Mitigating the Dilution Effect of Non-diagnostic Information on Auditors' Judgments Using a Frequency Response Mode

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- Motivation/Theory
- Method
- Findings
- Implications

AGENDA

Motivation/Theory

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Non-diagnostic or irrelevant data: it is everywhere!

- Substantial amount of research in various content areas (psychology, law, and marketing) that shows that individual judgments are affected by irrelevant ("non-diagnostic") information or evidence.
- Basic findings of this line of research: the presence of non-diagnostic evidence leads to a *dilution effect*; that is, individuals make less extreme (more regressive) decisions than those in the presence of diagnostic evidence only.
- Attention to irrelevant information has the potential to significantly limit the potential value from incorporating Big Data into the audit process (Brown-Liburd et al. 2015).

Motivation/Theory

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What is dilution effect?

- The information generated by Big Data is largely ambiguous, unstructured, voluminous, and represents a mix of relevant/diagnostic and irrelevant/non-diagnostic - all of these characteristics affect auditor judgments negatively.
- Several major studies in auditing addressing the issue of dilution effect of non-diagnostic evidence on auditor judgement: Hackenbrack (1992), Hoffman and Patton (1997), Glover (1997), Shelton (2008).
- In summary, auditors, similar to other humans, are unable to discount irrelevant/non-diagnostic information in making probabilistic judgements and in other JDM tasks.

Motivation/Theory

What is dilution effect?

- Hackenbrack [1992] assessed how much a company's exposure to fraudulent reporting changed when presented with *a mixture of diagnostic and non-diagnostic evidence*: the auditors' fraud risk assessments became less extreme in the presence of non-diagnostic evidence.
- Hoffman and Patton [1997] and Glover [1997] examined whether accountability and time pressure eliminated or mitigated the dilution effect.
- Hoffman and Patton [1997] report, “auditors' judgments exhibited the dilution effect both when they were held accountable and when they were not (p. 228).”

Motivation/Theory

What is dilution effect?

- Glover [1997]: accountability had no effect on the dilution effect; however, time pressure reduced the dilution effect, although it did not eliminate it.
- Shelton [2008]: audit managers and partners are less susceptible to the dilution effect than senior auditors.
- Assuming perceptual approach of dilution effect as in prior auditing studies, we continue to ask:
  - *How can dilution effect in auditor judgment be ameliorated?*

Motivation/Theory

What is dilution effect?

- Detecting financial reporting fraud continues to be a priority (PCAOB 2018).
- To improve auditors' fraud judgments, firms increasingly rely on Big Data and data analytics (FRC 2017).
- *Can dilution of fraud risk assessments can be reduced using a frequency mode in situations where diagnostic and non-diagnostic or irrelevant information supplements the output from a fraudulent client profile analytics?*

Motivation/Theory

What is frequency argument?

- Kochetova-Kozloski, Messier, and Eilifsen (KME) (2011): statistical reasoning within a Bayesian framework can be improved, especially in low base rate events (i.e., fraud): the auditors' fraud judgments using a frequency response mode, as compared to a probability response mode, are *closer* to the Bayesian benchmark.
- Gigerenzer and his colleagues (e.g., Gigerenzer, Hoffrage, and Kleinbolting 1991; Gigerenzer and Hoffrage 1995) and others (Cosmides and Tooby 1994, 1996): if people are asked to estimate the *probability* of a single event, the question does not connect to probability theory in their minds, whereas the *frequency* of such an event does (Gigerenzer and Goldstein 1996; Gigerenzer 2004).

Motivation/Theory

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What is frequency argument?

- Bayesian computations are *cognitively simpler* when information is encoded in a frequency format rather than in a probability format.
- The estimation of the likelihood of a single event and the judgment of frequency are *cognitively different processes* (Cosmides and Tooby 1994, 1996; Gigerenzer et al. 1991). Based on KME's findings, H1:
- *H1: Auditors demonstrate a lower dilution effect when they receive case information and make required judgments in a frequency response mode as compared to a probability response mode.*

Motivation/Theory

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Types of non-diagnostic evidence

- As in Hackenbrack (1992), three types : favorable, unfavorable, and neutral. In the fraud-risk setting:
- *Favorable* non-diagnostic evidence would be information that does not relate directly to possible fraud but may be viewed as positive by the auditor.
- *Unfavorable* non-diagnostic evidence describes negative client information that is not directly related to the presence of client fraud but might be viewed by the auditor as negative.
- *Neutral* non-diagnostic evidence includes information that is neither positive nor negative and evaluated as unrelated to the presence of client fraud by the auditor.

