

Does Time Constraint Lead to Poorer Audit Performance? Effects of Forewarning of Impending Time Constraints and Instructions

Kin-Yew Low and Hun-Tong Tan

SUMMARY: We conduct an experiment to investigate the effects of early versus late warning of impending time constraints, as well as the presence of instructions to think out of the box on auditors' time-constrained performance. We find that forewarning auditors during audit planning of impending time constraints (i.e., early warning) leads to better time-constrained performance on an inventory task. The incremental benefit of warning is greater when auditors are explicitly instructed to think out of the box. We find that the mechanism by which the joint effects of forewarning and instructions improve auditors' performance is via their allocation of time to effective audit tests that enable them to meet the audit objectives.

Keywords: forewarning of impending time constraints; “think-out-of-the-box” instructions; time-constrained audit performance.

INTRODUCTION

Time constraints are ubiquitous in many professions, including auditing. Public accounting firms impose on their staff time constraints in the form of time budgets or task deadlines because of seasonal deadlines that cluster together and constraints on available staff during peak periods. Clients that want audit reports filed faster than the previous year and at lower cost (Jelinek and Jelinek 2008) exacerbate this time constraint pressure. Studies in psychology and auditing using largely experiments and some surveys generally report that time constraints have deleterious impact on task performance and decision quality (e.g., Svenson and Maule 1993; DeZoort and Lord 1997); see Glover (1997) for an exception. Practitioners have also noted that a major challenge and priority for public accounting firms is to enable its staff to cope with severe time constraints (Satov 2003; Nixon 2004; Hayward 2005). In short, research suggests that time

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constraints have adverse performance effects on auditors, and that auditors need to identify ways to cope with time constraints.

Following the debiasing framework by [Arkes \(1991\)](#), we consider maladaptive behavior/judgments in the presence of time constraints to be a strategy-based error that can be corrected by adaptive responses, and investigate the effectiveness of two factors—warning of impending time constraints and instructions to think out of the box—that auditors can adopt to cope with time constraints. The first factor, warning of impending time constraints, is important because it is a feature that exists in the audit environment. Yet, a salient feature of extant experimental research in auditing (and psychology) investigating the effects of time pressure on performance is that the time constraint manipulated is largely unanticipated by the participants and they are generally informed of the time constraint immediately prior to the performance of the experimental task. As a consequence, participants do not have the opportunity to plan their work strategies in response to the impending time constraint.

Time constraints in the auditing environment, however, may be more predictable and, hence, controllable. In auditing, time constraints may be anticipated because of their common occurrences ([Kreutzfeldt 1992](#)) and the recurring nature of audit engagements. To the extent that auditors are able to anticipate time constraints during the early stages of an audit, they may be able to adapt their work strategies to mitigate the otherwise deleterious consequences of such constraints. Currently, there is no evidence on whether the adverse effects of time pressure on auditors' performance, documented in prior research, holds when this more real-world institutional feature (warning of impending time pressure) is present.

Whether warning of time constraints has a positive impact on auditor performance depends on the auditors' response to the warning. Auditors can respond to impending time constraints merely by trying to work faster, or by working more effectively (e.g., through revision of their audit plans). The former approach by itself is likely to have limited impact because there is a limit to how fast one can work. Thus, to the extent that audit plans are not already optimized, finding ways to work more effectively is likely the appropriate adaptive response to impending time constraints, and this involves modifying existing audit plans to identify more effective tests and/or to simply focus on more effective tests that are part of the existing audit plan. Effectiveness and/or efficiency gains can also arise from changes in a client's circumstances that allow for new and better ways to achieve the same audit objectives. However, research shows that auditors have a proclivity toward relying on previous audit plans—modifying an existing audit plan is effortful, and prior research indicates that auditors are influenced by the prior year's working papers ([Wright 1988; Tan 1995](#)). Thus, a second factor we investigate involves a simple intervention of instructing auditors to think out of the box (e.g., not to simply replicate audit procedures used in past audits or be confined to those suggested in their firms' audit manuals). We posit that the effectiveness of warning of anticipated time constraints is enhanced by this "think-out-of-the-box" intervention. Our theoretical framework rests on a premise that the joint effects of these variables on performance operate via auditors' reduced stress and/or their adoption of strategic responses to time constraints.

We investigate these issues by conducting a computerized experiment that requires auditors to plan and conduct audit tests on a client's inventory obsolescence allowance balance. We manipulate between subjects whether auditors are warned, at the beginning (versus near the end) of the planning stage, of impending time constraints that will be imposed in the completion stage. We also manipulate between subjects whether, at the planning stage, auditors are provided instructions to modify the prior year's audit procedures or develop new audit procedures, and not be restricted by what has been done in the previous year's audit and/or that specified in the firm's audit manuals. Results reveal that early warning of impending time constraints leads to better auditor performance (in terms of smaller absolute deviation in auditors' estimate from actual errors), and that this improvement from warning of time constraint is greater when auditors are instructed to consider alternative audit procedures. In

additional analysis, we assess whether the joint effects of warning and instructions on auditor performance operate through reduced experienced stress or by working more effectively. Our results support the latter mechanism. We find that the joint effect of these independent variables on auditor performance is mediated by the time auditors allocate on audit procedures that effectively test the audit objectives. This result highlights the importance of strategic allocation of time to appropriate audit procedures when auditors work under time constraints.

Our study adds to the accounting literature on auditors' performance under time constraints. While prior studies indicate that auditors' performance can suffer under time constraint, they ignore a distinctive feature in the audit environment—auditors generally are forewarned of impending time constraint and have the opportunity to revise their audit plans accordingly. We show that the adverse effect of time constraint can be reduced when auditors are provided early warning of time constraints. This finding suggests a boundary condition on extant studies demonstrating deleterious effects of time constraints. We also demonstrate the effectiveness of simple instructions for auditors to think out of the box, in that we show that the benefits of early warning of time pressure are greater when auditors are given instructions to consider audit procedures beyond those documented in prior working papers or audit manuals. Our study also contributes to the psychology literature. [Arkes \(1991\)](#) presents a debiasing framework that considers time-pressure-induced judgment deficiencies to be strategy-based errors that can be corrected with incentives.¹ We add to his framework by demonstrating that such judgment deficiencies can be improved by two other mechanisms (warning and instructions) not considered in his framework.

