The microfoundations of audit quality

Peters, Christian P. H.

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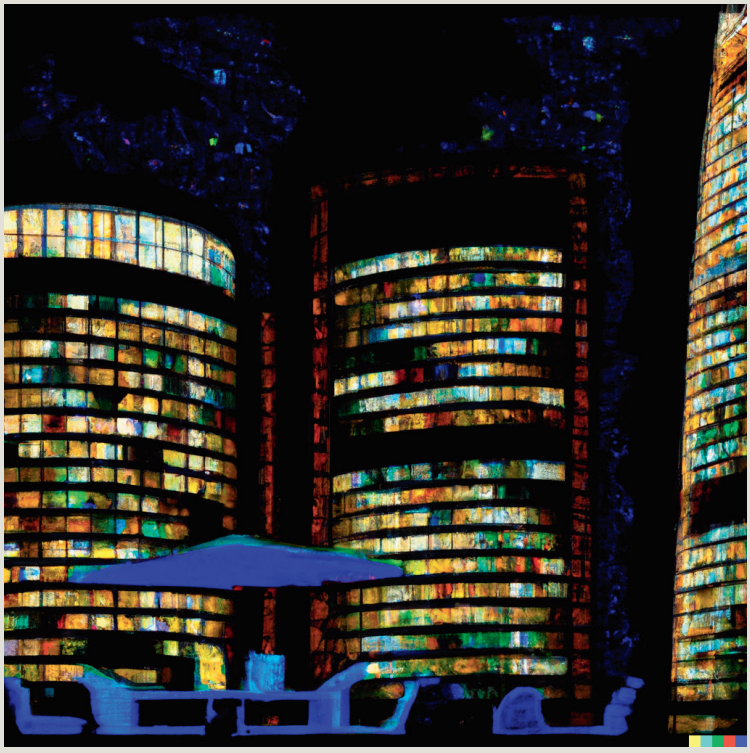
CHRISTIAN PETERS



TILBURG UNIVERSITY

The Microfoundations of Audit Quality

PROEFSCHRIFT

ter verkrijging van de graad van doctor aan Tilburg University op gezag van de rector magnificus, prof. dr. W.B.H.J. van de Donk, in het openbaar te verdedigen ten overstaan van een door het college voor promoties aangewezen commissie in de aula van de Universiteit op dinsdag 13 juni 2023 om 14.00 uur door

CHRISTIAN PETRUS HENDRIKUS PETERS

geboren op 25 oktober 1994 te Nijmegen.

PROMOTORES:	Prof. dr. B.C.G. (Bart) Dierynck *Tilburg University* Prof. dr. K. (Kathryn) Kadous *Emory University*
PROMOTIECOMMISSIE:	Dr. J.W. (Jeremiah) Bentley *University of Massachusetts Amherst* Prof. dr. E. (Eddy) Cardinaels *Tilburg University and Katholieke Universiteit Leuven* Prof. dr. A.H. (Anna) Gold *Vrije Universiteit Amsterdam* Prof. dr. M.W. (Mark) Nelson *Cornell University*

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Christian Peters
Atlanta, Georgia
April 2023

Contents

List of Figures

Chapter 2

Chapter 3

Chapter 4

List of Tables

Chapter 2

Chapter 3

Chapter 4

Chapter 1

General Introduction

What is the source of a high-quality audit? This question is not easy to answer. Academics and practitioners have long been struggling to understand the drivers of audit quality. Yet, for many it seems easier to answer the question ex negativo. That is, most people are aware of cases where an audit failed and had significant consequences for society, such as EY's failure in the Wirecard audit, KPMG's failure in the Carillion audit, and Arthur Andersen's failure in the Enron audit. To investigate why some audits are high or low quality, one can take a bird's eye view and examine how audit markets function, what type of client firms have higher demand for audit quality, and what role regulation and regulatory institutions play in shaping high-quality audits. Research studies that aim to tackle these questions from this perspective typically use large sets of publicly available data. These studies often rely on aggregated measures of audit quality and are large in scale and scope.

However, the audit failures that have shocked the financial markets and society have highlighted the need to further open the black box of what happens inside auditing firms. For instance, in the Wirecard audit failure, EY was criticized for failing to detect the fraud due to too heavily relying on management representations without performing sufficient independent verification, inadequate audit procedures to test the existence and completeness of the bank balances, and a lack of professional skepticism. That is, these audit deficiencies tend to occur due to judgments and decisions made by individual auditors or in the engagement team. As such, aggregate audit quality outcomes can be explained in terms of the actions and interactions of individual auditors and audit teams. I call these actions and interactions the **microfoundations of audit quality**.

With this premise, this dissertation has the objective to open the black box and dive into the operational level to explore how individual behavior by auditors shapes their judgment performance, learning, professional skepticism, and by extension audit quality. Thereby, this dissertation sheds a light on several microfoundations of audit quality. To provide a theoretical

foundation for my analysis, I bring together streams from auditing, accounting, psychology, operations, education, and ergonomics. Overall, I find that operational aspects of the audit, such as **(i)** the order in which tasks are conducted, **(ii)** the way in which auditors engage in workplace learning, and **(iii)** whether audit firms use human auditors or automated tools and techniques to conduct certain tasks shape auditors' judgments and decision making, and by extension audit quality.

This dissertation is comprised out of three studies. The first study is conducted together with my promotor Prof. dr. Bart Dierynck. In this study, we investigate how auditors prioritize auditing tasks of varying difficulties and how this influences their performance. We conduct two experiments with professional auditors and find that auditors tend to prioritize easy audit tasks. They may thus leave more difficult audit tasks to the end of the audit. At the end of the audit, auditors may not have the cognitive resources or energy to perform the audit tasks optimally, face deadline pressure, or have insufficient time to ask for more audit evidence from the client firm. We find that the prioritization of easy audit tasks results in worse overall performance and especially in those parts of the audit tasks that require a relatively high degree of cognitive processing. The prioritization of easy tasks is exacerbated when time pressure is high and may be mitigated by providing auditors more psychological ownership over their tasks, but the potential benefits of psychological ownership only materialize when time pressure is low. In a separate survey, we find that although auditors indicate that prioritizing an easy task is bad, they expect other auditors to engage in easy task prioritization. Thereby, our study shows that an operational aspect that hitherto received little attention has implications for auditors' judgment performance.

The second study, conducted with both my supervisors, Prof. dr. Bart Dierynck and Prof. dr. Kathryn Kadous, study how auditors learn in the workplace. Workplace learning is a central feature of the auditing profession, as auditors must develop a considerable body of expertise to establish their legitimacy and uphold their public responsibilities. The first purpose of this paper

is to facilitate integration of existing evidence related to auditor learning processes by structuring that research along key dimensions. These key dimensions are the location of learning: on-the-engagement or off-the-engagement, and the role of other auditors in the learning process: passive or active. The second purpose of this paper is to synthesize existing research to facilitate future research. To this end, we take a broad view of learning, incorporating prior research that directly examines processes that improve auditor knowledge, as well as research that likely has implications for auditor learning despite that learning is not the main focus of the study. We show that the way in which auditors learn, the interventions audit firms can take to foster learning, and which actors are involved in workplace learning depends on the learning process. We provide implications for practice and future research directions for academics.

The third study, a solo-authored one, investigates how auditors' usage of automated tools and techniques affects their professional skepticism. Using an experiment with professional auditors, I find that auditors tend to exercise less professional skepticism to workpapers that are prepared by automated tools and techniques than to the same workpapers prepared by human auditors. Based on psychology theory, I propose a counterarguing mindset intervention and find that it alleviates the negative effect of automated tools and techniques on professional skepticism. Furthermore, I investigate whether the professional skepticism reductions that are caused by automation usage also spillover to subsequent audit tasks, but do not find evidence for this. Collectively, the results of this study are relevant to regulators (such as the PCAOB and AFM), policymakers (including the IAASB), and audit firms. That is, for the potential advantages of automation to materialize, it is important that auditors' automation usage is based on thorough analysis of auditors' cognitive and motivational decision-making processes.

Collectively, these studies have further opened the black box on how individual auditor behaviors, judgments, and decision-making affect their performance, learning, professional skepticism, and by extension the audit quality that is delivered by the audit firm. These studies

examine auditing from an operational angle and show that task prioritization, workplace learning, and the way in which auditors deal with technology are important microfoundations of audit quality. That is, these findings can help to develop theories or build models that are more grounded in realistic assumptions about individual auditor behavior and that can better explain the complexities of the modern audit engagements. These theories and models can further investigate how aggregate outcomes such as accounting scandals, audit failures, and audit quality can be explained by the behavior of individual actions and interactions of auditors.

These studies are timely as regulators and policymakers in The Netherlands and worldwide, have raised concerns about the problematic level of audit quality and the gap between what the public and other stakeholders believe auditors should accomplish in an audit engagement and what auditors actually do in practice. As a response to these concerns audit firms have invested heavily in measures to improve audit quality, such as detailed procedures, second partner reviews, and refined incentive systems. Yet, it is questionable whether more rules, more protocols, more oversight, and more enforcement ultimately result in a better functioning auditing profession or instead are a postmodern medicine for a moral without an anchor. The studies in this dissertation show that auditors, audit firms, and policymakers could focus on interventions at the operational level, such as **(i)** creating environments of higher psychological ownership and lower time pressure such that auditors prioritize more difficult tasks, **(ii)** providing auditors with enough opportunities to reflect on their experience in the workplace and in that way make what is unconsciously learned more conscious by reflection, and **(iii)** prompting auditors with a counterarguing mindset when they are working with automated tools and technologies.

The dissertation continues as follows. Chapter 2 presents the study with Prof. dr. Bart Dierynck on auditors' task prioritization: "Auditor Task Prioritization: The Effects of Time Pressure and Psychological Ownership." Next, Chapter 3 presents the study with Prof. dr. Bart Dierynck and Prof. dr. Kathryn Kadous, where we develop the Auditor Learning Framework and

review of the literature on workplace learning in auditing: "Learning in the Auditing Profession: A Framework and Future Directions." Chapter 4 presents the study on how auditors' usage of automated tools and technologies affects their professional skepticism: "Auditor Automation Usage and Professional Skepticism." Chapter 5 concludes this dissertation. I hope the reader of this dissertation will enjoy reading it and develop a better understanding of the microfoundations of audit quality.

Chapter 2

Auditor Task Prioritization

The Effects of Time Pressure and Psychological Ownership

Abstract

This paper reports three studies examining easy task prioritization among auditors. The first study is a survey of auditors providing evidence that auditors perceive easy task prioritization to be a threat to audit quality, yet auditors do expect other auditors to prioritize easy tasks. In our first experiment, we find that auditors indeed prioritize easy tasks. Easy task prioritization is also exacerbated under time pressure. We further find that psychological ownership is only able to alleviate easy task prioritization in low time pressure conditions, but not in high time pressure conditions. In our second experiment, we find that prioritizing the easy task leads to lower judgment performance, and by extension, audit quality. Prioritizing the easy task led to lower performance in the difficult task and in particular in finding errors for which more cognitive processing is needed. Combined, our studies document easy task prioritization in auditing, the audit quality implications, and the role of time pressure and psychological ownership.

2.1. Introduction

Auditing standards require auditors to plan and control their work effectively (American Institute of Certified Public Accountants [AICPA] 2012). Such a planning is vital to an effective and efficient audit and implies that auditors must determine the order in which they will complete the audit tasks assigned to them. Typically, audit tasks assigned to an auditor vary in task difficulty. Task difficulty refers to the amount of attentional capacity or cognitive processing the task requires (Kahneman 1973; Bonner 1994; Bonner 2008, p. 159). For instance, the audit of a goodwill impairment test is typically considered as a more difficult audit task than the audit of the cash balances. Despite the fact that prioritizing audit tasks is at the auditor's discretion, virtually no research directly examines how auditors prioritize tasks that vary in difficulty. In this study, we investigate whether auditors prioritize easier audit tasks, whether the prioritization of easier audit tasks has repercussions for audit quality, and whether time pressure and psychological ownership influence the prioritization of easier audit tasks.

We leverage conservation of resources (COR) theory to investigate whether auditors prioritize easy tasks over difficult tasks (Hobfoll 1989; 2001). The basic tenet of COR theory is that individuals have limited cognitive resources and are motivated to protect their current cognitive resources and acquire new cognitive resources. Halbesleben, Neveu, Paustian-Underdahl, and Westman (2014) define resources as anything that helps an individual to attain a goal. In an auditing setting, we refer to cognitive resources such as cognitive capacity, motivation, willpower, self-discipline, resilience, self-efficacy, and vigilance that are needed to successfully complete an audit task (Halbesleben *et al.* 2014; Hurley 2015; 2019; Mullis and Hatfield 2018). COR theory further states that executing a task depletes these cognitive resources but also produces cognitive resources upon completion of the task. Based on COR theory, a difficult task thus differs from an easy task in two ways: a difficult task depletes more cognitive resources than an easy task but also produces more cognitive resources upon task completion because they generate, for instance, a

stronger feeling of efficacy and effectance (Hobfoll, Halbesleben, Neveu, and Westman 2018; Hurley 2019; Mullis and Hatfield 2018). When auditors choose which task they do first, they trade off the immediate resource losses and the potential future resource gains associated with the tasks in their task set. According to the *primacy of resource losses*, which is a core principle of COR theory, immediate resource losses are disproportionately more salient compared to potential resource gains (Halbesleben *et al.* 2014; Hobfoll 1989; 2001). As a result, when choosing to prioritize an easy or a difficult task, the immediate resource losses of difficult tasks loom disproportionately larger than those of easy tasks, inducing auditors to prioritize easy over difficult tasks. This leads us to our first predictions that auditors prioritize easy tasks.

Auditors often operate under high time pressure. COR theory predicts that when job demands are high, such as in high-time-pressure conditions, auditors will more defensively attempt to protect their cognitive resources (Demerouti, Bakker, Nachreiner, and Schaufeli 2001). One such defensive attempt involves overfocusing on minimizing the resource losses associated with a given task, instead of weighing those losses against resource gains (Lee and Ashforth 1996; Rubino, Perry, Milam, Spitzmueller, and Zapf 2012; Taris, Schreurs, and Van Iersel-Silfhout 2001). As a result, under time pressure, the primacy of resource losses is expected to be a stronger driver of task prioritization, leading to our second prediction that time pressure will exacerbate auditors' prioritization of easy tasks.

Next to the primacy of resource losses, another important principle of COR theory is that the size of potential resource gains upon completion of a task is not equal across people and situations. Drawing on research on psychological ownership and COR theory, we expect that psychological ownership, which is defined as an auditor's feeling that a task is theirs (Pierce, Kostova, and Dirks 2001; 2003), will increase the potential resource gains associated with a difficult task more than the potential resource gains associated with an easy task (Pierce and Jussila 2011; Pierce, Jussila, and Cummings 2009). That is, psychological ownership may increase resource gains in easy tasks, but will lead to proportionally larger resource gains in difficult tasks. However,

although psychological ownership influences resource gains, the benefits of psychological ownership will only materialize when auditors trade off resource gains against resource losses. Such a trade-off only occurs when time pressure is low. In contrast, when time pressure is high, auditors narrowly focus on minimizing resource losses, implying that the increased resource gains resulting from high psychological ownership are less likely to be part of the trade-off (e.g., Lee and Ashforth 1996). As a result, we predict that auditors with enhanced psychological ownership will exhibit less easy task prioritization when time pressure is low, which is Hypothesis 3a, but auditors with enhanced psychological ownership will not exhibit less easy task prioritization when time pressure is high, which is Hypothesis 3b.

We provide convergent evidence that is in line with our hypotheses using a survey and two experiments. In Study 1, we survey 54 auditors of different ranks, and present them with a vignette describing an auditor that needs to conduct an audit of cash and an audit of a client-prepared step one of a goodwill impairment test. Study 1 provides evidence that auditors can distinguish easy tasks from difficult tasks. Our survey results further demonstrate that auditors perceive the prioritization of difficult tasks as better for audit quality, but at the same time auditors expect that easy tasks will be prioritized in an audit.

Study 2 is a 2×2 between-participants experiment with 177 staff auditors. We present auditors with two tasks that vary in difficulty and operationalize task difficulty based on COR theory. Auditors can decide which task they prioritize. We manipulate psychological ownership (enhanced or limited) and time pressure (high or low). In line with Hypothesis 1 and Hypothesis 2, we find that on average auditors prioritize easy tasks over difficult tasks and that easy task prioritization is stronger when time pressure is high compared to when time pressure is low. We also find modest evidence for Hypothesis 3A and 3B. Specifically, we find marginally significant evidence that psychological ownership reduces the proclivity to prioritize easy tasks when time pressure is low but not when time pressure is high. Results from additional analyses do not lend

support for alternative explanations, such as that easy task prioritization is driven by learning effects or a lack of accountability.

Study 3 is a 1×2 between-participants experiment with 114 staff auditors and aims to examine the audit quality implications of easy task prioritization. As in Study 2, participants need to execute two tasks that vary in difficulty. In contrast with Study 2, the variation in task difficulty is larger as this allows for a cleaner test of audit quality implications. Also, participants have a fixed amount of time for both tasks, such that time spent on one task does not impair the amount of time available for the other task. We find that performance in the easy task does not differ depending on whether the easy task is prioritized or not. However, performance in the difficult task is lower when the difficult task is conducted after the easy task. Furthermore, the performance difference manifests itself in detecting 'deep issues' that require a relatively large amount of cognitive resources but not in 'surface issues.' Overall, this paper provides theory-consistent evidence that **(i)** auditors tend to prioritize easy tasks and this is a threat for audit quality, **(ii)** time pressure increases easy task prioritization, and **(iii)** psychological ownership has the potential to weaken easy task prioritization but not when time pressure is high.

These results provide several contributions. First, this study is among the first to examine how auditors use their discretion to determine the order in which they execute their tasks. Despite the fact that auditors of all levels have some degree of task discretion (e.g., Morrill, Morrill, and Kopp 2012), we know little about how auditors use this discretion. A notable exception is Mocadlo (2022), who examines how the subjectivity of task criteria influence auditors' ordering of audit tasks. Our study shows that auditors use their task discretion in a way that leads to the prioritization of easy tasks and that easy task prioritization hurts audit quality. These findings contribute to the auditing literature but also to the nascent literature on easy task prioritization (see for instance KC, Staats, Kouchaki, and Gino (2020)). Importantly, our study does not show that easy task prioritization is always bad in an audit. In some cases, when auditors could potentially learn from the tasks, it may be wise to prioritize easy tasks. However, when difficult tasks are systematically

postponed to the end of the audit engagement as a result of easy task prioritization, auditors may not have enough time to sufficiently address all the task criteria and may have depleted cognitive resources when doing the difficult tasks, leading to lower audit quality.

We also contribute by investigating the consequences of time pressure and psychological ownership in auditing. Prior literature has documented the importance of time pressure in auditing and shows that time pressure may increase or decrease auditor judgment quality depending on the level of time pressure (Kelley and Margheim 1990; DeZoort and Lord 1997; Bowrin and King 2010). The main focus until now is on how time pressure affects auditor behavior *within* a particular audit task (e.g., Asare, Trompeter, and Wright 2000; Coram *et al.* 2004; Gold, Knechel, and Wallage 2012; Pietsch and Messier 2017). By documenting that time pressure increases easy task prioritization, we examine how time pressure affects auditor behavior *between* audit tasks. Our findings also suggest that the benefits of interventions focused on enhancing psychological ownership may not materialize in an auditing setting with high time pressure. For audit firms and regulators, this finding suggests that job demands (e.g., time pressure) must be reduced if interventions aimed at improving job resources (e.g., enhancing psychological ownership, participation, feedback, growth mindset) are to be effective.

2.2. Background Literature and Hypothesis Development

2.2.1. Conservation of Resources Theory

We rely on conservation of resources (COR) theory to predict the type of task auditors prioritize. COR theory is built on the foundation of the resource construct. The fundamental tenet of COR theory is that individuals are motivated to protect their current resources and acquire new resources, which auditors need to maintain cognitive focus, complete complex tasks, and make decisions (Hobfoll 1989; 2001).[1] Hurley (2015) analogizes cognitive resources with a muscle in

[1] Examples of resources that are needed to successfully complete an audit task are cognitive capacity, motivation, willpower, self-discipline, resilience, self-efficacy, and vigilance.

one's body: performance decreases when using it and recuperation is necessary to restore and improve the muscle. COR theory states that individuals have a limited amount of cognitive resources and are motivated to mitigate the loss of cognitive resources and to keep resource costs below resource gains. This conservation tenet has a motivational element, suggesting that individuals engage in behaviors to avoid resource losses (Halbesleben *et al.* 2014). One way in which auditors can steer resource losses is by exercising task discretion. When auditors exercise task discretion, auditors must trade off the potential resource costs of the audit tasks in their choice set against the potential resource gains of those tasks. Difficult tasks are more demanding on auditors and exact more resource costs than do easy tasks.[2] However, difficult tasks also potentially yield higher resource gains, such as greater feelings of efficacy and effectance when completing a difficult task (Hobfoll 2001).

According to COR theory's first principle, the primary driver of decisions about which tasks to execute first is the disproportionate salience of resource losses (Hobfoll 1989; 2001; Lee and Ashforth 1996). According to COR theory, resource losses are disproportionally more salient than resource gains, which means those losses are perceived as disproportionately larger in magnitude, are felt immediately, and persist longer (Hobfoll *et al.* 2018).[3] Assuming that auditors want to conserve resources, we predict that auditors will prioritize easy tasks over difficult tasks, because losses are weighed disproportionately more in the trade-off and easy tasks allow auditors to invest fewer resources than do difficult tasks.

> **HYPOTHESIS 1:** Auditors will prioritize easy tasks over difficult tasks, all else being equal.

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2 It is important to mention that time is not directly considered as a resource in COR theory. Time could however be indirectly linked to task difficulty and thus the resources needed to attain a goal. Specifically, difficult tasks could take longer and thus require more resources. That said, a difficult task could take the same amount of time as an easy task but require a higher intensity of resources.

3 We are agnostic about the level of cognitive resources that auditors start with when exercising task discretion. The crucial part is that the potential marginal resource losses loom disproportionately larger than the potential marginal resource gains. As difficult tasks have both larger potential resource losses and resource gains, we expect to observe easy task prioritization irrespective of the level of resources that auditors start with.

2.2.2. Time Pressure

COR theory predicts that when auditors experience time pressure as one of their job demands, they will experience their resources as being threatened (Bakker and Demerouti 2007; Demerouti *et al.* 2001; Hobfoll 1989; 2001). In the face of threatened resources, individuals are more likely to engage in defensive attempts to protect these resources (e.g., Lee and Ashforth 1996; Rubino *et al.* 2012; Taris *et al.* 2001). Thus, auditors whose resources are threatened are more likely to engage in defensive attempts to prevent resource losses (e.g., Hobfoll *et al.* 2018). One such defensive attempt is to narrowly focus on minimizing resource losses while ignoring the potential resource gains associated with a task (e.g., Halbesleben *et al.* 2014; Hobfoll 2001).

Time pressure is an important contextual feature in the auditing setting. Following COR theory, we expect that, under high time pressure, auditors will narrowly focus on minimizing resource losses rather than weighing those potential losses against potential resource gains. As difficult tasks require more resources than do easy tasks, we predict that the prioritization of easy tasks will increase when time pressure is high. This leads to the following hypothesis.

> **HYPOTHESIS 2:** Auditors are more likely to prioritize easy tasks over difficult tasks when time pressure is high than when time pressure is low.

2.2.3. Psychological Ownership and Time Pressure

Psychological ownership—namely, the feeling of being psychologically tied to an object and as though the target of ownership is theirs (Pierce *et al.* 2001; 2003)—is a mechanism that can influence the perceived resource gains associated with audit tasks. The feelings associated with psychological ownership are ubiquitous and can be applied to tangible objects, such as desks, and intangible objects, such as tasks and ideas (Beaglehole 1932). Prior literature on organizational behavior shows that feelings of ownership are common in organizations and can be directed toward various levels of the organizational context, such as the organization itself, the job, the group, or the work (e.g., Pierce and Jussila 2011; Van Dyne and Pierce 2004). Psychological

ownership over one's work has been shown to increase organizational commitment, organization-based self-esteem, contributions to the team, commitment, and satisfaction (e.g., Van Dyne and Pierce 2004; Wang, Law, Zhang, Li, and Liang 2019). On the other hand, psychological ownership can have dark sides for the organization, for example, by producing territorial behavior (Brown, Crossley, and Robinson 2014; Wang *et al.* 2019) or by causing client managers to disclose less negative information to auditors (MacKenzie 2019).

According to psychological ownership theory, feelings of ownership allow individuals to satisfy three needs (i.e., the *roots* of psychological ownership): a sense of belonging, a feeling of self-identity, and a feeling of efficacy (Pierce *et al.* 2001; 2003; Van Dyne and Pierce 2004).[4] This is consistent with COR theory as Hobfoll (2011) argues that resources exist in organizational conditions that either foster and nurture or block the creation and sustenance of those resources. We argue based on prior literature that each of the three needs is more likely to be satisfied by difficult tasks rather than easy tasks (Pierce *et al.* 2009; Pierce and Jussila 2011). First, difficult tasks challenge auditors and require more of their skills, abilities, and motivation than do easy tasks (Bonner 2008). This variety of skill gives auditors a greater feeling of efficacy upon completing difficult tasks and may thus increase the potential resource gains related to a difficult task relatively more than those associated with an easy task (Pierce *et al.* 2009). Second, completing difficult tasks provides more opportunities for self-knowledge; auditors are more likely to identify with the difficult aspects of their job than with the easy aspects (Pierce and Jussila 2011). Third, auditors are more likely to feel a sense of belonging and identify with their work when performing difficult tasks, because difficult tasks require more investments into the task than do easy tasks (Porteous 1976). As a result, we predict that psychological ownership will enhance the potential resource

[4] In an organizational context, a *sense of belonging* refers to the feeling when individuals come to dwell in their work and for whom the job is central to their identity. The *self-identity motive* refers to organizational members who take on appealing aspects of their job as parts of their identity (i.e., as opportunities for self-revelation). Finally, the *effectance motive* can be described as the tendency to explore one's external environment (White 1959). That is, being able to control one's surroundings gives rise to feelings of efficacy (Pierce and Jussila 2011).

gains associated with a difficult task more than the potential resource gains associated with an easy task.

When time pressure is high, auditors feel that their resources are threatened (Bakker and Demerouti 2007; Demerouti *et al.* 2001; Hobfoll *et al.* 2018), and narrowly focus on resource losses instead of weighing those losses against resource gains when exercising task discretion (Hobfoll 1989; 2001; Hobfoll *et al.* 2018; Lee and Ashforth 1996). That is, in low time pressure conditions, auditors will evaluate both potential resource gains and losses when deciding which task to prioritize but, in high time pressure conditions, auditors will narrow their focus to resource losses. Thus, although psychological ownership enhances the potential resource gains associated with a difficult task more than the potential resource gains associated with an easy task (Pierce *et al.* 2009; Pierce and Jussila 2011), these gains do not materialize in high time pressure conditions because high time pressure induces a narrow focus on resource losses. As a result, psychological ownership may alleviate easy task prioritization in low time pressure conditions but not in high time pressure conditions. This reasoning implies that we cannot predict a main effect of psychological ownership but instead develop a third hypothesis that consists of two simple effects.

> **HYPOTHESIS 3A:** Psychological ownership reduces easy task prioritization when time pressure is low.
>
> **HYPOTHESIS 3B:** Psychological ownership does affect easy task prioritization when time pressure is high.

2.3. Survey and Experimental Evidence

2.3.1. Study 1: Survey of Auditors

Method

For our survey, we recruited 54 auditors via training sessions at a Big 4 audit firm in The Netherlands. The sample consists of 1 intern, 17 staff auditors, 35 senior staff auditors, and 1 manager. Survey participants are on average 25.54 years old (st. dev. = 3.44) and have, on average,

2.69 years of work experience (st. dev. = 0.84). 62.96 (35.19%) percent of the participants are male (female).

Participants first read a vignette description explaining that a staff auditor needs to conduct two tasks: the audit of cash and the audit of a client-prepared step one of a goodwill impairment test. We expect the audit of cash to be perceived as an easier task than the audit of a goodwill impairment test. Participants were asked to answer four questions related to the prioritization of these tasks: **(i)** "*[w]hich of the two tasks seems to be the most difficult based on the information provided?*", **(ii)** "*[w]hich of the two tasks does Jesse need to start with to maximize audit quality?*", **(iii)** "*[s]uppose there is not enough time to conduct both tasks sufficiently, to which task does Jesse have to devote most attention?*", and **(iv)** "*[b]ased on what you have hitherto experienced in the auditing profession, which task would you expect Jesse to begin with?*". Participants respond on a seven-point Likert scale with "1" labeled as the audit of the cash balances and "7" labeled as the audit of the step one of a goodwill impairment test.

In the second part of the survey, participants were asked to assess task prioritization in daily auditing practice. Specifically, they were asked how frequently they think that easy tasks are prioritized in an audit engagement. The answer options are 'Never,' 'Rarely,' 'Occasionally,' 'Often,' and 'Always.' We also asked four questions about the risks and threats of prioritizing either easy or difficult tasks.[5] Finally, we asked participants to what extent prioritizing easy tasks is a problem for audit quality compared to other threats to audit quality and the importance of doing research about easy task prioritization.

Results

The results of the survey are reported in Table 1. Participants first answered questions with respect to the vignette description. We find that participants judge the audit of the step one of the goodwill impairment test to be significantly more difficult than the audit of cash when testing the mean

[5] Specifically, these questions are: **(i)** "[p]rioritizing easy tasks poses a risk for the quality of an audit, when there is high time pressure", **(ii)** "[p]rioritizing difficult tasks poses a threat for the quality of an audit", **(iii)** "[p]rioritizing easy tasks poses a risk for the quality of an audit", and **(iv)** "[p]rioritizing difficult tasks poses a threat to the quality of an audit, when there is high time pressure." Participants respond on a seven-point Likert scale with 1(7) labeled as totally disagree (totally agree).

against the midpoint of the 7-point Likert scale (M = 6.35, t = 20.88, p < 0.01, two-tailed for a comparison against the midpoint of the scale). When asked which of the two tasks needs to be prioritized to maximize audit quality, auditors judge that this is the task they also perceive as being most difficult, i.e., the audit of the step one of the goodwill impairment test (M = 4.78, t = 2.43, p = 0.02, two-tailed for a comparison against the midpoint of the scale). We find a significant positive correlation between the two judgments (r = 0.342, p = 0.01). When asked about what task to provide most attention to when there is not enough time to conduct both tasks, there is no significant difference from the midpoint of the scale (M = 4.13, t = 0.43, p > 0.10, two-tailed for a comparison against the midpoint of the scale). Finally, based on what they have experienced in the accountancy sector, participants expect the auditor to begin with the easy task, i.e., the audit of cash (M = 2.54, t = -5.46, p < 0.01, two-tailed for a comparison against the midpoint of the scale). We find participants that judge the goodwill impairment test to be more difficult are less likely to expect that the auditor will prioritize the goodwill impairment test (r = -0.277, p = 0.04, two-tailed). Collectively, these results demonstrate that auditors perceive it is better for audit quality to prioritize a difficult task than to prioritize an easy task, but they expect auditors to start with the easy task. Hence, participants expect auditors to behave in a way that is not consistent with maximizing audit quality.

Auditors next evaluate statements regarding their experiences and perceptions in auditing practice. First, participants in general expect auditors to prioritize easy tasks quite frequently. 81.5 (50.0) percent of the participants expects easy task prioritization to take place at least occasionally (often). The mean answer of the frequency item is 3.41 (st. dev. = 1.02) on a five-point scale, which

TABLE 1

Study 1: Descriptive Statistics

Survey Items

Item		Mean	SD	t	p	Scale
(1)	Which of the two tasks seems to be the most difficult based on the information provided?	6.35	0.83	20.88	**< 0.01**	1 (Cash) - 7 (Goodwill)
(2)	Which of the two tasks can Jesse better start with to maximize audit quality?	4.78	2.35	2.43	**0.02**	1 (Cash) - 7 (Goodwill)
(3)	Suppose there is not enough time to conduct both tasks sufficiently, to which task does Jesse have to provide most attention?	4.13	2.22	0.43	0.67	1 (Cash) - 7 (Goodwill)
(4)	Based on what you have hitherto experienced in the accountancy sector, which task would you expect Jesse to begin with?	2.54	1.97	-5.46	**< 0.01**	1 (Cash) - 7 (Goodwill)
(5)	How frequent do you think that auditors prioritize easy tasks in an audit?	3.41	1.02	2.94	**< 0.01**	1 (Never) - 5 (Always)
(6)	Prioritizing easy tasks poses a risk for the quality of an audit, when there is high time pressure.	4.96	1.40	5.05	**< 0.01**	1 (Strongly disagree) - 7 (Strongly agree)
(7)	Prioritizing difficult tasks poses a danger for the quality of an audit.	3.85	2.73	-0.40	0.69	1 (Strongly disagree) - 7 (Strongly agree)
(8)	Prioritizing easy tasks poses a risk for the quality of an audit.	4.37	1.53	1.78	**0.08**	1 (Strongly disagree) - 7 (Strongly agree)
(9)	Prioritizing difficult tasks poses a danger to the quality of an audit, when there is high time pressure.	4.00	1.59	0.00	1.00	1 (Strongly disagree) - 7 (Strongly agree)
(10)	To what extent is the prioritization of easy tasks an important problem for audit quality in comparison to other threats for audit quality?	2.78	0.79	-2.06	**0.04**	1 (Not at all) - 5 (To a large extent)
(11)	How important is it that researchers study the prioritization of easy tasks?	2.96	1.10	-0.25	0.81	1 (Unimportant) - 5 (Very important)

is significantly higher than 'Occasionally' ($t = 2.94$, $p < 0.01$, two-tailed). Second, we find that participants agree with the statements that prioritizing easy tasks poses a risk for audit quality in general (M = 4.37, $t = 1.53$, $p = 0.08$, two-tailed for a comparison with the midpoint of the scale), and also when there is high time pressure (M = 4.96, $t = 5.05$, $p < 0.01$, two-tailed for a comparison with the midpoint of the scale). The mean of participants answers with respect to the negative implications for audit quality of the prioritization of difficult tasks does not significantly differ from the midpoint of the scale (M = 3.85, $t = -0.40$, $p > 0.10$, two-tailed for the general situation; M = 4.00, $t = 0.00$, $p > 0.10$, two-tailed for the case with time pressure). Hence, our results suggest that auditors perceive easy task prioritization to be a risk for audit quality, but do not think that prioritizing difficult tasks is a risk for audit quality. Finally, we ask participants to **(i)** compare easy task prioritization to other threats to audit quality and **(ii)** ask them how important it is that researchers study the prioritization of easy tasks. With respect to the former question, we find a mean of 2.78 on a five-point Likert-scale (st. dev. = 0.79). With respect to the latter question, we find a mean of 2.96 on a five-point Likert scale (st. dev. = 1.10).

