Cognitive Biases Understood from the Eyes: which Impact on Professional Skepticism?

Abstract

Although cognitive biases have been widely linked to poor quality decisions in auditing, their effect on certain behavioral variables critical to audit quality has not been fully verified. Previous studies have laid the groundwork by identifying the impact of cognitive biases on hypothesis generation, compliance testing, and other decision-making contexts. In this study, I seek to identify the impact of the framing bias, and the optimism bias on professional skepticism, a marker of audit quality. Furthermore, I use eye-tracking technology in order to develop an understanding of how cognitive load may interact with these cognitive biases and professional skepticism. Using a laboratory user experimental approach, I find that these cognitive biases unnecessarily increase cognitive load and processing levels, as measured by the total duration of fixation metric such that auditor's professional skepticism is negatively affected.

JEL Codes: G41, M42.

Keywords: eye-tracking, behavioral auditing, cognitive biases, professional skepticism.

1 Introduction

Cognitive biases have been a subject of increasing concern in auditing. This is as result of their adverse effects on decision making and the quality of audits as highlighted in several studies(Libby, 1985; Knapp and Knapp, 2012; Henrizi et al., 2021). Again, recent studies have shown that despite the increased awareness of cognitive biases and their effects, the search for a deeper understanding of the processes that underlie these biases remains fairly limited (Levin et al., 1998; Cho et al., 2009)

In view of this limitation in literature, I first seek to identify the impacts that the framing bias, and the optimism bias have on audit quality. These two cognitive biases are of particular interest because in the light of the current global economic downturn as well as the recent global pandemic, optimism has been heralded by various economic actors as an essential mindset for recovery. What could therefore be the impact of an untethered optimism for the auditor? Also, the framing bias has long been identified as an important bias in auditing (Fukukawa and Mock, 2011; Mock and Fukukawa, 2016). It will therefore be interesting to study these two biases.

In this effort, I use professional skepticism as a proxy for audit quality. Furthermore, given that cognitive biases are related to cognition(Daft and Lengel, 1986), I seek to identify whether cognitive load has an association with the particular cognitive biases tested. This will enable us understand the trends of certain eye-tracking metrics which could be possible indicators of the existence of particular cognitive biases.

Cognitive bias refers to a systematic pattern of thinking based on mental shortcuts which could lead to errors in judgment and deviations from rationality(Tversky and Kahneman, 1973; Frederick, 2002; Gilovich and Griffin, 2013). Research on cognitive biases, fundamentally emanating from the field of psychology (Tversky and Kahneman, 1974; Carroll, 1978; Arkes et al., 1988; Epley and Gilovich, 2006), has been widely applied to many other fields of study. As such, although many cognitive biases have been identified and catalogued, not all of them have been tested in auditing. One of the aims of this paper is therefore to test the optimism bias which has not received much attention in the auditing literature. In addition to the optimism bias, I test framing bias. This paper

studies the impacts of these biases on professional skepticism.

According to the International Auditing and Assurance Standards Board (IAASB), professional skepticism is at the heart of a quality audit(IAASB, 2019).Nelson (2009) defines professional skepticism as *"indicated by auditor judgments and decisions that reflect a heightened assessment of the risk that an assertion is incorrect, conditional on the information available to the auditor."*. This paper adopts this stance for its working definition of professional skepticism. This study also takes into consideration the trait (relatively stable, enduring,individual aspect) component of skepticism, and the state (a temporary condition evoked by the situation variables) component of skepticism (Robinson et al., 2018; Hurtt, 2010). Given the impacts of certain cognitive biases to affect high quality judgment, (Bhattacharjee et al., 2012; Pike et al., 2013; Henrizi et al., 2021), I posit that in general, the cognitive biases studied will reduce the level of professional skepticism. Following from this, I use eye-tracking to study the psychophysiological behaviors of auditors subject to these biases.

Eye-tracking is a technology that tracks eye movements and changes in pupil size, at specific points in time(Léger et al., 2014). In employing this tool in studying behaviors of biased auditors, this paper responds to the call by (Birnberg and Shields, 1984; Lynch and Andiola, 2019) for the use of eye-tracking in accounting and auditing research. The data from eye-tracking provides information about various constructs related to cognition such as processing levels, mental states, and cognitive load (Meißner and Josua, 2019; Holmqvist and Andersson, 2017). I posit that cognitive biases lead to an increase in cognitive load. That is, the reliance on mental shortcuts will lead to a sub-optimal cognitive analysis in the the assessment of audit evidence.

To test these predictions I conduct a laboratory test[1]. This study adopts the replication approach in the measurement of cognitive biases (Shanteau, 1989). I find that these cognitive biases unnecessarily increase cognitive load and processing levels, as measured by the total duration of fixation metric such that auditor's professional skepticism is negatively affected.

[1]I conducted the tests using human participants. For this purpose, I obtained approval from my institution's ethical committee in charge of experiments

With these findings, I offer a number of notable contributions. Firstly, this paper studies one bias that has been largely understudied in the auditing literature namely the optimism bias. It must be noted that though the optimism bias has garnered sufficient recognition in professional bulletins and newsletters(Knapp and Knapp, 2012; ACCA, 2017), very little can be found in terms of empirical studies. Secondly, the incremental contribution of the paper beyond the already existing studies on cognitive biases in auditing(Kinney Jr. and Uecker, 1982; Presutti, 1995; Emby and Finley, 1997; Henrizi et al., 2021) has to do with the psychophysiological behavioral perspective as measured by eye-tracking. Eye-tracking is a very useful tool in information search and decision-making (especially in complex settings)(Lynch and Andiola, 2019; Meißner and Josua, 2019). In this regard, eye-tracking is an effective non-intrusive tool in identifying patterns in visual behavior which might be indicative of the existence of certain cognitive biases. Third, from a managerial standpoint, this paper underscores the need, in the pursuit of high quality audits, to understand the cognitive make-up of individual auditors. Managers and seniors should be guided by the impacts of these biases on audit quality.

The rest of the paper is organized as follows. The next section reviews the relevant literature and the sets the hypotheses. The third section addresses the research methodology while the fourth section presents the empirical results of the study followed by the discussion of these results and conclusion.

2 Literature Review and Hypotheses

2.1 Heuristics and Biases

Arriving at the most appropriate decision based on the available evidence is at the core of audits. The specific decision of interest in this study is the auditor's recognition of a potential issue that may exist thus necessitating more work, review, or effort. Such decisions reflect professional skepticism of auditors (Hurtt et al., 2013). According to the Nelson (2009) model of professional skepticism, cognitive limitations affect professional skepticism in predictable ways, with some of these limitations offering the opportunities

to increase professional skepticism. Cognitive limitations lead to bounded rationality.

According to Simon (1957), decision-makers resort to rules of thumb as a result of bounded rationality. This limited rationality as a result of cognitive limitations could lead to systematic errors (Tversky and Kahneman, 1974; Frederick, 2002). As various studies have revealed, financial auditors are not exempt from the effects of cognitive biases (Biggs et al., 1988; Fay et al., 2015).

As earlier stated, the study of cognitive biases emanates from psychology literature(Simon, 1957; Tversky and Kahneman, 1974; Gilovich and Griffin, 2013). In adapting these studies to the auditing context, Shanteau (1989) identifies three approaches, namely; replication studies(accurate reproduction of the original studies but using auditors as subjects), adaptation studies(spin-offs from the original studies but concepts modified to reflect accounting/auditing issues), and problem-driven studies (uniquely concentrate on accounting/auditing issues and differ methodologically from original studies and cannot be considered as spin-offs). Regardless of the approach, there is evidence that auditors are subject to cognitive biases, although the effects may differ from one bias to another(Joyce and Biddle, 1981; Abdolmohammadi and Wright, 1987; Holt, 1987; Bucaro, 2019).