BACKGROUND AND HYPOTHESIS DEVELOPMENT

Psychology research indicates that the imposition of time constraints on task performance increases the psychological stress experienced by task performers ([Ben Zur and Breznitz 1981](#)). In turn, task performance and stress follow an inverted U-shaped curve ([Beehr 1985](#)), where task performance initially improves but subsequently deteriorates with increasing stress.² Figure 1 presents a graphical representation of this relationship. The stress threshold above which time pressure impairs performance is likely low, as most studies document performance decrement from increasing time pressure (e.g., [Rothstein 1986](#); [Payne et al. 1988](#); [Svenson and Maule 1993](#); [Dror et al. 1999](#)).

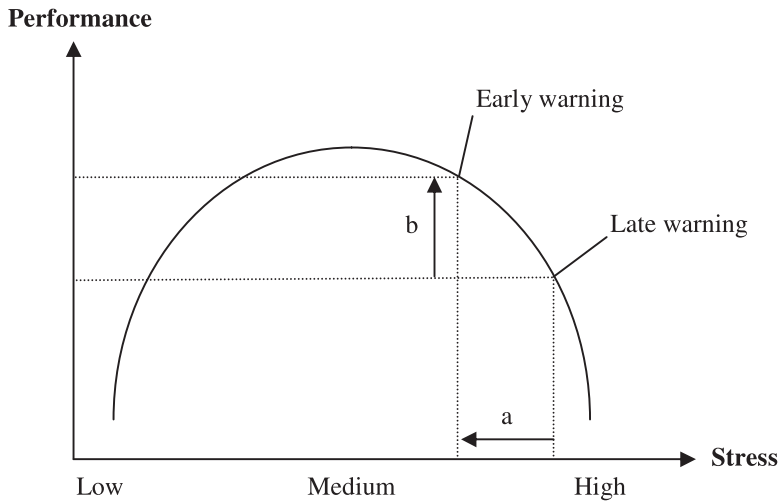
Similarly, prior research in auditing generally reports that time constraints have adverse effects on auditors' behavior and performance. Several studies experimentally manipulate the time available to perform an audit task (e.g., [McDaniel 1990](#); [Ponemon 1992](#); [Solomon and Brown 1992](#); [Choo 1995](#); [Braun 2000](#); [Robertson 2007](#)).³ These experiments inform participants of the time constraint only when they are about to perform the actual audit task/tests. Auditors in these studies have limited options in responding to these time constraints. In practice, auditors likely have developed a repertoire of responses to time constraints and generally have greater flexibility in

¹ [Arkes \(1991\)](#) considers a broader range of debiasing mechanisms for other errors (e.g., association-based or psychophysical errors), but limits the debiasing mechanism for strategy-based errors to incentives.

² The inverted U-shaped relation between task performance and stress is a variant of the Yerkes-Dodson Law that states that increasing arousal initially enhances but subsequently diminishes task performance beyond some threshold ([Yerkes and Dodson 1908](#); [Easterbrook 1959](#)). Researchers often use the two terms "stress" and "arousal" interchangeably ([Anderson 1976](#); [Weick 1983](#)), as stress is said to cause increases in physiological and neurological arousal ([Beehr 1985](#)). For our purposes, we adopt [Lazarus and Folkman's \(1984, 19\)](#) definition of (psychological) stress as a relationship between a person and the environment that is appraised by the person as taxing or exceeding his/her resources and endangering his/her well-being.

³ Surveys and interviews are also used to investigate this issue (e.g., [Rhode 1977](#); [Alderman and Deitrick 1982](#); [Lightner et al. 1982](#); [Kelley and Margheim 1990](#); [Carcello et al. 1996](#); [Kelley et al. 1999](#)).

FIGURE 1
Relationship between Task Performance and Stress at the Completion Stage



responding to time constraints than they have been accorded in extant audit studies (Solomon and Brown 1992; Kreutzfeldt 1992).

Other studies do not manipulate actual time constraints, but manipulate perceived time or budgetary constraints by asking auditors to assume the absence or presence of such constraints (e.g., Kermis and Mahapatra 1985; Asare et al. 2000). No prior study investigates how advanced notification of impending time constraints leads to different audit performance under actual time constraints.

Although much prior literature on time constraints suggests that auditors' performance suffers under time constraints, research in psychology on adaptive decision making indicates that decision makers adapt to environmental constraints by varying their decision strategies (Payne et al. 1988). In the auditing literature, Solomon and Brown (1992) suggest, *but do not test*, the notion that auditors' responses to time constraints differ depending on whether time constraints are anticipated or unanticipated.⁴ Our study empirically examines Solomon and Brown's (1992) untested proposition that anticipation of time constraints influences auditors' coping response and introduces a firm mechanism (instructions) that potentially moderates the effect of time constraint anticipation on auditors' performance.

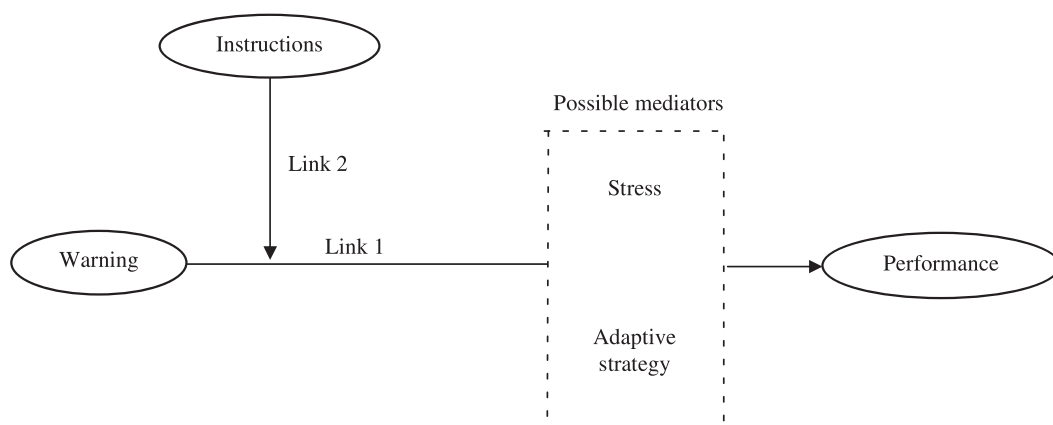
Overall Theoretical Framework

Arkes' (1991) debiasing framework considers judgment deficiencies induced by time constraints to be strategy-based errors that arise because people do not adequately adapt to time constraints.⁵ Following Arkes (1991), if time-constraint-induced judgment deficiencies arise because of inappropriate adaptive behavior, then the remedy is to identify appropriate mechanisms that enable auditors to better adapt to time constraints. Warning of impending time constraints

⁴ Specifically, using a within-subjects time pressure manipulation, Solomon and Brown (1992) find that increased time pressure reduces auditors' configural information processing and increases their judgment instability.

