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Long Series of Information and Nonprofessional Investors' Belief Revision

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ABSTRACT: This paper reports the results of an experiment designed to examine the effect of disclosure pattern (sequential versus simultaneous) and direction of information (positive/negative versus negative/positive) on nonprofessional investors' belief revisions. An important feature of the experiment is that long series of information are used. Prior research has largely examined individuals' belief revisions using short series of information.

Results indicate that individuals revise beliefs to a larger extent when the disclosure pattern is sequential rather than simultaneous. The findings extend the prior belief revision literature by providing evidence that results hold using long series of information: the current experiment uses 20 pieces of information, whereas most accounting studies only use four pieces of information. Results also contribute to the extant financial accounting literature on nonprofessional investors that is particularly relevant given the larger number of inexperienced investors entering the marketplace and recent legislation that requires more detailed firm disclosures (e.g., the Sarbanes-Oxley Act [SOX] of 2002).

Keywords: belief revision; nonprofessional investors; disclosure.

Data Availability: Please contact the author if you are interested in the data.

INTRODUCTION

In light of recent accounting scandals, regulators across the globe have instituted new disclosure models aimed at reducing the time public companies have to disclose information. For example, many European and other public companies are adopting International Financial Reporting Standards (IFRS) that require "prompt" disclosures. The Direct 2 APRA (Australian Prudential Regulatory Authority) initiative requires Australian financial institutions to disclose on their websites any material information within 24 hours of occurrence. In the U.S., Section 409 of the Sarbanes-Oxley Act (SOX, U.S. House of Representatives 2002) (henceforth, 409) reduces the reporting interval of material events from 15 days to 4 days.[1] The Securities and Exchange Commission (SEC 2000) has gone so far as to note that with existing technology, real-time disclosure of information is possible and worth investigating further.[2]

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[1] The actual range for reporting used to be 5–15 days, but the majority of transactions fell into the 15-day category.
[2] It should be noted that eight of the ten new items required by Section 409 represent nonfinancial information—similar to that used in the current study.

While a consortium of accounting bodies have focused attention on more frequent disclosures (Petravick 1999; AICPA 1996), belief revision research has indicated that individuals tend to over-revise in the direction of the last piece of information received when information is presented in a step-by-step (SbS) format (i.e., recency effects, Hogarth and Einhorn 1992). Controlling for the amount of information disclosed, a trend toward more timely disclosure implies a shift from lump sum, simultaneous disclosures toward a sequential pattern of disclosures. Tuttle et al. (1997) find that for a "short" series of information (i.e., four cues), individual investors who receive sequential disclosures are more subject to increased belief revisions compared to those receiving simultaneous disclosures. This finding may be of interest to management, capital providers, and other parties interested in a firm's disclosures.

The current experiment employs a 2 (disclosure pattern: sequential versus simultaneous) × 2 (direction: a series of ten positive followed by ten negative disclosures or vice versa) between-subjects design with undergraduate accounting students. The ten disclosures per series represent a significant increase in number compared to the typical two cues in accounting belief revision studies (see Kahle et al. [2005] for a summary). The total of 20 disclosures represents the first attempt in the accounting belief revision literature to use what Hogarth and Einhorn (1992) called a "long" series of cues (i.e., greater than 16 cues). Whereas prior belief revision accounting research in auditing and tax has focused on a "short" series of cues (e.g., Ashton and Ashton 1988; Bamber et al. 1997; Pei et al. 1990), the disclosure context is better represented by a "long" series, given that most public firms are large and issue frequent disclosures.

Results reveal that belief revisions are significantly different between disclosure patterns both after the consistent direction (i.e., short) series and after a direction reversal of disclosures (i.e., long series) for both direction sequences. The sequential release of information participants had larger revisions than the simultaneous disclosure participants given the same information. The results reflect the tendency of participants in the simultaneous conditions to aggregate disclosures in revising their beliefs (short series) and to be particularly sensitive to disclosures containing contrary information, thereby causing a higher "contrast effect" (long series). Thus, the belief revision prediction of Hogarth and Einhorn's (1992) model holds for a relatively longer sequence of consistent cues in a disclosure context, as well as for cues following a reversal of direction.

An interesting "twist" came from using a different form of testing in the long series. Specifically, given that there were two series used in analysis for the long series, after the consistent direction (i.e., short) series, the simultaneous condition can no longer be considered end-of-sequence (EoS), but rather, a different form of SbS (i.e., SbS 10). The findings contribute to the extant financial accounting and belief revision literatures on nonprofessional investors that is particularly relevant given the larger numbers of inexperienced investors entering the marketplace (Elliott et al. 2005) and recent legislation (e.g., the Sarbanes-Oxley Act) that requires more detailed firm disclosures. The finding for the long series of mixed (i.e., both positive and negative) cues is particularly important for two reasons: (1) a long series of direction-reversed information is more representative of larger firms' disclosure patterns (i.e., those firms typically have more disclosures than smaller firms) and (2) this setting evidences a new form of SbS not previously tested in the belief revision literature.

The next section discusses the changing disclosure environment and prior belief revision research, motivating the research hypotheses. The experimental methodology is presented next, followed by results, conclusions, and suggestions for future research.

THEORY AND HYPOTHESES

The Changing Disclosure Environment

In their seminal work, Ball and Brown (1968, 627) concluded that although an annual report provides information useful in determining stock values, the report is not a timely disclosure medium, because "most of its content (85 to 90 percent) is captured by more prompt media, which perhaps include interim reports." The implication is that if business information (i.e., financial and nonfinancial) were disclosed in a timelier manner, it would have a faster impact on investor decisions. New federal regulations and legislation in a number of countries require public companies to disclose important information more frequently (e.g., 409 in the United States; Direct 2 APRA in Australia) using well-defined media (e.g., Form 8-K).

