in a material adjustment to the financial statements. Based on this, we can assume the manager will not assert that this is the explanation, however if it is presented for comparative purposes. [see Table 2, pg 297]

If the manager asserts the most likely explanation (#4, p. = 0.50), the results are remarkably consistent: the naïve model based on refuted explanation neglect overstates the probability of that explanation being correct by 0.28-0.31, with a range in estimate of 0.77-0.83 when 0.45-0.56 is the range of Bayesian estimates. If one were to argue that such errors only matter with respect to alternative explanation number one since it alone will result in a material adjustment, the range of overconfidence for four asserted explanations (#2-5) is 0.28-0.33, with a range in estimate of 0.55-0.83 when 0.23-0.56 is the range of Bayesian estimates.

The magnitude of this overconfidence and the decision errors that might arise as a result is sobering for auditors who depend upon explanations provided selectively by managers.

3. **Five Explanations of Varying Likelihood, One Involving Intentional Error or Fraud.**

This scenario has the same structure as the previous example but varies the probabilities to include an explanation having a very low likelihood (#1 p. = 0.015), as would be expected for intentional error or fraud. Table 3 presents the results of the analysis. As in the previous scenario, we assume the manager will not assert the intentional error/fraud explanation but present it for comparative purposes. [see Table 3, pg 298]

In this scenario, the level of overconfidence is reduced for estimates where intentional error/fraud is the alternative explanation. The level of overconfidence across the four asserted explanations (#2-5) is 0.08-0.22, with a range in estimate of 0.89-0.97 when 0.67-0.89 is the range of Bayesian estimates. The intuitive reason for this, presented by examination of the formula, is that the low probability of the alternative explanation (0.015) has little deflationary effect on the neglectful estimate unless the asserted explanation also has a lower probability (e.g., #2). As in the last section, the magnitude of these effects should give pause to auditors who are concerned about violating their risk threshold.
Summary and Conclusions

An auditor’s ability to assess the risk of misstatement during an assurance service is a critical issue, when obtaining sufficient and appropriate evidence to support an opinion. It is even more critical when assessing management’s plausible alternative explanations for potential material misstatement within the financial statements. Cognitive bias when assessing risk has been an important domain for research in auditing. Significant prior research documents the MHP effect but has not been extended to investigate audit bias due to a “refuted explanation neglect.”

The purpose of this paper was to introduce an alternative framework for future research that explains auditors’ assignment of revised probabilities when multiple sources of risk is present. We further examine the effects of ‘refuted explanation neglect’, an extension of ‘refuted selection (door) neglect’ found in the traditional MHP. This form of neglect arises when auditors investigating the reasons for anomalous outcomes ignore the existence of alternative explanations that have been refuted by management. We use the MHP, a well-known decision-making problem, as an accessible illustration. We extend audit and applied psychology research by generalizing the MHP scenario to three audit settings where management offers alternative but incorrect explanations, then selectively refutes them. We further contribute to both areas of research by proposing a ‘refuted explanation neglect’ form of bias not previously identified, integrating this bias into the MHP model. We demonstrate how the MHP-based ‘refuted explanation neglect’ model is applied to the audit setting and use this final model to estimate the potential magnitude of the ‘refuted explanation neglect’ effect in an audit setting. This effect leads to overconfidence by auditors in plausible explanations asserted by managers. This overconfidence may lead auditors to accept management’s asserted explanation when they should not, or to perform fewer follow-up investigatory procedures, thereby gathering less evidence than is needed to achieve the target audit risk level.

To estimate the impact of bias created by a ‘refuted explanation neglect’ we analyze the structured scenarios presented in Sections 2 and 3 of the paper under three audit scenarios. The first scenario includes three explanations of equal probability, where one of the three alternatives would require a material adjustment to the financial statements. The second scenario expands the alternatives to five explanations with unequal probabilities, where one of the five alternatives has a moderately low probability and would require a material adjustment to the financial statements. The final scenario also has five alternative explanations with unequal probabilities, where one of the five alternatives has a low probability and would be indicative of intentional error or fraud. In each scenario, ‘refuted explanation neglect’ leads to auditor over-confidence in asserted explanations for the potential misstatements. The level of overconfidence ranges from 0.08 to 0.33, with a median of 0.29.

The results of this study are limited to the modeled MHP applied to an audit scenario. While prior studies indicate that individuals tend to ignore probabilities under Bayes’ Theorem, actual decisions by auditors’ may varying due to training, education, and professional experience. Future research may apply these scenarios to a sample of individuals with similar demographic/characteristic to experienced auditors. Comparative studies may also extend this work to samples of both internal and external auditors, or under different audit decision scenarios.
References


——. (2015). Inspection Observations Related to PCAOB “Risk Assessment” Auditing Standards (No. 8 through No. 15)


Table 1
Neglectful vs. Bayesian probabilities of winning by sticking and switching in a four-door MHP with unequal probabilities

<table>
<thead>
<tr>
<th>Door selected</th>
<th>Doors opened</th>
<th>Doors remaining</th>
<th>Neglectful estimate to win if</th>
<th>Bayesian estimate to win if</th>
<th>Diff</th>
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</thead>
<tbody>
<tr>
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<td></td>
<td></td>
<td>Stick</td>
<td>Switch</td>
<td>Stick</td>
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<td>1</td>
<td>.80</td>
<td>.20</td>
</tr>
</tbody>
</table>

Underlined figures denote optimal strategy (stick vs. switch) within each type of estimate.

