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Wearables in the Workplace: Examination Using a Privacy Boundary Model

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Abstract

Wearable technologies have become a popular consumer product for health, entertainment, etc., but the use of such wearables in the workplace is still somewhat new. Wearables also offer the potential to provide benefits for both employer and employee in the workplace but the implementation of such technologies creates privacy implications that may affect worker attitudes. Wearable types can take many forms but this study focuses on RFID wearables due to their low cost, proven durability and reusability (Zhu & Hou, 2020). This research investigates the use of RFID wearables in the context of a corporate environment. Utilizing privacy boundary research, findings show that while being monitored negatively impacts employee satisfaction, this satisfaction further varies based on the voluntary nature of the implementation and the gender of the employee. Findings suggest that greater transparency in implementation may alleviate some of the negative aspects of implanting such technologies in the workplace.

Keywords: privacy, wearable, gender, monitoring, voluntary

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1. Introduction

This research investigates the implementation of RFID wearable technologies within the workplace in relation to privacy. Radio Frequency Identification (RFID) has been utilized by corporations to provide business advantages for several years. These devices can be used for access control, inventory management, supply chain management, etc. (Wu, Nystrom, Lin, & Yu, 2006) and as a method to track assets and aggregate data to minimize human intervention and reduce costs (Asif, 2005). While RFID has been used to assist in certain business processes for many years, RFID can also be used to improve the experiences of employees in the workplace or help manage and monitor employee activities utilizing RFID wearables (Brady, 2018). This would generate benefits (both tangible and intangible) for the business (Wu et al., 2006) by implementing RFID to alter employee behavior by enabling enforcement of compliance with certain business processes (Kim & Garrison, 2010; Staats, Dai, Hofmann, & Milkman, 2017).

While wearables may provide benefits to both the business and employees, the impact on and attitudes of the employees regarding the implementation may differ due to privacy issues. These employee attitudes may negatively impact the satisfaction of employees with the implementation and the workplace. Previous research suggests that privacy is a social process whereby individuals interact with others implementing a regulation process depending on the individual's identified social group, those outside this group, and the control of the user over situational aspects (Altman, 1975; Palen & Dourish, 2003). Computer performance monitoring (CPM) systems used to measure, record, store, and compile data on the activities of employees (Schleifer & Shell, 1992) may improve employee performance but this increased monitoring runs the risk decreasing employee satisfaction due to a loss of privacy (Chalykoff & Kochan, 1989).

This research helps to contribute to the overarching question of what are the boundary conditions in relation to privacy in the area of wearable tracking in the workplace. We extend Palen's (2003) research on privacy boundaries given its applicability to the area of privacy and boundary conditions. We extend the theory by further explicating the identity boundary through division into both the *self* and the *other* boundary conditions. We then utilize an experiment to investigate the three boundary conditions of disclosure, self, and other on the satisfaction of employees with the technology. The research attempts to better understand the three interacting forces of control, privacy, and self within the context of wearable technology. Our findings show that the satisfaction of users with the wearable technology is affected by a combination of all three variables, providing usable findings in the workplace for such implementations.

2. Background

Privacy research has spanned a variety of contexts over a wide range of topics for several decades. With regard to individual privacy, Altman's privacy regulation theory is highly regarded as a seminal piece in social psychology (1975, 1977). Privacy regulation theory aims to understand individual privacy intentions within a larger social context rather than through a dichotomous lens. The theory posits that privacy is not just about the individual avoiding social situations (Palen & Dourish, 2003), but is a dynamic process of controlling access to one's self or socially identified group (Altman, 1975). Overall, Altman hypothesizes that an individual's desired level of privacy changes over time in response to the specific environment.