Overall, the results of the survey show that auditors can distinguish easy from difficult tasks, judge easy task prioritization as a threat for audit quality and expect others to start with an easy audit task. Given that auditors judge easy task prioritization as a threat for audit quality, we next investigate in an experiment whether auditors prioritize easy tasks over difficult tasks. Furthermore, we investigate how the contextual features time pressure and psychological ownership affect easy task prioritization.

2.3.2. Study 2: Auditor Task Prioritization: The Effects of Time Pressure and Psychological Ownership

Method

Overview and Participants. Study 2 is a 2 x 2 between-participants experiment in which auditors were asked to conduct two audit tasks: one easy and one difficult. Importantly, although there is a difference in the difficulty of the tasks, they are otherwise similar. Specifically, both tasks

involve the verification of information produced by the entity (IPE). Participants had to verify that the discounted cash flow (DCF) models prepared by the client are accurate and reliable. Before they could start working on the tasks, participants had to choose which task they wanted to start with. We manipulate psychological ownership (enhanced or limited) and time pressure (high or low) between participants.

We recruited 177 professional staff auditors during training sessions of a part-time professional accounting education program at a large public university in The Netherlands.[6,7] Most auditors were male (63.8 percent), worked for Big-4 accounting firms (72.9 percent), had an average work experience of 12.8 months (st. dev. = 7.8 months), and had an average age of 24.4 years (st. dev. = 1.9 years). Participants were provided with a computerized case developed using oTree software (Chen, Schonger, and Wickens 2016), and participated in the experiment using a link either provided during a classroom session or sent as an e-mail invitation (if participants were not present during the classroom session). Auditors were informed that the experiment would take approximately 30 minutes, and they received a fixed payment of ten euros (≈ $11.30) for their participation.[8]

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6 More specifically, we recruited participants during lectures of the Post-Experience Accountancy program. A Post-Experience Accountancy program typically is a two-and-half-year program that auditors follow part-time (usually one day a week in periods outside the busy-season) in The Netherlands to obtain a public accounting license equivalent to CPA.

7 The experiment was approved by the lab of the research institute. In the experimental descriptions we clearly stated that during the experiment there was no **(i)** physical discomfort, **(ii)** psychological discomfort, and **(iii)** any deception.

8 Participants may start the experiment with a different level of resources. Such variation should not influence the mean comparisons as long as there is successful randomization of the starting level of cognitive resources across conditions. We argue that vigor, which is a component of work engagement, can be considered as a predictor of one's cognitive resources. Vigor is defined by Schaufeli *et al.* (2002) as "high levels of energy and mental resilience while working, the willingness to invest effort in one's work, and persistence in the face of difficulties." In the post-experimental questionnaire, we included two items from the Utrecht Work Engagement Scale (UWES) that measure vigor. Specifically, the items are "At my work, I feel that I am bursting with energy." and "When I get up in the morning, I feel like going to work.". In line with the instructions for the UWES, we asked participants to assess the statements based on their general feelings and experiences. As the statements are not related to the experiment and likely not substantially influenced by the experimental manipulations, we argue that our 2-item vigor measure provides an appropriate way to assess successful randomization with respect to the starting level of cognitive resources. Taking the average of the 2 items measuring vigor, a one-way ANOVA does not reveal significant differences across conditions ($F=0.94$, $p>0.10$). Using a median-split of vigor, we find easy task prioritization in both the high-vigor and low-vigor group at 1-percent significance level. Overall, our tests indicate successful randomization.

Dependent Variable. Our dependent variable, *Easy Task Prioritization*, measures whether auditors prioritize the easy task and equals "1" when a participant chooses to start with the easy task and "0" when a participant chooses to start with the difficult task. Participants were asked to choose which audit task they wanted to start with and could switch once to the other task.[9] That is, once auditors switched from their first to second task, they could not switch back to the first task. Auditors could switch once at any moment during the task execution.

Independent Variables. We manipulate psychological ownership as either limited or enhanced in two ways. First, we manipulate participants' control over their work. Prior literature describes control over the target as the most salient predictor of ownership feelings (Furby 1978). We operationalized having control over one's work by varying whether a participant was given the opportunity to document the problem in their own words. More specifically, participants were asked to document why, after reading the background information and going through the training stage, a fair value estimate had to be used for the client's patents. In the enhanced psychological ownership condition, we informed participants that the team leader gives them full control over how to document this. In the limited psychological ownership condition, we informed participants that they had to fully and literally copy the documentation provided by the team leader. This manipulation is similar to psychological ownership manipulations used in prior literature (Baer and Brown 2012; Bauer, Estep, and Griffith 2022). Importantly, to alleviate the concern that documentation is more difficult for participants in the enhanced psychological ownership condition, we provided to all conditions a summary of the background information, such that participants in all conditions had similar information.[10] Second, to ensure consistency with the

[9] We allow participants to only switch between two tasks once because of three reasons. First, in line with prior research measure, we measure task prioritization by the chosen task order (e.g., KC *et al.* 2020; Mocadlo 2022). For task order to be a reliable measure of task prioritization, it is important that participants carefully think about which task they want to do first. Allowing multiple switches could instigate participants to first have a quick look at the tasks before working on the tasks. Such a behavior would make our measure for task prioritization noisier. Second, task prioritization is not an issue in a setting without switching as such a setting can be described as a mono-task environment. Given that every audit task needs to be tackled to some degree, prioritizing a task has more ecological validity than choosing one task. Third, a setting with multiple switches resembles a multi-task setting (see Mullis and Hatfield (2018), which is not the focus of our study.

[10] We cannot rule out the possibility that documentation is more difficult for participants in the enhanced

control manipulation, we adapted different aspects of the case that relate to having control over the target to either high or low control. As psychological ownership is created by a consistent set of beliefs and practices, adapting the text to the control manipulation ensures higher construct validity. The parts of the case text that varies between the psychological ownership conditions (limited and enhanced) are stated in Table 2.

We manipulated *Time Pressure* as either high or low. Participants in the low time pressure conditions had twelve minutes to complete both tasks, whereas participants in the high time pressure conditions only had eight minutes.[11] To test for a causal effect of time pressure on task choice, it is important that participants correctly estimate that time pressure during the task execution will be high or low before or at the moment of task choice. Stated differently, if participants only experience high or low time pressure during the task execution, which is after we derive our dependent variable, any variation in *Easy Task Prioritization* cannot be attributed to our manipulation of time pressure. We took three steps to ensure that participants before or at the moment of task choice correctly estimate high or low time pressure during the task execution.[12] First, participants in the low (high) time pressure

psychological ownership condition than for participants in the limited psychological ownership condition. Our hypotheses focus on a main effect of time pressure and two simple effects of psychological ownership based on time pressure. Hence, even if documentation is perceived as more difficult in the enhanced psychological ownership condition, this should not affect our hypothesis tests. Relying on COR theory, a difficult task consumes more resources but also produces more resources upon completion. Assuming that the relative level of produced resources vis-à-vis the consumed resources does not differ significantly across the psychological ownership manipulations, the level of participants' resources after going through the psychological ownership manipulations should not differ too much depending on the condition. Also, if the manipulation of enhanced psychological ownership strongly depletes resources, one would not find a significant effect of psychological ownership under low time pressure.

[11] Similarly, participants in the low (high) time pressure condition have a maximum of five (three) minutes in the training stage.

[12] Participants that in the low and high time pressure conditions do not spend a significantly different amount of time on the training stage, even though participants in the low time pressure condition had two minutes longer ($t = 0.20$, $p > 0.10$, two-tailed). More specifically, participants in the high time pressure condition spend on average 140.7 seconds (st. dev. = 44.90 seconds), whereas participants in the low time pressure condition spend on average 142.4 seconds (st. dev. = 69.1). Hence, it seems unlikely that the time pressure manipulation may have caused participants in the low time pressure condition to have more task experience than the participants in the high time pressure condition. We also do not find evidence that the number of seconds spent in the training stage is associated with *Easy Task Prioritization* ($z = -0.45$, $p > 0.10$, two-tailed for a univariate logit regression; $z = -0.31$, $p > 0.10$ two-tailed for logit regression while controlling for the conditions). This suggests that variation in time spent in the training stage does not explain variation in *Easy Task Prioritization*.

TABLE 2
Study 2: Psychological Ownership Manipulation
(Differences between treatments in italics)

Limited Psychological Ownership	Enhanced Psychological Ownership
You work in an audit team where your control over the audit tasks is seen as *totally unimportant*. At the end of audit engagements in this team, your contribution *does not feel* as your work.	You work in an audit team where your control over the audit tasks is seen as *important*. At the end of audit engagements in this team, your contribution *truly feels* as your work.
During evaluations of audit engagements with this team leader, *no* attention is paid to the extent to which you have control over the tasks.	During evaluations of audit engagements with this team leader, *a lot of* attention is paid to the extent to which you have control over the tasks.
In this audit team, you had *no* control over the way in which you conducted the previous audit tasks. Therefore, you *cannot* use the insights from the previous tasks in deciding how to conduct future audit tasks.	In this audit team, you had *a lot of* control over the way in which you conducted the previous audit tasks. Therefore, you *can* use the insights from the previous tasks in deciding how to conduct future audit tasks.
These tasks are regarded by the audit team as *a part of* the audit engagement.	These tasks are regarded by the audit team as *your contribution to* the audit engagement.
The audit team leader *has prepared a documentation and asks you to fully and literally copy his documentation.*	The audit team leader *grants you all control and freedom over how you document this.*
The Audit Tasks	*[Participant's Name]'s* Audit Tasks

condition have a maximum of five (three) minutes in the training stage. Second, in the high time pressure condition, a countdown timer was displayed saliently during the training phase and during the tasks. Third, we stated in the low time pressure condition that "twelve minutes should be enough to conduct both tasks."

Procedure and Task. The task requires participants to assume the role of an auditor at the year-end audit of a client operating in the agriculture industry. Participants read background information about the two fair value estimates, which are the two tasks in this experiment, that participants need to complete before the audit deadline. The client uses two DCF models to

determine the fair value estimates for the patents and participants read that the use of a DCF model and the model's input parameters had been audited by the engagement partner.[13]

After reading the background materials, participants enter a training stage in which they receive instructions about DCF models and were able to inspect the two spreadsheets of the DCF models used by the client. The order in which the models were presented was counterbalanced between participants. After the training stage, participants are informed that the models are information produced by the entity (IPE), and that they need to verify that the two DCF models produce accurate and reliable estimates. That is, participants need to check whether both models produce a mathematically sound and computationally correct fair value.

The two fair value estimates have the same forecast length and degree of uncertainty and only differ with respect to the number of information cues each DCF model uses.[14] The number of information cues is indicative of task difficulty (Bonner 2008, p. 160): for the easy (difficult) task the number of information cues in the DCF model was three (seven).[15] This difference in information cues makes verifying the accuracy and reliability of the difficult task more challenging computationally and analytically than the easy task. Moreover, the numbers used in the easy task are easier to compute (e.g., a royalty rate of 10 percent) compared to the difficult task (e.g., royalty rates of 7, 9, or 12 percent), and the information cues in the easy task are correlated (e.g., a 10

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[13] The fair value estimates relate patents of agricultural inventions that the client owns. The patents give the client the rights to exclude other parties from commercial exploitation of their inventions for eight years. However, the client, rather than exploiting the inventions themselves, grants exclusive rights of commercial use and exploitation of the inventions to a third party and receives royalty payments based on the third party's revenues in return. As there are no observable market prices or quoted prices available, a Level 3 fair value measurement is necessary (FASB 2008).

[14] We made the conscious design choice to feature two tasks that are objective and contain errors that are mechanical. Doing so allows us to better test for easy task prioritization. Specifically, it allows us to create a setting in which the tasks differ from one another in terms of only one independent variable and controlling all other variables, which helps to avoid the omitted-variables bias and eliminate alternative explanations for observed differences (Bloomfield and Anderson 2010). If we would have used two very different tasks, task prioritization may, for instance, be driven by personal preferences for a particular task and prior experience with a particular task. The disadvantage of this design choice is that detecting performance differences is more challenging because performance effects are less likely to appear in objective tasks (compared to subjective tasks) and in mechanical errors (compared to conceptual errors) (see for instance Mullis and Hatfield (2018) and Mocadlo (2022). In line with this, we do not find a performance difference between those who prioritize the easy task and those who prioritize the difficult task. In Study 3, we design a setting that is better suited to test performance differences.

[15] See Figure A.1 and Figure A.2 in the appendix for screenshots of the spreadsheets containing the DCF models used in the experimental case.

percent growth rate and a 10 percent discount rate counterbalance each other), thereby reducing task difficulty (Bonner 2008, p. 160).

After reading the background information and going through the training stage, participants are asked to judge which DCF model they consider more difficult on a slider ranging from –100 to 100. Following this judgment, participants choose which task they would like to prioritize. When participants make these judgments, it is crucial that they are aware of the relative task difficulty to accurately test our theory. We fulfilled this important condition by showing both tasks (i.e., the easy and difficult DCF model) during the training stage. Next, as explained earlier, we manipulated time pressure and psychological ownership before participants need to judge task difficulty and decide which task they need to prioritize. Participants are also informed that they can only switch tasks one and cannot go back to the first task after switching to the second task.

During the task execution, participants are asked to verify whether the DCF models produced accurate and reliable fair value estimates based on Excel spreadsheets embedded in the experimental environment. The Excel spreadsheets can be edited by the participants and the formulas used are shown in separate cells (see Appendix). For both fair value estimates, participants have to supply two outputs: participants are asked (1) to identify the cells that contain seeded errors and (2) to provide the correct fair value estimate given their adjustments of the model.[16] To provide the fair value estimates, participants could use the spreadsheets embedded in the experimental environment. A post-experimental questionnaire included manipulation checks and questions about the process and participants' personalities and demographics. Figure 1 provides an overview of the experimental procedures.

[16] Both the easy and the difficult tasks contain three seeded errors. If the session expired due to a timeout instead of due to submission, the inputs given by the participant were still saved.

FIGURE 1
Instrument Flow of Study 2

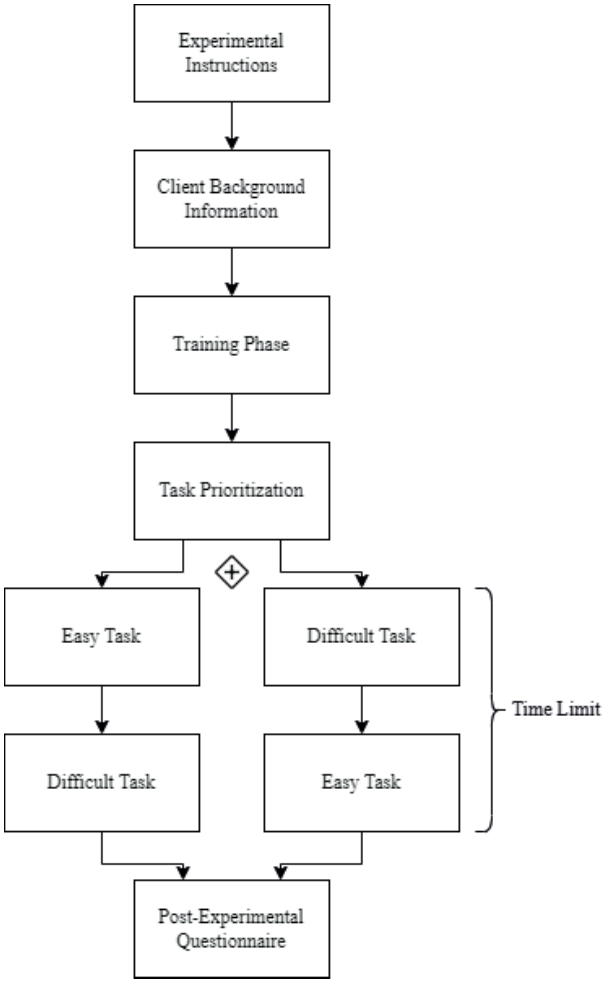

Figure 1– Instrument flow of Study 2

Notes: Figure 1 presents the instrument flow of Study 2. At the *Task Prioritization* stage, participants choose whether to prioritize the easy task or the difficult task. Participants need to conduct both the easy and difficult task within a specified time limit, namely eight (twelve) minutes in the high (low) time pressure condition.

Main Analyses

Manipulation Checks. In the post-experimental questionnaire, we asked participants several questions about the extent to which they felt psychological ownership during the case. To elicit these feelings, we used the four-item Van Dyne and Pierce (2004) scale tailored to our setting and measured responses on a Likert scale ranging from 1 to 7 (Cronbach's alpha = 0.92). We find that perceived psychological ownership is significantly higher in the enhanced psychological ownership conditions (mean = 4.86) than in the limited psychological ownership conditions (mean = 3.21), indicating that our psychological ownership manipulation was successful ($p < 0.01$, two-tailed).[17,18] Next, we also elicited participants' feelings about time pressure during the experiment. In the post-experimental questionnaire, we asked three questions about time pressure.[19] We find that time pressure is significantly higher ($p < 0.01$, two-tailed) in the high time pressure conditions (mean = 5.76) than in the low time pressure conditions (mean = 4.66). Despite this difference, the time pressure in the low time pressure condition was higher than the midpoint of the scale. Given that time pressure is endemic in the audit environment, the time pressure manipulation may vary conditions that are *relatively low* and *relatively high* in time pressure.

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17 We also find that perceived psychological ownership is significantly higher than the midpoint of the scale (4) in the enhanced psychological ownership condition ($t = 7.04$, $p < 0.01$, two-tailed) and lower than the midpoint of the scale in the limited psychological ownership condition ($t = –5.69$, $p < 0.01$, two-tailed).

18 When we exclude participants that are in the *Limited Psychological Ownership* condition and report on average above the midpoint of the scale ($n = 26$) as well as participants that are in the *Enhanced Psychological Ownership* condition and report on average below the midpoint of the scale ($n = 16$), we find a main effect for psychological ownership ($F = 4.11$, $p = 0.044$, two-tailed) that is stronger than in our main analyses. We also find that the simple effect of psychological ownership in the low time pressure condition (H3a) becomes significant at the two-tailed level ($t = 1.95$, p = 0.055, two-tailed).

19 We asked **(i)** to what extent participants experienced time pressure when getting familiar with the tasks, **(ii)** to what extent participants experienced time pressure while conducting the tasks, and **(iii)** to what extent they felt they had enough time to conduct the tasks properly. The three items were measured on a Likert scale ranging from 1 to 7. Based on these three questions, we averaged the items measuring the extent to which participants felt time pressure during the experiment (Cronbach's alpha = 0.85). For the time pressure manipulation, we do not find that experienced time pressure is lower than the midpoint of the scale in the low time pressure conditions. One reason could be that auditors always work under at least some time pressure, implying that it is difficult to get them in a situation with very low time pressure during an experiment that asks them to work on an audit task. Importantly, the goal of our time pressure manipulation is not to create a condition with very low time pressure but to create a difference in experienced time pressure across conditions. Furthermore, there are no indications in our data that the level of the perceived time pressure in our experiment threatens the validity of our tests and the inferences we draw from those tests.

We also tested whether participants perceived the difficult task to be more difficult than the easy task in two ways. First, just before participants made the decision about which task to prioritize, they were asked to evaluate on a slider ranging from "-100" to "100" which task they judged ex ante to be more difficult based on the training stage and the information they received about the tasks. Consistent with the idea that information cues are positively related to task difficulty, we find that participants judge the Robofer audit (i.e., the task with more information cues) as significantly more difficult (M = 51.86, t = 15.76, p < 0.01, two-tailed for a comparison with the midpoint of the scale). Second, in the post-experimental questionnaire, we asked participants to evaluate the statements: "The Robofer audit was difficult" and "The Feeder 2000 audit was difficult" on a seven-point Likert scale ranging from 1 (totally disagree) to 7 (totally agree). A simple t-test shows that participants evaluated the Robofer audit (i.e., the difficult task) as significantly more difficult than the Feeder 2000 audit (i.e., the easy task) (3.72 vs. 3.39, t = 2.92, p < 0.01, two-tailed).

Main Analyses. We start by analyzing whether auditors prioritize easy over difficult tasks in a pooled sample. If difficulty played no role in the prioritizing of tasks, we would expect 50 percent of participants to choose the easy task and 50 percent to choose the difficult task. However, if participants behave in a way that is consistent with our hypothesis, we expect more than 50 percent to prioritize the easy task. Table 3 shows that, of the 177 participants, 123 (69.49 percent) prioritized the easy task over the difficult task. A simple binomial test shows that the number of participants prioritizing the easy task is significantly higher than our benchmark of 50 percent (p < 0.01, two-tailed).[20] This result provides support to our hypothesis that auditors tend to prioritize easy tasks over difficult tasks when they have discretion over task ordering (i.e., Hypothesis 1).

[20] We further find that participants that prioritize the easy task have lower *Priority for Audit Quality* (t = -1.66, p = 0.099, two-tailed). *Priority for Audit Quality* consists of three (reverse-coded) items from the post-experimental questionnaire: **(i)** "[w]hen I work under high time pressure, I prefer to finish work as soon as possible, even if this potentially decreases audit quality," **(ii)** "[t]o get work done, some audit procedures are sometimes neglected," and **(iii)** "[i]f not enough people are there for the work that needs to be done, audit procedures are less strictly followed." This indicates that participants that prioritize audit quality to be higher are less likely to prioritize easy tasks.

TABLE 3
Study 2: Proportion (Percentage) of Auditors Prioritizing the Easy Task by Condition

	Psychological Ownership		
	Limited	**Enhanced**	**Collapsed**
Low Time Pressure	28/40 (70.0)	21/39 (53.8)	49/79 (62.0)
High Time Pressure	40/52 (76.9)	34/46 (73.9)	74/98 (75.5)
Collapsed across Time Pressure	68/92 (73.9)	55/85 (64.7)	123/177 (69.4)

Notes: Table 3 presents the number of participants per condition that prioritize the easy task as a proportion of the number of participants in that condition. The dependent variable *Easy Task Prioritization* equals "1" if participants prioritized the easy task and equals "0" if participants prioritized the difficult task.

Next, we consider the effects of time pressure and psychological ownership on auditors' prioritization of easy tasks. Our second hypothesis predicts that auditors are more likely to prioritize easy tasks when time pressure is higher. Our third hypothesis predicts that psychological ownership reduces auditors' tendency to prioritize easy tasks in low time pressure conditions (H3a), but not in high time pressure conditions (H3b). We graph mean proportions of easy task prioritization by experimental condition in Figure 2. The visual fit of the observed data matches the predicted pattern (i.e., a main effect for time pressure and a simple effect for psychological ownership in lower time pressure conditions). Table 3 shows the proportion of auditors who prioritized the easy task, both collapsed across conditions and separately for each condition.

We provide formal tests of significance in Table 4. The ANOVA model, as reported in Panel A of Table 4, shows a statistically significant main effect for time pressure ($p = 0.053$, two-tailed). This result is consistent with Hypothesis 2 and indicates that easy task prioritization is significantly higher (lower) when time pressure is high (low). Next to that, the ANOVA model shows an insignificant main effect for psychological ownership ($p > 0.10$, two-tailed) and an insignificant interaction effect of time pressure and psychological ownership ($p > 0.10$, two-tailed).

FIGURE 2
Observed Interaction Plot for Easy Task Prioritization

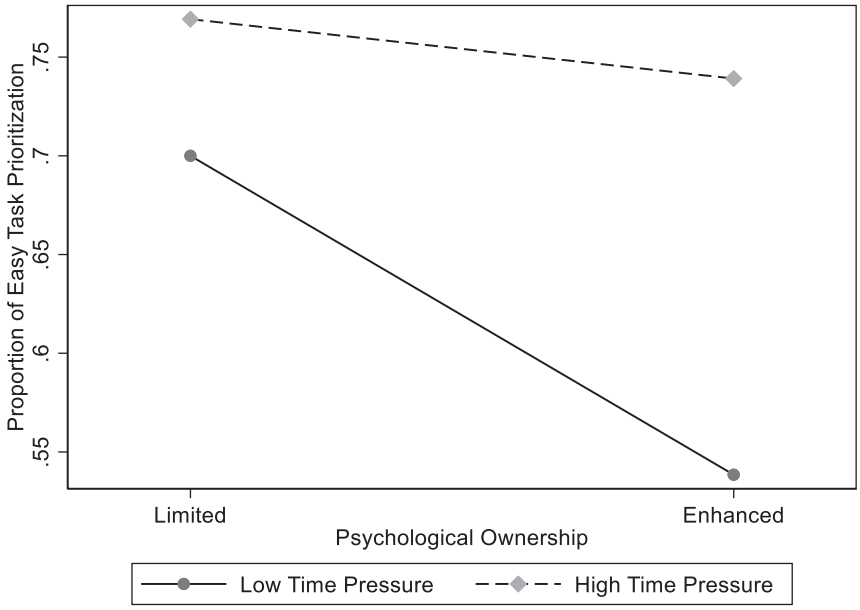

Fig. 2 – Observed Interaction Plot for Easy Task Prioritization

Notes: Figure 2 presents the observed interaction plot for *Easy Task Prioritization*, by experimental condition in Study 2. *Easy Task Prioritization* equals "1" if participants prioritized the easy task, and "0" if participants prioritized the difficult task.

To test Hypothesis 3A and 3B, we provide analyses of simple effects for psychological ownership conditional on the time pressure condition in Panel C of Table 4. We find modest results that psychological ownership significantly reduces the prioritization of easy tasks in the low time pressure condition based on a one-tailed *t*-test (difference in proportion of easy task prioritization: 0.70 vs. 0.54, $t = 1.48$, $p = 0.071$, one-tailed) in line with our predictions. Next to that, consistent with our predictions we do not find that the effect of psychological ownership on easy task prioritization is significant in the high time pressure condition ($t = 0.34$, $p > 0.10$, two-tailed). To further explore the simple effect of psychological ownership in the low time pressure condition, we run the same analyses but with perceived time pressure as a measured variable instead of the time pressure manipulation. More specifically, we use a median split of perceived time pressure based on responses to the manipulation check. Results are reported in Panel C of

Table 4. We find a statistically significant difference between psychological ownership conditions in the low perceived time pressure condition based on a two-tailed test ($t = 1.81$, $p = 0.073$, two-tailed) and do not find a statistically significant difference in the high perceived time pressure condition ($t = -0.133$, $p > 0.10$, two-tailed).[21,22] To summarize, our tests for Hypothesis 3A and 3B provide modest yet converging evidence that psychological ownership attenuates easy task prioritization when time pressure is low but not when time pressure is high.

Overall, our results support our first and second hypotheses.[23] That is, we find that auditors tend to prioritize easy tasks over difficult tasks and that easy task prioritization is exacerbated under high time pressure. Furthermore, we find modest support for our third hypothesis that psychological ownership alleviates easy task prioritization under low time pressure but not under high time pressure.

Additional Analyses

Time Spent on Easy Task and Difficult Task. We analyze the amount of time participants spent on both tasks to investigate whether easy task prioritization has implications for effort allocation across tasks. We know from prior literature that auditors reduce their effort and workload in certain situations (e.g., López and Peters 2012; Pierce and Sweeney 2004), but how effort is allocated among different types of tasks remains an empirical question. Panel A of Table 5 shows the proportion of total time spent on the easy task by condition.[24] Across all conditions, participants spent, on average, 59.18 (40.82) percent of their time on the easy (difficult) task. An

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21 We interpret the results from analyses with the measured variable with caution by relying on two-tailed statistics because pre-experimental determinants may influence both the measured variable as well as the dependent variable (Peecher and Solomon 2001).

22 We also conduct the same analyses using non-parametric Chi-Square and Fisher's Exact tests. For both simple effects, our inferences do not change. That is, for the low time pressure conditions we find the same inferences for the Chi-Square ($\chi^2 = 2.19$, p = 0.139) and Fisher's Exact (p = 0.168, two-sided) test. Next to that, we find insignificant results for the high time pressure conditions for both the Chi-Square ($\chi^2 = 0.120$, p = 0.729) and Fisher's Exact (p = 0.816, two-sided) test.

23 As easy task prioritization may potentially be impacted by participants' prior work experience, experience with fair value estimates, and experience with discounted cash flow analyses, we test whether these variables are correlated with easy task prioritization and whether including them as covariate would change our inferences. We find that none of the variables is significantly univariately correlated with easy task prioritization (all p > 0.10, two-tailed). Also, including any of the three variables in our analyses does not change our inferences.

24 As participants in the different time pressure conditions have different amounts of time available, analyses of the

TABLE 4
Study 2: Inferential Statistics Regarding Auditor Task Prioritization

Panel A: ANOVA

Source	*df*	F	Two-sided p-value
Psychological Ownership	1	1.92	0.168
Time Pressure	1	3.80	0.053 *
Psychological Ownership × TP	1	0.90	0.344

Panel B: Main Effects

Variable	*df*	F	Two-sided p-value
Psychological Ownership	1	1.76	0.185
Time Pressure	1	3.79	0.053 *

Panel C: Simple Effects for Psychological Ownership

Variable	*df*	F	Two-sided p-value
Psychological Ownership *if* Time Pressure is Low Condition	1	2.19	0.142
Psychological Ownership *if* Time Pressure is High Condition	1	0.12	0.737
Psychological Ownership *if* Perceived Time Pressure is below median	1	3.29	0.073 *
Psychological Ownership *if* Perceived Time Pressure is above median	1	0.02	0.895

Notes: ***, **, and * indicate significance levels at the 1%, 5%, and 10% level, respectively. All significance levels are two-tailed.

untabulated *t*-test shows that this is significantly different from 50 percent ($t = 4.25$, $p < 0.01$, two-tailed). We analyze whether the prioritization of easy tasks amounts to less effort spent on the difficult task. Figure 3 graphically shows the *Time Spent on Easy Task* scaled by the total amount of time spent on both tasks and conditional on the first task chosen. We find that participants who prioritize the easy task spend significantly more time on the easy task than did participants who prioritized the difficult task (73.38 percent versus 26.84 percent, $t = –14.92$, $p < 0.01$, two-tailed). Similarly, we find that participants who prioritized the difficult task spent significantly more time on the difficult task than did participants who prioritized the easy task (73.16 percent versus 26.61 percent, $t = 14.92$, $p < 0.01$, two-tailed). In sum, easy task prioritization is positively associated

effect of time pressure on the relative time spent on easy tasks could also be driven by a denominator effect. Hence, the results should be interpreted with caution.

with the relative time spent on the easy task. This suggests that task prioritization is an important antecedent of effort allocation among tasks that vary in difficulty.

Learning. An alternative explanation for our findings is that participants prioritize the easy task to learn from experience. We tried to minimize the likelihood that learning effects are at play in our experiment by designing both tasks in such a way that they match with the ability of the participants we recruited. That is, our participants should have the ability to complete both tasks without resorting to a strategy wherein they first do the easy task to learn how they can approach the difficult task. To further test the learning explanation, we included the following item in the post-experimental

FIGURE 3
Proportion of Time Spent on Both Tasks Conditional on First Task Chosen

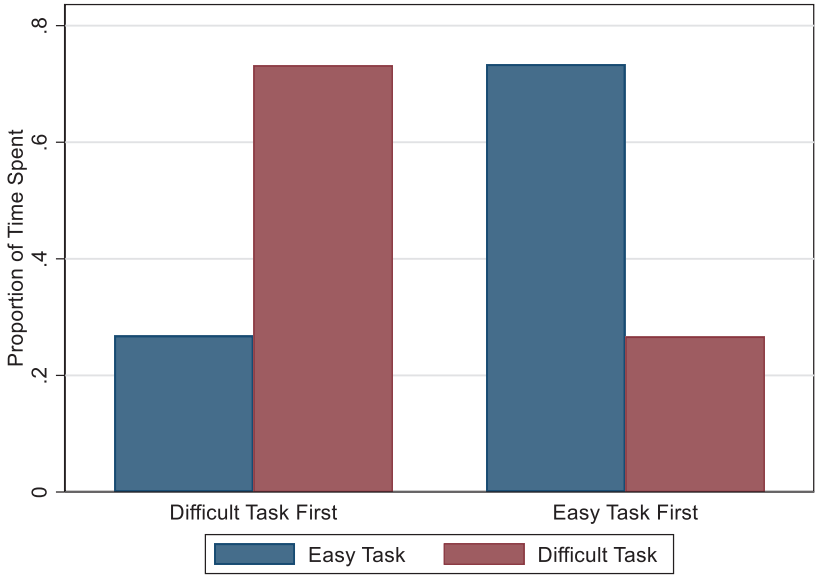

Figure 3 – Proportion of Time Spent on Easy and Difficult Task, Conditional on Task Prioritization

Notes: Figure 3 presents the *Proportion of Time Spent* on both tasks, conditional on the task prioritized in Study 2. *Proportion of Time Spent* is the time spent by the participant on the particular task, scaled by the total time spent on both tasks. The blue (left) bar is the *Proportion of Time Spent* on the easy task. The red (right) bar is the *Proportion of Time Spent* on the difficult task.

questionnaire, "*When I had to decide which audit task to conduct first, the expected learning effects associated with the task influenced my decision*," on a seven-point Likert scale ranging from 1 (totally disagree) to 7 (totally agree). If learning effects indeed make easy task prioritization more likely, we expect that participants who prioritized the easy task perceived learning effects to be more important than participants who prioritized the difficult task. However, we do not find this. Specifically, participants who prioritized the easy task do not rate the item significantly different from participants who prioritized the difficult task (4.07 vs. 3.94, $t = -0.39$, $p > 0.10$, two-tailed). Overall, the results of our analyses do not support that learning effects play a role in the easy task prioritization observed in our experiment. These results should be interpreted with care as people are generally not very good at assessing why they behaved in a certain way, which reduces the validity of using an item from the post-experimental questionnaire to assess behavior during the experiment.

