Inheriting vs. Developing Data Analytic Tests and Auditors' Professional Skepticism

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ABSTRACT: As the use of audit data analytic (ADA) tests becomes increasingly established in practice, auditors will often confront a situation where they typically inherit ADA tests developed by others. For example, auditors may inherit ADA tests that are developed by other members of their audit team or their firm's centralized analytics team. Despite the potential benefits of ADA, using ADA tests inherited from others, rather than developed by auditors themselves, could hinder auditors' application of professional skepticism due to their lack of psychological ownership of the ADA tests. In an experiment where an ADA test identifies a fraud red flag, we find that auditors who inherited the ADA test are less likely to exercise professional skepticism compared to those who were personally involved in the development of the ADA test. We then provide evidence that informing auditors who inherited the ADA test about the test development activities (e.g., a brief ADA memorandum documenting the ADA's development) boosts their skepticism levels.

JEL codes: G34, M40, M41, M42

Keywords: audit data analytics, fraud red flag, professional skepticism, psychological ownership, test development

I. INTRODUCTION

We examine whether auditors' application of professional skepticism suffers when they use an audit data analytic (ADA) test inherited from others, as opposed to an ADA test they developed themselves. ADA is defined as "the science and art of discovering and analyzing patterns, identifying anomalies, and extracting other useful information in data underlying or related to the subject matter of an audit through analysis, modeling, and visualization for the purpose of planning or performing the audit" (AICPA 2015, p. 92; 2017, p. 1). Although ADA tests take various forms, in this study we operationalize ADA tests as visualizations (i.e., graphical representations such as charts, scatter diagrams, or trend lines) because they are featured prominently in the AICPA's Guide to Audit Data Analytics and are currently used by most audit firms (e.g., AICPA 2015, 2017; Deloitte 2016; PwC 2020; Higginbotham, Nash, and Demeré 2021; BDO 2022). Other ADA techniques, such as full population testing, are often accompanied by visualizations to display their outcomes (e.g., AICPA 2015, 2017).[1]

In practice, auditors may inherit an ADA test, or they may develop their own ADA tests. Inheriting an ADA test occurs when someone else (e.g., another audit team member) developed the ADA test in the current or prior year and auditors are then given the ADA test to use in their own work. In contrast, developing an ADA test means that auditors themselves need to spend hours determining the data sources, collecting the data, verifying data reliability, evaluating the calibration of the data, and creating the visualizations. While inheriting an ADA test potentially benefits audit efficiency, we posit that it may hinder the auditor's application of professional skepticism when the ADA test identifies a red flag.

[1] To be clear, we investigate the effects of inheriting vs. developing ADA *tests* (e.g., the incorporation of visualizations into a substantive analytical procedure), not inheriting or developing ADA *tools* or *software* (e.g., Tableau). Related to full population testing, discussions with audit practitioners indicate that the initial testing of full populations of transactions is often performed by a centralized ADA team and then auditors of the engagement team *inherit* the transactions identified as anomalies to potentially investigate.

We argue that inheriting an ADA test decreases auditors' *psychological ownership* of the ADA, the feeling that the ADA test is 'theirs' (e.g., Rudmin and Berry 1987; Pierce, Kostova, and Dirks 2001; Van Dyne and Pierce 2004). Auditors' psychological ownership of an ADA test develops through three paths that strengthen as auditors' personal involvement increases: control over the ADA test, being associated with the ADA test, and investing the self into the ADA test (e.g., Vandewalle, Van Dyne, and Kostava 1995; Pierce et al. 2001; O'driscoll, Pierce, and Coghlan 2006; Paré, Sicotte, and Jacques 2006; Mayhew, Ashkanasy, Bramble, and Gardner 2007). As the use of ADA becomes more established, there will be fewer opportunities for auditors to cultivate psychological ownership of the tests. When auditors inherit the ADA test, they potentially miss out on all three routes to psychological ownership. Due to the diminished feelings of responsibility and commitment to the ADA test, auditors inheriting an ADA test are less likely to investigate red flags identified by the ADA (i.e., a decrease in professional skepticism).

Auditors' professional skepticism is a bedrock of audit quality and is defined as an attitude that includes a questioning mind and critical assessment of audit evidence (e.g., Nelson 2009; Nolder and Kadous 2018; IAASB 2020, ISQM 1). ADA visualizations offer powerful opportunities for potentially improving auditors' professional skepticism due to improved insights into client data allowing for more effective and efficient detection of unusual patterns and anomalies (e.g., FRC 2017; Anderson, Hobson, and Peecher 2020; Higginbotham et al. 2021). Lacking psychological ownership of the ADA test, auditors who inherit an ADA test, as opposed to those who engage in the development of the ADA test, potentially are less motivated to act skeptically when a red flag is visualized by the ADA test. Thus, the benefits of ADA tests may remain unrealized when auditors inherit them from others.

To combat the negative effect of inheriting an ADA test on auditors' professional skepticism, we propose a remedy that can be used in practice: informing auditors about the ADA test development activities (e.g., the time and effort invested by others in developing the ADA test). This

information could be conveyed via an ADA development memorandum (ADA memo) preceding the workpapers documenting the current year ADA test. We posit that being informed about the ADA test development activities increases auditors' psychological ownership of the ADA test, even if they do not personally invest (e.g., energy, time, and effort) in the ADA test. Providing auditors with intimate knowledge of the test development activities fosters the feeling of being associated with the ADA test, one of the three routes to psychological ownership (e.g., Rudmin and Berry 1987; Pierce et al. 2001). As such, we expect that informing auditors about the ADA test development activities will counter the adverse effect of inheriting ADA tests.

We test our hypotheses with a between-subjects experiment with 173 experienced senior-level auditors in the Netherlands from Big-Four and medium-sized firms. In a hypothetical audit case, participants performed a substantive analytical procedure related to a division's sales account.[2] After receiving background information, participants learned that the audit team had recently incorporated data analytic visualizations for the current year audit. Prior to presenting the visualizations, participants were randomly assigned to condition (1) requiring them to engage actively in the ADA visualizations development activities, (2) telling them that the visualizations had been previously developed by another audit team member, or (3) telling participants that the ADA visualizations were developed by another audit team member but providing an ADA memo documenting the ADA visualization development activities.[3]

Participants were then provided with five ADA visualizations presenting a rich five-year time series of financial and non-financial data from five different sources (e.g., prior year balances, budgets, industry trends, etc.). All participants received the same set of ADA visualizations and

[2] We employed a substantive analytical procedure task because ADA tests are often viewed as an outgrowth and expansion of analytical procedures (e.g., Appelbaum, Kogan, and Vasarhelyi 2017; AICPA 2017).

[3] There were two additional conditions: (4) Participants inherited the ADA visualizations with an ADA memo and being prompted to imagine that they themselves had developed the visualizations (this condition was collapsed in condition (3) inherit with an ADA memo) and (5) a *no ADA* condition which is used as a baseline condition where no visualizations were present. See the Method section for additional information.

detailed supporting data to hold the information set content constant across experimental conditions.[4] While sales growth was constant and the associated financial data pertaining to prior year balances, industry trends, budgeted amounts, and growth in related accounts were consistent with sales growth, one visualization revealed a sharp decline in the client's current year non-financial measures (e.g., number of employees, square footage of facilities, etc.), creating a NFM red flag for financial statement fraud (Brazel, Jones, and Zimbelman 2009). Participants then developed an expectation for the sales account, compared the expectation to the recorded balance, and concluded as to whether additional testing related to the analytical procedure was needed, which serves as a measure of skeptical action.

Our results indicate that auditors who inherit, as opposed to those who develop, an ADA test are less likely to act skeptically in response to the fraud red flag revealed by the ADA test. In a supplemental mediation analysis, we demonstrate that this effect is driven by the lack of psychological ownership for auditors who inherit the ADA test. Our proposed solution of informing auditors about the ADA test development activities appears to be effective as it boosts the skeptical actions of auditors who inherit the ADA test.

Our study contributes to the literature by examining the crucial relationship between ADA use and auditor professional skepticism (e.g., Dilla and Raschke 2015; Backof, Carpenter, and Thayer 2018; Barr-Pulliam, Brazel, McCallen, and Walker 2023; Commerford, Dennis, Joe, and Ulla 2022; Koreff 2022; Koreff and Perreault 2023; Lombardi, Brown-Liburd, and Munoko 2023; Peters 2023). Although ADA tests are expected to improve auditors' professional skepticism (e.g., Murphy and Tysiac 2015; FRC 2017, 2020), we demonstrate that the effectiveness of ADA tests depends on auditors' involvement in the development of these tests. Our study illustrates that the full benefits of utilizing ADA tests may not be realized when auditors inherit ADA from others, a likely situation as

[4] When the development stage of the experiment was complete, participants who developed the ADA were "fast forwarded" and presented with five visualizations that were the exact same as those provided to participants who inherited the ADA.

ADA becomes commonplace in audit practice. Therefore, we also contribute to the literature that addresses the added challenges ADA brings to auditor skepticism (e.g., Austin, Carpenter, Christ, and Nielson 2021; Walker, Barr-Pulliam, and Brown-Liburd 2022; Fiolleau, MacTavish, Osecki, and Thorne 2022; Bibler, Carpenter, Christ, and Gold 2022; Barr-Pulliam et al. 2023). This study highlights the importance of the "human" side when implementing ADA tests. Despite the technical features of ADA, we provide insights on the importance of psychological ownership of ADA tests, and therefore complement other studies of psychological ownership in the audit literature (e.g., Dierynck and Peters 2021).

Our findings have important implications for audit firms regarding their current practices vis-à-vis data analytics. Current education and training of the next generation of auditors increasingly emphasizes technology and data science, with the intent to prepare auditors to incorporate their own ADA tests into their work. This education and training also matches the younger generations' inherent interest in new technologies and innovations (CompTIA 2017). Having audit professionals participate more in ADA test development could help audit firms attract and retain talented professionals and combat the deepening shortage of auditors (e.g., IFAC 2019; Maurer 2023; Ellis and Overberg 2023). However, audit firms are potentially moving towards centralizing and specializing their ADA test development activities within their firms (e.g., Fedyk, Hodson, Khimich, and Fedyk 2022). Although such a move potentially benefits audit efficiency, we demonstrate that auditor skepticism may suffer when inheriting ADA tests developed by someone else. As such, our remedy of an ADA development memo may become even more crucial as auditors in the field inherit even more advanced forms of ADA tests, such as tests employing artificial intelligence technology.[5] Sufficient documentation of ADA development activities is also critical since, as the use of ADA

[5] In relation to shortage of accounting majors, the CEO of Grant Thornton recently stated that audit firms will have to rely more on artificial intelligence with fewer human professionals who will need to be trained in how to harness the technology (Ellis and Overberg 2023).

tests progresses over time, the team member(s) who developed the ADA test may no longer be on the engagement or with the firm and hence would not be available for consultation.

II. THEORY AND HYPOTHESIS DEVELOPMENT

Audit Data Analytics and Auditor Professional Skepticism

The use of audit data analytic (ADA) tests has the potential to benefit auditor professional skepticism. ADA allows auditors to incorporate more data from a wider variety of sources (e.g., Alles 2015; Alles and Gray 2016). ADA also helps auditors focus their testing on higher risk areas, improving the detection of financial statement errors and fraud (e.g., Schneider, Dai, Janvrin, Ajayi, and Raschke 2015; Perols, Bowen, Zimmermann, and Samba 2017). Visualizations – an important feature of ADA – enable auditors to simultaneously evaluate rich sets of data that are suggested by auditing standards (IAASB 2018, ISA 520; PCAOB 2020, AS 2305). For example, ADA visualizations that graphically depict trends in prior year balances, budgets or forecasts, industry data, data from related accounts, and non-financial measures could be incorporated into an auditor's substantive analytical procedures. Visual representations facilitate the identification of patterns and relationships and the detection of anomalies in the data (e.g., AICPA 2017).

However, audit practice should not take the realization of ADA benefits for granted. ADA can create challenges to auditor skepticism, such as information overload and an abundance of false positives (e.g., Austin et al. 2021; Walker et al. 2022; Fiolleau et al. 2022;; Bibler et al. 2022; Barr-Pulliam et al. 2023). We add to this stream of literature by investigating if inheriting ADA tests developed by others could be a substantial barrier to auditors' application of professional skepticism when employing ADA tests in the field.

