Speech Analysis in Financial Markets

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Foundations and Trends® in Accounting

Published, sold and distributed by:
now Publishers Inc.
PO Box 1024
Hanover, MA 02339
USA
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www.nowpublishers.com
sales@nowpublishers.com

Outside North America:
now Publishers Inc.
PO Box 179
2600 AD Delft
The Netherlands
Tel. +31-6-51115274

The preferred citation for this publication is W. J. Mayew and M. Venkatachalam, Speech Analysis in Financial Markets, Foundation and Trends® in Accounting, vol 7, no 2, pp 73–130, 2012

ISBN: 978-1-60198-652-8

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Foundations and Trends® in Accounting, 2012, Volume 7, 4 issues. ISSN paper version 1554-0642. ISSN online version 1554-0650. Also available as a combined paper and online subscription.

Foundations and Trends® in
Accounting
Vol. 7, No. 2 (2012) 73–130

DOI: 10.1561/1400000024

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Abstract

The ways in which managers communicate information to capital market participants go far beyond financial statements and accounting numbers. Managers communicate economically relevant information both verbally, in documents distributed and available to investors (such as annual reports and SEC filings), and nonverbally, through meetings and conference calls with analysts and investors. We review research on the information contained in nonverbal communication, particularly vocal communication that occurs in organizational contexts. We also explore possible ways in which accounting researchers can draw useful insights from investigating managerial vocal communication. The advances in computerized voice analysis coupled with the increasing availability of audio files containing managerial communication presents promising research opportunities.

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Introduction

"Accounting is the language of business"

The American Accounting Association defines accounting as "the process of identifying, measuring, and communicating economic information to permit informed judgments and decisions by users of the information." The role that accounting, more broadly, and financial information, in particular, plays in capital markets has been the subject of considerable research over the last four decades.[1] However, much of this research focuses on the role of numbers reported in the financial statements, either in the main body or the footnotes. The ways in which managers communicate information to capital market participants go far beyond financial statement numbers. In particular, managers communicate economically relevant information both verbally in documents distributed and available to investors (such as annual reports and SEC filings) and nonverbally through meetings and conference calls with analysts and investors. Over the past five years, advances in computational linguistic software and

[1] For a review of empirical research on relation between financial reporting and capital markets, we refer the reader to a detailed survey article by Kothari (2001).

availability of large repositories of corporate text have facilitated an explosion of studies examining the information contained in verbal communication from management (see Li, 2010 for a discussion). In this monograph, we review research on the information contained in nonverbal communication that occur in organizational contexts, and explore ways in which accounting researchers can draw useful insights from investigating managerial nonverbal communication.

Nonverbal communication refers to the communication process that is distinct from verbal usage (that is, the use of language and word choices). It includes facial expressions, gestures, postures, body movements, vocal tone, and other physical ways in which people express themselves (Burgoon et al., 2010). Nonverbal communication is ubiquitous in our daily life and is central to our well-being. The relevance of nonverbal communication has been studied as early as the nineteenth century by Charles Darwin among others. Charles Darwin, in one of his treatises, The Expression of Emotions in Man and Animals, says:

> "The movements of expression in the face and body, whatever their origin may have been, are in themselves of much importance for our welfare. They serve as the first means of communication between the mother and her infant; she smiles approval, and thus encourages her child on the right path, or frowns disapproval. We readily perceive sympathy in others by their expression; our sufferings are thus mitigated and our pleasures increased; and mutual good feeling is thus strengthened. The movements of expression give vividness and energy to our spoken words. They reveal the thoughts and intentions of others more truly than do words, which may be falsified."
>
> Darwin (1892)

Nonverbal communication is no less important in a corporate context, as organizations are represented by a collection of individuals who interact and communicate to achieve a common collective pursuit. Research in social psychology suggests that nonverbal behavior of individuals within organizations differs based on status and power and this differential behavior is crucial for relationship building and sustaining organizational hierarchy (Remland, 2006). Thus, communication by individuals both within and outside the organization can have important ramifications for corporate success.

