It's not just what we say, it's how we move: An examination of postural activity during a disclosure event

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Abstract

The current study incorporates concepts from dynamical systems theory (DST) and embodied cognition to propose a novel method of answering traditional questions in social psychology. Namely, we were interested in understanding postural sway complexity during the important interpersonal task of disclosing a hidden stigmatized identity (e.g., mental health disorder, history of sexual abuse). Using detrended fluctuation analysis and multifractal detrended fluctuation analysis, we captured postural activity while people shared their personal secrets to an imagined other. Results suggest that disclosure context, defined by both disclosure confidant and antecedent goals, is indeed embodied in our complex postural activity.

Keywords: Postural Sway; Concealable Stigmatized Identities; Detrended Fluctuation Analysis; Multifractal Detrended Fluctuation Analysis

Introduction

The current project applied concepts from dynamical systems theory (DST) to common social-psychological phenomenon through the analysis of complex postural activity. Postural sway refers to subtle, unintentional movements that all people exhibit even when standing still. These nearly imperceptible fluctuations have demonstrated a functional role in maintaining balance and even efficiently exploring the environment (i.e., detecting depth) (Era & Heikkinen, 1985). Generally, healthy adults tend to sway approximately 1 cm in the anterior-posterior (AP) direction and .5 cm in the medio-lateral (ML) direction during quiet stance leading to great variability in postural activity within individuals (Baldan et. al., 2014). Research has found that there is meaningful structure to this movement variability in both the AP and ML planes that exhibits fractal scaling, or self similarity across different timescales (Delignières, Torre, & Bernard, 2011). This complex structure of postural sway allows us to adapt to different types of constraints—either personal, task relevant, or environmental—that exist across different time scales. The current project utilized two nonlinear data analytic techniques well suited to postural sway time series including detrended fluctuation analysis (DFA), and multifractal detrended fluctuation analysis (MFDFA) to characterize the spatio-temporal structure of postural activity during a social psychological event.

The complex (i.e., fractal) structure of postural variability can be influenced by a number of factors including schizophrenia (Kent et al., 2002), age, and movement disorders such as Parkinson's disease and Huntington's disease (lipsitz, 2004). A change in complexity is characterized by shifts from persistent pink noise to either anti-persistent white noise, or deterministic Brownian motion. As such, fractal, or pink noise, in postural sway has been consistently found in healthy adult populations, and a decline in complexity towards either white or Brownian noise is associated with a decline in health (Lipsitz, 2004).

While a change in the complex structure of postural variability is typically associated with poor health, recent research has found that cognitive activity can also impact postural behavior. For example, Riley, Baker, and Schmit (2003) found that postural sway standard deviation was reduced when participants were asked to complete a difficult digit rehearsal task. This change in postural sway as a function of a cognitive tasks, paired with the fractal nature of sway suggests a functional link between the brain and the body whereby the dynamics of human perceptual, motor, and cognitive processes are interaction-dominant (Riley, Shockley, van Orden, 2012). Interaction dominant-dynamics further suggest that each component system are coupled and therefore are reciprocally linked. This means that the behavior of each component, in this case the brain, the motor system, and the environment, depends on the activity of the other components (van Orden, Hollis, & Wallot, 2012). To examine this phenomenon in a social psychological context, we will determine how postural activity changes while people disclose a concealable stigmatized identity (CSI) to an imagined other.

Concealable Stigmatized Identity Disclosure

A CSI is any identity that is not immediately available to others, but could be socially devaluing if revealed, for example a mental health disorder, LGBT status, or a history of sexual abuse. While avoiding discrimination through concealment seems like an ideal solution, the extant literature has noted the numerous positive outcomes to disclosing (e.g., building trust, greater quality of life, etc.) as well as the negative impact of concealing (e.g., social isolation, anxiety, etc.) (Chaudoir & Quinn, 2010).