⁵ Kennedy (1995) also presents a similar debiasing framework.

FIGURE 2
Framework of the Joint Effects of Warning and Instructions on Auditors' Time-Constrained Performance



(which enables cognitive resources to be channeled toward adapting to the time constraint; [Payne et al. 1988](#)) is one such adaptive mechanism naturally occurring in the audit environment. Likewise, psychology research indicates that decision makers under time constraints exhibit increased tendencies to lock in on a decision strategy ([Ordonez and Benson 1997](#)), and auditing research documents auditors' proclivity to rely on the prior year's procedures ([Wright 1988](#); [Tan 1995](#)). Thus, instructing auditors to think out of the box in terms of audit procedures is a strategic response that public accounting firms can adopt in response to time constraints.

The theoretical model of our study is depicted in Figure 2. The model also suggests that experienced stress and/or adoption of strategic responses (e.g., allocation of more time to effective audit procedures, prioritization of audit procedures based on audit risks) are possible mediators. In our hypotheses development that follows, we first discuss the direct effects of the independent variables, and then test for mediation effects in additional analysis. Each of our independent variables is new to the auditing literature, and in the discussion that follows, we therefore develop hypotheses that build upon the incremental effect of each variable.

Warning of Time Constraints and Auditor Performance

We posit that early warning of time constraints improves auditors' performance (see Figure 2, Link 1). One mechanism by which this can occur is via reduced stress. Findings in psychology research indicate that increased predictability and/or actual or perceived controllability of an aversive event lead to lower stress and improved performance ([Glass and Singer 1972](#)). This suggests that early warning of impending time constraints helps auditors better predict the eventual task conditions, which reduces their subsequent stress experienced during task performance, compared to a situation where late warning is provided, say, at the start of task performance.⁶ Assuming that the performance effect of stress from late warning of time constraint is on the

⁶ Auditors' stress at the time of receiving this early warning of time constraint (i.e., the planning stage) is likely higher than those not receiving this early warning, but this pattern is expected to reverse for task performance (i.e., the completion stage).

downward slope of the inverted U-shaped stress-performance curve, early warning of impending time constraint reduces the stress experienced during task performance (i.e., the completion stage), leading to improved performance. This is illustrated graphically in Figure 1, where the reduction in stress is labeled as “a” and the improvement in performance is labeled as “b.”

It is also possible that warning of time constraints before auditors perform the task aids auditors’ performance because this allows auditors to adopt strategic responses to the impending time constraint. This effect can occur with or without affecting auditors’ stress level. When auditors are required to react immediately to time constraints, strategic responses by the auditor are much restricted and the auditors’ best response is likely to work faster. In contrast, when time constraints are anticipated, the repertoire of strategic responses available to the auditor is much expanded—various aspects of the audit plan can be modified, including varying the staff allocation, audit procedures, and audit focus or emphasis. In all prior auditing studies on how time pressure affects performance, the participants do not have the option to amend their audit plan. Consequently, the auditors in these studies have little or no opportunity to review and modify their responses to time constraints when they become known. In practice, auditors would have greater flexibility in responding to time constraints than they had been given in extant audit studies. Hence, when auditors work under time constraints, early warning of the impending time constraint helps auditors to better focus on the task at hand and provides them with an opportunity to review and, if necessary, modify and/or re-prioritize their audit plans or procedures so as to work more effectively in response to reduction in time available to conduct audit tests.

Our discussion above suggests the following hypothesis:

- H1:** Auditors perform better under time constraints when given early rather than late warning of the time constraints.

Instructions to Think-Out-of-the-Box

To the extent that there is a limit to simply working faster under time constraints, a necessary condition for the incremental benefits of early (versus late) warning of time constraints is that auditors with early warning will work more effectively. In an auditing context, this entails modifying their audit plans after being aware of the impending time constraints. However, there are a few reasons why auditors may not sufficiently modify these audit procedures even if they are aware of impending time constraints. First, auditors may believe that working faster will be sufficient and that a modified audit plan is unnecessary. Second, they may be overly influenced by an existing audit plan (that they recently developed or inherited from prior years) or by prescribed audit procedures documented in their audit manuals. Psychology research documents that decision makers do not make sufficient adjustments for the anchors they rely on in their decision making ([Tversky and Kahneman 1974](#); [Northcraft and Neale 1987](#)), and prior auditing research indicates that auditors tend to be influenced by judgments documented in prior working papers, whether these judgments are previously made by another auditor or the same auditor performing the audit (e.g., see [Wright 1988](#); [Tan 1995](#)). A client’s operations and circumstances are seldom static; hence, audit risks are likely to change from year to year. Thus, relying on the prior year’s audit program is not necessarily the best approach for the current year’s audit ([Wright 1988](#); [Tan 1995](#)). Audit partners we interviewed made similar observations, and also indicated that auditors need to select and modify audit procedures found in standard audit programs depending on a client’s current circumstances. Changes in a client’s circumstances can provide opportunities for more efficient ways of achieving the same audit objectives. The audit partners also noted that changes in deadlines are fairly common (i.e., clients want to bring forward deadline, clients delay providing required paperwork), so audit programs/procedures may have to be modified accordingly. We investigate the effects of a simple set of “think-

out-of-the-box” instructions. These inform auditors, at the planning stage, to not restrict themselves to procedures documented in past working papers or in standard audit programs found in audit manuals, but are required to modify audit procedures used in prior years or develop alternative audit procedures that can achieve greater effectiveness and/or efficiency.