Considerable anecdotal evidence exists that suggest the importance of nonverbal communication between corporate management and the firm's outside stakeholders. Eighty percent of analysts in a recent survey by Deloitte preferred to meet face to face with management to assess their ability to lead the firm, with one analyst stating explicitly "to me, it's very important to listen to them" (Deloitte, 2012). Managers no doubt are aware of this. CFOs note that they get calls from analysts who are trying to "get a read on the quarter" based on their "tone of voice" (O'Sullivan, 2006) and hedge funds employ ex-CIA agents trained in reading nonverbal cues to assess public statements of management (Javers, 2010). Given the interest in nonverbal cues, best practices in earnings conference calls suggest that managers should rehearse, record, and listen to their calls in advance to better control the message that is ultimately communicated through their speech (Cossette, 2009).

Relatedly, recent academic research has found evidence broadly consistent with the notion that nonverbal communication is important. In a laboratory setting, Elliott et al. (2012) show that when managers provide online videos to explain firm performance rather than merely reporting performance in a press release, the nonverbal communication influences both the investors' investment levels and their perceptions of trust in management. Using archival data, Kimbrough and Louis (2011) show stronger stock market reactions to merger announcements that are accompanied by a conference call relative to announcements made by a press release alone, suggesting perhaps that analysts and investors perceive the signal to be more credible when managers discuss mergers through direct interactions with investors. The precise component of nonverbal communication that influences investor perceptions is not well understood, however.

Challenges to understanding the influence of nonverbal communication in a corporate context include the difficulty in isolating the multiple channels through which nonverbal communication can occur. For example, in an online video of a CEO, facial gestures, vocal expressions, and body movements can each convey nonverbal information in a single interaction. Further, tools for the systematic measurement in real-life settings are far less advanced for voice and kinesics than tools for analyzing text. Nevertheless, attempting to gain a better understanding of nonverbal aspects of communication is essential particularly because they may contain important and relevant clues for decision making by various interested parties, particularly the investor community. For example, nonverbal exchanges may help reveal important clues about a manager's inherent characteristics. In addition, they may also help evaluate managerial emotions that can contain clues about a firm's financial future as well as managerial truth-telling behavior. Research on the extent to which managerial communication can supplement information contained in other disclosures provided by management would be quite useful for investor decision making.

This monograph focuses on nonverbal communication from voice, with a particular emphasis on discussing voice analysis from the standpoint of a researcher interested in conducting empirical archival assessments. In Section 2, we discuss the research approaches to speech analysis and the importance of identifying speech corpus. In Section 3, we review the existing literature on voice analysis in accounting and finance that focuses primarily on management communication. Section 4 details the challenges facing the literature and offers some directions for future research. Section 5 offers concluding remarks.

References

Addington, D. W. (1968), 'The relationship of selected vocal characteristics to personality perception'. *Speech Monographs* **35**, 492–503.

Ambady, N. and R. Rosenthal (1993), 'Thin slices of expressive behavior as predictors of interpersonal consequences: A meta-analysis'. *Psychological Bulletin* **111**(2), 256–274.

Andersen, P. A. and L. K. Guerrero (1998), 'Principles of communication and emotion in social interaction'. In: P. A. Andersen and L. K. Guerrero (eds.): *Handbook of Communication and Emotion — Research, Theory, Applications, and Contexts*. San Diego: Academic Press, pp. 49–96.

Apicella, C. L., D. R. Feinberg, and F. W. Marlowe (2007), 'Voice pitch predicts reproductive success in male hunter–gatherers'. *Biology Letters* pp. 682–684.

Apple, W., L. A. Streeter, and R. M. Krauss (1979), 'Effects of pitch and speech rate on personal attributions'. *Journal of Personality and Social Psychology* **37**, 715–727.

Arnold, M. B. (1960), *Emotion and Personality*. New York: Columbia University Press.