While privacy is not a new area for research, the impact of new information technologies on privacy is still fairly novel and fluid due to the rapid pace of technological change. Altman's research was analyzed within the context of information technologies by Palen and Dourish (Palen & Dourish, 2003). In their work, they extended Altman's idea of the changing nature of privacy per environmental circumstance to define three specific boundaries that effect privacy with the environmental context: the disclosure boundary, the identity boundary, and the temporal boundary. The disclosure boundary deals with the selective disclosure of personal information by individuals to others and is most closely associated with the traditional view of privacy. The identity boundary deals with the boundary set between self and other, specifically within the individual's social groups and affiliations. Lastly, the temporal boundary deals with differences in privacy over time where past actions impact current actions with regard to privacy. These boundaries can differ substantially from the historical understanding of privacy due to the impact of information and communication technologies in the environment (Petronio, 2002).

For this research we investigate and adapt two of the boundaries in Palen's model: the disclosure and identity boundaries. The third, temporal, boundary is likely relevant and applicable to understanding the impact of new information technologies on privacy. The challenges of capturing longitudinal data at this early exploratory stage have been foregone in this study in order to use the expedient methodology of written scenarios and survey questions. The disclosure boundary is utilized in line with Palen's original definition. Conversely, the identity boundary is expanded. Palen described the identity boundary as "self vs. other" and is therefore the only boundary condition within the model

consisting of two different subsections. Many research streams have looked at the delineation between self and others. Ecologists study the interaction of separate organisms within an environment (Malmstrom, 2012). Personality psychology investigates differences between separate individuals (Friedman & Schustack, 2016). Social psychology, while looking at individuals within social environments, still delineate an individual from others (Myers, 2012). For this reason, we separated the identity boundary to include two separate boundary conditions: self and other. Figure 1 displays the research model as used in this research.

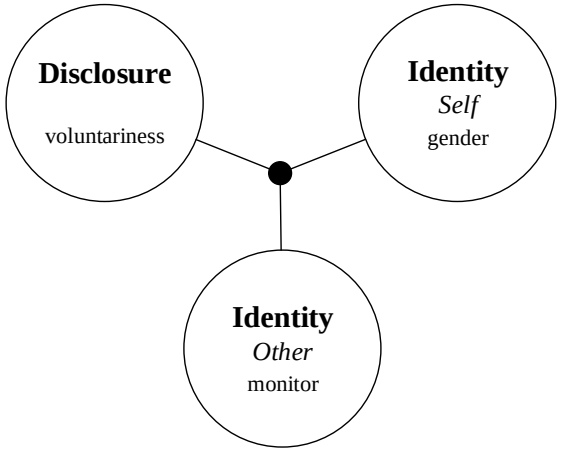

Figure 1. Research model with operationalizations.

The three boundaries in the proposed theoretical model are operationalized in this research in the context of electronic performance monitoring using RFID wearable devices. Specifically, the *other* involves the organizational use of these devices for monitoring. *Self* is defined as a social construction with respect to the individual and their perceived group. For this research we employ the socially constructed gender grouping of the individual (Myers, 2012) utilizing two self-identified facets, namely male and female. *Disclosure* pertains to the voluntariness of the wearable use. The interaction of these three items is explained below.

First, the *other* identity boundary refers to the environmental context within which privacy is assessed by the individual. If the environment is specifically monitoring individuals, this would make the boundary between self and other more apparent and would increase tension between the other and those in the environment (Palen & Dourish, 2003). As noted by McNall and Roch (2007), Electronic Performance Monitoring (EPM) raises privacy concerns that can differ by the type of EPM. Direct types of EPM surveillance such as an RFID wearable have a larger impact on employee feelings of privacy invasion than indirect methods such as computer logging; however, any use of EPM leads to some significant degree of employee perceptions of privacy invasion. They suggest that this could be due to participants experiencing a loss of perceived control that then adds to the feelings of privacy invasion (Eddy, Stone, & Stone-Romero, 1999). Yost et al. (2019) also point out that privacy entails autonomy, or control over one's personal information and utilize psychological reactance theory (Brehm, 1966) as a lens to explain the negative behaviors that arise from loss of that control. They find that perceptions of privacy invasion are positively related to state reactance, an aversive motivational state. This set of research points to a negative impact when the environment (other) imposes privacy reducing measures. Given that employee perceptions of autonomy and control have repeatedly shown to affect job satisfaction (Chung-Yan, 2010; Ganster & Fusilier, 1989; Hackman & Oldham, 1975, 1980; Spector, 1986) we expect that:

H1: Individuals have higher job satisfaction when not being monitored as compared to monitored regardless of the mandated nature of the use or gender.