Advances in information technology have allowed information to be quickly and reliably communicated, without using an intermediary. Thus, complying with new disclosure models as mandated by regulation and legislation is increasingly feasible. However, the effects of new disclosure rules on individual investors is, as of yet, unknown.

Before SOX Section 409 in the U.S. or Direct 2 APRA in Australia (for example) firms had longer timelines to disclose required information (up to 15 days for most disclosures in the U.S.). As a result, multiple items that needed to be disclosed could be done so in a simultaneous fashion that would either offset each individual item's effects on investors (in the case of both positive and negative information) or take one big hit or increase stock price (in the cases of all negative or positive items, respectively). However, with the new regulation and legislation, management has significantly less time to "lump" disclosures together, which should result in more sequential disclosure patterns.

Disclosures made in a sequential, rather than a lump sum pattern, are likely to evoke heuristics (i.e., rules of thumb) and biases in individual investors' decisions. Under such conditions, decision makers tend to rely on heuristics and biases because the complexity of the decision process becomes overwhelming (Calegari and Fargher 1997).

Belief Revision Theory

Hogarth and Einhorn (1992) adapted the general concept of belief revision to include biases, and formed a psychological framework known as the belief-adjustment model. Empirical evidence offered by Ashton and Ashton (1988) validated the model in general, and Bamber et al. (1997) provided strong support for the descriptive validity of the model. The belief-adjustment model predicts order effects in almost all cases of response mode (i.e., SbS or EoS), task complexity, and length of information. From a strict normative perspective, a final judgment should approximate the initial reference point (i.e., referent), if an equal number of negative (−) and positive (+) pieces of equally weighted evidence are presented. However, due to more weight being placed on the most recent piece of evidence (predicted in most scenarios), final judgments are different, depending on the sequencing (+ + +/− − − or − − −/+ + +) of evidence.

Consistent with the predictions of the belief-adjustment model, Ashton and Ashton (1988) found that auditors who were "evidence-prone" (i.e., searched for objective evidence to make decisions) made larger belief revisions when information was presented sequentially in an SbS format, as compared to an EoS, or simultaneous format for a short series of information (i.e., four cues). The result was due to a "dilution effect" that weakened the impact of evidence presented in the simultaneous (EoS) compared to that of the sequential (SbS) cues. Specifically, the individual's sensitivity to new evidence plays a critical

role in determining the amount of belief revision.[3] The dilution effect refers to a reduced sensitivity to new evidence that then causes a relatively smaller belief revision. Ashton and Ashton (1988) reasoned that dilution occurred in their EoS condition, because participants needed to aggregate new evidence before forming a revised belief. Such a requirement does not apply to the SbS response mode.

Like auditors, many individual investors are also evidence-prone, as they search for market information on which to base their investment decisions. Indications that investors are searching for information are offered by the rapid growth in business related media (e.g., company websites, CNBC, Dow Jones Newswire, etc.) and their demand for more timely information (Financial Accounting Standards Board [FASB] 2000). Although some individual investors' decisions are likely swayed by subjective factors, investors nevertheless spend a great deal of time and effort searching through various sources for relevant objective information. Hence, the current paper assumes that individual investors are, for the most part, evidence-prone.

Tuttle et al. (1997) studied order effects on market efficiency in an experimental asset market and concluded that individual investors that received four cues of sequential information displayed significant recency effects. DeBondt and Thaler (1985) found that extreme stock price movements in one direction tend to be followed by price movements in the other direction, such that the more extreme the initial movement, the greater the subsequent adjustment. Barberis et al. (1998) and Bloomfield and Hales (2002) suggested that investors have "regime-shifting" beliefs and the prevalence of past trend reversals are an indicator of the likelihood of future reversals. What is missing in these studies, however, is a consideration of what occurs to beliefs when a large number of consistent (i.e., all positive or all negative) information is presented using different response modes (which reflects different disclosure patterns).

Belief Revisions in Stock Price Judgments

The current experiment examines belief revisions in stock price judgments over time, using an evaluation task. In order for managers to comply with new disclosure requirements, they need to potentially change their disclosure pattern from a lump sum/aggregating of disclosures to a sequential release of material information over time. A significant amount of belief revision literature has indicated support for order effects for a short series (i.e., less than 17 cues) of consistent information (e.g., Bamber et al. 1997; Trotman and Wright 1996; Ashton and Ashton 1990; Tuttle et al. 1997). However, the studies cited have used between two and four cues of concisely worded phrases in each direction to measure their findings and have focused on order effects, rather than comparative belief revision amounts.

Hogarth and Einhorn (1992, 2) note that their model is sensitive to contextual and task factors. Walker et al. (1972) and Adelman et al. (1997) reasoned that belief revision results might not hold in differing contexts. For example, given a short series of simple cues presented simultaneously, the model predicts primacy effects (i.e., more weight is placed on the earliest cues). In a disclosure context, Baird and Zelin (2000) found evidence of primacy effects, but in a medical context, Chapman et al. (1996) found evidence of recency effects. Ashton and Ashton (1995) go even farther by distinguishing accounting environments from more generic settings. Thus, evidence suggests that accounting studies using the belief-adjustment model as its framework may have varying results even across different

[3] Ashton and Ashton (1988) refer to "attitudes" in describing the dilution effect, which is consistent with the working paper that preceded Hogarth and Einhorn's (1992) published work. However, as indicated by Kahle et al.'s (2005) review of the belief revision literature, "sensitivity" is now the prevalent term.

accounting contexts. The inconsistency is significant, because the auditing context (where most accounting belief revision research has been conducted) represents a professional competency context (i.e., auditors' efficiency and effectiveness); whereas, the disclosure context is comprised of a fiduciary, principal-agent relationship between management and investors. Adelman et al. (1997) assert that beyond contextual factors, one must also consider situational-specific (i.e., task) factors in making predictions regarding individual judgments. They found evidence of different judgments based on task characteristics.