TABLE 5
Study 2: Proportion of Time Spent on Easy Task (Standard Deviation) [N] by Condition.

	Psychological Ownership		
	Limited	**Enhanced**	**Collapsed**
Low Time Pressure	0.54 (0.22) [40]	0.52 (0.25) [39]	0.53 (0.24) [79]
High Time Pressure	0.66 (0.33) [52]	0.62 (0.30) [46]	0.64 (0.31) [98]
Collapsed across Time Pressure	0.61 (0.29) [92]	0.57 (0.28) [85]	0.59 (0.30) [177]

Notes: Table 5 presents the number of participants per condition that prioritize the easy task as a proportion of the number of participants in that condition. The dependent variable *Easy Task Prioritization* equals "1" if participants prioritized the easy task, and equals "0" if participants prioritized the difficult task.

Accountability. Because of the presence of audit reviews, accountability is typically considered quite high in audit settings. It is often argued that accountability induces auditors to

exhibit behavior that improves audit quality. Assuming that prioritization of easy tasks is a threat for audit quality, one could argue that the emphasis on accountability in audit settings will weaken easy task prioritization. To test for this potential external validity threat, we elicited participants' perceived accountability during the experiment using one item in the post-experimental questionnaire. We asked participants to evaluate the statement "*During the audit engagement, I felt accountable to the audit team leader*" on a seven-point Likert scale ranging from 1 (totally disagree) to 7 (totally agree). The mean response to this item is 3.71 (st. dev. = 1.65), which is significantly lower than the midpoint of the scale ($t = -2.37$, $p = 0.019$, two-tailed). We use logit regression to test whether variation in *Accountability* is significantly related to variation in *Easy Task Prioritization* in Table 6. As accountability can be considered a component of psychological ownership (Avey, Avolio, Crossley, and Luthans 2009), we also control for the psychological ownership manipulation. In all specifications, we find that the effects of perceived accountability on easy task prioritization are statistically insignificant (all specifications report $p > 0.10$, two-tailed).[25] Hence, our results do not support the idea that a lack of accountability in our experimental setting drives our results.

As our results suggest that easy task prioritization occurs in an auditing setting and is influenced by time pressure and psychological ownership (only when time pressure is low), we next investigate whether prioritizing the easy or difficult task has performance effects. Given our focus in Study 2 on audit tasks that have mechanical errors, performance effects are more difficult to observe. Thus, in Study 3, we will feature tasks that are more different from each other.

2.3.3. Study 3: Performance Effects of Task Prioritization

Method

[25] In addition, we create a dummy variable for accountability, which takes "1" if reported accountability is higher than the midpoint of the scale and "0" if reported accountability is lower than the midpoint of the scale. In untabulated analyses, we conduct the same regressions as in Table 6 and find that this does not change our inferences ($p > 0.10$, two-tailed, in all specifications). Also, when we create a dummy variable for accountability, where we use a median split, top quartile, top quintile, and top-decile, we find no significant relationship between accountability and easy task prioritization.

TABLE 6
Study 2: Logistic Regression of *Easy Task Prioritization* on *Accountability*

Variable	(1) Coefficient (z-stat)	(2) Coefficient (z-stat)	(3) Coefficient (z-stat)	(4) Coefficient (z-stat)
Accountability	0.031	0.060	0.058	0.048
	(0.31)	(0.58)	(0.56)	(0.42)
Psychological Ownership		-0.475	-0.440	-0.468
		(-1.41)	(-1.28)	(-1.26)
Presentation Order			-1.077***	-1.155***
			(-3.11)	(-3.06)
Controls	NO	NO	NO	YES
Pseudo R^2	0.04%	0.97%	5.64%	14.00%
Observations	177	177	177	177

Notes: ***, **, and * indicate significance levels at the 1%, 5%, and 10% level, respectively. All significance levels are two-tailed. Table 6 shows analyses of logistic regressions of *Easy Task Prioritization* on *Accountability*. The table shows a logistic regression with *Easy Task Prioritization* as dependent variable. This variable takes the value "1" if a participant prioritized the easy task and takes the value "0" if a participant prioritized the difficult task. *Accountability* is measured using one item in the post-experimental questionnaire. More specifically, we asked participants to evaluate the statement "*during the audit engagement, I felt accountable to the audit team leader*" on a seven-point Likert scale ranging from totally disagree (1) to totally agree (7). *Psychological Ownership* is a dummy variable that equals "1" if the participant was in the 'Enhanced Psychological Ownership' treatment and "0" if the participant was in the 'Limited Psychological Ownership' treatment. *Presentation Order* is a dummy variable that equals "1" if the difficult task was presented on the left and "0" if the easy task was presented on the left when participants had to make a choice. Control variables consist of *Time Pressure* (a dummy that takes the value "1" ["0"] if participants are in the high [low] time pressure condition), age, gender work experience, and a dummy indicating "1" if the participant works for a Big 4 firm and "0", a three-item Need for Cognition scale (adapted from Cacioppo and Petty 1982), a three-item Work Engagement scale (based on Schaufeli et al. 2002), a three-item Priority of Audit Quality scale (based on Katz-Navon, Naveh, and Stern 2005) and the Ten-Item Personality Inventory (TIPI) consisting of the Big Five traits: extraversion, agreeableness, conscientiousness, emotional stability, and openness to new experiences (Gosling, Rentfrow, and Swann Jr. 2003).

Overview and Participants. Study 3 is a 1 × 2 between-participants experiment in which participants are asked to conduct two audit tasks: one easy and one difficult. Specifically, the easy task is an audit of cash balances, and the difficult task is the audit of a goodwill impairment test. As the main goal of Study 3 is to examine performance implications of prioritizing the easy task, we manipulate whether participants first execute the easy task or first execute the difficult task. We recruited 114 professional auditors (9 senior auditors, 102 staff auditors, 3 interns) during sessions of a part-time professional accounting education program at a large public university in

The Netherlands.[26] Most auditors were male (n = 82, 71.9 percent), had an average work experience of 15.9 months (st. dev. = 12.0 months) and had an average age of 24.3 years (st. dev. = 1.7 years). Participants were provided with a computerized case developed using Qualtrics software and participated in the experiment using a link provided during classroom sessions. Participants were informed that the experiment would take approximately 25-30 minutes.

Procedure and Task. The task requires participants to assume the role of an auditor. Auditors are informed they have to conduct two audit tasks for two different clients: *Cobbenhagen Marketing* and *Morris Technologies*.[27] For *Cobbenhagen Marketing*, participants are asked to audit the cash balances and for *Morris Technologies* participants are asked to audit the client-prepared step-one analysis of a goodwill impairment test.[28] The audit of the goodwill impairment test is arguably more difficult than the audit of the cash balances, as also suggested by auditors in Study 1.

For the audit of the cash balances, participants receive a lead sheet with the balances for **(i)** cash on hand, **(ii)** a general bank account, and **(iii)** a payroll bank account. Participants are tasked to verify the amount using bank confirmations and the count of cash on hand by a senior auditor. Next to that, participants need to perform a cut-off test to verify whether accounting entries are recorded in the correct accounting period. Next to the lead sheet, participants receive: **(i)** a cash disbursements journal, **(ii)** bank confirmations for the two bank accounts, **(iii)** cutoff statements for the two bank accounts, and **(iv)** the count of cash on hand by the senior auditor.

For the audit of the step one of the goodwill impairment test, participants need to form a preliminary conclusion about the reasonableness about the fair value of the goodwill. To do so, they need to review the five-year projections of the revenues. They are informed that the firm's

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26 Participants are recruited from the same educational program and university as in Study 2. We made sure that participants did not participate in both experiments.

27 We chose two different clients such that seeded errors identified in one task are less likely to influence behavior in a subsequent task.

28 The case for the audit of the goodwill impairment test is adapted from Kadous and Zhou (2019). Out of the four important assumptions that underlie the client's discounted cash flow model in Kadous and Zhou (2019), we use only two: the *projections for future revenue* and the *estimated discount rate*. We did this to shorten the case such that participants had enough time to complete the task.

specialist would audit the discount rate. Despite that individual information cues are not suggestive that an impairment of goodwill is necessary, the combined evidence suggests that the fair value of the goodwill is too rosy and may be overstated. Whereas some of the seeded cues are in the section on revenues, some are also in the section on the discount rate that the firm's specialist would audit. Even though participants are not explicitly asked to audit the discount rate assumption, auditing standards require them to do so (Kadous and Zhou 2019).[29] Cues are either surface-level or deep-level, depending on the amount of cognitive processing required to find them.

Dependent Variables. The dependent variables relate to the performance in both tasks. In the audit of the cash balances, we elicit whether auditors were able to find the seeded errors. More specifically, the client-prepared numbers do not agree with the bank confirmations and need to be adjusted. Also, two entries are booked in the wrong accounting period. We label indicator variables *Cash on Hand*, *Bank 1*, and *Bank 2* "1" if auditors correctly identified the amount and "0", otherwise. We label indicator variable *Cutoff* "1" if the auditor correctly identified the entries that were booked in the wrong accounting period, and "0" otherwise. In the audit of the goodwill impairment test, we use five dependent variables: *Reasonableness*, *Surface Issues*, *Deep Issues*, *Total Issues*, and *Contact Directly*. First, *Reasonableness* indicates auditors' assessment of the overall reasonableness of the fair value, measured on an 11-point Likert scale, ranging from "0" ("not at all likely to be reasonable") to 10 ("extremely likely to be reasonable"). Second, *Surface Issues* is constructed in a similar way to Kadous and Zhou (2019), where the number of surface issues, for which relatively fewer cognitive processing is necessary, is counted (two in total). Third, *Deep Issues* is defined in the same way as *Surface Issues*, but then the number of deep issues, for which relatively more cognitive processing is necessary (three in total). Fourth, *Total Issues* is the sum of *Surface Issues* and *Deep Issues*.[30] Finally,

[29] These auditing standards are AU sec. 336 *Using the Work of a Specialist* and International Standards on Auditing (ISA) 620, *Using the Work of an Auditor's Expert*. They require auditors to obtain an understanding of the methods and assumptions used by the specialist.

[30] Two doctoral students coded the number of issues identified by the auditors. Both were blind to experimental conditions. Cohen's Kappa was 0.82 (0.80) for *Surface Issues* (*Deep Issues*), indicating good interrater agreement.

consistent with Kadous and Zhou (2019), *Contact Directly* is an indicator variable that equals "1" when auditors decide to call their manager immediately, and equal to "0" otherwise.

Independent Variable. We manipulate whether participants conduct the audit of the cash balances first (*Easy First*) or the audit of the goodwill impairment test first (*Difficult First*).

Results

Manipulation checks. We test whether the order manipulation was successful. We find that 107 out of 114 (93.9 percent) of participants correctly recalls whether they conducted the cash or goodwill impairment task first.[31] We also ask participants to evaluate **(i)** whether they found the audit of cash difficult, **(ii)** whether they found the audit of the goodwill impairment test difficult, and **(iii)** whether they found the audit of the goodwill impairment test more difficult than the audit of cash, all on a seven-point Likert scale ranging from 'Strongly Disagree' to 'Strongly Agree'. We find that participants perceive the audit of the goodwill impairment test to be significantly more difficult than the audit of cash (4.97 vs. 2.91, $t = 11.66$, $p < 0.01$, two-tailed). Next to that, participant judge statement **(iii)** significantly higher than the midpoint of the scale ($M = 5.51$, $t = 11.37$, $p < 0.01$, two-tailed), confirming that the audit of the goodwill impairment test is indeed significantly more difficult than the audit of cash.

Main analyses. Panel A of Table 7 shows the descriptive statistics related to the audit of cash balances. We find that the vast majority of participants is able to obtain the correct amounts for the two bank accounts and the cash on hand. For the cutoff analysis, we find that auditors struggle more. When we compare performance in the audit of cash balances between the *Easy First* and *Difficult First* conditions in Panel B of Table 7, we do not find any significant differences for the total number of correct answers ($p > 0.10$, two-tailed). We do not find significant differences for correctly obtaining the bank numbers ($p > 0.10$, two-tailed), but we do find a marginally significant difference for the cutoff statement. Specifically, we find that participants in the *Difficult First*

[31] Specifically, we find that in the *Easy First* condition, 61 out of 66 auditors (92.4 percent) recall this correctly, and in the *Difficult First* condition, 46 out of 48 auditors (95.8 percent) recall this correctly. Our inferences remain the same when we exclude participants that failed the manipulation check.

TABLE 7
Study 3: Performance Effects of Task Prioritization

Panel A: Descriptive Statistics Cash: Mean (Standard Deviation)

Condition	*N*	Cash on Hand	Bank 1	Bank 2	Cutoff	Total
Easy First	66	0.95	0.92	0.88	0.32	3.08
		(0.21)	(0.27)	(0.33)	(0.47)	(0.85)
Difficult First	48	0.94	0.96	0.79	0.48	3.17
		(0.24)	(0.20)	(0.41)	(0.50)	(0.88)
Combined	114	0.95	0.94	0.84	0.39	3.11
		(0.22)	(0.24)	(0.37)	(0.49)	(0.86)

Panel B: Test for Difference between Conditions: t-stat (p-value)

Variable	Cash on Hand	Bank 1	Bank 2	Cutoff	Total
Easy First ≠ Difficult First	-0.40	0.74	-1.26	1.75*	0.56
	(0.690)	(0.458)	(0.211)	(0.083)	(0.579)
N	114	114	114	114	114

Panel C: Descriptive Statistics: Mean (Standard Deviation)

Condition	*N*	Reason-ableness	Surface issues	Deep issues	Total issues	Contact immediately
Easy First	66	5.70	0.36	0.15	0.52	0.26
		(1.52)	(0.57)	(0.36)	(0.64)	(0.44)
Difficult First	48	5.15	0.35	0.42	0.77	0.44
		(1.61)	(0.60)	(0.61)	(0.81)	(0.50)
Combined	114	5.46	0.36	0.26	0.62	0.33
		(1.58)	(0.58)	(0.50)	(0.72)	(0.47)

Panel D: Test for Difference between Conditions: t-stat (p-value)

Variable	Reason-ableness	Surface issues	Deep issues	Total issues	Contact immediately
Easy First ≠ Difficult First	-1.81*	-0.09	2.89***	1.89*	2.03**
	(0.073)	(0.932)	(0.005)	(0.061)	(0.045)
N	114	114	114	114	114

Notes: ***, **, and * indicate significance levels at the 1%, 5%, and 10% level, respectively. All significance levels are two-tailed. Variables are defined in the *Method* section of Study 3.

condition are more likely to correctly identify the recordings that were booked in the wrong accounting period than participants in the *Easy First* conditions (0.48 versus 0.32, p = 0.08, two-

tailed). Overall, these results reveal that performance on the easy task does not depend on whether the easy task is executed first or not.

Panel C of Table 7 shows the descriptive statistics for the performance in the audit of the client-prepared step one of the goodwill impairment test. We find that, on average, participants identify 0.62 seeded issues (st. dev. = 0.72). The score for the reasonableness of the fair value is 5.46 reasonable on a 11-point Likert scale ranging from 0 to 10 and 33 percent of participants decides to contact the manager immediately. Panel D of Table 7 tests the effect of task ordering on performance in the audit of the client-prepared step one of the goodwill impairment test. We find that participants in the *Easy First* condition judge the fair value as more reasonable than participants in the *Difficult First* condition (5.70 vs. 5.15, $p = 0.07$, two-tailed), identify less total issues (0.52 vs. 0.77, $p = 0.06$, two-tailed), and are less likely to contact the manager immediately (0.26 versus 0.44, $p = 0.04$, two-tailed). When we split the identified issues in surface issues and deep issues (Kadous and Zhou 2019), we find that participants in the *Difficult First* condition identify significantly more deep issues (0.42 vs. 0.15, $p < 0.01$, two-tailed). We do not find differences across conditions in surface issues identified ($p > 0.10$, two-tailed). Collectively these results suggest that auditors that conduct the easy task first are less likely to identify the issues in the difficult task for which relatively much cognitive processing is necessary but are equally likely to find the issues for which relatively limited cognitive processing is necessary.

2.4. Discussion

We investigate which type of task (easy or difficult) auditors prioritize and the performance effects of task prioritization. We conduct a survey and two experiments. Our survey findings show that auditors perceive easy task prioritization to be a risk for audit quality and that an auditor can better start with a difficult task in order to maximize audit quality. Despite the audit quality concerns of easy task prioritization, our respondents expect other auditors to prioritize easy tasks. Our first experiment provides evidence that auditors on average prioritize easy tasks over difficult

tasks and that easy task prioritization is stronger when time pressure is high compared to when time pressure is low. We further find that psychological ownership reduces easy task prioritization in settings where time pressure is low but not in settings where time pressure is high. In our second experiment, we test the performance effects of task prioritization. We find that prioritizing the easy task leads to worse performance in the difficult task and that performance differences in the difficult task are especially observed in areas where a relatively high amount of cognitive processing is necessary. Performance on the easy task does not depend on whether the easy task is executed first or not.

Our findings have implications for policy makers and practitioners. First, we provide evidence on how auditors structure their work and use their on-the-job discretion. Despite the prevalence of this discretion in practice, little is known about how auditors use this discretion to order tasks. Our study addresses this gap in the literature. We also inform policy makers and audit firms about the conditions that influence easy task prioritization. We find that psychological ownership can alleviate easy task prioritization in low time pressure conditions but not in high time pressure conditions. This suggests that interventions focused on enhancing psychological ownership may not materialize when job demands are high, such as in high time pressure conditions. More research is needed to find out how easy task prioritization can be reduced when time pressure is high. Next to that, our results suggest that easy task prioritization reduces performance in areas that require a relatively high amount of cognitive processing. One implication for audit firms is postponing more difficult tasks until the end of the audit, which is when resources tend to be more depleted, may hamper audit quality.

Our study also contributes to several streams of literature. First, we contribute to the nascent but growing literature on easy task prioritization (e.g., Ibañez *et al.* 2018; Arshad, Dierynck, and Ibanez 2022; KC *et al.* 2020). We show that easy task prioritization occurs in an auditing setting, while it can have negative consequences for audit quality. Second, we contribute to the already voluminous literature on time pressure in auditing. Although prior literature has examined how

time pressure affects auditor behavior *within* audit tasks (e.g., Asare, Trompeter, and Wright 2000; Agoglia, Brazel, Hatfield, and Jackson 2010; Coram, Ng, and Woodliff 2004; Gold, Knechel, and Wallage 2012), little research has examined how time pressure affects auditor behavior *between* audit tasks (see Mocadlo 2022 for a notable exception). We find that time pressure may cause the potential gains of interventions, such as psychological ownership, not to materialize. Thereby, we dive deeper in the mechanism how time pressure affects the trade-offs that auditors make. Third, we contribute to the literature on psychological ownership. To the best of our knowledge, the relationships between psychological ownership and easy task prioritization as well as the interaction between psychological ownership and time pressure have not been studied before. Next to that, we are among the first to study psychological ownership in an auditing context. Typically, studies on psychological ownership focus on tasks where individuals develop new products and services and develop ownership through such a development process (e.g., Baer and Brown 2012). The auditing environment, where auditors mainly inspect client-prepared files may preclude the development of psychological ownership. More specifically, auditing tasks may create conditions that make it more difficult for auditors to experience accomplishments as a function of their own skills and abilities. That is, auditors may instead attribute successful task accomplishment to the routines that were created by others, such as auditing procedures (Pierce *et al.* 2009).

This study should be interpreted in light of its limitations. First, auditing is a social phenomenon and occurs within the environment of an audit team. When performing an audit, auditors face constraints and a complex set of relations, and auditors' decisions are a function of their environment (i.e., the client, the audit team, the audit organization). This experiment focuses on the individual behavior of the auditor and largely ignores environmental variables. Second, although our time pressure manipulation is successful, we do not find that participants in the low time pressure condition report time pressure as lower than the midpoint of the scale. Hence, one could also argue that we instead compare moderate time pressure with high time pressure. On a positive note, this suggests that time pressure does not have to be extremely low for psychological

ownership to reduce easy task prioritization. Third, when auditors do not meet the time pressure requirements in the experiment, there are no direct adverse consequences, whereas in reality there may be such consequences. These consequences may cause auditors to make different decisions in task prioritization, which we acknowledge as a limitation of our study. Finally, with respect to our first hypothesis that auditors tend to prioritize easy tasks, there may be alternative theories or psychological phenomena that may explain easy task prioritization, such as a desire for practice or a desire for closure. Yet, these do not allow to make specific predictions regarding the role of time pressure and psychological ownership.

Future research can further address easy task prioritization in auditing. For instance, research can be conducted with respect to other types of prioritizations besides task difficulty and task criteria subjectivity (Mocadlo 2022). Another potential avenue is to investigate interventions that alleviate easy task prioritization when time pressure is high. For instance, audit firms could take measures such that difficult tasks are perceived to cost less cognitive resources. Moreover, not much is known about how feelings of psychological ownership develop within audit firms. Future research could investigate this development and examine specific practical interventions that can enhance psychological ownership in audit firms.

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2.6. Appendix

FIGURE A.1

	B	C	D	E	F	G	H	I
2				**DISCOUNTED CASH FLOW ANALYSIS**				
3				**FEEDER 2000**				
4	**2018 Revenues of CMG Machines**	€ 40,000,000		**Growth Rates**				
5				Years 1-4	10%			
6	Discount rate	10%		Years 5-7	0%			
7	Royalty rate	10%						
8								
9	**Year**	**1**	**2**	**3**	**4**	**5**	**6**	**7**
10	Agrifirm	2019	2020	2021	2022	2023	2024	2025
11	Revenues of CMG Machines	€ 44,000,000	48,400,000	53,240,000	58,564,000	64,420,400	70,862,440	70,862,440
12		=C4+F5*C4	=C11+F5*C11	=D11+F5*D11	=E11+F5*E11	=F11+F5*F11	=G11+F5*G11	=H11+F6*H11
13	Patent Royalty (10%)	€ 4,400,000	4,840,000	5,324,000	5,856,400	6,442,040	7,086,244	7,086,244
14		=C7*C11	=C7*D11	=C7*E11	=C7*F11	=C7*G11	=C7*H11	=C7*I11
15								
16	Present Value of CF from Royalty	€ 4,400,000	4,000,000	4,000,000	4,000,000	4,000,000	4,000,000	3,636,364
17		=C13	=D13/(1+C6)^(D9)	=E13/(1+C6)^(E9)	=F13/(1+C6)^(F9)	=G13/(1+C6)^(G9)	=H13/(1+C6)^(H9)	=I13/(1+C6)^(I9)
18								
19	**Total Present Value of CF**	**€ 28,036,364**	=SUM(C16:I16)					

Figure A.1 presents a screenshot of the audit task related to the Feeder 2000 patent, i.e., the easier task in Study 2. Participants were asked to conduct audit procedures on the Discounted Cash Flow model provided by the client (Information Provided by Entity). More specifically, it was their job to verify the accuracy and reliability of the client-provided model, operationally they were asked to identify (if any) errors in the formulas used by the client in their spreadsheets. Participants were able to alter the spreadsheet which was embedded in the experimental oTree environment.

FIGURE A.2

	B	C	D	E	F	G	H	I
2				**DISCOUNTED CASH FLOW ANALYSIS**				
3				**ROBOFER**				
4	**2018 Revenue of CMG Machines**	€ 40,000,000		**Growth Rates**			**Royalty Rate**	
5				Years 1-3	15%		Years 1-3	12%
6	Discount rate	10%		Years 4-5	-5%		Years 4-5	9%
7				Years 6-7	-12%		Years 6-7	7%
8								
9	**Year**	**1**	**2**	**3**	**4**	**5**	**6**	**7**
10	Agrifirm	2019	2020	2021	2022	2023	2024	2025
11	Revenues of CMG Machines	€ 46,000,000	52,900,000	60,835,000	57,793,250	54,903,588	50,858,060	44,755,093
12		=C4+F5*C4	=C11+F5*C11	=D11+F5*D11	=E11+F6*E11	=F11+F6*F11	=F11+F7*F11	=H11+F7*H11
13	Patent Royalty	€ 5,520,000	6,348,000	7,300,200	5,201,392.50	4,941,323	4,577,225	3,132,856
14		=I5*C11	=I5*D11	=I5*E11	=I6*F11	=I6*G11	=I6*H11	=I7*I11
15								
16	Present Value of Cash Flow from Royalty	€ 5,018,182	5,246,281	5,484,748	3,552,621	3,068,173	2,583,724	2,139,783
17		=C13/(1+C6)^(C9)	=D13/(1+C6)^(D9)	=E13/(1+C6)^(E9)	=F13/(1+C6)^(F9)	=G13/(1+C6)^(G9)	=H13/(1+C6)^(H9)	=I13/(1+C6)^(F9)
18								
19	**Total Present Value of Cash Flow**	**€ 27,093,512**	=SUM(C16:I16)					

Figure A.2 presents a screenshot of the audit task related to the Robofer patent, i.e., the difficult task in Study 2. Participants were asked to conduct audit procedures on the Discounted Cash Flow model provided by the client (Information Provided by Entity). More specifically, it was their job to verify the accuracy and reliability of the client-provided model, operationally they were asked to identify (if any) errors in the formulas used by the client in their spreadsheets. Participants were able to alter the spreadsheet which was embedded in the experimental oTree environment.

Chapter 3

Learning in the Auditing Profession

A Framework and Future Directions

Abstract

Rapid changes in capital markets, expanded assurance models, and technological developments have increased the need for auditors to learn in the workplace. Drawing on literature in auditing and workplace learning, this paper develops the Auditor Learning Framework. Based on a general workplace learning framework by Jacobs and Park (2009), the Auditor Learning Framework distinguishes auditor learning processes along two dimensions: the location of learning (on-the-engagement or off-the-engagement) and the role of the others in the learning process (active or passive). We review the auditing literature, classifying papers that directly or indirectly improve our knowledge of auditor learning into our framework to identify gaps in our understanding of the auditor learning processes. Our study provides a comprehensive view of auditor learning processes and provides suggestions for future research aimed at improving auditor learning.

3.1. Introduction

Auditing is a knowledge industry: its production function relies on efficient application of business, accounting, auditing, and regulatory knowledge to a client's financial reports. Assurance firms rely on auditors, as well as the processes and technology that firms have developed, to provide this knowledge. Auditors must develop a considerable body of expertise to establish their legitimacy and uphold their public responsibilities, implying that learning is a central feature of the auditing profession (Westermann, Bedard, & Earley 2015). Moreover, auditors must learn the firm's processes and technology in order to tap into the knowledge stored there, and also to ensure the consistently high-quality work that the regulatory environment demands. The global scale of many audit firms magnifies the importance of these processes and technology in promoting consistent quality of work.

Although auditors' need for learning is formalized by education and testing requirements for professional credentials, auditors indicate that most of their learning occurs in the workplace (Hicks, Bagg, Doyle, & Young 2007; Daoust & Malsch 2019). Workplace learning is defined as "*[c]hanges in behavior and knowledge based on activities and programs experienced in the workplace*" (Cranton 2013). As business models, regulation, and firm processes and technology are continually changing, auditors must continuously update their skills to meet current demands in the workplace. Standard-setters and regulators propose that lifelong learning is critical for audit quality (e.g., PCAOB 2002, AS 1010; IAASB 2014; ICAS & FRC 2016).

Prior research in auditing has studied several learning processes in the auditing workplace, including learning from training (e.g., Earley 2001; Moreno, Bhattacharjee & Brandon 2007; Plumlee, Rixom, & Rosman 2015) and learning from experience (e.g., Bonner, Libby, & Nelson 1997; Salterio 1994). Although auditing research focused on workplace learning is limited, the auditing literature often provides insights into workplace learning as a by-product of examining other outcomes. As workplace learning is not the explicit focus of many auditing studies, it can be

difficult to extract and integrate these insights. This lack of integration hampers auditing researchers' ability to build on each other's work and increases the probability that audit practitioners and regulators make decisions about auditor learning in the absence of valuable academic evidence. As research about various auditor learning processes advances, it becomes increasingly important to take stock of what is already known.

Thus, the first purpose of this paper is to facilitate integration of existing evidence related to auditor learning processes by structuring that research along key dimensions. We adapt Jacobs and Park's (2009) framework to develop the Auditor Learning Framework (ALF). We use the ALF to classify existing research that provides insights into auditors' learning processes along two dimensions. First, we distinguish whether learning takes place *on the engagement* or *off the audit engagement* (i.e., the location of learning). On-the-engagement learning takes place while auditors are conducting their primary work functions and is therefore likely to be incidental to other work tasks. Off-the-engagement learning takes place outside of the primary job tasks. The audit engagement is typically characterized as one of high stress and time pressure, without much room for innovation, implying that it likely provides a unique learning environment. We thus expect that location of learning will influence how different types of knowledge are best learned. Second, auditors have the opportunity to learn from a variety of others, including trainers, supervisors, colleagues, clients, etc. We distinguish whether there is *active* or *passive* involvement of other auditors in the learning process (i.e., the role of others).

Based on prior literature, we distinguish seven learning processes that take place in the audit profession, and we classify them along the two dimensions of the ALF. Four learning processes occur on the engagement. In two of the four on-the-engagement processes (i.e., learning from experience and learning from clients), others have a passive role in the learning process. The other two on-the-engagement learning processes (i.e., learning from colleagues and learning from the audit review) occur with active involvement of others, and learning in these processes depends on effective communication between auditors. We identify three learning processes that occur off

the engagement. In all three of these learning processes, others play an active role in the auditor's learning (i.e., learning from mentoring, learning from performance evaluation, and learning from training).

The second purpose of this paper is to synthesize existing research to facilitate future research. To this end, we take a broad view of learning, incorporating prior research that directly examines processes that improve auditor knowledge, as well as research that likely has implications for auditor learning despite that learning is not the main focus of the study. Incorporating studies that examine processes that increase auditors' knowledge and job performance is important, as auditors indicate that most learning occurs in the workplace, where learning is often a by-product of working (e.g., Eraut 2007; Hicks *et al.* 2007).

We highlight four important insights that emerge from our review. A first insight starts from the observation that learning in the auditing profession is often a by-product of working and is unstructured. The auditing literature identifies four important determinants of judgment performance: ability, knowledge, motivation, and environment (e.g., Bonner & Lewis 1990; Libby 1995; Libby & Luft 1993). Although our review identifies several papers examining relationships among these determinants, it also reveals that we still know little about the effect of motivation on how auditors gain knowledge or improve their performance. This is important as audit partners worry that the current generation of auditors lacks the motivation to invest the necessary resources in their job (Westermann *et al.* 2015). An exception is provided by Kadous and Zhou (2019), who show that intrinsic motivation improves auditors' cognitive processing behaviors and subsequent judgments in complex estimates. Future research can further investigate how and through what mechanisms motivation affects workplace learning and how auditors' motivation to learn can be enhanced.

Second, the literature could move forward by investigating interactions among auditor learning processes. The extant literature focuses on analyzing distinct auditor learning processes, but the processes likely interact. For instance, when auditors conduct tasks during engagements,

they may learn from *experience*. However, this learning may be unconscious and tenuous. When the same tasks are highlighted in *audit review*, this learning may become more conscious and may be solidified. Better knowledge of potential interactions among auditor learning processes could help audit firms to develop a coherent approach towards auditor learning.

Third, a recurring theme is that auditors need to engage deeply in their work or training in order to learn. Use of higher-order cognitive capabilities such as reasoning, active learning, and critical thinking are therefore crucial for auditor learning. For instance, Earley (2001) finds that self-explanation of the rationale underlying a judgment increases acquisition of procedural knowledge. Plumlee *et al.* (2015) show that auditors who consciously think about their thought process outperform a control group of auditors that do not. Future research could further investigate when auditors do and do not spontaneous engage in higher-order cognitive capabilities and how audit firms can intervene to prompt such thinking.

Fourth, we know little about the learning processes related to professional skills such as professional skepticism, integrity, objectivity, and professional identity. As junior auditors increasingly interact with clients, professional skills have become more important at an earlier stage of the auditor's career, increasing the need for auditors to learn them in an earlier stage (Bol, Estep, Moers, & Peecher 2018). Facilitating learning related to professional skills likely requires that supervisors take an active role by providing feedback. The effectiveness of feedback requires consensus among supervisors about the criteria that should be used and accurate assessment of subordinates on these criteria. We know little about whether there is consensus among supervisors about the criteria to evaluate professional skills; nor do we know whether supervisors accurately assess auditors on those criteria. Future research could examine these issues.