In the presence of a warning of impending time constraints, instructions to modify their audit procedures to achieve greater effectiveness and/or efficiency can induce auditors to develop adaptive strategies or audit plans to cope with the anticipated time constraints, rather than rely on past procedures. As a result, the beneficial effects of warning on auditors’ performance are more likely to be realized in the presence of such instructions.

Similar to our earlier discussion, the joint effects of warning and instructions on performance may also operate through auditors’ stress levels. Specifically, we expect these instructions to increase the task demands and thereby increase auditors’ stress during the planning stage where they are attempting to devise alternative audit procedures (Weick 1983). For the completion stage where auditors are supposed to execute their audit plans, these instructions will reduce auditors’ stress if they have also been given early warning, as they will be better prepared to cope with the anticipated time constraint. On the other hand, receiving the “think-out-of-the-box” instructions at the planning stage without early warning does not help auditors to purposefully direct their audit procedures at the planning stage toward mitigating the impending time constraint at the completion stage (since they are not aware of time constraint in the completion stage). Thus, their stress level at the completion stage is unlikely to reduce, and performance is unlikely to improve.

Our prediction is that the effect of warning is moderated by instructions to think out of the box (see Figure 2, Link 2), and our hypothesis is formally stated below:

H2: The positive impact of early warning on auditors’ time-constrained performance is greater when auditors are given instructions to develop alternative audit procedures.

RESEARCH METHOD

Participants and Procedure

One hundred thirty audit seniors from the Singapore office of three Big 4 firms participated in our study, and the participants comprised 126 (97 percent) audit seniors, two audit assistants, and two audit supervisors. On average, the participants had two and a half years ($s.d. = 0.93$) of audit experience, spent about 12 percent ($s.d. = 13.76$) of their audit time in the preceding year on inventory audit, and rated the audit deadline/budgetary pressure experienced by them in the preceding year as 7.0 ($s.d. = 1.60$) on a scale ranging from 0 (no pressure at all) to 10 (very high pressure). There were no significant differences in the participants’ audit rank, audit experience, inventory audit experience, and experienced deadline/budgetary pressure across firm and treatment conditions.

The participants completed a computerized inventory audit task during an in-house training session. The computerized materials comprised two parts: an audit case and a post-experiment questionnaire. The audit case was adapted from the experiment materials used in McDaniel (1990) and Braun (2000). In the audit case, the participants had to plan and conduct two audit tests on a client’s inventory obsolescence allowance balance to ensure that (1) the obsolete inventory items were recorded at correct unit costs (valuation) and (2) the listing of obsolete inventory items was complete (completeness).⁷ The background information provided in the audit case materials

⁷ We used the terms “inventory reserve” and “accuracy” in place of “inventory obsolescence allowance” and “valuation” in the experimental case. The descriptions of these terms in the experimental case convey the same exact meanings of “inventory obsolescence allowance” and “valuation,” which are more widely used in practice.

suggests an increase in audit risk for the completeness objective; and unknown to the participants, the total amount of embedded errors was insignificant for the valuation objective (less than 0.5 percent of the inventory balance), but significant for the completeness objective (about 10 percent of the inventory balance or 100 percent under-provision of the audit client's inventory obsolescence allowance balance).⁸ More specifically, the embedded errors comprised one obsolete inventory item recorded at below its actual unit cost (total error sum of \$19), and 47 inventory items that were slow moving per the company's inventory obsolescence allowance valuation policy but were not included in the listing of obsolete inventory items (total error sum of \$297,538). Having two audit tests allows us to observe whether auditors respond to time constraints, among other ways, by prioritizing their audit work according to their assessment of audit risks associated with different audit objectives. We presented the audit task with a lower risk (test of valuation objective) *before* the audit task with a higher risk (test of completeness objective) in the experimental materials. If auditors do not prioritize their work under time pressure and merely perform according to the order the tasks are presented, they will likely perform the valuation (less risky) task before the completeness (more risky) task, leaving less time to complete the latter. Given the number and value of our embedded errors, we expect a greater differentiation in the participants' performance for the completeness objective than the valuation objective.

The audit case was conducted in two stages. In Stage 1, the participants read the background information on the client's industry and business operations. They were briefed on their immediate audit task and provided with last year's audit procedures used to test the stated valuation and completeness objectives.⁹ Although these procedures could allow the participants to detect the errors embedded in the case, they were not the only way to do so. Participants were given a predetermined amount of time to think about how they could test the stated audit objectives in the current year's audit. The allotted planning time was based on the average time taken by a separate group of audit seniors from one of the participating Big 4 firms in a pilot study. The planning time was held constant across all treatment conditions. In Stage 2, the participants were required to execute their planned audit tests and document their audit findings within a constrained time period. The constrained time period (24 minutes) was 20 percent less than the average time taken by a separate group of auditors during our pilot study.¹⁰ The completion time was also held constant across all treatment conditions. Thus, the total time available to the participants was the same in all the treatment conditions. The participants would need the client's current-year listings of final inventory and obsolete inventory items to carry out their audit tests. Both softcopies and hardcopies of these listings were made accessible to the participants at the start of Stage 2. By providing the participants with both the soft and hardcopies of the client's inventory listings, the participants would have greater flexibility in determining how to best accomplish their assigned audit tasks within a constrained time period. For instance, the participants could choose to perform their audit

⁸ The case facts mention that the industry of the audit client's customers is experiencing good growth but intense competition. Consequently, some of the client's customers are not doing as well and are not purchasing as much as before, suggesting a heightened risk that adequate allowance might not have been made for all slow-moving and obsolete inventory items. The inventory items are customer specific, with customers' logos printed on them. On the other hand, the case facts do not suggest any increase in risk for the valuation objective.

⁹ The two audit partners who reviewed our materials during the design stage confirmed that the procedures were appropriate.

