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Understanding the Impact of Instant Messaging (IM) on Subjective Task Complexity and User Satisfaction

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Abstract

Instant messenger is being rapidly deployed in the workplace. Current studies largely focus on the adoption of IM and how IM is used. Little research has been conducted to understand the potential impact of using IM in the workplace. This paper theorized and empirically tested how the frequency and social network characteristic of IM interruptions could interact with an individual's polychronic orientation, i.e. multitasking preference, and jointly influence employee satisfaction and subjective task complexity. The study illustrates that polychrons are more satisfied with the multitasking work process deploying IM technology than monochrons. In addition, the effect of interruptions is dependent upon an individual's polychronic orientation. The increase in interruption frequency only reduces the process satisfaction of monochrons but not polychrons. Further, the polychronic orientation of message receivers also influences how they process information. When IM messages are sent from their supervisors, monochrons tend to prioritize tasks and perceive a lower level of overall task complexity. The information processing of polychrons seem to be less influenced by the social characteristic of interruptions.

Keywords: Interruption Frequency, Social Networks, Instant Messaging, Polychronicity, User Satisfaction, Task Complexity.

1. INTRODUCTION

Instant Messaging (IM) is being rapidly adopted in and outside the workplace. A recent survey found that one third of computer users utilize instant messaging at work to keep connected with coworkers and clients (Garrett, 2007). There will be 250 million IM accounts, inclusive of business accounts, by year 2010 (Gantz et al., 2007). The wide deployment of IM in the workplace could be attributed to key attributes of IM such as presence awareness, near-synchronous communication. Some firms integrate IM

into their IT infrastructure to create a multi-tasking working environment (Cameron & Webster, 2005; M. L. Cummings, 2004; Rennecker & Godwin, 2005).

A growing body of studies has been conducted to understand the application, adoption and potential consequences of IM in the workplace (Cameron & Webster, 2005; Garrett, 2007). Some studies have examined the impact of IM on the level of interruptions in the workplace (M. L. Cummings, 2004; Garrett, 2007; Rennecker & Godwin, 2005). The deployment of IM in the workplace has raised concerns about the potential detrimental effects of IM. Unstructured IM use may increase communicative workload and interruptions (Rennecker & Godwin, 2005). Knowledge workers are more likely to be distracted by instant messages than emails because of several characteristics of IM. First, instant messages are often delivered in the form of pop-up windows accompanied by audio alert. Second, the presence awareness feature increases the pressure for knowledge workers to respond to IM requests instantaneously. Further, IM engenders a multitasking work environment (Cameron & Webster, 2005) where IM conversation is performed concurrently with other work tasks. This may greatly increase the level of workload of employees and reduce employee satisfaction.

Despite of these research efforts, extant studies largely ignored the effect of social context of IM communications and IM users' personal characteristics. We propose to consider the social network of dyadic IM communication. For example, the hierarchy level of a message sender may influence the multitasking priority of message receivers and, further, adjust their perception of the task complexity. In addition, we propose to explore IM users' polychronicity, one type of personal characteristic, on their task perception and satisfaction. Polychronicity reflects an individual's time management orientation and is an individual's preference to switch among multiple tasks with the same time period (A. Bluedorn, Kalliath, Strube, & Martin, 1999). Considering the multitasking working environment from using IM, polychronicity, as an important employee's personal characteristic, has clear relevance to understanding the impact of IM.

In this study, we investigated how IM influences knowledge workers' perceived task complexity and satisfaction about the multi-tasking working process. We are interested in how polychronicity, together with the interruptions and social influence of message senders, influences message receivers' perceived task complexity and satisfaction. Our approach takes into account the interruptive nature of IM, personal factors and social characteristics. In particular, our research questions are: 1) how interruptions from IM influence users' perceived task complexity and satisfaction? 2) how polychronicity of IM users influence their perceived task complexity and satisfaction? 3) how polychronicity moderates the impact of social influence and interruptions on IM users' perceived task complexity or satisfaction.

The remainder of the paper is organized as follows: in the next section, we review the literature and propose our research model, and hypotheses underlying the model. Next, we describe our experiment, followed by a discussion of the findings of this study. Finally, we present the limitations of the study followed by concluding remarks.