Bamber, L., J. Jiang, and I. Wang (2010), 'What's my style? The influence of top managers on voluntary corporate financial disclosure'. *The Accounting Review* **85**(4), 1131–1162.

Barsade, S. G. (2002), 'The ripple effect: Emotional contagion and its influence on group behavior'. *Administrative Science Quarterly* **47**(4), 644–675.

Beneish, M. D. (1997), 'Detecting GAAP violation: Implications for assessing earnings management among firms with extreme financial performance'. *Journal of Accounting and Public Policy* **16**, 271–309.

Berry, D. (1992), 'Vocal types and stereotypes: Joint effects of vocal attractiveness and vocal maturity on person perception'. *Journal of Nonverbal Behavior* **16**(1), 41–54.

Bertrand, M. and K. F. Hallock (2001), 'The gender gap in top corporate jobs'. *Industrial and Labor Relations Review* **55**, 3–21.

Bertrand, M. and A. Schoar (2003), 'Managing with style: The effect of managers on firm policies'. *The Quarterly Journal of Economics* **118**(4), 1169–1208.

Bettman, J. A. and B. A. Weitz (1983), 'Attributions in the board room: Causal reasoning in corporate annual reports'. *Administrative Science Quarterly* **28**(2), 165–183.

Boersma, P. and D. Weenink (2010), 'Praat: Doing phonetics by computer (version 5.2.05)'. [Computer program], Retrieved from http://www.praat.org/.

Burgoon, J. K., T. Birk, and M. Pfau (1990), 'Nonverbal persuasion, behaviors, and credibility'. *Human Communication Research* **17**, 140–164.

Burgoon, J. K., L. K. Guerrero, and K. Floyd (2010), *Nonverbal Communication*. New York: Pearson Education Inc.

Callahan, C. and R. Smith (2004), 'Firm performance and management's discussion and analysis disclosures: An industry approach'. Working paper, University of Memphis.

Case, A. and C. Paxson (2008), 'Stature and status: Height, ability, and labor market outcomes'. *Journal of Political Economy* **116**(3), 499–532.

Cohen, J. F. and P. Ekman (2008), 'Measuring facial action'. In: J. A. Harrigan, R. Rosenthal, and K. R. Scherer (eds.): *The New Handbook of Methods in Nonverbal Behavior Research*. New York: Oxford University Press.

Cossette, J. (2009), 'Thirty tips for better earnings calls: Inside investor relations'. (available at: http://www.insideinvestorrelations.com/articles/earnings-calls-financial-reporting/15307/thirty-tips-better-earnings-calls/).

Coval, J. D. and T. Shumway (2001), 'Is sound just noise?'. *Journal of Finance* **56**(5), 1887–1910.

Dabbs Jr., J. M. and A. Mallinger (1999), 'High testosterone levels predict low voice pitch among men'. *Personality and Individual Differences* **27**, 801–804.

Darwin, C. (1892), *The Expression of the Emotions in Man and Animals*. London: John Murray.

Dechow, P. M., W. Ge, C. R. Larson, and R. G. Sloan (2011), 'Predicting material accounting misstatements'. *Contemporary Accounting Research* **28**(1), 17–82.

DeGroot, T. and S. J. Motowidlo (1999), 'Why visual and vocal interview cues can affect interviewers' judgments and predict job performance'. *Journal of Applied Psychology* pp. 986–993.

Deloitte (2012), 'The leadership premium: How companies win the confidence of investors'. (available at: http://www.deloitte.com/assets/Dcom-Global/Local%20Assets/Documents/Human%20Capital/dttl_The_Leadership_Premium_29Mar12.pdf).

Dyreng, S., M. Hanlon, and E. Maydew (2010), 'The effects of executives on corporate tax avoidance'. *The Accounting Review* **85**(4), 1163–1189.

Ekman, P. and W. V. Friesen (1974), 'Detecting deception from body or face'. *Journal of Personality and Social Psychology* **29**(3), 288–298.