Conversely, when individuals are not being monitored, the tension of the other in the environment is not as high and the boundary between self and other lessens (Palen & Dourish, 2003). Given this decrease in tension from the other, disclosure would have a less salient impact on an individual's privacy decisions. Furthermore, it has been established that there are no significant differences in job satisfaction between men and women in the workplace when all other environmental conditions are held constant (Mason, 1995). Therefore, given the lack of monitoring from the other, we hypothesize:

H2: When not being monitored, there is no difference in job satisfaction between men and women regardless of the mandated nature of the use.

As noted, the impact of *other* on both *disclosure* and *self* is hypothesized to have an overarching effect such that both *disclosure* and *self* are impacted. The disclosure boundary within Palen's model implies a degree of choice with regard to the individual's decision to disclose information, but a problem occurs when the level of volition is lessened or complexly stricken. Palen notes that "problems emerge when participation in the networked world is not deliberate, or… not within one's total control" (2003, p. 4). Mandated use of a technology engenders a loss of personal control with regard to technology use. Furthermore, Venkatesh et al. (2000) conducted a longitudinal study of individual technology adoption specifically looking at gender differences in decision making. Their study found the impact of perceived behavioral control on intention to adopt and use a new technology to be significantly moderated by gender. Specifically, women's perceptions of their level of control is far more relevant than those of men in the context of adopting a new technology. This loss of control is exacerbated when they know they are being monitored which, as discussed earlier, leads to some sense of privacy invasion that when combined with the feeling of control loss, may drive negative affect even further. This leads to a confounding effect of both the loss of privacy when being monitored and a loss of control when use is mandatory that is different between men and women. Therefore:

H3: When being monitored, the level of job satisfaction for men and women differs based on the mandated nature of the use.

H3a: When being monitored, there is no difference in job satisfaction for men whether the use is mandatory of voluntary.

H3b: When being monitored, there is a difference in job satisfaction for women depending on the mandated nature of the use such that women have higher job satisfaction for voluntary use as compared to mandated use.

Given the intersection of the three boundaries in the model and the above arguments, the overarching hypothesis for this research is a three-way interaction on individual job satisfaction with RFID wearable tracking that will depend on 1) the monitored nature of the environment (other), 2) the voluntary nature of the implementation (disclosure), and 3) the self-identified gender of the subject (self). The delineated hypotheses discuss the simple main effects and simple-simple main effects to paint the specific interaction effects, yet the above hypotheses are all dependent on an overarching significant three-way interaction.

3. Data Collection

Subjects were solicited from two sections of a core undergraduate business course at a large Midwestern university. The course was a required course for all majors in the college. Students were offered extra credit by the course instructor for participating in the research. The course instructor was the same for all sections of the course and did not discuss the specifics of the study with the students. RFID technology was selected as the focal research artifact due to its familiarity with the subjects and clear disassociation from biometric monitoring devices like a smart watch, yet also novel as a personal tracking device, thereby presenting little preexisting bias. Also, the student sample was chosen as a conservative sample for the research. Given surveys showing less privacy concerns among Gen Z'ers as compared to other generations,[12] significant results in this study would provide more definitive proof that there would be privacy issues among other generations that have a higher degree of privacy concerns.

The experiment was a 2 (voluntary vs. mandatory) x 2 (not monitored vs. monitored) factorial design, with an added non-experimental independent variable of self-identified gender, making the entire study a 2x2x2 factorial study. Subjects for this experiment were randomly assigned to both levels of the experimentally implemented independent variables. The subjects were sent an email with a link to the survey that consisted of one of the four randomly-assigned scenarios and identical questions for each subject regardless of scenario. The scenarios consisted of a short paragraph

[1] https://www.f5.com/labs/articles/threat-intelligence/are-gen-z-ers-more-security-savvy-online-than-millennials-#:~:text=While%20the%20majority%20of%20respondents,86%25%20for%20Gen%20X).