Disclosure of a CSI, or the interpersonal process of sharing personal information, is a complicated process. The discloser must first decide how and when they want to share their identity with someone. Further, the discloser should be constantly evaluating their confidant's reaction to determine if they can expect a positive reaction with the desired social support, or a negative reaction and little or no support. Research suggests that, when disclosing a CSI to a confidant people will have specific goals for disclosing such as to build intimacy in a relationship, or to explain certain behaviors. Research suggests that the numerous goals for disclosure are either approach oriented—focused on achieving positive outcomes—or avoidance oriented—focused on avoiding negative outcomes (Chaudoir & Fisher, 2010).

Approach and Avoidance Goal Motivation Research on goal motivation suggests that approach and avoidance systems result in differential exploration of the environment such that those who possess approach goals are interested in "reducing the discrepancy between themselves and their goal" (e.g., closing the gap between the discloser and the confidant; Chaudoir & Fisher, 2010). Further, individuals who utilize approach goals in their disclosure may attend to positive stimuli in the environment. Conversely, when utilizing avoidance goals, individuals are interested increasing the distance between themselves and potential negative outcomes (e.g., increasing distance between the discloser and the confidant; Carver & White, 1994). As research from embodied cognition suggests, changes in emotional or motivational systems would be reflected in behavioral outcomes. Therefore, postural sway behavior provides a unique look into the embodiment of goal during the disclosure of a CSI. Further, as research has found a loss of complexity in postural sway as a function of increased cognitive load, it is likely the case that avoidance motivation, which is associated with attuning to negative environmental cues and less relaxed behaviors, would also lead to a loss of complexity. Further, there are many people in our lives with whom we can disclose such as with our friends and family (close others) and with our coworkers and bosses (professional others).

Disclosure Confidant Disclosure of a CSI can occur across all life domains and within different types of relationships. Our relationships with others can vary greatly as a function of domain context (e.g., workplace, family life, and social setting, etc.). Often, our relationships with family members will be different from our relationships with a boss or a coworker due to social norms associated with these contexts. Therefore, the level of detailed disclosure of a CSI is likely less for those we have a professional relationships with compared to our close friends or family members. In fact, many people may feel motivated to keep a CSI hidden completely from their coworkers as revealing such information could have a detrimental impact on their career path and job outcomes (Jones & King, 2014).

Despite the potential for negative outcomes due to CSI disclosure, disclosure in the workplace should not be discounted. Research suggests potential negative workplace consequences of concealing including less job satisfaction and attention (Day & Scheonrade, 1997). With a large portion of the workforce continuously making decisions about the information they reveal and conceal in a workplace setting, it is becoming increasingly apparent that a better understanding of workplace disclosure is necessary. However, the increased tension and threat involved with disclosing across different life domains might also impact the behavioral expression via postural sway behavior.

Postural Activity While the current literature has noted the importance of positive interpersonal disclosure outcomes across multiple life domains (i.e., home life, work life) utilizing different goals, little is known about how these different contexts impact the embedded nature of our cognitive and behavioral systems within the world. The present study is the first of its kind to examine the disclosure experience through the lens of embodied cognition in order to understand how the disclosure context is differentially manifested in measurable behavioral outcomes (i.e., postural activity).

Despite attempts to understand the impact of nonverbal behaviors on personal self-disclosure (see Derlega & Berg, 2013), the existent literature has focused on general self-disclosure, not disclosure of a CSI specifically. Further, nonverbal behaviors have typically been characterized by discrete, observable behaviors (e.g., facial expression, nods, and openness). The current project examines time dependent postural sway by utilizing dynamic data analytic tools that can capture the disclosure process as it occurs. By examining postural sway behavior during the disclosure of a CSI we can gain a better understanding of how our mental processes are manifested in our bodies relationship with the environment. Further, support for this claim would suggest that shifting motivation systems might lead to more positive behaviors, both verbal and nonverbal, during a disclosure event, and therefore more positive disclosure outcomes.