2. LITERATURE REVIEW

The deployment of IM engenders a multitasking work environment. To have a better understanding of the impact of IM on users' perceived task complexity and satisfaction, it is necessary to integrate the literature of interruption and polychronic communication. In the below subsections, we will first discuss the subjective task complexity and process satisfaction as the dependent variables of our model. Then, we will give an overview about theories of interruption and polychronic communication and elaborate the impact of interruptions and polychronicity on subjective task complexity and user satisfaction and their potential interactions considering the hierarchy level of message senders.

2.1 Subjective Task Complexity

In this study, we examine subjective task complexity as one of the dependent variables. Subjective task complexity is the level of task complexity perceived by employees. Instead of

examining objective task complexity directly, we use subjective task complexity as a proxy for objective task complexity. Subjective task complexity reflects objective task complexity and is often used as a manipulation check for objective task complexity in experimental studies. A task could be made more complex by adjusting objective task features such as increasing the amount and/or diversity of information processed (Earley, 1985). IM messages increase the volume of information available to knowledge workers. IM interruptions are expected to play a role in influencing IM users' subjective task complexity. Besides objective task features, the perceived level of task complexity was also found to be influenced by individual characteristics such as previous task experience, personal task motivation, etc (Maynard, 1997).

2.2 Process satisfaction with Multitasking Work Process

Process satisfaction is the attitude about the process using information technology in the task. In this study, we focus on satisfaction with the process of using IM to engage in multiple tasks, i.e. responding to IM requests while performing a main task. Process satisfaction is a more direct indicator of satisfaction with information technology (i.e. IM) than outcome satisfaction. Process satisfaction has been found to be influenced by tasks and medium types. In the study by Sul (1999), process satisfaction was found to be higher for intellectual tasks (with one correct answer) than for negotiation tasks and face-to-face communication yielded higher level of process satisfaction than other communication medium types.

2.3 Interruptions

According to distraction theory, an interruption is defined as “an externally generated, randomly occurring, discrete event that breaks the continuity of cognitive focus on a primary task” (Corragio, 1990). The timing of an interruption is usually random and beyond the control of a receiver. It breaks the attention of the message receiver and typically requires immediate switching from main task to the interruption task. Main task and interruption task compete for the limited cognitive processing resources of an individual.

When an IM arrives, a worker has to switch from a current work medium to the IM medium. This switching time, is usually small and is a non-value added, is often referred to as interruption lag (Trafton, Altmann, Brock, & Mintz, 2003). After processing the IM request, a worker has to spend extra non-value added time to restart a task due to re-immersion. The recovery time due to interruptions caused by IM is referred to as resumption lag (Trafton et al., 2003) or penalty. Although unknown for an IM interruption, this penalty has been reported to be about 64 seconds per email interruption (T. Jackson, Dawson, & Wilson, 2001; Thomas Jackson, Dawson, & Wilson, 2003). According to these authors, although this time may appear to be small, the cumulative interruption and resumption lags become large due to the large number of messages arriving on a daily basis.

The effect of interruptions has been examined from multiple dimensions in previous studies. Speier et al. (1999) investigated the effect of frequency and content relevancy of interruptions on task performance. Our study focused on the frequency and social characteristics of interruptions. We compared the effects of low interruption frequency with high interruption frequency on perceived task complexity and user satisfaction. For social characteristics of the interruption, we examined the effect of hierarchy level of sender on perceived task complexity. Few studies have examined the interruptions from a social network perspective.

2.4 Polychronicity

Time has long been considered as a fundamental concept in explaining organizational behaviors (L. L. Cummings & Staw, 1995). Recently, polychronicity, as an individual's time management orientation, is gaining growing research attention. Polychronicity was originally introduced by Hall (1959) as a cultural-level construct, reflecting organizational members' shared preference

for time-use. Hall and Hall (E. T. Hall & Hall, 1990) suggested that polychronicity involves the ability to handle interruptions. For polychrons, time is not considered as a tangible resource and timely completion of tasks is not a major concern for them.