¹⁰ Participants in [McDaniel \(1990\)](#) and [Braun \(2000\)](#) were required to test *four* audit objectives within an average time of 50 minutes in the high time-pressure condition. Our task is based on that used in [McDaniel \(1990\)](#) and [Braun \(2000\)](#) but modified to require the test of only two audit objectives. Thus, our completion time limit of 24 minutes, which is slightly under half the time limit imposed in [McDaniel \(1990\)](#) and [Braun \(2000\)](#), appears reasonable. In addition, our participants' average rating of the time pressure experienced during the completion stage is 7.9 on an 11-point scale ranging from 0 (not pressurized at all) to 10 (very pressurized), which suggests that they experienced relatively high/severe time pressure.

tests manually on the hardcopies and/or use Excel to conduct their tests on the softcopies. All but one participant subsequently completed the audit tests using either only the softcopies (on Excel) or both the soft and hardcopies of the client's inventory listings.¹¹ We captured the participants' responses electronically on thumb drives and also recorded the participants' computer screens during Stage 2 of the audit case. We also collected all hardcopies of the inventory listings from the participants at the end of the study.

Design

Our design comprises a 2×2 warning (early, late) by instructions (with, without) between-subjects design.¹² We randomly assigned the participants to one of the four manipulated treatment conditions resulting from crossing the warning and instructions variables. For the participants assigned to the early warning condition, they were informed at the start of Stage 1 (planning stage) in the audit case that, owing to a new tight reporting deadline, they had only 24 minutes in Stage 2 (completion stage) to perform and document their audit tests. The participants in the late warning condition were told of the imposed time constraint just before the commencement of Stage 2. On the other hand, the participants in the with-instructions condition but not the participants in the without-instructions condition were given instructions, at Stage 1, to modify last year's audit procedures or develop new audit procedures to achieve greater effectiveness and/or efficiency in meeting the stated audit objectives. They were reminded not to restrict their audit procedures to what have been done in the past and/or that specified in their firm's audit manuals.

Dependent Variable

Participants were asked to estimate the total over- or under-provision in the client's year-end inventory obsolescence allowance balance for each of the two stated audit objectives based on their audit findings. We measured the participants' performance in terms of their accuracy in estimating the inventory obsolescence allowance balance, and computed the absolute difference between the participants' estimated total errors and the actual total embedded errors (with a score of zero implying perfect accuracy).

RESULTS

Manipulation Checks

As a check on our warning manipulation, we ask participants, in the post-experiment questionnaire, to choose one of three options: the engagement office has not informed the auditor (i.e., the participant) of any imposed reporting deadline, the engagement office has informed the auditor of an imposed deadline at the start of the planning stage, or it has informed the auditor of an

¹¹ The percentage of participants who used only the softcopies (both soft and hardcopies) is 45 (52) percent for the early warning-without instruction condition, 64 (34) percent for the early warning-with instruction condition, 30 (70) percent for the late warning-without instruction condition and 42 (58) percent for the late warning-with instruction condition. Logistic regression of the participants' test mode (0 for using only softcopies and 1 for using both soft and hardcopies) on warning and instructions (including both the two-way interaction) as independent variables reveals no significant main or interaction effect (two-tailed $p > 0.234$).

¹² We do not have a control condition where participants had unlimited time to complete their audit testing (i.e., no time pressure condition). This is because under unlimited time condition, participants could conduct a thorough audit by testing all items; this will enable them to detect all the errors embedded in the audit case. Prior studies have also extensively shown that task performance deteriorated under severe time pressure.

imposed deadline at the start of the completion stage. Ninety-two percent of the participants correctly answer the question.¹³ On a scale of 1 (not at all timely) to 10 (extremely timely), participants in the early warning condition also rate the warning of the impending deadline as more timely than the participants in the late warning condition (5.9 versus 4.3, one-tailed $p < 0.001$). Hence, our warning manipulation is successful.

We also analyze the amount of time participants spend during planning (i.e., Stage 1), captured during the experiment by the computer program, in reviewing the prior year's audit procedures and the current year's working papers (containing the suggested audit procedures, which are based on the prior year's audit procedures) for the valuation and completeness objectives. We expect participants with instructions to spend more time scrutinizing and thinking about the proposed audit procedures. As expected, the participants with instructions spend more time reviewing the proposed audit procedures (562.7 seconds versus 444.6 seconds, one-tailed $p < 0.001$).¹⁴

Tests of H1 and H2

We test our hypotheses using the absolute deviation of the participants' error estimate from the actual error amount. By design, the embedded audit errors for the valuation test are very small and immaterial, and our results are similar whether we include the valuation test data. Hence, for simplicity, our hypotheses tests in the discussion that follows center only on the completeness objective. We perform an ANOVA with the absolute errors in the participants' estimates as the dependent variable, and warning (early versus late) and instructions (with versus without) as independent variables. The ANOVA results are shown in Panel B of Table 1.

H1 predicts that auditors will perform better under time constraints when they are forewarned of the time constraints early rather than late. Our results show that the mean absolute error in the participants' estimates is smaller when they are given early warning rather than late warning of the time constraint (\$175,241 versus \$229,661, one-tailed $p = 0.017$). H2 predicts that the benefit of warning will be greater in the presence of instructions to develop alternative audit procedures that have higher audit effectiveness/efficiency. This hypothesis suggests a two-way warning by instructions interaction, which we find (one-tailed $p = 0.074$). The pattern of interaction is shown in Panel C of Table 1. Further analyses reveal that early warning of time constraints leads to better auditors' performance only when they are explicitly instructed to develop more effective and efficient audit procedures (with instructions, one-tailed $p = 0.003$; without instructions, one-tailed $p = 0.331$). Thus, H2 is supported.¹⁵

Panel A of Table 1 shows that the average absolute error in the participants' estimates ranges from \$145,629 to \$237,510. Considering that the tolerable error used in the audit case is \$150,000, the participants' performance in the audit case is not very good, but is largely consistent with prior audit research findings that time constraints have an adverse impact on auditors' performance. Of greater interest here is that the average absolute error of participants in the early warning and with-

¹³ H1 and H2 remain supported when the responses of participants who incorrectly answer the warning manipulation check question are excluded from the subsequently reported statistical tests for H1 and H2.

¹⁴ We had planned for another manipulation check question that directly asks participants whether they have received instructions not to merely rely on past audit procedures. However, because of an administrative error, the question loaded to the computer is an erroneous one used in an earlier developmental version.