Ekman, P. and E. L. Rosenberg (1997), *What the Face Reveals: Basic and Applied Studies of Spontaneous Expression using the Facial Action Coding System (FACS)*. New York: Oxford University Press.

Elkins, A. C., J. Burgoon, and J. Nunamaker (2012), 'Vocal analysis software for security screening: Validity and deception detection potential'. *Homeland Security Affairs,* Supplement **4.1**, 1–4. (available at: http://www.hsaj.org/?special:fullarticle=supplement.4.1).

Elliott, W. B., F. D. Hodge, and L. M. Sedor (2012), 'Using online video to announce a restatement: Influences on investment decisions and the mediating role of trust'. *The Accounting Review* **87**(2), 513–535.

Eriksson, A. and F. Lacerda (2007), 'Charlatanry in forensic speech science: A problem to be taken seriously'. *International Journal of Speech, Language and the Law* **14**(2), 169–193.

Evans, S., N. Neave, D. Wakelin, and C. Hamilton (2008), 'The relationship between testosterone and vocal frequencies in human males'. *Physiology and Behavior* pp. 783–788.

Feinberg, D. R., B. C. Jones, A. C. Little, D. M. Burt, and D. I. Perrett (2005), 'Manipulations of fundamental and formant frequencies affect the attractiveness of human male voices'. *Animal Behaviour* pp. 561–568.

Festinger, L. (1957), *A Theory of Cognitive Dissonance*. Stanford, CA: Stanford University Press.

Frijda, N. H. (1988), 'The laws of emotion'. *American Psychologist* **43**(5), 349–358.

Gregory, S. W. and T. J. Gallagher (2002), 'Spectral analysis of candidates' nonverbal vocal communication: Predicting U.S. presidential election outcomes'. *Social Psychology Quarterly* pp. 298–308.

Gregory, S. W. and S. Webster (1996), 'A nonverbal signal in voices of interview partners effectively predicts communication accommodation and social status perceptions'. *Journal of Personality and Social Psychology* pp. 1231–1240.

Hatfield, E., J. T. Cacioppo, and R. L. Rapson (1994), *Emotional Contagion*. New York, NY: Cambridge University Press.

Hobson, J., W. Mayew, and M. Venkatachalam (2012), 'Analyzing speech to detect financial misreporting'. *Journal of Accounting Research* **50**(2), 349–392.

Hodges-Simeon, C. R., S. J. C. Gaulin, and D. A. Puts (2010), 'Voice correlates of mating success in men: Examining "contests" versus "mate choice" modes of sexual selection'. *Archives of Sexual Behavior* **40**(3), 551–557.

Hollander, E. P. and L. R. Offermann (1993), 'Power and leadership in organizations'. In: W. E. Rosenbach and R. L. Taylor (eds.): *Contemporary Issues in Leadership*. Boulder, CO: Westview Press.

Javers, E. (2010), 'CIA moonlights in corporate world'. *Politico.com* (available at: http://www.politico.com/news/stories/0110/32290.html).

Juslin, P. N. and K. R. Scherer (2008), 'Vocal expression of affect'. In: J. A. Harrigan, R. Rosenthal, and K. R. Scherer (eds.): *The New Handbook of Methods in Nonverbal Behavior Research*. New York: Oxford University Press.

Kachelmeier, S. (2010), 'Introduction to a forum on individual differences in accounting behavior'. *The Accounting Review* **85**(4), 1127–1128.

Kappas, A., U. Hess, and K. R. Scherer (1991), 'Voice and emotion'. In: B. Rimé and R. Feldman (eds.): *Fundamentals of Nonverbal Behavior*. Cambridge: Cambridge University Press.

Kent, R. D. (1994), *Reference Manual for Communicative Sciences and Disorders: Speech and Language*. Pro-Ed, Inc, first edition.

Keynes, J. M. (1936), *The General Theory of Employment, Interest, and Money*. London: MacMillan.