The paper proceeds as follows: Section 3.2. presents the Auditor Learning Framework. Section 3.3. presents the method and sample description. In Section 3.4., we review literature for the off-the-engagement processes. In Section 3.5., we review literature for the on-the-engagement

learning processes. We provide a discussion and directions for future research for each learning process. Section 3.6. concludes.

3.2. The Auditor Learning Framework

We develop the Auditor Learning Framework (ALF), which is shown in Figure 4 to structure and synthesize the audit learning literature. Although some prior literature in auditing has focused on learning, learning is often captured as a by-product of other audit processes, such as interactions with clients, the audit review process, and performance evaluations. That is, while these studies allow insights that are potentially relevant for learning in the auditing profession, the insights are not directly linked to learning. Our framework can help to identify potentially relevant results and insights, shedding light on the different ways in which learning takes place in the auditing profession. This is important as different ways of learning may represent incompatible levels of discourses, making it difficult to develop a cohesive understanding of workplace learning (e.g., Clarke 2005; Colley, Hodkinson, & Malcom 2003; Jacobs & Park 2009). If researchers want to build on the existing knowledge on learning in auditing, it is important that they are aware about the various ways in which learning may occur in auditing. Similarly, if audit firms or policymakers want to provide an optimal context for auditors to develop and grow in their job, the context and interventions necessary depend on the type of learning process.

In the ALF, we distinguish learning processes based on two dimensions: the location of learning and the role of a trainer, facilitator, or others during the learning process.[32] First, the location of learning can vary as off-the-engagement and on-the-engagement. Second, we classify learning processes based on whether a trainer, facilitator, or someone else has an active or passive involvement in the learning process (e.g., Sambrook 2005). Active involvement of others implies

[32] Jacobs and Park (2009) also identify an "extent of planning" dimension. This dimension captures the extent to which there is a systematic implementation of assessment, analysis, design, development, implementation, or evaluation of workplace learning (i.e., the extent of structuring). We exclude this dimension because in the auditing setting most learning processes can be characterized as unstructured. Only learning from performance evaluation and learning from training can be characterized as structured, we discuss the structure in the respective sections.

that learning takes place through an interaction with others. We discuss the two dimensions sequentially.

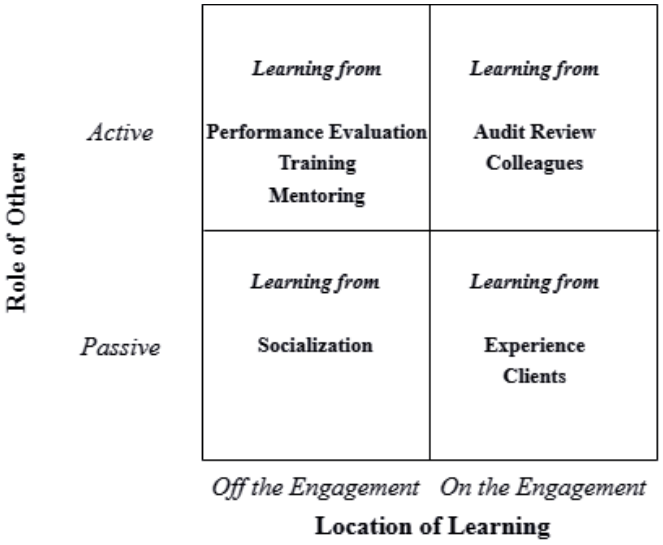
The location of learning determines to a large extent how learning takes place (e.g., Sambrook 2005). Off-the-engagement learning typically happens away from the workplace and hence learning and work are separated, whereas on-the-engagement learning refers to workplace learning that is carried out at the workplace to develop changes in behavior and knowledge.[33] As off-the-engagement learning occurs away from the workplace **(i)** it is more formal, **(ii)** it is more intentionally designed, **(iii)** learners use a more deliberative mode of cognition, **(iv)** there is more time to reflect, and **(v)** learning and working are easier to separate from each other (Colley *et al.* 2003; Eraut 2007). In contrast, on-the-engagement learning occurs at the actual work setting, where learning is **(i)** more informal, **(ii)** often a by-product of working, **(iii)** learners use a more reflexive or intuitive mode of cognition, and **(iv)** working and learning are hard to separate (e.g., Eraut 2007; Sambrook 2005). Learning at the actual work setting may occur through observing, asking questions, teamwork, problem solving, and social interactions with colleagues and clients (Manuti, Pastore, Scardigno, & Giancaspro 2015). In their transparency reports, audit firms indicate that learning may occur both on-the-engagement and off-the-engagement. For instance, PwC (2022, p. 14) states that: "The composition of our audit teams provides newer team members the opportunity to work with more seasoned team members, which promotes meaningful on-the-job training. […] [This] is supplemented through participation in classroom, virtual, and on-demand training programs."

Second, the role of others in auditor learning can either be *active* or *passive*. Others in active roles directly and proactively intervene in the learning process, whereas others in passive roles may impart learning as a byproduct of conducting some other tasks. Auditing is often characterized as

[33] A report by Michaels, Handfield, and Axelrod (2001) indicates that, in general, 70 percent of workplace learning occurs at the work setting, indicating the potential relevance of on-the-engagement learning. Also in auditing, audit partners indicate that they developed most of their technical knowledge and proficiency on-the-job (Westermann *et al.* 2015).

an apprenticeship, and both active and passive learning processes are important in this apprenticeship model (e.g., Fogarty 1992; Anderson-Gough, Grey, & Robson 1998; Westermann *et al.* 2015).

FIGURE 4
Auditor Learning Framework



Notes: Figure 4 presents the Auditor Learning Framework (ALF). The framework distinguishes learning processes based on two dimensions: the location of learning and the role of others.

Together, the two dimensions of the framework lead to the four possible combinations, as shown in Figure 4. Based on the more general workplace learning framework by Jacobs and Park (2009) and an initial scan of the auditing literature, we identify seven learning processes within these four combinations. We identify three off-the-engagement learning processes: learning from performance evaluation, training, and mentoring. We consider all three of these learning processes—performance evaluation, training, and mentoring—as typically involving an active role for others. On-the-engagement learning processes include learning from experience, clients, audit review, and colleagues. Others typically play an active role in learning from audit review and learning from colleagues, while others typically play a more passive role in learning from experience and clients.

3.3. Methodology and Sample Description

We use the Auditor Learning Framework to classify and review the relevant auditing literature. The goal of our review is to map out and categorize existing literature on a particular topic, thereby synthesizing and characterizing the quantity and quality of literature and identifying gaps in the literature that can lead to future research. Importantly, in line with our working definition of workplace learning as "*[c]hanges in behavior and knowledge based on activities and programs experienced in the workplace*" (Cranton 2013), we take a broad view of learning in selecting papers for our literature study.[34] This is consistent with the idea that workplace learning is the most inclusive term to describe the many ways that employees learn in organizations (Jacobs and Park 2009).

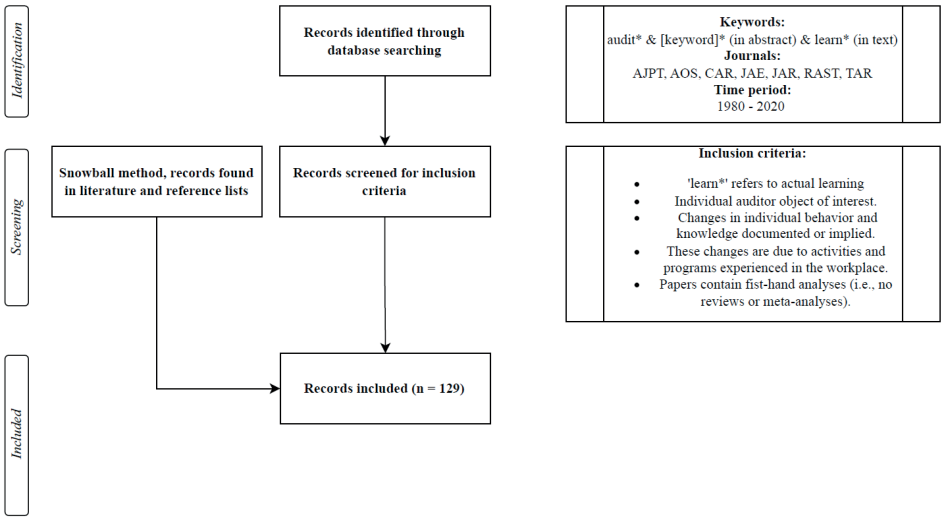
Our procedures are shown in Figure 5. We reviewed studies from the six top-core accounting journals and the leading field journal in auditing using relevant keyword searches in the journal databases.[35] Within the journal databases, we required articles to mention "audit*" in the abstract and "learn*" in the text. We developed keywords (e.g., experience, clients) based on the Auditor Learning Framework. We further required that the keyword appeared in the abstract of the paper. Our literature search included papers published from 1980 until 2020. Despite these requirements, the database search returned irrelevant hits. Hence, we subject the records to our inclusion criteria. First, some of the keywords can be used in multiple ways (e.g., "we *learn* from analysis X that…", "participants *learned* that…", or mentioned in the reference list). We used judgment to eliminate these irrelevant papers. Second, as we are interested in how individual auditors learn, we ensured that either individual auditors are the object of interest in the study, or the study draws implications for individual auditors. Third, in line with our definition of workplace

[34] Reviewing the work on workplace learning, there is no unified approach or singular definition as workplace learning is theorized and approached by many different backgrounds, different point of view, and serves different purposes in different contexts and environments (e.g., Boud and Garrick 2012; Manuti *et al.* 2015).

[35] We review published literature from seven leading journals. Namely, the six top-core accounting journals and the highest field journal in auditing. This leads us to the following set of journals: Accounting, Organizations, and Society (AOS), Auditing: A Journal of Practice and Theory (AJPT), Contemporary Accounting Research (CAR), Journal of Accounting and Economics (JAE), Journal of Accounting Research (JAR), the Review of Accounting Studies (RAST), and The Accounting Review (TAR).

learning, to be included changes in individual behavior should be documented or implied by the study.

FIGURE 5
Sample Selection and Inclusion Criteria



Notes: Figure 5 displays the sample selection criteria and the inclusion criteria. The methodology and sample selection process are described in Section 3.3. We reviewed studies from the six top-core accounting journals and the leading field journal in auditing using relevant keyword searches in the journal databases. The keywords, journals, and time period are displayed in the top right box. Furthermore, we use inclusion criteria displayed in the middle right box. The number of included papers per journal and per learning process are displayed in the bottom right boxes. The number of papers is higher than the total number of papers in the per process box as some papers cover multiple processes.

Fourth, also in line with our workplace learning definition, these changes in individual behavior are due to activities and programs experienced in the workplace. Fifth, the studies included should be first-hand, instead of other reviews or meta-analyses (e.g., Machi and McEvoy 2021). To ensure we did not miss relevant articles, we used the snowball method and reviewed discussions of prior literature and reference lists in covered papers (e.g., Tynjälä 2013).[36] For papers that appeared relevant, we used the same set of screening criteria. The total process yielded 129 papers.

[36] More specifically, we made an initial assessment based on the prior literature and reference lists and their descriptions whether a paper **(i)** examined learning directly, **(ii)** examined learning indirectly, or **(iii)** had implications for learning despite learning not being the main focus of the paper. If so, we read the paper and judged whether our initial assessment was correct and to include the paper in our literature overview.

3.4. Off-the-Engagement Learning

We start reviewing auditor learning processes that take place outside the audit engagement. In these processes, the main focus is on *learning* and hence learning is more deliberate compared to on-the-engagement learning. We identify three learning processes. *Learning from performance evaluation*, *learning from training*, and *learning from mentoring*. Off-the-engagement learning in auditing typically occurs with an active role for a supervisor.

3.4.1. Off-the-engagement learning processes where others have an active role

3.4.1.1. Learning from performance evaluation

Prior literature outside auditing finds that performance evaluation can lead to better learning outcomes in two ways. First, performance evaluation can provide a direct way of learning as they can reveal areas of strength and weakness in individuals' performance. Second, performance evaluations are used to allocate resources such as leadership training and mentoring (Ibarra, Carter, and Silva 2010; Finkelstein, Costanza, and Goodwin 2018). In that way, performance evaluation could have potential overlaps with learning from training and learning from mentoring.

Yet, receiving accurate feedback during performance evaluations is important for effective learning and development; however, both audit partners and regulators have expressed concerns that feedback is ineffective because auditors are either unable or unwilling to provide negative comments to junior colleagues (PCAOB 2010b, Westermann *et al.* 2015). In this section, we focus on performance evaluations that take place outside the audit engagement. We identify nine studies examining aspects related to learning from performance evaluation. The studies are divided into three categories: criteria for learning from performance evaluation, types of feedback, and dark sides of performance evaluation. Table 8 provides an overview of this literature.

TABLE 8

Learning from Performance Evaluation

Criteria for learning	**Types of feedback**	**Dark sides**
Consensus	*Types of feedback*	*Ex ante*
Bol *et al.* (2018)	Harding and Trotman (2009)*	Brazel *et al.* (2016)
Kida (1984)*	Leung and Trotman (2005)	Nelson and Proell (2018)*
Tan and Libby (1997)		
Wright (1982)		
Accuracy of assessments		*Ex post*
Harding and Trotman (2009)*		Kida (1984)*
Jamal and Tan (2001)		Andiola and Bedard (2018)*
Kennedy and Peecher (1997)		
Tan and Jamal (2001)*		

* Studies are covered in multiple sections.

Criteria for learning from performance evaluations

One important insight is that the criteria relevant to job performance may change over time. Tan and Libby (1997) distinguish between tacit managerial knowledge (related to social interactions) and technical knowledge and examine how each type of knowledge relates to variation in performance evaluations of auditors at different level of the organizational hierarchy. They find that tacit managerial knowledge is associated with better performance evaluations among auditors higher in the organizational hierarchy, but that it does not explain variation in performance evaluation among auditors lower in the organizational hierarchy. More recently, Bol *et al.* (2018) find that audit firms now *do* value tacit managerial knowledge in inexperienced auditors. They argue that this discrepancy occurs because the work of lower-level auditors has changed over the years such that lower-level auditors now need tacit managerial knowledge to execute their tasks well. This is an important reminder that job content and thus, the knowledge and skills required for the job, may change over time.

A second important insight is that performance evaluations do not always accurately capture performance. Several studies identify potential inaccuracies in ratings. Kennedy and

Peecher (1997) find that auditors are overconfident in assessing their own knowledge. Moreover, auditors heuristically use their own knowledge as an anchor when assessing subordinates' knowledge, making these assessments also inaccurate (Jamal & Tan 2001; Kennedy & Peecher 1997; Tan and Jamal 2001). This anchoring process tends to lead to overconfidence in others' knowledge, and that overconfidence is increasing in the size of the knowledge gap between the evaluator and evaluatee. Overconfidence in others' knowledge can be disastrous for learning as it can lead to auditors being assigned tasks for which they are underqualified, receiving less supervision than needed, and having their work reviewed less closely than appropriate. Harding and Trotman (2009) provide additional insight into this problem. They find that the process by which auditors assess another auditor's competence is affected by how familiar the auditors are with each other. When familiarity is high, assessors rely on the perceived specific competence, whereas when familiarity is low, assessors rely on the average competence of the peer group. This suggests different types of assessment errors for familiar and unfamiliar auditors.

Types of feedback

Leung and Trotman (2005) examine the effectiveness of four different types of feedback (outcome, task properties, cognitive, combined task properties/cognitive) for improving performance of a task requiring configural cue processing and a task not requiring configural cue processing. Many associative learning experiments show that humans use configural cues during learning. However, the relationships in configural tasks also add complexity, making it more difficult to work backwards from the outcome. Leung and Trotman (2005) find that *outcome feedback* – feedback on whether a judgment is correct or not - is less effective in stimulating learning in configural tasks, which are common in auditing, though it works better for non-configural tasks. *Task properties* feedback provides information on what policy is optimal given the environment. As a result, it reduces task ambiguity and is effective for both types of tasks. Leung and Trotman (2005) also find that cognitive feedback, which provides information on how one obtained a particular judgment, and combined feedback are more effective in configural tasks than in non-

configural tasks. Harding and Trotman (2009) compare two other types of feedback: individual-specific and average-group feedback. They find that individual-specific feedback is most effective when familiarity with the evaluatee is high, as it reduces overconfidence. In contrast, average-group feedback is most effective when familiarity with the evaluatee is low.

Dark sides of performance evaluations

In some cases, performance evaluations can be ineffective or have adverse consequences. Kida (1984) finds that negative feedback affects job performance positively, but only if the criticism is aimed at specific aspects of the work rather than at the auditor's personal characteristics. However, negative feedback can also lead to worse attitudes towards the coaching relationship and increased efforts to manage impressions unless the reviewer frames the review with learning goals and the subordinate is more receptive towards feedback (Andiola & Bedard 2018).

Brazel, Jackson, Schaefer, & Stewart (2016) show that performance evaluations of auditors who take skeptical actions are affected by the outcomes of auditors' decisions (i.e., an outcome effect). They argue that auditors anticipate this outcome effect, and, as a result, may forego taking skeptical actions that might otherwise result in finding errors. While a large literature supports the existence of outcome effects in performance evaluation (e.g., Lipe 1993); other research notes that auditors' speaking up about potential issues, while often met with negative reactions "in the moment", is generally rewarded in performance evaluations (Nelson and Proell 2018). This suggests that the reward for skeptical actions may be positive, in spite of outcome effects.

Avenues for future research

Despite the prevalence and importance of performance evaluations in auditing, they have received very little attention from researchers. Moreover, existing research in this area focuses largely on how well feedback captures performance on technical tasks, while professional skills, such as professional skepticism, auditor independence, and professional identity, are increasingly important and may be more difficult to assess accurately. In addition, updated research on how features of feedback and the context in which feedback is given affect learning would be valuable

given the changing audit environment. Bol *et al.* (2018) provide an excellent example how established relationships may change over time. It may be that organizational features related to leader characteristics and firm climate may influence the value of feedback on learning. In addition, research might consider whether some types of feedback are more or less effective for auditors with different characteristics. Finally, auditors are likely more receptive to feedback under some conditions versus others; research might consider when feedback interventions are most effectively provided.

3.4.1.2. Learning from training

Effectiveness of training as a learning mechanism

Many audit firms operate training programs and seminars both face-to-face and online. For example, Deloitte (2019, 13) offers more than 880,000 training hours to its auditors, including interactive simulation-based programs, case studies, and immersion courses. In these training programs and seminars, the main focus is on learning, rather than working. Training programs are structured, discrete events during which auditors are taught how to conduct specific tasks. In training, learning is structured and the supervisor takes an active role in guiding learners. As a result, auditors learn much more deliberately from training than they do on the engagement. We identify six papers that examine training in the audit environment. In general, these papers suggest that training is only effective when auditors deeply engage in the materials. Table 9 provides an overview of studies related to learning from training.

TABLE 9

Learning from Training

Training interventions	Alternative training techniques
Bonner *et al.* (1997)*	Moreno *et al.* (2007)
Bonner and Walker (1994)	Plumlee *et al.* (2015)
Borthick *et al.* (2006)*	
Earley (2001)*	

* Studies are covered in multiple sections.

Four papers focus on how interventions can improve learning gains from training. Bonner and Walker (1994) examine how various combinations of instruction and experience in the audit environment affect knowledge acquisition. They find that *explanatory feedback* (rather than *outcome feedback*) is necessary for auditors to acquire procedural knowledge. That is, only when outcome feedback is combined with instruction in the form of *understanding rules* (instead of *how-to-rules*) do auditors acquire knowledge from outcome feedback.[37,38] Earley (2001) extends this research and finds that the combination of explanatory feedback (as in Bonner & Walker 1994) and self-explanation leads to more learning than either alone. Bonner *et al.* (1997) argue that instruction can impart category knowledge (i.e., knowledge about transaction cycles, audit objectives) to inexperienced auditors, and this can accelerate learning from experience. Borthick *et al.* (2006) similarly show that specific instruction about knowledge structures can be helpful in improving judgments of inexperienced auditors. This finding is important as it may be difficult for auditors to develop knowledge structures from their limited experience, particularly if repetition of simpler work is reduced due to outsourcing or automation. Overall, current work suggests that training can help novice auditors to use appropriate structures when the need arises.

Two studies address the effectiveness of alternative training techniques. Moreno *et al.* (2007) analyze how two alternative training techniques, using *worked-out examples* and learning from *problem solving,* affect performance in analytical procedures. Worked-out examples specify the problem, the steps to get to the solution and the correct solution. Learning from problem solving involves auditors receiving the solution after doing the problem themselves. Moreno *et al.*, (2007) find that training using either of these methods is effective only if it is combined with self-explanation. That is, requiring auditors to explain the reasons behind their judgments can enhance learning from training, again implying that auditors need to engage deeply in training in order to learn. Plumlee

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[37] Two types of instruction can frequently be found in classrooms and audit firms: understanding rules and how-to-rules (Bonner & Walker 1994). How-to-rules are checklists and sequential steps to be followed in tasks. Understanding rules provide explanations with every step and show how different steps are linked to each other.

[38] Contrary to their expectations, Bonner and Walker (1994) find that the group of participants that received only *how-to-rules* but no experience also acquired procedural knowledge.

et al. (2015) conduct an experiment in which auditor participants are trained in either divergent thinking, convergent thinking, or both. Divergent thinking occurs when auditors have to produce explanations for unusual evidence and convergent thinking occurs when the produced explanations are analyzed and those judged as infeasible are rejected. Auditors trained in both cognitive processes performed significantly better than a control group. Thus, auditors consciously separating generation of hypotheses from assessing their viability performed better.

Avenues for future research

Research into learning by training is quite sparse, despite that this is an important means of auditor learning. While research has examined the relative efficacy of a few methods, the methods studied could be expanded. Further, different methods are likely differentially useful for conveying varying types of knowledge. In addition, electronic learning has become ubiquitous in recent years, but limited research studies its effectiveness, or the extent to which results from in person learning interventions apply to the online environment. Hicks *et al.* (2007) find that auditors view e-learning to be among the least valuable ways to learn. Future research can examine how the value of e-learning can be enhanced. For example, research might examine means of making e-learning more engaging to spark the deep reflection necessary for learning. Alternatively, research might provide evidence regarding which types of material is more and less amenable to learning in this format.

3.4.1.3. Learning from mentoring

Mentoring is an important process in audit firms through which socialization and learning can take place (Dirsmith & Covaleski 1985). The main goal of mentoring in audit firms is to instruct auditors in the nuances of politics and power within the firm and to socialize the auditor into the profession (Scandura & Viator 1994). Mentoring typically occurs off-the-engagement involves an active role for the mentor. We identify five papers that investigate the effectiveness of mentoring in audit firms. Table 10 lists these papers.

TABLE 10

Learning from Mentoring

Role of a mentor	Types of mentoring	Mentorship separation
Dirsmith and Covaleski (1985)*	Viator (2001)	Viator and Pasewark (2005)
Scandura and Viator (1994)		Daoust and Malsch (2019)

* Studies are covered in multiple sections.

Effectiveness of mentoring as a learning mechanism: Roles, types, and mentorship separation

Dirsmith and Covaleski (1985) argue that due to the complexity of public accounting, bureaucratic and rules-oriented approaches are not effective in establishing control in audit firms. Instead, mentoring is a more suitable way through which control is exercised. In this way, mentoring benefits the mentor, protégé, and the firm. Using qualitative interviews, Dirsmith and Covaleski (1985) find that mentoring relationships form at different boundaries in the audit hierarchy: partner-manager, manager-senior, and senior-staff. In the early years of an auditor's career, mentoring occurs primarily by explanation, whereas in the later years of an auditor's career mentoring occurs via demonstration through action and role modeling. Using quantitative survey data from auditors, Scandura and Viator (1994) find that mentoring consists of a triad of separate functions: *career development*, *role modeling*, and *social support*. They further find that the career development function, in particular, leads to lower employee turnover.

Viator (2001) examines the effects of mentoring on role stress and job outcomes and hypothesizes that receiving mentoring reduces role stress (i.e., role conflict, role ambiguity, and perceived environmental uncertainty), increases job performance, and reduces turnover intentions. Results show that formal mentoring (i.e., those appointed by a formal program) is instead often ineffective. Informal mentoring, on the other hand, reduces role ambiguity and environmental uncertainty; however intensive informal mentoring is likely to cause higher role conflict. Furthermore, Viator (2001) finds that informal mentoring is positively associated with job performance and negatively associated with turnover intentions.

Viator and Pasewark (2005) analyze the nature of mentorship in public accounting. They find that some auditors are structurally separated from their mentors after the formal mentorship relation is terminated. This occurs when either the auditor or the mentor leaves the firm. Other auditors continue to work in close proximity to their mentor after the mentorship relation is terminated. The latter set of auditors report more often that their mentor exhibits jealousy and shows lack of support, suggesting that separation from mentors can improve learning opportunities. Daoust and Malsch (2019) find that the mentoring culture at audit firms allows ex-auditors to remain in contact with their former colleagues for advice and professional opinions.

Avenues for future research

Avenues for future research include investigating how to best match mentors with auditors. Viator (2001) established that mentoring is more effective when the relationship between the mentor and the auditor arises informally. In this case, the parties can get to know each other before committing to the mentorship. In case of formal mentoring, research could examine what mentor-auditor combinations are most effective for learning and how good matches can best be made, perhaps by approximating informal matches. Moreover, it is still unclear when separation or rotation ideally occur, what typifies an ideal mentoring relationship, and what mentoring roles are most effective in stimulating learning. Finally, research can examine the role of mentoring in increasing diversity among audit firms and facilitating development and promotion of women and minority auditors.

3.5. On-the-Engagement Learning

The ALF classifies a process as *on-the-engagement learning* when learning takes place at the actual work setting. As a result of being enmeshed with work, learning on the engagement is often incidental and a by-product of working (Eraut 2000; 2007). In our framework, we define four types of on-the-engagement learning: learning from experience, learning from clients, learning from colleagues, and learning from the audit review process. Two processes occur without the active

involvement of a supervisor (i.e., learning from experience and learning from clients) and two occur with the active involvement of a supervisor (learning from colleagues and learning from the audit review).

3.5.1. On-the-engagement learning processes where a supervisor has an active role

3.5.1.1. Learning from colleagues

While working on the engagement, auditors can learn from their colleagues both directly and indirectly (Libby and Luft 1993). Direct learning occurs when an auditor explicitly asks another auditor how to do something. Indirect learning occurs when an auditor observes and imitates colleagues. In the auditing setting, learning from colleagues occurs mostly on the engagement and with active involvement of a supervisor or more senior auditor that professionally develops the learner (Westermann *et al.* 2015). Eraut (2007) distinguishes three categories in which auditors can learn from colleagues: participation in group processes, working alongside others, and consultation. In Table 11 and in the following paragraphs, we classify research on *learning from colleagues* into these three categories.

Learning from participation in group processes

One of the group processes through which auditors may learn is audit team brainstorming. A brainstorming session typically involves indirect learning, in that auditors can observe and listen to others, thereby gaining knowledge and learning new perspectives on how to address particular auditing problems (Osborn 1957). We identify nine papers that focus on audit team brainstorming. Most compare judgments across groups that vary in compositions or brainstorming procedures. Following an overhaul of auditing standards that requires auditors to discuss (ISA 240, ISA 315) or brainstorm (AU 316) about fraud risks during audit planning (AICPA 2002; IFAC 2009a; 2009b), Carpenter (2007) compares the fraud judgments made by audit brainstorming teams and by nominal groups of individual managers, seniors, and staff auditors. In a two-stage experiment, she

finds that putting auditors together in a brainstorming team leads to synergies. Specifically, brainstorming in the second stage generated ideas that were not identified by any auditor in the first stage. Theis implies that brainstorming can give auditors new insights by encouraging them to build on ideas raised by other team members. While the interacting groups in Carpenter's study generated fewer ideas than nominal groups, the quality of the ideas was higher.

TABLE 11

Learning from Colleagues

Participation in group processes	**Working alongside others**	**Consultation**
Group structures	*Voice*	*Formal advice*
Brazel *et al.* (2010)	Gold *et al.* (2014)	Asare and Wright (2004)
Carpenter (2007)	Griffith *et al.* (2020)	Bauer and Estep (2019)
Chen *et al.* (2015)	Kadous *et al.* (2019)	Cannon and Bedard (2017)
Hoffman and Zimbelman (2009)	Nelson and Proell (2018)*	Gold *et al.* (2012)
Lynch *et al.* (2009)	Nelson *et al.* (2016)	Griffith (2018)
Trotman *et al.* (2009)		Griffith (2020)
		Griffith *et al.* (2015)
		Knechel and Leiby (2016)
		Salterio (1996)
		Salterio and Denham (1997)
		Salterio and Koonce (1997)
Voice		*Informal advice*
Dennis and Johnstone (2018)		Emby and Gibbins (1988)
Gissel and Johnstone (2017)		Kadous *et al.* (2013)
		Kennedy *et al.* (1997)
		Duh *et al.* (2020)

* Studies are covered in multiple sections.

A related stream of research compares the effectiveness of various brainstorming procedures and their effects on judgment quality. Brazel, Carpenter, and Jenkins (2010) show that the quality of brainstorming sessions strengthens the relationship between fraud risk factors and

fraud risk assessments. Trotman, Simnett, and Khalifa (2009) compare three types of group discussions: **(i)** an interacting group *without* brainstorming guidelines (as in Carpenter [2007]), **(ii)** an interacting group *with* brainstorming guidelines, and **(iii)** an interacting group with pre-mortem instructions.[39] They find that both the group with brainstorming guidelines and the pre-mortem group outperform the group without guidelines, indicating the importance of setting appropriate ground rules. Other research finds that both computer-mediated brainstorming using interactive groups and nominal groups are more effective than traditional face-to-face brainstorming (Lynch, Murthy, and Engle 2009). Conditional on using computer-mediated brainstorming, Chen, Trotman, and Zhou (2015) show that nominal groups outperform interacting groups due to social loafing by less experienced auditors. Hoffman and Zimbelman (2009) compare brainstorming effectiveness of individuals to that of three-person groups. They use an experiment that manipulates whether auditors engage in strategic reasoning. Results show that strategic reasoning groups outperform brainstorming groups without guidelines; however, auditors that conduct both strategic reasoning and brainstorming do not outperform auditors that conduct one of the two.

In order to learn from participation in group processes, group members need to speak up and share information during those processes. If auditors have valuable incremental information and remain silent, learning from colleagues is inhibited. Gissel and Johnstone (2017) find that perceived psychological safety and auditor knowledge interactively affect auditors' willingness to speak up during brainstorming sessions. That is, less knowledgeable auditors' willingness to share private information is positively affected by the perceived psychological safety engendered by the audit team leader. Dennis and Johnstone (2018) find a positive relationship for the interaction of auditor knowledge and audit team leadership on auditors' willingness to speak up using a field experiment.

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[39] In Trotman *et al.* (2009), the brainstorming guidelines are consistent with Osborn's (1957, 84) guidelines: "criticism is ruled out; freewheeling is welcome; combination and improvement are sought; and most important: quantity is wanted". In a pre-mortem group, auditors have to simulate how an action may be carried out and have to take the perspective in which they actively search for flaws in their plans.

Learning from working alongside others

Auditors generally work in a team and acquire knowledge from colleagues by observing and listening to others and by participating in discussions (Eraut 2007). Auditors indicate that learning from working alongside others is "*extremely important*" (Eraut 2007, p. 409). One way that auditors can learn from working alongside others is by sharing and discussing ideas, information about errors, or audit issues. Thus, effective learning from others in the audit environment requires knowledge sharing within audit teams (Nelson, Proell, and Randel 2016; PCAOB 2010a, Solomon 1987). To facilitate the learning process of junior auditors, knowledge sharing should work two ways. First, it is important that junior auditors raise issues and ask for help when they need it. Second, it is important that experienced auditors' communications with junior auditors not be restricted to the errors and issues, themselves, but that these more senior auditors also communicate how staff-raised audit issues are resolved (Griffith, Kadous, and Proell 2020).

The PCAOB (2012) has raised concerns that certain audit management practices, including inappropriate "tone at the top", reduce audit quality by limiting valuable communication among auditors. Research in auditing has investigated how such audit management practices affect an auditor's willingness to speak up about audit issues and errors. The tradeoff that is typically studied is that, on the one hand, speaking up about potential errors and audit issues can generate benefits, such as increased audit quality or an improved reputation, when the detected error is made by someone else. On the other hand, speaking up about potential errors and audit issues also comes with potential costs for the auditor that speaks up. These include loss of reputation when one speaks up about one's own errors, the need to do additional work, a deterioration of relationships with colleagues, and the triggering of a supervisor's negative emotions. Gold, Gronewold, and Salterio (2014) investigate whether auditors report errors found after a detailed workpaper review and find that auditors in an *open* (vis-à-vis *blame*) error management climate (EMC) are more willing to report errors when they are mechanical, but not conceptual. Gold *et al.* (2014) also find that an

open EMC increases auditors' willingness to report an error made by a peer, providing an opportunity for the peer to learn from the error.

Other research focuses on audit issues that may arise during the engagement. Across a survey and four experiments, Nelson *et al.* (2016) show that auditors are more willing to speak up about audit issues if the audit team leader is oriented toward team success, rather than personal success. They also show that auditors are more likely to raise issues that are aligned (versus misaligned) with the team leader's primary concern (i.e., either audit efficiency or audit effectiveness). Nelson and Proell (2018) complement Nelson *et al.* (2016) by examining how audit team leaders react to auditors who speak up about audit issues. They find that although audit team leaders generally display irritation with those who speak up in the moment, they give auditors who speak up higher performance ratings, particularly when auditors speak up about an issue that aligns with the effectiveness or efficiency focus of the team leader.

