A Graph is Worth a Thousand Words: how overconfidence and graphical disclosure influence financial analysts' perception and decision-making regarding numerical tasks

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Abstract
Previous research (Davis, 1989; Vessey, 1991) showed that graphical information presented in different types can help (or harm) the perception and decision making of accountants and financial analysts. However, no research compared the different ways of graphic presentation with table and text disclosure. This paper makes three contributions. First, it replicates previous research with a larger sample size (295) of financial analysts, instead of a smaller sample size of students. Second, it brings the text as a baseline comparison to test how the different ways of information presentation (line and column graphs, tables, and textual disclosure) can enhance the understandability of information. Third, it brings an internal factor to this process: overconfidence, a personal trait (Mannes & Moore, 2013; Moore & Healy, 2008) that harms the decision-making of individuals in financial decisions (Hammond, Keeney, & Raiffa, 2006). A randomized experiment was presented to the subjects. The results show that, compared to text, column graph was the one that enhanced the perception and decision-making at most, followed by line graphs. No difference was found between table and textual disclosure. Overconfidence harmed the perception and decision-making, and both genders behaved overconfidently. Also, the disclosure type (text, table, line graph and column graph) did not affect the overconfidence of individuals, providing evidence that overconfidence is a personal trait. At the end of this paper several research paths are highlighted to further study the effect of internal factors (personal traits) on financial analysts' perception and decision-making regarding numerical information presented in a graphical form. Additionally, we suggest some implications for professional accountants, auditors and standard-setters.

Palavras chave: behavioral accounting; decision-making in accounting; graphical disclosure of information; notes; financial reports.

1. Introduction

The study of the interpretation of graphical information by accountants is not something new. Graphs are shown to improve the understanding of information, and also improve the accuracy of forecast judgments (Desanctis & Jarvenpaa, 1989). Multidimensional graphs are also shown to improve the judgment and decision-making process (Moriarty, 1979).

However not every way to present information has the same effect on the users of the accounting information. Vessey (1991) argued that spatial information is represented better with graphs, while symbolic information is better represented with tables. A recent study (Tang, Hess, Valacich, & Sweeney, 2014) showed that interactivity, visualization and difficulty affects the decision-making of accountants and financial analysts. However, there is a gap in the literature, in which no study has analyzed both intrinsic characteristics of the individual and how it affects the interpretation of graphic information with the same degree of difficulty. Indeed, this study provides empirical experimental evidence from 295 professional accountants who work as financial analysts that different ways of disclosing the same information can increase (or decrease) the accuracy of judgment and decision-making by financial analysts.

The study of graph interpretation ability by accountants and financial analysts is relevant in the accounting context because most modern annual reports contain graphs. For example, the International Accounting Standards Board (IASB) recently amended its accounting standard on financial instruments disclosure requiring that "if the quantitative data disclosed as at the end of the reporting period are unrepresentative of an entity's exposure to risk during the period, an entity shall provide further information that is representative" (IFRS 7 paragraph 35). Whether this is the case, the implementation guidance exhorts the presentation of graphs: "[…] if an entity typically has a large exposure to a particular currency, but at year-end unwinds the position, the entity might disclose a graph that shows the exposure at various times during the period […]" (IFRS 7 paragraph IG20).

Indeed, because standard-setters are exhorting entities to present graphs in the notes, the use of graphs in financial reporting might increase significantly. Therefore, the knowledge of individuals' ability to interpret graphs and the impact of their personal characteristics in performing such a task becomes very important, either to prepares and auditors of financial reports, standard-setters and accounting professors; and may enhance impression management literature in many venues.

Additionally, impression management literature suggests that graphs are much vulnerable to manipulation because graphs are non-audited and not prescribed (Jones, 2011). The three main types of impression management through graphs are: selectivity (i.e., occurs when a company deliberately chooses graphs so that they will convey a favorable impression of the company); measurement distortion (i.e., the figures on the graphs do not accurately represent the underlying financial data); and presentational enhancement (i.e., graphs are constructed so as to emphasize certain design features) (Jones, 2011; Beattie & Jones, 1993; 2000).