Motivation/Theory

Types of non-diagnostic evidence

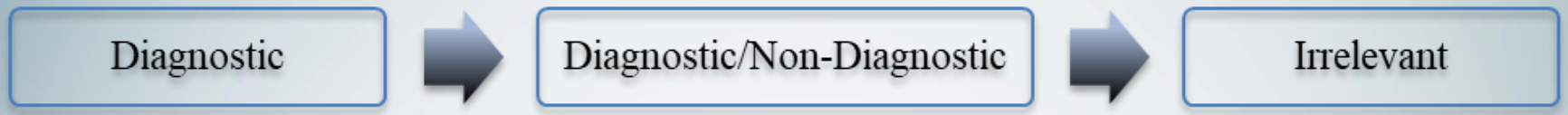
- Hackenbrack's (1992) H: non-neutral (favorable and unfavorable combined) non-diagnostic evidence has a higher dilutive capacity than neutral non-diagnostic evidence:
  - non-neutral, non-diagnostic evidence is more *salient* and auditors will devote more attention to such evidence (e.g., Tversky 1977;
  - Hackenbrack (1992): mixed results across the two versions of the task (increasing versus decreasing fraud risk);
  - Hoffman and Paton (1997) distinguish between favorable and unfavorable non-diagnostic information but find no differences in their dilutive effect.
- Literature in psychology: neutral non-diagnostic evidence is more likely to be ignored than non-neutral (e.g., LaBella and Koehler 2004).

Motivation/Theory

Types of non-diagnostic evidence

- *RQ*: *In a frequency response mode, do auditors exhibit the dilution effect differentially across the different types of non-diagnostic/irrelevant evidence?*

Continuum of Evidence Relevance/Diagnosticity



- *Diagnostic*: information that is clearly relevant to the specific fraud event; i.e., it is a robust "red flag" indicating increased likelihood of fraud; e.g. fraud risk factors identified by Bell and Carcello (2000) (and those clearly rated by our experts).
- Diagnostic/non-diagnostic: e.g. there are many fraud-related factors in auditing standards that auditors believe to be diagnostic - but which are not (e.g., see Hogan et al. 2008; Trompeter et al. 2014; Bell and Carcello 2000).
- *Irrelevant:* has not predictive ability or association with event being judged .

Method: 2 Experiments

Participants

- Norwegian auditors in NHH MRR program
- A mix of senior auditors, staff or associates, and managers
- Some had a master's degree, while all had a bachelor's degree
- All participants either had or were in the process of obtaining a professional designation
- The majority of the participants worked for a Big 4 firm at the time of the experiment
- Experiment 2 participants were, on average, more experienced than Experiment 1
- Paper and pencil vs. *Qulatrics* administration

Method: 2 Experiments

Design

- *Experiment 1:*
  - 2 (Response Mode) x 3 (Type of Non-diagnostic Evidence) x 2 (Order) between-participants
  - Response Mode (RM) at two levels: frequency response mode vs. probability response mode;
  - Type of Non-diagnostic Evidence (TYPE-EV) at three levels: neutral, favorable, and unfavorable; and
  - Order (ORDER) of the non-diagnostic evidence cues at two levels.

Method: 2 Experiments

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Design

- *Experiment 2:*
  - 2 (Response Mode) x 3 (Type of Irrelevant Evidence) Response Mode (RM) at two levels: frequency response mode vs. probability response mode;
  - Type of Irrelevant Evidence (TYPE-EV) at two levels: favorable and unfavorable; and
  - Order (ORDER) of the non-diagnostic evidence cues was randomized in *Qulatrics*

Method

Procedure: Experiment 1

- Expert panel evaluated 41 fraud risk factors: see Appendix A.
- We selected 3 diagnostic factors and three each of neutral, favorable, and unfavorable non-diagnostic factors: see Table 1 for selected factors (cues).
- Same case materials as KME except: presented 3 pieces of diagnostic evidence and then 3 pieces of either neutral, favorable, and unfavorable non-diagnostic factors.
- This approach follows a belief revision procedure followed by LaBella and Koehler [2004].
- Auditors were asked to rate the fraud risk factors in the same manner as the expert managers.
- Participants were asked a series of demographic questions.

Method

Procedure: Experiment 2

- Used Hoffman and Patton (1997) irrelevant cues: 3 favorable and 3 unfavorable.
- Same case materials as KME except: presented 3 pieces of diagnostic evidence and then 3 pieces of either favorable, or unfavorable irrelevant cues.
- Otherwise similar to Experiment 1.

- *Note: an* alternative approach would have been to "bundle" diagnostic and non-diagnostic cues (Fanning et al. 2015; Lambert and Peytcheva 2017) vs. our "step-by-step," sequential, approach.

Method

Dependent Variables

- Replication of KME: *F-DEV* = |Auditor's Fraud Response – Fraud Bayesian Response|.
- Tests of H1 and RQ:
- *F-ABSREV* = |Auditor's Fraud Response: diagnostic evidence only – Auditor's Fraud Response: added non-diagnostic evidence| and
- *F-REV* = Auditor's Fraud Response: diagnostic evidence only – Auditor's Fraud Response: added non-diagnostic evidence.
- Ps agreement with Expert Panel in Experiment 1: a reasonable level of agreement but we also conducted sensitivity analyses.

