

## The Link Between Changes in Social Support and Changes in Job Satisfaction: An Investigation with the Sociometric Badge

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Interactions with other people can change how a person feels about themselves and their situation. This is a basic tenet of much previous work on research as diverse as social network, psychology, and management. Studying these changes previously has been extremely laborious due to the necessity of employing surveys, human observers, or interviews. These methods also mostly preclude observing how changes on a micro scale affect one’s perceptions, and are on the most part very subjective.

The advent of low cost, flexible sensing systems has changed this equation, particularly in the workplace. Many employees in larger companies are required to wear RFID name tags that allow them to open doors or access other resources, but more often than not this data is not harnessed so people can understand how people are actually moving around the workplace. In addition, it is possible to augment these name tags with additional sensors to understand in more detail how people interact with each other and even fiddle at their desks.

We have created a wearable *Sociometric* badge that has advanced sensing, processing, and feedback capabilities (Olguin Olguin, Waber, et al. 2009). In particular, the badge is capable of:

- Recognizing common daily human activities (such as sitting, standing, walking, and running) in real time using a 3-axis accelerometer (Olguin Olguin and Pentland, Human activity recognition: Accuracy across common locations for wearable sensors 2006).
- Extracting speech features in real time to capture nonlinguistic social signals such as interest and excitement, the amount of influence each person has on another in a social interaction, and unconscious back-and-forth interjections, while ignoring the words themselves in order to assuage privacy concerns (Pentland 2005).
- Performing indoor user localization by measuring received signal strength and using triangulation algorithms that can achieve position estimation errors as low as 1.5 meters, which also allows for detection of people in close physical proximity (Sugano, et al. 2006).
- Communicating with Bluetooth enabled cell phones, PDAs, and other devices to study user behavior and detect people in close proximity (Eagle and Pentland 2006).
- Capturing face-to-face interaction time using an IR sensor that can detect when two people wearing badges are facing each other within a 30°-cone and one meter distance. Choudhury (Choudhury 2004) showed that it was possible to detect face-to-face conversations of more than one minute using an earlier version of the Sociometric badge with 87% accuracy.

This technology has the potential to fundamentally alter the types of questions that we ask. This data is naturally more precise, and so we have examined, for example behavioral data on the order of five-minute chunks related to specific tasks automatically logged by an IT services firm (Wu, et al. 2008) and the relationship between face-to-face and e-mail communication (Olguin Olguin, Waber, et al. 2009).

Using the Sociometric Badges we discovered that social support in the form of cohesion (how much time do the people you talk to spend with each other) was strongly positively associated with productivity in an IT services firm (Wu, et al. 2008). However the badges allow us to examine this behavior in more detail. We can see how fluctuations in social support, observed by aggregating data over periods of the study, relate to productivity and job satisfaction. This approach reconceptualizes job satisfaction as a process driven largely by social variables, and with time series data we can be more confident of a causal link.

### **Study Description**

We deployed the research platform described above for a period of one month (20 working days) in the marketing division of a bank in Germany that consisted of 22 employees distributed into four teams. Each employee was instructed to wear a Sociometric badge every day from the moment they arrived at work until they left their office. In total we collected 2,200 hours of data (100 hours per employee).

At the end of each day employees were asked to respond to an online survey that included the following questions:

- Q1. What was your level of productivity today?
- Q2. What was your level of job satisfaction today?
- Q3. How much work did you do today?
- Q4. What was the quality of your group interaction today?

Each question could be answered according to the following 5-point scale: (1 = very high) (2 = high) (3 = average) (4 = low) (5 = very low). In our analysis below we flipped the scale (i.e. |6 - previous value|) for ease of interpretation. These questions were been used for another study within the company (Oster 2007) and management wanted to minimize the amount of time spent by employees answering surveys. Since these surveys were taken daily, lowering complexity was certainly important, and these questions have been used frequently in previous studies (e.g. (Van der Vegt and Van de Vliert 2002), (Churchill, Ford and Walker 1976)). Each person had to enter their badge number when they answered the survey.

### **Results**

We created two data panels of 10 days each and observed the changes in cohesion detected over that time. Splitting data weekly does not change the effects that we report here. Over each panel we averaged survey responses and aggregated interactions detected using IR over

that time. Most people's patterns changed slightly, and these variables are all distributed normally.

We found that changes in job satisfaction correlated strongly with changes in cohesion as detected by the Sociometric badge ( $r = 0.72$ ,  $p < 0.0005$ ), confirming our hypothesis. While baseline levels of job satisfaction are predicted by a variety of factors, it appears that changes in social support may be the major factor in changes in job satisfaction. Below we discuss some implications of this finding and future work.

## **Discussion**

In this study we hoped to get closer to inferring causality by analyzing the data using panels. Similar results from other studies in different organizational contexts strengthen our case for causality, although there is clearly a complex set of causes and consequences at work. We found a strong relationship between objective productivity and cohesion in an IT services firm, where a one standard deviation increase in cohesion implied a 10% increase in productivity (Wu, et al. 2008). A recent study at a call center of a major US-based bank also showed indications that changes in cohesion reduced stress for customer service representatives ( $r = -0.36$ ,  $p = 0.06$ ) (Waber, Olguin Olguin and Pentland Forthcoming).

Processes other than changes in cohesion may be at work, such as changing project tasks or one off events. During the course of this study, however, the members of all teams were working on only one project and their tasks did not change considerably. Participation also dropped over the second half of the study, but cohesion is fairly robust to fluctuations in the amount of data available as long as the drop in participation is randomly distributed.

A natural question is how to practically apply these results. One simple intervention is to give workers more opportunities to socialize in groups. Currently we are implementing a strategy at a call center for a national bank chain where we are changing the break structure of the employees. Previously each employee on a team of around 20 people had a separate 15 minute break in order to reduce the need to shift call loads to other teams, although in practice this issue is not terribly important. This makes it very difficult for cohesive relationships to develop, since groups of friends will by design have limited opportunities for shared interactions.

To create more of these opportunities we changed the break structure of two of the four teams that we had studied previously so that all of the employees on a team are given a break at the exact same time. We hypothesize that this intervention will increase social cohesion and correspondingly increase job satisfaction and performance.

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