¹⁵ We also developed a set of post-experiment questions to measure the participants' propensity to adapt under time pressure. These questions loaded onto three dimensions in a factor analysis. Only one of the three dimensions influenced participants' performance in that the joint effects of warning and instructions were significant for participants who scored lower on this adaptability dimension, but not for those who scored higher on this dimension. However, Cronbach's alpha for this dimension is low (0.50), so this finding should be interpreted with caution.

TABLE 1

Effects of Warning and Instructions on Auditors' Time-Constrained Performance

Panel A: Descriptive Statistics—Mean Absolute Deviation from Actual Errors (Standard Deviations in Parentheses) [Sample Size]

	Without Instructions	With Instructions	Total
Early warning	204,854 (176,842) [33]	145,629 (118,089) [33]	175,241 (152,157) [66]
Late warning	222,286 (142,191) [33]	237,510 (139,242) [31]	229,661 (139,861) [64]
Total	213,570 (159,458) [66]	190,134 (135,860) [64]	202,032 (148,205) [130]

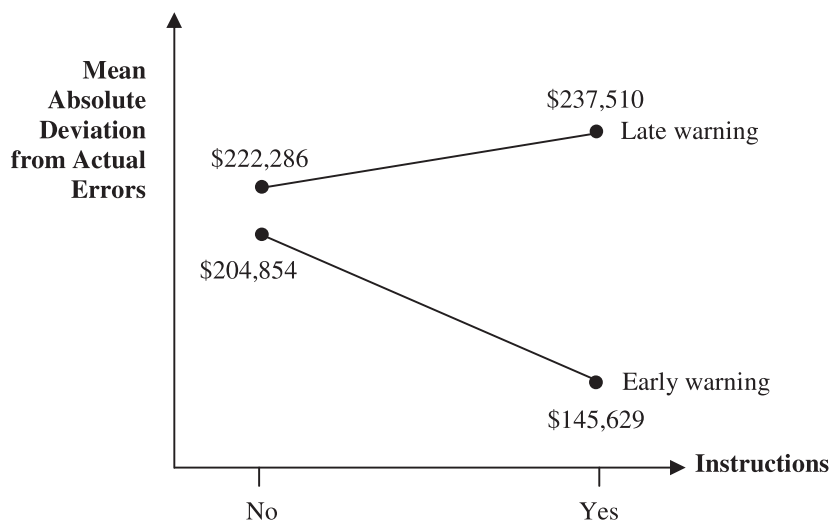
This table summarizes the participants' performance in the audit task to test the completeness objective. Performance is measured as the absolute deviation of a participant's estimate of the population error from the actual errors found in the population. Participants complete the audit task in two stages: a planning stage (Stage 1) and a completion stage (Stage 2). Participants assigned to the early (late) warning condition are informed of the time constraint imposed on Stage 2 at the start (end) of Stage 1. Participants in the with-instructions condition are told in Stage 1 not to restrict their proposed audit procedures to what has been done in the past and/or that is specified in the firm's audit manuals. Participants in the without-instructions condition receive no such instructions.

Panel B: Two-Way ANOVA

Source	df	F-value	Significance
Warning (early versus late)	1	4.57	0.017
Instructions (without versus with)	1	0.74	0.196
Warning \times Instructions	1	2.12	0.074
Error	126		

All p-values reported in ANOVA table are one-tailed significance.

Panel C: Plot of Participants' Time-Constrained Performance



instructions condition is 29 percent to 39 percent smaller than that of participants in the other three treatment conditions.

Test of Experienced Stress

We assess whether warning and instructions change the stress experienced by auditors as a result of imposed time constraints. We do not have direct measures of our participants' stress levels, but captured their perceptions of felt time pressure and adequacy as proxies. Specifically, we ask the participants to rate on 11-point Likert scales the extent of time pressure that they felt during the planning and completion stages (i.e., Stages 1 and 2 of the audit case) and the adequacy of the time given for the planning and completion stages. As both measures of time pressure and adequacy are highly correlated for the planning stage (Pearson correlation = -0.56 , two-tailed $p = 0.000$) and the completion stage (Pearson correlation = -0.58 , two-tailed $p = 0.000$), we average the two measures (after reverse coding the time adequacy responses) to obtain a composite rating of stress experienced by participants during the planning and completion stages (see Table 2, Panels A and B, respectively). For the composite rating of stress experienced during planning (Cronbach's alpha = 0.70), we find only a marginally significant main effect of warning (one-tailed $p = 0.062$); none of the other main or interaction effects is significant (one-tailed $p > 0.139$). The participants experienced greater stress during planning when given early rather than late warning (5.58 versus 4.93). The finding suggests that early warning of impending time constraint increases the stress experienced by participants at the planning stage.

For the composite rating of stress experienced during the completion stage (Cronbach's alpha = 0.69), we find a marginally significant main effect of warning where participants who receive late rather than early warning experience greater stress during completion (7.81 versus 7.45, one-tailed $p = 0.09$), which is not moderated by instructions (one-tailed $p > 0.444$). The finding supports the proposition that increased predictability of an aversive event reduces the event's resulting stress. Thus, there is an affective benefit to warning (via reduction in stress). Consistent with our design that participants experience time pressure at the completion stage, we find that the participants experienced greater stress during the completion stage than the planning stage (7.63 versus 5.26, two-tailed $p < 0.001$).¹⁶

Procedures Used by Auditors

Testing Time Allocated to Correct Procedures

We coded how the participants conducted their audit tests to investigate the strategies or procedures employed as a function of their experimental conditions. Using the participants' testing video clips and both the soft (Excel) and hardcopies of the inventory records, a research assistant (who was a former audit supervisor with five years of audit experience) and one of the researchers (who had four years of audit experience) coded whether the participants performed the correct audit procedures to achieve the valuation and completeness objectives. During the coding, both the assistant and the researcher were unaware of the participants' treatment condition. Correctness of participants' audit procedures was coded as a dummy variable based on whether the participants'

¹⁶ With respect to participants' ratings of adequacy of planning time, ANOVA results with warning and instructions as independent variables reveal only a marginally significant main effect for warning (one-tailed $p = 0.056$). Participants rate their planning time to be more adequate for late warning than early warning (6.11 vs. 5.26). With respect to participants' ratings of the adequacy of completion time, we find no significant main or interaction effect of warning and instructions (one-tailed $p > 0.197$). Taken together, these results suggest that participants with late warning did not perceive that they were given insufficient time to plan during both the planning and completion stages compared to participants with early warning.