Individual-level polychronicity has been linked to a number of work and non-work activities. For example, polychronicity has been found to be negatively related to following schedules and deadlines (Benabou, 1999) and positively correlated with creativity (A. C. Bluedorn, 2000) and absence (J. M. Conte, & Jacobs, R. R., 2003). Previous studies have also examined the effect of polychronicity on productivity with inconsistent results. For example, polychronicity has been used to explain people's job performance in a multi-tasking environment such as retail sales. Sales persons with high polychronicity received higher ratings of sales performance from their supervisors (Jeffrey M. Conte & Gintoft, 2005). In general, polychronicity is not considered to be a good predictor of task performance (Hecht & Allen, 2005). "Polychronicity is about how work is done, not about how much work is done" (Slocombe & Bluedorn, 1999, p. 77). For this reason, we will examine the effect of polychronicity on IM users' task perceptions and satisfaction instead of the effect on actual task performance. The following subsection presents our research model and theoretical underpinning of each of the hypotheses.

3. Theoretical Framework and Hypotheses

Drawing upon interruption and polychronic communication (i.e. polychronic/monochronic) literatures, our research model (Figure 1) depicts how the interruptive features of IM communication may intertwine with polychronicity and jointly influence users' perception of task complexity and satisfaction with the multitasking work process.

3.1 Direct Effects of Interruption Frequency

Prior studies suggest that a task could be made more complex by increasing the *number* of information cues and/or the *diversity* of information processed (Earley, 1985). Simple tasks require processing fewer cues than complex tasks. In a context of IM communication, more frequent IM interruptions increase the number of information cues to be processed by knowledge workers and are very likely to increase their subjective task complexity. Perceived overall task complexity could further increase in a multitasking work environment involving both IM tasks and primary tasks. IM interruptive tasks diversify the information processed, requiring additional processing effort for switching between tasks. Therefore,

H1: Interruption frequency has a positive impact on perceived task complexity.

3.2 Effects of Polychronicity and Interruption frequency

Polychronicity refers to an individual's tendency to be involved in two or more tasks simultaneously (Jeffrey M. Conte & Gintoft, 2005). Polychronicity is a fairly stable personal trait (Turner, Grube, Tinsley, Lee, & O'Pell, 2006). Individuals with low polychronicity prefer to complete one task at one time, whereas individuals with high polychronicity prefer to do several tasks at the same time. The literature on polychronicity emphasizes the fit between an individual's polychronic orientation and task. Monochrons may become disoriented in a multitasking work environment and, were found to be more bothered by interruptions than polychrons (Frei, 1999). The congruence between polychronic orientation and task setting could increase the perceived fairness of the work process and, therefore, enhance the knowledge workers' satisfaction with the work process. Therefore,

H2: Polychrons are more satisfied with multitasking work process than monochrons.

Monochrons prefer to concentrate on activity at a time and view multitasking as fragmented, confusing, stressful, and lack of focus (J. M. Conte, Rizzuto, & Steiner, 1999). The increase in interruption frequency of IM messages is expected to reduce monochrons' satisfaction with the

working process. Conversely, polychrons prefer to switch between tasks and perceive polychronic behavior as efficient and motivating (J. M. Conte et al., 1999). They feel satisfied at a multitasking environment such as the one with interruptions. Clearly, under extremely high level of interruptions far beyond an individual's mental processing capacity, a polychron also expects to suffer reduced satisfaction with the working process. Therefore,

H3: Polychronicity moderates the relationship between interruption frequency and users' satisfaction with multi-tasking work process.

3.3 Effects of Polychronicity and Hierarchy Level of Message Sender

Besides interruption frequency, we also examined the effect of polychronicity and the hierarchy level of message senders, as one type of social network characteristics of interruptions, on subjective task complexity. In the literature of polychronic communication, monochrons "lean more toward strict planning, time allocation, and prioritizing in attempting to meet their obligations." (Kaufman-Scarborough & Lindquist, 1999, p.289). When monochrons are under the time pressure to process interruption messages from their supervisors, they are expected to prioritize tasks and give a higher priority to IM tasks to meet their immediate obligations to their supervisor. As a result, when message senders are their supervisors, monochrons may use a heuristic approach to work on the main tasks or process fewer information cues of main tasks.

In contrast, polychrons do *not* view time as a tangible resource (Slocombe & Bluedorn, 1999) and are less concerned about deadlines (E. T. Hall, 1983). Therefore, they are less pressured to prioritize tasks. They attempt to seek a balance between multiple tasks. The interruption messages from peer and supervisor are very likely to be handled in a similar way. So, hierarchy level has no or weak impact on task complexity when message receivers are polychrons. Therefore,

H4: Polychronicity moderates the relationship between hierarchy level and perceived task complexity.