Kimbrough, M. D. and H. Louis (2011), 'Voluntary disclosure to influence investor reactions to merger announcements: An examination of conference calls'. *The Accounting Review* **86**(2), 637–667.

Klofstad, C., R. Anderson, and S. Peters (2012), 'Sounds like a winner: Voice pitch influences perception of leadership capacity'. *Proceedings of the Royal Society B* **279**, 2698–2704.

Kothari, S. P. (2001), 'Capital markets research in accounting'. *Journal of Accounting and Economics* **31**(1–3), 105–231.

Kramer, E. (1963), 'Judgment of personal characteristics and emotions from nonverbal properties'. *Psychological Bulletin* **60**, 408–420.

Kumar, A. (2009), 'Self-selection and the forecasting abilities of female equity analysts'. *Journal of Accounting Research* **48**(2), 393–435.

Lacerda, F. (2009), 'LVA-technology- The illusion of "lie detection"'. In: *Proceedings, FONETIK 2009*. Department of Linguistics, Stockholm University, pp. 220–226.

Larcker, D. and A. Zakolyukina (2012), 'Detecting deceptive discussion in conference calls'. *Journal of Accounting Research* **50**(2), 495–540.

Laukka, P. (2004), 'Vocal expression of emotion: Discrete-emotions and dimensional accounts'. *Comprehensive Summaries of Uppsala Dissertations from the Faculty of Social Sciences 141*, Uppsala, Sweden.

Lazarus, R. S. (1966), *Psychological Stress and the Coping Process*. New York: McGraw-Hill.

Li, F. (2010), 'Textual analysis of corporate disclosures: A survey of the literature'. *Journal of Accounting Literature* **29**, 143–165.

Li, F., V. Nagar, M. Minnis, and M. Rajan (2012), 'Knowledge, competition and firm value: An empirical analysis of firm communication'. Working paper, University of Chicago.

Lindqvist, E. (2012), 'Height and Leadership'. Forthcoming*, Review of Economics and Statistics*.

Loughran, T. and B. McDonald (2011), 'When is a liability not a liability? Textual analysis, Dictionaries and 10-Ks'. *Journal of Finance* **66**, 35–65.

Mayew, W., C. Parsons, and M. Venkatachalam (2012), 'Voice pitch and the labor market success of male chief executive officers'. Working paper, Duke University and University of California at San Diego.

Mayew, W. and M. Venkatachalam (2012), 'The power of voice: Managerial affective states and future firm performance'. *Journal of Finance* **67**(1), 1–43.

Mazar, N., O. Amir, and D. Ariely (2008), 'The dishonesty of honest people: A theory of self-concept maintenance'. *Journal of Marketing Research* **45**(6), 633–644.

Mehrabian, A. (1971), *Silent Messages*. Belmont, CA: Wadsworth.

Meschke, F. and Y. H. Kim (2011), 'CEO interviews on CNBC'. Working paper, University of Kansas.

Neumann, R. and F. Strack (2000), '"Mood Contagion": The automatic transfer of mood between persons'. *Journal of Personality and Social Psychology* **79**(2), 211–223.

O'Sullivan, K. (2006), 'Hungry for more: Reg FD has changed the way companies serve up information, leading to plenty of tension between CFOs and analysts'. *CFO Magazine*.

Owren, M. J. (2008), 'GSU praat tools: Scripts for modifying and analyzing sounds using Praat acoustics software'. *Behavioral Research Methods* **40**(3), 822–829.

Owren, M. J. and J. Bachorowski (2007), 'Measuring emotion-related vocal acoustics'. In: *Handbook of Emotion Elicitation and Assessment*. New York, NY: Oxford University Press.

Pear, T. H. (1931), *Voice and Personality*. New York: John Wiley and Sons.

Penton-Voak, I. S. and J. Y. Chen (2004), 'High salivary testosterone is linked to masculine male facial appearance in humans'. *Evolution and Human Behavior* **25**(4), 229–241.