Across multiple studies, Kadous, Proell, Rich, and Zhou (2019) find that an auditor's intrinsic motivational orientation (i.e., an interest in learning) positively affects willingness to speak up. Moreover, auditors are more likely to speak up when audit team leaders emphasize intrinsic versus extrinsic goals and when the audit issue is less versus more ambiguous. The results hold whether the leader focus comes directly from a supervisor or indirectly from tone at the top or firm culture. Nonetheless, a significant proportion of participants report unwillingness to speak up even about unambiguous issues that clearly are required to be communicated, indicating foregone opportunities for learning from errors.

Griffith *et al.* (2020) show that staff auditors often seek advice about whether to raise an audit issue from their colleagues, and this advice influences staff auditors' willingness to speak up, particularly when expectations about supervisor feedback on issues raised are low. Griffith *et al.* (2020) find that peer advice is problematic for two reasons. First, staff auditors underestimate the importance of raising audit issues and feel uncomfortable advising others to raise such issues. Second, staff auditors incorporate non-diagnostic information (e.g., social information about

supervisor preferences) into their advice. Expectations of high-quality supervisor feedback increase staff auditors' willingness to raise issues, alleviating the negative effect of contradictory peer advice on the willingness to speak up. In sum, these studies show that junior auditors often do not speak up about potentially important audit issues. They also demonstrate that individual characteristics, leader behavior, and even aspects of the issues themselves contribute to the likelihood that an issue is raised, providing an opportunity for learning.

Learning from consultation

Consultation represents a common and potentially valuable way for an auditor to learn about complex accounting and auditing issues. Consultation provides an auditor with new opinions and information to address such situations, potentially increasing audit quality (PCAOB 2012). As a result, it is expected that audit firms should cultivate a culture of consultation to facilitate the difficult judgments and decisions that accompany auditing (IAASB 2014). Indeed, auditors do consult with each other routinely. Emby and Gibbins (1988) found that 90 percent of auditors responding to a survey indicated that they consulted others during or after making audit judgments. They do so not only to improve the quality of their judgments, but also to increase the justifiability of their judgments and decisions (Kennedy, Kleinmuntz, and Peecher 1997).

Auditors often consult colleagues on an informal basis about accounting issues (AICPA 2002; Emby and Gibbins 1988; IAASB 2005). Learning is evidenced when the auditor receives new information or different perspectives and takes this into account in making a judgment. Accordingly, Kadous, Leiby, and Peecher (2013) investigate how willing an auditor is to follow contrary advice from colleagues. They find that non-specialist auditors often use a *trust heuristic* in which they rely on advice from a close friend without regard to its quality. On the other hand, they rely on the advice from an auditor they do not know in proportion to its quality (justifiability). This demonstrates that social bonds both help and hinder learning from advice: they apparently facilitate openness to contrary opinions but can interfere with calibration. Duh, Knechel, and Lin (2020) find that knowledge sharing (through peer consultation and other sources) improves audit

quality and audit efficiency simultaneously. This suggests that knowledge sharing facilitates learning among auditors.

Auditors also engage in formal consultation. Many accounting firms have *Accounting Consultation Units* (ACUs) that practicing auditors can consult when they are confronted with difficult judgments (Salterio 1994; Salterio and Denham 1997). Following the logic above, research examines auditors' propensity to follow formal advice. Salterio (1996) finds that auditors are more likely to follow ACU-provided precedents that resemble the issue at hand. However, this effect is greater when the precedent is consistent with the client's preferred accounting. Salterio and Koonce (1997) similarly find that although auditors will follow multiple precedents that are consistent with each other, even when they conflict with the client's preference, they tend to accept client-preferred methods when multiple precedents are conflicting, even when other alternatives are more appropriate. Thus, in both formal and informal consultation, it appears that auditors' desire to support a client-preferred position can interfere with use of advice and thus, with auditor learning.

Some research also examines auditors' willingness to seek advice. This is particularly important when auditors lack the requisite knowledge to adequately assess accounting issues, such as when auditing complex estimates or when fraud is suspected. Several studies investigate when auditors use specialists. Asare and Wright (2004) find that the willingness to consult a fraud expert increases with fraud risk. Gold, Knechel, and Wallage (2012) show that the strictness of fraud consultation requirements increases an auditors' propensity to consult fraud experts, but only when fraud risk and time pressure are high. Cannon and Bedard (2017) examine associations of task and environmental characteristics with the use of valuations specialists. They show that estimation uncertainty is associated with higher risk assessments, which in turn makes it more likely that auditors use a valuation specialist. In addition, client use of specialists is associating with higher auditor use of specialists.

Other studies provide insights into how auditors and specialists cooperate. Bauer and Estep (2019) interview auditors and IT specialists and find that the quality of the relationship between the auditor and the expert is important in the consultation decision. A hurdle to improving the relationship between the auditor and the specialist is that auditors regard specialists as part of their team, whereas specialists see themselves as separated from the audit team. Griffith, Hammersley, and Kadous (2015) provide insight into communication problems between auditors and specialists. Based on interviews, they indicate that one cause of auditors' difficulties with appropriately using specialists in auditing complex estimates is that auditors tend to lack specialized (i.e., valuation) knowledge, resulting in a lack of a common vocabulary to facilitate communication. Griffith (2018) finds that when auditors review the work done by specialists, their effectiveness is improved by a specialist-provided relational cue (e.g., commentary that assumptions are aggressive) under high risk, but not under low risk. The results are robust to two risk indicators: client source credibility and engagement risk. Finally, Griffith (2020) finds that auditors use specialists to gain comfort rather than insight, suggesting that learning can be facilitated by affective reactions. However, using specialists also poses a threat to auditors' jurisdictional claim to fair value audits. Because of this, auditors keep specialists' role subordinated to their own, for instance, by minimizing client-specialist contact and making specialists' work conform to their views. This suggests potential institutional barriers to learning that future research could address.

Limited research has studied determinants of auditors' advice-giving. Griffith *et al.* (2015) argue that especially third-party specialists may be reluctant to disclose information, preventing auditors from adequately learn about the client's models. Knechel and Leiby (2016) identify two properties of advice that would help recipients improve their judgments: *contrariness* (i.e., the extent to which the information or perspective differs from the advice seeker's) and *precision* (i.e., specificity). The authors posit that contrariness and precision are positively associated with the advice-giver's status motives (i.e., the desire to gain respect from others). They find that active

status motives lead advice-givers with higher knowledge to provide less contrary, but more precise, advice. This indicates boundaries on the value of advice for learning and improving judgment.

Avenues for future research

In this subsection, we provide avenues for future research for the three processes in which auditors learn from their colleagues while performing: learning from participation in group processes, learning from working alongside others, and learning from consultations. First, with respect to participation in group processes, the reviewed research provides promising evidence that composition of the group, behaviors of the leader including the climate the leader provides, and the way in which the group session is conducted affect learning outcomes. However, research in each of these areas, particularly the first two, is relatively sparse, and so our knowledge of these facilitators of and barriers to learning from group processes is limited. Future research could examine which leader characteristics encourage robust discussion and learning, as well as what mix of participants best facilitates learning. Moreover, research has begun to look more carefully at the processes that influence learning both positively (process gains) and negatively (social loafing) (Chen *et al.* 2015). Future research could leverage these insights to identify additional relevant determinants but also to intervene to improve learning processes.

Second, with respect to working along others, research has only recently begun to examine factors determining auditors' willingness to speak up about issues that might influence audit effectiveness. Raising such issues is essential to audit quality but also to the auditor's workplace learning. In this area, the sparse research has provided converging evidence that leader behavior, firm culture and tone at the top, as well as characteristics of the individual auditor and the issue itself affect the likelihood that the issue will be raised. However, we do not have a complete picture of how auditors determine whether to raise an issue or remain silent. Future research can further explore this promising area. In particular, it may be valuable to investigate training and interventions that nudge audit team leaders to act in ways that facilitate communication and knowledge sharing within the audit team.

Third, much remains to be learned about the role of formal and informal consultation for auditor learning. While existing studies on advice taking show a variety of factors that influence receptiveness to advice, they also consistently show that auditors resist new information in order to support even inappropriate client positions, and that this limits the usefulness of advice as a learning tool. Future research can examine whether interventions can address this issue. Moreover, relative to advice taking, we know very little about advice seeking and advice giving. Future research could examine what drives individuals to seek advice, to provide versus withhold advice, and, when advice is provided, what drives the quality of advice. For example, we know little about how environmental characteristics influence whether auditors consult their colleagues. Future research that opens the black box of audit team dynamics in order to see which auditors are most likely to consult a peer, which questions they ask, who they ask, would be very valuable, as would information about when consultation is more and less likely to lead to learning. Additional avenues for research include examining how modes of communication affect the willingness to consult colleagues and learn from them. Currently, auditors are not limited to their audit team, but can instead send an internal message to a peer in another audit team. Further research could shed light on how technological developments affect an auditors' advice-seeking and advice-giving behavior.

Finally, we note that there are commonalities across these three processes of learning from colleagues. Across the areas, leader behaviors, firm tone at the top, and other organizational issues appear to play large roles in the extent to which auditors are open to learning from others. Future research can identify specific commonalities and differences in learning processes across these areas. For example, it may be that some factors influencing learning in one area extend to others, but other factors may facilitate learning in one area but interfere with it in others. For example, status differences might improve advice taking but limit open discussion within teams.

3.5.1.2. Learning from audit review

In this section, we focus on a process that is unique to the audit environment: the audit review. During audit review, superiors examine the work of workpaper preparers and prior

reviewers down the hierarchy. At each level, the reviewer has two important objectives. First, the audit review is an element of quality control, and the reviewer aims to detect and correct errors made by the preparer (ASB 2011; PCAOB 2010a). Workpapers are iteratively reviewed by more experienced auditors and comments are provided, either in written or face-to-face format (Asare and McDaniel 1996; Payne, Ramsay, and Bamber 2010). Typically, when a staff auditor prepares a workpaper, a senior provides a *detailed review* and is accountable to a manager, who subsequently provides a *general review* (Bamber and Ramsay 1997). The manager, in turn, is accountable for the quality of the entire workpaper to the engagement partner. As a result, the audit review provides an opportunity for auditors at different levels to learn about their performance during the audit engagement.

Second, the reviewer aims to professionally develop the workpaper preparer through coaching (Andiola, Brazel, Downey, and Schaefer 2018; Trotman, Bauer, and Humphreys 2015; Westermann *et al.* 2015). Although learning from the audit review process typically involves no specified learning goals for the learner, the reviewer takes an active role in professionally developing preparers. In doing so, reviewers have to balance the short-term need to detect errors, which provides learning opportunities through task-level feedback, with the long-term need to professionally develop the preparer, which provides learning opportunities through process-level feedback (Andiola *et al.* 2018).

In the first subsection, we review literature investigating performance gains resulting from the audit review process. In the second subsection, we review literature that investigates how preparers try to persuade reviewers, which may hamper learning from errors. Third, we cover literature that compares the effectiveness of alternative forms of the audit review process. Fourth, we review literature examining the effects of contextual factors on the effectiveness of the audit review process. At the end of the section, we discuss avenues for further research. Table 12 provides an overview of the literature that we cover about learning from the audit review.

TABLE 12

Learning from Audit Review

Performance gains	**Persuasion**	**Different forms**	**Contextual factors**
Structure	*Preparer stylization*	*Hierarchy*	*Reviewers affected*
Trotman (1985)	Agoglia *et al.* (2003)	Bamber and Ramsay (1997)	Asare and McDaniel (1996)
Trotman and Yetton (1985)	Gibbins and Trotman (2002)	Harding and Trotman (1999)	Frank and Hoffman (2015)
Ismail and Trotman (1995)	Rich *et al.* (1997)	Ramsay (1994)	Tan and Jamal (2001)*
			Tan and Shankar (2010)
Control mechanism	*Reviewer responses*	*Mode of review*	*Preparers affected*
Libby and Trotman (1993)	Fargher *et al.* (2005)*	Agoglia *et al.* (2009)	Andiola and Bedard (2018)*
Ricchiute (1999)	Tan and Trotman (2003)	Agoglia *et al.* (2010)	Andiola *et al.* (2019)
		Brazel *et al.* (2004)	Lambert and Agoglia (2011)
		Fargher *et al.* (2005)*	
		Payne *et al.* (2010)	

* Studies are covered in multiple sections.

Performance gains of the audit review process

Despite limitations inherent in the review process, the audit review significantly improves judgment accuracy (Trotman 1985) and consensus (Trotman and Yetton 1985) compared to judgments prior to review. However, Trotman (1985) finds no significant difference in accuracy between two interacting seniors and the review process. Ismail and Trotman (1995) provide evidence that having gone through the review process increases auditors' performance in a subsequent analytical procedures task. Discussion within the review process was found to be particularly effective in and auditor's improving performance, suggesting that learning occurs as a result of audit review.

Libby and Trotman (1993) find that the review process is an effective quality control mechanism as preparers have incentives to justify their positions while reviewers have incentives to question them, leading preparers (reviewers) to recall more information consistent (inconsistent) with the judgment. Although the evidence discussed to date suggests effective learning, Ricchiute (1999) finds that, due to the biased memory of preparers, reviewers evaluate only the subset of the evidence that is documented by the preparer. Hence, the reviewer's decisions are biased towards the preparer's decisions. This situation would seem to limit opportunities for learning from review.

Persuasion in the audit review process

Rich, Solomon, and Trotman (1997) describe the audit review process from a *persuasion perspective*. They argue that preparers aim to enhance their own reputations and persuade reviewers by stylizing working papers. For instance, preparers might focus on conceptual errors when their workpapers are reviewed by a manager who places high value on finding conceptual errors, but they focus on mechanical errors when their workpapers are reviewed by a senior who tends to focus on mechanical errors. Stylizing also occurs when a preparer acts differently in various audits to meet the preferences of the different reviewers they face (Gibbins and Trotman 2002). Agoglia, Kida, and Hanno (2003) find that preparers stylize even when reviewers' preferences are unknown but a preference for structure is known. On the one hand, stylization may increase audit efficiency as reviewers will be more likely to accept working papers. On the other hand, stylizing potentially reduces audit effectiveness, and, to the extent reviewers are persuaded by the stylization, workpapers may be accepted prematurely and errors may go unnoticed, impeding learning.

Reviewers, in turn, are likely to have developed strategies to cope with stylization attempts. Tan and Trotman (2003) find that reviewers anticipate preparers focusing on some errors more than others. As a result, reviewers counteract the neglect of the errors that they expect to be stylized but not the errors that they do not expect to be stylized. In a field-based study, Fargher, Mayorga, and Trotman (2005) find that reviewers anticipate stylization attempts for both presentation format and the type of work done. Overall, although stylization may threaten audit quality and

limit learning from the review process, research indicates that reviewers are often able to anticipate stylization and may counteract it.

Different forms of the audit review process

Research has also investigated the effectiveness of alternative forms of the audit review process. Three papers examine the allocation of sequential stages of the workpaper review among different hierarchical ranks. Ramsay (1994) compares managers and seniors that review simulated workpapers seeded with both *mechanical* and *conceptual* errors.[40] He finds that managers are better at detecting conceptual errors, whereas seniors are better at detecting mechanical errors. Harding and Trotman (1999) generalize Ramsay's finding to staff and senior auditors. Bamber and Ramsay (1997) examine whether reviewers can better specialize in detecting one kind of errors (mechanical or conceptual) or conduct an all-encompassing review. Findings show that reviewers that conduct all-encompassing reviews outperform reviewers that conduct a specialized review.

Five papers investigate the effectiveness of different modes of the audit review. Payne *et al.* (2010) compare an interactive review with a traditional written review. In their study, auditors indicate that interactive reviews focus more on audit procedures and how findings were obtained, whereas written reviews focus more on overall findings and documentation. Payne *et al.* (2010) also compare how preparers anticipate a real-time interactive review vis-à-vis the traditional written-based review; they find that an interactive review nudges auditors to provide effort to more cognitively demanding procedures.

Other research compares electronic and face-to-face reviews. Brazel, Agoglia, and Hatfield (2004) find that, in the face-to-face condition, preparers feel a stronger need to be prepared for any review question, so they focus more on audit effectiveness, which increases time spent on preparation and audit quality. Additional advantages of face-to-face reviews are that preparers rely less on last year's workpapers and feel more accountable for their work. In electronic reviews,

[40] Ramsay (1994) defines mechanical errors as objective, verifiable, and concrete and conceptual errors as subjective, unverifiable, and imprecise. Detecting conceptual errors requires the use of conceptual, analytical, cognitive processing.

auditors focus more on efficiency and are more likely to use a heuristic approach (Brazel *et al.* 2004). Results thus indicate that the two types of review cannot be viewed as substitutes—face-to-face reviews tend to nudge auditors to focus on audit effectiveness, whereas electronic reviews nudge auditors to focus more on audit efficiency. Agoglia, Hatfield, and Brazel (2009) also find that preparers using electronic audit reviews provided reviewers with lower quality workpaper documentation compared to preparers with face-to-face reviews. When considering the determinants of the choice for a review mode, Agoglia, Brazel, Hatfield, and Jackson (2010) find that electronic reviews are more likely when workload pressure is high, but only when misstatement risk is low. Finally, Fargher *et al.* (2005) find in a field study that face-to-face reviews are common, constituting roughly 60% of communications in the audit review.

Contextual factors that affect the effectiveness of the review process

Several studies have investigated how reviewers are influenced by characteristics of the workpaper preparer. Asare and McDaniel (1996) investigate the separate and joint effects of familiarity with the preparer and task complexity on the reviewers' effectiveness at detecting errors. They find that greater familiarity with the preparer increases reviewer confidence in the preparer and decreases the amount of work that reviewers ask preparers to reperform. As less work is reperformed, reviewers of familiar preparers focus more on the strategic phase of the review and find more *conclusion errors* on complex tasks but not on routine tasks. Tan and Jamal (2001) examine whether the reviewer's general impression of a preparer influences the review. They conduct an experiment with participants that have been classified by their firm as either average or outstanding. They find that when reviewers are aware of the preparers' identities, outstanding preparers are evaluated more favorably. However, this does not occur when preparers are anonymous, indicating that reviewers do not objectively evaluate the preparers' work. Relatedly, Tan and Shankar (2010) find that reviewers have difficulties adjusting from their initial opinions during the audit review, and they form opinions in an earlier stage in real-time reviews. Moreover, reviewers judge working papers more favorably when reviewers and preparers have similar opinions.

Frank and Hoffman (2015) argue that preparers' judgments may be influenced by the affect felt towards the client, and that this could influence reviewers' judgments. A preparer's *positive affect* felt toward the client may result in overly favorable judgments, whereas *negative affect* may lead to overly critical judgments. In their experiment, Frank and Hoffman (2015) find that when reviewers are informed about the preparer's affect towards the client, they rely more (instead of less) on the preparer's judgment. This is called the *ironic rebound effect*: decision-makers trying to discount information instead rely more on it. Overall, stylization, the nature of the review process, and contextual factors such as a reviewer's familiarity with the preparer appear to hamper reviewers in making accurate judgments, interfering with the preparer's learning process.

Other studies have investigated how preparers respond to review comments and to what extent they incorporate and learn from the review comments. First, responding to comments from reviewers can help preparers learn from the review process. Lambert and Agoglia (2011) examine how two contextual factors – review timeliness and framing of review objectives as either reaching an appropriate conclusion or documenting to withstand scrutiny – affect audit staff follow-through. They find that preparers who receive timely reviews spend more time following up on review points, including examining more evidence. They also find that this effect is attenuated when the review objective is framed as reaching an appropriate conclusion.

Andiola, Bedard, and Westermann (2019) utilize an experiential questionnaire to understand auditors' attributions and emotions following audit review. The authors predict and find that preparers attribute negative events during the audit review to external factors, but they attribute positive events to their own effective communication and good relationships with their supervisor. Attributing negative events to external factors is likely to hamper learning from errors, as it reduces the probability that preparers will consciously reflect on what they did wrong and how they can improve. In addition, when preparers receive negative feedback, this evokes frustration, worse attitudes toward coaching, and more impression management. However,

Andiola *et al.* (2019) find that negative feedback also leads to a performance improvement, suggesting that these expected learning problems do not occur.

Avenues for future research

Reviewers have two important objectives in the audit review: detecting and correcting errors and providing both guidance and coaching to preparers. Although many papers focus on the former objective, we know little about how reviewers provide guidance and coaching to workpaper preparers. Future research could further explore how coaching is provided and differences in effectiveness across methods (Andiola *et al.* 2018). Such research has the potential to identify and share best practices, improving learning throughout the profession. In addition, regulators have raised concerns about the effectiveness of the review process (IAASB 2013; PCAOB 2016; 2017). Future research can consider whether interventions such as engagement quality control (EQR) – where a concurring partner reviews the work – improve reviewer effort and subsequent learning from review comments. Finally, it is also important to understand interactions of the audit review with other types of learning. That is, if a preparer receives a review comment, she may consult colleagues, clients, or specialists to address this comment. The review process can thus also spark other learning processes within the audit firm.

The audit review is of great significance to the learning process of workpaper preparers. To that end, preparers receive coaching from reviewers. However, these mechanisms may not always effective as preparers may not follow through (Lambert and Agoglia 2011) or may not internalize provided feedback. Future research could examine which types of feedback and conditions facilitate versus stifle learning. For instance, Hattie and Timperley (2007) distinguish among feedback aimed at the self, self-regulation, process, and task levels. Most feedback in the audit review process is focused on the task level (i.e., the feedback explains what exactly needs to be corrected for a specific task). Feedback at the process level could nudge preparers to focus on questions such as how the information is obtained or how the task is connected to relating tasks and could improve learning from the audit review. Hattie and Timperley (2007) also find that

feedback aimed at the process level is most effective. Future research can investigate how feedback in the audit review process can improve review quality and preparer learning from the audit review.

3.5.2. On-the-engagement learning processes where a supervisor has a passive role

3.5.2.1. Learning from experience

Learning from experience is long recognized as important to building expertise in auditing. Libby (1995, p. 180) defines experiences as "task-related encounters that provide opportunities for learning." Based on a survey, Hicks *et al.* (2007, p. 67) find that auditors view "learning from completing new tasks in my work" and "learning from applying past experience" as their most favored learning strategies. In this subsection, we discuss how auditors learn from first-hand experiences, including task completion.

Most literature on learning from experience is based on the early "*expertise paradigm*". In the expertise paradigm, there are two dominant views: the *behavioral view of expertise* and the *cognitive view of expertise*. The behavioral view compares judgments made by expert auditors with those made by novice auditors. A typical study taking the behavioral view focuses on how auditor expertise (as proxied by years of experience) affects judgment outputs. As we highlight below, this stream of literature produced some surprising results, such as that expert auditors do not behave differently from novice auditors. However, these contrary findings have been attributed to numerous design problems (see, for example, Bédard 1989; Bonner and Lewis 1990; Graham 1993; Libby and Luft 1993; Nanni 1984). Fueled by advances in psychology, audit researchers looked deeper, studying the cognitive processes and knowledge bases that expert auditors use to make judgments. These "cognitive view" studies tend to focus on cognitive processes and knowledge, rather than ultimate judgments.

Research in this area was largely conducted within a framework developed during the early 1990s. At this time, researchers started to analyze the antecedents of judgment performance,

beginning with the idea that experience is an important antecedent of knowledge. Bonner and Lewis (1990) proposed that such knowledge and ability are key antecedents of judgment performance. Libby and Luft (1993) extended the model by **(i)** adding motivation and the audit environment as determinants of judgment performance and **(ii)** arguing that knowledge is determined by ability, experience, motivation, and the audit environment.

An important question prompted by the early literature on auditor learning from experience is whether the audit environment is conducive to learning. That is, although experience offers an opportunity to learn, learning from experience in the audit profession may be hampered by characteristics of the environment. For instance, Ashton (1991) argued that auditors' encounters with actual errors are rare, auditors conduct relatively few audits every year, and the audits are very different from each other. As a result, she posited that auditors do not acquire error frequency knowledge based on repetitive experience. Salterio (1994) used field data to further explore the question of whether the audit environment is conducive to learning. He examined national office managers working in a central research unit of an audit firm over six months. Results show that, during this period, national office managers learned to resolve financial accounting inquiries in less time over the period, while the effectiveness of the inquiries increased. Salterio (1994) shows that auditors do learn from experience in some settings, and frequency of task performance is an important contextual factor that enhances learning. Earley (2001) investigates whether audit firms can enhance learning from experience through low-cost interventions. She finds that both explanatory feedback and self-explanation of the rationale underlying a judgment improve procedural knowledge acquisition. She further finds that a combination of both interventions is more effective than either of the interventions alone. Finally, Causholli (2016) finds that audit labor costs decrease with experience at a client, though the effect is limited to the partner- and manager-level.

We next review the links in the experience-knowledge-performance relationship step-by-step. First, we review literature on the direct relationship between experience and performance.

Second, we separately review how experience affects knowledge and how knowledge affects performance. Table 13 provides a detailed overview of the subsections of this section and the literature reviewed in each subsection.

The relationship between experience and performance

Studies that focus on the direct relationship between experience and performance typically adopt the behavioral view of auditor expertise and examine the effect of an auditor's expertise (as proxied by their years of experience) on attributes of judgment, including consensus, stability, self-insight, cue importance, and the judgment itself (e.g., Ashton 1974; Ashton and Brown 1980; Ashton and Kramer 1980; Hamilton and Wright 1982; Gaumnitz, Nunamaker, Surdick, and Thomas 1982; Joyce 1976; Messier 1983; Nanni 1984).

Although it may seem intuitive that experience and performance are positively related, the literature showed mixed results on this relationship, with performance sometimes improving with experience (e.g., Messier 1983; Nanni 1984), but sometimes not (e.g., Joyce 1976; Hamilton and Wright 1982). The mixed results can be at least partially explained by methodological challenges. These challenges include **(i)** testing a range of auditor experience levels that is too narrow to observe effects (Bédard 1989), **(ii)** relying on general, rather than specific, relevant experience (Nanni 1984), **(iii)** incongruence between the demands of the experimental task and the experience of the auditor (Graham 1993), **(iv)** testing theoretical links between experience and performance that are equivocal at best (Bonner and Lewis 1990), and **(v)** other failures to implement the conceptual approach, including failure to conduct an adequate task analysis (Libby and Luft 1993).

TABLE 13

Learning from Experience

Experience and performance	**Experience and knowledge**	**Knowledge and performance**
Behavioral view	*Cognitive view*	*Specific knowledge*
Ashton (1974)	Choo and Trotman (1991)	Bonner and Lewis (1990)*
Ashton and Brown (1980)	Frederick (1991)*	Choo (1996)
Ashton and Kramer (1980)	Libby (1985)	
Gaumnitz *et al.* (1982)	Libby and Frederick (1990)	
Graham (1993)	Waller and Felix (1984)	
Hamilton and Wright (1982)	Weber (1980)	
Joyce (1976)		
Messier (1983)		
Nanni (1984)		
Determinants of expertise	*Knowledge as a precondition*	*Knowledge-task interactions*
Bonner and Lewis (1990)*	Bonner *et al.* (1997)*	Bonner (1990)
Frederick (1991)*	Borthick *et al.* (2006)*	Bonner (1991)
Libby and Luft (1993)		
Libby and Tan (1994)		
Task experience		*Studying knowledge effects*
Ahn *et al.* (2020)		Davis (1996)
Moroney and Carey (2011)		Frederick (1991)*
Wright (2001)		Frederick and Libby (1986)
Learning in audit environment		*Negative effects*
Ashton (1991)		Moeckel and Plumlee (1989)
Butt (1988)		Nelson *et al.* (1995)
Causholli (2016)		
Earley (2001)*		
Salterio (1994)		

* Studies are covered in multiple sections.

Research in this area has generated some important insights. First, Butt (1988) finds that error frequency judgments from subjects with direct experience were more accurate than error frequency judgments from subjects with indirect experience, suggesting that error frequency information is most effectively learned through direct experience. This may potentially be problematic in learning error frequencies from experience, as Ashton (1991) pointed out that direct experience with errors is seldom. Second, it is important to consider specific types of experience instead of general experience. Wright (2001) finds that task-specific experience leads to better judgment performance and higher judgment consensus, supporting the idea that not all experience contributes equally to performance. Moreover, Moroney and Carey (2011) compare the relative importance of task-based and industry-based experience on auditor performance in identifying what audit procedures are necessary. They find that industry-based experience has a larger impact on auditor performance, indicating that there are different ways for auditors to specialize and some ways may be more beneficial for performance than others. Ahn, Hoitash, and Hoitash (2020) find that experience with fair value estimates is associated with greater audit quality at the office level, but not at the national level. This indicates that experience that resides at the office level is relevant for performance, and audit firms can think of ways to leverage learning from experience at the national level.

The relationship between experience and knowledge

Studies that examine the relationship between experience and knowledge generally take the *cognitive view of expertise*. Research in this area has established that experience can lead to increased knowledge content and better organized knowledge structures. Early studies in this area focused on whether expert auditors indeed have different knowledge structures than novice auditors. A seminal study uses a free recall experiment to examine auditors' recall after reading a list of internal controls in random order (Weber 1980). Weber (1980) finds that auditors are able to recall more controls than are students, and that auditors appear to cluster the controls in memory. This study provides evidence that memory organization depends on experience. Frederick (1991) builds on

this work and found that more experienced auditors recalled more controls when they were presented in a schematic versus taxonomic listing, whereas auditing students did not, indicating that experienced auditors likely use a schematic organization scheme for controls in memory.[41] Choo and Trotman (1991) study the amounts, types, and clustering of items being recalled by experienced and inexperienced auditors. They find that experienced auditors cluster their recalls contingent on their memory organization.

Additional studies in the area focused on how an auditor's experience affects memory organization. Studying auditor's hypothesis generation in an analytical review task, Libby (1985) finds that perceived error frequencies and recency of experience with an error affect the accessibility of error hypotheses. Libby and Frederick (1990) find that auditors learn error occurrence rates as they gain experience, and they organize error knowledge based on dimensions such as the position in the transaction cycle. This organization increases their efficiency in evidence evaluation. Another noteworthy study in this area is by Waller and Felix (1984). They provide a rationale for how learning from experience alters one's knowledge structure. At the beginning of an auditor's career, knowledge is mostly declarative and is organized in categories and schemata. Waller and Felix (1984) posit that when an auditor learns from experience, the auditor's production system is modified such that condition-action pairs are changed after repeated application, resulting in more experienced auditors having more refined condition-action pairs.

Research further finds that appropriate knowledge structures are a precondition to learning from experience. Bonner *et al.* (1997) analyze whether having audit category knowledge (e.g., transaction cycles) in place prior to experience can enhance auditors' learning from experience. The study finds that category knowledge organizes experiences, fostering learning from experience. Moreover, as auditors with category knowledge learned more, having category knowledge also led to superior audit decisions. Borthick, Curtis, and Sriram (2006) find similar

[41] A taxonomic structure is typified by categoric checklists, whereas a schematic structure is typified by information flowcharts.

effects of a knowledge structure intervention. That is, they find that an intervention to provide auditors with a relevant knowledge structure leads to better performance in internal control reviews, and that knowledge structure mediates the effect of the intervention on this performance.

The relationship between knowledge and performance

Frederick and Libby (1986) developed the '*expertise paradigm*' for more effectively studying the effects of knowledge on judgment performance. This paradigm highlights the importance of (1) specifying the knowledge and cognitive processes needed to perform a task in advance, then (2) constructing the experimental task such that there are observable implications of using and not using knowledge. When this is accomplished, (3) careful manipulation of stimuli that should activate a given knowledge elements can be used to test hypotheses.

Several studies have investigated the different types of knowledge and cognitive processes required for given tasks. Notably, Bonner and Lewis (1990) distinguish three types of relevant knowledge content: general domain knowledge (e.g., accounting and auditing knowledge), subspecialty knowledge (e.g., knowledge about an industry), and world knowledge (e.g., general business concepts). They find that, together with ability, these three types of knowledge are associated with improved performance on tasks for which the knowledge type is relevant. Choo (1996) finds that knowledge distinctiveness, abstractness, and contingency for the task are positively associated with judgment performance.

Several studies highlight the importance of knowledge-task interactions. Bonner (1990) investigates the role of task-specific knowledge in audit judgments across a variety of audit tasks. Whereas relevant knowledge is expected to be similar between experienced and inexperienced auditors for some tasks (e.g., control risk assessment), relevant knowledge is gained later and thus is expected to be higher for experienced auditors than for inexperienced auditors for other tasks (e.g., analytical risk assessment). Bonner (1990) finds that experienced auditors outperform inexperienced auditors in both cue selection and cue weighting in analytical risk assessment but not in control risk assessment. Bonner (1991) shows that less experience is required for cue

measurement in analytical risk assessments. These results indicate experience improves performance differentially for different tasks and aspects of tasks.

Several studies use the expertise paradigm to disentangle knowledge elements by manipulating the stimuli and/or contexts that trigger these knowledge elements. Frederick and Libby (1986) manipulate internal control weakness and find that experienced auditors adjust their predictions of financial statement errors based on the internal control weakness, whereas student participants do not, showing that experienced auditors have better knowledge of the relations between contexts (internal control weaknesses) and stimuli (errors). Davis (1996) finds that experience leads to a more top-down judgment process in control risk assessments. This top-down judgment process causes auditors with developed knowledge structures to selectively examine cues based on situational features, rather than considering all cues, potentially explaining the interaction above. Frederick (1991) also provides an example of context-stimuli interactions. Training exposes both experienced and inexperienced auditors to a taxonomic structure for internal controls and experience exposes (only) experienced auditors to a schematic structure for internal controls. Frederick (1991) finds that experienced auditors are able to recall more internal controls than inexperienced auditors when they are listed in a schematic structure, but not when the internal controls are listed in a taxonomic structure. These studies demonstrate how careful examination of stimuli/context interactions allow researchers to eliminate alternative explanations and identify specific knowledge effects.