3.4 Perceived Task Complexity and Process Satisfaction

According to Suh (1999), "efficient and effective processes will result in higher process satisfaction." The interruptions of IM messages incur additional switching time that is not productive. When tasks are perceived to be complex, more information cues and/or interrelationships among cues would need to be recalled for switching between IM tasks and main tasks. As a result, longer non-productive switching time is needed to process complex tasks, which reduces the efficiency and effectiveness of the work process, and, therefore, may lower knowledge workers' satisfaction with the interruptive working process using IM. Therefore,

H5: Perceived task complexity reduces users' satisfaction with multi-tasking work process.

Besides the above independent variables, the research model consists of four control variables: gender, IM experience, previous task experience, and task motivation. Gender may directly influence an individual's information processing strategy and, therefore, his/her perceived task complexity. Further, prior experience with the technology, i.e. IM, may influence an individual's process satisfaction and perceived task complexity. More experience with IM may improve an individual's process satisfaction and reduce his or her perceived task complexity. Also, an individual's task experience and motivation to perform the task is likely to influence his or her perceived task complexity. Maynard (1997) suggest that higher levels of task motivation and task experience were significantly associated with higher levels of subjective task complexity. Figure 1 describes the research model and various proposed hypotheses in the study.

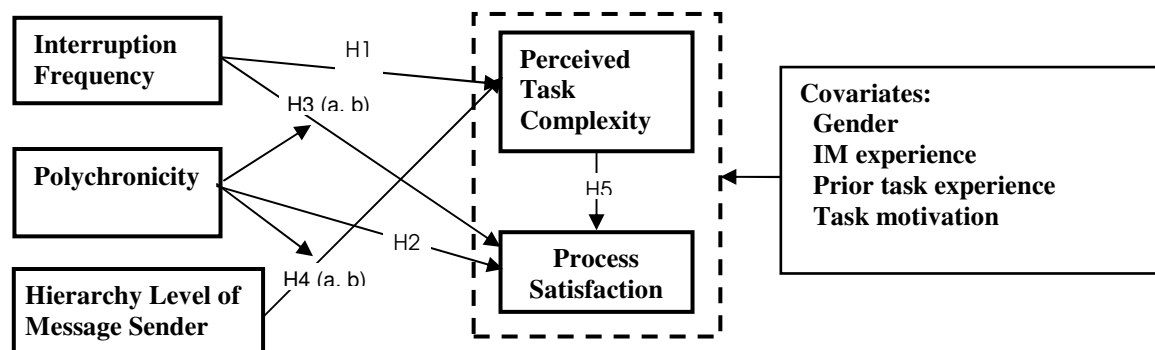


Figure 1. Research Model

4. RESEARCH METHODOLOGY

An experimental design was deployed to manipulate the two characteristics of interruptions, i.e. interruption frequency and hierarchy level of the message sender. Interruption frequency was manipulated at two levels: low interruption and high interruption. Subjects received one IM message at low interruption level and four IM messages at high interruption level. The hierarchy level of message senders was manipulated at two levels: peer and supervisor. In this study, subordinate was not considered as one of the roles of message senders since it would shift our research focus from the impact of IM on knowledge workers to that on managers. So, the two manipulated variables jointly form four treatment conditions. Subjects were randomly assigned to only one of four treatment conditions. The main task was to browse the websites of UPS and U.S. Postal Service and search for shipping costs of two different packages to a warehouse. When subjects were performing the search tasks, they were interrupted by instant message(s). The instant messages requested subjects to compare eight suppliers based on account payable term, delivery time, or product costs. The information of the eight suppliers was provided in a printed table. Subjects were instructed to respond to instant messages once they received them.

Undergraduate student volunteers at a major midwestern U.S. university were used as subjects. All subjects were enrolled in general business core courses and received less than 1% extra credit for participation. 112 usable responses (50 females and 62 males) were included in our final data analysis. Partial least square (PLS) technique was performed to test the measurement model and research hypotheses. PLS requires a smaller sample size than other SEM techniques (Chin, Marcolin, & Newsted, 2003). A sample size of 112 was sufficient for PLS analysis.

Perceived task complexity and task motivation were measured using the instruments by Maynard and Hakel (Maynard & Hakel, 1997). Polychronicity orientation was measured using the scales by Conte and Jacobs (2003). Process satisfaction was modified from the instruments by Green and Taber (1980). Perceived work overload was adapted from the instruments by Moore (2000).