Numerous cognitive biases have been identified with each having different effects on judgment and decision-making. In this study, I focus on two of these biases namely; the framing bias, and the optimism bias.

2.1.1 Framing Bias

A framing bias is said to occur when a change in the description of a task, which does not alter its normative meaning, changes the decision that is made(Kahneman and Tversky, 1984; Jamal et al., 1995). The framing effect is thus characterized by inconsistencies in decisions across tasks which remain fundamentally unchanged. According to (Tversky and Kahneman, 1981), rational choice requires that the preference between options should not reverse with changes of frame. They further explain that these violations can be traced to the psychological principles that govern the perception of decision problems and the evaluation of options.

Despite the vast body of literature on the framing bias, populations considered to be experts on the issue and should thus be resistant to framing effects still exhibit it. Gächter et al. (2009), in a natural field experiment, find that while the behavior of junior experimental economists was affected by the description of the decision task they faced, this was not the case for the more senior members. More specifically, concerning the early registration for a conference, they found that 67 percent of junior experimentalists responded to the discount frame whereas 93 percent responded to the penalty frame. It is thus possible that despite advances in research and high levels of awareness created about the framing bias in auditing, these effects might still persist among a segment of the auditor population.

In auditing, various studies have been carried out concerning framing effects, primarily focusing on its existence, effects, or debiasing techniques. Consistent with Fukukawa and Mock (2011), Mock and Fukukawa (2016) find that assessed risks are significantly higher and relatively more skeptical when negatively versus positively stated assertions are provided. Again Emby (1994) finds that auditors who received the risk versions of the experimental instrument on average chose a higher revised level of substantive testing and that there was an interaction effect between presentation mode and frame. These findings indicate the existence of the framing bias in audits.

The existence of this bias could impact the quality of audits. Although Asare (1992) found no impact of framing moderating the recency effects of going concern judgments, (Johnson et al., 1991) show that a manager can deceive an auditor by creating a frame that induces the activation of nonirregularity hypotheses. To mitigate the detrimental impacts of the framing bias, (Jamal et al., 1995) demonstrate that auditors who used a standard representation (using a single hypothesis and a common unit of analysis) successfully detected management's frames. I therefore hypothesize that

H1a: The framing bias leads to less professional skepticism

The second bias studied is the optimism bias.

2.1.2 Optimism Bias

The optimism bias refers to the tendency of individuals to overestimate their chances of experiencing positive events and underestimating their chances of experiencing negative events compared to the average other (Weinstein, 1987; Hoorens and Smits, 2001; Cossette, 2015). According to Shepperd et al. (2002), three other terms have been used to describe this phenomenon, namely unrealistic optimism, optimistic bias (Weinstein, 1980), and illusions of unique invulnerability (Perloff, 1987). What makes the optimism bias irrational is that it is not formed on the basis of sufficiently robust evidence(Jefferson et al., 2017).

Within the general population of which auditors are a part, the optimism bias has been found to have negative consequences for individuals. The optimism bias has been found to be problematic as a result of its tendency to induce risky behavior or inadequate precautionary behavior such as exercise and diet (Weinstein and Lachendro, 1982; Radcliffe and Klein, 2002). Again, the optimism bias of entrepreneurs has been found to have a negative impact on the quality of their strategic decisions, and firm performance (Koellinger et al., 2007; Hmieleski and Baron, 2009; Mehrabi and Kolabi, 2012).

Compared to other cognitive biases, the optimism bias has remained largely unexplored in accounting and auditing research. A number of papers find evidence of the optimism bias among auditors. According to Bigus (2016), under strict liability (auditors are held liable when they cause damages to investors), optimism makes the auditor overestimate the chances of finding material mistakes and thus induces suboptimal care. Due care, as defined by the auditing standards (AU Section 230), is an important element of quality audits (Ewert and Breuer, 1999; Willekens and Simunic, 2007). Thus the optimism bias could lead to a reduction in audit quality. Owhoso and Weickgenannt (2009) find that auditors, regardless of their rank, systematically overrate their ability to detect material errors in financial reports. Johnston et al. (2003) found that auditors, in their use of highly structured workpapers for tests of controls, performed less effectively and less efficiently than they perceived. Following from these findings, I posit the following:

H1b: The optimism bias leads to less professional skepticism

Given that cognitive biases influence the way individuals process stimuli in their environment and the eventual decisions they take, it is important to understand, in the auditing context, how cognitive biases affect the cognitive load of auditors.

2.2 Mediating role of Cognitive Load

Cognitive load, also sometimes referred to as mental workload (Na, 2021), according to Wickens (2008) is the portion of the human operator's limited capacities or resources that are required to perform a particular task. Cognitive load is used as a measure of information seeking and processing effort (Hu et al., 1999). A lower cognitive load in information seeking and processing effort is associated with higher efficiency, and a higher user satisfaction(Back and Oppenheim, 2006).

As regarding the information seeking effort associated with cognitive loads, cognitive biases impact the attention paid to stimuli (Hertel et al., 2012; Bistricky et al., 2014; Van Bockstaele et al., 2017). Particularly with the framing bias, Levin et al. (1998) found that individuals prone to a negative frame focused more on, and were more influenced by, negative information relative to positive information. This shows that framing bias, in influencing decisions, impacts information seeking(Dong et al., 2017; Dondzilo et al., 2020).

Knight et al. (2015) identifies the role of cognitive biases in guiding cognition, however they notice that this has almost exclusively been studied within abnormal psychology. As such, individuals with various cognitive related issues such as anxiety, depression and specific phobias all appear to preferentially process items related to their concerns (Constantine et al., 2001; Gotlib et al., 2004; Mogg and Bradley, 2005). The aforementioned effects of cognition on attention can be observed using eye-tracking (Leber and Egeth, 2006; Belopolsky and Theeuwes, 2010; Kawahara, 2010). Based on this evidence of cognitive biases having a negative impact on cognitive load, I formally posit the following:

H2a: Cognitive biases lead to a higher cognitive load.

In exercising professional skepticism, a heightened level of awareness on audit evidence is indispensable. An overload of levels of cognition could turn out to be detrimental for appropriate levels of professional skepticism. Although professional skepticism has been defined in various ways both in academic research and in professional standards(Cushing and Ahlawat, 1996; Shaub, 1996; Nelson, 2009; Hurtt, 2010), an element which seems to run through all these definitions is that of a critical assessment of audit evidence.

The evaluation of audit evidence plays a central role in the audit process(Felix Jr. and Kinney Jr., 1982; Hammersley et al., 2010). The level of attention paid in the assessment and evaluation process impacts the quality of the audits(Gillett and Peytcheva, 2011; Mubako and O'Donnell, 2018). Eye-movements captured through the Total duration of fixation metric can be used as a proxy for cognitive load(Léger et al., 2014; Lynch and Andiola, 2019).

Fixation duration is the length of time of a single fixation and some psychological constructs it represents are cognitive load, and processing levels(Lynch and Andiola, 2019). Various studies have highlighted that attributes with greater importance to the decision-maker receive more fixation duration(Glöckner et al., 2012; Menon et al., 2016). Given that higher levels of professional skepticism is associated with heightened attention in the assessment of audit evidence(Robinson et al., 2018), in eye-tracking terms, this could represent higher levels fixations(Wedel and Pieters, 2007; Sirois et al., 2018). However, this should be in turn associated with optimal decisions. Optimal decisions in this case refers to decisions taken with more skepticism.