Inheriting vs. Developing ADA Tests

Auditors' training and education increasingly emphasize data analytics (e.g., Dzuranin, Jones, and Olvera 2018; Surgent 2019; Richardson and Watson 2021, 2022; Hines and Tapis 2022; Losi, Isaacson, and Boyle 2022). Thus, auditors are increasingly equipped to be meaningfully involved in

the development of ADA tests. On the other hand, as the use of ADA becomes increasingly common in practice, auditors will very often inherit and use ADA developed by others. These "others" could be another team member or a centralized data analytics team. Indeed, audit firms have begun to centralize functions specializing in the development of audit tests using advanced technologies (e.g., Fedyk et al. 2022). As the use of ADA matures and ADA tests are established in each audit engagement, there will be fewer opportunities for auditors to engage in the development of the ADA tests they use in their audit work. In other words, inheriting ADA tests is likely to become commonplace in future audit practice. Although such a move potentially benefits audit efficiency, we suggest that inheriting an ADA test can impair an auditor's psychological ownership of the ADA test, resulting in lower levels of auditor skepticism when the ADA identifies a red flag.[6]

Psychological ownership is defined as "a state in which individuals feel as though the target of ownership or a piece of it is 'theirs'" (e.g., Rudmin and Berry 1987; Pierce et al. 2001; Van Dyne and Pierce 2004). In this context, the target is the ADA test. Psychological ownership is fostered through three potentially interrelated routes that likely increase with auditors' personal involvement in the ADA test development activities: control over the target, being associated with the target, and investing the self into the target (e.g., Pierce et al. 2001). Specifically, control over the ADA test refers to being able to manage the test. The organizational behavior literature finds that feelings of control predict employees' levels of psychological ownership (e.g., Pierce, O'driscoll, and Coghlan 2004; McIntyre, Srivastava, and Fuller 2009; Liu, Wang, Hui, and Lee 2012; Peng and Pierce 2015). Association with the ADA test relates to an auditor's intimate knowledge about the test. Possessing information about the test and coming to know it intimately also facilitates fostering feelings of ownership (e.g., Rudmin and Berry 1987; Beggan and Brown 1994). Investing energy, time, and effort ("the self") into the ADA test can be key to experiencing psychological ownership (e.g.,

[6] This argument is not without tension. Inheriting ADA tests is potentially more efficient and hence auditors have more cognitive resources available for applying skeptical actions, compared to developing ADA tests. In other words, inheriting an ADA test may also result in high levels of auditor skepticism when the ADA identifies a red flag.

Rudmin and Berry 1987; Pierce et al. 2001). The investment of an individual's energy, time, effort, and attention into the target (e.g., the ADA test) causes the self to become "one" with the target (e.g., Csikszentmihalyi and Halton 1981; Pierce et al. 2001). Compared to developing the ADA tests, inheriting ADA tests potentially lacks all three routes to psychological ownership, as auditors inheriting an ADA test are less personally engaged with the ADA.

Higher levels of psychological ownership of the ADA test are likely to motivate auditors to more thoroughly investigate any red flags identified by the test (i.e., increase skeptical actions) because psychological ownership reflects a sense of responsibility and affective commitment to the ADA test (e.g., Vandewalle et al. 1995; Pierce et al. 2001; O'driscoll et al. 2006; Paré et al. 2006; Mayhew et al. 2007). For instance, research in organizational behavior finds that feelings of ownership motivate a feeling of organizational commitment, spurring organizational citizenship and stewardship behaviors (e.g., Patchen 1970; Rodgers 1998; Han, Chiang, and Chang 2010; Hernandez 2012; Liu et al. 2012). Feelings of ownership also indicate a perceived responsibility to invest time and energy to care, protect, nurture, and advance the target (e.g., Korman 1970; Dipboye 1977; Long 1978, 1979; Vandewalle et al. 1995; Pierce et al. 2001; Avey, Avolio, Crossley, and Luthans 2009). We therefore posit that, due to a *lack* of psychological ownership, auditors inheriting an ADA test are less likely to thoroughly investigate any red flags identified by the ADA (i.e., a decrease in skeptical actions).[7] This leads to our first hypothesis, stated formally:

> **Hypothesis 1**: When a red flag is identified by an ADA test, auditors who inherit the ADA test will apply a lower level of skeptical action compared to auditors who have engaged in the development of the ADA test.

Being Informed About the ADA Test Development Activities

As the use of ADA tests matures and becomes established across audit engagements, there will likely be fewer opportunities for auditors to meaningfully engage in the development activities

[7] This expectation is not without tension. Using inherited ADA tests (compared to auditors developing ADA tests themselves) potentially saves auditors cognitive effort and hence they potentially have more cognitive resources available to allow for greater skeptical action. If this is the case, auditors inheriting ADA test will apply greater skeptical action than those who develop ADA tests themselves.

of ADA they employ in their testing. We propose that a potential remedy for inheriting ADA tests is *informing* auditors about the ADA test development activities. In practice, this development-related information could be conveyed via an ADA test development memorandum (ADA memo) preceding the workpapers where the ADA test is used.

We expect that informing auditors about the development activities of the ADA test (e.g., the number of hours spent on data reliability testing and diagnostics performed) will provide auditors with intimate knowledge about and familiarity with the ADA test, increasing their association with the ADA test. As mentioned beforehand, the feeling of association with the ADA test is one of the three routes (i.e., control, *association and intimate knowledge*, and investment of self) to psychological ownership (e.g., Rudmin and Berry 1987; Pierce et al. 2001). Psychological ownership theory suggests that any single route can result in feelings of ownership independent of the others, given the three routes are distinct, complementary, and additive in nature (e.g., Pierce et al. 2003).[8] We therefore expect that being informed about the development activities of the ADA test will increase auditors' psychological ownership of the ADA test, countering the adverse effect of inheriting ADA tests on skeptical actions.[9] This leads to our second hypothesis, stated formally:

> **Hypothesis 2:** When a red flag is identified by an ADA test, auditors who inherit the ADA test and are also informed about the ADA test development activities will apply a higher level of skeptical action compared to auditors who simply inherit the ADA test without being informed.

III. METHOD

Experimental Design

[8] Among the three routes, the second one, association and intimate knowledge, is potentially the only applicable route to increased psychological ownership when auditors inherit the ADA test. One can come to know a target intimately without personally creating it. The other two routes - control and investment of self - are more difficult to trigger without auditors' actual personal engagement in the ADA test development activities.

[9] A potential alternative explanation is that being informed about the development activities of the ADA test, compared to merely inheriting the ADA without this information, helps auditors to better assess the quality of the test. Informed auditors should therefore have more confidence in reliability of the ADA test (vs. auditors that simply inherit the ADA). However, in non-tabulated tests we observe that our experimental participants' confidence in the ADA test's reliability does not differ across conditions. Further, perceptions of confidence do not mediate the effect of being *informed* on our participants' skeptical actions.

To test our hypotheses, we conducted an experiment with a between-participants design.[10] Participants were randomly assigned to one of five conditions: *Develop ADA*, *Inherit ADA*, *Inherit and Inform ADA*, *Inherit and Inform ADA with a Prime*, or *No ADA*. As a stronger test of the mechanism underlying "*being informed*" and its effect on psychological ownership, we included an exploratory condition (*Inherit and Inform ADA with a Prime*), in which we prompted participants to imagine that they themselves had developed the ADA visualizations. We also included a *No ADA* condition as a baseline condition where no visualizations were present. We adapted the experimental case from Brazel et al. (2022) and Barr-Pulliam et al. (2023). Participants completed the experiment online.[11]

Participants

We obtained access to Dutch audit practitioners at four firms through the Foundation for Auditing Research. Liaisons at those firms helped us to recruit participants satisfying our requirement of audit seniors (i.e., 3 to 5 years' financial statement audit experience). At two of the audit firms, participants completed our online instrument during in-person training sessions. Liaisons at another audit firm organized online masterclasses and invited suitable candidates to join the classes and complete our instrument as part of the masterclass. Contacts at the fourth audit firm allowed us to introduce our study and call for participants during their training sessions so that participants could complete our instrument on their own time.[12]

Auditors (n = 173, mean audit experience = 4.5 years) were randomly assigned to one of the five treatment conditions and completed the experiment during their non-busy season. Twenty-nine percent of the participants are employed by Big Four audit firms. Our participants' primary industries of expertise are diverse (e.g., retail 18 percent, financial institutions 17 percent, and

[10] We obtained Institutional Research Ethical Review Board approval for the experiment used in this study.
[11] Representatives from the Foundation for Auditing Research (FAR) and audit professionals from the participating firms reviewed our instrument to ensure its clarity and realism.
[12] Our primary findings do not change when controlling for audit firm or data collection methods. The significant effects observed for our full sample are still observed when we split our full sample into two subsamples: (1) Big Four audit professionals and (2) Non-Big Four audit professionals.

manufacturing 16 percent). On average, 35 percent of their total chargeable audit hours over the last three years were spent on clients in the manufacturing industry (our experimental context). Eighty-five percent of the participants report experience performing a substantive analytical procedure related to sales (our experimental task). When performing substantive analytical procedures, participants on average report that they use non-financial measures or NFMs (the red flag embedded in our experiment) approximately 50 percent of the time when developing their expectations for current year balances.

Participants' average level of experience with using data visualizations is 5.25 measured on an 11-point Likert scale ranging from 0 (None) to 10 (Extensive). On average, participants report that when developing expectations for current year balances during substantive analytical procedures, they use visualizations 25 percent of the time. They further indicate that, when using data analytics, they inherit data analytics developed by others (e.g., audit team members, data specialists, or a centralized data analytics team) on average 38 percent of the time, ranging from 0 to 100 percent of the time. As such, whether auditors inherit ADA tests or develop their own ADA tests varies substantially in practice.[13]

Experimental Procedures and Independent Variables

Our experiment consisted of four stages (see Appendix A). In Stage 1, participants received background information about a hypothetical audit client and then were directed to perform a substantive analytical procedure. We employed a substantive analytical procedure task because data analytics are often viewed as an outgrowth and expansion of traditional analytical procedures (e.g., Appelbaum et al. 2017; AICPA 2017). Stages 2 and 3 asked questions verifying the success of our

[13] There are overall no significant differences between conditions for participants' demographic characteristics and experience levels, although there are differences between some conditions regarding participants' experience with using non-financial measures in substantive analytical procedures and experience with using data analytics developed by others. Our primary findings do not change when controlling for these two variables. These variables also do not significantly influence our participants' skeptical actions.

manipulations and capturing process variables. Stage 4 collected measures about their own audit practice experiences.

After receiving the background information, participants were told that their audit team recently introduced data analytic visualizations for the current year audit of the hypothetical client (except for participants in the *No ADA* condition). We operationalized ADA with visualizations because ADA visualizations (i.e., graphical representations such as charts, scatter diagrams, or trend lines) are used in most large audit firms and are featured prominently in the AICPA's Guide to Audit Data Analytics (e.g., Deloitte 2016; PwC 2020; BDO 2022; AICPA 2015, 2017), and hence are more likely to reflect current ADA practice. Participants in the *Develop ADA* condition were asked to *develop* ADA visualizations themselves (see Appendix B, Panel A). First, we asked them to think about and write down how they would develop the ADA visualizations.[14] Specifically, they indicated: 1) what data they would use, 2) how many years of data they would collect, and 3) where they would get the data. Next, they were told about the number of hours and substantial effort they had spent determining the data sources, collecting the data, verifying data reliability, and evaluating the calibration of the data. Finally, they created one of the five visualizations themselves. To avoid potential confounding factors, participants in the *Develop ADA* condition were purposely instructed to set up a visualization that did not reveal any red flag (i.e., Visualization 1 which uses prior year sales).[15] The *final* version of the five visualizations and supporting data provided were identical for all participants, with the exception of the *No ADA* condition where participants saw no visualizations.[16]

[14] To mitigate the potential confounding effect of writing vs. no writing and its related effect on working memory, participants in all conditions received a question requiring them to briefly summarize and write down the general steps of performing substantive analytical procedures.

[15] To clarify, we did not ask participants to use this visualization created themselves in their analytical procedure task; instead, they later were provided with the same visualizations as those in *Inherit ADA* and *Inherit and Inform ADA* conditions. This design aimed to increase participants' feeling of engagement with the visualizations.

[16] The five visualizations and supporting data were kept constant across all conditions (except the *No ADA* condition) to keep the information set equivalent between conditions (even for the *Develop ADA* condition). This design choice potentially diminishes the psychological ownership effect of *developing* ADA tests since participants in the *Develop ADA* condition did not really have complete control over the ADA test. The visualizations used in our study are reflective of the current use of ADA visualizations on audit engagements (Eilifsen, Kinserdal, Messier, and McKee 2020). Our

Participants in the *Inherit ADA* condition learned that another audit team member, Sam, had recently developed the ADA visualizations and hence they were now able to use those visualizations during their substantive analytical procedure (see Appendix B, Panel B). Similar to the *Inherit ADA* condition, participants in the *Inherit and Inform ADA* condition also learned that another team member, Sam, recently developed the ADA visualizations. In addition, they were *informed* about the development process of the ADA visualizations in an "Audit Data Analytic Visualizations Development Memorandum" (i.e., ADA memo) prepared by Sam (see Appendix B, Panel C). Specifically, they were informed about the number of hours that Sam had spent determining the data sources, collecting the data, verifying data reliability, evaluating the calibration of the data, and creating the visualizations.