In sum, psychological and auditing research has shown greater belief revisions for sequentially disclosed information than for simultaneous disclosures (Hogarth and Einhorn 1992; Ashton and Ashton 1988). As previously mentioned, a likely reason is that new evidence presented simultaneously gets diluted in terms of importance (due to the necessary aggregating), causing a lower amount of belief revision. However, the contextual (i.e., psychological and auditing versus disclosure) and task factor (i.e., two cues versus ten cues in a consistent direction) differences between the prior research and the current experiment suggest the need to investigate if those results would extend to the current setting. Consistent with belief-adjustment model predictions and prior literature, the following hypothesis is predicted (alternate form):

H1: When a short series of consistently positive (negative) disclosures is sequentially disclosed, as compared to simultaneously disclosed, belief revisions in stock price judgments will be significantly greater in the sequential condition.

Hypothesis 1 tests the equivalent of a step-by-step (i.e., sequential) versus end-of-sequence (i.e., simultaneous) response mode disclosure pattern, given consistent information. What is unknown and previously untested in the accounting belief revision literature is if the same result would occur over a "long" series of disclosures and a direction reversal of cues. The change in disclosure direction after the first set of disclosures for the simultaneous conditions creates a unique category of response mode (i.e., it cannot be considered end-of-sequence anymore). Thus, the second sequence of simultaneous disclosures creates a new form of step-by-step pattern (i.e., different from sequentially releasing the disclosures one at a time), named SbS 10.

The belief-adjustment model predicts that mixed evidence will produce more belief change when it is processed after viewing evidence of the opposite sign. Its cause is the increased level of sensitivity the decision maker encounters when viewing evidence contrary to the existing belief. For example, after reviewing all positive information, a piece of negative information will cause the decision maker to be more sensitive to the new evidence (because it is contrary information to what that individual has previously received). As indicated earlier, the increased sensitivity should increase the amount of belief revision, but in the opposite direction. Hogarth and Einhorn (1992) call this result the "contrast effect."[4]

Hogarth and Einhorn (1992) and Ashton and Ashton (1988) find evidence that stronger referents will result in a more significant contrast effect (i.e., larger belief revisions). The effect is due to the greater "surprise" sensed by individuals who had stronger prior beliefs than others, after receiving information contrary to prior beliefs. In terms of response modes, consistent with H1, individuals who revise their beliefs sequentially for consistent

[4] A contrast effect causing recency is expected in the current study, due to the assumed information-prone nature of the participants, weak initial referent, and the strength of the successive cues. Anchoring would be expected if the referent was strong and following cues was weak or if the participants had minimal sensitivity toward the cues.

positive (negative) information are more likely to have a higher (lower) ending referent than those who revise simultaneously. Therefore, after receiving direction-reversed information, they will be more sensitive to the information (as compared to those receiving the same prior information simultaneously) which will result in greater belief revisions. Such a result is also consistent with the general investor research previously discussed, relating to the effects caused by a reverse in the direction of information (e.g., DeBondt and Thaler 1985; Barberis et al. 1998; Bloomfield and Hales 2002).

Hogarth and Einhorn (1992) warn that even though a simultaneous response mode may be elicited, decision makers could still use sequential processing to ease cognitive strain if the task becomes too complex. Complexity could arise if a long series of cues is presented or if the decision makers are unfamiliar with the task. Thus, in order to mitigate complexity, I used only one-sentence disclosures in a paper-and-pencil format. Participants receiving disclosures simultaneously were able to go back and check all previous disclosures as many times as they deemed necessary. Combined with the low levels of words involved in the disclosures, checking previous disclosures should have lessened task complexity and eased the cognitive strain on memory. Similar to Baird and Zelin (2000), the disclosures should have been familiar enough to the study participants to avoid potentially confounding task complexities. The Method section provides further discussion.

In sum, consistent with the belief-adjustment model's contrast effect and general investor research findings, the second hypothesis is as follows (alternate form):

H2: After a change in disclosure direction, when a series of consistently negative (positive) information is sequentially disclosed, as compared to being simultaneously disclosed, the belief revisions in stock price judgments will be significantly greater in the sequential condition.

The two hypotheses are illustrated graphically in Figure 1.

METHOD

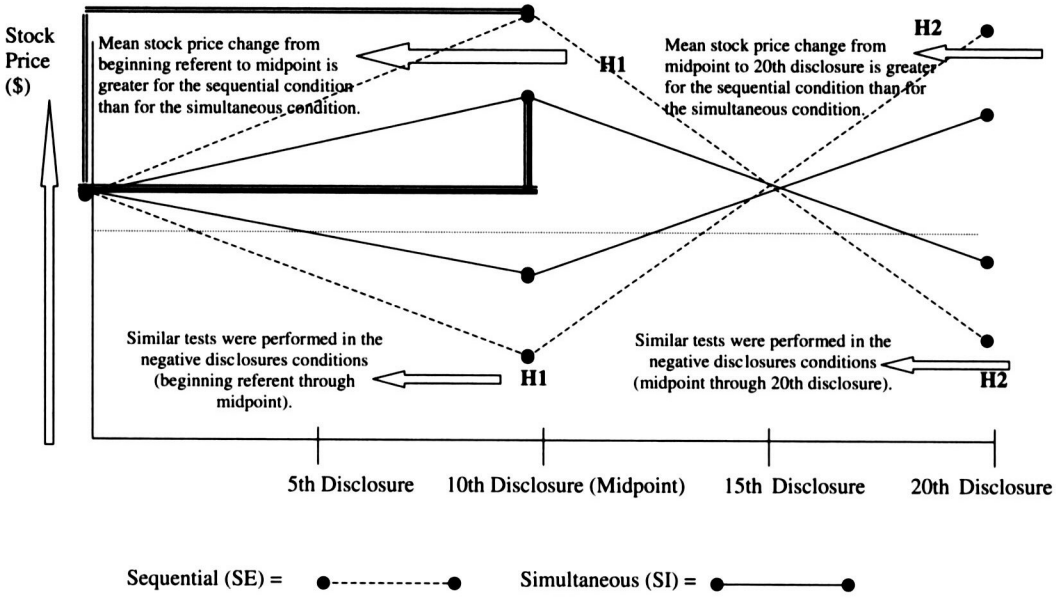
The experiment employed a 2 (disclosure pattern: sequential versus simultaneous) × 2 (direction: a series of ten positive followed by ten negative disclosures or vice versa) between-subjects design using volunteer undergraduate accounting students. Participants in each session were randomly assigned to one of four experimental conditions. Because the simultaneous condition had fewer valuations to perform than the sequential condition, participants in this condition were given two distracter tasks to delay their completion of the experimental materials.[5]