Based on this evidence, I formally hypothesize that,

H2b: More cognitive load leads to less professional skepticism.

Following from the connection of cognitive load and cognitive biases as well as the connection of cognitive load with professional skepticism as reviewed above, I hypothesize that,

H2c: Cognitive load is a mediator between cognitive biases and professional skepticism.

To verify these hypotheses, I conduct a laboratory test using eye-tracking in order to

understand the underlying mechanism at play.

3 Methods

3.1 Participants

I develop a user experiment[2] testing the framing bias, and the optimism bias for their effects on professional skepticism. Participants are young professionals with varying levels of work experience, ranging from three months to one year, from various auditing firms of different sizes in France. To ensure that these young professionals had sufficient levels of knowledge in auditing, I selected only auditors who had both a first degree and a master's degree in accounting and auditing. The use of young professionals for this study is justified as a result of various studies indicating the higher likelihood of young non-experienced auditors being subject to cognitive biases compared to their more experienced counterparts(Joyce and Biddle, 1981; Butler, 1986; Henrizi et al., 2021), and exhibit a lesser degree of skepticism compared to their more experienced colleagues(Knechel et al., 2010; Olsen and Gold, 2018; Gao and Zhang, 2019). I received to total of 40 responses, all of whom were aged between 21 to 25 years. 40 percent were female.

3.2 Design

To test the hypotheses, I conducted a computerized test in which participants had to examine pieces of audit evidence. I presented the framing and the optimism bias in a randomized order. I do not introduce any manipulation conditions. The presentation order of the audit evidence is also fully randomized.

3.3 Material

The material for testing the framing bias was obtained from (Tversky and Kahneman, 1981) on the framing of acts. It indicates two decisions to be made, with each decision

[2]It should be noted that the study does not have manipulation conditions as is the case of a classical experiment, but it however follows an experimental approach in the sense that I use laboratory equipment to estimate the neurophysiological measurements of gaze

point having two options. The options in both decision points indicate either risk aversion, or risk tolerance.

The material for the optimism bias was adapted from (Puri and Robinson, 2007) miscalibration of life expectancy. I indicated the actuarial life expectancy as at the time of the experiment. I then ask participants to indicate their expected life expectancy, as well as that of an average person of the same age and gender as themselves.

The audit evidence material (adapted from (Phillips, 1999)) refers to two cases of aggressive financial reporting: Trueblood Case 91-1 ((Touche, 1991) and United States Surgical Corporation (Johnson et al., 1991). I constructed 6 pieces of audit evidence that summarize the main findings of each client's financial statements; each piece of evidence can be understood and analyzed independently. Among the 6 pieces of evidence, 3 indicate aggressive financial reporting and the remaining three non-aggressive financial reporting.

3.4 Eye-tracking equipment

Eye movements were recorded using a screen-based eye tracker (Tobii pro nano) at a sampling frequency of 60 Hz. The computerized test was conducted in a light-controlled room. At the beginning of the test, the eye tracker was calibrated using a nine-point fixation technique thus adjusting for participants' individual differences in eye characteristics (Just and Carpenter, 1976; Rose et al., 2022). I placed 6 Areas of Interest(AOI) on the page reflecting the 6 financial account items. Due to randomization on the page, these AOIs could have different representations for each participant and each attempt.

3.5 Procedure

Participants undertook the test in the laboratory; they first had to read and accept the terms and conditions of participating. Subsequently, participants read the instructions for the audit exercise, which required them to undertake a self-paced review of audit evidence about a fictitious company. The instructions for the audit exercise were preceded by background information about the company and key information about the audit such

as the level of materiality and the accounting year.

Participants examined each of the 6 pieces of audit evidence carefully and at their own pace (see appendix A.2). The order of appearance of the audit evidence was fully randomized. After this, they developed a general assessment, on a scale of 1-10, of the level of financial reporting, where 1= "not aggressive at all" and 10= "very aggressive" (see appendix A.3), on the following page. Participants also identified the financial reporting items they adjudged aggressive. Following this, participants responded to the Hurtt's Professional skepticism scale (see appendix A.4).

Subsequently, participants responded to the tasks testing their cognitive biases. The order of appearance of the cognitive biases is randomized. Regarding the framing bias (see appendix A.5.1), participants were faced with a pair of concurrent decisions. They were instructed to examine both decisions after which they were to indicate the option they preferred. The first decision had two options; one option being a sure gain of $240 while the other option was a 25% chance to gain $1000 and 75% chance to gain nothing. The second decision had two options; one option being a sure loss of $750 while the other option was 75% chance to lose $1000 and 25% chance to lose nothing.

With respect to the optimism bias(see appendix A.5.2), participants were provided with their actuarial life expectancy. They were then asked to estimate their life expectancy, and then that of an average person of the same gender and age as themselves. After the optimism bias, I obtained demographic data of participants.

3.6 Variables

The independent variables are the framing bias, and the optimism bias. The dependent variable is professional skepticism while the eye-tracking metric serves as mediating variables. For the dependent variable, professional skepticism, I develop two measures. The first (Skepticism 1), being the overall assessment on a scale of 1 to 10 of the level of aggressiveness of the audit items (Bauer, 2015), and the second (Skepticism 2) being the identification of aggressive financial reporting elements (Phillips, 1999). I use two measures of skepticism because the first measure represents a self-declarative form of

skepticism whereas the second measure is an objective form of measuring the construct.

4 Results

4.1 Descriptive Statistics of Variables

The demographic information presented in Table 1. serves as control variables. On the average, participants had audit work experience of within 3 months to 1 year, indicating experience at the novice level. Regarding experience relating to tasks on cognitive biases, 10% of participants had prior experience on such tasks. Again, I measure participant's level of trait skepticism using the Hurtt's Professional Skepticism Scale (HPSS). It could be observed that the mean score on the HPSS was 25.12 with a standard deviation of 2.73. In verifying the internal validity of the HPSS, I obtain a Cronbach's Alpha of 0.82

Insert Table 1 here

The Total duration of fixations (measured in milliseconds), which is the eye-tracking metric measuring cognitive load presented in Table 1. A mean of 4678.70 and a standard deviation of 1873.89 could be observed.

Following this, I present the descriptive statistics for the dependent variable as per the various independent variables. It could be observed that for the first measure of professional skepticism, concerning the framing bias, the unbiased participants had a mean of 6.64(SD=1.80) compared to the biased conditions (mean=5.30; SD=1.92). Concerning the optimism bias, a mean of 6.03(SD=1.29) for the unbiased participants and a mean of 4.5(SD=1.98) for the biased participants could be observed. It could be seen that in both cases, unbiased participants had on the average a higher score for professional skepticism compared to their counterparts who were subject to the cognitive biases.

Concerning the second measure of professional skepticism, it could be seen that results consistent with that of the first measure. Firstly, for the framing bias, a mean of 1.53(SD=0.62) for the unbiased participants could be seen whereas the biased participants had a mean of 1.09(SD=0.73). As regarding the optimism bias, We can observe

a mean of 1.28(SD=0.70) for the unbiased participants whereas the biased participants had a mean of 1.25(SD=0.96). Again in both cases, the unbiased participants had on the average a higher score for professional skepticism compared to their biased counterparts.

