THE EFFECTS OF MODALITY OF SOCIAL INTERRUPTIONS ON JOB PERFORMANCE AND ANXIETY

by

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Abstract of the Thesis

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The purpose of this study was to examine the effect of social interruptions communicated via different mediums on task performance and on affective measures such as anxiety, stress, and annoyance. The study sought to investigate the effect of a personal visit, phone call, or instant message interruption on individuals working on a simple and a complex task. Participants were randomly assigned to either interruption or non-interruption conditions and to one of the three communication mediums. Twice confederates interrupted interruption participants during the course of the experiment in the medium to which they were assigned (either face-to-face, phone, or instant message). They were interrupted once while they were completing a simple typing task and once while they were completing a complex payroll task. No-interruption participants served as control participants. These individuals were still contacted by confederates. However, they were not contacted while typing or working on the payroll task. Unlike individuals in other interruption conditions, individuals in the instant message interruption condition were impaired on the simple task. Overall, interruption participants suffered impairment on the complex task. Individuals interrupted by phone calls were impaired the most on the complex task. Participants did not report any major differences across conditions' in state anxiety, stress, or annoyance. Implications of these results and possible organizational applications are discussed.

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Introduction and Background

Interruptions are "incidents or occurrences that obstruct or delay members of organizations as they attempt to make progress on work tasks and, thus, are typically thought of as disruptive for organizational members" (Jett and George, 2003, p. 496). An interruption breaks a worker's attention on a primary task and forces them to turn their attention towards the interruption—if only briefly (Speier, Vessey, and Valacich, 2003). Today, as the work environment becomes increasingly complex, workers have to deal with increasing numbers of interruptions. According to Jett and George (2003), the four types of interruptions include intrusions, breaks, distractions (nonsocial), and discrepancies. Intrusions are interruptions initiated by another person, breaks are self-initiated recesses from tasks, non-social distractions are triggered by external stimuli that interrupt concentration, and discrepancies occur when individuals observe in their environment unexpected stimuli.

Interruptions, although a ubiquitous part of 21st Century work life, are a form of distraction (anything that does not advance an individual toward completion of his/her primary task) and therefore can be extremely detrimental. For example, McFarlane and Latorella (2002) describe an incident where a flight crew crashed an airplane because they had trouble resuming the preflight checklist after being interrupted by an air traffic control operator. The crew got so caught up in the air traffic controller's instructions warning about a possible windshear that they took off without moving the plane's flaps to the right position. This is an extreme example, but it highlights the possible consequences of interruptions. An information technology firm estimated that interruptions cost the US economy $588 billion a year (Spira, 2005).

There is a whole language for describing how an interruption is structured. The disruptive effects of an interruption often are measured by determining how much time the actors needs to resume the primary (interrupted) task after the interrupting task is completed. This phenomenon is known as "resumption lag." The cost associated with switching from a primary task to an interrupted task is known as "the switch cost." According to a 2005 New York Times Magazine article, "[in the workplace] information is no longer a scarce resource, attention is" (Thompson, 2005, p. 41). Information processing technology and therefore work demands has evolved a great deal faster than our own minds. Information overload results when the brain is not able to deal with all the stimuli employees come in contact with at the modern office.

Sometimes individuals can anticipate or control interruptions. The cost of switching attention from one task to another can be reduced if cues are provided about the task to be performed next (Roda and Thomas, 2006). Carton and Aiello (in press) found that participants who were able to anticipate interruptions performed significantly better than those who could not anticipate them. However, the present experiment deals with situations where individuals are caught off guard and unable to anticipate interruptions. Individuals in control of their task switches can also effectively multitask, although this takes a great deal of cognitive energy (Trafton, Altmann, Brock, and Mintz, 2003). However, there is a large difference between multitasking when one is in control of when he/she switches tasks or at least receives some warning when the task switch will occur and dealing with unexpected interruptions. Law (2004) illustrated that compared to normal individuals patients with dysexecutive syndrome suffered from a traumatic brain injury or cerebral vascular accident have severely impaired multitasking abilities

yet do not have an impaired ability to deal with the unexpected effects of interruptions (Law, 2004).