Procedures

The task involved providing stock price assessments of Autismo, Inc., a hypothetical semiconductor company. To familiarize the participants with the nature of the task and directional scale, participants completed a "training" phase that consisted of sample information. For realism, the information used for training came from various Pfizer Pharmaceuticals' disclosures that were slightly modified to avoid recognition. The information was

[5] The first task, given after the valuation task but before the demographic questions, was a modified personality test from the Internet. The second task (that all conditions received) was a crossword puzzle at the end of the experimental materials.

FIGURE 1
Hypotheses 1 and 2



similar to what participants would receive in the main experiment, and similar to the approach used by Callahan and Gabriel (1998).[6] After the training session, at time period zero (t_0), participants were given initial company background information and a seeded stock price valuation of $50 to be used as an initial reference point.[7] Background disclosures were based on a combination of Intel and AMD Lexis-Nexis disclosures that were modified to avoid recognition.

Upon the release of each disclosure (sequential) or set of disclosures (simultaneous), participants were asked to revalue the company's stock price (based on their prior valuation) and rate the direction of each disclosure on a scale that ranged from −10 (Very Bad News) to +10 (Very Good News).[8] A 21-point scale (essentially incorporating two 11-point scales)

[6] Although the purpose of the training phase was to familiarize the participants with the scale, potential demand effects cannot be completely ruled out. Two methods were used to counteract the potential demand effects. First, a focus group of students who did not participate in the experiment was used to gauge clarity and understandability of the research instrument. During the session, the participants went through all training-phase questions on their own and then went back and discussed each one with the researcher. The results clearly indicated different disclosure ratings (in the correct directions) and significant magnitude differences in stock price adjustments between participants (i.e., evidence against demand effects). Second, the subject matter of the disclosures in the practice phase was not referenced in the actual task, and the background information also differed.

[7] Background information included chief officer turnover, annual dividend, earnings growth, and competition information.

[8] The specific question for the first valuation was, "Based on this news announcement (above) and the last share price of Autismo's stock just provided ($50), how much would you pay for one share of Autismo's stock?" There was no number in parentheses after the first valuation. The scaling question was, "On a scale of −10 (very important, bad news) to +10 (very important, good news), where 0 indicates the news is neutral (neither bad nor good) and unimportant, please circle your opinion regarding the importance of this news announcement from an Autismo investor's point of view. (Please circle only one number.)"

was used, because disclosures could have been perceived as either negative or positive. Scales of this nature were tested and used in Tan et al. (2002) and Hunton et al. (2002). Because the interval nature of such scales can be questioned, both parametric and nonparametric tests of scale responses were used in the analyses.

For subsequent disclosures, participants were reminded of the last share price they provided. After reading and responding to all 20 disclosures, participants responded to manipulation-check questions, post-experiment psychological debriefing questions, and demographic items. The Appendix contains the wording of all 20 disclosures.

Participants

Undergraduate business students were used in the experiment (as a proxy for nonprofessional investors [SFAC No. 1, FASB 1978]). Participants were recruited from upper division accounting courses at the University of South Florida. They were paid a flat amount of $10 and many were offered extra credit by their instructors for participation.[9] A total of 129 students participated in the experiment (75 females [58.14 percent], 53 males [41.08 percent], and one nonrespondent [0.78 percent]), with a mean (standard deviation) age of 26.57 (7.52) years. Two responses that were greater than three standard deviations from the mean were deleted, yielding a final usable sample of 127 participants. There were 63 (49.6 percent) participants in the simultaneous conditions, of which 32 received two lump sums of ten disclosures in a positive-negative sequence, and 31 received the lump sum disclosures in the reverse order. There were 64 (50.4 percent) participants in the sequential conditions, of which 33 received ten positive disclosures one at a time followed by ten negative disclosures one at a time, and 31 received disclosures in the reverse order.

Two questions elicited participant perceptions of the stock valuation task difficulty.[10] Results indicated a mean response that was significantly less than the midpoint of the scale (below the midpoint of "neutral" represented an "easy" task and above the midpoint represented a "difficult" task) of the summed scale ($t = -3.03$, $p < 0.01$). Thus, overall, participants perceived the task to be relatively easy. Both sequential and simultaneous conditions reported similar evaluations. This finding is salient, because it provides evidence indicating that the task was familiar to the participants. Task familiarity guards against potentially confounding task complexities, as discussed earlier.

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[9] Participants were asked about the salience of the $10 payment and extra credit as motivators. In terms of the $10, the item was phrased: "How much did receiving the $10 motivate you to do your best on the stock valuation task? (1 = I was not motivated at all by the $10, 4 = I was somewhat motivated by the $10, 7 = I was extremely motivated by the $10)." T-test results indicated sample means of all participants were below the scale midpoint (mean = 2.70, $t = -9.87$, $p < 0.01$). In terms of extra credit, participants were asked: "How much did the extra credit points motivate you to do your best on the stock valuation task? (1 = I was not motivated at all by the extra credit points, 4 = I was somewhat motivated by the extra credit points, 7 = I was extremely motivated by the extra credit points." Because not all instructors offered extra credit for participation, a t-test, similar to the one for the $10 payment, was performed on the midpoint of the scale only for those participants who were offered extra credit. The mean (5.30), t (8.05), and p (< 0.01) indicated statistical significance. Hence, the $10 payment did not appear to represent a large motivational incentive for participation, but extra credit points offered did.