4.2 Auditor's Subjection to Cognitive Biases

First, I consider whether auditors are subject to cognitive biases. The first cognitive bias in consideration is the framing bias. Following from the task from (Tversky and Kahneman, 1981), participants can be categorized into one of four groups; risk takers, risk averse, optimal decision takers, and biased. Risk takers consistently prefer the riskier prospects of equal or greater expected value at both decision points whereas the risk averse consistently prefer the less risky prospects at both decision points. The optimal decision takers, although neither consistently risk takers nor risk averse in both decision points, choose the combination of options that maximises their expected value. These first three groups represent the unbiased participants. The fourth group who are the biased decision takers on the other hand, are neither consistently risk takers nor risk averse in both decision points, but however choose the combination of options that does not maximise their expected value.

Insert Table 2 here

Table 2. shows the descriptive statistics for the various categories. It could be observed that the biased position has a frequency of 57.5%, compared to the unbiased position 42.5%). This supports the hypothesis that auditors are subject to cognitive biases.

Concerning the optimism bias, I measure the life expectancy miscalibration of participantsPuri and Robinson (2007) compared to an average person of the same gender and age as themselves. Participants self-reporting a life expectancy higher than that of an average person of the same gender and age as themselves exhibit the optimism bias and are categorized as biased in Table 2. These represent 35% of participants while the unbiased group represents 65%. This shows that in contrast to the framing bias, the majority of participants do not exhibit the optimism bias.

4.3 Impact of Cognitive Bias on Professional Skepticism

For the test of H1, I consider whether cognitive biases exercise significant effects on professional skepticism using a linear regression with random intercepts model, controlling for the participant's trait skepticism, measured by the Hurtt's professional skepticism scale, as well as prior experience of related experiments.

Insert Table 3 here

The results in Table 3. indicate a significant effect of the framing bias on professional skepticism (estimate=-0.49, p-value=0.03) for the second measure of professional skepticism, thus validating H1a. Although we can observe this significant effect on the first measure of skepticism (estimate=-1.35, p-value=0.03), the overall model is not significant. This indicates that the Framing bias reduces the level of professional skepticism when skepticism is considered in an objective manner rather than in a declarative form.

Regarding the optimism bias, we do not observe any significant effects on the level of professional skepticism regardless of the measure. This seems to indicate that the effect of the optimism bias on skepticism may not be direct and may necessitate an enquiry into a possible mediating variable which I investigate in subsection 4.5.

I carry out the variance inflation factor test to verify for multicollinearity among the independent variables. I obtain the following factors; 1.02, 1.31 and 1.29 for the framing bias, experiment experience and the HPSS respectively thus indicating the absence of multicollinearity among the independent variables.

4.4 Cognitive biases and Cognitive load

For H2a, it is hypothesized that cognitive biases lead to a higher cognitive load. To test this, I conduct t-tests on the differences between biased participant's and unbiased participant's Total duration of fixations. Results are reported in Table 4.

Insert Table 4 here

It could be observed that the participants subject to the framing bias are associated with a higher Total duration of fixations (t=1.98, p-value=0.06). Again, we could observe

that the optimism bias is associated with a higher Total duration of fixations(t=3.82, *p*-value<0.01). It could therefore be seen that both cognitive biases are associated with higher Total duration of fixations.

A higher total duration of fixations in this situation could indicate a higher cognitive load and levels of processing (Lynch and Andiola, 2019). A higher cognitive load and processing levels resulting in suboptimal decisions is indicative of ineffective searches for target information(McMillan and White, 1993; Holmqvist and Andersson, 2017). We could therefore conclude that the existence of cognitive biases leads to an ineffective approach in the review of audit evidence.

To verify the impact of this observed higher total fixation duration in the presence of cognitive biases on professional skepticism, I conduct mediation analysis in the subsequent subsection.

4.5 The mediating effect of cognitive biases on professional skepticism

I hypothesize in H2c that cognitive load is a mediator between cognitive biases and professional skepticism. To verify this hypothesis, I conduct mediation analysis (Baron and Kenny, 1986)

Insert Figure 1 here

Insert Table 5. here

We could observe from Table 5. that the total duration of fixations serves as mediator between the optimism bias and skepticism. More specifically, the presence of the optimism bias leads to a significant increase in the total duration of fixations and this increase in total duration of fixations is associated with a significant decrease in skepticism.

As previously explained, the total duration of fixation which is indicative of cognitive load and processing levels is exacerbated by the presence of the optimism bias. However, this higher processing level does not translate into appropriate decisions as should be the case with a higher level of skepticism. The measure of skepticism in question is the

first measure. We could therefore conclude that cognitive biases unnecessarily increase cognitive load such that auditor's professional skepticism is negatively affected.

Insert Table 6. here

5 Conclusion

The aim of this paper is to examine the effect of cognitive biases on professional skepticism. More specifically, I concentrate on the framing bias and the optimism bias. The interest in studying these two biases are due to their importance in leading to sub-optimal decisions as identified in various literature. The results indicate that auditors are subject to the framing bias and the optimism bias. Comparing the level of subjection to these two biases, auditors were observed to be more likely to fall for the framing bias than the optimism bias. Again, I observe for both cognitive biases that they have a negative effect on skepticism. I further observe that these biases increase cognitive load and processing levels as indicated by the total duration to fixation metric. For the optimism bias, it is this metric that mediates its effect on professional skepticism.

This study contributes to prior literature, notably concerning professional skepticism, by providing empirical evidence of factors that could diminish it. Specifically, this study fills the gap of understanding a mechanism underlying the interaction between cognitive biases and skepticism in the auditing context. In doing so, this paper responds to the call by Lynch and Andiola (2019) for the application of eye-tracking in accounting and auditing research. In precis, these findings elucidate the psychological construct involved in the reduction of professional skepticism by the afore-mentioned cognitive biases.

The participants in this study were young auditors at the early stages of their careers. The effects of cognitive biases on individuals could differ based on levels of experience(Gächter et al., 2009). The findings of this study may therefore not hold for more experienced auditors and thus may not be completely generalizable. Furthermore, the homogeneous nature of the sample may not take cultural differences, a factor which may influence the effects of cognitive biases(Loibl et al., 2018), into account. I do well to

include two measures of skepticism to capture the broad nature of the concept but I am cognizant that there exists many approaches to the measurement of skepticism (Shaub and Lawrence, 2002; Robinson et al., 2018). More generally as a limitation of experiments, the method used in this study, is that results are hardly generalizable beyond the specific circumstances used in the study.

These limitations nonetheless, these results have many practical implications. Firstly, the study shows how the subject of cognitive biases should be paid more attention to in audit and accounting programs in schools and professional bodies. Many current audit curricula at universities follow a traditional based approach focusing on auditing techniques and procedures. Although this is very necessary, issues relating to behavioral auditing such as cognitive biases should become more mainstream. Relating to audit firms, many aptitude tests utilized in the selection of candidates for employment include a number of tests for cognitive biases. This notwithstanding, studies show the existence of cognitive biases even among highly experienced auditors. It is therefore necessary for audit firms highlight the effect of cognitive biases in in-service training for auditors.

Finally, I provide avenues for further research. The most important phenomenon in recent times to significantly impact the way audits are organized is the increased recourse to remote work which was spurred by the COVID_19 global pandemic. Various studies have shown that remote work is associated with a less media rich environment, with this leading poorer quality communication eventually having adverse impacts on cognition (Daft and Lengel, 1986; Andres, 2002). Further experimental research could empirically verify whether level of cognitive biases for on-site work situations versus remote work situations.

References

Abdolmohammadi, M. and A. Wright (1987). An examination of the effects of experience and task complexity on audit judgments. *Accounting Review 62*(1), 1 – 13.

ACCA (2017). *Banishing bias?Audit, objectivity and the value of professional scepticism*. The Association of Chartered Certified Accountants.

Andres, H. (2002, 02). A comparison of face-to-face and virtual software development teams. *Team Performance Management 8*, 39–48.