Larger and more structured knowledge can also *decrease* auditor performance. For instance, Moeckel and Plumlee (1989) find that auditors with more knowledge also are more confident, and they tend to rely more on their memory instead of the observed evidence, reducing judgment performance. Nelson, Libby, and Bonner (1995) argue that experience leads auditors to structure their knowledge of financial statement errors based on the relevant audit objective. This can negatively impact performance for tasks that are, instead, structured on transaction cycles.

Avenues for future research

Research to date shows us that to understand how experience leads to better judgment, it is critical to understand the antecedents and consequences of knowledge (Libby 1995; Libby and Luft 1993). Previous research has thoroughly examined the experience-knowledge-performance relationship (e.g., Libby and Luft 1993). Further, Libby and Luft (1993) identify ability, motivation, and environment as antecedents of knowledge. Research has investigated the effects of ability on knowledge and performance (e.g., Bonner and Lewis 1990; Libby and Tan 1994), as well as how environmental and task factors, such as time pressure, type of task, and audit structure, determine the relationships between knowledge and ability with performance (e.g., McDaniel 1990; Libby and Luft 1993). However, we still know little about the role that the auditor's motivation plays in driving the knowledge – performance relationship. Research examining the effects of the auditor's motivation on learning from experience could be valuable. Westermann *et al.* (2015) document that audit partners raise concerns that current-generation auditors do not have the motivation to invest the necessary time and effort into the profession. If this concern is valid, it could imply that the range of motivation levels for auditors is larger than in the past, which further implies that differences in motivation may be causing differences in knowledge and performance. Recent research has begun to acknowledge the role of motivation in affecting auditor performance. Kadous and Zhou (2019) find that intrinsic motivation improves audit judgment through improvements in cognitive processing. Additional research into how an auditor's motivation impacts knowledge and performance will help us to better understand learning from experience.

In addition, we note that most of the literature about learning from experience was published more than two decades ago, and the profession has been undergoing rapid change (e.g., Deloitte 2015; EY 2015; ICAS & FRC 2016; PwC 2015a; 2015b). Thus, it may be useful to test whether established relationships still hold in the new audit environment, especially if there are a priori reasons to think so.

3.5.2.2. Learning from clients

Most novice auditors spend around half of their time on the client's premises, implying that there are ample opportunities to learn from clients (Eraut 2007). We identify two ways auditors can learn from clients. First, by learning about the client's business and industry, auditors develop subspecialty knowledge and industry expertise (Bonner and Lewis 1990; Solomon, Shields, and Whittington 1999). Second, auditors learn from encounters with the client (Eraut 2007). Learning from clients occurs on the engagement and typically includes only passive supervisor involvement. Table 14 provides an overview of studies examining factors relating to learning from clients.

Learning about the client

We find nine papers focusing on how auditors learn about the client. Six of them focus on industry specialization and three focus on how developing deep but narrow knowledge about a client can also improve judgments in other domains. Industry specialists develop subspecialty knowledge through specific indirect experience (e.g., training) and direct experience in a particular industry (Bonner and Lewis 1990). Research demonstrates that industry specialization leads to higher audit quality (Chin and Chi 2009; Chi and Chin 2011).[42] Reasons supporting industry specialization leading to higher audit quality include that industry-specialist auditors are better able to assess risks and make audit planning decisions (Low 2004) and better able to detect industry-specific errors (Owhoso, Messier, and Lynch 2002). Solomon *et al.* (1999) find mixed evidence about whether industry-specialist auditors have more knowledge of financial statement errors (e.g., fictitious revenue) in analytical procedures conducted in their own industry compared to other industries. However, the study finds specialization gains for non-error explanations for discrepancies (e.g., increases in fees charged), suggesting that focused training and experience in an industry particularly benefit an auditor's non-error knowledge. Hammersley (2006) finds that

[42] There are also numerous studies that examine industry specialization at the office-level or firm-level (e.g., Francis, Reichelt, & Wang 2005; Reichelt & Wang 2010; Gaver & Utke 2020), as those studies do not bear implications for auditor learning at the individual level, they are not part of the inclusion criteria and hence outside the scope of our literature review.

industry specialist auditors have more complete problem representations about misstatements in their matched (versus mismatched) industry, allowing them to diagnose problems from partial cue patterns. This indicates a comparative advantage for industry-specialist auditors compared to non-specialist auditors.

TABLE 14

Learning from clients

Learning about the client	**Learning from the client**
Industry specialization	*Communication*
Chi and Chin (2009)	Bennett and Hatfield (2013)
Chin and Chi (2011)	Bennett and Hatfield (2018)
Hammersley (2006)	Bobek *et al.* (2012)
Low (2004)	Daoust and Malsch (2020)
Owhoso *et al.* (2002)	Dirsmith and Covaleski (1985)*
Solomon *et al.* (1999)	
Knowledge spillovers	*Internal Audit Function (IAF)*
Beck and Wu (2006)	Brandon (2010)
Joe and Vandervelde (2007)	Brown (1983)
Thibodeau (2003)	DeZoort *et al.* (2001)
	Glover *et al.* (2008)
	Maletta (1993)
	Maletta and Kida (1993)
	Margheim (1986)
	Messier and Schneider (1989)
	Messier *et al.* (2011)
	Schneider (1984)
	Schneider (1985)
	Whittington and Margheim (1993)

* Studies are covered in multiple sections.

Thibodeau (2003) finds that when knowledge is acquired by experience in a specialized domain, this knowledge can be transferred across industries. Relatedly, Joe and Vandervelde (2007) show that knowledge gained from working on non-audit services (NAS) at a client can be

transferred to audit tasks, but only if the same auditor conducts both tasks. Beck and Wu (2006) model the joint effects of auditor on-the-job learning and involvement in NAS and conclude that NAS help an auditor to better understand the client's business model.

Learning from encounters with the client

Auditors can learn from interactions with the client (Eraut 2007). Daoust and Malsch (2020) interviewed auditees at client firms who are also former auditors. These auditees indicate that they play an important role in the learning curve of staff auditors, teaching them aspects of audit procedures and even basic accounting notions. Daoust and Malsch (2020) note that some of these auditees even felt they proactively fulfilled the role of superiors in coaching junior auditors.

More generally, staff auditors appear to consider auditees as a source of knowledge about auditing. Auditors often resolve audit issues by communicating with the client (Bobek, Daugherty, and Radtke 2012; Dirsmith and Covaleski 1985).[43] Thus, unimpeded client communication is important both to auditors' work but also to their ability to learn. Extant auditing literature, however, shows that auditors avoid interactions with clients that they expect will be unpleasant. For example, Bennett and Hatfield (2013) show that junior auditors are less willing to ask more senior client managers for necessary audit evidence because they feel intimidated due to a social mismatch. Further, the communication mode influences these interactions. That is, Bennett and Hatfield (2018) find that computer-mediated communication reduces the effect of intimidation; however, it also leads to shorter interactions, fewer follow-up questions, and less "back and forth" dialogues. These results suggest computer-mediated communication has both positive and negative effects on auditor learning from the client.

Finally, the client's Internal Audit Function (IAF) can facilitate learning from the client. Internal auditors are likely to have more knowledge of client-specific issues than external auditors,

[43] Although several studies examine negotiations between auditors and clients, it is not clear how auditors can learn more than their counterpart's expectations and behaviors from negotiations. Hence, negotiations are outside the scope of this literature review. For an overview of the literature on negotiations in auditing, see Brown and Wright (2008).

and this knowledge can be transferred to external auditors. Early research on the IAF investigates how features of the IAF affect an external auditor's decision to rely on the IAF. Most of this research has considered how IAF quality factors as specified by *SAS No. 65* – objectivity, competence, and nature of work performed – determine the extent at which external auditors rely on the IAF. Several studies find that these factors do influence the external auditor's decision to rely on the IAF (e.g., Brown 1983; Schneider 1984; 1985; Messier and Schneider 1989; Maletta 1993). However, there is mixed evidence regarding which IAF quality factors are most important. For instance, Schneider (1984; 1985) finds that the nature of work performed is most important, Margheim (1986) finds an insignificant relationship for objectivity, and Messier and Schneider (1989) find that competence is the most important factor, followed by objectivity, and nature of work performed. In addition, Glover, Prawitt, and Wood (2008) identify outsourcing of an IAF as an additional determinant of reliance on the IAF. They find that based on attribution theory, external auditors perceive the IAF to be more objective if it is outsourced and rely more on the IAF, but only when inherent risk is high. Brandon (2010) finds that reliance on outsourced IAFs is lower when the IAF also provides additional non-audit services. Messier, Reynolds, Simon, and Wood (2011) find that auditors perceive IAFs as less objective but no less competent when they are used as a management training ground. In that case, external auditors rely less on the work of the IAF.

A related body of research examines how features of the audit or the underlying audit work affect reliance on the IAF. Client risk and internal control quality are important factors. Maletta (1993) and Maletta and Kida (1993) find that the IAF quality factors do not significantly determine reliance on the IAF when inherent risk is low, but they do when inherent risk is high and controls are strong. The subjectivity of the evidence also drives reliance on the IAF. Whittington and Margheim (1993) find that external auditors rely more on the IAF when the audit assertion requires the external auditor to evaluate more subjective evidence. DeZoort, Houston, and Peters (2001) find the effect of evidence subjectivity on reliance is moderated by IAF objectivity.

Avenues for future research

Although we know that auditors learn from clients, little is known about auditor communication with clients outside of negotiations. As communication is an important mechanism through which auditor learning could occur, such research is critical. Moreover, audit work is evolving such that more meaningful auditor-client communication occurs in early stages of the auditor's career (Bol *et al.* 2018), implying that even early career learning might benefit from client communications. However, opportunities to learn from clients appear to be hampered by auditors feeling uncomfortable speaking to clients due to a social mismatch (Bennett and Hatfield 2013). This implies that individual auditor characteristics such as extraversion, self-confidence, and self-esteem may be important in determining the extent to which auditors interact with and can learn from clients. While computer-mediated communication reduces the effect of the social mismatch on auditor-client communications, it also leads to less rich interactions (Bennett and Hatfield 2018). Westermann *et al.* (2015) find that audit partners worry about auditors' heavy reliance on computer-mediated communication. Further investigation of how computer-mediated communication affects auditor learning, in terms of development of client relationships, detection of non-verbal cues, and professional skepticism, among other aspects is therefore warranted.

Similarly, although we know under what conditions auditors tend to rely on the work of the IAF, we know little about *how* and *to what extent* auditors rely on the IAF. Our knowledge of how auditors may learn from the IAF is, therefore, also limited. Future research could also investigate the content and dynamics of these communications.

3.6. Discussion and Future Research Directions

Due to the rapid developments in auditing that are fueled by continuous changes in clients' business models, expanded assurance, and technology, learning is becoming increasingly important for the development of auditors (Hicks *et al.* 2007). This paper starts with the observation that the auditing literature contains much prior research that can illuminate learning processes in the audit

profession. Many of these papers do not explicitly focus on auditor learning, but they have important implications for learning, nonetheless. That said, the auditor literature on learning lacks a clear structure, making it difficult for researchers to build on each others' work and for practitioners to develop a comprehensive view of how auditor learning can be facilitated. To address these issues, we develop the ALF, and we classify existing research that provides insights into seven learning processes that occur in audit firms. We distinguish auditor learning processes among two dimensions: the location of learning and the involvement of the supervisor. These dimensions are important as they affect the ways in which learning occurs in these processes. These different processes likely benefit from different interventions for enhancing auditor learning.

Based on the ALF, we provide an overview of existing research that has implications for learning processes in audit firms. We review published literature from seven leading journals using relevant keyword searches in the journal databases. For each learning process, we provide avenues for further research. As noted throughout the paper, several important insights emerge from reviewing the literature on auditor learning.

First, the auditing literature identifies four important antecedents of knowledge: ability, experience, motivation, and environment (e.g., Libby and Luft 1993); however, we know little about how motivation affects auditor learning. This question is particularly important now, as audit partners worry that the current generation of auditors lacks the motivation to invest the necessary resources into their job (Westermann *et al.* 2015). Future research could further examine what role motivation plays in learning and how auditors' motivation to learn can be enhanced. Second, most prior literature studies auditor learning processes in isolation; however, we note commonalities and potential points of intersection among the processes. Future research could explore which results generalize across processes and which do not, as well as how different learning processes interact with each other. Third, research has shown that higher-order cognition such as reasoning, active learning, and critical thinking are crucial for learning across several processes (e.g., training, experience). Future research could further investigate **(i)** when engaging in higher-order cognitive

cognition is problematic for auditors, **(ii)** which interventions might be successful in prompting such cognition, and **(iii)** how they can best be implemented. Fourth, most research on performance evaluation is dated and feedback focuses on auditors' technical skills. We know little about the extent to which auditors are evaluated on professional skills, such as professional skepticism, auditor independence, and professional identity, or about how these evaluations affect learning. Future research can address evaluation and development of these capabilities. Next to that, the literature sheds little light on ineffective learning strategies, learning in higher ranks (e.g., managers and partners), and recent events and trends that could affect learning (e.g., the Covid-19 pandemic and developments in technology such as ChatGPT). Furthermore, the evidence originates mostly from a United States setting and it is unclear to what extent which results generalize to other country settings. Future research can address these issues.

Our study is subject to limitations. Learning is an elusive concept and most studies that we identify as relevant to auditor learning provide indirect evidence on learning by examining performance enhancements. We assume learning is responsible for such enhancements. Further, although our framework aims to capture the most important learning processes in audit firms, it is possible that we failed to identify papers that have implications for learning processes in audit firms. Finally, it is possible that learning processes that were identified in earlier studies are no longer applicable as the audit environment has changed substantially. Importantly, we believe that our framework is flexible and captures relevant dimensions of learning in auditing. Thus, it can be further enriched by adding new learning processes that might be observed and new research, so that it can provide a continuing contribution.

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Chapter 4

Auditor Automation Usage and Professional Skepticism

Abstract

Audit firms are using automated tools and techniques with the aim to improve audit effectiveness and efficiency. However, regulators have expressed concerns that auditors may rely too much on these automated tools, which could reduce professional skepticism. Using an experiment, I predict that auditors are subject to automation bias and may use automated cues as a heuristic replacement for seeking information and thereby reduce professional skepticism. To mitigate the negative effects of automation on skepticism, I employ a counterarguing mindset intervention based on psychology theory. The study also tests whether the reduction in professional skepticism caused by automation usage spills over to subsequent tasks but do not find any evidence of such an effect.

4.1. Introduction

Audit firms invest unprecedented amounts in automated tools and techniques (ATT, hereafter automation) with the aim to increase both audit effectiveness and audit efficiency (e.g., EY 2018a, KPMG 2019, PwC 2019, Bloomberg Tax 2020).[44,45] For the intended benefits of automation in audit engagements to materialize, auditors should use automated tools and techniques adequately (e.g., KPMG 2016, PwC 2017, Zhang, Thomas, and Vasarhelyi 2022). That is, it is questionable whether auditors tend to rely more or less on automated tools and techniques than other auditors. Most prior literature in auditing finds that auditors are sometimes averse to rely on new technologies (Emett, Kaplan, Mauldin, and Pickerd 2021, Cao, Duh, Tan, and Xu 2022, Commerford, Dennis, Joe, and Ulla 2022). However, both theory and policymakers suggest that relying too much on automated tools and techniques may also be a concern (e.g., Parasuraman and Riley 1997, Harris 2017, IAASB 2021a). For instance, the IAASB (2021a, p.2) suggests that relying too much on automation may result in a lack of professional skepticism. Yet, little is known about the potential consequences of auditors' reliance on automation for professional skepticism (e.g., IAASB 2021a, PCAOB 2022).

The first aim of this study is to fill this gap and to examine whether, and if so how, auditors' automation usage affects their professional skepticism. Professional skepticism is a foundational

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44 KPMG (2019), PwC (2019), and EY (2018a, 2022) announced to invest US$5 billion, US$3 billion, and US$2 billion in digital transformation, respectively. Most of the investments focus on upskilling digital skills of employees, developments of technologies, and engagement in strategic alliances with tech companies such as Microsoft, IBM, and Google.

45 The IAASB (2021a, p. 1) uses the term 'automated tools and techniques' to describe all of the emerging technologies that are being used when designing and performing audit procedures today, such as artificial intelligence (AI) applications, robotics automation processes, and data analytics. Throughout this manuscript I use the terms 'automated tools and techniques' and 'automation' interchangeably. Merriam-Webster defines automation as an "automatically controlled operation of an apparatus, process, or system by mechanical or electronic devices that take the place of human labor." Automation focuses on streamlining repetitive, instructive tasks. Examples of traditional automation include the autopilot in an airplane, auto-generation of marketing e-mails, and automated production lines. Whereas automation is manually configured – meaning that automation works based on preprogrammed workflows, scenarios and the like – artificial intelligence goes beyond automation by mimicking and eventually superseding human intelligence and actions. Although there are differences between the two concepts, such as the usage of data, audit firms mainly use artificial intelligence effectively to automate audit procedures. This type of AI-enhanced automation is typically used by audit firms (e.g., KPMG 2016).

construct in auditing and can be viewed as the force that drives auditors to recognize potential errors and irregularities (Nolder and Kadous 2018). My predictions are rooted in automation bias and behavioral mindset theory.[46] Specifically, I predict that auditors are less skeptical towards automation compared to the same information but then provided by an audit team member. I argue that auditors are less skeptical towards automation because individuals have a 'perfect automation schema' that results in all-or-none beliefs with respect to automated tools and techniques (Dijkstra 1998; Dzindolet *et al.* 2002, Madhavan and Wiegmann 2007). Conversely, individuals are more nuanced when relying on other humans. This likely results in vigilance reductions and hamper an auditor's cognitive processing and readiness to respond to certain issues. These consequences could have implications for the effectiveness of auditing procedures, as they may reduce professional skepticism and impede an auditor's ability to identify potential issues and respond accordingly.

At first glance, my predictions may seem at odds with a burgeoning literature that suggests that decision-makers, including auditors, may rely less on automated tools and techniques than on other humans (e.g., Dietvorst, Massey, and Simmons 2015; 2018; Commerford *et al.* 2022). Given the richness of decision-making environments, it is not surprising that prior literature has arrived at different predictions than mine and my predictions are not at odds with prior predictions, but complement them. First, reliance on technology may be task-dependent and depend on the objectivity of a task (e.g., Castelo, Bos, and Lehmann 2019). Second, reliance may be dependent on the expertise of the human against which the technology is benchmarked (e.g., Logg, Minson, and Moore 2019). For instance, some of the previous studies compare an individual's reliance on automation to their own judgment, but this can be influenced by egocentric discounting and overconfidence. Third, individuals tend to have perfect automation schema, which can lead to lower reliance on automation for probabilistic forecasts, as these are inherently uncertain. Hence,

[46] Automation bias is defined as "*the tendency to use automated cues as a heuristic replacement for vigilant information seeking and processing*" (Mosier and Skitka 1996).

my predictions particularly apply to relatively objective and structured audit tasks, which are most likely to be automated (Zhang *et al.* 2022).

A second aim of the study is to test a theory-based intervention to reduce the negative effect of auditors' automation usage on professional skepticism. I propose a counterarguing mindset intervention to mitigate the negative effects of automation usage on professional skepticism. Counterarguing is defined as "*the generation of arguments against the validity of information's implications*" and requires auditors to generate reasons why a proposition is not true or a state of affairs could not occur (Wyer and Xu 2010, p. 110, Xu and Wyer 2012). Counterarguing could be particularly effective to prompt professional skepticism, as regulators refer to professional skepticism as an attitude that includes a questioning mind and a critical assessment of evidence (AICPA 1997 AU §316.02, PCAOB 2010a ¶7, IAASB 2021b).[47] The theory of counterarguing mindset suggests that the impact is most pronounced when it activates a different cognitive behavior than what would occur in its absence (Xu and Wyer 2012). In this study, this means that prompting a counterarguing mindset is likely to have a more significant effect on professional skepticism when relying on automation compared to human auditors. This is because auditors are predicted to have a perfect automation schema, where they hold less nuanced beliefs about automation than about humans, and a counterargument thus triggers cognitive behavior that is more different in the case of automation. Therefore, the study predicts that the difference in professional skepticism between automation and human auditors will be smaller when a counterarguing mindset is prompted compared to when it is not.

A third aim of the study is to investigate whether using automation has negative externalities on subsequent, arguably unrelated, tasks. Specifically, I investigate whether a reduction in auditor's vigilance and professional skepticism caused by automation usage, spills over to

[47] A counterarguing mindset prompt should trigger a different causal reasoning process in which auditors should be more likely to generate arguments that refute the validity of information's implications (Xu and Wyer 2012). Based on behavioral mindset theory, I propose that a counterarguing mindset prompt before the audit tasks causes the level of professional skepticism to vary.

subsequent tasks conducted by that auditor, even if there is no automation involved in those subsequent tasks. Prior literature shows that mindsets tend to be sticky as mindset switching is costly (Hamilton, Vohs, Sellier, and Meyvis 2011). Auditors that have vigilance reductions as a result of automation usage may therefore face difficulties acting professionally skeptical when working on subsequent tasks. As a result, the adverse behavioral ramifications of automation usage may not only lead to performance reductions when using automation, but also in subsequent audit tasks.

I conduct an experiment where I recruit 119 professional auditors. The auditors first conducted a case in which I asked them to review the workpapers of an inventory counting procedure. I employ a 2×2 between-subjects design to test my predictions. The first manipulation varies whether the workpaper of the inventory count is prepared by automation or by an audit team member. In the inventory counting tasks, participants are tasked to recount the inventory count by the workpaper preparer (i.e., either automation or human). To capture professional skepticism, I examine the number of seeded errors identified, the propensity to agree with the workpaper preparer, and the time spent recounting. Inventory counting procedures are relatively structured tasks. I use a structured task for two reasons.[48] First, Abdolmohammadi (1999) documents that only one percent of substantive audit tasks is classified as unstructured and the majority is classified as structured. Second, structured audit tasks are the first-order candidate for being automated (Zhang *et al.* 2022). The second manipulation varies whether a *counterarguing* mindset or *no* mindset is prompted to auditors. After the inventory counting task, auditors had to audit the client's step-one analysis of a goodwill impairment test, adapted from (Kadous and Zhou 2019). In this spillover task, there were no differences between conditions. Instead, the task was used to test a potential spillover effect arising from the manipulations. In the audit of the goodwill impairment test, auditors had to judge the reasonableness of the fair value, state the (skeptical)

[48] Task structure is defined as the level of specification of what is to be done in a task (Simon 1973).

action they would take, and list reasons for being skeptical or the additional evidence they would require.

I find that, absent a counterarguing mindset intervention, auditors are less skeptical when they rely on work conducted by the audit firm's automated tools and techniques than when relying on the same work conducted by an audit team member. Next, I find that a counterarguing mindset intervention alleviates the negative effects of automation on professional skepticism. Finally, I investigate whether reductions in professional skepticism that are caused by automation usage also spill over to subsequent unrelated tasks. I do not find any evidence indicating a spillover effect.

This study extends two streams of literature. First, this paper contributes to a nascent but growing stream of literature that focuses on the adoption of technology in the auditing profession (e.g., Munoko, Brown-Liburd, and Vasarhelyi 2020, Christ, Emett, Summers, and Wood 2021, Commerford *et al.* 2022). Most papers in this area focus on the technical capabilities of technology (e.g., Yoon, Hoogduin, and Zhang 2015, No, Lee, Huang, and Li 2019). However, in comparison to the technical capabilities of technology, much less is written about the behavioral ramifications of technology. This study seeks to fill this void. One notable exception is Commerford *et al.* (2022), who find that auditors tend to under-rely on algorithmic advice versus human advice when auditing complex estimates, especially when management uses objective inputs. My study differs in several ways from Commerford *et al.* (2022), with the focus of my study on relying to a greater extent on automation being the most remarkable difference.[49] The warnings of auditing regulators and standard setters against potential overreliance on automated tools and techniques highlight the importance of investigating auditors' usage of automation and their effects of professional skepticism (e.g., Harris 2017, IAASB 2021a).

[49] Next to that, I investigate the effect of a counterarguing mindset intervention and a potential spillover effect. Furthermore, Commerford *et al.* (2022) focus on complex accounting estimates, whereas I focus on structured audit tasks. Implications of differences are discussed in Section 4.2.3.

Second, I contribute to the literature on professional skepticism in auditing (e.g., Nelson 2009; Nolder and Kadous 2018). With the emergence of automated tools and techniques such as data analytics, artificial intelligence, and robotic process automation, auditors increasingly must exhibit professional skepticism to information prepared by those objects (Olsen and Gold 2018). Olsen and Gold (2018, 132) mention that the research question whether professional skepticism may be exercised differently toward a person versus technology is an important one and has hitherto not been investigated. Despite these claims, to the best of my knowledge, no research has yet investigated the effects of automation usage on auditors' professional skepticism. My study shows that these effects are negative, but these negative effects can be mitigated when auditors are prompted with a counterarguing mindset.

My findings are potentially relevant to regulators (such as the PCAOB), policymakers (including the IAASB), and audit firms. That is, for the potential advantages of automation to materialize, it is important that auditors' automation usage is based on thorough analysis of auditors' cognitive and motivational decision-making processes. Despite that regulators worry that auditors may rely too much on automation (e.g., Harris 2017, IAASB 2021a), the behavioral ramifications of auditors' automation usage have only recently started to draw attention from researchers. My study shows that automation usage has a negative effect on professional skepticism. Next to that, I also evaluate a theory-based intervention that addresses this negative effect. Regulators and audit firms can use this intervention to alleviate professional skepticism reductions when auditors use automated tools and techniques. An important caveat is that it is not an aim of this study to run a horserace between auditors and automation. My experiment does not lend itself to draw valid conclusions with respect to such questions. Neither do I want to make the point that professional skepticism reductions due to reliance on automation are always suboptimal. Rather, this study helps audit firms and regulators making trade-offs and navigating inherently difficult decisions that play a role when implementing or using automation in an audit.

4.2. Background Literature and Hypothesis Development

4.2.1. Adoption of Automated Tools and Techniques in the Auditing Profession

Audit firms adopt automated tools and techniques to increase both audit effectiveness and efficiency (EY 2018a, KPMG 2019, PwC 2019). Key benefits of automation in the audit environment are that automation allows auditors to process an entire population of transactions instead of a sample (No *et al.* 2019), incorporate Big Data from social media websites with audit evidence (Yoon *et al.* 2015), mine large amounts of unstructured and structured data (Harris 2017), and share valuable insights with clients (Austin, Carpenter, Christ, and Nielson 2021). Research shows that in certain aspects of the audit engagement, the usage of automation leads to performance gains. For instance, Christ *et al.* (2021) find that the use of drones and automated counting software improves audit efficiency, audit effectiveness, and documentation quality in inventory counting procedures.

Although automation may lead to performance gains in the audit, auditor expertise may not easily be fully replicated by automated tools and techniques (e.g., Libby 1976; KPMG 2016, Zhang *et al.* 2022). Therefore, audit firms emphasize that automation will not replace auditors but enhance their efficiency and effectiveness. That is, auditors, in the end, make the critical decisions and offer key analysis and insights (KPMG 2016, PwC 2017, Zhang *et al.* 2022). For instance, Christ *et al.* (2021) demonstrate that even in relatively objective tasks such as automated inventory counting using drone technology, auditors are involved to **(i)** ensure that the images taken by the drones are collectively comprehensive (to ensure *completeness*) and mutually exclusive (to ensure

existence), **(ii)** verify whether the counting algorithm functioned well, and **(iii)** follow up with the client on discrepancies.[50,51]

As auditors' judgment is still needed even though tasks are automated (e.g., KPMG 2016, Zhang *et al.* 2022), it is important that the use of automation by auditors is based on thorough analysis of auditor cognition and decision-making processes. When adopting automation, many audit firms, audit regulators, and academics focus on gains in audit efficiency and audit effectiveness that can be achieved through adopting automation (e.g., IAASB 2017, EY 2018b, Christ *et al.* 2021, Austin *et al.* 2021). However, the potential benefits of automation may not (fully) materialize if there are unintended behavioral ramifications as a result of the adoption. Audit regulators have already expressed concern that auditors may 'over-rely' on automation in audits (Harris 2017, IAASB 2021a). For instance, in a speech to the PCAOB/AAA Annual Meeting, PCAOB board member Harris (2017) stated that "*[a]uditors should take care that they are not over relying on data analytics. As powerful as these tools are, or are expected to become, they nonetheless are not substitutes for the auditor's knowledge, judgment, and exercise of professional skepticism*."

Despite worries that auditors may rely too much on automation, prior literature also finds that decision-makers may under-rely on technologies, even if they outperform human decision-makers (Dzindolet, Pierce, Beck, and Dawe 2002, Dietvorst, Simmons, and Massey 2015, 2018). Some studies have specifically investigated auditors' reliance on technologies and find that auditors tend to under-rely on technologies. First, Commerford *et al.* (2022) show that, when auditing complex estimates, auditors rely less on artificial intelligence when client management uses

[50] Also in other fields, the combination of humans and AI outperforms either one of them alone, even in very objective tasks such as chess. For instance, a typical example of man versus machine is the 1997 chess match between IBM's "Deep Blue" and then world champion Garry Kasparov, ultimately won by "Deep Blue". However, it is not that widely known that a team of both a person and a computer outperformed either another computer or an expert chess player alone (Cassidy 2014).

[51] Related research in financial accounting indicates that human judgment is still essential to augment machine-based models. Specifically, Costello, Down, and Mehta (2020) find that lenders who rely on machine-generated credit scoring models, perform better when they have discretion to adjust the machine-based model when assessing the creditworthiness of opaque borrowers. Also in auditing, a main consideration is that auditors can bring their intuition, judgment, creativity, and experience to interpreting the data, leading to deeper insights than those of AI alone (KPMG 2016, PwC 2017).

structured estimation processes. Second, Emett *et al.* (2021) show that engagement reviewers judge audit procedures conducted with data & analytics tools to be of lower audit quality as they entail less effort by the auditor. Third, Cao *et al.* (2022) find that the negative effects of inspection risk on reliance on data and analytics are alleviated by prompting auditors with a growth instead of a fixed mindset.

4.2.2. Automation Bias

Literature in human factors and organizational behavior has examined conditions for decision-makers to effectively use automation and suggests that there may be detrimental performance effects as a result of automation usage. Parasuraman and Riley (1997) posit that decision-makers may either use, misuse, disuse, or abuse automation.[52] A well-documented bias that may particularly arise when using automation is the *automation bias* (Mosier and Skitka 1996, Parasuraman and Manzey 2010). Automation bias is defined as "*the tendency to use automated cues as a heuristic replacement for vigilant information seeking and processing*" (Mosier and Skitka 1996). More specifically, decision-makers have a tendency to rely to a greater extent on automation than humans, resulting in *errors of omission* (i.e., failure to notice problems) and *errors of commission* (i.e., act on incorrect advice given by automation). Two main factors reinforce the occurrence of automation bias (Mosier and Skitka 1996, Parasuraman and Manzey 2010). First, decision-makers, including auditors, tend to conserve their cognitive resources (e.g., Hobfoll 1989, 2001, Dierynck and Peters 2023). Second, decision-makers tend to rely more on automation than on another person under some conditions, such as in objective tasks (Dijkstra, Liebrand, and Timminga 1998, Dijkstra 1999; Castelo *et al.* 2019; Logg, Minson, and Moore 2019). When decision-makers rely more on automation than on another person, decision-makers tend to develop a premature cognitive commitment when using automation, which affects their subsequent attitude towards the

[52] *Use* of automation refers to the voluntary activation or disengagement of automation, *misuse* refers to the overreliance on automation, which may result in behavioral biases, *disuse* refers to the neglect or underutilization of automation, and *abuse* refers to the implementation of automation without due regard for the consequences for human performance (Parasuraman and Riley 1997).

automation (Langer 1989, Parasuraman and Riley 1997) That is, when decision-makers over-trust automation and aim to conserve cognitive resources, this causes them to engage in less cognitively engaging behavior and an inappropriate allocation of attentional resources leading to a loss of situational awareness and reductions in vigilance (e.g., Parasuraman and Manzey 2010).

4.2.3. Automated Tools and Techniques and Auditors' Professional Skepticism

With the adoption of automation, auditors increasingly have to apply professional skepticism to information prepared by automation (Olsen and Gold 2018). I investigate whether auditors tend to rely to a greater extent on automation than on the same information provided by human auditors, and whether this results in a reduction of professional skepticism. Regulators, researchers, and audit methodologies emphasize the importance of exercising an appropriate level of professional skepticism (e.g., Nelson 2009, PCAOB 2010a ¶7, Quadackers, Groot, and Wright 2014). Yet, audit regulators identify a lack of professional skepticism as a root cause of audit deficiencies (e.g., IFIAR 2018). Professional skepticism is often described as a requirement of due professional care (PCAOB 2010a ¶7) and consists of the need to maintain a questioning mind and critically assess audit evidence throughout the planning and performance of an audit (IAASB 2012 ¶13, PCAOB 2003 ¶13, PCAOB 2010b ¶7). Appropriate exercise of professional skepticism is essential for identifying and responding to conditions that indicate material misstatement and reduces the risk of **(i)** overlooking unusual circumstances, **(ii)** overgeneralizing when drawing conclusions from audit observations, and **(iii)** using inappropriate assumptions in determining the nature, timing, and extent of the audit procedures and evaluating the results thereof (IAASB 2012 ¶15).