With the aim of a stronger test of the effect of being *informed*, we tested a fourth condition: *Inherit and Informed ADA with a Prime*. Participants in this condition not only inherited the ADA visualizations and were informed about the ADA development process, but additionally were prompted to imagine that they themselves had developed the ADA visualizations. Specifically, they were told that "While reading the memorandum, try to imagine how you yourself would feel ***if you were experiencing*** the uncertainty and stress of developing the data analytic visualizations performed by Sam and how this experience would affect your work. Try to imagine how you yourself would feel ***if you were Sam***." Despite this addition, we observe no difference in our dependent variables between *Inherit and Inform ADA* and *Inherit and Inform ADA with a Prime*. As such, we combined the two conditions in our analyses (i.e., labeled as the *Inherit and Inform ADA* in our analyses).

We also added a baseline condition where participants were not given any visualizations or any information about using ADA visualizations (i.e., our *No ADA* condition). While the practical

discussions with practitioners also confirm that auditors have not yet widely incorporated more complex, advanced ADA visualizations into their audits.

implications of this condition are limited given audit firms' continuous move toward incorporating ADA on engagements, it may however provide further evidence on the adverse effects of inheriting ADA tests by comparing the skeptical actions between the *Inherit ADA* and *No ADA* conditions.

Similar to prior studies where the intent was to make skeptical actions costly for participants (e.g., Brazel et al. 2022), we held the budget and time pressure constant and relatively high across all conditions. Specifically, all participants were informed that the hours spent developing the ADA visualizations were charged to the budget of the sales and collection cycle, that their sales substantive analytical procedures were currently about to go over budget, and that the client's filing deadline was approaching.

Next, all participants performed a substantive analytical procedure related to a sales account. Specifically, they (1) developed an expectation for the sales account, (2) documented how they developed their expectation, and (3) compared their expectation to the recorded balance. Participants were provided with buttons to access a rich set of information to develop their expectation for the sales account. This information included both financial and non-financial data for the past five years and from sources suggested by auditing standards, including (1) prior year balances, (2) budgets, (3) industry growth rates, (4) growth in related accounts, and (5) growth in non-financial measures (PCAOB 2020, AS 2305; IAASB 2018, ISA 520). All financial measure trends were positive and consistent with the client's current year sales growth. However, the current year trend for all of the NFMs (e.g., number of customers, number of patents) was substantially negative and inconsistent with reported current year sales, reflecting the NFM red flag observed by Brazel et al. (2009) for fraud firms. One button, "Visualizations", provided participants with ADA visualizations presenting the five sources of data in visualized form (see Appendix B, Panel D). As stated previously, the five ADA visualizations were identical across all ADA conditions. Based on the information provided, participants next developed an expectation for the sales account and decided whether additional testing would be required related to the analytical procedure.

Dependent Variables

The dependent variable *Additional Testing* reflects our first measure of participants' skeptical actions and is coded as "1" if participants chose to perform additional testing, and "0" if not. For those participants choosing to perform additional work, we further measured their skeptical actions by asking what additional testing they would perform and/or what questions they would ask of client management. Based on their responses, we coded *Inquire MGMT* as "1" if participants chose to perform additional testing related to the NFMs and/or would inquire of the client management about the NFM red flag, and "0" otherwise.[17] All participants, regardless of whether they did or did not conclude that additional testing was required, were also asked whether there was anything that they would communicate to their audit manager, which serves as an additional measure of skeptical action. Based on their responses, we coded *Inform Manager* as "1" if participants mentioned in their open-ended responses that they would inform their audit manager about the NFM red flag, and "0" otherwise.

We then constructed our second dependent variable, *Composite Skeptical Action*, which is equal to "1" if participants would test/inquire of the client management about the NFM red flag *and/or* communicate the NFM red flag to their audit manager, and "0" otherwise. We used this composite measure of *Inquire MGMT* and *Inform Manager* rather than using them as separate dependent variables in our analyses because these actions represent the initial skeptical actions that auditors would undertake before subsequent, more costly skeptical actions are undertaken (e.g., expanding substantive testing, collecting additional evidence, etc.).

IV. RESULTS

Manipulation Checks

To confirm that our *Develop ADA* vs. *Inherit ADA* manipulation was successful, we asked participants to choose between "Me" or "Sam" in response to the question: "Who developed the

[17] For brevity, we will refer to this measure as simply inquiring of client management (*Inquire MGMT*).

ADA visualizations?" Approximately 86 percent of the participants in the *Develop ADA* condition passed this manipulation check (i.e., choosing "Me"). Approximately 91 percent of the participants in the three *Inherit ADA* conditions passed this manipulation check (i.e., choosing "Sam").[18, 19] The results indicate that participants internalized our *Develop ADA* vs. *Inherit ADA* manipulation.

We next offer evidence that participants in the *Inherit and Inform ADA* condition were more informed about the ADA test development activities than participants in the *Inherit ADA* condition, as intended. Specifically, we compare the time that participants in the *Inherit and Inform ADA* condition spent on the page where the ADA memo was provided (see Appendix B, Panel C) with the time that participants in the *Inherit ADA* condition spent on the corresponding page where they were simply told that Sam, a team member, recently developed data analytic visualizations for the current audit engagement (see Appendix B, Panel B). Participants in the *Inherit and Inform ADA* condition spent significantly more time on that page than participants in the *Inherit ADA* condition (129.08 seconds vs. 39.83 seconds, $t(102) = 9.29$, $p < 0.01$).[20, 21] This result indicates that participants in the *Inherit and Inform ADA* condition, compared to participants in the *Inherit ADA* condition, received

[18] Excluding participants who failed the manipulation checks does not qualitatively change our results.

[19] To provide additional insights on our manipulation of *Develop ADA* vs. *inherit ADA*, we also checked whether participants in the *Develop ADA* condition answered the three questions related to how they would develop the visualizations (i.e., what data they would use, how many years of data they would collect, and where they would get the data). All participants in the *Develop ADA* condition answered the three questions in a valid, comprehensible manner. For the first question "what data they would use," 83 percent mentioned prior year data and 74 percent mentioned industry data. Other examples of data they mentioned were sales budgets/forecasts (5 participants), and NFMs (e.g., number of products, number of employees) (11 participants). For the second question "how many years of data they would collect," the average number of years of data they would collect for developing the visualizations was four years. For the third question "where they would get the data," 94 percent of the participants noted that they would collect the data from internal sources (e.g., the client's system or prior audit files) and 77 percent of the participants indicated they would acquire the data from external sources (e.g., the Dutch Central Bureau of Statistics). As previously noted, participants in *Inherit ADA* conditions did not receive those questions.

[20] Reported *p*-values are two-tailed, except as otherwise noted as one-tailed given our hypotheses are directional.

[21] We also asked participants in the *Inherit ADA* vs. *Inherit and Inform ADA* conditions who chose "Sam", whether "Sam ALSO provided an ADA memo" or "Sam did NOT provide an ADA memo." Approximately 45 percent of the participants in the *Inherit ADA* condition who chose "Sam" correctly indicated that "Sam did NOT provide an ADA memo". The incorrect choice of the 55 percent of the participants in the *Inherit ADA* condition (i.e., who incorrectly indicated that "Sam ALSO provided an ADA memo") is likely due to the extensive amount of information and data present in our experimental case study (i.e., incorrectly recalling that, in all of the information and data provided, an ADA memo was present). Seventy five percent of the participants in the *Inherit and Inform ADA* condition who chose "Sam" correctly indicated that "Sam ALSO provided an ADA memo". Among those in both conditions who correctly indicated the visualizations were developed by Sam, participants in the *Inherit and Inform ADA* condition are significantly more likely to choose "Sam ALSO provided an ADA memo" than participants in the *Inherit ADA* condition (0.75 vs. 0.55, $\chi^2(1) = 3.83$, $p = 0.05$).

the ADA memo, spent time reading it, and hence were informed about the ADA development process.[22]

Hypothesis 1: Inheriting vs. Developing ADA Tests

H1 predicts that auditors who inherit ADA tests, compared to auditors who develop their own ADA tests, apply a lower level of skeptical action when a fraud red flag is present. Figure 1, Panel A graphically presents the levels of skeptical actions in the *Inherit ADA* condition and *Develop ADA* condition with corresponding descriptive statistics provided in Table 1. Visual inspection of the results across the *Inherit ADA* and *Develop ADA* conditions is consistent with our hypothesis. Participants in the *Inherit ADA* condition are less likely to conclude that additional testing related to the analytical procedure is needed, compared to participants in the *Develop ADA* condition (*Additional Testing*, 0.26 vs. 0.54). As shown in Panel A of Table 2, the logistic regression results reveal a significant negative effect of *Inherit ADA* vs. *Develop ADA* on *Additional Testing* (β = -1.19, χ^2 = 5.35, p = 0.01, one-tailed).

With respect to our second dependent measure, *Composite Skeptical Action*, auditors in the *Inherit ADA* condition are marginally less likely to either inquire of client management about the NFM red flag and/or inform their audit manager about the NFM red flag versus those in the *Develop ADA* condition (i.e., *Composite Skeptical Action*, 0.21 vs. 0.37; β = -0.82, χ^2 = 2.25, p = 0.07, one-tailed). Overall consistent with our prediction in H1, our results indicate that inheriting ADA tests, compared to developing ADA tests, impairs auditors' skeptical actions when an ADA test identifies a fraud red flag.[23]

[22] Regarding the manipulation check of *Prime*, we asked participants to indicate if they were told to imagine how they themselves would feel if they were Sam and experiencing the uncertainty and stress of developing the data analytic visualizations (1 = "Yes" or 2 = "No"). Ninety-one percent of the participants in the *Inherit ADA* condition and 97 percent of the participants in the *Inherit and Inform ADA* condition chose 2 or "No" and hence passed this manipulation check. Ninety percent of the participants in the *Inherit and Inform ADA, with a Prime* condition chose 1 or "Yes" and hence passed this manipulation check.

[23] Splitting participants based on their experience using data visualizations (mean = 5.25), we find that the negative effect of inheriting ADA tests, compared to developing ADA tests, is present only in the high-experience group rather than the low-experience group. This indicates that, as ADA become more prominent on more engagements and auditors gain more experience with ADA tests, the negative effects of inheriting ADA that we observe in this study could become more pronounced in practice.

Hypothesis 2: Informing About the ADA Test Development Process

Given that inheriting ADA tests impairs auditors' skeptical actions, identifying a potential remedy to mitigate this adverse effect is important. In H2 we posit that informing auditors about the development activities of the ADA test they inherited will apply a higher level of skeptical action (vs. auditors merely inheriting the ADA without further information). Figure 1, Panel B graphically presents the level of skeptical actions in the *Inherit ADA* and *Inherit and Inform ADA* conditions with corresponding descriptive statistics in Table 1. Visual inspection of the results across the *Inherit ADA* and *Inherit and Inform ADA* conditions is consistent with our hypothesis. The logistic regression results in Table 3 show that auditors in the *Inherit and Inform ADA* condition and in the *Inherit ADA* condition are not significantly different in their likelihood to perform *Additional Testing* (0.34 vs. 0.26; $\beta = 0.37$, $\chi^2 = 0.64$, p = 0.21, one-tailed). However, participants in the *Inherit and Inform ADA* condition, compared to those in the *Inherit ADA* condition, are more likely to either inquire of client management about the NFM red flag or inform their manager about the NFM red flag (i.e., *Composite Skeptical Action*, 0.47 vs. 0.21; $\beta = 1.24$, $\chi^2 = 6.44$, p < 0.01, one-tailed). Overall, our results indicate that when inheriting ADA tests, informing auditors about ADA test development can improve their skeptical actions, depending on how such actions are measured. H2 is therefore partially supported.

Supplemental Analyses

Mediation of Psychological Ownership

The proposed theoretical explanation for our first hypothesis is that auditors inheriting the ADA test, compared to those developing the ADA test, lack psychological ownership of the test, thus impairing their perceived responsibility related to the test and hence motivation to exercise skeptical actions when using the ADA test.[24] The proposed theoretical explanation for our second hypothesis

[24] *Psychological Ownership* is measured by asking participants to what extent they felt that they "owned" the data analytic visualizations (or at least some part thereof) with an 11-point Likert scale ranging from 0 (Very Little) to 10 (Very Much). Participants in *Develop ADA* condition, compared to *Inherit ADA* condition, perceive a higher level of psychological ownership of the ADA visualizations (4.74 vs. 3.63, $t(67) = 1.94$, p = 0.06).

is that informing auditors about the development activities related to the ADA test, compared to simply inheriting the ADA, is expected to increase auditors' feeling of ownership of the ADA test developed by the other team member.