Therefore, the knowledge of individuals' ability to interpret information represented in many different forms (e.g., text, table, line graph, and column graph) may enhance impression management literature in many venues. For example, the selectivity type could be investigated in deep and far beyond the traditional approach (i.e., "occurs when a company chooses to include, or not include, a graph in its annual report contingent upon the companies' underlying performance" (Jones, 2011). For instance, selectivity could also be investigated as the choice of the graph format (e.g., line, column or pie chart), or presenting a table instead of a graph.

Thus, our work aims to assess if different disclosure practices of numerical information (text, table, column graph and line graph) affect the financial analysts' perception. Incidentally, we also investigate if personal characteristics (overconfidence and gender) also affect their perception ability.
The remaining sections of this paper are organized as follows. Next section presents the literature review and hypotheses development. Section three describes the experiment design, data collection process and methods to test hypotheses. Section four presents and discusses the results for each hypothesis. Finally, section five presents the final remarks and suggestions for further research.

2. Literature Review and Hypotheses Development

Different types of accounting information disclosure by companies are shown to change the decision-making of both financial analysts (Ghosh & Wu, 2012) and investors (Dilla, Janvrin, & Jeffrey, 2013). It also affects the confidence interval of forecasts (Lawrence & O'Connor, 1993). In an experiment with undergraduate students, Beattie & Jones (2002) showed that students perceived a company whose graphic had received a measurement distortion as better than the same company if such graphs had not being distorted.
Different types of presenting financial information are shown to influence the accuracy of accounting tasks (Davis, 1989; Tang et al., 2014). Both researches achieve with experimental empirical evidence the same conclusion by Vessey (1991): different types of information disclosure have different effects in the understanding performance in different situations. However, Davis' study was performed with a small sample size (30) of MBA students and the paper by Tang et al. also uses students, but with a larger sample (157). Our study attempts to provide replication with a sample comprised by financial analysts, instead of students. A second advancement is that no study used textual disclosure as a basement measure to provide a comparison between the different types of graphical information disclosure.
Therefore, we propose the following hypothesis:

H1: *Different forms of information representation (text, table, column graph and line graph) differently affect the informational perception and the decision-making of financial analysts.*
This study also attempts to investigate if intrinsic characteristics of the individual alter the interpretation of the different ways of disclosing information. Previous research (Cardoso, Barcellos, Aquino, & Sales, 2014) provided evidence that intrinsic characteristics of an accountant can alter their decision-making process. This study will focus on overconfidence trait, which can be divided in three subtypes: overestimation, over-placement and over-precision (Mannes & Moore, 2013). In this study we will use the over-placement sub dimension, that can be described as "the over-placement of one's performance relative to others" (Moore & Healy, 2008). The "overconfidence trap" can lead to "errors in judgment and, in turn, bad decisions" (Hammond et al., 2006).
There is empirical evidence that overconfident individuals will commit more errors and that gender has a role in this intrinsic characteristic: males are more overconfident (and commit more errors) than females. Economics undergraduate male students are shown to be more overconfident than females (Bengtsson, Persson, & Willenhag, 2005) and male traders trade with more overconfidence than females (Barber & Odean, 2001). A cross-cultural study in the US, Germany, Italy and Thailand confirmed that women financial analysts were more risk averse than male financial analysts (Beckmann & Menkhoff, 2008) Therefore, we postulate two additional hypotheses:

H2: *Overconfident financial analysts commit more errors than non-overconfident ones.*

H3: *Male financial analysts are more overconfident than females.*

To test those hypotheses we applied an online survey experiment through Surveymonkey. It can be a way to improve both internal validity and external validity (Brandon, Long, Loraas, Mueller-Phillips, & Vansant, 2014), since it is a randomized experiment with professional financial analysts that actually make decisions in their day-to-day basis.

3. Methodological approach

3.1 Data collection and experiment design

Data were collected via electronic questionnaire applied by the Brazilian Accounting Association (BAA). The electronic message containing the web link to the questionnaire was sent to all Brazilian accountants regularly registered with the association at August 2012. Professionals were exhorted to access the BAA's webpage to answer the survey. Based on respondents expertise, they were required to answer a determined batch of questions; actually, those that presented themselves as financial analysts were required to answers questions related to graph interpretation. In total, 295 professional accountants which main duties are related to financial analysis comprise the sample for this research. This sample was randomly classified among four subsamples to each we presented the same informational content in regard to the amount of people going in and out of a store during a 12 minutes time period, as presented in Figure A1 (in the appendix).
Hence, it is a 4×2 mixed-design experiment (four types of information presentation: textual information, table, line graph and column graph – between subjects, and two questions: in which minute is there the highest amount of people entering the store, and in which minute is there the highest amount of people exiting the store – within subjects). The subjects were randomly assigned to one of the four types of information presentation with a probability of .40 of being assigned to the line graph and a probability of .60 of being assigned to one of the other 3 conditions. Table 1 presents data descriptive statistics.