Arkes, H. R., D. Faust, T. J. Guilmette, and K. Hart (1988, 05). Eliminating the hindsight bias. *Journal of Applied Psychology 73*(2), 305.

Asare, S. K. (1992, 04). The auditor's going-concern decision: Interaction of task variables and the sequential processing of evidence. *The Accounting Review 67*(2), 379.

Back, J. and C. Oppenheim (2006, 5). A model of cognitive load for information retrieval: implications for user relevance feedback interaction. *Information Research 6*(2), .

Baron, R. M. and D. A. Kenny (1986, 12). The moderator-mediator variable distinction in social psychological research: Conceptual, strategic, and statistical considerations. *Journal of personality and social psychology 51*(6), 1173.

Bauer, T. D. (2015). The effects of client identity strength and professional identity salience on auditor judgments. *The Accounting Review 90*(1), 95–114.

Belopolsky, A. V. and J. Theeuwes (2010). No capture outside the attentional window. *Vision Research 50*(23), 2543–2550.

Bhattacharjee, S., K. K. Moreno, and T. Riley (2012). The interplay of interpersonal affect and source reliability on auditors' inventory judgments* the interplay of interpersonal affect and source reliability on auditors' inventory judgments. *Contemporary Accounting Research 29*(4), 1087 – 1108.

Biggs, S. F., T. a. Mock, and P. R. Watkins (1988). Auditor's use of analytical review in audit program design. *Accounting Review 63*(1), 148.

Bigus, J. (2016). Optimism and auditor liability. *Accounting and Business Research 46*(6), 577.

Birnberg, J. G. and M. D. Shields (1984). The role of attention and memory in accounting decisions. *Accounting, Organizations & Society 9*(3/4), 365 – 382.

Bistricky, S. L., R. A. Atchley, R. Ingram, and A. O'Hare (2014). Biased processing of sad faces: An erp marker candidate for depression susceptibility. *Cognition & Emotion 28*(3), 470 – 492.

Bucaro, A. C. (2019). Enhancing auditors' critical thinking in audits of complex estimates. *Accounting, Organizations and Society 73*, 35–49.

Butler, S. A. (1986). Anchoring in the judgmental evaluation of audit samples. *Accounting Review 61*(1), 101.

Carroll, J. S. (1978). The effect of imagining an event on expectations for the event: An interpretation in terms of the availability heuristic. *Journal of Experimental Social Psychology 14*, 88–96.

Cho, C. H., J. R. Phillips, A. M. Hageman, and D. M. Patten (2009). Media richness, user trust, and perceptions of corporate social responsibility: An experimental investigation of visual web site disclosures. *Accounting, Auditing & Accountability Journal 22*(6), 933–952.

Constantine, R., R. McNally, and C. Hornig (2001, 01). Snake fear and the pictorial emotional stroop paradigm. *Cognitive Therapy and Research 25*, 757–764.

Cossette, P. (2015). Heuristics and cognitive biases in entrepreneurs: a review of the research. *Journal of Small Business and Entrepreneurship 27*(5), 471–496.

Cushing, B. E. and S. S. Ahlawat (1996). Mitigation of recency bias in audit judgment: The effect of documentation. *Auditing: A Journal of Practice & Theory 15*(2), 110 – 122.

Daft, R. L. and R. H. Lengel (1986, 05). Organizational information requirements, media richness and structural design. *Management Science (1986-1998) 32*(5), 554.

Dondzilo, L., E. Rieger, R. Shao, and J. Bell (2020). The effectiveness of touchscreen-based attentional bias modification to thin body stimuli on state rumination. *Cognition & Emotion 34*(5), 1052 – 1058.

Dong, Y., A. De Beuckelaer, L. Yu, and R. Zhou (2017). Eye-movement evidence of the time-course of attentional bias for threatening pictures in test-anxious students. *Cognition & Emotion 31*(4), 781 – 790.

Emby, C. (1994). Framing and presentation mode effects in professional judgment: Auditors' internal control judgments and substantive testing decisions. *Auditing: A Journal of Practice & Theory 13*(1), 102 – 115.

Emby, C. and D. Finley (1997, Summer). Debiasing framing effects in auditors' internal control judgements and testing decisions. *Contemporary Accounting Research 14*(2), 55–77.

Epley, N. and T. Gilovich (2006, 05). The anchoring-and-adjustment heuristic: Why the adjustments are insufficient. *Psychological science 17*, 311–8.

Ewert, R. and W. Breuer (1999, 03). Auditor liability and the precision of auditing standards. *Journal of institutional and theoretical economics 155*(1), 181–213.

Fay, R., J. G. Jenkins, and V. Popova (2015). Effects of awareness of prior-year testing strategies and engagement risk on audit decisions. *Managerial Auditing Journal 30*(3), 226 – 243.

Felix Jr., W. L. and W. R. Kinney Jr. (1982). Research in the auditor's opinion formulation process: State of the art. *Accounting Review 57*(2), 245.

Frederick, S. (2002). *Heuristics and biases: The psychology of intuitive judgment*. Cambridge University Press.

Fukukawa, H. and T. J. Mock (2011). Audit risk assessments using belief versus probability. *Auditing: A Journal of Practice & Theory 30*(1), 75 – 99.

Gao, P. and G. Zhang (2019). Auditing standards, professional judgment, and audit quality. *Accounting Review 94*(6), 201 – 225.

Gillett, P. R. and M. Peytcheva (2011). Differential evaluation of audit evidence from fixed versus sequential sampling. *Behavioral Research in Accounting 23*(1), 65 – 85.

Gilovich, T. and D. Griffin (2013). *Introduction – heuristics and biases: then and now", in Gilovich, T., Griffin, D. and Kahneman, D. (Eds), Heuristics and Biases*. Cambridge University Press, New York, pp. 1-18.

Glöckner, A., S. Fiedler, G. Hochman, S. Ayal, and B. Hilbig (2012, 06). Processing differences between descriptions and experience: A comparative analysis using eye-tracking and physiological measures. *Frontiers in psychology 3*, 173.

Gotlib, I., E. Krasnoperova, D. Yue, and J. Joormann (2004, 03). Attentional biases for negative interpersonal stimuli in clinical depression. *Journal of abnormal psychology 113*, 121–35.

Gächter, S., H. Orzen, E. Renner, and C. Starmer (2009). Are experimental economists prone to framing effects? a natural field experiment. *Journal of Economic Behavior & Organization 70*(3), 443–446.

Hammersley, J. S., E. M. Bamber, and T. D. Carpenter (2010, 03). The influence of documentation specificity and priming on auditors' fraud risk assessments and evidence evaluation decisions. *The Accounting Review 85*(2), 547–571.

Henrizi, P., D. Himmelsbach, and S. Hunziker (2021). Anchoring and adjustment effects on audit judgments: experimental evidence from switzerland. *Journal of Applied Accounting Research 22*(4), 598 – 621.

582 Hertel, P., A. Benbow, and E. Geraerts (2012). Brooding deficits in memory: Focusing
583 attention improves subsequent recall. *Cognition & Emotion 26*(8), 1516 – 1525.

584 Hmieleski, K. M. and R. A. Baron (2009, 06). Entrepreneurs' optimism and new venture
585 performance: A social cognitive perspective. *Academy of Management Journal 52*(3),
586 473.

587 Holmqvist, K. and R. Andersson (2017, 11). *Eye-tracking: A comprehensive guide to*
588 *methods, paradigms and measures*. Lund Eye-Tracking Research Institute, Lund, Swe-
589 den.