To examine the proposed underlying process, we use the Hayes (2018) PROCESS model 4 in SPSS to test the indirect effect via *Psychological Ownership*. We use 5,000 bootstrap resamples with replacement to estimate 90 percent confidence intervals for the indirect effect, with significant mediations indicated by intervals that exclude zero. As shown in Figure 2, we find a significant indirect effect of *Develop ADA*, compared to *Inherit ADA,* on *Additional Testing* through *Psychological Ownership* ($a_1 * b_1$ = 0.16, SE = 0.11; 90% LLCI = 0.03, 90% ULCI = 0.38). This significant indirect effect supports that inheriting an ADA test from someone else, compared to engaging in the development of the ADA test, decreases auditors' psychological ownership of the ADA test, reducing their skeptical action of performing additional testing when a fraud red flag is present. However, the indirect effect of *Inherit and Inform ADA*, compared to *Inherit ADA,* on *Additional Testing* through *Psychological Ownership* is not significant ($a_2 * b_1$= -0.07, SE = 0.07; 90% LLCI = -0.21, 90% ULCI = 0.03). We address this insignificant result in the analysis that follows.

Moderating Effect of Trait Empathy

The indirect effect of *Inherit and Inform ADA*, compared to *Inherit ADA,* on *Additional Testing* through *Psychological Ownership* may be moderated by participants' level of trait empathy. Empathy includes "vicariously experiencing another person's emotions (affect-sharing), deliberately considering another person's perspective in order to understand their thoughts and feelings (mentalizing), and a desire to improve another person's welfare" (Gaesser 2013, 1). Although empathy is regarded as an intuitive ability of humans, the level of trait empathy varies across individuals (e.g., Davis 1980; Dale 2014; Wondra and Ellsworth 2015). Auditors with higher

empathy are more likely to develop an empathic understanding of the person who developed the ADA test, motivating a higher level of ownership of the ADA test (e.g., Goleman 1995). As such, being informed about the ADA test development process is more likely to increase psychological ownership of the ADA test and thereby skeptical actions among high-empathy auditors compared to low-empathy auditors.

To address the conjecture, we first add a measure of our participants' trait empathy as a control variable to the analyses for Hypothesis 2 and the mediation analysis. It does not change our results.[25] We next separate participants into high-empathy and low-empathy groups based on the mean of their measured trait empathy (23.73). We find that the positive effect of being informed on skeptical action is present only in the higher empathy group (*Composite Skeptical Action*, 0.55 vs. 0.11; $\beta = 2.35$, $\chi^2 = 8.31$, $p < 0.01$), and not in the lower empathy group (*Composite Skeptical Action*, 0.38 vs. 0.33; $\beta = 0.18$, $\chi^2 = 0.08$, $p = 0.78$).[26]

We also add the auditors' trait empathy as a moderator to our simple mediation model depicted in Figure 2. We use Hayes (2018) PROCESS model 8 in SPSS to test the moderation of trait empathy on the indirect effect via *Psychological Ownership*. Results in Figure 3 reveal that the moderated mediation index is significant (index = 0.02, SE = 0.01, 90% LLCI = 0.01, 90% ULCI = 0.04). The level of auditors' trait empathy has a significant positive effect on their feeling of ownership of the ADA test and skeptical action when they are informed of ADA development activities. If and how auditors' traits impact their use of future ADA innovations, such as the incorporation of artificial intelligence into audits, represents a fruitful area for future research.

Developing vs. Inheriting and Informing ADA

Informing auditors about the ADA test development activities may be weaker in increasing their psychological ownership compared to personally developing the ADA test because theory

[25] We measured participants' trait empathy using questions related to perspective taking, fantasy, and empathic concern aspects of the interpersonal reactivity index (Davis 1980). The measure of the trait empathy itself is also not significant in the model.

[26] The effects of being informed on *Additional Testing* are not significant in both the higher and lower empathy groups.

further suggests that psychological ownership is stronger when the state is reached through multiple routes rather than just one route (e.g., Pierce et al. 2003). Moreover, Pierce et al. (2003) speculate that the routes of control and investment of self in the target have the potential to be more effective in fostering psychological ownership than intimate knowledge. The logic being that controlling and investing the self in a target can naturally lead to the other route, knowing intimately, but not the other way around. For example, building a house is likely to result in a detailed and in-depth understanding of the house. However, possessing an in-depth understanding of a house does not necessarily require the individual to build the house. Given the potential additive effects of the three routes, the joint effect of ownership through the three routes may be greater than simply coming to intimately know the target (Pierce et al. 2003).[27] Therefore, informing auditors about the ADA test development activities and hence enhancing their association with the ADA test may be weaker in increasing their psychological ownership and skeptical action compared to personally developing the ADA test where all of the three routes are involved.

Comparing the *Develop ADA* condition with the *Inherit and Inform ADA* condition, Table 4, Panel A indicates that participants in *Inherit and Inform ADA* condition are less likely to recommend additional work related to the analytical procedure than participants in *Develop ADA* condition (*Additional Testing* 0.34 versus 0.54; β = -0.82, χ^2= 3.79, p = 0.05). This potentially supports the speculation in Pierce et al. (2003) that the joint effect of the three routes (present in our *Develop ADA* condition) may have a greater effect than simply coming to know the target as was the case in our *Inherit and Inform ADA* condition. Still, there is no significant difference in their likelihood of either inquiring of client management or informing their manager about the NFM red flag as shown in Table 4, Panel B (i.e., *Composite Skeptical Action* 0.47 vs. 0.37; β = 0.41, χ^2= 0.94, p = 0.33).

[27] The theory does not conjecture about the separate effect of each route (i.e., controlling vs. investing the self vs. knowing intimately) or whether some combinations of the routes are more effective at generating psychological ownership than others.

Overall, informing auditors about the ADA visualization development activities boosts their skeptical actions, but not fully to the levels we observe in our *Develop ADA* condition.[28]

This also motivates a rank ordering of the three conditions in terms of their skeptical action levels (i.e., *Inherit ADA* < *Inherit and Inform ADA* < *Develop ADA*). We conduct contrasts to examine the pattern of the three conditions. Results in Table 4, Panel C and Panel D show that the rank ordering is partially supported, specifically when using *Additional Testing* as the dependent variable.

Baseline No ADA Condition

We included a baseline *No ADA* condition in our experiment. Since we expect that inheriting ADA tests will impair auditors' application of professional skepticism, we further explore this issue by comparing *Inherit ADA* vs. *No ADA*. We do not observe a significance difference for *Additional Testing*, but we do find that the level of *Composite Skeptical Action* in the *Inherit ADA* condition is significantly lower compared to the *No ADA* condition (*Composite Skeptical Action* 0.21 vs. 0.53; β = -1.47, χ^2 = 7.23, p < 0.01). This provides some additional evidence for the detrimental effect of inheriting ADA tests.

The level of skeptical actions in the *No ADA* and the *Develop ADA* conditions are similar overall. Our manipulation of *Develop ADA* is more condensed/shorter than what auditors experience in practice when developing ADA tests themselves (given our time constraints related to participant access during our experimentation). For experimental control, we fast forwarded them to the same visualizations as in other conditions to maintain information content constant. This design choice potentially limits the extent of psychological ownership effect in our *Develop ADA* condition and hence auditors' skeptical actions. Future research can examine how the *extent* of ADA development impacts psychological ownership and auditors' skeptical actions.

[28] Using the Hayes (2018) PROCESS model 4 in SPSS, we find a significant indirect effect of *Develop ADA*, compared to *Inherit and Inform ADA*, on *Additional Testing* through *Psychological Ownership* (a $*$ b_1 = 0.19, SE = 0.16; 90% LLCI = 0.01, 90% ULCI = 0.49). The indirect effect of *Develop ADA*, compared to *Inherit and Inform ADA*, on *Composite Skeptical Action* through *Psychological Ownership* is not significant (a $*$ b_1 = 0.05, SE = 0.11; 90% LLCI = -0.11, 90% ULCI = 0.25).

However, compared with participants in the *Develop ADA* condition, those in the *No ADA* condition spent significantly more time examining the data and information provided (758.62 seconds vs. 534.66 seconds, $t(67) = 2.38$, $p = 0.02$) and clicked the buttons to access the raw data more times (4.37 vs. 2.53, $t(67) = 3.04$, $p < 0.01$), representing a 42 percent increase in time and a 73 percent increase in accessing the raw data. These results imply that, although in the end they achieved equal levels of skeptical actions as those in the *Develop ADA* condition, auditors in the *No ADA* condition expended more time and effort. Considering the budget and time pressure that auditors usually face, our results indicate that developing and using ADA tests have the potential to increase audit efficiency with no impairment of skepticism. Given the claims that advances in ADA will improve audit quality (e.g., KPMG 2023), additional research comparing ADA versus non-ADA settings would be useful to identify the conditions where ADA enhances (or does not enhance) the auditor's ability to detect material misstatements in financial statements.

Skeptical Judgment

In our primary analyses (i.e., Hypotheses 1 and 2), we focus on auditors' skeptical *actions*. In this supplemental analysis, we also investigate their skeptical *judgments*. Prior literature identifies two distinct stages of professional skepticism: *skeptical judgment* which involves auditors' cognitive assessments of information (e.g., identifying a red flag or evidence inconsistency), and *skeptical action* which involves their follow-up actions (e.g., investigating the identified red flag) (e.g., Shaub and Lawrence 2002; Nelson 2009). Skeptical judgment is generally expected to motivate skeptical action, but prior research shows that this does not always occur (e.g., Brazel et al. 2022).

Our primary measure for *Skeptical Judgment* is a coded variable based on the participant's response to a post-experimental open-ended question asking if they noticed any unexpected relationships or inconsistencies in the data provided. *Skeptical Judgment* is coded as "1" if the participant mentioned the NFM red flag in his/her response, and "0" if otherwise. *Confidence in Skeptical Judgment* is measured for participants who indicated that they did notice an unexpected

relationship or inconsistency in the data provided *and* who mentioned the NFM red flag in their response. We measured *Confidence in Skeptical Judgment* by asking participants to what extent they were confident that the unexpected relationship or inconsistency that they identified (i.e., the NFM red flag) should be investigated with an 11-point Likert scale ranging from 0 (Very Low Confidence) to 10 (Very High Confidence). Our secondary measure capturing the participants' skeptical judgments is *Risk Assessment for Material Misstatement* for the sales account, measured with an 11-point Likert scale ranging from 0 (Very Low) to 10 (Very High).

Table 5 summarizes the descriptive statistics for our measures related to skeptical judgment in the *Develop ADA*, *Inherit ADA*, *Inherit and Inform ADA*, and *No ADA* conditions. Even though we observe variation between experimental conditions in relation to skeptical *actions*, there are *no* significant differences across conditions for *Skeptical Judgment* and *Confidence in Skeptical Judgment*, as indicated in Panel A and Panel B of Table 6. However, participants in the *Develop ADA* condition and *Inherit and Inform ADA* condition, compared to those in the *Inherit ADA* condition, assess a marginally higher likelihood that the sales account is materially misstated as shown in Panel C of Table 6 (5.17 vs. 4.15, $t(67) = 1.02$, p = 0.09; 4.99 vs. 4.15, $t(102) = 1.71$, p = 0.09).

We also post-experimentally asked participants: "How confident were you in the reliability of the data analytic visualizations related to the sales account?" Results of *Confidence in the ADA Test* show no significant difference between any of our experimental conditions ($F_{2, 136} = 0.49$, $p = 0.61$). This indicates that engaging in the development of an ADA test or being informed about the ADA test development activities does not make auditors believe the ADA test is of higher reliability. This finding potentially alleviates the concern about a potential alternative explanation that being informed about the development activities of the ADA test, compared to merely inheriting without this information, helps auditors to better assess the quality of the test.

V. CONCLUSION

This study investigates the effects of inheriting versus developing ADA tests on auditors' application of professional skepticism when those tests identify a red flag. Auditors who inherit an ADA test, compared to auditors who are personally involved in the development of the ADA test, are overall less likely to exercise skeptical actions, and this effect can be explained by their lack of psychological ownership of the ADA test. Informing auditors about the development activities involved in the ADA test, compared to simply inheriting the ADA tests, helps boost auditors' skeptical actions. This study contributes to an emerging literature linking ADA to professional skepticism (e.g., Barr-Pulliam et al. 2023). It also provides practical findings with respect to ADA development practice within audit firms and on audit engagements. Our study contributes to the argument about standardized vs. customized audit approaches, implying that standardizing audit innovations can inhibit auditor skepticism and ultimately decrease audit quality (e.g., Glover, Prawitt, and Spilker 1997; Bowrin 1998). This study also contributes to the psychological ownership research, especially research related to its three routes (e.g., intimate knowledge) and the role of personality traits with respect to psychological ownership (e.g., Pierce et al. 2003; McIntyre et al. 2009; Dawkins, Tian, Newman, and Martin 2017).