Two t-tests were conducted to check the manipulation on the direction of the social tie (peer versus supervisor) and interruption frequency (low versus high). The manipulation of both the hierarchy level of the message sender and interruption frequency were found to be successful with a p-value <0.01 and p-value <0.05 respectively. Results of testing the measurement model are available with the authors. Overall, these results indicate that our measurement model has adequate convergent and discriminant validity. So, the structural model can be examined further.

5. Results

Figure 2 summarizes the results of testing the hypotheses. The model could explain 24.2% of the variance in the perceived task complexity and 40.7% of the variance in process satisfaction.

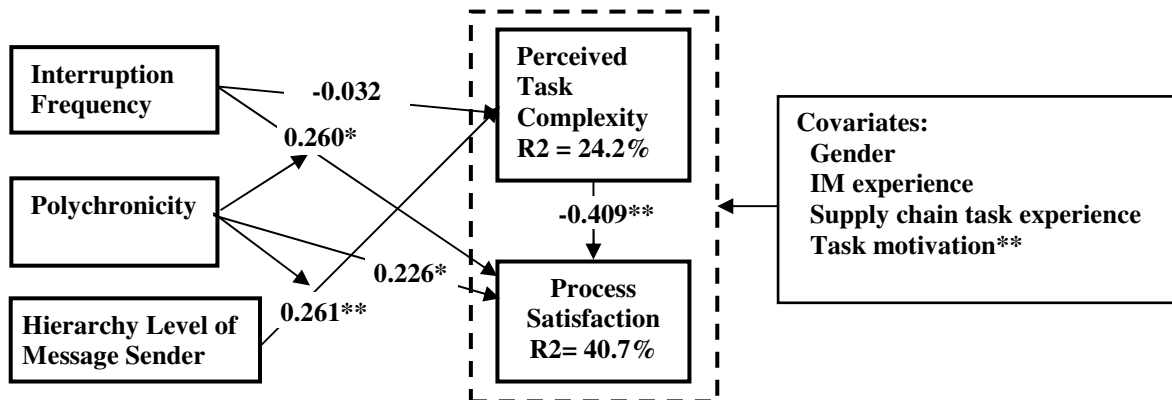
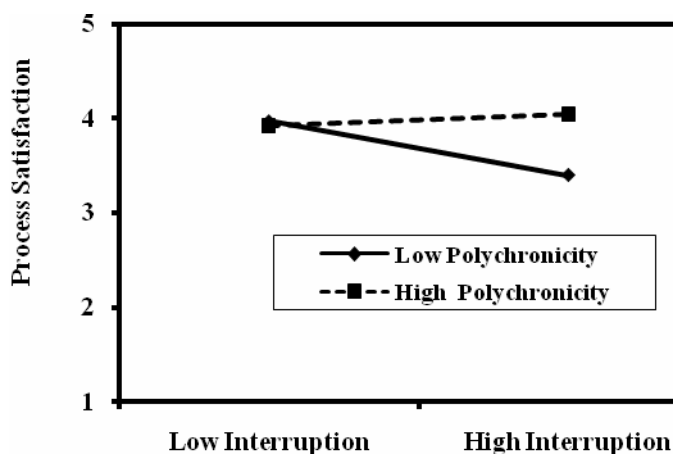


Figure 2. Results of testing hypotheses using PLS analysis. Completely standardized estimates, controlled for covariates in the research model, * $p < 0.05$, ** $p < 0.01$ (two-tailed).

We first analyzed the moderation effects of the polychronicity or Hypotheses 3 and 4 and, then tested other main effect hypotheses. Following the procedures by Chin et al. (2003), we examined both effect size and statistical significance of the moderation effect. The effect size (f^2) was 0.06 for the interaction between polychronicity and interruption frequency and 0.07 for the interaction between polychronicity and the hierarchy level of message sender. Both of the effect size values satisfies the 0.02 cutoff for small effect size (Cohen, 1988)¹ and are found to be statistically significant ($p < 0.05$). Therefore, polychronicity moderates the effect of interruption frequency on process satisfaction and the effect of hierarchy level of message sender on perceived task complexity. The interaction patterns of the two moderation effects are shown in Figures 3 and 4. Both patterns are consistent with the hypotheses. We found that, for knowledge workers with low polychronicity, the increase in interruption frequency reduces their process satisfaction and the hierarchy level of message senders significantly reduces their perceived task complexity. For knowledge workers with high polychronicity, interruption frequency has no significant effect on process satisfaction and hierarchy level of message senders has no significant effect on perceived task complexity. Therefore, H3 and H4 were supported.