The initial probability of each door hiding the car is:
- 0.10 for door 1
- 0.20 for door 2
- 0.30 for door 3
- 0.40 for door 4

Bayesian probability of the initially selected door is calculated using the formula:

\[
P(\text{Door selected has car} | \text{Doors a, b opened}) = \\
\frac{P(\text{Doors a and b opened} | \text{Door selected has car})P(\text{Door selected has car})}{P(\text{Doors a and b opened} | \text{Door selected has car})P(\text{Door selected has car}) + P(\text{Door remaining has car})}
\]

where ‘Doors a and b’ are the two doors opened, and ‘Door remaining’ is the remaining unopened door not selected by the contestant.

To enhance readability, this formula’s denominator has omitted three elements of the standard Bayesian formula applicable to having four alternatives to reflect the conditions of the MHP:

i. Terms for

\[
P(\text{Doors a and b opened} | \text{Door a is a winner}) P(\text{Door a has a car}), \text{ and } P(\text{Doors a and b opened} | \text{Door b is a winner}) P(\text{Door b has a car}) \text{ have been eliminated because they equal zero}
\]

(both could be opened if they hid a car)

ii. The last term omits P(Doors a and b opened | Door remaining is winner), equivalent to giving it a value of one because, in any n-door scenario, if one door is selected, and the remaining door has the car (and cannot be opened), the remaining n-2 doors (a and b in the four door case) must all be opened.
Table 2
Neglectful vs. Bayesian probabilities of finding truth by sticking and switching with five-explanations having unequal probabilities (min p = 0.10)

<table>
<thead>
<tr>
<th>Expl’n p</th>
<th>Expl’n asserted</th>
<th>Expl’n refuted</th>
<th>Expl’n remaining</th>
<th>Neglectful estimate of finding truth if</th>
<th>Bayesian estimate of finding truth if</th>
<th>Diff</th>
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<td>Stick</td>
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<td>0.83</td>
<td>0.17</td>
<td>0.56</td>
</tr>
</tbody>
</table>

Underlined figures denote optimal strategy (stick vs. switch) within each type of estimate.

Diff(ference) figures sometimes differ from apparent column differences due to rounding of column figures.

Bayesian probability for sticking with the manager’s asserted explanation is calculated using the formula:

\[
P(\text{Explanation asserted is true} | \text{Explanations a, b, and c refuted}) = \frac{P(\text{Expl'ns a, b, and c refuted}|\text{Expl'n asserted is true})P(\text{Expl'n asserted is true})}{P(\text{Expl'ns a, b, and c refuted}|\text{Expl'n asserted is true})P(\text{Expl'n asserted is true}) + P(\text{Expl'n remaining is true})}
\]

where ‘Explanations a, b, and c’ are the three explanations refuted by the manager, and ‘Explanation remaining’ is the remaining unrefuted explanation not selected by the manager.

To enhance readability, this formula’s denominator has omitted three elements of the standard Bayesian formula applicable to having five alternatives to reflect the conditions of the MHP:

iii. Terms for

\[
P(\text{Expl'ns a, b, and c refuted}|\text{Expl'n a is true}) P(\text{Expl'n a is true})
\]

\[
P(\text{Expl'ns a, b, and c refuted}|\text{Expl'n b is true}) P(\text{Expl'n b is true}),
\]

\[
P(\text{Expl'ns a, b, and c refuted}|\text{Expl'n c is true}) P(\text{Expl'n c is true})
\]

have been eliminated because they equal zero (they cannot be refuted if they are true)

iv. The last term omits \(P(\text{Expl'ns a, b, and c refuted}|\text{Expl'n remaining is true})\), equivalent to giving it a value of one because in any n-explanation scenario, if one explanation is selected and the remaining explanation is true (and cannot be refuted), the remaining n-2 doors (a, b, and c in the five explanation case) must all be refuted.
Table 3

Neglectful vs. Bayesian probabilities of finding truth by sticking and switching with five-explanations having unequal probabilities (min p = 0.015)

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<tr>
<th>Expl’n</th>
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<th>Expl’n refuted</th>
<th>Expl’n remaining</th>
<th>Neglectful estimate of finding truth if</th>
<th>Bayesian estimate of finding truth if</th>
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<td>Stick</td>
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<td>0.97</td>
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</table>

Underlined figures denote optimal strategy (stick vs. switch) within each type of estimate.
Diff(ERENCE) figures sometimes differ from apparent column differences due to rounding of column figures.
See Figure 2 for further explanatory notes.