Intrusions

Often organizational tasks are interactive, social, and creative. A certain amount of unplanned interaction is necessary to develop a creative and open workplace culture (Solingen, Berghout, and Van Latum, 1998). Intrusions also referred to as social interruptions, involve human actors. Human actors, who serve as the catalyst for intrusions, can interrupt the flow and continuity of an individual's work and bring that work to a temporary halt (Adamczyk and Bailey, 2004). However, the atmosphere of today's workplace is extremely fast paced and involves a great deal of task switching and altering of focus (Gonzalez and Mark, 2004). Social interruptions can be disruptive, but they are a necessary part of organizational communication.

Social Facilitation

Studies drawing on empirical evidence and establishing theoretical frameworks to describe specifically the effect of social interruptions on primary task performance remain scarce. There has been little consensus and only a small amount of theoretical progress (Hodgetts and Jones, 2006). However, theories about the related phenomenon known as social facilitation abound (Aiello and Douthitt, 2001). In order to better understand one of these theories that will be central to this study, the distraction-conflict theory (proposed by Baron, 1986); it is essential to first discuss the concept of social facilitation. The first study to demonstrate an enhancement of an individual's performance due to the presence of another was conducted by Norman Triplett (Triplett, 1897). This phenomenon would later be coined "Social Facilitation" by Allport (Allport,

1920). However, not all researchers found increases in performance when others were present. Some actually found decreases in performance when individuals were present. Zajonc explained these seemingly conflicting results by theorizing that an individual's performance was linked to drive levels. Drawing on the learning theories of Hull (1943) and Spence (1956), Zajonc theorized that the "mere presence" of others enhances dominant responses (responses where the tendency is for the correct response to be "dominant") by increasing the individual's level of general "drive" (later referred to more often as arousal), but impairs subordinate responses (Zajonc, 1965). This has been generally agreed upon to mean that the performance of simple or well-learned tasks (those that involve dominant responses) is enhanced by the presence of others and the performance of complex (or novel) tasks is impaired (Feinberg and Aiello, 2006). Nevertheless, the effects of social facilitation on simple and complex task performance are not equal. The results of a meta-analysis showed that complex task impairment is seven times more likely than simple task enhancement (Bond and Titus, 1983).

One major subsequent explanation of social facilitation is known as distraction-conflict theory (Baron, 1986). According to distraction-conflict theory, the presence of others (or any other distracting stimuli) causes an attentional conflict, i.e., a situation where an individual needs to pay attention to two or more inputs. Baron does not believe that social facilitation occurs only due to mere presence. One study supporting this is Aiello, Chomiak, and Kolb (Unpublished Manuscript). In the aforementioned study, data entry performance was enhanced greatly for subjects contending not only with co-actors and a supervisor in their proximity but also an individual posing as a computer repairperson. This repairperson was presented as not

being a part of the study, but created loud sounds, e.g., opening and closing doors, talking on the phone. Subjects dealing with this distracting repairperson experienced enhanced performance above and beyond participants who worked with only a supervisor and co-actors in the room. In addition, according to distraction-conflict theory, some non-social distracters can cause social facilitation as well (Baron, 1986). In support of this model of social facilitation, Rajecki, Ickes, Corcoran, and Lenerz (1977) showed evidence that social facilitation could be caused by a non-human object. Participants experienced the same social facilitation effects in the company of a mannequin as a real life human being.

According to distraction-conflict theory, many attentional conflicts will lead to an increase in cognitive load and therefore an increase in arousal. This increase generally benefits an individual on a simple task. However, Baron warns eventually too much distraction will impair simple task performance by producing too stressful and disruptive an attentional conflict diverting too much attention from the simple task. Therefore, the relationship between distraction and simple task performance is curvilinear. Moreover, Baron theorizes that distraction will impair complex task performance because of the attentional conflict as well (Baron, 1986).