Professional skepticism comprises both a skeptical attitude and a skeptical mindset (Nolder and Kadous 2018). Whereas a skeptical attitude is typically defined as a stable individual trait (e.g., Hurtt 2010, PCAOB 2010a ¶7, Quadackers *et al.* 2014), a skeptical mindset is typified as a state

which can be aroused by situational factors (e.g., Hurtt, Brown-Liburd, Earley, and Krishnamoorthy 2013, Bauer 2015, Robinson, Curtis, and Robertson 2018, Kadous and Zhou 2019). A salient situational factor is whether the work is conducted by a human auditor or by automation (Olsen and Gold 2018).[53] If auditors tend to have perfect automation schema and subject these schema to imperfect automated tools and techniques (Harris 2017), this may result in less presumptive doubt and an attentional bias that leads them to engage in lesser cognitive processing (Parasuraman and Manzey 2010). Cognitive processing is an important determinant of an auditor's ability to exercise appropriate skeptical judgment, especially when tasks require deeper processing (Griffith, Hammersley, Kadous, and Young 2015, Griffith, Kadous, and Young 2016, Nolder and Kadous 2018). If an auditor's skeptical judgment is inhibited by the use of automation, a deterioration of an auditor's intentions and skeptical actions is likely to follow (Nelson 2009). This leads to the following hypothesis.

HYPOTHESIS 1: In the absence of a counterarguing mindset intervention, auditors exhibit less professional skepticism when they rely on work conducted by automated tools and techniques compared to work conducted by another auditor.

Given the richness of decision-making environments, it is not surprising that prior literature has arrived at different predictions than mine. I highlight three reasons why my study does not undermine other predictions, but instead complements them. First, many prior studies compare an individual's reliance on automation to reliance on one's own judgment (e.g., Dzindolet *et al.* 2002, Dietvorst *et al.* 2015, 2018). An important result from the decision-making literature is *egocentric discounting*: individuals underweight the advice of others compared to their own judgments

[53] This is also consistent with the Elaboration Likelihood Model of Persuasion (Petty and Cacioppo 1986). In this model, the persuasiveness of the source (i.e., automated tools and techniques vs. auditor) is a peripheral cue that may affect the auditor's attitudes toward the work (Dijkstra *et al.* 1998). Especially when auditors are less motivated or unable to judge work on its contents, auditors may base their decision on a peripheral cue such as the persuasiveness of the source.

when making decisions as a result of egocentrism (Yaniv and Kleinberger 2000; Logg *et al.* 2019). As a result, automation reliance is related to decision-makers' estimates of the trustworthiness of automation relative to estimates of *their own* ability, which is potentially subject to egocentric discounting and overconfidence (Logg *et al.* 2019).

Second, individuals tend to have a "*perfect automation*" schema (Dzindolet *et al.* 2002, Madhavan and Wiegmann 2007). A perfect automation schema is conceptualized as cognitive beliefs that automation will perform with near-perfect reliability and individuals that have such a schema are less-forgiving when automation errs (Merritt, Unnerstall, Lee, and Huber 2015). This *all-or none* thinking with respect to automation performance may cause individuals to under-rely on automation when making judgments or forecasts about the future, as the future is inherently probabilistic. Many prior studies that document under-reliance on automated tools and techniques involves probabilistic forecasts about the future (Eastwood, Snook, and Luther 2012, Dietvorst *et al.* 2015, 2018, Commerford *et al.* 2022).

Third, most studies investigate reliance on automated tools and techniques by asking individuals to report the degree to which they wish to rely on automated tools and techniques (e.g., Dietvorst *et al.* 2015, 2018). However, this should not be confused by Mosier and Skitka's (1996) automation bias, where individuals tend to heuristically rely on automation. There is a difference between being consciously asked to what extent one wishes to rely on automation (i.e., a conscious decision) and using heuristics when one is actually relying on automation (i.e., partially an unconscious process). All in all, prior literature shows that these conditions are important in determining reliance on automation.

4.2.4. Joint Effect of a Counterarguing Mindset and Automation on Auditor Professional Skepticism

To mitigate the negative consequences of automation on auditor professional skepticism, I propose prompting a *counterarguing mindset*.[54] Counterarguing is defined as "*the generation of arguments against the validity of information's implications*" (Wyer and Xu 2010, p. 110). Counterarguing requires auditors to generate reasons why a proposition is not true or a state of affairs could not occur (Wyer and Xu 2010, Xu and Wyer 2012). Xu and Wyer (2012) find that these mindsets can be situationally induced and reflect the activation and use of cognitive procedures in subsequent unrelated situations. Specifically, counterarguing mindsets activate cognitive behavior that leads to a tendency to refute the validity of assertions. Such a mindset persists in subsequent tasks, even if they serve a different purpose. For instance, Xu and Wyer (2012) find that individuals that watch a political speech by a politician they opposed are less likely to consider a product in subsequent commercial breaks.

Closely related to a counterarguing mindset is *counter-explanation*. Counter-explanation is conceptualized as generating reasons why a certain assessment may not be true. Prior literature has studied the effect of counter-explanation in auditing and financial accounting settings. For instance, generating and reading counter-explanations reduced auditors' likelihood assessments for suggested causes in analytical review tasks. Kadous, Krische, and Sedor (2006) show that financial analysts that generate counter-explanations make less optimistic forecasts, and show that this effect is alleviated when generating counter-explanations is relatively difficult for an analyst, thereby providing an important boundary condition. A key difference between a counterarguing mindset and counter-explanation is that a counterarguing mindset is prompted by unrelated statements whereas counter-explanation refers to explaining why a focal assertion may not be true. Counter-explanation may thus directly impact a decision-maker's assessments of something, whereas a

[54] Sets of cognitive processes that produce a disposition or readiness to respond to a particular matter can be characterized as mindsets (Gollwitzer 1990).

counterarguing mindset is prompted by unrelated statements and should only situationally affect a decision-maker's assessments of something. In my setting, as counter-explanation could cause auditors to form more pessimistic perceptions about automation that may lead to disuses, and hence be harmful in other domains.

The effect of the counterarguing mindsets is more impactful when the cognitive behavior activated by these mindsets is different from the behavior that would occur in the absence of these mindsets (Xu and Wyer 2012). Given that I argue that auditors have a perfect automation schema where they are more likely to believe that the automation functions at a (nearly) perfect rate, but are more nuanced with respect to their beliefs about other humans, the cognitive behavior activated by a counterarguing mindset is more divergent when auditors rely on work conducted by automation than by another person. This implies that a counterarguing mindset alleviates the negative relationship between automated tools and techniques and professional skepticism. This leads to the following hypothesis.

HYPOTHESIS 2: The negative effect of automated tools and techniques usage on professional skepticism is weakened when auditors are prompted with a counterarguing mindset.

4.2.5. Mindset Spillover to Distinct Subsequent Tasks

Automation can increase audit efficiency and effectiveness, leading auditors to devote less attention to tasks conducted by automation that are free or nearly free from errors, or where the cost of an error is low enough to be acceptable (e.g., Christ *et al.* 2021, Austin *et al.* 2021). In that case, being less skeptical may result in a more efficient process without causing significant reductions in audit quality. However, reduced professional skepticism caused by automation may spill over to subsequent tasks, as prior studies show that judgments from unrelated tasks can affect other judgments (Phillips 1999, Piercey 2011, Van Rinsum, Maas, and Stolker 2018). Therefore,

even with nearly flawless automation and low error costs, there is a risk of spillover to other tasks, potentially resulting in lower audit quality.

The theoretical buildup to Hypothesis 1 highlighted that auditors engage in vigilance reductions when working with automation. As a result, this hampers an auditor's cognitive processing and readiness to respond to certain issues. Although auditors are not locked into a single mindset and optimal decision-making may require mindset switching, Hamilton *et al.* (2011) show that mindset switching is costly. That is, they argue that mindset switching diminishes self-regulation resources, which are limited for auditors, like other decision-makers (Baumeister 1998, Baumeister, Bratslavsky, Muraven, and Tice 1998, Mullis and Hatfield 2018, Hurley 2019, Dierynck and Peters 2023). When switching mindsets, auditors need to override habitual, natural, or dominant responses and this taxes their self-regulatory resources. As a result, spillover effects from automation usage may be induced in two different ways. First, mindsets induced by automation may be "sticky" and a mindset imparted in automated tasks may carry over to audit tasks where no automation is involved (Wyer and Xu 2010, Hamilton *et al.* 2011). Second, auditors may switch mindsets and lose self-regulatory resources that are needed to maintain cognitive focus, complete complex tasks, and make decisions (Mullis and Hatfield 2018). This leads us to hypothesize that when auditors have conducted tasks using automation before conducting a subsequent task, this causes them to exercise less professional skepticism in that task. In other words, I predict that the professional skepticism reduction from a task relying on automation spills over to subsequent tasks that are not conducted by automated tools and techniques.

HYPOTHESIS 3: Auditors exhibit less professional skepticism in a subsequent unrelated task when they relied on automated tools and techniques in a previous task.

4.3 Method

4.3.1. Participants

119 professional auditors were recruited during sessions of a part-time professional accounting education program at a large public university in Western Europe.[55,56] Auditors were provided with a web-based experiment that was developed using Qualtrics software. Auditors were informed that the experiment would take approximately between 30 and 45 minutes. Most auditors were male (n = 79, 66.39 percent), had an average work experience of 1.80 years (st. dev. = 0.72 years), and were on average 24.84 years old (st. dev. = 1.84 years). The sample consists of 102 staff auditors, eleven senior staff auditors, and six auditors that classify themselves as 'Intern/Trainee.'

4.3.2. Experimental Case and Procedures

I presented auditors with a scenario in which they assume the role of an auditor at a year-end audit of a client operating in the agriculture industry. Specifically, I told auditors that they were responsible for auditing the inventory audit procedures and the client's step-one analysis of a goodwill impairment test.[57] These inventory audit procedures consist of the counting procedures of the client firm's livestock to provide assurance over the existence (i.e., all inventory exists and is real) and completeness (i.e., all inventory owned is reported) of the inventory.[58] The scenario adopts a four-step process as put forward by Christ *et al.* (2021). That is, the client conducts physical counts of the inventory, while the auditor has observed these physical counts. As the livestock is nonstationary, large, and dispersed across wide areas, the inventory counting is a nontrivial and challenging task. As in Christ *et al.* (2021), the audit team captures images by flying drones over the agricultural assets (PwC 2016) and processes the images to ensure only relevant

55 More specifically, I recruited participants during lectures of the Post-Master Accountancy program. A Post-Master Accountancy program is a program that auditors follow part-time (usually on Fridays) to obtain a public accounting license equivalent to CPA.

56 The Institutional Review Board (IRB) at the author's institution approved the experimental study in this paper.

57 PwC (2016) estimates that companies spent $127.3 billion on inventory management in 2015.

58 Abdolmohammadi (1999) documents that auditors rate substantive audit procedures related to the inventory counting procedures as relatively structured tasks.

assets are captured. Next, in Christ *et al.* (2021), they apply automated tools and techniques to count the livestock using the *Countthings algorithm*.[59] Auditors in the *Automation* conditions are informed that the livestock is counted by the algorithm. In the *Human* conditions, an audit team member counts the livestock (which will be discussed in more detail in Section 4.3.3.). Finally, the auditors were tasked to review each image after the source (either *Automation* or *Human*) had reported the initial count.

Auditors were tasked to conduct the final step in this four-step process. That is, they were presented the count by the preparer, and had to manually identify whether assets had been missed or items had been incorrectly included. To do this, they would have to perform recounts. Auditors received four aerial photos to review. Auditors were informed that the inventory of the livestock is material to the financial statements, both quantitatively and qualitatively due to the moderate likelihood of management fraud in inventories. As they were also informed that misstatements are likely systematically biased into one direction, it was important that *any* deviation from client's reported numbers was detected and discussed with the audit team. Next, they received background information about the client and the audit procedures. Directly after receiving the background information, auditors were subject to the counterarguing mindset manipulation (discussed in Section 4.3.3.). After being subject to the counterarguing mindset manipulation, auditors were provided an example of an inventory count and were subject to the source manipulation (also discussed in Section 4.3.3.). Next, auditors continued to the main task.

In the main task, auditors had to review the inventory counting procedures that were already prepared by either automated tools and techniques or by an audit team member, depending on the condition they were in. Specifically, they had to review four photos of livestock that was captured by a drone (see also Appendix A). In each of the photographs, auditors were provided with an initial number and had to verify whether this was correct (*yes*/*no*). Only if auditors selected

[59] For a demonstration of the *Countthings* algorithm, see https://countthings.com/ (last accessed on April 19, 2023).

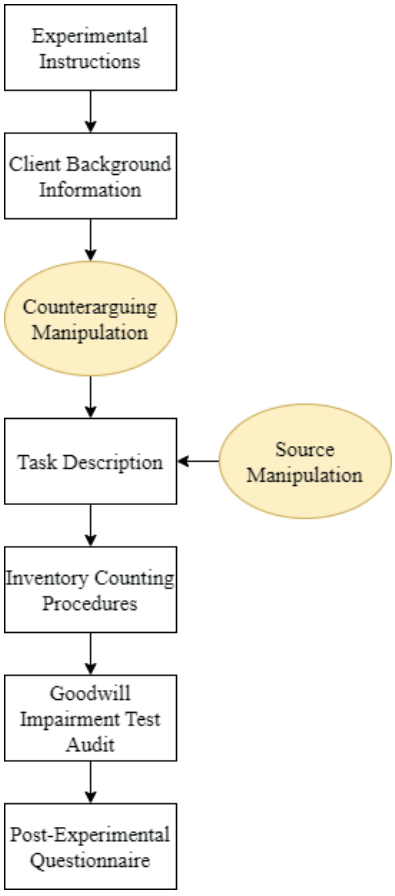
"*no*", they were asked what the correct number should be. Whereas in the first three photos the correct number was provided by the workpaper preparer (*Automation* or *Human*), there were six seeded errors in the fourth photograph. The review of the inventory counting procedures can be characterized as a relatively structured task (Abdolmohammadi 1999). I use a structured task for two reasons. First, Abdolmohammadi (1999) shows that most substantive audit tasks are structured (i.e., 67% structured, 32% semi-structured, and 1% unstructured). Second, Zhang *et al.* (2022) argue that structured tasks are potentially automated, while automating unstructured tasks is less likely. Hence, when auditors use automation, this is more likely to occur in a structured task.

After reviewing the inventory audit procedures, auditors were tasked to audit the client's step-one analysis of a goodwill impairment case, which was adapted from Kadous and Zhou (2019).[60] I use the goodwill impairment case to measure a potential spillover effect (i.e., Hypothesis 3). In the case, the client uses a discounted cash flow (DCF) model to estimate the fair value of a business unit. Auditors' task was to evaluate the projections for future revenues and form a preliminary conclusion about the reasonableness of the fair value of goodwill (Kadous and Zhou 2019). Auditors were informed that the firm's internal valuation specialist had already determined that the DCF model was appropriate from the client and the team had tested the mathematical accuracy of the model and found no exceptions. The only parts that the audit team still needed to evaluate were the five-year projections of revenues and the discount rate used in the DCF model. Auditors were tasked with evaluating the revenue projections, whereas an internal specialist would audit the discount rate. In the case, there were five seeded issues indicating that the revenue projections may have been too rosy and fair value is overstated, and some of these issues were in the discount rate section. Even though auditors were not explicitly asked to audit the discount rate assumption, auditing standards require them to obtain an understanding of it (Kadous and Zhou

[60] Out of the four important assumptions that underlie the client's discounted cash flow model in Kadous and Zhou (2019), I use only two: the projections for future revenue and the estimated discount rate. This was to shorten the case to provide auditors with enough time to finish the experiment.

2019).[61] There were both surface- and deep-level cues, depending on the amount of cognitive processing needed to find the issues. At the end of the case, auditors were asked to judge the reasonableness of the case, state what (skeptical) action they would take following the case, and identify the reasons for doing so, or the additional evidence they wanted to request from the client.

FIGURE 7: **Instrument Flow**



Notes: Figure 6 presents the instrument flow. The experimental case and procedures are described in Section 4.3.2. The *Counterarguing Manipulation* and *Source Manipulation* are described in Section 4.3.3. The manipulations are shown in Table 15.

[61] Kadous and Zhou (2019) report that auditing standards AU sec. 336 *Using the Work of a Specialist* and International Standards on Auditing (ISA) 620, *Using the Work of an Auditor's Expert*, among others require auditors to obtain an understanding of the methods and assumptions used by the specialist.

After the tasks, auditors were provided a post-experimental questionnaire, in which they were asked about the process, personality, and demographics. The process variables include manipulation checks, attention checks, and questions about how auditors felt during the experiment. The other variables include questions about feelings about the auditing profession and the Hurtt professional skepticism scale (Hurtt 2010). Demographic variables include age, gender, work experience, position in the firm, and certifications. Figure 7 shows the instrument flow.

4.3.3. Independent Variables

I conduct an experiment with a 2×2 between-subjects design. I manipulate whether the preparer of the working paper (i.e., the source) is either a human colleague (*Human*) or the working paper is prepared by automated tools and techniques (*Automation*) using a vignette description.[62,63] Using a vignette description is in line with most of the studies manipulating automation vis-à-vis human (e.g., Dzindolet *et al.* 2002, 2003, Dietvorst *et al.* 2015, 2018, Castelo, Bos, and Lehmann 2019, Logg *et al.* 2019, Commerford *et al.* 2022). Specifically, both *Human* and *Automation* are described in identical terms, except for them being named as *the audit team member* and *the counting algorithm*. Panel A of Table 15 provides an overview of the source manipulations.

TABLE 15
Manipulations
(Differences between treatments in italics)

Panel A: Source Manipulation

Automation	**Human**
The inventory on the photos was counted by *your firm's proprietary counting software*.	The inventory on the photos was counted by *an audit team member*.
The counting algorithm is based on the Countthings (machine-learning based) algorithm, and applies firm-approved methodologies to conduct the inventory count.	*The audit team member* applies firm-approved methodologies to conduct the inventory count.
the counting algorithm [used throughout]	*the audit team member* [used throughout]

[62] An important design choice is that I compare the initial count conducted by automation with an initial count conducted by a human colleague instead of one's own initial count. In this case, I address the concern that individuals underweight others' advice due to egocentrism, a robust result from utilization of human advice (Yaniv and Kleinberger 2000). My results in Hypothesis 1 are thus unable to speak to comparisons between an auditor's choice to conduct a task by oneself or by automation (see also Section 4.2.3.).

[63] Although I do not specify the rank of the audit team member in the experimental case, Abdolmohammadi (1999) reports that most substantive procedures related to inventory counts are conducted from the staff level on.

Panel B: Mindset Manipulation

Mindset Present	**Mindset Absent**
Before you continue the audit engagement, you are asked to write some *arguments about one of the propositions, testing your ability to articulate arguments.*	Before you continue the audit engagement, you are asked to write some *facts about one of the topics, testing your general knowledge.*
Topic 1: *For a business, it is acceptable to do anything to make a profit.*	Topic 1: *The pyramids of Egypt.*
Topic 2: *Higher education should not be available to all, but only to a small minority of selected students.*	Topic 2: *The solar system.*
Topic 3: *Human activity has no major impact on the environment.*	Topic 3: *The First World War.*
Think about one of the above *propositions that you have the strongest feeling about.* Write a short essay *indicating why you agree or disagree with it.* You have three to four minutes to mention *a couple of arguments.*	Think about one of the above *topics that you know most about.* Write a short essay *about this topic.* You have three to four minutes to mention *a couple of facts.*

The second manipulation varies whether auditors are prompted with a counterarguing mindset intervention (i.e., the generation of arguments against the validity of information's implications) or are not prompted with a mindset intervention as control group (*Mindset Present* and *Mindset Absent* conditions, respectively). I operationalize the mindset intervention by asking auditors to list their thoughts about propositions that they are likely to disagree with, thereby triggering a counterarguing mindset (e.g., Xu and Wyer 2012). In the counterarguing mindset, the propositions were worded in such a way that led auditors to disagree with them (e.g., "Human activity has no major impact on the environment"). Although I expect auditors in both conditions to have similar thoughts about these propositions due to randomization, the thoughts trigger a counterarguing mindset in the *Mindset Present* conditions, because auditors are prompted with these thoughts. As a result, they are likely to induce a counterarguing mindset. In the *Mindset Absent* conditions, auditors are tasked to write their thoughts about arguably neutral things: the pyramids of Egypt, the solar system, and the First World War. Panel B of Table 15 provides an overview of the mindset manipulations.

4.3.4. Dependent Variables

In the main task (i.e., the audit of the inventory counting procedures), I use three dependent variables to proxy for professional skepticism: *Time Spent*, *Agree with Preparer*, and *Seeded Errors Identified*. In the spillover task (i.e., the audit of a client's step-one analysis of a goodwill impairment test), I use five dependent variables to proxy for professional skepticism: *Reasonableness*, *Surface Issues*, *Deep Issues*, *Total Issues*, and *Contact Directly*. These variables are described below.

I start by outlining the dependent variables for the inventory counting procedures. The first dependent variable used is *Time Spent*; the amount of time spent on reviewing the four inventory counting tasks, measured in seconds. Given that the audit of the inventories consists of recounts, the time spent on a task is arguably a valid proxy for how much effort auditors apply (i.e., more extensive recounting takes more time). If auditors are less skeptical, they are more likely to choose a less effortful strategy and spend less time (Nolder and Kadous 2018). Second, I use *Agree with Preparer*, an indicator variable equal to "1" if an auditor judged the initial count by the workpaper preparer to be correct for a given photograph, and equal to "0" if not. Third, I use *Seeded Errors Identified*, defined as the number of seeded errors identified by auditors in the inventory counting procedures. Given that there are six seeded errors in the fourth (and none in the other photographs), the variable is bounded by zero (lower-bound) and six (upper-bound). The number of seeded errors identified is also a proxy for professional skepticism (Nolder and Kadous 2018).

Next, I outline the dependent variables for the audit of the client's step-one analysis of the goodwill impairment test. I base these dependent variables on Kadous and Zhou (2019). First, *Reasonableness* is defined as auditors' assessment of the overall reasonableness of the fair value, measured on an 11-point Likert scale, ranging from 0 ("not at all likely to be reasonable") to 10 ("extremely likely to be reasonable"). Second, *Surface Issues* are the issues in the goodwill impairment case that require relatively little cognitive processing (two in total). Third, *Deep Issues* are the issues that require relatively a lot of cognitive processing (three in total). Both *Surface Issues* and *Deep Issues*

were coded by two independent raters.[64] Fourth, *Total Issues* is the sum of *Surface Issues* and *Deep Issues*. Fifth, *Contact Directly* is an indicator variable that equals "1" when auditors decide to call their manager immediately regarding issues that may indicate the fair value is not reasonable, and equals "0" otherwise (Kadous and Zhou 2019). The strong reliance on management's process, failure to gather sufficient evidence, and failure to identify seeded issues are typically seen as resulting from a lack of professional skepticism (PCAOB 2011, Hurtt *et al.* 2013, Griffith *et al.* 2015).

4.4. Results

4.4.1. Manipulation Checks

4.4.1.1. Source Manipulation

In the post-experimental questionnaire, auditors were asked to evaluate several statements. First, auditors were asked to evaluate who or what conducted the initial count.[65] In the *Human* conditions, auditors were significantly more likely to indicate that the initial count was conducted by a colleague than in the *Automation* conditions ($z = 6.66, p < 0.01$, two-tailed). Similarly, in the *Automation* conditions, auditors were significantly more likely to indicate that the initial count was conducted by an algorithm than in the *Human* conditions ($z = 6.74, p < 0.01$, two-tailed). In addition to directly asking auditors who or what conducted the initial count, auditors were also asked to evaluate the statements about their perceptions during the counting task.[66] Auditors in the *Human* conditions agreed significantly more to the statement about the initial count being conducted by an algorithm than auditors in the *Automation* conditions ($t = 8.51, p < 0.01$, two-tailed). Also, auditors in the *Automation* conditions agreed significantly more to the statement about

[64] Two doctoral students coded the number of issues identified by the auditors. Both were blind to experimental conditions. Cohen's Kappa was 0.85 (0.89) for *Surface Issues* (*Deep Issues*), indicating good interrater agreement.

[65] Specifically, auditors were asked to evaluate the following statement: "[w]ho or what conducted the initial count of the livestock?", where the options were **(i)** "a colleague", **(ii)** "the Countthings algorithm", **(iii)** "both a colleague and the Countthings algorithm", **(iv)** "neither a colleague nor the Countthings algorithm, and **(v)** "I don't know."

[66] Specifically, auditors were asked to evaluate the following statements: "While working on the inventory counting task, I thought about the initial count being conducted by a person" and "While working on the inventory counting task, I thought about the initial count being conducted by an algorithm." They evaluated these statements on a seven-point Likert scale ranging from *strongly disagree* to *strongly agree*.

the initial count being conducted by a person (t = -9.10, p < 0.01, two-tailed). Overall, the results of this manipulation check indicate that the source manipulation was successful.

4.4.1.2. Mindset Manipulation Validation

I elicited auditors' attitude toward each of the three propositions used in the counterarguing mindset conditions in the post-experimental questionnaire. These were coded as agreement or disagreement.[67] 88 out of 119 auditors (73.95 percent) disagree with each of the three propositions, potentially generating arguments against the validity of the propositions.[68] Only one participant (0.84 percent) agreed with each of the three propositions. On average, auditors disagreed with the propositions that were prompted in the counterarguing mindset condition (M = 1.93 on a seven-point Likert scale ranging from "1 – Strongly Disagree" to "7 – Strongly Agree"). The mean evaluation was significantly lower than the midpoint of the scale (p < 0.01, two-tailed, for each proposition). Overall, the results of this validation indicate that auditors indeed tend to disagree with the propositions that were prompted in the counterarguing mindset conditions, allowing them to generate arguments against their validity and thus activating a counterarguing mindset.

4.4.2. Tests of Hypotheses

4.4.2.1. Does Automation Usage Reduce Auditors' Professional Skepticism?

The first hypothesis examines whether auditors exhibit less professional skepticism when they rely on work conducted by automated tools and techniques compared to work conducted by another auditor. To test this, I compare the amount of time spent of tasks, the propensity to agree with the workpaper preparer, and the number of seeded errors identified in the *Mindset Absent* conditions, where no counterarguing mindset is prompted (i.e., a simple effect). First, I analyze the

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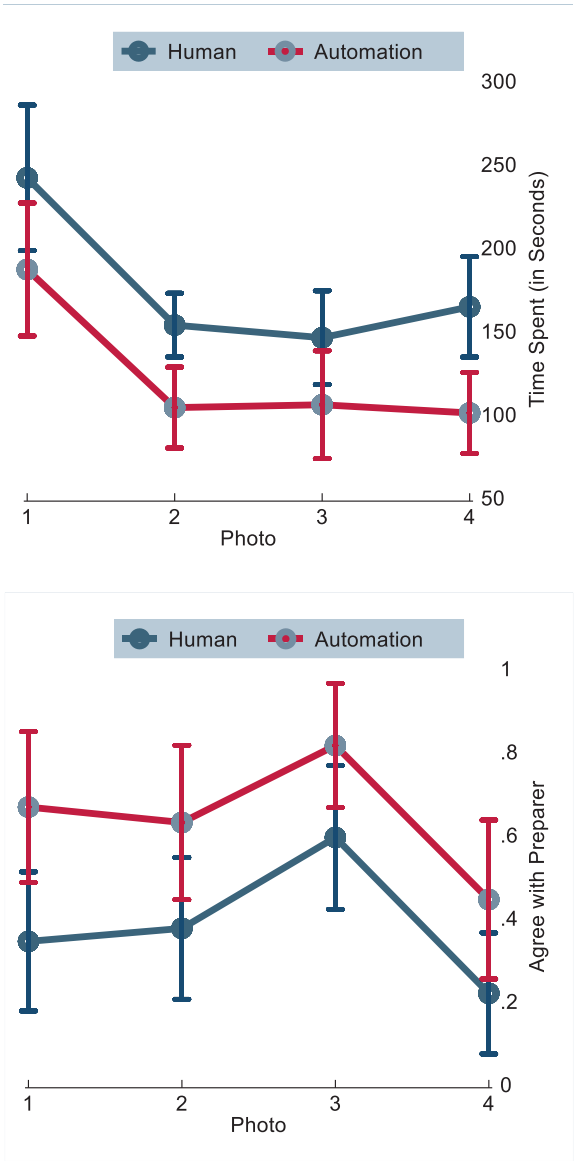
67 Auditors were asked to evaluate the extent to which they agreed or disagreed with the following statements on a seven-point Likert scale ranging from *strongly disagree* to *strongly agree*: **(i)** "For a business, it is acceptable to do anything to make a profit", **(ii)** "Higher education should not be available to all, but only to a small minority of selected students", and **(iii)** "Human activity has no major impact on the environment."

68 This number is similar to the counterarguing mindset manipulation in Wyer and Xu (2012), where 76 percent of auditors disagreed with each of three statements.

amount of time auditors spent on reviewing the tasks. Figure 7 (top figure) shows the amount of time spent by auditors on each photograph.

Figure 7: Simple Effect of Automation on Professional Skepticism in *Mindset Absent* Conditions



Notes: Figure 7 displays *Time Spent* (top figure) and *Agree with Preparer* (bottom figure) for both the *Human* and *Automation* conditions nested within the *Mindset Absent* conditions (i.e., the simple effect of *Automation* in the *Mindset Absent* conditions).

Table 16 reports the time spent by condition. Results show that auditors in the Automation/Mindset Absent condition spent significantly less time reviewing the initial count ($M = 497.46$ seconds) than auditors in the Human/Mindset Absent condition ($M = 705.72$ seconds), and this difference is statistically significant at the one-percent level ($t = 3.46, p < 0.01$, two-tailed). In untabulated t-tests, I find that for every individual photo the difference is statistically significant at the five percent level, two-tailed.

Table 16
Time Spent by Condition

Panel A: Descriptive Statistics: Mean (Standard Deviation) [N]

	Mindset Intervention		Collapsed across Mindset
	Absent	**Present**	
Human	705.72	514.21	618.08
	(226.16)	(266.82)	(261.75)
	[32]	[27]	[59]
Automation	497.46	602.73	555.36
	(235.63)	(257.95)	(251.68)
	[27]	[33]	[60]
Collapsed across Source	610.42	562.89	586.46
	(251.35)	(263.50)	(257.56)
	[59]	[60]	[119]

Panel B: Planned Simple Effects

Simple Effect	**t**	**Two-Sided p-value**
Effect of Automation on Time Spent in the Mindset Absent Conditions	3.46	**< 0.01**
Effect of Automation on Time Spent in the Mindset Present Conditions	-1.30	0.20

Panel C: Analysis of Variance (ANOVA)

Source	**MS**	**F**	**Two-Sided p-value**
Automation	105724.49	1.73	0.19
Counterarguing	54851.10	0.90	0.35
Automation × Counterarguing	649391.71	10.65	**< 0.01**
Residual	60951.18		

Notes: Table 16 reports descriptive statistics and hypotheses tests for *Time Spent*. Panel A provides the descriptive statistics by condition. Panel B reports the planned simple effects of automation depending on the *Counterarguing* conditions. Panel C reports an analysis of variance (ANOVA). See Appendix B for variable definitions.

Next, I analyze auditors' propensity to agree with the workpaper preparer. That is, after each of the four photos, auditors had to indicate whether they judged the initial count by the *Human/Automation* to be correct. Here, I again analyze a simple effect and compare differences in judgments that result from the source manipulation (*Automation* vs. *Human*), while only examining auditors in the conditions where a mindset intervention was absent. Figure 7 (bottom figure) provides graphical evidence that auditors in the *Automation* conditions are more likely to agree with the workpaper preparer, even in cases when the workpaper preparer is wrong. Despite having seen the same photos and the same counts, auditors in the *Automation/Mindset Absent* report that significantly more counts are correct than auditors in the *Human/Mindset Absent* ($t =$ -3.26, $p <$ 0.01, two-tailed).[69] This suggests that auditors' automation usage reduces professional skepticism when a counterarguing mindset intervention is absent. That is, when using automation auditors are significantly more likely to judge it to be correct. This suggests that auditors' automation usage can indeed result in professional skepticism reductions, which is in line with Hypothesis 1.

Next, I examine whether auditors failed to find seeded errors. In the experimental case there were four photos where auditors had to review the inventory counting procedures. Whereas the number reported by the initial counter was correct in the first three photos, there were errors seeded in the fourth photo. Specifically, six false positives were seeded into the case. The correct count was 131 and the initial counter reported 137 (see Appendix A). First, I find that in the *Automation/Mindset Absent* condition 12 out of 27 auditors (44.4 percent) incorrectly judge the initial count to be correct, whereas in the *Human/Mindset Absent* condition only 7 out of 32 auditors (21.9 percent) incorrectly judge the initial count to be correct. The difference in proportion between conditions is in line with Hypothesis 1 ($t =$ -1.87, $p =$ 0.066, two-tailed). If auditors indicated that the number of the initial counter was incorrect, they were asked to provide their

[69] When a separate *t*-test is conducted for each photo, I find that our inferences remain the same. That is, for photo 1 ($t =$ -2.56, $p =$ 0.012, two-tailed), photo 2 ($t =$ -1.98, $p =$ 0.052, two-tailed), photo 3 ($t =$ -1.86, $p =$ 0.068, two-tailed), and photo 4 ($t = -1.87$, $p =$ 0.066, two-tailed) a higher proportion of auditors in the *Automation/Mindset Absent* condition report that the initial count is correct than in the *Human/Control* condition.