[10] The first question was phrased: "Overall, how would you rate the difficulty of the stock price valuation task you had to do in this study? (1 = not difficult, 4 = somewhat difficult, 7 = extremely difficult)." The second question was reversed scored and asked: "I thought that the experimental task (valuing the stock price of a company) was very easy. (1 = strongly disagree, 4 = not sure, 7 = strongly agree)." The correlation ($r = 0.55$, $p < 0.01$) was deemed sufficient to use a summed index of the two measures for testing. An ANOVA indicated participants' perceptions did not differ across experimental conditions ($F = 0.28$, $p > 0.50$).

Two other questions elicited participants' knowledge and experience with investing.[11] Results indicated a mean response that was significantly below the midpoint of the scale for the knowledge question ($t = -5.76$, $p < 0.01$). A similar result was found for the experience question ($t = -12.03$, $p < 0.01$). Although both knowledge and experience responses were below average, they were well above the lowest point of the scale (i.e., no knowledge or experience) and appear to be representative of the investing knowledge and experience of undergraduate students.

RESULTS

Preliminary Analyses

A manipulation check for "direction" was captured each time participants responded to the importance weightings associated with each disclosure.[12] The means and standard deviations for the importance weightings in the sequential conditions are shown in Table 1.[13] For each disclosure within each condition, parametric t-tests as well as nonparametric Mann-Whitney and Kolmogorov-Smirnov tests were conducted to determine if mean responses are significantly greater than zero. Test results are significant at $p < 0.01$, and the means are in the expected direction in all four conditions for all disclosures; accordingly, the "direction" manipulation was successful.[14]

Tests of Hypotheses 1 and 2

ANCOVA analyses for the revision from the initial referent of \$50 to the 10th valuation ($t_0 - t_{10}$; henceforth the "short" series) and the revision in stock price from the 10th to 20th valuations ($t_{10} - t_{20}$; henceforth, the "long" series) are shown in Table 2. Table 3 presents the least-squared means for each dependent variable per condition and a summary of the hypothesis tests. Figure 2 depicts the data.

Hypothesis 1 predicts that stock price revisions would be significantly greater in the sequential condition than in the simultaneous condition. As hypothesized and shown in Table 2 (Panel A), the disclosure "pattern" main effect is significant ($F = 46.93$, $p < 0.01$). Further, Table 3 indicates that the sequential condition has the higher least-squared means in each direction (i.e., positive-negative, negative-positive) of disclosures. The Wilcoxon/Kruskal Wallis results ($\chi^2 = 17.35$, $p < 0.01$ for the positive-negative disclosures sequence; $\chi^2 = 22.02$, $p < 0.01$ for the negative-positive disclosures sequence) confirmed the ANCOVA analysis. Thus, findings support H1.

Hypothesis 2 predicts that the greater revisions in the sequential conditions would continue but reverse sign after a change in disclosure direction. As hypothesized and shown

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[11] Participants were asked: "How would you rate your overall knowledge with respect to investing in the stock market? (1 = not very knowledgeable, 4 = somewhat knowledgeable, 7 = very knowledgeable)." The sample mean (standard deviation) was 3.41 (1.40). The other question asked: "How would you rate your experience in evaluating prices for common stock? (1 = very inexperienced, 4 = average experience, 7 = very experienced)." The sample mean (standard deviation) was 2.70 (1.49).

[12] Two questions were elicited for each pattern of disclosure manipulation. Each set was highly correlated and summed into single indexes. For the sequential condition, a t-test subtracting the mean of the sequential condition from the mean from the simultaneous condition indicated significant differences in the anticipated direction ($t = -17.86$, $p < 0.01$). For the simultaneous condition, a t-test of the other index subtracting the mean of the sequential condition from the mean from the simultaneous condition indicated significant differences in the anticipated direction ($t = 19.76$, $p < 0.01$). Thus, the manipulation was successful.

[13] The experiment attempted to hold the weights of each disclosure constant, such that belief revision would come from the pattern of disclosure, rather than the strength of the disclosure. As indicated in Table 1, this did not occur. In order to counteract the disclosure strength differences, least-squared means were used in the analysis, calculated by including the corresponding disclosure weightings as covariates.

[14] Although not displayed, each set of ten disclosures was tested. t-tests as well as Mann-Whitney and Kolmogorov-Smirnov tests all are significant at a $p < 0.01$.

TABLE 1
Means and Standard Deviations of the 20 Disclosures in the Sequential Conditions

Absolute Disclosure #	Expected Sign	Mean (n = 64)	Standard Deviation
1	−	−6.48	2.56
2	+	4.62	2.65
3	−	−5.81	2.57
4	+	7.08	2.02
5	−	−6.44	2.19
6	−	−5.80	2.99
7	+	5.31	2.63
8	−	−5.85	3.29
9	+	4.64	2.71
10	−	−6.06	2.52
11	+	5.99	2.34
12	+	6.31	2.41
13	+	6.93	2.77
14	−	−7.39	2.28
15	+	5.58	2.67
16	−	−7.07	2.38
17	+	5.15	2.52
18	−	−6.41	3.31
19	+	7.14	2.28
20	−	−6.66	2.50

in Table 2 (Panel B), the disclosure "pattern" main effect was significant ($F = 33.21$, $p < 0.01$). The results in Table 3 indicate the sequential condition has the higher least-squared means in each direction of disclosures. The Wilcoxon/Kruskal Wallis results ($\chi^2 = 14.00$, $p < 0.01$ for the positive-negative news sequence; $\chi^2 = 11.48$, $p < 0.01$ for the negative-positive news sequence) confirmed the ANCOVA analysis. Thus, H2 is also supported.[15] Figure 2 graphically portrays the greater belief revisions for the sequential conditions, showing a pattern similar to the predicted pattern in Figure 1.