Persico, N., A. Postlewaite, and D. Silverman (2004), 'The effect of adolescent experience on labor market outcomes: The case of height'. *Journal of Political Economy* **112**(5), 1019–1053.

Planalp, S. (1998), 'Communicating emotion in everyday life: Cues, channels and processes'. In: P. A. Andersen and L. K. Guerrero (eds.): *Handbook of Communication and Emotion*. New York: Academic Press.

Puts, D. A., C. L. Apicella, and R. A. Cárdenas (2012), 'Masculine voices signal men's threat potential in forager and industrial societies'. *Proceedings of the Royal Society B* **279**, 601–209.

Puts, D. A., S. J. C. Gaulin, and K. Verdolini (2006), 'Dominance and the evolution of sexual dimorphism in human voice pitch'. *Evolution and Human Behavior* **27**, 283–296.

Remland, M. (2006), *Uses and Consequences of Nonverbal Communication in the Context of Organizational Life*. Newbury Park, CA: Sage.

Sapienza, P., L. Zingales, and D. Maestripieri (2009), 'Gender differences in financial risk aversion and career choices are affected by testosterone'. *Proceedings of National Academy of Sciences* **106**(36), 15268–15273.

Sapir, E. (1927), 'Speech as a personality trait'. *American Journal of Sociology* **32**(6), 892–905.

Scherer, K. R. (2003), 'Vocal communication of emotion: A review of research paradigms'. *Speech Communication* **40**(1–2), 227–256.

Scherer, K. R., H. London, and J. Wolf (1973), 'The voice of confidence: Paralinguistic cues and audience evaluation'. *Journal of Research in Personality* **7**, 31–44.

Schuller, B. (2010), 'On the acoustics of emotion in speech: Desperately seeking a standard'. *Journal of Acoustical Society of America* **127**(3), 1995–1995.

Schuller, B., A. Batliner, S. Steidl, and D. Seppi (2011), 'Recognising realistic emotions and affect in speech: State of the art and lessons learnt from the first challenge'. *Speech Communication* **53**(9–10), 1062–1087.

Stirrat, M. and D. I. Perett (2012), 'Face structure predicts cooperation: Men with wider faces are more generous to their in-group when out-group competition is salient'. *Psychological Science* **23**, 718–722.

Sundberg, J. (1988), 'Expressivity in singing: a review of some recent investigations'. *Logopedics Phoniatrics Vocology* **23**, 121–127.

Tannen, D. (1984), 'The pragmatics of cross-cultural communication'. *Applied Linguistics* **5**, 189–195.

Tigue, C., D. Borak, J. O'Connor, C. Schandl, and D. Feinberg (2011), 'Voice pitch influences voting behavior'. *Evolution and Human Behavior* **33**, 210–216.

Vrij, A. (2008), *Detecting Lies and Deceit: Pitfalls and Opportunities*. Chichester, UK: Wiley.

Vrij, A., K. Edward, K. P. Roberts, and R. Bull (2000), 'Detecting deceit via analysis of verbal and nonverbal behavior'. *Journal of Nonverbal Behavior* **24**, 239–264.

Wallbott, H. G. and K. R. Scherer (1986), 'Cues and channels in emotion recognition'. *Journal of Personality and Social Psychology* **51**, 690–699.

Wolfers, J. (2006), 'Diagnosing discrimination: Stock returns and CEO gender'. *Journal of European Economic Association* **4**, 531–541.

Wong, E., M. Ormiston, and M. Haselhuhn (2011), 'A face only an investor could love: CEOs' facial structure predicts their firms' financial performance'. *Psychological Science* **22**(12), 1478–1483.

Zuckerman, M. and R. Driver (1989), 'What sounds beautiful is good: The vocal attractiveness stereotype'. *Journal of Nonverbal Behavior* **13**, 67–82.

Zuckerman, M. and K. Miyake (1993), 'The attractive voice: What makes it so?'. *Journal of Nonverbal Behavior* **17**, 119–135.