There have been many other proposed explanations for the phenomenon of social facilitation, e.g., evaluation apprehension (Cottrell, 1972) and a biopsychosocial model accounting for cognitive processes (Blascovich, Mendes, Hunter, and Salomon, 1999). No framework or combination of frameworks has been able to totally explain the phenomenon (Feinberg and Aiello, 2006). There are still missing pieces of the puzzle as far as the kinds of people and relationships for whom social facilitation effects are predicted, the time boundaries within which these effects will occur, and the kinds of

performance that may be affected (Aiello and Douhitt, 2001). Several studies have shown that other variables may play a role in predicting physiological arousal such as interpersonal distance (Aiello, 1987), gender (Aiello and Thompson, 1980) and physical attractiveness (Harnett, Gottlieb, and Hayes, 1976). Recent studies have challenged the way presence has been defined and expanded social facilitation findings to include electronic presence (Aiello and Kolb, 1995). It has been suggested that presence be expanded to include electronic presence (Aiello and Svec, 1993) and that presence be viewed not as a dichotomous variable, but as a continuous variable differing on the salience of presence (Feinberg and Aiello, 2006).

Social Facilitation and "Residual" Effects

Traditional social facilitation studies have often dealt with the effects of stimuli raising individuals' arousal level concurrently while they are working on a task causing enhancement or impairment on that task. However, Spence (1956, pp. 179-189) hypothesized that drive persists in the form of a covert emotional response and has a relatively persisting effect, which lasts at least a couple minutes. Zillman (1971) describes a similar phenomenon called excitement transfer theory, stating that residual excitement from a previous arousing stimulus or situation may intensify a later state. Excitement transfer theory is strengthened by the fact that sympathetic nervous system arousal does not terminate abruptly when the eliciting conditions terminate, but it slowly declines resulting in residual arousal (Cantor, Zillman, and Bryant, 1975).

Sanders and Baron (1975) tested this "distraction carryover effect" by comparing participants' performance in no distraction trials in two studies. Overall, participants in two studies, who had been distracted in previous trials minutes earlier, performed

significantly better in simple task trials than those who were never distracted at all. In study 2 participants' in "no distraction" complex task trials, who had been distracted in previous trials, performed significantly worse than those who had never been distracted. The same complex task impairment had not observed for participants in their first study; however, study 2 controlled for the practice effects that confounded study 1. Sanders and Baron concluded that the "carryover effect" applied to simple and complex tasks.

Social Facilitation, Interruptions, and Performance

Individuals who intrude often cause individuals to be distracted and no longer focus all their attention on their primary task. Interruptions often disrupt ongoing activities causing a slowing of an individual's performance and/or an increase in the number of errors they make (Gillie and Broadbent, 1989). There is some evidence that interruptions can actually improve an individual's performance. Supporting the distraction-conflict theory of social facilitation, this evidence is restricted only to interruptions of simple tasks (Speier, et al., 2003; Zijlstra, Roe, Leonora, and Krediet, 1999). Interestingly enough, like Sanders and Baron (1975), in Speier, et al. (2003), the effects of the distraction did not occur until a few minutes after the distraction was over, when individuals returned to their regularly scheduled primary task.

Not all studies of interruptions of simple tasks have produced increased performance on the simple task. Many have found that interrupted users always complete tasks slower or at best equivalent to when they perform the same tasks without being interrupted at all (Burmistrov and Leonova, 2003; Cutrell, Czerwinski and Horvitz, 2001, Bailey, Konstan, and Carlis, 2001). In a study reported by Eyrolle and Cellier (2000) the intensity of the temporal strain was one possible reason the simple

primary task speed was impaired. This contrasts with Zijlstra et al. (1999), where the time constraints were not very strict. The timing of an interruption is also important. In Cutrell, Czerwinski and Horvitz, (2001) interruptions coming early in a memory intensive task were found to be more detrimental than interruptions that arrived later.