[2] https://www.fintechbusiness.com/industry/1265-gen-z-value-personalisation-over-data-privacy

describing the individual working for a company that has decided to implement RFID wristband technology for employee use. From here each subject received one of four scenarios from the categories in Table 1.

Table 1. 2x2 experimental manipulations.

Voluntary Not Monitored	Voluntary Monitored
Mandatory Not Monitored	Mandatory Monitored

The mandatory-monitored scenario would require the employee to adopt the technology and its purpose would be to monitor the employee. A mandatory-not monitored scenario would also require the employee to adopt the technology, but the purpose of the technology would be to improve access control through the unlocking of doors, devices, etc. A voluntary-monitored scenario would give the employee the option to adopt, but the technology would be used to monitor the employee. Finally, a voluntary-not monitored scenario would give the employee the option to adopt, but the purpose of the technology would be to improve access control through the unlocking of doors, devices, etc. Following the scenario, subjects answered questions pertaining to their perceived job satisfaction adapted using previous research (Bowling & Hammond, 2008; Weiss, Dawis, & England, 1967).

4. Results

369 subjects participated in the study. The dependent variable of job satisfaction had a Cronbach alpha value of 0.85, showing good internal consistency. The three items that made up the dependent variable were then averaged to create a single dependent measure. The two experimental independent variables of voluntariness and monitoring and the third independent variable of self-identified gender were coded using 0 and 1 as per previous research (Luse, Townsend, & Mennecke, 2018). The sample also contained 49 percent females, providing a good proportion of men and women across the four experimental conditions.

To test the hypotheses, an ANOVA-based general linear model was run. The results showed a three-way interaction of mandated use, monitored use, and gender on job satisfaction ($F = 5.50$, $p = 0.02$). To examine the presence of an overall effect of monitoring regardless of the voluntary nature of the RFID use and the gender of the individual, simple-simple main effects were examined. Results found that job satisfaction was higher when individuals are not monitored for men when use is voluntary ($F = 35.78$, $p < 0.001$) or mandatory ($F = 38.75$, $p < 0.001$) and for women when use is voluntary ($F=21.91$, $p < 0.001$) or mandatory ($F = 95.15$, $p < 0.001$), thereby supporting H1. Furthermore, simple-simple main effects found that when not being monitored, there are no differences in job satisfaction for men versus women whether RFID use is voluntary ($F=0.26$, $p=0.614$) or mandatory ($F=2.88$, $p=0.090$), supporting H2. Conversely, when being monitored, the level of job satisfaction is dependent on both the voluntary nature of the RFID use and the gender of the individual ($F=5.95$, $p = 0.015$), supporting H3. Results (see Figure 2) show that while the job satisfaction of voluntary versus mandatory use is not significantly different for men when being monitored ($F=0.029$, $p=0.864$ – supporting H3a) (i.e. the solid lines are basically on top of one another) there is a significant difference in job satisfaction of voluntary versus mandatory use for women when being monitored ($F=13.05$, $p<0.001$) (the dashed lines) with women showing higher job satisfaction for voluntary use when being monitored, supporting H3b. Figure 2 graphically depicts the effects.

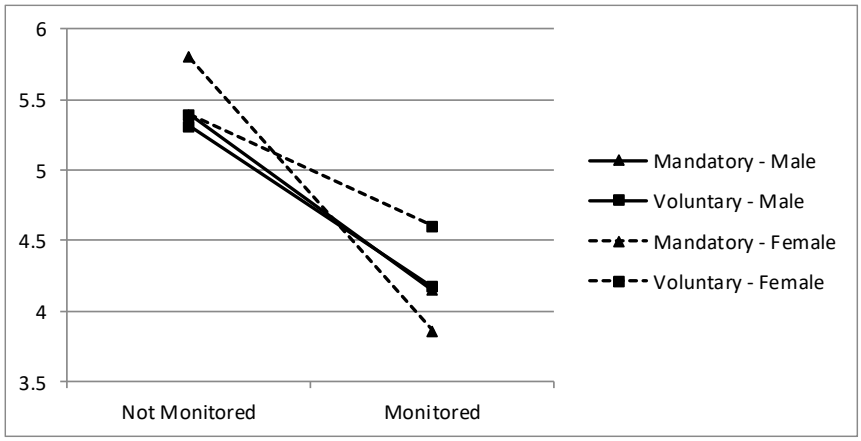

Figure 2. Graphical results.