590 Holt, D. L. (1987). Auditors and base rates revisited. *Accounting, Organizations and*
591 *Society 12*(6), 571–578.

592 Hoorens, V. and T. Smits (2001). Why do controllable events elicit stronger comparative
593 optimism than uncontrollable events? *Revue International de Psychologie Sociale 14*,
594 11–44.

595 Hu, P. J.-H., P.-C. Ma, and P. Y. Chau (1999). Evaluation of user interface designs
596 for information retrieval systems: a computer-based experiment. *Decision Support*
597 *Systems 27*(1), 125–143.

598 Hurtt, R. K. (2010, 05). Development of a scale to measure professional skepticism.
599 *Auditing: A Journal of Practice & Theory 29*(1), 149–171.

600 Hurtt, R. K., H. Brown-Liburd, C. E. Earley, and G. Krishnamoorthy (2013). Research
601 on auditor professional skepticism: Literature synthesis and opportunities for future
602 research. *Auditing: A Journal of Practice & Theory 32*, 45 – 97.

603 IAASB (2019). *Professional Skepticism Focus*. International Auditing and Assur-
604 ance Standards Board url: https://www.iaasb.org/publications/focus-professional-
605 skepticism.

606 Jamal, K., P. E. Johnson, and R. G. Berryman (1995). Detecting framing effects in
607 financial statements. *Contemporary Accounting Research 12*(1), 85 – 105.

608 Jefferson, A., L. Bortolotti, and B. Kuzmanovic (2017). What is unrealistic optimism?
609 *Consciousness and cognition 50*, 3–11.

610 Johnson, P. E., K. Jamal, and R. G. Berryman (1991). Effects of framing on auditor
611 decisions. *Organizational Behavior & Human Decision Processes 50*(1), 75.

612 Johnston, H., W. D. Lindsay, and F. Phillips (2003). Undetected deviations in tests of
613 controls: Experimental evidence of nonsampling risk. *Canadian Accounting Perspec-*
614 *tives 2*(2), 113 – 134.

615 Joyce, E. J. and G. C. Biddle (1981). Are auditors' judgments sufficiently regressive?
616 *Journal of Accounting Research 62*, 120–145.

617 Just, M. and P. Carpenter (1976). Eye fixations and cognitive processes. *Cognitive*
618 *Psychology 8*, 441–480.

619 Kahneman, D. and A. Tversky (1984). Choices, values, and frames. *American Psychol-*
620 *ogist 39*(4), 341–350.

621 Kawahara, J.-i. (2010). Identifying a "default" visual search mode with operant condi-
622 tioning. *Acta Psychologica 135*(1), 38–49.

623 Kinney Jr., W. R. and W. C. Uecker (1982). Mitigating the consequences of anchoring
624 in auditor judgments . *Accounting Review 57*(1), 55.

625 Knapp, M. C. and C. A. Knapp (2012). Cognitive biases in audit engagements. *CPA*
626 *Journal 82*(6), 40 – 45.

627 Knechel, W. R., S. E. Salterio, and N. Kochetova-Kozloski (2010). The effect of bench-
628 marked performance measures and strategic analysis on auditors' risk assessments and
629 mental models. *Accounting, Organizations & Society 35*(3), 316 – 333.

630 Knight, H., D. Smith, D. Knight, and A. Ellison (2015, 03). Altering attentional control
631 settings causes persistent biases of visual attention. *Quarterly journal of experimental*
632 *psychology (2006) 42*, 1–46.

633 Koellinger, P., M. Minniti, and C. Schade (2007, 08). "i think i can, i think i can":
634 Overconfidence and entrepreneurial behavior. *Journal of Economic Psychology 28*(4),
635 502.

636 Leber, A. and H. Egeth (2006, 03). It's under control: Top-down search strategies can
637 override attentional capture. *Psychonomic bulletin & review 13*, 132–8.

638 Levin, I. P., S. L. Schneider, and G. J. Gaeth (1998). All frames are not created equal: A
639 typology and critical analysis of framing effects. *Organizational Behavior and Human*
640 *Decision Processes 76*(2), 149–188.

641 Libby, R. (1985). Availability and the generation of hypotheses in analytical review.
642 *Journal of Accounting Research 23*(2), 648–667.

643 Loibl, C., C. R. Sunstein, J. Rauber, and L. A. Reisch (2018, Fall). Which europeans
644 like nudges? approval and controversy in four european countries. *The Journal of*
645 *Consumer Affairs 52*(3), 655–688.

646 Lynch, E. J. and L. M. Andiola (2019). If eyes are the window to our soul, what role
647 does eye-tracking play in accounting research?. *Journal of Information Systems 33*(3),
648 107 – 133.

649 Léger, P.-M., S. Sénecal, F. Courtemanche, A. O. de Guinea, R. Titah, M. Fredette,
650 and E. Labonte-LeMoyne (2014, 10). Precision is in the eye of the beholder: Applica-
651 tion of eye fixation-related potentials to information systems research. *Journal of the*
652 *Association for Information Systems 15*(10), 651–678.

653 McMillan, J. J. and R. A. White (1993, 07). Auditors' belief revisions and evidence
654 search: The effect of hypothesis frame, confirmation bias, and professional skepticism.
655 *The Accounting Review 68*(3), 443.

656 Mehrabi, R. and A. M. Kolabi (2012). Investigating effect of entrepreneur's personal
657 attributes and cognitive heuristics on the quality of entrepreneurial strategic decision
658 making. *Global Business & Management Research 4*(2), 178 – 192.

Meißner, M. and O. Josua (2019, 04). The promise of eye-tracking methodology in organizational research: A taxonomy, review, and future avenues. *Organizational Research Methods 22*(2), 590–617.

Menon, R. V., V. Sigurdsson, N. M. Larsen, A. Fagerstrøm, and G. R. Foxall (2016). Consumer attention to price in social commerce: Eye tracking patterns in retail clothing. *Journal of Business Research 69*(11), 5008 – 5013.

Mock, T. J. and H. Fukukawa (2016). Auditors' risk assessments: The effects of elicitation approach and assertion framing. *Behavioral Research in Accounting 28*(2), 75 – 84.

Mogg, K. and B. Bradley (2005, 02). Attentional bias in generalized anxiety disorder versus depressive disorder. *Cognitive Therapy and Research 29*, 29–45.

Mubako, G. and E. O'Donnell (2018). Effect of fraud risk assessments on auditor skepticism: Unintended consequences on evidence evaluation. *International Journal of Auditing 22*(1), 55 – 64.

Na, K. (2021). The effects of cognitive load on query reformulation: mental demand, temporal demand and frustration. *Aslib Journal of Information Management 73*(3), 436–453.

Nelson, M. W. (2009). A model and literature review of professional skepticism in auditing. *Auditing: A Journal of Practice & Theory 28*(2), 1 – 34.

Olsen, C. and A. Gold (2018). Future research directions at the intersection between cognitive neuroscience research and auditors' professional skepticism. *Journal of Accounting Literature 41*, 127 – 141.

Owhoso, V. and A. Weickgenannt (2009, 02). Auditors' self-perceived abilities in conducting domain audits. *Critical perspectives on accounting 20*(1), 3–21.

Perloff, L. S. (1987). *Social Comparison and Illusions of Invulnerability to Negative Life Events*. Boston, MA: Springer US.

Phillips, F. (1999). Auditor attention to and judgments of aggressive financial reporting. *Journal of Accounting Research (Wiley-Blackwell) 37*(1), 167 – 189.

Pike, B. J., M. B. Curtis, and L. Chui (2013, 07). How does an initial expectation bias influence auditors' application and performance of analytical procedures? *The Accounting Review 88*(4), 1413.