Table 1: Descriptive Statistics

			Correlations							
Variables	**Mean**	**SD**	**Gender**	**Age**	**Line**	**Column**	**Table**	**Text**	**Overc.**	**Answers**
Gender (1 = Female)	0.6565	0.0277	1							
Age (years)	39.024	0.6158	0.2028	1						
Line Dummy	0.4218	0.0289	-0.0058	-0.0085	1					
Column Dummy	0.2449	0.0251	-0.0211	-0.0943	-0.4864	1				
Table Dummy	0.1599	0.0214	-0.0362	0.0149	-0.3726	-0.2484	1			
Text Dummy	0.1735	0.0221	0.0666	0.1038	-0.3913	-0.2609	-0.1998	1		
Overconfidence (1 = yes)	0.3559	0.0279	0.0011	-0.0313	0.0103	-0.0613	0.0042	0.0522	1	
Correct Answ. (0-2 range)	1.6088	0.0414	-0.0152	-0.0333	0.0340	0.0687	0.0050	-0.1272	-0.1594	1

After the experiment, under the same electronic questionnaire, respondents were asked if they thought that they would be in the "10% group" that responded right both questions. Those that

answered "yes" were coded as overconfident, since overconfidence can be defined as "the over-placement of one's performance relative to others" (Mannes & Moore, 2013; Moore & Healy, 2008).

3.2 Randomization test

To test if the randomization of the 4 types of information presentation worked properly, three chi-squared tests were performed. In the first we tested the distribution of the types of information presentation regarding the age of participants. In the second regarding their gender. The third test was regarding the participants' city residence (State capital or interior city). Because age is a continuous variable, it needed to be converted to a discreet variable for the test to be performed. Therefore, age was converted into a dummy variable: below median (0) and above median (1), the median age of the sample is 37 years old.

After this variable transformation a total of three chi-squared tests were performed and the p-values were non-significant ($\chi^2_{age}(3) = 3.99, p = .263$; $\chi^2_{gender}(3) = 1.39, p = .707$; $\chi^2_{residence}(3) = 4.18, p = .243$), showing that there was no bias of gender, age or place of residence in the subjects assignment in each one of the four between conditions. This suggests that the randomization worked well, and provides evidence that our sample was not biased.

Due to the fact that the analyzed conditions (i.e., types of information presentation/disclosure) were randomized in the sample, it eliminates the problem of endogeneity and self-selection, reducing the systematic bias significantly. However, there may be a possible confounder in this study regarding overconfidence. Maybe some way of disclosing numerical information may influence the participant's overconfidence, causing bias. Aiming to assess if this was an issue in this study another chi-squared test was performed and the result was non-significant ($\chi^2(3) = 1.52, p = .678$), suggesting that the manipulation did not affect the participants' overconfidence. In addition, this provides more evidence that the randomization process worked well, since there was no meaningful difference in the participants' overconfidence.

4. Results

First, the two questions asked to the respondents were grouped in one variable that could assume the value of 0 (no correct answer), 1 (one correct answer) or 2 (both questions correctly answered), for the results to be estimated in one statistical test. A chi-square model was estimated on the effect of the different ways of information disclosure on the performance in getting the right answers, as presented on Table 2.

The result from the chi-squared test shows that different types of information disclosure affect the perception and decision-making of financial analysts, providing support for H1. However, the chi-squared test cannot test if a specific type of information presentation is better than another. Thus, we estimated the following ordered logit model:

$$Correct = \beta_0 + \beta_1 Overconf + \beta_2 Line + \beta_3 Column + \beta_4 Table + \varepsilon$$

Where *Correct* denotes the number of correct answers (0, 1 or 2), *Overconf* is a dummy for overconfidence (1 = overconfident). *Line* is a dummy that assumed 1 if the respondent received a line graph, *Column* is a dummy that assumed 1 if the respondent received a column graph and *Table* is a dummy that assumed 1 if the respondent received a table. Therefore, the baseline category is the text disclosure. We used the ordered logit model, since *Correct* is a discreet hierarchical variable.