Further Analyses

The belief-adjustment model indicates that sensitivity to information is a major factor in producing the amount of a revised belief. Consequently, it serves as the overriding factor in both hypotheses. Three sets of analyses gauged the participants' sensitivity to information. First, Tables 4 (positive-negative sequence) and 5 (negative-positive sequence) display

[15] Levene's test for equal variances shows significant results for both variables. Additionally, probability plots, histograms, and the Kolmogorov-Smirnov statistic with a Lilliefor's correction showed deviations of univariate normality in several treatment conditions. Given the departures of the normality and equal variance assumptions, I analyzed the hypotheses, using both parametric and nonparametric tests. The covariates in the ANCOVA model included gender, age, number of college semesters completed, major, number of finance classes taken, months of work experience, area of primary work experience, self-efficacy, knowledge of the task, experience with the task, and the importance weightings for the 10th and 20th cues (i.e., how the least-squared means were calculated). Self-efficacy beliefs were measured in a manner similar to Hunton and Beeler (1997), using three items summed into a single index (Cronbach's alpha [0.89]). Only gender and the disclosure weightings were significant at an alpha of 0.05, and thus were used in further hypothesis testing.

TABLE 2

Panel A: Analysis of Covariance for "Short" Series

Source of Variation	df	SS	MS	F-Statistic	p-value
Main Effects					
Direction	1	2132	2132	12.46	< 0.01
Pattern	1	8027	8027	46.93	< 0.01
Interaction					
Direction*Pattern	1	376.16	376.16	2.20	0.14
Covariates					
Gender	1	565.42	565.42	3.31	0.07
Weighting 10	1	821.78	821.78	4.81	0.03
Model	5	12,030	2406	14.07	< 0.01

Panel B: Analysis of Covariance for "Long" Series

Main Effects					
Direction	1	2484	2484	5.20	0.02
Pattern	1	15,858	15,858	33.21	< 0.01
Interaction					
Direction*Pattern	1	229.40	229.40	0.48	0.49
Covariates					
Gender	1	17.92	17.92	0.04	0.85
Weighting 10	1	1994	1994	4.18	0.04
Weighting 20	1	4093	4093	8.57	< 0.01
Model	6	24,064	4011	8.40	< 0.01

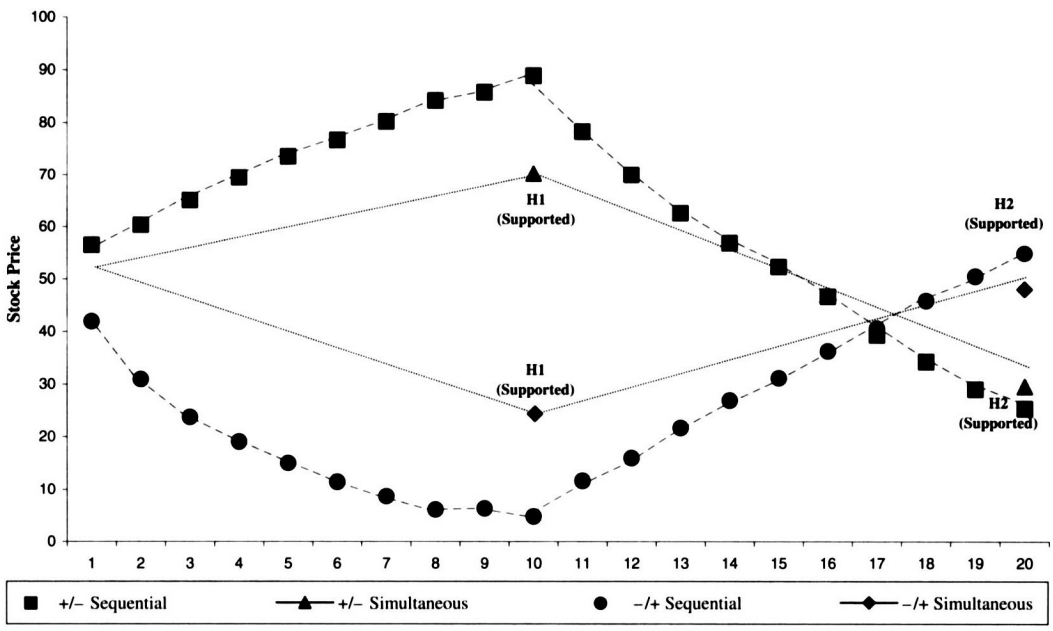
Variable Definitions:
Direction = the order of sequence (positive/negative or negative/positive);
Pattern = the disclosure pattern used (sequential versus simultaneous); and
Weighting 10 and 20 = the weights assigned by the participants to the tenth and twentieth disclosures, respectively.

TABLE 3
Summary of Results for H1 and H2

	Parametric		Nonparametric	
Hypothesis	LS Mean S[a]	LS Mean L[b]	Kruskal χ^2 (p-value)	Support
1	33.70*	14.13	17.35 (< 0.01)	Yes
(The positive-negative disclosure sequence, "short" series, sequential > simultaneous)				
1	50.52*	38.23	12.02 (< 0.01)	Yes
(The negative-positive disclosure sequence, "short" series, sequential > simultaneous)				
2	71.81*	46.65	14.00 (< 0.01)	Yes
(The positive-negative disclosure sequence, "long" series, sequential > simultaneous)				
2	42.49*	22.95	11.48 (< 0.01)	Yes
(The negative-positive disclosure sequence, "long" series, sequential > simultaneous)				

* Indicates significant differences between least-squared mean S and least-squared mean L at an alpha of 0.05.
[a] Least-squared means for the sequential condition.
[b] Least-squared means for the simultaneous condition.