Presutti, Anthony H., J. (1995). Anchor and adjustment heuristic effect on audit judgement. *Managerial Auditing Journal 10*(9), 13.

Puri, M. and D. T. Robinson (2007). Optimism and economic choice. *Journal of Financial Economics 86*(1), 71 – 99.

Radcliffe, N. M. and W. M. P. Klein (2002). Dispositional, unrealistic, and comparative optimism: Differential relations with the knowledge and processing of risk information and beliefs about personal risk. *Personality and Social Psychology Bulletin 28*(6), 836–846.

Robinson, S. N., M. B. Curtis, and J. C. Robertson (2018, 02). Disentangling the trait and state components of professional skepticism: Specifying a process for state scale development. *Auditing: A Journal of Practice & Theory 37*(1), 215.

Rose, A. M., J. M. Rose, K. Rotaru, K.-A. Sanderson, and J. C. Thibodeau (2022). Effects of uncertainty visualization on attention, arousal, and judgment. *Behavioral Research in Accounting 34*(1), 113 – 139.

Shanteau, J. (1989). Cognitive heuristics and biases in behavioral auditing: Review, comments and observations. *Accounting, Organizations & Society 14*(1/2), 165 – 177.

Shaub, M. K. (1996). Trust and suspicion: The effects of situational and dispositional factors on auditors' trust of clients. *Behavioral Research in Accounting 8*, 154.

Shaub, M. K. and J. E. Lawrence (2002). A taxonomy of auditors' professional skepticism. *Research on Accounting Ethics 9*, 167–194.

709 Shepperd, J., P. Carroll, J. Grace, and M. Terry (2002, 01). Exploring the causes of
710 comparative optimism. *Psychologica Belgica 42*, 65–98.

711 Simon, H. (1957). *Models of Man: Social and Rational*. Wiley, New York.

712 Sirois, L.-P., J. Bédard, and P. Bera (2018). The informational value of key audit mat-
713 ters in the auditor's report: Evidence from an eye-tracking study. *Accounting Hori-*
714 *zons 32*(2), 141 – 162.

715 Touche, D. . (1991). The robert m. trueblood accounting and auditing case study series.
716 wilton, conn. *Deloitte & Touche Foundation .*, .

717 Tversky, A. and D. Kahneman (1973). Availability: A heuristic for judging frequency
718 and probability. *Cognitive Psychology 5*(2), 207–232.

719 Tversky, A. and D. Kahneman (1974). Judgment under uncertainty: Heuristics and
720 biases. *Science 185*(4157), 1124–1131.

721 Tversky, A. and D. Kahneman (1981). The framing of decisions and the psychology of
722 choice. *Science 211*(4481), 453–458.

723 Van Bockstaele, B., E. Salemink, S. M. Bögels, and R. W. Wiers (2017). Limited gener-
724 alisation of changes in attentional bias following attentional bias modification with the
725 visual probe task. *Cognition & Emotion 31*(2), 369 – 376.

726 Wedel, M. and R. Pieters (2007). Informativeness of eye movements for visual marketing:
727 Six cornerstones. *Visual marketing: From attention to action 01*, 43–47.

728 Weinstein, N. D. (1980). Unrealistic optimism about future life events. *Journal of Per-*
729 *sonality and Social Psychology 39*, 806–820.

730 Weinstein, N. D. (1987). Unrealistic optimism about susceptibility to health problems:
731 Conclusions from a community-wide sample. *Journal of Behavioral Medicine 10*, 481–
732 500.

733 Weinstein, N. D. and E. Lachendro (1982). Egocentrism as a source of unrealistic opti-
734 mism. *Personality and Social Psychology Bulletin 8*(2), 195–200.

735 Wickens, C. (2008, 07). Multiple resources and mental workload. *Human factors 50*,
736 449–55.

737 Willekens, M. and D. A. Simunic (2007). Precision in auditing standards: effects on
738 auditor and director liability and the supply and demand for audit services. *Accounting*
739 *and Business Research 37*(3), 217–221,223–232.

6 Tables

Table 1: Descriptive Statistics

Demographic Variables		
Number of participants	40	
Gender: % Female	0.40	
Prior experiment Experience (%)	0.10	
	Mean	**SD**
Age (years)	21-25	
Work Experience (years)	0.25-1	
HPSS	25.12	2.73
Mediating Variable		
Total duration of fixations	253.46	123.65
Dependent Variables		
Skepticism1:		
Framing biased	5.30	1.92
Framing unbiased	6.64	1.80
Optimism biased	4.5	1.29
Optimism unbiased	6.03	1.98
Skepticism2:		
Framing biased	1.09	0.73
Framing unbiased	1.53	0.62
Optimism biased	1.25	0.96
Optimism unbiased	1.28	0.70

Notes: This table shows the descriptive statistics of the various variables. HPSS is the Hurtt's professional skepticism scale

Table 2: Frequency Distribution of Cognitive Biases

Framing Bias

Description	**Frequency**	**Percentage**
Unbiased	17	42.50%
Biased	23	57.50%
Total	40	100.00%

Optimism Bias

Description	**Frequency**	**Percentage**
Biased	14	35.00%
Unbiased	26	65.00%
Total	40	100.00%

Notes: This table shows the percentage of participants who are subject to the cognitive biases tested.

Table 3: Direct effect of Cognitive Biases on Professional Skepticism

Variables	**Skepticism1**	**Skepticism2**
	(1)	(2)
Framing Bias		
Intercept	3.57	3.13
	(0.26)	(<0.01)***
Framing Bias	-1.35	-0.49
	(0.03)**	(0.03) **
Experiment Experience	0.16	0.63
	(0.89)	(0.14)
HPSS	0.73	-0.39
	(0.33)	(0.16)
F-Statistic	2.13	2.38
DF	36	36
R-squared	0.15	0.17
Adjusted R-squared	0.08	0.10
p-value	0.11	(0.09)*
Optimism Bias		
Intercept	3.09	2.74
	(0.35)	(0.03) **
Optimism Bias	-1.38	-0.06
	(0.20)	(0.87)
Experiment Experience	-0.24	0.50
	(0.84)	(0.26)
HPSS	0.70	-0.36
	(0.38)	(0.22)
F-Statistic	1.02	0.66
DF	36	36
R-squared	0.08	0.05
Adjusted R-squared	0.01	<-0.03
p-value	0.40	0.58

Notes: The number of observations equals 40. Each line corresponds to a multiple regression model, $Y_i = \beta_0 + \beta_1$*Cognitive Bias + β_2*Experiment Experience + β_3*HPSS + ϵ_i, where HPSS is the Hurtt's Professional Skepticism Scale

p-values in parentheses. Estimates not in parentheses. *, **, and *** indicate, significance at the 10%, 5% and 1% levels, respectively.

Table 4: Cognitive biases and Cognitive load

Variable	**Total Duration of fixations**					
	Frequency	**Mean**	**SD**	**t**	**DF**	**p-value**
Framing Bias				1.98	37.94	0.06
Biased	42.5%	5333.26	2195.58			
Unbiased	57.5%	4044.72	1523.34			
Optimism Bias				3.82	8.18	<0.01
Bias	35.00%	6101.00	667.31			
Unbiased	65.00%	5011.97	2101.47			

This table shows the effect of the optimism and framing bias on the Total duration of fixations metric.