TABLE 2

Effects of Warning and Instructions on Auditors' Self-Reported Stress

Panel A: Mean Composite Stress Rating for Planning Stage (Standard Deviations in Parentheses) [Sample Size]

	<u>Without Instructions</u>	<u>With Instructions</u>	<u>Total</u>
Early warning	5.53 (2.33) [33]	5.64 (2.32) [33]	5.58 (2.31) [66]
Late warning	4.55 (2.49) [33]	5.34 (2.22) [31]	4.93 (2.38) [64]
Total	5.03 (2.45) [66]	5.49 (2.62) [64]	5.26 (2.36) [130]

This table summarizes the participants' self-assessment of stress (a composite measure of time pressure and time inadequacy) experienced during the planning stage on an 11-point Likert scale. Participants are tasked to complete an audit task in two stages: a planning stage (Stage 1) and a completion stage (Stage 2). Participants assigned to the early (late) warning condition are informed of the time constraint imposed on Stage 2 at the start (end) of Stage 1. Participants in the with-instructions condition are told in Stage 1 not to restrict their proposed audit procedures to what has been done in the past and/or that is specified in the firm's audit manuals. Participants in the without-instructions condition receive no such instructions.

Panel B: Mean Composite Stress Rating for Completion Stage (Standard Deviations in Parentheses) [Sample Size]

	<u>Without Instructions</u>	<u>With Instructions</u>	<u>Total</u>
Early warning	7.42 (1.42) [33]	7.48 (1.63) [33]	7.45 (52) [66]
Late warning	7.82 (1.49) [33]	7.81 (1.48) [31]	7.81 (1.47) [64]
Total	7.62 (1.46) [66]	7.64 (1.56) [64]	7.63 (1.50) [130]

This table summarizes the participants' self-assessment of stress (a composite measure of time pressure and time inadequacy) experienced during the completion stage on an 11-point Likert scale.

testing (e.g., correct population was used in sampling tested items, correct formulas were used in computations, and selected items were tested against the correct source information) allowed them to correctly test the stated audit objective for all sampled items. The overall inter-rater agreement is 98.4 percent and 97.9 percent for the valuation and completeness objectives, respectively. We also coded the total amount of time (in seconds) that participants spent on testing the audit objective using Excel and/or manual computations ("total test time"). The coding for time spent on these procedures was performed by the research assistant based on the participants' testing video clips and subsequently reviewed by one of the researchers. All coding disagreements were subsequently resolved by the coders.

Our participants worked under time constraints, so correctly testing the completeness objective improves time-constrained performance only if sufficient time is devoted to the appropriate tests. Hence, our measure of effectiveness is proxied by the time participants spent on audit procedures that correctly test the completeness objective ("effective total test time"), a measure that incorporates whether participants correctly identify the correct procedures and the time they spent on these procedures.

The results of the ANOVA test with the participants' effective total test time as dependent variable, and warning and instructions as independent variables, reveal marginally significant main effect of warning (one-tailed $p = 0.062$) and two-way interaction between warning and instructions (one-tailed $p = 0.047$) (see Table 3, Panel B). Participants spend more effective total test time when given instructions than no instructions, but only when they receive early warning (625.7 versus 477.3 seconds, one-tailed $p = 0.055$) and not late warning (390.9 versus 487.7 seconds, one-tailed $p = 0.198$). The two-way interaction is illustrated in Panel C of Table 3. These results mirror the main results observed in the test of H2, suggesting that the benefits of early warning and instructions on the participants' time-constrained performance arise from the allocation of more time to effective audit procedures.¹⁷

Test of Mediation

We assess whether differences in (1) stress experienced by participants during the planning and completion stages and/or (2) effective total test time mediate the joint effect of warning and instructions on the participants' time-constrained performance.

Kenny et al. (1998, 260) outline two steps to establish mediation: (1) the independent variable is related to the mediator; and (2) the mediator affects the dependent variable, after controlling for the independent variables (see also MacKinnon et al. 2002; Shrout and Bolger 2002). As our earlier analysis shows, the first condition is satisfied for effective test time (but not experienced stress) in that it is associated with a two-way interaction involving warning and instructions. For the second condition, results of the ANCOVA test with the independent variables and the above-mentioned potential mediators as covariates reveal a significant effect of effective total test time (one-tailed $p < 0.001$) but not experienced stress (one-tailed $p > 0.377$). More importantly, the two-way interaction effect of warning and instructions is no longer significant (one-tailed $p = 0.237$). Thus, the differential benefits of instructions on warning of time constraint on the participants' time-constrained performance disappears after controlling for time devoted to correct audit procedures. This suggests that effective total test time completely mediates the joint effect of warning and instructions on auditors' time-constrained performance (Kenny et al. 1998). The results indicate that the incremental benefit of instructions on warning of impending time constraints on auditors' time-constrained performance accrue from auditors adopting more effective audit responses to imposed time constraints.

CONCLUSION

We conduct an experiment to investigate the effects of warning of time constraints and presence of instructions to think out of the box on auditors' performance under time constraints. Consistent with prior audit findings, we find that auditors generally perform poorly under time constraints imposed on audit completion. More importantly, we find that forewarning auditors of

¹⁷ Logistic regression of the participants' test sequence (1 for testing completeness first and 0 for testing valuation first) on warning and instructions (including the two-way interaction) as independent variables reveals no significant main or interaction effect (one-tailed $p > 0.135$). We also find no significant main or interaction effect of warning and instructions on the participants' planned and tested sample sizes, total value of tested items, and number of observed errors for the completeness objective (one-tailed $p > 0.122$).