Our experiment includes a number of design choices that provide opportunities for future research. We positioned our experimental task as utilizing ADA visualizations during substantive analytical procedures of a sales account. We do not believe that the underlying mechanism related to psychological ownership is limited to the context of ADA visualizations used during analytical procedures. Although the spectrum of ADA is broad (e.g., regression, visualization, full population testing, artificial intelligence, etc.), the effect of inheriting vs. developing ADA on auditors' psychological ownership and skeptical actions likely generalizes to other types of ADA tests. Future research can examine whether the effect of developing vs. inheriting indeed generalizes to different types of ADA and other substantive tests where ADA are employed.

With the increasing integration of artificial intelligence into audit practice, it is realistic to assume that auditors will most likely inherit such advanced ADA from centralized ADA centers (Fedyk et al. 2022). This is potentially worrisome given our finding that using inherited ADA tests could impair auditors' skeptical actions. On the other hand, artificial intelligence could motivate auditors' skepticism by, for example, screening out false positives, which can inhibit auditors' skeptical actions (Barr-Pulliam et al. 2023). Examining these counter-vailing effects represents a fruitful area for further research.

Participants in our inherit conditions inherited an ADA test developed by another team member in the current year. Future research can examine whether the negative effect of inheriting ADA tests becomes weaker or stronger when the ADA tests are developed by data specialists or a centralized data analytics center that would be would relatively independent of the audit team. Further, future studies can examine if the inherit effect increases when ADA are inherited from prior years and the team member(s) who developed the ADA test are likely no longer on the engagement team or employed by the audit firm.

Although prior research examines the effects of inheriting audit evidence, judgments, or tests from prior years (e.g., Tan 1995; Bhattacharjee, Kida, and Hanno 1999), inheriting ADA tests is different compared to inheriting something related to traditional audit procedures due to the fact that auditors potentially lack a solid understanding of ADA compared to more traditional audit approaches. Under this circumstance, engagement with and developing of ADA tests potentially plays a more crucial role. Examining if the effects of inheriting ADA tests differ from inheriting traditional audit testing represents a fruitful area for further research.

Last, since ADA tests are being increasingly used on audit engagements, inheriting ADA will potentially become commonplace. Future studies can investigate other potential remedies to mitigate the adverse effects of inheriting ADA. Inheriting ADA tests, rather than being engaged in the development of the ADA, could also potentially "deskill" auditors in relation to ADA (e.g., Sutton,

Arnold, and Holt 2018). A longitudinal study using archival or survey data could be conducted to examine the effect of inheriting ADA on auditors' ADA skillsets, professional skepticism, and audit quality over time.

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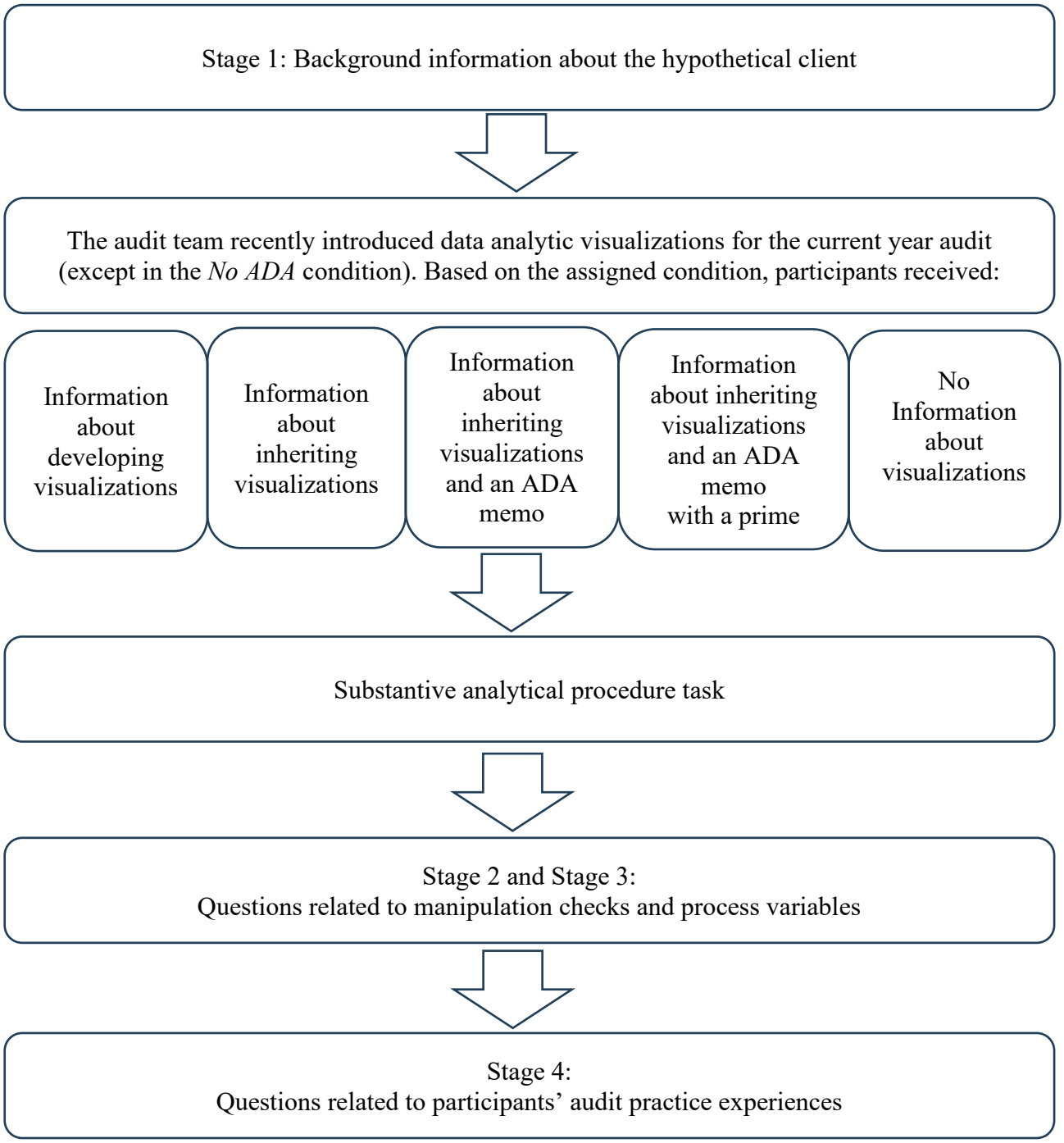
APPENDIX A
Summary of Experimental Procedures



APPENDIX B

Excerpts from Experiment

Panel A: Information related to data analytic visualizations received by *Develop ADA* condition

Your audit manager asked **you** to ***develop data analytic visualizations*** for Ruiter's *Sporting Goods Sales account*. Your manager granted you control and freedom over how you will develop and use the visualizations.

Based on your initial consideration, this task includes determining the data sources, collecting the data, verifying data reliability, evaluating the calibration of the data in relation to predicting Ruiter Sporting Goods Sales, and setting up the visualizations.

Now, take a moment to think about how you would develop your visualizations related to your substantive analytical procedure for Ruiter's *Sporting Goods Sales account*. Please briefly summarize and write down your thoughts related to each of the following questions in the space below.

1) What data (e.g., prior year balances, industry trends) would you use in your visualizations to compare with Ruiter Sporting Goods Sales?

2) How many years of the data would you collect?

3) Where would you get the data?

Next

One week later

After extensive consideration, you have decided to use the following data to develop your visualizations to compare with Ruiter Sporting Goods Sales over the last five years:

- **Prior Years' Sales**
- **Ruiter B.V. Consolidated Sales**
- **Industry Sales Growth**
- **Non-Financial Measures**
- **Budgeted Sales**

You have spent **16 chargeable hours** determining the data sources, collecting the data, verifying data reliability, and evaluating the calibration of the data in relation to predicting Ruiter Sporting Goods Sales.
You have also charged **4 hours** (in addition to the previous 16 hours) determining the most appropriate form to set up your visualizations based on firm training materials and watching firm tutorials: You will use **line graphs**.

After these efforts, you have now come to the final step: Setting up your visualizations to use in relation to your substantive analytical procedure for Ruiter's *Sporting Goods Sales account*. Your visualizations include:
***Visualization 1**, Ruiter Sporting Goods: Current Year Sales vs. Prior Year Sales*
***Visualization 2**, Ruiter Sporting Goods Percentage of Consolidated Sales: Current Year vs. Prior Year*
***Visualization 3**, Annual Sales Growth: Ruiter Sporting Goods vs. Sporting Goods Industry*
***Visualization 4**, Ruiter Sporting Goods: Sales Growth vs. Average Change in Non-Financial Measures*
***Visualization 5**, Ruiter Sporting Goods: Current Year Sales vs. Budgeted Sales*

It is now time to set up your visualizations. Please proceed by downloading the Excel file provided where you will set up your ***Visualization 1***. Please use your ***best judgment*** to set up a **line graph** for your ***Visualization 1***.

Note: Setting up the visualization will take you about 5-10 minutes.

Please click the button below to **download** the Excel file and then **set up** your ***Visualization 1*** in this file. After finishing, please **save** your ***Visualization 1*** in the excel file.

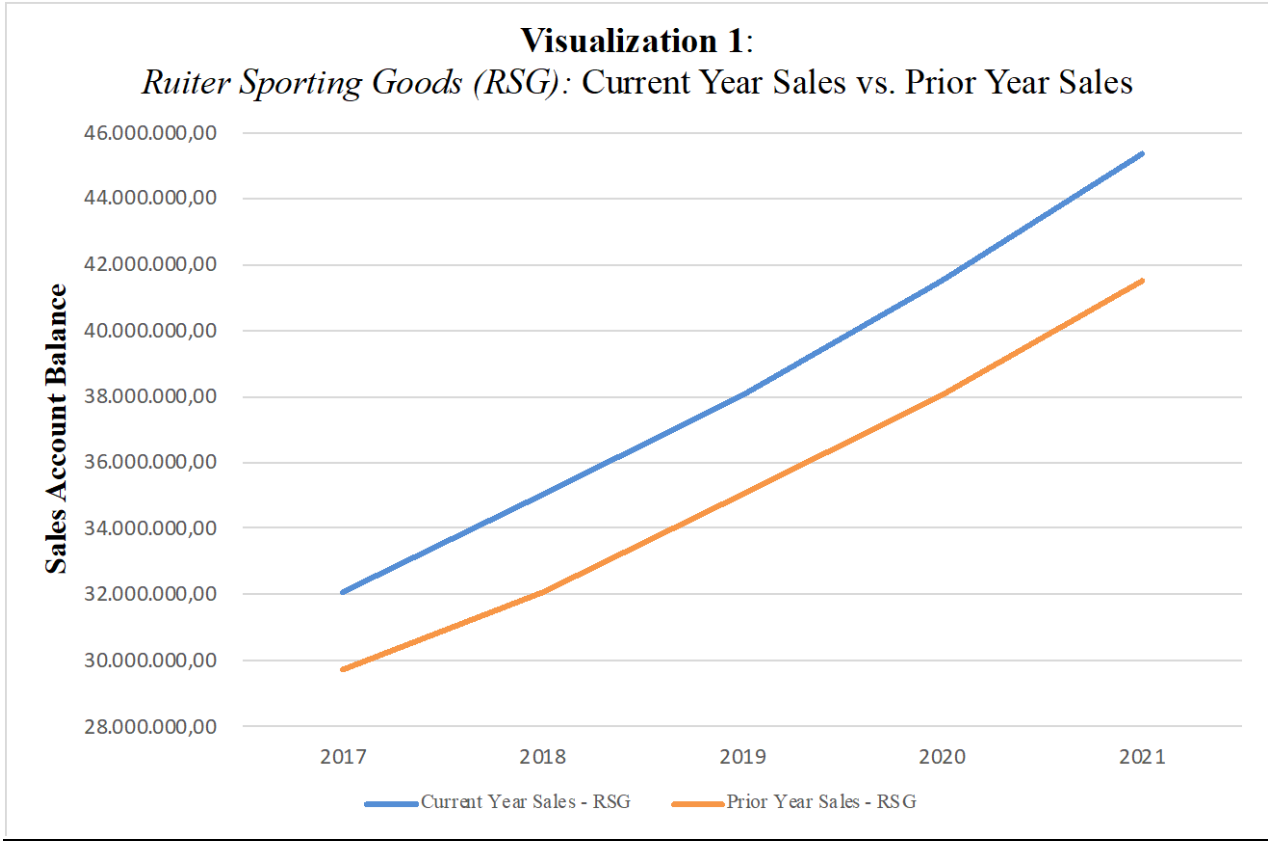
Download Excel file

After finishing and saving your ***Visualization 1*** in the Excel file, please **upload** the Excel file back by clicking the space below.