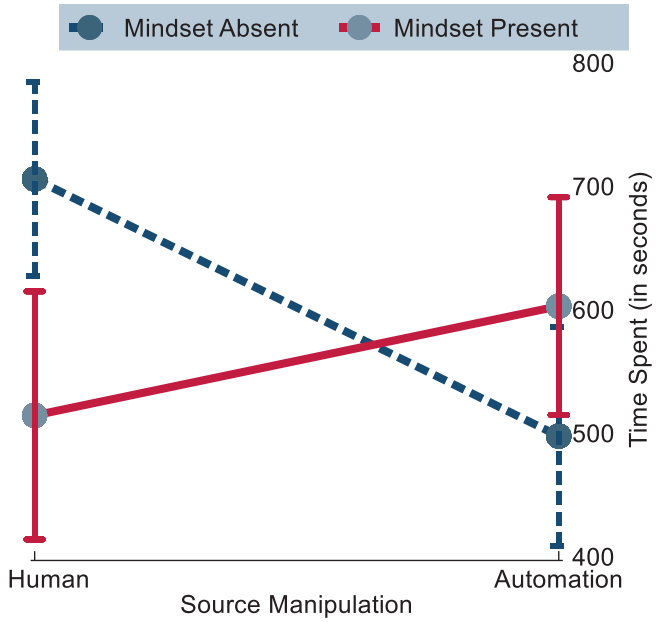
own count. Based on their own count, I examine how many seeded errors auditors identify. I find that absent any mindset intervention, auditors in the *Automation* condition identify less seeded errors than those in the *Human* condition (1.59 vs. 2.75 out of 6, $t = 1.91$, $p = 0.061$, two-tailed).

Collectively, these results demonstrate that when auditors rely on work conducted by automated tools and techniques, they will be less professionally skeptical, as indicated by lower time spent (*Time Spent*), a higher likelihood to (incorrectly) judge a task to be correct (*Agree with Preparer*), and a lower number of seeded errors to be identified (*Seeded Errors Identified*). This is consistent with my predictions.

4.4.2.2. Does a Counterarguing Mindset Help to Alleviate the Professional Skepticism Reductions?

The second hypothesis predicts that the negative effect of automated tools and techniques usage on professional skepticism is weakened when auditors are prompted with a counterarguing mindset. First, I examine how automation usage (*Automation*) and a counterarguing mindset intervention (*Counterarguing*) affect auditors time spent on reviewing the inventory counting tasks (*Time Spent*). Figure 8 graphically demonstrates the observed interaction plot for auditors' time spent reviewing the inventory counting procedures. A visual inspection reveals that the negative effect of automation is visible in the *Mindset Absent* conditions, but not in the *Mindset Present* conditions. In fact, the effect in the *Mindset Present* conditions is slightly positive. I also provide formal tests of significance. Panel C of reports an ANOVA model. I find the difference in slopes is significant at the one percent level ($p < 0.01$, two-tailed). Together with the visual fit, this indicates that the slope of the effect of *Automation* on *Time Spent* is significantly less negative in the *Mindset Present* conditions than in the *Mindset Absent* conditions, implying that a counterarguing mindset alleviates the negative effect of automation on professional skepticism. The two main effects of *Automation* and *Counterarguing* are insignificant ($p > 0.10$, two-tailed).

Figure 8: Observed Interaction Plot for Auditors' Time Spent Reviewing Counting Procedures

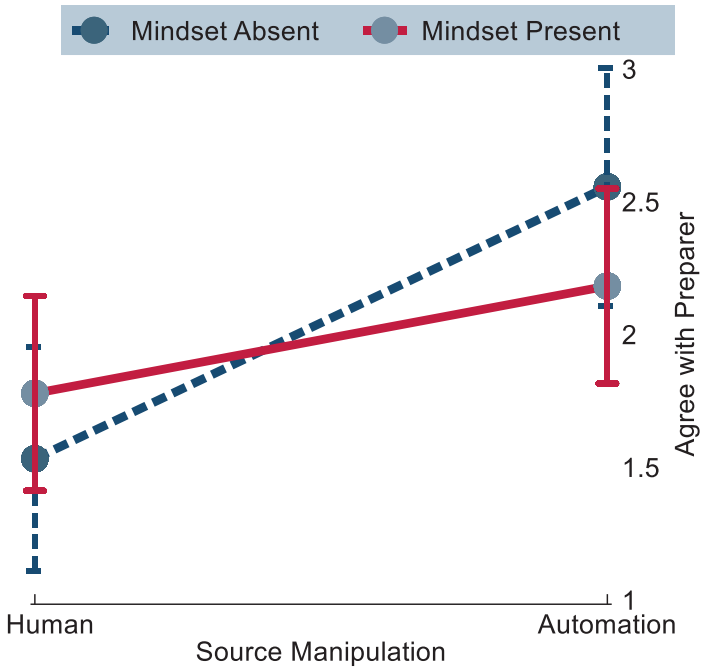


Notes: Figure 8 shows the interaction plot of the *Source* and *Mindset* manipulations. The dependent variable is *Time Spent*, the time that auditors spent on reviewing the inventory counts, measured in seconds. The blue dashed (darker dots) line indicates the *Mindset Absent* conditions (i.e., those that were not prompted with a counterarguing mindset). The red (lighter dots) line indicates *Mindset Present* conditions (i.e., those that were prompted with a counterarguing mindset). 95 percent confidence intervals are provided. Robust standard errors are used. See Appendix B for variable definitions.

Second, I examine the effects of *Automation* and *Counterarguing* on the number of tasks that auditors judge to be correctly prepared by the workpaper preparer (*Agree with Preparer*). Figure 9 graphically depicts the observed interaction plot for *Agree with Preparer*. The visual fit shows that auditors are more likely to agree with the workpaper preparer when the workpaper is prepared by automation than by a human colleague, suggesting that they are less skeptical. Also, the increase from *Human* to *Automation* is greater in the *Mindset Absent* conditions than in the *Mindset Present* conditions. This suggests, at least visually, that a counterarguing mindset alleviates the effects of *Automation* on professional skepticism. I also conduct formal tests of significance in Panel C of Table 17. The interaction effect is marginally significant based on a one-tailed test in line with my prediction ($p = 0.07$, one-tailed; $p = 0.14$, two-tailed). Next to that, I find a main effect for

Automation on *Agree with Preparer* ($p < 0.01$, two-tailed), while finding no significant main effect for *Counterarguing* ($p > 0.10$, two-tailed).

Figure 9: Observed Interaction Plot for Agree with Preparer



Notes: Figure 9 shows the interaction plot of the *Source* and *Mindset* manipulations. The dependent variable is *Agree with Preparer*, an indicator variable equal to "1" if auditors judged the initial count by the workpaper preparer to be correct, and equal to "0" if not. The blue dashed (darker dots) line indicates the *Mindset Absent* conditions (i.e., those that were not prompted with a counterarguing mindset). The red (lighter dots) line indicates *Mindset Present* conditions (i.e., those that were prompted with a counterarguing mindset). 95 percent confidence intervals are provided. Robust standard errors are used. See Appendix B for variable definitions.

Table 17
Agree with Preparer by Condition

Panel A: Descriptive Statistics: Mean (Standard Deviation) [N]

	Mindset Intervention		Collapsed across Mindset
	Absent	**Present**	
Human	1.53	1.78	1.64
	(1.22)	(0.97)	(1.11)
	[32]	[27]	[59]
Automation	2.56	2.18	2.35
	(1.19)	(1.07)	(1.13)
	[27]	[33]	[60]
Collapsed across Source	2.00	2.00	2.00
	(1.30)	(1.04)	(1.17)
	[59]	[60]	[119]

Panel B: Planned Simple Effects

Simple Effect	**t**	**Two-Sided p-value**
Effect of Automation on Agree with Preparer in the Mindset Absent Conditions	-3.29	**< 0.01**
Effect of Automation on Agree with Preparer in the Mindset Present Conditions	-1.51	0.14

Panel C: Analysis of Variance (ANOVA)

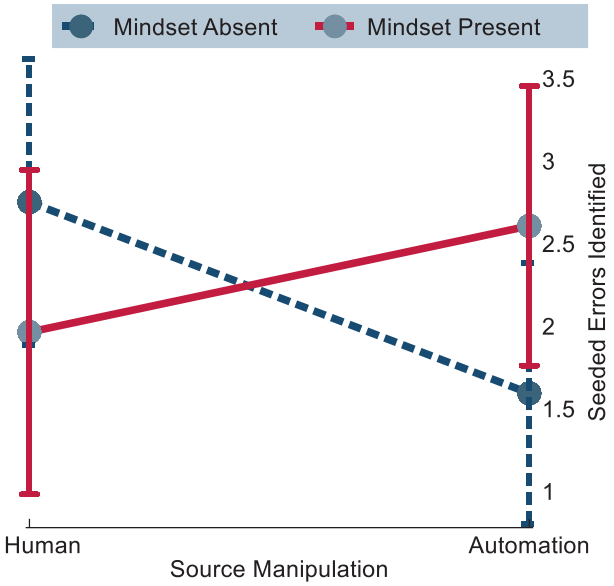
Source	**MS**	**F**	**Two-Sided p-value**
Automation	15.04	12.00	< 0.01
Counterarguing	0.12	0.90	0.76
Automation × Counterarguing	2.84	10.65	**0.14**
Residual	1.25		

Notes: Table 17 reports descriptive statistics and hypotheses tests for *Agree with Preparer*. Panel A provides the descriptive statistics by condition. Panel B reports the planned simple effects of automation depending on the *Counterarguing* conditions. Panel C reports an analysis of variance (ANOVA). See Appendix B for variable definitions.

Third, I also test the effects of *Automation* and *Counterarguing* on the number of seeded errors identified (*Seeded Errors Identified*). Figure 10 shows the observed interaction plot for *Seeded Errors Identified*. The interaction plot shows a disordinal interaction, where the slope of the effect of

Automation on *Seeded Errors Identified* is positive (negative) when a counterarguing mindset is present (absent). Table 18 reports formal tests of significance. I find that the interaction effect is statistically significant at the five percent level ($p = 0.05$, two-tailed), which is in line with earlier findings and Hypothesis 2. None of the main effects is significant ($p > 0.10$, two-tailed).

Figure 10: Observed Interaction Plot for Seeded Errors Identified



Notes: Figure 10 shows the interaction plot of the *Source* and *Mindset* manipulations. The dependent variable is *Seeded Errors Identified*, the number of seeded errors identified by auditors in the inventory counting procedures. Bounded by zero (lower-bound) and six (upper-bound). The blue dashed (darker dots) line indicates the *Mindset Absent* conditions (i.e., those that were not prompted with a counterarguing mindset). The red (lighter dots) line indicates *Mindset Present* conditions (i.e., those that were prompted with a counterarguing mindset). 95 percent confidence intervals are provided. Robust standard errors are used. See Appendix B for variable definitions.

Collectively, the results suggest that the negative effect of automated tools and techniques usage on professional skepticism is weakened when auditors are prompted with a counterarguing mindset. This is in line with my prediction and indicates that a counterarguing mindset could be a helpful tool for audit firms to use when auditors work with automation. However, audit firms need to be careful if the automation is (nearly) perfect as a counterarguing mindset condition may result in inefficiencies.

Table 18
Seeded Errors Identified by Condition

Panel A: Descriptive Statistics: Mean (Standard Deviation) [N]

	Mindset Intervention		Collapsed across Mindset
	Absent	**Present**	
Human	2.75	1.96	2.39
	(2.49)	(2.61)	(2.55)
	[32]	[27]	[50]
Automation	1.59	2.61	2.15
	(2.10)	(2.47)	(2.35)
	[27]	[33]	[60]
Collapsed across Source	2.22	2.32	2.27
	(2.37)	(2.53)	(2.44)
	[59]	[60]	[119]

Panel B: Planned Simple Effects

Simple Effect	**t**	**Two-Sided p-value**
Effect of Automation on Time Spent in the Mindset Absent Conditions	1.91	**0.06**
Effect of Automation on Time Spent in the Mindset Present Conditions	-0.98	0.33

Panel C: Analysis of Variance (ANOVA)

Source	**MS**	**F**	**Two-Sided p-value**
Automation	1.95	0.33	0.57
Counterarguing	0.38	0.06	0.80
Automation × Counterarguing	23.90	4.05	**0.05**
Residual	5.91		

Notes*:* Table 18 reports descriptive statistics and hypotheses tests for *Seeded Errors Identified*. Panel A provides the descriptive statistics by condition. Panel B reports the planned simple effects of automation depending on the *Counterarguing* conditions. Panel C reports an analysis of variance (ANOVA). See Appendix B for variable definitions.

Next to that, the results also indicate that audit firms need to be careful. That is, an unexpected finding is that *Counterarguing* may also reduce *Time Spent* when the workpaper is prepared by a human colleague.[70] One potential explanation for this unexpected finding may be

[70] Tests of simple effects of *Counterarguing* on the three dependent variables in the *Human* conditions show a significant effect when *Time Spent* is the dependent variable ($p < 0.01$, two-tailed), while showing an insignificant effect when *Agree with Preparer* and *Seeded Errors Identified* are the dependent variable ($p > 0.10$, two-tailed).

based on social projection theory, which implies that auditors that are prompted with a counterarguing mindset may perceive other humans to have a counterarguing mindset as well and are therefore less skeptical in reviewing the work of other humans, this is less likely to play a role for automation as counterarguing may be perceived as something humans do but automation does not.[71] Furthermore, it might be the case that participants in the control group are primed by facts, whereas participants in the counterarguing mindset condition have to generate arguments. As automated tools and techniques (humans) are perceived to be good at facts (arguments), but less so in arguments (facts), this may be a potential driver for this finding.

4.4.2.3. Do Professional Skepticism Reductions Caused by Automation Spill Over to Subsequent Audit Tasks?

The third hypothesis predicts that auditors exhibit less professional skepticism in a subsequent task when they relied on automated tools and techniques in a previous task. I test this using the five dependent variables elicited from the goodwill impairment case that followed the inventory counting task: *Reasonableness*, *Surface Issues*, *Deep Issues*, *Total Issues*, and *Contact Directly* (see Appendix B for variable definitions). Panel A of Table 19 reports the descriptive statistics of these variables. The mean of the variables is similar to mean of those variables in Kadous and Zhou (2019). I start by investigating whether *Automation* affects the dependent variables in the *Mindset Absent* conditions. For all five dependent variables, I do not find a significant effect ($p > 0.10$, two-tailed).[72] In Panel B of Table 19, I use a negative binomial regression model to test Hypothesis 3, given the nature of the dependent variables (Kadous and Zhou 2019). In the spillover case, I do not find evidence for statistically significant main effects, nor for a significant interaction effect. The only exception is the positive coefficient of a main effect *Counterarguing* on *Reasonableness* ($p =$

[71] This is consistent with social projection theory (Robbins and Krueger 2005).

[72] A potential concern may be that participants in the automation condition spent less time in the inventory counting task and have more cognitive resources available, thereby presenting a potential countervailing effect. In untabulated analyses, I do not find that any of the dependent variables in the spillover task is significantly correlated with the total time spent counting during the inventory counting task ($p > 0.10$, two-tailed).

0.02, two-tailed). Hence, overall I do not find evidence that professional skepticism reductions caused by automation usage in a first task spill over to a second task.

Table 19
Test of Spillover Effect (H3)

Panel A: Descriptive Statistics: Mean (standard deviation)

Condition	*n*	Reason-ableness	Surface issues	Deep issues	Total issues	Contact directly
Human/Absent	32	5.28	0.20	0.48	0.69	0.44
		(1.40)	(0.54)	(0.64)	(0.85)	(0.50)
Human/Present	27	6.07	0.43	0.37	0.80	0.52
		(1.30)	(0.58)	(0.58)	(0.86)	(0.51)
Automation/Absent	27	5.33	0.28	0.57	0.85	0.44
		(1.49)	(0.45)	(0.78)	(0.73)	(0.51)
Automation/Present	33	5.33	0.56	0.42	0.98	0.52
		(1.53)	(0.70)	(0.60)	(1.03)	(0.51)

Panel B: Negative binomial regression model: Z (robust standard errors)

Variable	Reason-ableness	Surface issues	Deep issues	Total issues	Contact directly
Automation	0.01	0.31	0.17	0.21	0.02
	(0.07)	(0.55)	(0.35)	(0.27)	(0.30)
Counterarguing	0.14**	0.74	-0.27	0.15	0.17
	(0.06)	(0.53)	(0.38)	(0.30)	(0.27)
Automation * Counterarguing	-0.14	-0.04	-0.03	0.00	-0.02
	(0.10)	(0.65)	(0.52)	(0.38)	(0.39)
N	119	119	119	119	119

Notes*:* Table 19 reports descriptive statistics and hypotheses tests for the spillover effect (H3). Panel A provides the descriptive statistics by condition. Panel B reports a negative binomial regression model. Robust standard errors are used. * $p \leq 0.10$, ** $p \leq 0.05$, and *** $p \leq 0.01$, all p-values are two-tailed.

4.4.3. Supplemental Analyses

In this section, I perform supplemental analyses to provide further process evidence about the role of attention and the role of effortful analysis in explaining the findings. The literature on automation bias identifies reductions in attention and effortful processing following automation usage as drivers of the automation bias.

4.4.3.1. Process Evidence: Attention During Inventory Counting Procedures

The cognitive processes underlying the automation bias involve reductions in vigilance and attention spent to the task. I investigate whether auditors' attention during the review of the inventory counting procedures differs between conditions. During the inventory counting

procedures, auditors had to review four photos. Whereas three of the four photos included cattle, the other photo they had to count included sheep. To test the attention spent by auditors, I asked auditors in the post-experimental questionnaire to recall what other animals than cattle were shown in the photos.[73] 93 out of 119 auditors were able to correctly recall that the other animals in the inventory counting procedures were sheep. First, not surprisingly, I find that auditors that were able to correctly recall the animals spent significantly more time on the inventory counting task than auditors that did not recall the animals (t = -2.43, p = 0.02, two-tailed). Second, I find a marginally significant interaction effect of *Automation* and *Counterarguing* on a dummy variable that captures whether auditors were able to correctly recall the animals (F = 3.54, p = 0.06, two-tailed).

4.4.3.2. Process Evidence: Path Analysis

Next, I conduct path analyses to test whether *Time Spent* mediates the relationship between *Automation* and *Seeded Errors Identified*. That is, I test whether a reduction in effortful processing causes the negative effect of automation on auditors' propensity to identify seeded errors.[74] Thereby, I further examine to what extent the negative effects of automation on professional skepticism are driven by less effortful processing and attention spent to the evidence provided by the automation (Parasuraman and Manzey 2010). displays the mediation models for both the *Mindset Absent* (top figure) and *Mindset Present* (bottom figure) conditions. In the *Mindset Absent* conditions, I find that *Automation* significantly reduces *Time Spent* (β = -208.26, z = -3.48, p < 0.01, two-tailed) and *Time Spent* is significantly positively related to *Seeded Errors Identified* (β = 0.002, z = 1.99, p = 0.047, two-tailed). Although the total effect (i.e., the c-path) of *Automation* on *Seeded Errors Identified* is marginally significant (β = -1.16, z = -1.95, p = 0.051, two-tailed), the direct effect (i.e., the c'-path) in the mediated

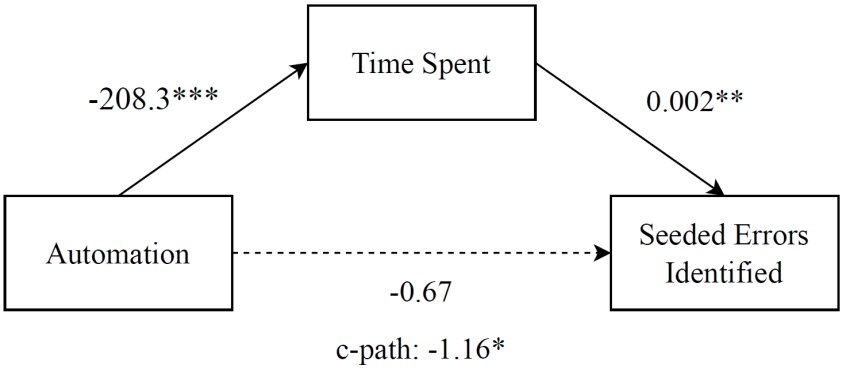
[73] Specifically, the item included the question: "*In the inventory counts, there were four aerial views of animals. Three of them contained cattle (i.e., cows and bulls). Which animals did the other one contain?*"

[74] Nolder and Kadous (2018, p. 7) identify both the time spent on task and the seeded errors identified as measures of a skeptical mindset. Yet, arguably the degree to what effortful analysis is conducted (i.e., time spent) can affect the number of seeded errors identified.

model is insignificant ($p > 0.10$, two-tailed). The indirect effect is insignificant at conventional two-tailed significant levels, but marginally significant at one-tailed significance levels ($p = 0.12$, two-tailed; $p = 0.06$, one-tailed).

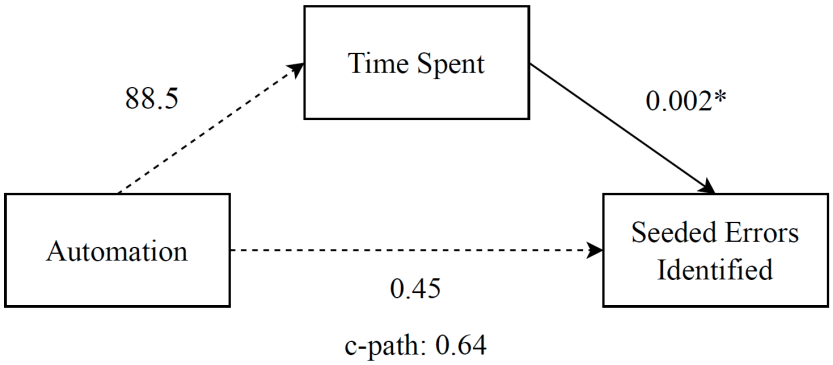
Figure 11: Path Analyses

Panel A: Mediation Analysis in the *Mindset Absent* Conditions



Indirect effect: $\beta = -0.48$, $z = -1.56$, $p = 0.12$, two-tailed, n = 59.

Panel B: Mediation Analysis in the *Mindset Present* Conditions



Indirect effect: $\beta = 0.19$, $z = 0.91$, $p = 0.36$, two-tailed, n = 60.

Notes: Figure 11 shows the path models that demonstrate how *Time Spent* mediates between *ATT* and *Seeded Errors Identified*. Two models are reported: Panel A (B) reports the mediation analysis in the *Mindset Absent* (*Mindset Present*) conditions. The c-path represents a univariate regression of *Seeded Errors Identified* on *Automation*. Robust standard errors are used. See Appendix B for variable definitions. Standardized path coefficients provided. Nonsignificant results are denoted by a dashed line. $^{*}p \leq 0.10$, $^{**}p \leq 0.05$, and $^{***}p \leq 0.01$, all p-values are two-tailed.

In the *Mindset Present* conditions, I do not find evidence for a significant total effect of *Automation* on *Seeded Errors Identified* ($p > 0.10$, two-tailed). Nor do I find a significant effect of *Automation* on *Time Spent* ($p > 0.10$, two-tailed). The only relationship in the mediation model that shows marginal significance is the relationship between *Time Spent* and *Seeded Errors Identified* (i.e., the b-path, $\beta = 0.002$, $z = 1.66$, $p = 0.097$, two-tailed). This supplementary analysis shows that when a counterarguing mindset intervention is absent, auditors engage in less effortful processing and this leads them to identify less seeded errors. When auditors are prompted with a counterarguing mindset, the automation does not cause them to engage in less effortful processing, and therefore there are no adverse effects of automation on the number of seeded errors identified.

4.5. Conclusion

In this study, I investigate the effect of auditors' automation usage on their professional skepticism. I find that absent a counterarguing mindset intervention, auditors are less skeptical when they rely on work conducted by the audit firm's automated tools and techniques than when relying on the same work by an audit team member. This indicates potential drawbacks of using automated tools and techniques. To alleviate these drawbacks, I employ a counterarguing mindset intervention that successfully alleviates the negative effects of automation usage on professional skepticism. Finally, I investigate whether reductions in professional skepticism that are caused by automation usage also spill over to subsequent unrelated tasks. I do not find any evidence indicating a spillover effect.

These findings are relevant for audit practice and theory. That is, for the potential advantages of automation to materialize, it is important that auditors' reliance on automated tools and techniques is based on thorough analysis of auditors' cognitive and motivational decision-making processes. Audit firms could, for instance, employ counterarguing mindset interventions to mitigate the negative effects of automated tools and techniques on professional skepticism. Also, my findings could help regulators and standard setters, such as the IAASB and PCAOB, to better

make decisions in inherently difficult trade-offs regarding the use of automation in an audit. Next to that, this study contributes to the literature on professional skepticism in auditing (e.g., Nolder and Kadous 2018). With the emergence of automated tools and techniques such as data analytics, artificial intelligence, and robotic process automation, auditors increasingly have to exhibit professional skepticism to information prepared by those objects (Olsen and Gold 2018). Yet, to the best of my knowledge, no study has hitherto investigated how professional skepticism may be different towards automation.

My study is also subject to limitations. In the auditing setting, there are numerous possible automated tools and techniques, audit team members, audit tasks, and auditors. In my study, partially due to the nature of experiments, I was constrained in testing various alternatives and provide directional evidence. Therefore, readers need to be cautious in generalizing findings to other tasks. For instance, if in practice auditors' reliance is appropriate a counterarguing mindset intervention could also result in inefficiencies. Future research can further explore different variations, and potentially explore boundary conditions. Overall, the relationship between automated tools and techniques and professional skepticism appears to be a fruitful area for future research.

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4.7. Appendix A: Examples of Photographs Used in the Inventory Counting Procedures

FIGURE A.1.

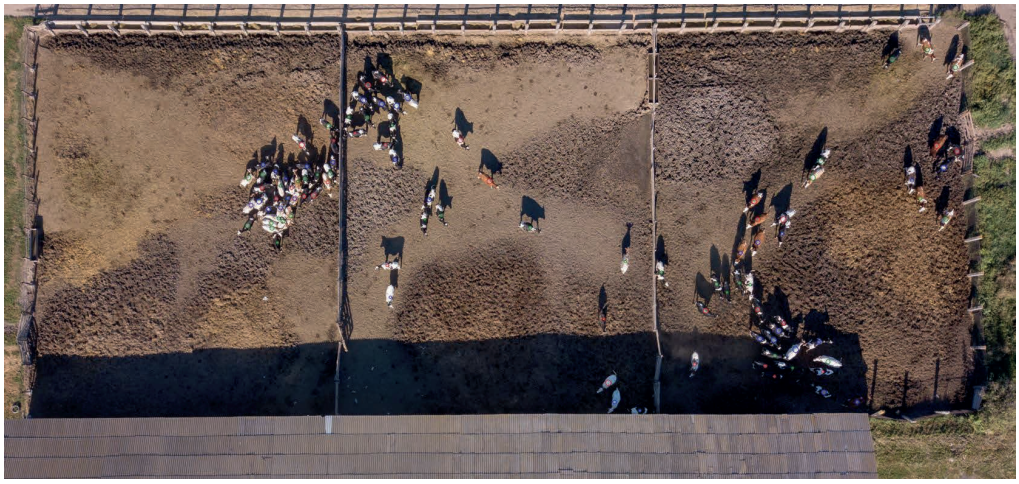

Figure A.1. presents a screenshot of the first aerial photograph of a pen that auditors needed to review. The count by the preparer is 98 and the actual number of cattle is also 98. Hence, there are no seeded errors in this subtask. The image in the experimental case was large, and an additional magnifier was provided, such that auditors were able to manually check whether the initial count was correct.

FIGURE A.2.

Figure A.2. presents a screenshot of the fourth and last aerial photograph of a pen that auditors needed to review. The count by the preparer is 137, while the actual number of cattle 131. There are 6 seeded errors in this subtask. The image in the experimental case was large, and an additional magnifier was provided, such that auditors were able to manually check whether the initial count was correct.

4.8. Appendix B: Variable Definitions

Variable	Definition
Dependent Variables - Main Task	
Time Spent	The amount of time spent on reviewing the four inventory counting tasks, measured in seconds.
Agree with Preparer	An indicator variable equal to "1" if auditors judged the initial count by the workpaper preparer to be correct, and equal to "0" if not.
Seeded Errors Identified	The number of seeded errors identified by auditors in the inventory counting procedures. Bounded by zero (lower-bound) and six (upper-bound).
Dependent variables - Spillover Task	
Reasonableness	Auditors' assessment of the overall reasonableness of the fair value, measured on an 11-point Likert scale, ranging from 0 ("not at all likely to be reasonable") to 10 ("extremely likely to be reasonable").
Surface Issues	The number of surface issues identified in the goodwill impairment case. (0 - 2)
Deep Issues	The number of deep issues identified in the goodwill impairment case. (0 - 3)
Total Issues	The total number of issues (surface + deep) identified in the goodwill impairment case. (0 - 5)
Contact Directly	An indicator variable that equals "1" when auditors decide to call their manager immediately regarding issues that may indicate the fair value is not reasonable, and equals "0" otherwise (Kadous and Zhou 2019).
Independent Variables	
Automation	An indicator variable that equals "1" if auditors are in the *Automation* conditions and equals "0" if auditors are in the *Human* conditions.
Counterarguing	An indicator variable that equals "1" if auditors are in the *Mindset Present* conditions and equals "0" if auditors are in the *Mindset Absent* conditions.

Chapter 5

Conclusion

In this dissertation, I investigate the microfoundations of audit quality by exploring how individual auditors' behavior shapes their judgment performance, learning, professional skepticism, and ultimately audit quality. Understanding the actions and interactions of individual auditors and audit teams is crucial to explain the aggregate outcomes of audit quality. The dissertation comprises three studies that provide insights into how operational aspects of the audit, such as task prioritization, workplace learning, and the use of automated tools, influence auditors' judgment performance, decision making, and professional skepticism. The studies suggest that operational interventions can help improve audit quality, such as providing auditors more psychological ownership over their tasks, fostering learning, and using counterarguing mindset interventions to alleviate the negative effect of automated tools on professional skepticism. Overall, this dissertation highlights the importance of exploring the operational side of audit engagements and better understand microfoundations of audit quality.

The first study involved two experiments with professional auditors, which revealed that they tended to prioritize easy audit tasks, leaving more difficult tasks until the end of and audit engagement. We found that prioritization of easy tasks had a negative effect on overall performance, particularly in those parts of the audit that required higher levels of cognitive processing. Moreover, when time pressure was high, the tendency to prioritize easy tasks became more pronounced. Nevertheless, we found that providing auditors with greater psychological ownership over their tasks could mitigate this issue, but only when time pressure was low. In a separate survey, we discovered that although auditors acknowledged the drawbacks of prioritizing easy tasks, they expected other auditors to engage in such behavior. Our study highlights the implications of this operational aspect (i.e., task prioritization), which has received little attention thus far, on auditors' judgment performance.

In the second study, we examined how auditors learn on the job. Workplace learning is a critical aspect of the auditing profession since auditors must acquire significant expertise to uphold their public responsibilities and establish their credibility. This study aimed to achieve two main

objectives. First, we sought to consolidate the existing research on auditor learning processes by categorizing it according to two key dimensions: the location of learning (on-the-engagement or off-the-engagement) and the role of other auditors in the learning process (passive or active). Secondly, we aimed to synthesize the existing research to enable future research. We provide recommendations for auditing practice and directions for future research.

In the third study, I conducted an experiment involving professional auditors to examine their level of professional skepticism towards workpapers prepared using automated tools and techniques, compared to the same workpapers prepared by human auditors. The results show that auditors tend to be less skeptical towards the former than the latter. Drawing on psychological theory, I propose a counterarguing mindset intervention that can mitigate the negative impact of automation on professional skepticism. In addition, I also investigated whether the reduction in professional skepticism caused by automation usage spills over to subsequent audit tasks. However, the findings do not support this idea. These findings help regulators and audit firms to make better trade-offs in the inherently difficult decisions that they face when determining what role automation should play in audit engagements.

In conclusion, the studies presented in this dissertation shed light on how individual auditor behaviors, judgments, and decision-making can impact audit quality. By examining auditing from an operational perspective, these findings provide a more realistic understanding of the complexities of modern audit engagements and shed light on the microfoundations of audit quality. As regulators and policymakers continue to express concerns about audit quality, these studies offer actionable interventions that can help improve audit quality.

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The three essays collected in this dissertation relate to the microfoundations of audit quality. The first essay shows how auditors prioritize easy tasks and how this affects their judgment performance, and by extension audit quality. The second essay deals with how auditors learn in the workplace. The third essay investigates how auditors' usage of automated tools and techniques affects their professional skepticism. Together, these essays shed light on how individual auditor behaviors, judgments, and decision-making can impact audit quality. By examining auditing from an operational perspective, these findings provide a more realistic understanding of the complexities of modern audit engagements and shed light on the microfoundations of audit quality. As regulators and policymakers continue to express concerns about audit quality, these studies offer actionable interventions that can help improve audit quality.

Christian Petrus Hendrikus Peters (Nijmegen, 1994) graduated from Tilburg University with a BSc in International Business Administration, a MSc in Accountancy, and a MPhil Research Master in Business. He started his PhD in Accounting in 2019 and spent part of his PhD as visiting researcher at Emory University in The United States. After his PhD, he will join Nanyang Technological University in Singapore as an Assistant Professor in Accounting.

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