FIGURE 2
Least-Squared Means of Stock Price Judgments for Each Disclosure and Results of Hypothesis Testing



disclosure weightings for all conditions before and after the direction reversal of disclosures. The sequential conditions in both tables reveal no apparent drop-off of importance to disclosures later in the sequences. In fact, the means are typically larger around the middle-to-later part of the sequences (except at the very end). The same pattern is not observable in the simultaneous conditions for both sequences. Specifically, there is a small decline in mean importance weightings between the first and second sets of disclosures. Therefore, it did not appear that sequential condition participants became less sensitive to disclosures throughout the sequences, while a loss of sensitivity for the simultaneous condition participants is possible.

Second, I compared participant sensitivity to disclosures between disclosure pattern conditions, in order to provide descriptive support for the first hypothesis.[16] Specifically, Tables 6 (positive-negative sequence) and 7 (negative-positive sequence) display the raw mean beliefs after each disclosure (or set of disclosures) for the first ten disclosures. If the simultaneous conditions did not become less sensitive, their beliefs should have been in line with the sequential condition beliefs after all disclosures.

As indicated in Tables 6 and 7, beliefs at t_{10} for the simultaneous condition were in line with the sequential condition beliefs between the fourth and fifth disclosures. Results

[16] A similar analysis for the second set of ten disclosures revealed that in both direction sequences, it took until between the 18th and 19th disclosures for the SbS conditions to have stock price beliefs in line with the SbS 10 conditions. The relatively longer time needed is due to more "distance to cover," given the larger beliefs after the first sequence of disclosures.

TABLE 4
Means and Standard Deviations for the Disclosures in Order Seen by Participants (Positive-Negative Sequence)

Disclosure #	Condition	Mean	Standard Deviation
1	Sequential	4.97	2.10
2	Sequential	5.30	2.51
3	Sequential	5.82	2.95
4	Sequential	6.15	2.77
5	Sequential	5.76	2.89
6	Sequential	6.12	2.48
7	Sequential	5.91	2.75
8	Sequential	5.79	2.93
9	Sequential	6.03	2.44
10	Sequential	5.97	2.71
11	Sequential	−4.52	1.91
12	Sequential	−6.21	1.50
13	Sequential	−6.73	1.89
14	Sequential	−6.88	2.03
15	Sequential	−6.64	2.40
16	Sequential	−7.00	2.09
17	Sequential	−7.21	1.95
18	Sequential	−7.09	2.39
19	Sequential	−6.42	2.59
20	Sequential	−6.76	2.25
1–10	Simultaneous	7.88	4.69
11–20	Simultaneous	−7.78	2.50

support the notion that the simultaneous condition aggregated the disclosures, which reduced the sensitivity, overall weight, and amount of their belief revisions as compared to the sequential condition. The result is consistent with H1.

Finally, a t-test compared the means between the belief revision differences at t_9 and t_{10} (the last revision in the consistent series) and t_{10} and t_{11} (the first revision after the direction reversal). The latter mean revision of 9.07 was significantly greater than the former revision of 2.27 ($t = 6.04$, $p < 0.01$). Thus, there is evidence supporting the "contrast effect" prediction in which sequential condition participants became more sensitive to disclosures after a direction reversal (consistent with H2).

CONCLUSION

This experiment examines the effect of disclosure pattern and direction on stock price beliefs. Research findings provide empirical evidence of greater belief revisions for sequential than for simultaneous disclosure patterns after both the first series of consistent information (i.e., short series) and after the second series of direction-reversed information (i.e., long series). Further analysis indicated that participants in the simultaneous conditions appeared to aggregate the short series disclosures. The aggregation caused those participants to be less sensitive to the disclosures later in the sequence, which resulted in lower belief

TABLE 5
Means and Standard Deviations for the Disclosures in Order Seen by Participants (Negative-Positive Sequence)

Disclosure #	Condition	Mean	Standard Deviation
1	Sequential	−4.45	3.30
2	Sequential	−7.32	1.97
3	Sequential	−7.29	2.85
4	Sequential	−7.16	3.35
5	Sequential	−7.45	2.45
6	Sequential	−7.03	2.54
7	Sequential	−6.65	3.18
8	Sequential	−7.16	4.04
9	Sequential	−6.94	2.76
10	Sequential	−6.45	4.23
11	Sequential	4.94	2.38
12	Sequential	5.81	2.14
13	Sequential	6.29	2.40
14	Sequential	6.77	2.49
15	Sequential	6.87	2.00
16	Sequential	7.10	2.52
17	Sequential	7.61	2.35
18	Sequential	7.00	2.86
19	Sequential	7.00	2.63
20	Sequential	6.55	2.95
1–10	Simultaneous	−8.97	2.37
11–20	Simultaneous	8.06	4.13

TABLE 6
Raw Mean Beliefs after the First Ten Disclosures (Positive-Negative Sequence)

Disclosure #	Condition	Mean	Standard Deviation
1	Sequential	56.76	8.70
2	Sequential	60.30	10.18
3	Sequential	65.09	12.59
4	Sequential	69.45	13.34
1–10	Simultaneous	70.66	13.38
5	Sequential	73.70	13.49
6	Sequential	76.58	14.04
7	Sequential	79.94	15.30
8	Sequential	83.36	17.23
9	Sequential	85.61	17.58
10	Sequential	88.79	17.91

revisions compared to those in the sequential conditions. Even though this experiment used many more cues (ten) than typically used (two) for short series accounting studies, the

TABLE 7
Raw Mean Beliefs after the First Ten Disclosures (Negative-Positive Sequence)

Disclosure #	Condition	Mean	Standard Deviation
1	Sequential	41.83	7.52
2	Sequential	31.33	9.08
3	Sequential	24.15	11.50
4	Sequential	18.82	12.17
1–10	Simultaneous	18.71	13.06
5	Sequential	14.67	11.32
6	Sequential	11.40	10.41
7	Sequential	9.04	9.05
8	Sequential	7.13	8.07
9	Sequential	6.01	7.03
10	Sequential	4.70	6.22

results are consistent with prior belief revision auditing and tax research. Thus, in my setting, the belief revision prediction of Hogarth and Einhorn's (1992) model holds for a relatively longer sequence of consistent cues in a disclosure context.