Current Project

This project hopes to be the first to bridge the gap between the three discussed areas of research: disclosure context (i.e., close other and professional other disclosure), antecedent goals for disclosure events, and embodied cognition during the disclosure of a CSI. With this project, we hope to integrate theory from stigma, embodied cognition, and interaction-dominant dynamics to capture a holistic understanding of the cognitive and movement processes at play during CSI disclosure. As such, this project will utilize theory unique to postural sway literature, and measurement and data analytic techniques novel to disclosure. Finally, our results and discussion will be presented in such a way that both social and ecological psychologists might be able to utilize theory and methods from each other in future research endeavors. Based on previous postural sway research, we expect disclosures utilizing approach goals to close others would exhibit pink noise compared to avoidance disclosures to professional targets.

Method

Design

This study employed a 2 (goal motivation: approach/avoidance) × 2 (target: close other/professional other) mixed design with goal motivation is the between subjects variable and disclosure target the within subjects variable. The primary dependent variables are postural sway dynamics measured at the head and waist (via mono-fractal and multi-fractal scaling) and responses on the Behavioral Approach System/Behavioral Avoidance System (BIS/BAS) scale.

Participants

43 undergraduates were recruited from a large Midwestern University to participate in this study. Prior to recruitment, participants were prescreened to determine their eligibility. In order to participate in this study, participants had to self-identify as living with a CSI. One participant was excluded from data analysis due to technical errors resulting in a sample of 42 participants. The majority of participants were female (36) and identified as white (35). The mean age was 20.21 (*SD* = 3.09). See table 1 for a breakdown of each CSI represented in this study.

Table 1. Table 1 shows the number of participants with each CSI type

CSI Type	*N*
Mental Health Disorder	16
Sexual Assault	7
Gender/Sexual Minority	10
Eating Disorder	4
Multiple CSI's	2
Other	3

Procedure

In the first portion of the study participants were seated at a computer equipped with Media Lab software (Empirisoft, 2014) where they completed the majority of the experiment. They were first asked to think about and describe a secret that they often keep hidden. Each participant was then instructed to write two disclosure letters sharing this secret to a close friend/family member and the other to someone with whom they have a professional relationship. Specifically, they were asked to think about a person in their life that they have not told this secret, but would like to. Prior to writing each letter, participants were told to write 3-5 goals they have for their disclosure. To manipulate approach and avoidance goals, participants were simply told to either "think about achieving positive outcomes with their letter" or "think about avoiding negative outcomes with their letter" respectively.

After writing both disclosure letters, participants acted out their disclosure as if the person they wrote the letter to was standing in the room. During the disclosure event, two Polhemus sensors (one attached to a headband on the back of the head, the other attached to a belt just bellow the belly button) recorded postural activity at 60 Hz (FASTRAK, Polhemus, VT, USA). The experimenter explained that they should act as though they were talking to the person that they chose, using their letter as a guide. After completing the disclosure for both written letters, participants completed a number of self-report measures including the BIS/BAS scale (Carver & White, 1994).

Data Analysis

To capture the time dependent structure of postural variability as a function of both goal priming and disclosure confidant during the disclosure of a CSI, both DFA and MFDFA were used. Because postural data exhibits non-stationary, time-dependent variation, these data are characterized by fractional Brownian motion (fBm) making it particularly well suited to DFA (et al., 2000; Delignières, Torre, & Bernard, 2011).

DFA provides the scaling exponent, α, which describes the fractal scaling of a time series whereby: $\alpha \approx .5$ indicates random, white noise scaling; $\alpha \approx 1$ suggests persistent pink noise scaling; and $\alpha \approx 1.5$ indicates Brownian motion.