Interruptions and Affective State

In addition to often slowing down an individual's speed and/or accuracy, interruptions generally have a negative impact on an individual's psycho-physiological state. Much research has posited that interruptions can cause undue stress on workers as they scramble to fulfill their responsibilities (Burmistrov and Leonova, 2003). Speier et al. (2003) demonstrated that task interruption tends to increase stress and anxiety. In order to process interrupting tasks and compensate for the way they impact progress on the primary task, more effort is needed. Changing foci of attention causes cognitive (or mental) fatigue, i.e., a decrease in the total available attention capacity. Interruptions have a cumulative effect; the more interruptions, the more individuals become not just mentally fatigued, but physically exhausted (Zijlstra et al., 1999).

A recent study (Bailey and Konstan, 2006) involved participants working on a variety of primary and peripheral tasks representative of those performed by employees. Participants were more affected by peripheral tasks when these tasks interrupted primary tasks than when the same peripheral tasks were executed at the boundary between primary tasks. Individuals interrupted during primary tasks experienced 31% to 106% more annoyance and twice the anxiety as those completing the same tasks without being interrupted [as measured by the state anxiety form (Y-1) of the STAI)] (Bailey and Konstan, 2006). Furthermore, in another recent study, Carton and Aiello (in press)

showed that individuals who did not feel they could control interruptions experienced more stress.

Communication Mediums

One recent social facilitation study (Feinberg and Aiello, 2006) suggests that presence be viewed along a continuum. Perhaps the salience of the intrusion relates to its effect. One would expect intrusions of varying saliencies to have different effects on performance as well as affective dimensions. For example, social interruptions consisting of intrusions initiated in different mediums vary in salience and therefore would be expected to differ in their effects.

Communication is affected by the medium within which it takes place. For example, compared to face-to-face (FTF) interaction, individuals communicating by phone are affected by a loss of nonverbal cues. Individuals communicating by computer are affected not only due to a loss of nonverbal cues, but due to a loss of paralinguistic cues as well (Connell, Mendelsohn, Robins and Canny, 2001). A number of media choice theories exist for examining media-task fit, i.e., which media are more appropriate to use to communicate in a variety of different contexts. Media richness or information richness theory deals with the effects of using different media (Daft, Lengel, and Trevino, 1987; Daft and Lengel, 1986; Daft and Lengel, 1984). According to media richness theory, performance on high equivocality (uncertainty) tasks (e.g., priority-negotiation tasks) improves when people use richer media. "Richness" is operationalized as the number of communication channels or cues available in media. High equivocality tasks such as priority/negotiation tasks are tasks that involve multiple interpretations. Face-to-face is the richest media, a telephone is an intermediate richness medium, and e-mailing is an

example of communication using a" lean" medium (Daft et al., 1987; Daft and Lengel, 1986, Daft and Lengel,1984). Another related theory is social presence theory. Social presence emphasizes how well a medium facilitates the sender's awareness of the receiver of the communication and the overall relationship between the sender and the receiver of the communication (Short, Williams, and Christie, 1976). Short, Williams, and Christie (1976) explained social presence as the salience of another person in a mediated environment.

Regardless of the loss of cues associated with it, computer-mediated communication including synchronous communication, e.g., instant messaging and asynchronous communication, e.g., e-mailing, has become ubiquitous in organizations following recent advances in technology (Baltes, Dickson, Sherman, Baur, and LA Ganke, 2002). Corporate instant messaging was estimated to have grown from 18.3 million in 2001 to 229 million users worldwide in 2005 (Mingail, 2001). Instant messaging (IMing) allows employees to send and receive short text-based messages in real-time and to see whom else is "online" and currently able to receive messages. IMing allows employees to reach the most people at once, but symbolic cues can affect media choice. Sometimes face-to-face communication or communication by phone might carry more urgency, caring, legitimacy etc. than instant messaging (Cameron and Webster, 2005).