¹ $f^2 = [R^2 (\text{interaction model}) - R^2 (\text{main effects model})] / [1 - R^2 (\text{main effects model})]$.

Figure 3. The moderation effect of polychronicity on the relationship between interruption frequency and process satisfaction.

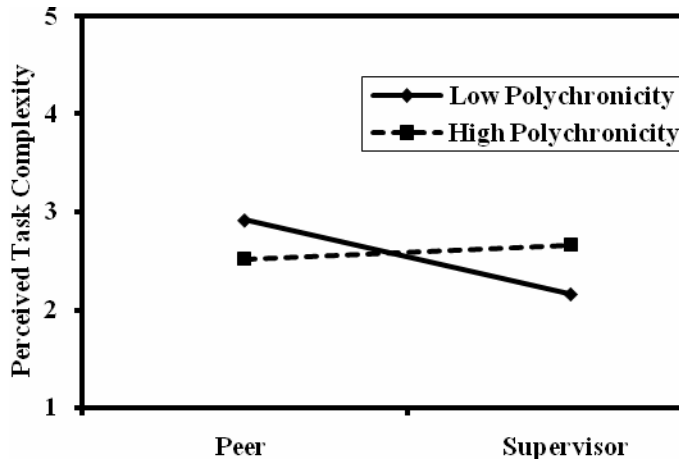


Figure 4. The moderation effect of polychronicity on the relationship between the hierarchy level of message sender and perceived task complexity.

We went on to examine the other hypotheses. They were all found to be statistically significant except H1. Interruption frequency is not found to significantly influence the perceived task complexity. This may be related to the relatively low overall perceived complexity level of tasks used in this study. The average perceived task complexity is 2.6. Under relatively low task complexity (including both main task and interruptive IM tasks), the increase in interruption frequency may add little to or have little impact on the perceived task complexity. Overall, the research model is well supported. In addition, among the four covariates, task motivation was found to significantly increase perceived task complexity and process satisfaction ($p < 0.01$).

6. DISCUSSIONS

6.1 Implications for Research

This study has several important implications for research. First, our study found that a knowledge worker's satisfaction with the work process deploying IM is influenced by the interaction between interruption frequency and his or her multitasking preference (polychronicity). Studies ignoring the moderation effect of polychronicity will provide incomplete results. Second, the results suggest that an individual's polychronic tendency also interacts with the social characteristic of interruptions (i.e. hierarchy level of message sender) in determining his or her perceived task complexity. Finally, it is important to consider the effect of social network when examining the potential consequence of IM interruptions. The findings of this study suggest that the hierarchy level of message senders plays a role in influencing the way in which message receivers, especially monochronic receivers, process tasks, and subsequently shaping their perceived task complexity.

6.2 Implications for Practice

The findings of this study also have important implications for companies deploying IM technology. First, our study suggests that polychrons tend to be more satisfied with the working setting with IM interruptions than monochrons. Second, we found that the increase in interruption frequency quickly reduce monochrons' process satisfaction but has little impact or

only slightly enhance polychrons' process satisfaction. Third, monochrons and polychrons take different approaches in managing their time. Fourth, when deploying IM technology, organizations need to consider the social network characteristics of IM interruptions such as the direction of relationship (peer vs. supervisor), strength of the relationships, etc.

7. CONCLUSIONS

This paper adds to extant literature by better understanding the effect of IM interruptions on employee satisfaction and subjective task complexity. To examine interruptive nature of IM technology, we consider both an individual's time management orientation (polychronicity) and the social network characteristic of interruptions. Polychrons are found to be more satisfied with the multitasking work process deploying IM technology than monochrons. Besides the direct effect on process satisfaction, polychronicity was found to moderate the effect of interruptions on employee satisfaction and subjective task complexity. When IM messages are sent from their supervisors, monochrons tend to prioritize tasks and perceive a lower level of overall task complexity. The information processing of polychrons seem to be less influenced by the social characteristic of interruptions.

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