MFDFA is an extension of the DFA and examines differences in the scaling exponents between small and large fluctuations. The relevant outcome parameter of interest in MFDFA is a characterization of the width of the multifractal spectrum $h_{MAX-MIN}$. Because MFDFA tells us whether there are different scaling exponents that exist at fast and slow fluctuations, if $h_{MAX-MIN}$ is greater than 0, we can assume the time series exhibits multifractality. See Ihlen (2012) for a detailed description of both DFA and MFDFA procedures.

Finally, Prior to analyzing each postural sway time series in the AP plane at the head (AP_{HEAD}) and waist (AP_{WAIST}) and the ML plane at the head (ML_{HEAD}) and waist (ML_{WAIST}), the data were downsampled from 60 Hz to 30 Hz, linearly detrended, and, low-pass filtered at 20Hz using a 2nd order Butterworth filter. A surrogate analysis (detailed below) was also performed for DFA and MDFA for validation purposes.

Results

A series of separate mixed method ANOVA's were performed on all relevant outcome parameters for DFA, and MFDFA to test our hypotheses that approach and avoidance goal motivation and target confidant would impact the dynamical structure of postural activity during a disclosure event. Four separate 2 (goal: approach/avoidance) × 2 (target: close other/professional other) ANOVA's were performed on all outcome parameters, one each for AP_{HEAD}, ML_{HEAD}, AP_{WAIST}, and ML_{WAIST} sway. Prior to statistical analysis, outliers 3 SD above and below the mean were identified and replaced with the mean value.

Detrended Fluctuation Analysis

A series of ANOVAs were performed to capture differences in sway as a function of α. To verify that there was a difference between the original time series and the randomly reshuffled, surrogate time series, a third 2 level term in the ANOVA (data: original/randomly reshuffled) was included making the analysis a 2 × 2 × 2 design. There was a main effect of data type for all AP_{HEAD}, AP_{WAIST}, ML_{HEAD}, and ML_{WAIST},, (for all $F(1,40) > 2097$, $p < .0001$) such that the original data results were significantly larger from the randomly reshuffled, surrogate time series. That is, the original time series produced an average α around 1.3 for all directions of sway and the reshuffled time series produced α of .5 for all directions of sway. There were 2-way interactions of goal and data type for ML_{HEAD}, and ML_{WAIST} ($F(1,40) = 5.52$, $p = .024$, and $F(1,40) = 4.74$, $p = .035$, respectively), however, these results simply reflect a main effect of goal priming for the original data; no differences emerged in the reshuffled time series as a function of goal priming. As such, below is the planned 2 × 2 ANOVAs on the analysis of real (non-shuffled) data.

The ANOVA comparing the α exponent for AP_{HEAD} revealed a significant target by group interaction, $F(1,40) = 4.32$, $p = .04$, $\eta_p^2 = .098$. Bonferroni post hoc comparisons were used to examine differences between α for close other and professional other disclosures for each approach and avoidance primed disclosures separately. Results indicate a marginally significant difference in the α exponent between close other and professional other target disclosures in the avoidance primed condition, whereby close other disclosures exhibited less persistent fractal scaling in their postural sway ($M = 1.36$, $SD = .11$) compared to professional other disclosures; which were more persistent and closer to pink noise ($M = 1.3$, $SD = .1$). There was no difference between close other and professional other disclosures during approach primed disclosures ($T(21) = .49$, $p > .05$). There were no other main effects for AP_{HEAD} sway (all $F(1,40) < 1.8$, $p > .05$).