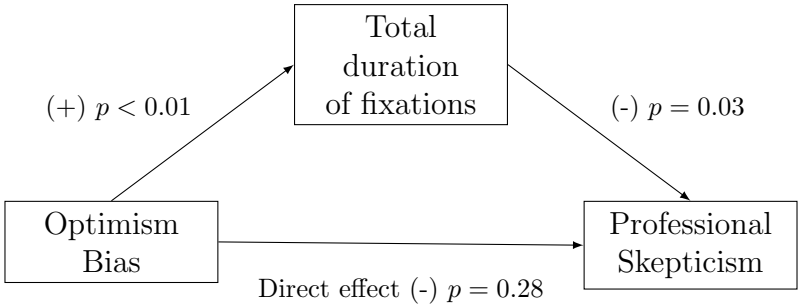

Figure 1: Path model of mediation of the effect of the optimism bias on skepticism through Total duration of fixations

Table 5: Mediation Analysis

Effect	**Estimate**	**Std. Err**	**z-value**	**p-value**
Skepticism1 ∼ Optimism Bias (c)	-0.827	0.760	-1.088	0.28
Total duration of fixations ∼ Optimism Bias (a)	1870.33	439.28	4.26	<0.01***
Skepticism1 ∼ Total duration of fixations (b)	<-0.01	<0.01	-2.12	0.03**
ab	-0.70	0.38	-1.84	0.07*

Notes: Each line reflects the outcome of a linear regression model. *, **, and *** indicate, significance at the 10%, 5% and 1% levels, respectively.

Table 6: Summary of results

Finding	**Related Hypothesis**
The framing bias leads to less professional skepticism	H1a validated
The optimism bias leads to less professional skepticism	H1b validated
Total duration of fixations is a mediator between the optimism bias and professional skepticism	H2 validated

A Appendix: Experimental Materials

A.1 Informed Consent form

Dear Participant,

This study was developed as part of a research program conducted by X University in collaboration with researchers at Y University. It deals with practices related to financial auditing.

Your answers will remain strictly anonymous and will only be used for academic purposes. The accuracy and sincerity of your answers are crucial to the quality of this work. We thank you in advance for your kind cooperation.

Informed consent form This study attempts to gather information on the differences in individual performances during auditing tasks among professionals. You will be presented with a series of questions about an auditing task, your preferences, and your personality. The questionnaire lasts about 15 minutes. The risks of participation are minimal in this study. However, you may feel emotionally uncomfortable when you have to make judgments. We hope that thanks to your participation, researchers at X University and Y University will know more about the relationship between contextual and personal factors impacting performance during auditing tasks. All data obtained from participants will be kept confidential and will only be reported in a global format (ie only combined results and never individual reports on a particular person). All the questionnaires will be anonymous and know that the research team will have access to them. The collected data will be stored on a secure server of the Qualtrics company until the principal investigator removes them. There is compensation for complete and valid participation. You should have validated all attention checks to receive compensation. Participation in this study is entirely voluntary. You have the right to withdraw at any time or refuse to participate fully. If you wish to withdraw, please inform the principal researcher at this email address: xxx. If you have any questions about this study, you can contact the principal researcher. x University's Ethics Board has determined that the data collection related to this study meets the ethics standards for research involving humans. If you have any questions

related to ethics, please contact the Research and Ethics Board secretariat at xxx or by e-mail at xxx

I consent to participate in this study a.Yes b.No

A.2 Audit Task

You will now proceed to a self-paced review of audit evidence of Meter-Tek Company reported in 6 sentences, categorized into one of various financial statement accounts.

Meter-Tek is a manufacturer and marketer of water, electricity and natural gas meters and you are their auditor. Materiality as with other audits is set at $100,000.

Meter-Tek's accounting year is from 1st January to 31st December. The accounting year being audited is 2021.

The audit evidence will be displayed one at a time

Cash: The staff accountant noted that bank accounts are reconciled monthly

Trade Receivables: An examination of year-end customer balances indicates that the December 31, 2021 allowance for doubtful accounts is inadequate.

R&D and Engineering Expenses: Total engineering expenses decreased by $40,000 from 2020

Inventories: Test counts conducted at the December 31, 2021 inventory observation did not reveal exceptions and were subsequently agreed to the final inventory listing.

Investments in Affiliated Companies: Meter-Tek continues to hold equity interests of 25% in two profitable companies that are accounted for using the equity method.

Accounts Payable and Accrued Liabilities: The search for unrecorded liabilities involved an examination of payments and invoices processed subsequent to year-end and revealed significant understatements.

A.3 Audit Task Questions

Please evaluate the client's financial reporting as a whole.

Aggressive financial reporting refers to accounting practices that are designed to overstate a company's financial performance. It includes but is not limited to

1. Sharp rises in incomes or sharp decreases in expenses from previous years

2. Manipulations or violations of accounting principles, policies or standards to enhance financial performance

3. Misreporting

Not aggressive at all 1	2	3	4	5	6	7	8	9	10 Very aggressive

Of the following 6 accounts you have read on the previous page, which warrant further examination?

a. Cash
b. Trade Receivables
c. Inventories
d. Investments in Affiliate Companies
e. Accounts Payable and Accrued Liabilities
f. R&D and Engineering Expenses
g. None

A.4 Hurtt's Professional Skepticism Scale

Statements that people use to describe themselves are given below. Please circle the response that indicates how you generally feel. There are no right or wrong answers. Do not spend too much time on any one statement.

	Strongly Disagree					**Strongly Agree**
I often accept other people's explanations without further thought	1	2	3	4	5	6
I feel good about myself.	1	2	3	4	5	6
I wait to decide on issues until I can get more information	1	2	3	4	5	6
The prospect of learning excites me.	1	2	3	4	5	6
I am interested in what causes people to behave the way that they do.	1	2	3	4	5	6
I am confident of my abilities.	1	2	3	4	5	6
I often reject statements unless I have proof that they are true	1	2	3	4	5	6
Discovering new information is fun	1	2	3	4	5	6
I take my time when making decisions.	1	2	3	4	5	6
I tend to immediately accept what other people tell me.	1	2	3	4	5	6
Other people's behavior does not interest me.	1	2	3	4	5	6
I am self-assured.	1	2	3	4	5	6
My friends tell me that I usually question things that I see or hear	1	2	3	4	5	6
I like to understand the reason for other people's behavior.	1	2	3	4	5	6
I think that learning is exciting.	1	2	3	4	5	6

A.5 Cognitive Biases

A.5.1 Framing Bias

Imagine that you face the following pair of concurrent decisions. First examine both decisions, then indicate the options you prefer.

Decision (i). Choose between: A. a sure gain of $240 B. 25% chance to gain $1000, and 75% chance to gain nothing

Decision (ii). Choose between: C. a sure loss of $750 D. 75% chance to lose $1000, and 25%

A.5.2 Optimism Bias

In 2020, the Covid-19 pandemic caused the French to lose around half a year of life expectancy. Life expectancy at birth reaches 79.2 years for men and 85.3 years for women, according to INSEE.

In your opinion what is the life expectancy of a.yourself b.an average person of the same gender and age as you

A.6 Demographic Questions

1. What is your gender? a. Male b.Female

2.In which age range (in years) are you? 18-20; 21-25; 26-30; 31-35; 36-40; 41-45; 46-50; 51-55; 56-60; 61-65; 66-70; 71-75; 76-80; 81-85

3. What is the highest level of education you have attained? a. No higher education degree b.Undergraduate c.Graduate d.PhD

4.What is your undergraduate major? Finance; Economics; Accounting; Marketing; HRM; Strategy; Supply Chain/logistics; Management; Other

5. Do you have any audit work experience (including internships)? Yes; No

6. Do you currently any accounting or auditing professional designation? CA; CGA; CMA; CPA; CFA; No

7. Prior to this experiment, have you participated in either accounting, finance,

auditing, economics, or psychology experiments? Yes; No