Findings

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Replication of KME

- The Bayesian benchmarks for the frequency and probability response modes are 0.0776 and 0.0767, respectively (KME [2011, p. 846]).
- *Experiment 1:* For the low base rate (1%), the absolute deviations from the Bayesian benchmark are *smaller in the frequency response mode* (marginal mean =0.262) than in the probability response mode (marginal mean =0.423) (F = 7.504, p =0.004, one-tailed, not tabled).
- Note: this mean is significantly different from zero (t=7.190, p=.000, two-tailed), i.e. the participants *still show significant base rate neglect*. This result is also consistent with KME [2011, p. 853].
- Did the same for Experiment 2.

Findings

Tests of H1

- *Experiment 1*: Tables 2 and 3 - main analyses (n=174); Table 4- sensitivity analyses on reduce sample (n=108)
- *Experiment 2*: Table 6 (n=110)
- In both experiments, the use of a frequency response mode only reduced the dilution effect in the presence of favorable non-diagnostic evidence using both specifications of the DV.
- In Experiment 2, we observe “opposite-to-dilution” effect in the cells with unfavorable irrelevant evidence

Findings

Experiment 1: Tests of H1 on Full Sample (*n*=174)

Panel A: Analysis of Variance (*n*=174); Signed Revision (*F-REV*) as a Dependent Variable

Source	SS	df	*F*	*p*–value
Intercept	.559	1	18.683	.000
RM	.172	1	5.728	.018
TYPE-EV	.893	2	14.918	.000
RM x *TYPE-EV*	.195	2	3.249	.041
Error	5.030	168		

Panel B: Analysis of Variance (*n*=174); Absolute Revision (*F-ABSREV*) as a Dependent Variable

Source	SS	df	*F*	*p*–value
Intercept	1.810	1	71.584	.000
RM	.260	1	10.266	.002
TYPE-EV	.191	2	3.780	.025
RM x *TYPE-EV*	.234	2	4.625	.011
Error	4.248	168		

Findings

Experiment 2: Tests of H1

Panel A: Analysis of variance (*n*=110); Signed Revision (*F-REV*) as a Dependent Variable

Source	SS	df	*F*	*p*–value
Intercept	.010	1	12.662	.001
RM	.000	1	.176	.675
TYPE-EV	.006	1	7.922	.006
RM x *TYPE-EV*	.004	1	4.676	.033
Error	.085	106		

Panel B: Analysis of variance (*n*=110); Absolute Revision (*F-ABSREV*) as a Dependent Variable

Source	SS	df	*F*	*p*–value
Intercept	.027	1	37.115	.000
RM	.001	1	.697	.406
TYPE-EV	.000	1	.374	.542
RM x *TYPE-EV*	.001	1	.995	.321
Error	.076	106		

Findings

Tests of RQ

- RQ: In a frequency response mode, do auditors exhibit the dilution effect differentially across the different types of non-diagnostic evidence?
- *Experiment 1*: signed revisions as a DV(*F-REV*), *TYPE-EV* is significant (p=.026):
  - Statistically significantly different regressive (dilutive) effect of non-diagnostic evidence between conditions with favorable and unfavorable cues, and between neutral and unfavorable cues.
  - Affected by the direction of revision (*F-ABSREV*)- sensitivity to DV specification
- *Experiment 2*: *F-REV* as DV, *TYPE-EV* is significant (p=.001):
  - Dilutive effect of irrelevant evidence is larger for cell with unfavorable cues than for the cell with favorable cues.

Findings

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Tests of RQ

- RQ Conclusion: Indeed, auditors are still susceptible to dilution effect in frequency response mode, and differentially so across the different types of non-diagnostic/irrelevant evidence.
- Frequency response mode with irrelevant unfavorable cues appears to increase fraud risk assessments and produce opposite-to-dilution effect ("over-reaction" to negative irrelevant information)

Implications

What does it all mean?

- A simple approach to representing probability information as frequencies to auditors may mitigate a bias in risk assessment that has been shown to be extremely robust to various settings (Hackenbrack [1992]; Hoffman and Patton [1997]; Glover [1997]).
- Our results indicate that while the use of a frequency response mode reduced the dilution effect, this finding is driven by the auditors' responses to cases where non-diagnostic evidence is favorable.
- This is an important finding since clients who are committing fraud are likely to present favorable (non-diagnostic) explanations/evidence to an auditor's inquiry about fraud.

Implications

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Where do we go from here?

- Future research should investigate *why* the dilution effect appeared to be unaffected by response mode when non-diagnostic/irrelevant cues were neutral or unfavorable.
- Why did auditors exhibit "opposite-to-dilution" effect in response to unfavorable cues in frequency response mode?
  - Excessive sensitivity to negative information? (Bhattacharjee et al. 2012)
  - Conversational approach to dilution? (Tetlock an Boettger 1989)
- Cue bundling/aggregation design vs. sequential approach: does response mode matter?
- Impact of time pressure, experience, other factors on dilution effect in frequency mode


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