Table 2: Results from H1 testing

	Number of correct answers			
Type of disclosure	**0**	**1**	**2**	**Total**
Line	15 12.10%	15 12.10%	94 75.80%	124 100%
Column	10 13.89%	2 2.78%	60 83.33%	72 100%
Table	5 10.42%	8 16.67%	35 72.91%	48 100%
Text	9 17.65%	12 23.53%	30 58.82%	51 100%
Total	39 13.22%	37 12.54%	219 74.24%	295 100%

$Pearson\ \chi^2(6) = 14.72, p = .023$

Table 3 presents the results from the ordered logit model, as well the ordered probit and OLS regression. Supporting H2 the coefficient for the overconfidence was negative and significant ($\beta_1 = -0.705, p < 0.01$).

Table 3: Regressions Results

	Ordered Logit			Ordered Probit			OLS		
	Model 1	**Model 2**	**Model 3**	**Model 4**	**Model 5**	**Model 6**	**Model 7**	**Model 8**	**Model 9**
Overconfidence	-.705***	-.679**	-.681**	-.420***	-.402**	-.402**	-.237***	-.226***	-.226***
	(.269)	(.271)	(.271)	(.157)	(.158)	(.158)	(.085)	(.085)	(.085)
Line Graph		.694**	.692**		.387*	.386*		.214*	.214*
		(.345)	(.345)		(.207)	(.207)		(.117)	(.117)
Column Graph		1.046**	1.043**		.533**	.532**		.259**	.258**
		(.421)	(.421)		(.240)	(.241)		(.128)	(.129)
Table		.545	.541		.325	.323		.200	.199
		(.423)	(.414)		(.253)	(.253)		(.140)	(.141)
Gender (1 = male)			-.061			-.020			-.009
			(.285)			(.164)			(.086)
N	295	295	295	295	295	295	295	295	295
Chi² / F †	6.84***	13.67***	13.71**	7.17***	12.60**	12.62**	7.75***	3.09**	2.47**
Pseudo-R² / AdjR² ‡	0.016	0.031	0.031	0.016	0.029	0.029	0.026	0.028	0.024

Standard Errors in parenthesis.
* p<.1, ** p<.05, *** p<.01
All interactions in all models are non-significant.
† Chi²-test for the Orderded Logit and Ordered Probit models and F-test for the OLS models.
‡ Pseudo-R² for the Orderded Logit and Ordered Probit models and AdjR² for the OLS models.

Table 4 presents the percentages correct answers per cluster of respondents (overconfident and non-overconfident financial analysts), and the respective chi-squared test. It shows that overconfident financial analysts committed more errors than non-overconfident ones in this experiment set-up.

While overconfident financial analysts are the majority at those that answered incorrectly both questions, they are the minority on those that correctly answered at least 1 question. This shows that overconfident individuals commit more errors, once their slope is negative.

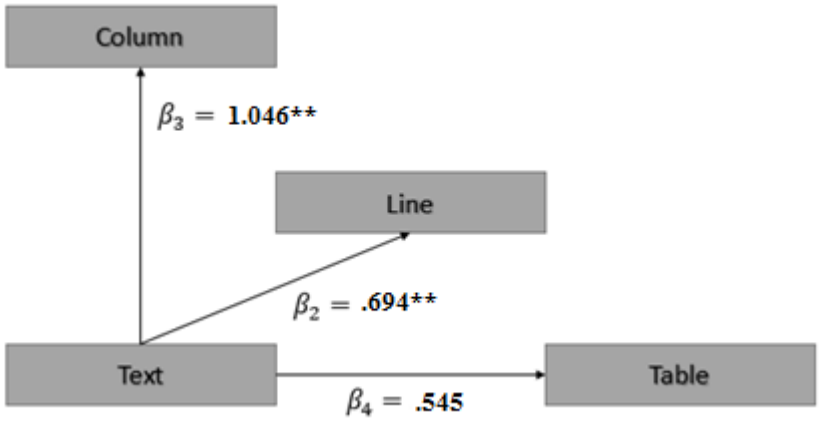
Table 4: Results from the chi-squared test of H2