The research design testing the long series necessitated a form of SbS processing not previously tested (i.e., the SbS 10 conditions). Although in line with prior general investing literature (e.g., Bloomfield and Hales 2002; DeBondt and Thaler 1985), the long series result is new to the accounting belief revision literature. Consequent to a change in disclosure direction, the belief revisions are more significant for sequential conditions than for simultaneous conditions. The result is attributed to a larger contrast effect for the former as compared to the latter conditions. After the short series of consistent disclosures, participants in the sequential conditions had more extreme beliefs than participants in the simultaneous conditions. Then, upon receiving contrary information, the sequential conditions became more sensitive to the disclosures and revised their beliefs in a greater fashion than those in the simultaneous conditions. Further analysis of disclosure weightings and beliefs around the first contrary disclosure provided evidence of the sensitivity differences between disclosure pattern conditions.

Given the above findings, new legislation and regulation (e.g., Section 409 of the Sarbanes-Oxley Act [SOX] of 2002) requiring quicker disclosures consistent with a sequential pattern, may lead to greater swings in stock price (presuming individual investors' judgments can alter stock price in accordance with Tuttle et al. [1997]). However, the current experiment was designed so no specific disclosure was (normatively) more important than another. In a true market setting, old news tends to get superseded by recent news regardless of disclosure frequency. Therefore, the potential cost of greater swings in stock price caused by quicker disclosure must be weighed against the intended benefit of quicker access to firm information by investors.

The current study is subject to several limitations. The dependent variables of *interest* measured participant judgments and not necessarily their behavior. It is unknown whether or not the participants would have bought or sold the stock for the prices they indicated. Also, potential demand effects cannot be ruled out. Participants were instructed to provide stock price valuations after considering their prior judgments. It is conceivable that participants could have felt prompted to revise. As with any experiment, it is not recommended

to generalize the results outside of the specific participant pool and context used in the current study.

There are several exciting areas for future research. First, the current study provided evidence of increased belief revision for sequential or simultaneous conditions. The next step would be to find out whether the increased belief revision leads to recency effects, consistent with prior short series accounting belief revision research. If recency effects are found, creating mitigation techniques represents a significant contribution to the belief revision literature.

Second, the current study's results are context-specific. Future research should investigate long series effects on belief revision in other accounting domains (e.g., auditing). Finally, the current study predicted and found evidence of a contrast effect. As a result, participants were highly sensitive to cues in the second sequence of the sequential conditions and revised their beliefs. Anchoring occurs when the decision maker does not significantly revise beliefs. Future research should identify task characteristics that can produce significant belief revisions in one scenario and anchoring effects in another.

APPENDIX
TWENTY DISCLOSURES (NEGATIVE-POSITIVE DIRECTION)

1. Jasmine Financial Group, which controls billions of dollars worth of stocks, sharply decreased stock holdings in Autismo.
2. The technology index, the best measure of the health of technology stocks, has slumped an enormous 19 percent since the end of last month, mostly due to Autismo's announcement of continuously decreasing profits.
3. Sales of midrange computers containing Autismo computer chips decreased from 32 percent to 15 percent of total computer sales.
4. Continuing its recent trend, Autismo's profit outlook declined significantly yesterday, triggered by falling microprocessor prices and general PC market weakness.
5. Confirming speculation that customers are flocking from Autismo's to Sagee's low-end processors, Sagee said last week that it doubled sales of low-end chips from the previous quarter.
6. Voiding its current contract with Autismo, data processing giant Moyer Applications entered into a $1.2 billion contract with Sagee to buy its high-end processor chips.
7. Due to Autismo's recent $1 billion fine for illegally dumping toxic waste, recent sales to environmentally-friendly consumers are significantly increasing Sagee's revenues.
8. The amount of cash investment in Autismo is significantly lower than previous years, as market demand for Autismo's products continues to plummet.
9. "This will be a quarter of record low revenue and earnings," said Autismo CEO Craig Biggins.
10. Autismo's profits are falling due to the company's inability to reduce inventory obsolescence and storage costs.
11. A recent survey has indicated that, for the fourth year in a row, Autismo has the highest level of customer satisfaction among semiconductor companies.
12. Autismo's stock price has been higher recently, because many analysts believe the company offers excellent earnings growth potential.

13. Autismo said it won a $1 billion order to supply Somers, the world's largest cell phone manufacturer, with flash-memory chips over the next four years.
14. Autismo announced today that its second largest market, Europe, has shown a sharp increase in demand for its products.
15. A new alliance between BrainVision and Autismo will provide customers with a unique computer hardware package that offers twice the performance as its next closest competitor Sagee.
16. "Yesterday, after the close, Autismo web-casted its analyst conference reiterating its incredibly strong, industry-leading 20 percent revenue growth," said Jonathan Jonas, an analyst at Jasmine Financial Group.
17. Technology giant NetJournal decided to form a lucrative business alliance with Autismo, rather than Sagee, which is likely to yield huge profits for Autismo in the next five years.
18. As a result of adopting a new management style, Autismo has incurred higher levels of production efficiency and now manufactures its products significantly faster.
19. Autismo's alliance with Ramble Technology Chips has increased significantly, resulting in hundreds of millions of dollars in additional profits for Autismo.
20. Autismo's price cut for its new, low-end chip has spurred an extreme increase in demand for the product, resulting in significantly higher profits.

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