Please select the file that you want to upload

Next

Based on your development of your ***Visualization 1***, your final version looks as follows.



Note: The final version may differ slightly from what you have set up. Please treat the visualization as though you created it yourself.

You have also set up your other four visualizations to be consistent with your ***Visualization 1*** as shown above. The five visualizations you developed will be shown on the next page when clicking the button "Visualizations".

Panel B: Information related to data analytic visualizations received by *Inherit ADA* condition

Your audit manager asked ***Sam***, ***another in-charge/senior***, to develop data analytic visualizations for the current year Ruiter audit engagement. Therefore, Sam recently developed data analytic visualizations for Ruiter's *Sporting Goods Sales account*. Your manager granted you control and freedom over how you will use the visualizations developed by Sam. The visualizations developed by Sam will be shown on the next page when clicking the button "Visualizations".

Panel C: Information related to data analytic visualizations received by *Inherit & Inform ADA* condition

Your audit manager asked ***Sam***, ***another in-charge/senior***, to develop data analytic visualizations for the current year Ruiter audit engagement. Therefore, Sam recently developed data analytic visualizations for Ruiter's *Sporting Goods Sales account*. Your manager granted you control and freedom over how you will use the visualizations developed by Sam. The visualizations developed by Sam will be shown on the next page when clicking the button "Visualizations".

The following is a memorandum describing the development of the data analytic visualizations performed by Sam.

Prepared by: SGR 15/1/2022

Audit Data Analytic Visualizations Development Memorandum

Subject: Ruiter's *Sporting Goods Sales account*

Task: ***Develop data analytic visualizations***: determine the data sources, collect the data, verify data reliability, evaluate the calibration of the data in relation to predicting Ruiter Sporting Goods Sales, and set up the visualizations.

The following data were used to develop the visualizations to compare Ruiter Sporting Goods Sales over the last five years:

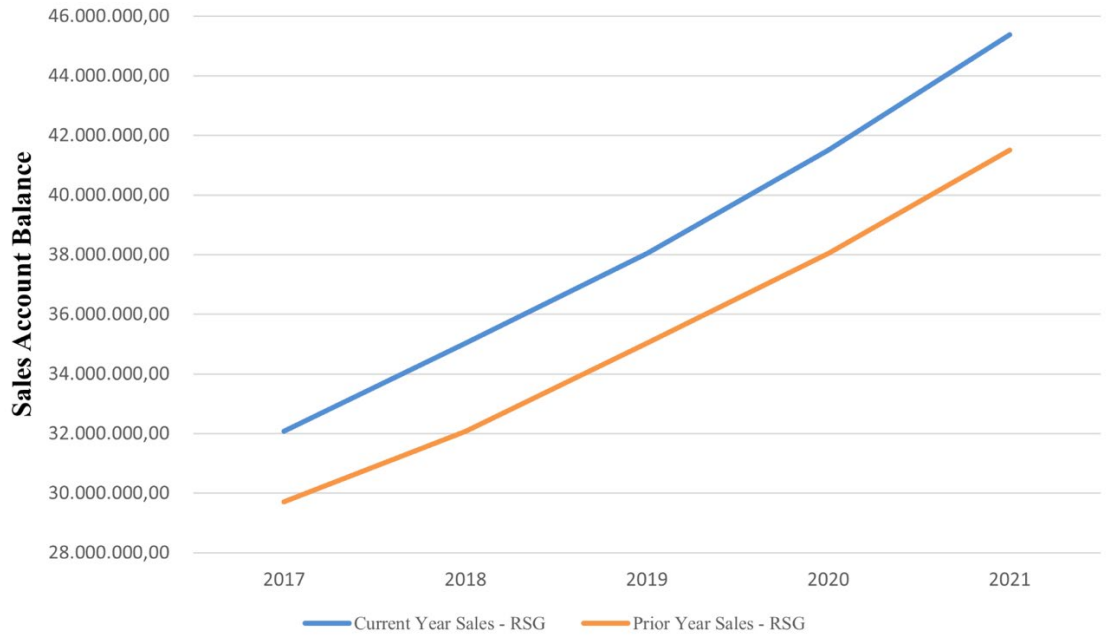
- **Prior Years' Sales**
- **Ruiter B.V. Consolidated Sales**
- **Industry Sales Growth**
- **Non-Financial Measures**
- **Budgeted Sales**

Costs: Spent **16 chargeable hours** determining the data sources, collecting the data, verifying data reliability, and evaluating the calibration of the data in relation to predicting Ruiter Sporting Goods Sales. Charged **4 hours** (in addition to the previous 16 hours) determining the most appropriate form (i.e., **line graphs**) to set up the visualizations based on firm training materials and watching firm tutorials.

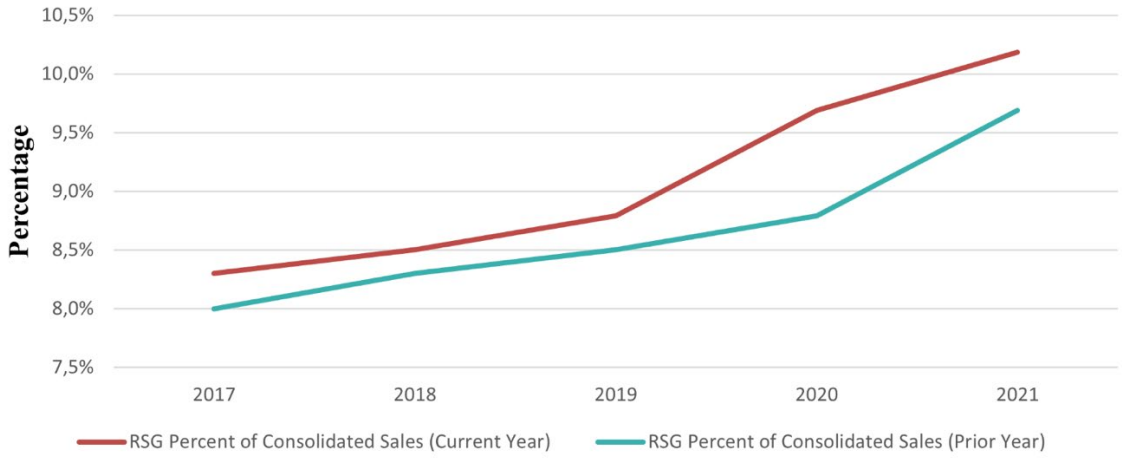
Visualizations to be used in relation to the substantive analytical procedure for Ruiter's *Sporting Goods Sales account* include:
Visualization 1*, Ruiter Sporting Goods: Current Year Sales vs. Prior Year Sales*
Visualization 2*, Ruiter Sporting Goods Percentage of Consolidated Sales: Current Year vs. Prior Year*
Visualization 3*, Annual Sales Growth: Ruiter Sporting Goods vs. Sporting Goods Industry*
Visualization 4*, Ruiter Sporting Goods: Sales Growth vs. Average Change in Non-Financial Measures*
Visualization 5*, Ruiter Sporting Goods: Current Year Sales vs. Budgeted Sales*

Panel D: The five ADA visualizations

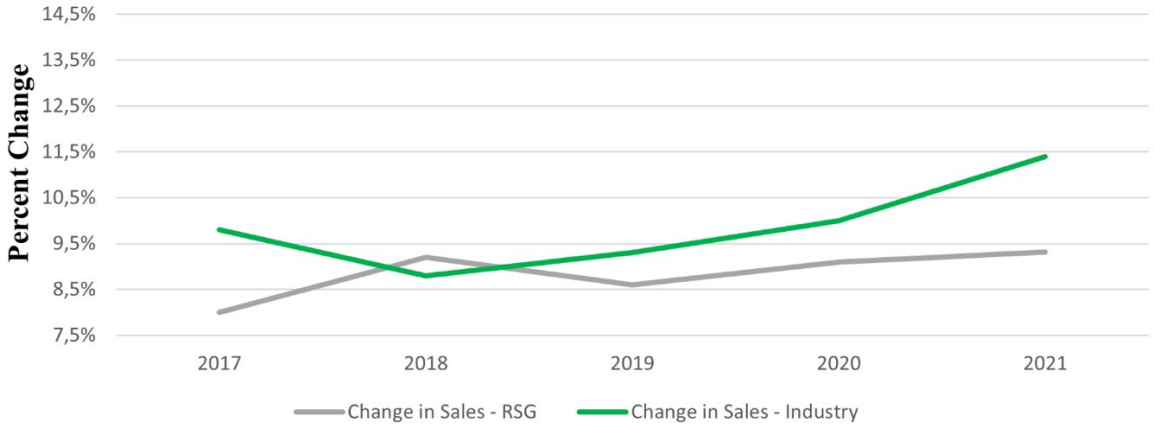
Visualization 1:
Ruiter Sporting Goods (RSG): Current Year Sales vs. Prior Year Sales



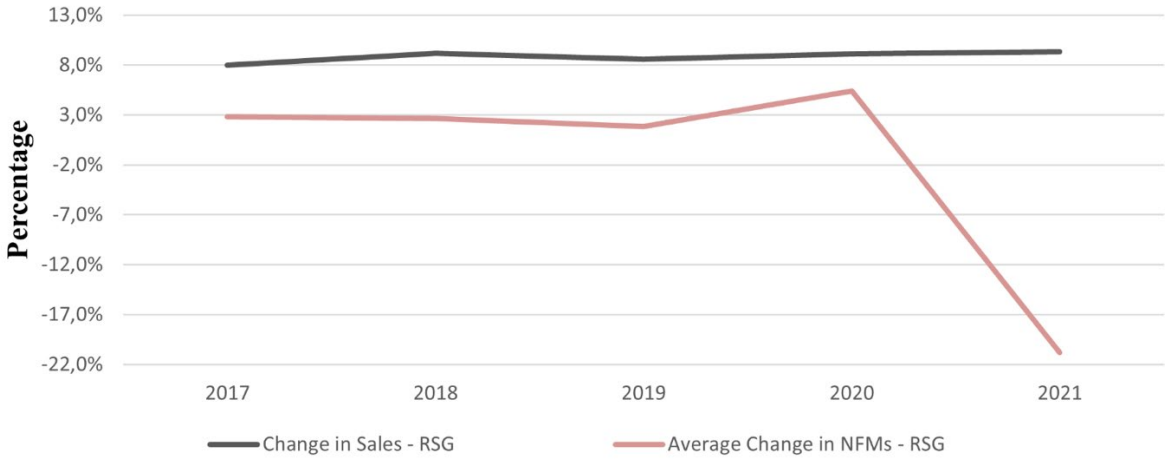
Visualization 2:
Ruiter Sporting Goods (RSG) Percentage of Consolidated Sales:
Current Year vs. Prior Year



Visualization 3:
Annual Sales Growth: Ruiter Sporting Goods (RSG) vs. Sporting Goods Industry



Visualization 4:
Ruiter Sporting Goods (RSG): Sales Growth vs. Average Change in Non-Financial Measures (NFMs)



Visualization 5:
Ruiter Sporting Goods (RSG): Current Year Sales vs. Budgeted Sales