	Number of Correc. Answers			
Overconfidence	**0**	**1**	**2**	**Total**
No	18 9.47%	22 11.58 %	150 78.95%	190 100.00%
Yes	21 20%	15 14.29 %	69 65.71%	105 100%
Total	39 13.22%	37 12.54 %	219 74.24%	295 100.00%

Pearson $\chi^2(2) = 7.66, p = .022$

Figure 2 presents the different types of information disclosure compared to the textual presentation. As it can be seen, the type of information presentation that provided the highest coefficient when compared to text was the column graph ($\beta = 1.046, p < 0.05$), followed by the line graph ($\beta = .694, p < 0.05$). The table coefficient did not significantly improve the perception and the decision-making of financial analysts when compared to textual presentation.

Figure 2: Comparison of column graph, line graph and table versus text



** Significant at 5%. *Significant at 10%.

It sheds some light at the "black box" of the chi-squared test of H1. The column graph type was the best way of providing the numerical flow information to individuals, followed by line graph. On the other hand, the table representation did not enhance the perception and decision-making when compared to text disclosure.

To test H3, a chi-squared test was performed with the distribution of males and females in the overconfidence distribution. The results presented on Table 5 show that there is no difference in overconfidence between genders ($\chi^2(1) < .001, p = .99$).

Table 5: Results from H3 testing

	Overconfidence		
Gender	**No**	**Yes**	**Total**
Female	65 64.36%	36 35.64%	101 100%

Male	125	69	194
	64.43%	35.57%	100%
Total	190	105	295
	64.41%	35.59%	100%

Pearson $\chi^2(1) < .001, p = .99$

Table 6 summarizes the evidence collected in this study for the four hypotheses.

Table 6: Summary of evidences

Hypothesis	Supported?	p-value
H1: Different forms of information representation (text, table, column graph and line graph) differently affect the informational perception and the decision-making of financial analysts.	Yes	.02
H2: Overconfident financial analysts commit more errors than non-overconfident ones.	Yes	<.01
H3: Male financial analysts are more overconfident than females.	No	.99

5. Discussion and Concluding remarks

This paper sheds some light in two points in the investigation of decision-making of financial analysts: external and internal factors and how they interact with each other.

This research provided evidence to the previous literature that showed that different ways of representing numerical information about flow could help or harm the perception and decision-making by accountants, financial analysts and investors (Davis, 1989; Ghosh & Wu, 2012; Tang et al., 2014; Vessey, 1991). Table disclosure was not different from textual, and it can be explained by the fact that the both display *symbolic* information (numbers). However column graph ($p<.05$) and line graph ($p<.05$) had significant positive impact on the financial analysts' perception, enhancing their ability to correctly answer the questions. This may be attributed to their *spatial* information disclosure. Since time is a continuous variable, it is no surprise that the line and column graphs presented the best results compared to textual disclosure, since it may be easier to visualize the change in a continuous variable in a spatial disclosure. Therefore, this research shows that for *continuous* variables change, the graphs that enhance the perception ability of the user are the ones that communicate more *spatial* information (such as column and line graphs).

The internal factor considered in this research is overconfidence, more specifically over-placement. Overconfidence was shown to harm the perception of numerical information (across all types of information presentation/disclosure). This is in line with previous research (Bengtsson et al., 2005; Mannes & Moore, 2013; Tang et al., 2014) showing that overconfidence harms the decision-making process.

Contrary to previous research (Barber & Odean, 2001; Bengtsson et al., 2005) gender did not influence the overconfidence of individuals in our sample, suggesting that male and female financial analysts are equally overconfident when analyzing graphical representation of information. This may be an effect of self-selection. Maybe only the overconfident females choose to be a financial analyst, or this profession changed their overconfidence, making both genders homogeneous in this trait.

Also, the type of information disclosure did not influence overconfidence, showing evidence that different types of disclosure with similar difficulty does not impact in the overconfidence of

financial analysts.