TABLE 3

Effects of Warning and Instructions on Auditors' Time Spent on Correctly Testing the Completeness Objective

Panel A: Descriptive Statistics—Mean Effective Total Test Time in Seconds (Standard Deviations in Parentheses) [Sample Size]

	Without Instructions	With Instructions	Total
Early warning	477.26 (345.24) [33]	625.7 (368.37) [33]	550.26 (361.64) [66]
Late warning	487.66 (452.1) [33]	390.85 (410.21) [31]	443.36 (432.49) [64]
Total	482.54 (399.87) [66]	514.46 (402.98) [64]	497.7 (399.98) [130]

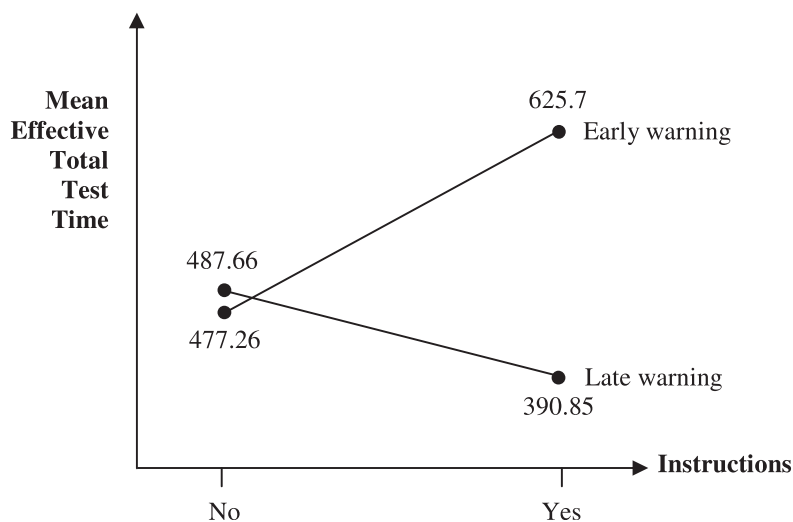
This table summarizes the participants' time spent (in seconds) on correctly testing the completeness objective ("effective total test time"). Participants complete the audit task in two stages: a planning stage (Stage 1) and a completion stage (Stage 2). Participants assigned to the early (late) warning condition are informed of the time constraint imposed on Stage 2 at the start (end) of Stage 1. Participants in the with-instructions condition are told in Stage 1 not to restrict their proposed audit procedures to what has been done in the past and/or that is specified in the firm's audit manuals. Participants in the without-instructions condition receive no such instructions.

Panel B: Two-Way ANOVA

Source	df	F-value	Significance
Warning (early versus late)	1	2.40	0.062
Instructions (without versus with)	1	0.13	0.361
Warning \times Instructions	1	2.86	0.047
Error	126		

All p-values reported in ANOVA table are one-tailed significance.

Panel C: Plot of Participants' Effective Total Test Time in Seconds



impending time constraints during audit planning (i.e., early warning) helps to mitigate the adverse impact of time constraints on auditors' task performance. The benefit of time constraint warning is greater when auditors are given explicit instructions during audit planning to develop more effective and efficient audit procedures, and not be restricted to what has been done in past audits and/or that specified in their firm's audit manuals.

Extant literature on auditors' performance under time constraints has examined largely unanticipated time constraints when, in fact, time constraints are often anticipated by auditors in practice. Our study adds to the literature by providing the first empirical evidence that the adverse impact of time constraints on auditors' performance can be mitigated by forewarning auditors of impending time constraints. This suggests a boundary condition on current findings documenting adverse effects of time pressure. The beneficial effects of warning may potentially be magnified in practice given that auditors likely have more time to respond to warnings of impending time pressure than our participants.

Our study also illustrates the effectiveness of a simple set of instructions to think out of the box when planning audit procedures in enhancing the mitigating effect of early warning. Facing an (expected) increase in time pressure, auditors might hasten to rely on standard or the prior year's audit procedures without sufficiently considering changes in the current year's circumstances that allow for more efficient ways to achieve the same audit objectives. Thus, instructing auditors to think out of the box may cause them to pause and consider such possibilities. However, instructions to think out of the box *per se* do not improve time-constrained performance, these instructions incrementally improve auditors' performance only in conjunction with early warning of time constraints. These results suggest that public accounting firms that emphasize the need for auditors to think out of the box and presumably provide incentives to do so may be better able to induce superior performance in the face of anticipated time constraints. Given that time constraints are ubiquitous in many professional settings (SkillSoft 2006), our findings have potential useful implication beyond that for the public accounting profession. Finally, our study adds on to Arkes' (1991) debiasing framework by showing that for strategy-based judgment deficiencies, warning and instructions are possible mechanisms that can ameliorate such deficiencies.

A number of limitations of our study should be noted. Our study imposes a deadline time constraint on the participants as opposed to a budgetary time constraint. Strategies used to cope with time constraints may vary depending on the form of the time constraint. For example, one can assign more personnel to do a task to cope with a deadline time constraint. On the other hand, one can under-report the amount of time spent to meet a budgetary time constraint. While some strategies can be used to cope with both forms of time constraint (such as working faster and smarter), other coping strategies are constraint specific. Participants in our study also could not adopt strategies that they might otherwise use to cope with a budgetary time constraint (such as under-reporting of time).

In our experiment, we used a relatively simple audit task that our participants are expected to be knowledgeable and competent in. While this minimizes the confounding effect of knowledge, it reduces the generalizability of our study. For instance, the benefits of warning and instructions may not apply to situations where the auditor does not have the requisite technical knowledge to think of options beyond what is documented in the working papers or what has been done in the past. In addition, in practice, time constraints occur over longer periods, which may be across days. The time pressure in such settings may differ from that in our experimental setting. In our study, we focus on individual auditors' responses to imposed time constraints. In practice, audits are carried in teams that often have greater resources at their disposal than that accorded to participants in our study in adapting to time constraints. Our findings also may not generalize to settings where auditors experience severe time constraints and/or are under extreme stress. For instance, if the auditor were at a breaking point in terms of stress levels, he/she may not have the cognitive resources to respond to warning of time pressure. Similarly, where severe time constraints are

imposed at the audit planning stage, auditors may not be able to appropriately adapt their audit procedures/plans in response to warning of impending time pressure. In addition, our results may not generalize to audits in which existing audit procedures or a prior year's audit procedures remain the most effective and efficient ones given a client's current-year circumstances, or where auditors are limited by their abilities to think of alternative audit procedures. The above limitations present interesting avenues for future research.

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