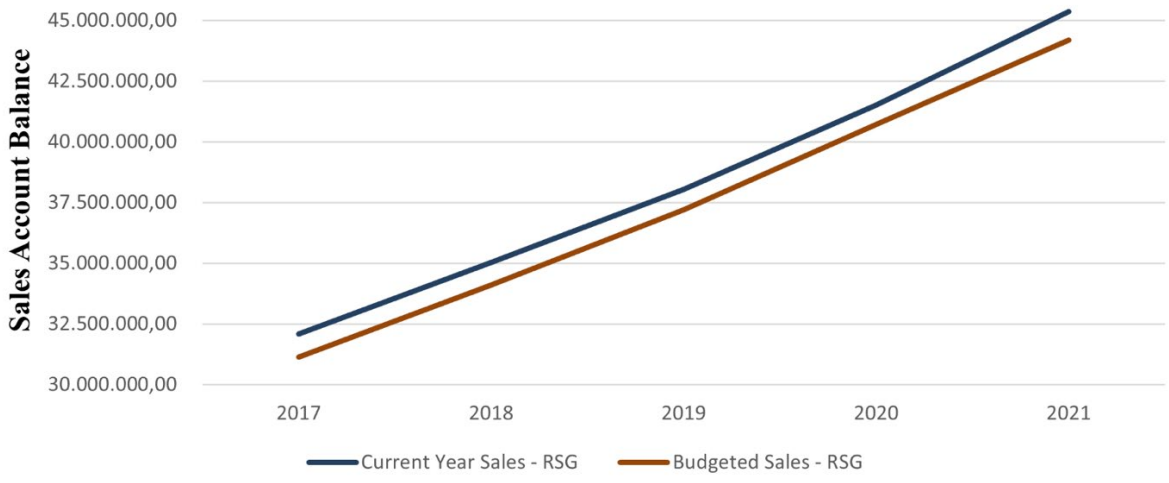


FIGURE 1

Visualized Descriptive Statistics for Skeptical Actions

Panel A: Skeptical Actions - Inherit ADA vs. Develop ADA

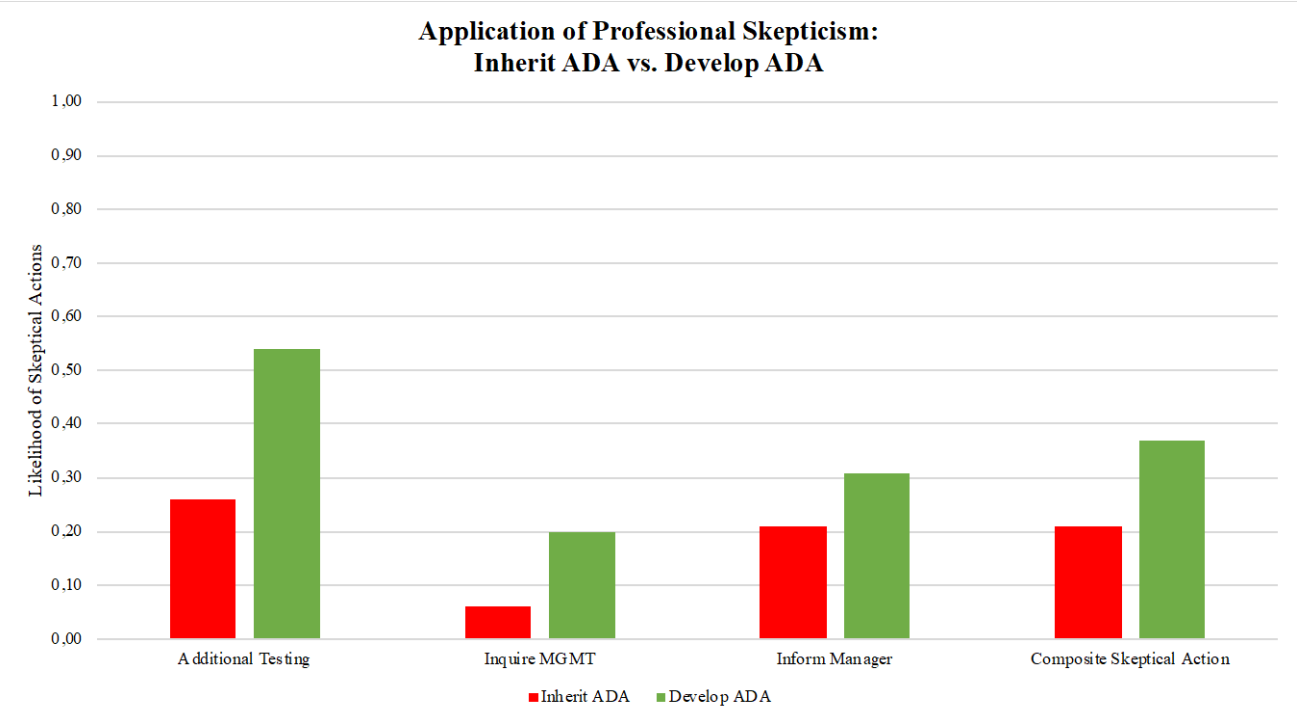


Figure 1, Panel A illustrates the cell means for *Additional Testing*, *Inquire MGMT*, *Inform Manager*, and *Composite Skeptical Action* in Inherit ADA and Develop ADA conditions.

Additional Testing is coded as "1" if participants chose to perform additional testing related to the analytical procedure, and "0" if not.
Inquire MGMT is coded as "1" if participants mentioned in their open-ended responses that they would inquire of the client management about the NFM red flag, and "0" otherwise.
Inform Manager is coded as "1" if participants mentioned in their open-ended responses that they would inform their audit manager about the NFM red flag, and "0" otherwise.
Composite Skeptical Action is equal to "1" if participants would inquire of the client management about the NFM red flag (i.e., *Inquire MGMT* = 1) and/or communicate the NFM red flag to their audit manager (i.e., *Inform Manager* = 1), and "0" otherwise.

Panel B: Skeptical Actions - Inherit ADA vs. Inherit and Inform ADA

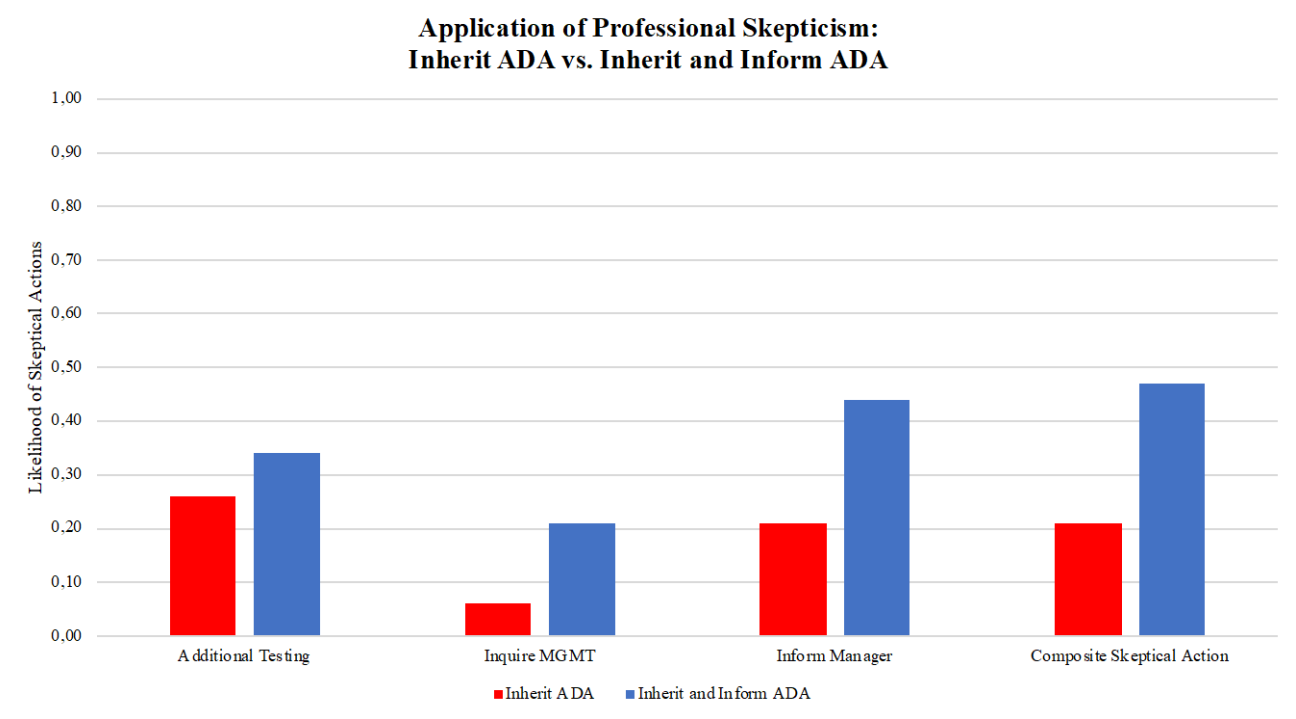
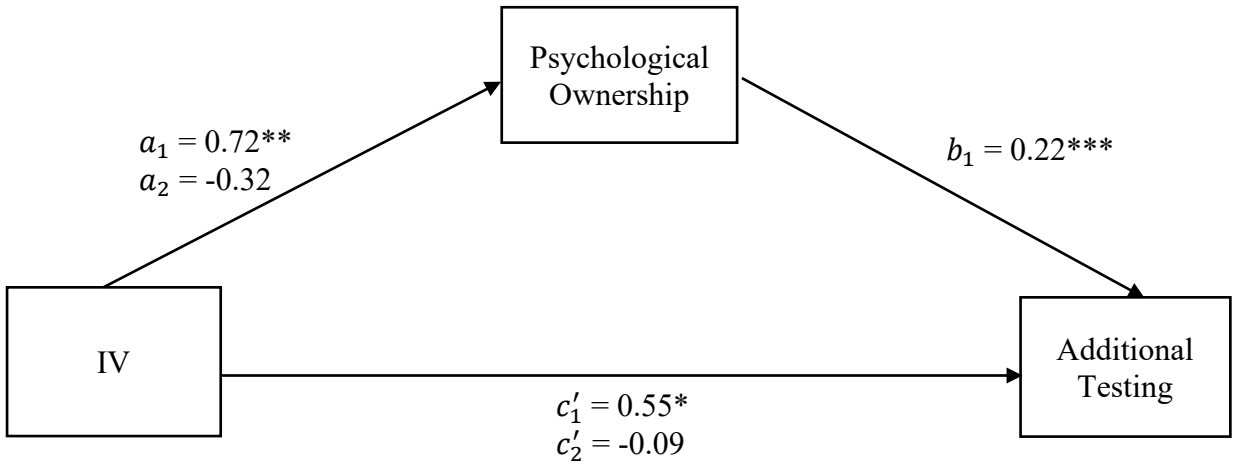


Figure 1, Panel B illustrates the cell means for *Additional Testing*, *Inquire MGMT*, *Inform Manager*, and *Composite Skeptical Action* in Inherit and Inform ADA and Inherit ADA conditions.

Additional Testing is coded as "1" if participants chose to perform additional testing related to the analytical procedure, and "0" if not.
Inquire MGMT is coded as "1" if participants mentioned in their open-ended responses that they would inquire of the client management about the NFM red flag, and "0" otherwise.
Inform Manager is coded as "1" if participants mentioned in their open-ended responses that they would inform their audit manager about the NFM red flag, and "0" otherwise.
Composite Skeptical Action is equal to "1" if participants would inquire of the client management about the NFM red flag (i.e., *Inquire MGMT* = 1) and/or communicate the NFM red flag to their audit manager (i.e., *Inform Manager* = 1), and "0" otherwise.

FIGURE 2

Mediation of Psychological Ownership



Effect of *Develop ADA* vs. *Inherit ADA* on *Additional Testing* through *Psychological Ownership* = $a_1 b_1$ = 0.16, Confidence interval = (0.03, 0.38).
Effect of *Inherit and Inform ADA* vs. *Inherit ADA* on *Additional Testing* through *Psychological Ownership* =$a_2 b_1$ = -0.07, Confidence interval = (-0.21, 0.03).

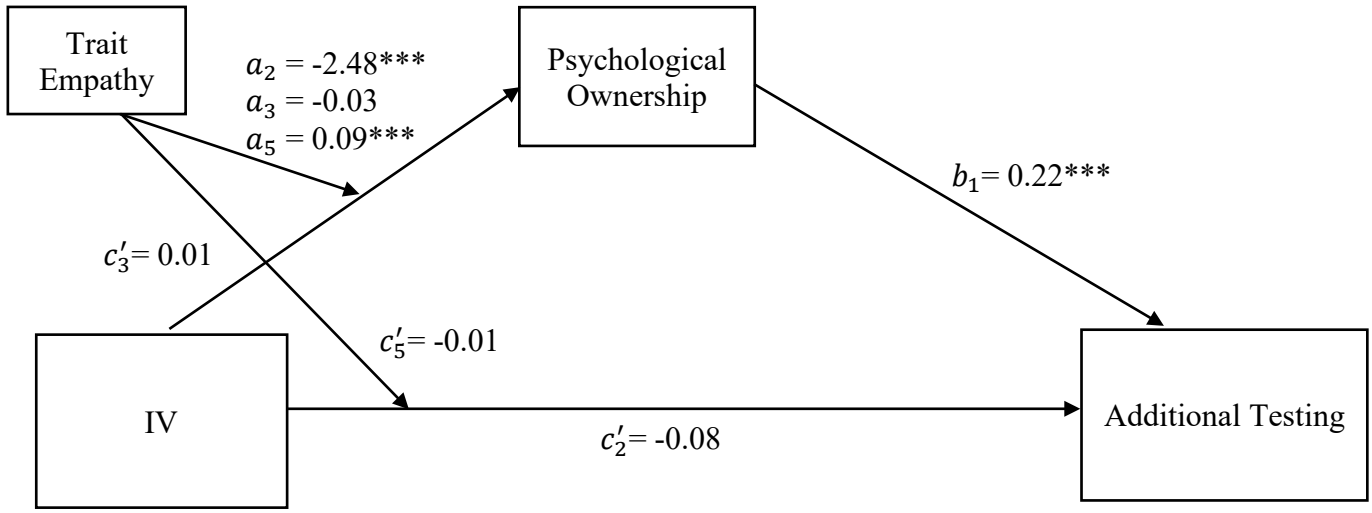
The following equations are used:
$Psychological\ Ownership = i_M + a_1 X_1 + a_2 X_2 + \varepsilon$
$Additional\ Testing = i_Y + c_1' X_1 + c_2' X_2 + b_1 Psychological\ Ownership + \varepsilon$

A multicategorical IV is constructed for this mediation analysis. The *Inherit ADA* is set as the baseline condition. X_1 represents the comparison of *Develop ADA* vs. *Inherit ADA*, and X_2 represents the comparison of *Inherit and Inform ADA* vs. *Inherit ADA.*
Psychological Ownership is measured by asking participants to what extent they felt that they "owned" the data analytic visualizations (or at least some part thereof) with an 11-point Likert scale ranging from 0 (Very Little) to 10 (Very Much).
Additional Testing is coded as "1" if participants chose to perform additional testing related to the analytical procedure, and "0" if not.