Although in many ways the effects of phone communication are at an intermediate saliency level in between IM and FTF communication, there are benefits ascribed to phone communication over other media as well. There is evidence that individuals not acquainted with each other are more satisfied introducing themselves to

each other on the phone than through computer communication or face-to-face interaction (Connell et al., 2001). Apparently, telephone calls contain rich aural information that allows for more complex expression than in computer-mediated communication. However, the lack of visual cues makes phone callers feel less public pressure and allows individuals communicating via phone to relax enough to feel more comfortable than in face-to-face interactions. Therefore, individuals behave more as they intended to on the phone than in person and perceive that their partners do as well (Connell, Mendelsohn, Robins and Canny, 2001). In a recent unpublished study (Glushakow and Aiello, 2006), dyads communicating by phone performed the closest to experts on a priority negotiation task. Dyads communicating via computer performed the worst on the task, performing worse than each member did individually. It was concluded that the phone dyads were the most successful. Phone dyads, at least in one-time interactions, spent less time building a relationship with their partner than when their partner's presence was more salient in the face-to-face interaction yet they benefited from communicating in a richer medium than computer-mediated communication.

Modality of Interruption

The modality of a social interruption has been found to affects the impact of the interruption. Although very little research has compared interruptions involving different communication mediums, studies have examined the role of interruptions involving different sensory channels on primary tasks. In two experiments where users performed mostly visual simulated air traffic control tasks, visual interruptions were determined to be more disruptive than interruptions from other sensory channels. In Latorella (1998), visual interruptions were found to be more disruptive than auditory or tactile

interruptions. In Ho, Nikolic, and Sarter (2001), participants' performance suffered when they were interrupted by visual as opposed to auditory interruptions. This was considered evidence for multiple resource theory, (i.e., that separate attentional resources are associated with different processing pathways). Therefore, the brain is better able to process stimuli involving two different sensory passageways to avoid competition of resources. However, multiple resource theory is generally applied to situations where no task switch is involved. In these situations the actor must concentrate on a primary task even while dealing with an interruption (which does not constitute a separate interruption task).

Effect of Interruption Task Similarity on a Primary Task

In situations where a primary task is interrupted causing a momentary task switch, there is a controversy as to whether (or when) the brain is better able to process interruptions that are similar or dissimilar to a primary task. Research in cognitive psychology supports that task accuracy is decreased when tasks that are similar in nature are processed simultaneously (Gillie and Broadbent, 1989). It is hypothesized that this is caused by interference between the information associated with the primary task and the interruption task within the working memory. This interference then causes an attentional overload as resources from working memory cannot be properly allocated to each task (similar to multiple resource theory). In contrast, Iselin (1988) and Speier, Valacich, and Vessey (1999) found that the more different the interruption task was from the primary task, the greater the participant's cognitive capacity will be exceeded. In addition, participants would be less accurate and require greater decision time.

One difference between these studies is the type of primary task. The studies where task similarity caused the impairment included simple tasks, which were more short-term and memory intensive. The latter group of studies involved more advanced cognitive tasks, e.g., those involving decision-making (Speier et al., 1999). However, there is still ambiguity about which tasks fall into which category. It can be postulated that tasks that are both memory intensive as well as cognitively complex are characterized by a backward U-shape trend where both similarity and difficulty of the tasks would cause primary task impairment. However, no research has been conducted to clarify this issue.