Next, an ANOVA comparing the alpha exponent from ML_{HEAD} revealed a significant main effect of goal priming ($F(1,40) = 5.81$, $p =.02$, $\eta_p^2 = .13$) such that approach primed disclosures exhibited more persistent fractal scaling in their postural sway ($M = 1.28$, $SD = .13$) compared to avoidance primed disclosures; which were less persistent and closer to Brown noise ($M = 1.35$, $SD = .13$). There were no other main or interaction effects for ML_{HEAD} (all $F(1,40) < 2.1$, $p > .05$). Similar to the results found in ML_{HEAD} sway, a significant main effect of goal priming emerged in ML_{WAIST} sway ($F(1,40) = 4.56$, $p = .04$, $\eta_p^2 = .1$), whereby those in the avoidance condition exhibited a loss of complexity compared to those in the approach primed condition ($M = 1.34$, $SD = .14$ and $M = 1.28$, $SD = .14$ respectively). No other main effects or interactions were significant for ML_{WAIST} (all $F(1,40) < 1.9$, $p > .05$). Finally, there were no significant effects of α on AP_{WAIST} sway (all $F(1,40) < 2.47$, $p > .05$) (see Figure 1).

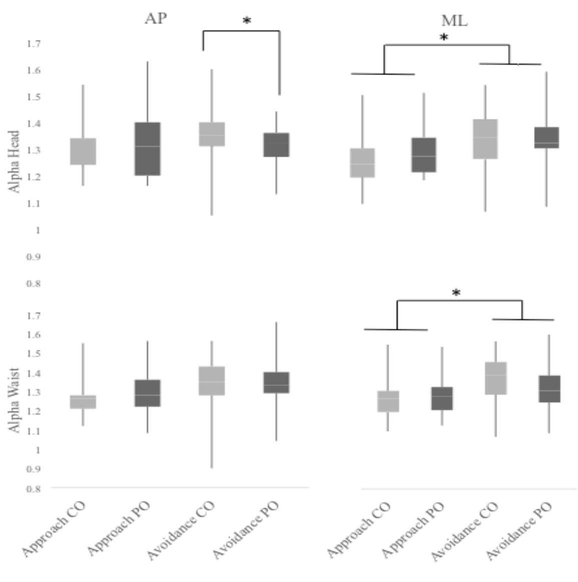

Figure 1: This figure represents mean α.
* $p < .05$, ** $p < .01$

Multifractal Detrended Fluctuation Analysis

The final series of ANOVA's compared the $h_{MAX\text{-}MIN}$ value for each independent variable. To check that there is a difference between the original time series and the surrogate time series, a third 2 level term (data: original/surrogate) was included in the initial analysis. The surrogate time series was developed by shuffling the time series using an inverse amplitude-adjusted Fourier transform to maintain the same scaling relation α (see Ihlen & Vereijken, 2010 for detailed description) There was a significant main effect of data type for all ML_{HEAD}, ML_{WAIST}, AP_{HEAD}, and AP_{WAIST} (all $F(1,40) > 54.7$, $p < .0001$) whereby the $h_{MAX\text{-}MIN}$ was greater in the original data compared to the phase reshuffled time series. There were no 2-way interactions including data type suggesting there was no impact of goal priming or target confidant on results of the surrogate analysis (all $F(1,40) < 3.9$, $p > .05$). Therefore, results of the planned 2-way ANOVA examining goal priming and target confidant are reported below.

The analysis of $h_{MAX\text{-}MIN}$ for AP_{HEAD} revealed a main effect of goal priming ($F(1,40) = 4.95$, $p = .03$, $\eta_p^2 = .11$) such that the width was larger for approach primed disclosures ($M = .97$, $SD = .04$) compared to avoidance primed disclosures ($M = .85$, $SD = .04$). There were no other significant results for AP_{HEAD} (all $F(1,40) < 3.01$, $p > .05$). The same pattern of significant results emerged for ML_{HEAD} and ML_{WAIST}, such that a main effect of goal motivation was revealed for both ($F(1,40) = 8.57$, $p = .006$, $\eta_p^2 = .18$ and $F(1,40) = 7.62$, $p = .009$, $\eta_p^2 = .16$ respectively). The width for ML_{HEAD} was larger for approach-primed disclosures ($M = 1.04$, $SD = .22$) than avoidance primed disclosures ($M = .89$, $SD = .22$). Similarly, the ML_{WAIST} width was larger for approach-primed disclosures ($M = 1.02$, $SD = .18$) than avoidance primed disclosures ($M = .9$, $SD = .18$) (Figure 2).