We used the Hayes (2018) PROCESS model 4 in SPSS and the Preacher and Hayes (2008) bootstrapping approach to test the indirect effect via *Psychological Ownership*. We used 5,000 bootstrap resamples with replacement to estimate 90% confidence intervals for the indirect effect, with significant mediations indicated by intervals that exclude zero.

FIGURE 3

Moderated Mediation:
Moderation of Trait Empathy on the Mediation of Psychological Ownership



Index of moderated mediation *Trait Empathy*: Index = 0.02, Confidence interval = (0.01, 0.04).

The following equations are used:

$$Psychological\ Ownership = i_M + a_1X_1 + a_2X_2 + a_3Empathy + a_4X_1Empathy + a_5X_2Empathy + \varepsilon$$

$$Skeptical\ Action = i_Y + c_1'X_1 + c_2'X_2 + c_3'Empathy + c_4'X_1Empathy + c_5'X_2Empathy + b_1Psychological\ Ownership + \varepsilon$$

Given that we examine the moderation of trait empathy on the effect of being *informing*, we use the same multicategorical IV in this moderated mediation model but focus on X_2, the comparison of *Inherit and Inform ADA* vs. *Inherit ADA*.

Trait Empathy is measured by questions related to Perspective Taking, Fantasy, and Empathic Concern aspects of the interpersonal reactivity index (Davis 1980).

Psychological Ownership is measured by asking participants to what extent they felt that they "owned" the data analytic visualizations (or at least some part thereof) with an 11-point Likert scale ranging from 0 (Very Little) to 10 (Very Much).

Additional Testing is coded as "1" if participants chose to perform additional testing related to the analytical procedure, and "0" if not.

We used the Hayes (2018) PROCESS model 8 in SPSS and the Preacher and Hayes (2008) bootstrapping approach to test the indirect effect via *Psychological Ownership*. We used 5,000 bootstrap resamples with replacement to estimate 90% confidence intervals for the indirect effect, with significant mediations indicated by intervals that exclude zero.

TABLE 1

Descriptive Statistics for Skeptical Actions

	Additional Testing	*Composite Skeptical Action*	*Inquire MGMT*	*Inform Manager*
Inherit ADA	0.26 (0.45) n = 34	0.21 (0.41) n = 34	0.06 (0.24) n = 34	0.21 (0.41) n = 34
Develop ADA	0.54 (0.51) n = 35	0.37 (0.49) n = 35	0.20 (0.41) n = 35	0.31 (0.47) n = 35
Inherit and Inform ADA	0.34 (0.48) n = 70	0.47 (0.50) n = 70	0.21 (0.41) n = 70	0.44 (0.50) n = 70

Table 1 presents the cell means, standard deviations, and sample sizes for *Additional Testing*, *Composite Skeptical Action*, *Inquire MGMT*, and *Inform Manager* in each experimental condition Inherit ADA, Develop ADA, and Inherit and Inform ADA.
Additional Testing is coded as "1" if participants chose to perform additional testing related to the analytical procedure, and "0" if not.
Composite Skeptical Action is equal to "1" if participants would inquire of the client management about the NFM red flag (i.e., *Inquire MGMT* = 1) and/or communicate the NFM red flag to their audit manager (i.e., *Inform Manager* = 1), and "0" otherwise.
Inquire MGMT is coded as "1" if participants mentioned in their open-ended responses that they would inquire of the client management about the NFM red flag, and "0" otherwise.
Inform Manager is coded as "1" if participants mentioned in their open-ended responses that they would inform their audit manager about the NFM red flag, and "0" otherwise.

TABLE 2

Regression Results for Skeptical Actions on Inherit ADA vs. Develop ADA

Panel A – Logistic Regression Results – *Additional Testing*

	B	Wald	Df	Sig. (one-tailed)
Inherit ADA vs. Develop ADA (H1)	-1.19	5.35	1	0.01
Constant	0.17	0.26	1	0.31

Panel B – Logistic Regression Results – *Composite Skeptical Action*

	B	Wald	Df	Sig. (one-tailed)
Inherit ADA vs. Develop ADA (H1)	-0.82	2.25	1	0.07
Constant	-0.53	2.26	1	0.07

Additional Testing is coded as "1" if participants chose to perform additional testing related to the analytical procedure, and "0" if not.
Composite Skeptical Action is equal to "1" if participants would inquire of the client management about the NFM red flag (i.e., *Inquire MGMT* = 1) and/or communicate the NFM red flag to their audit manager (i.e., *Inform Manager* = 1), and "0" otherwise.
In the logistic regressions, a dummy independent variable (1 = Inherit ADA, 0 = Develop ADA) is used. Reported p-values in this table are one-tailed given our directional hypothesis.

TABLE 3

Regression Results for Skeptical Actions on Inherit and Inform ADA vs. Inherit ADA

Panel A – Logistic Regression Results – *Additional Testing*

	B	Wald	Df	Sig. (one-tailed)
Inherit and Inform ADA vs. Inherit ADA (H2)	0.37	0.64	1	0.21
Constant	-1.02	6.91	1	<0.01

Panel B – Logistic Regression Results – *Composite Skeptical Action*

	B	Wald	Df	Sig. (one-tailed)
Inherit and Inform ADA vs. Inherit ADA (H2)	1.24	6.44	1	<0.01
Constant	-1.35	10.13	1	<0.01

Additional Testing is coded as "1" if participants chose to perform additional testing related to the analytical procedure, and "0" if not.
Composite Skeptical Action is equal to "1" if participants would inquire of the client management about the NFM red flag (i.e., *Inquire MGMT* = 1) and/or communicate the NFM red flag to their audit manager (i.e., *Inform Manager* = 1), and "0" otherwise.
In the logistic regressions, a dummy independent variable (1 = Inherit and Inform ADA, 0 = Inherit ADA) is used.
Reported p-values in this table are one-tailed given our directional hypothesis.

TABLE 4

Regression Results for Skeptical Actions on Develop ADA vs. Inherit and Inform ADA

Panel A – Logistic Regression Results – *Additional Testing*

	B	Wald	Df	Sig.
Inherit and Inform ADA vs. Develop ADA	-0.82	3.79	1	0.05
Constant	-0.65	6.68	1	0.01

Panel B – Logistic Regression Results – *Composite Skeptical Action*

	B	Wald	Df	Sig.
Inherit and Inform ADA vs. Develop ADA	0.41	0.94	1	0.33
Constant	-0.11	0.23	1	0.63

Panel C – Logistic Regression Results Polynomial Contrast – *Additional Testing*

	B	Wald	Df	Sig.
Inherit ADA vs. Inherit and Inform ADA vs. Develop ADA		6.08	2	0.05
Contrast [-0.707, 0, 0.707]	0.84	5.35	1	0.02
Contrast [0.408, -0.816, 0.408]	0.18	0.39	1	0.53
Constant	-0.50	6.83	1	<0.01

Panel D – Logistic Regression Results Polynomial Contrast – *Composite Skeptical Action*

	B	Wald	Df	Sig.
Inherit ADA vs. Inherit and Inform ADA vs. Develop ADA		6.51	2	0.04
Contrast [-0.707, 0, 0.707]	0.58	2.25	1	0.13
Contrast [0.408, -0.816, 0.408]	-0.67	5.10	1	0.02
Constant	-0.66	11.02	1	<0.01

Additional Testing is coded as "1" if participants chose to perform additional testing related to the analytical procedure, and "0" if not.
Composite Skeptical Action is equal to "1" if participants would inquire of the client management about the NFM red flag (i.e., *Inquire MGMT* = 1) and/or communicate the NFM red flag to their audit manager (i.e., *Inform Manager* = 1), and "0" otherwise.
In the logistic regressions in Panels A and B, a dummy independent variable (1 = Inherit and Inform ADA, 0 = Develop ADA) is used.
In the logistic regressions in Panels C and D, a categorical independent variable (1 = Inherit ADA, 2 = Inherit and Inform ADA, 3 = Develop ADA) is used.
Repeated contrast refers to the comparisons of adjacent categories of an independent variable. In other words, each category is compared to (i.e., minus) the next category.
The regression coefficient for the linear effect [-0.707, 0, 0.707] is our focus. The two contrasts are orthogonal and hence using all available degrees of freedom. Thus, the contrast weight of zero does not amount to dropping the condition from the analysis (Guggenmos et al. 2018).

TABLE 5

Descriptive Statistics for Skeptical Judgments

	Skeptical Judgment	*Confidence in Skeptical Judgment*	*Risk Assessment for Material Misstatement*
	0.29	7.90	4.15
Inherit ADA	(0.46)	(2.28)	(2.39)
	n = 34	n = 10	n = 34
	0.31	8.64	5.17
Develop ADA	(0.47)	(1.12)	(2.48)
	n = 35	n = 11	n = 35
	0.46	7.97	4.99
Inherit and Inform ADA	(0.50)	(1.40)	(2.33)
	n = 70	n = 32	n = 70
	0.41	8.29	4.88
No ADA	(0.50)	(1.38)	(2.06)
	n = 34	n = 14	n = 34

Table 5 presents the cell means, standard deviations, and sample sizes for *Skeptical Judgment*, *Risk Assessment for Material Misstatement*, and *Confidence in Skeptical Judgment* in each experimental condition Inherit ADA, Develop ADA, Inherit and Inform ADA, and No ADA.
Skeptical Judgment is coded based on their answers for an open-ended question asking whether they notice any unexpected relationships or inconsistencies in the data provided. Responses identifying the NFM red flag are coded as 1, otherwise 0.
Confidence in Skeptical Judgment is measured for participants who indicated that they noticed unexpected relationships or inconsistencies in the data provided and who mentioned the NFM red flag in their response, to what extent they were confident that those unexpected relationships or inconsistencies they identified should be investigated with an 11-point Likert scale ranging from 0 (Very Low Confidence) to 10 (Very High Confidence).
Risk Assessment for Material Misstatement is measured by asking participants their assessment of the likelihood that the sales account is material misstated with an 11-point Likert scale ranging from 0 (Very Low) to 10 (Very High).

TABLE 6

Panel A – Logistic Regression Results – *Skeptical Judgment*

	B	Wald	Df	Sig.
Inherit ADA vs. Develop ADA	-0.10	0.03	1	0.86
Inherit and Inform ADA vs. Inherit ADA	0.70	2.49	1	0.12

Panel B – *t*-statistic – *Confidence in Skeptical Judgment*

	t-value	Df	Sig.
Inherit ADA vs. Develop ADA	0.95	19	0.35
Inherit and Inform ADA vs. Inherit ADA	0.12	40	0.91

Panel C – *t*-statistic – *Risk Assessment for Material Misstatement*

	t-value	Df	Sig.
Inherit ADA vs. Develop ADA	1.75	67	0.09
Inherit and Inform ADA vs. Inherit ADA	1.71	102	0.09

Skeptical Judgment is coded based on their answers for an open-ended question asking whether they notice any unexpected relationships or inconsistencies in the data provided. Responses identifying the NFM red flag are coded as 1, otherwise 0.

Confidence in Skeptical Judgment is measured by asking participants to what extent they were confident that the unexpected relationships or inconsistencies they identified (i.e., NFM red flag) should be investigated with an 11-point Likert scale ranging from 0 (Very Low Confidence) to 10 (Very High Confidence). It is measured only for participants who indicated that they did notice an unexpected relationship or inconsistency in the data provided and who mentioned the NFM red flag in their response.

Risk Assessment for Material Misstatement is measured by asking participants their assessment of the likelihood that the sales account is material misstated with an 11-point Likert scale ranging from 0 (Very Low) to 10 (Very High).