5. Discussion

This research investigates the use of wearables within the organization. Results show that monitoring by others in the environment has a differential impact on *disclosure, self,* and *other* boundaries. Specifically, when not being monitored, both the impact of the voluntariness of use of wearables within the workplace and the gender of the subject have no combined or separate impact on individual satisfaction with the wearables. Conversely, when being monitored, individual satisfaction is differentially impacted by voluntariness of use and gender of the individual such that women are significantly less satisfied with mandatory use whereas men are not.

Theoretically, this research provides several important contributions. First, we adapt Palen's model of privacy boundaries (Palen & Dourish, 2003), by differentiating between the two opposing forces within the identity boundary yet providing an interacting link between all three. This separation in the model provides a delineation of the self from others that has been researched in various areas (Friedman & Schustack, 2016; Malmstrom, 2012; Myers, 2012). Furthermore, we provide a study operationalizing each of the three boundaries in the model and demonstrating that all three interact.

This research also provides valuable findings for corporations. While wearables might provide benefits for the company, employee satisfaction may vary. While using these technologies to monitor employees will lower employee satisfaction, the voluntary nature of the implementation can have differing impacts. Men may not be significantly affected by the voluntary nature but caution should be used for women when the monitoring is mandatory as this may adversely affect their satisfaction, thus leading to a negative impact on work morale. Given the tension in this boundary between the individual and the corporate other (Palen & Dourish, 2003), methods should be used to better convey the interaction of the corporation with the system and its overall use to allow employees to better understand the boundary and hopefully alleviate some qualms they may have with the system.

One avenue for further exploration is in the longitudinal aspect of this research. While we used and modified two boundaries within the boundary model of Palen, this research did not investigate the original model's temporal boundary (Palen & Dourish, 2003). Altman's original privacy regulation theory postulates that privacy levels change with the environment over time (Altman, 1975). Our model adds to the theoretical literature by more fully articulating the duality of the identity boundary, but this interaction may be impacted longitudinally. Future research should investigate the impact of temporal disparities in tandem with the developed model in this research.

6. Conclusion

This research investigates the impact of the use of wearables to monitor employees. Palen's privacy boundaries are adapted to better understand the interplay of *disclosure*, *self*-identity, and *other* identity on individual privacy attitudes. Specifically, we look at the impact of voluntariness, self-identified gender, and monitoring on employee satisfaction. Results show that while monitoring always has a negative effect on satisfaction, the voluntariness of the implementation differentially impacts men versus women with women having significantly less satisfaction when the monitoring is mandatory. The research provides an updated theoretical model to build on other privacy research. Practically, the results

provide organizations with guidelines for aiding in more successful implementation of monitoring systems.

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8. Appendix - Scenarios

Mandatory-Monitored
The company has informed you that the technology will have the ability to track what you are doing at the company. The company will be able to know your location at all times while you are in the building. The company has also informed you that this technology is required to be used by all employees.

Mandatory-Not Monitored
The company has informed you that the technology will be used in order to improve security throughout the building. You will be able to scan into the building as well as unlock doors and devices that you are normally allowed to access. The company has also informed you that this technology is required to be used by all employees.

Voluntary-Monitored
The company has informed you that the technology will have the ability to track what you are doing at the company. The company will be able to know your location at all times while you are in the building. The company has also informed you that this technology is optional. You are under no obligation to adopt the technology.

Voluntary-Not Monitored
The company has informed you that the technology will be used in order to improve security throughout the building. You will be able to scan into the building as well as unlock doors and devices that you are normally allowed to access. The company has also informed you that this technology is optional. You are under no obligation to adopt the technology.

Author Biographies

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