Most experimental research have internal validity but lacks external validity (Brandon et al., 2014). By using an online instrument to perform this survey experiment, we tried to achieve a higher degree of external validity, since the participants were professionals, instead of students. However, since the task proposed was hypothetical, the external validity is harmed. A possible way to enhance the external validity even more could be triangulating the data by collecting information of the respondents in their work, if the respondent is perceived as overconfident by her peers, and how her superiors judge her performance, for example.

Another research pathway that could be followed is how other external factors influence the perception and decision-making involving financial information. One personal trait was analyzed: overconfidence, but other "traps" may exist, such as self-consistency (persisting in a wrong decision only because one cannot admit that his/her decision was wrong) and confirming-evidence seekers (one only seeks evidence that confirms his/her perception and beliefs). Both "traps" can harm the perception and decision-making of financial analysts regarding graphical information.

A third research line is if risk avoiding changes the perception of financial analysts regarding graphical information. One graph that shows a lot of ups and downs (big variance) could be regarded as worse than a graph showing consistent results (small variance), even if the expected return of the first is bigger than the second. Additionally, companies are increasing the usage of videos and webcasts to present their reports. Hence, the impact of disclosure medium (e.g., printed versus video) on graphical perception and interpretation was not investigated so far.

There are multiple further implications of these results for practitioners and researchers. Prepares and auditors of financial reports should identify which type of numerical disclosure better and faithfully present what they purport to represent; for example: text, table, column graph or line graph. Additionally, auditing firms might develop auditors' ability to audit graphs; i.e., not only if data presented in graphs are reliable, moreover, they should develop auditors' ability to assure if the graph type chosen by companies are the best appropriate for disclosed data interpretation by users.

Investment banks and rating agencies might assess personal traits of their financial analysts, such as overconfidence. As presented in literature and reinforced in this paper, overconfident individuals commit more errors than non-overconfident ones. Indeed, investment banks and rating agencies could also develop financial analysts' ability to detect impression management and other graph distortions, and judge if the graph type chosen by companies are the best appropriate for disclosed data interpretation.

Therefore, we end this section stressing that this field of study on how internal factors (personal traits) affects individuals' perception on graphical information is a growing field in behavioral accounting and has several research paths and question to be researched.

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Appendix

Figure 1: Four Experimental Conditions (Line, Column, Table and Text)

1.A Textual information

The following paragraph presents the amount of people getting in and out of a store in a 12 minutes time period.

In the first minute, 9 people entered and 8 exited from the store. In the second minute, 10 people entered and 5 exited from the store. In the third minute, 9 people entered and 8 exited from the store. In the fourth minute, 14 people entered and 12 exited from the store. In the fifth minute, 9 people entered and 8 exited from the store. In the sixth minute, 9 people entered and 8 exited from the store. In the seventh minute, 8 people entered and 8 exited from the store. In the eighth minute, 7 people entered and 9 exited from the store. In the eighth minute, 7 people entered

1.B Table

The following table presents the amount of people getting in and out of a store in a 12 minutes time period.

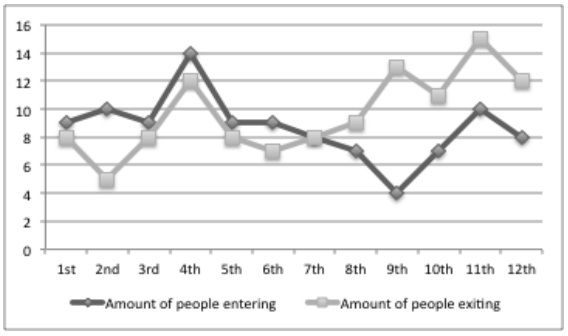
Minute	Amount of people entering	Amount of people exiting
1st	9	8
2nd	10	5
3rd	9	8
4th	14	12
5th	9	8
6th	9	7
7th	8	8
8th	7	9

and 9 exited from the store. In the ninth minute, 4 people entered and 13 exited from the store. In the tenth minute, 7 people entered and 11 exited from the store. In the eleventh minute, 10 people entered and 15 exited from the store. In the twelfth minute, 8 people entered and 12 exited from the store.

9th	4	13
10th	7	11
11th	10	15
12th	8	12

1.C Line graph

The following graph presents the amount of people getting in and out of a store during a 12 minutes time period.



1.D Column graph

The following graph presents the amount of people getting in and out of a store during a 12 minutes time period.