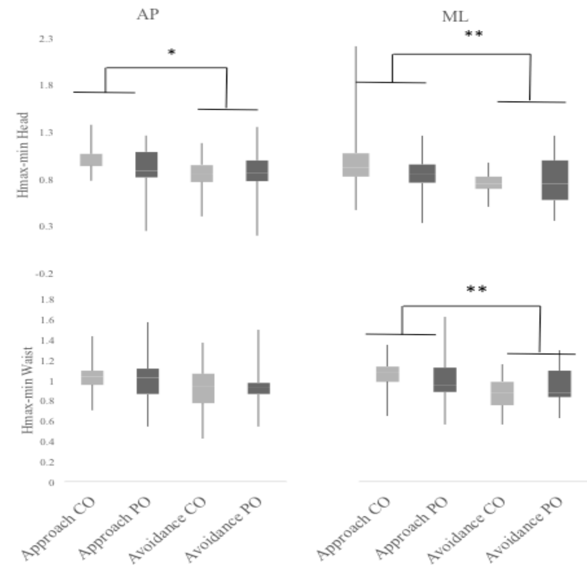

Figure 2: This figure demonstrates mean $h_{MAX\text{-}MIN}$.
$p < .05$, ** $p < .01$

Discussion and Conclusion

Taken together, these results support our hypotheses that both goal motivation and disclosure confidant would impact unintentional postural activity. We sought to examine the disclosure event on a very small scale (i.e., postural behavior) in order to understand how context shapes the way people communicate through behavior. These results broadly support the idea that our cognition and emotional content are manifested and embodied in measureable behavioral outcomes (Marsh, Ambady, & Kleck, 2005). Most notable in these results is the influence of antecedent goal priming on the structure of postural variability. By utilizing nonlinear data analytic techniques novel to disclosure research, we have provided support that our cognitive and motor systems are functionally linked as a complex dynamical system.

Specifically, the significant interaction of the scaling exponent α, which revealed that close other disclosures exhibited more deterministic behavior than professional other disclosures at AP_{HEAD}, is contrary to our hypothesis that professional other disclosures would be more deterministic. However, since this effect was only found in the avoidance condition, which is associated with negative outcomes, these results may indicate that participants expected greater threat to their intimate relationships during close other disclosures when they were utilizing avoidance goals. Because this effect was only found in the AP direction, it is important that future work seek to replicate these results.

Finally, results of the MFDFA support the mounting evidence that postural sway behavior exhibits multiple scaling exponents, as well as our hypothesis that disclosure context would functionally impact movement variability. Importantly, a significant difference in the $h_{MAX\text{-}MIN}$ parameter suggests that approach primed disclosures exhibit a wider range of scaling exponents than avoidance primed disclosures. This supports the theory that approach systems are associated with attuning to more positive stimuli in the environment. As theory of postural sway variability suggests, our postural system aids in efficiently exploring the environment. Because we see differences in the smallest and largest scaling exponents, this suggests participants are able to explore different stable states in the approach condition compared to the avoidance condition. This could make approach primed disclosures more adept at adjusting behaviors with new information.

The results of this project provide evidence that both disclosure confidant and antecedent goals can affect the disclosure event itself. Further, this research suggests that postural sway behavior is an emergent property of a complex system and serves a functional role in both attaining environmental information and embodying ones cognitive and emotional processes. This has implications for developing tools for people who want to disclose a CSI. For example, by simply shifting internal motivation from avoidant to approach a reciprocal distribution across behaviors at different time scales could cascade, from very fast processes including postural sway, to slower timescale behaviors such as gross body movement, language, and confidant reactions. Future research should examine this relationship as well as how number of disclosures or fear of disclosure impacts these effects.

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