Communication Mediums and Interruption

Since communication via different communication mediums have varied effects on individual's attentional load, personal visits, phone calls, and instant messages may impact employees' anxiety levels, annoyance and performance differently. Only one study that we are aware of, Storch (1992), compared social interruptions in different mediums. Storch (1992) found that a screen task interrupted participants working on a data entry task more than a phone call or a personal visit. Storch concludes that the screen task was more disruptive because often interruptions similar to the main task (in this case a typing task) are more disruptive than interruptions not similar to the main task. This was supported by that fact that the phone call was actually the least disruptive interruption, not significantly disruptive at all. The phone interruption was possibly less disruptive than the personal visit because the personal visit had a visual component to it that was interfering with the primary task. However, the condition with the screen task was different from the others since the screen task locked the subject out of the main task

until he/she responded to it. This "locking" of the main task affected the results of the experiment since individuals were able to work on the typing task during the other interruptions. This study poorly simulated an individual working on two computer tasks simultaneously today. Since 1992 computers have become exponentially more powerful and complex and have become much better at running more than one application at once.

The Current Study

The current study was designed to investigate the effect of the communication medium of an interruption on task performance, anxiety, annoyance, and stress. Like Storch (1992), this study was designed to compare performance for individuals interrupted in various mediums (i.e., interrupted by a personal visitor, a phone call, or computer messages). However, unlike in Storch (1992), the present study contained three control conditions where individuals were not interrupted. This study also not only examined the effects of interruptions occurring during a data entry task, like Storch (1992), but also those occurring during a payroll task involving a large number of calculations. In line with the definitions in Wood (1986), the data entry task was expected to be a simple task involving dominant responses and the payroll task was expected to be a complex task involving subordinate responses. Wood (1986) defined simple tasks as tasks that required information acquisition only or information acquisition and some simple calculations. Complex tasks were defined as those that required more processing of information cues and perform a larger number of separate acts. Furthermore, in addition to measuring performance effects, this study also utilized questionnaire responses to measure the effect of the interruptions on affective measures such as anxiety, annoyance and stress.

This study expands social facilitation theory, specifically distraction-conflict theory, into the domain of communication mediums. Previous literature has shown that social facilitation effects can be produced without the physical presence of an individual (Aiello and Kolb, 1995). Studies have shown differential effects of communication in different mediums both in terms of performance as well as affective dimensions (Connell et al., 2001; Glushakow & Aiello, unpublished manuscript). In addition to a visitor coming in unexpectedly, the presence of the phone caller and an instant message initiator are expected to uniquely affect participants. The purpose of this study is twofold. One goal is to broaden the literature on distraction-conflict theory to reflect this differential impact of distractions in different communication mediums. The other is while broadening the literature, to also generate results that are very applicable to managers in the workplace whose employees deal with a great deal of distractions on a daily basis.

This study contains a design which differs from one of a "traditional" social facilitation study. While most "traditional" social facilitation studies deal with "presence" effects observed concurrently while an individual is working on a task, this study dealt with the potential "carryover" effects of arousal resulting from social facilitation. However, research has shown the effect of a distraction on arousal does not go away immediately after a distraction is over (Cantor et al., 1975; Sanders and Baron, 1975). Therefore, we will investigate this often overlooked "carryover" effect of distraction.

Hypotheses:

According to Baron's distraction-conflict theory, when a task is complex the arousal generated by a distraction will have a negative impact on an individual's

performance due to increased cognitive load (Baron, 1986). This idea has been supported in numerous experiments, e.g., Burmistrov and Leonova (2003), Speier et al. (2003), Bailey et al. (2001), Speier et al. (1999), Gillie and Broadbent (1989).

Hypothesis 1: Subjects in the no interruption conditions will perform better on the complex task than those in the interruption conditions.

Also in line with Baron's theory and subsequent studies, e.g., Speier et al. (2003) and Zijlstra et al. (1999), when a task is simple, the arousal generated by a distraction will facilitate performance (Baron, 1986). Simple task enhancement is predicted even though there will be some temporal urgency for participants, which Eyrolle and Cellier (2000) showed could sometimes be responsible for a distraction impairing simple task performance. This is also predicted despite the fact that the effects of social facilitation on simple task performance are seven times weaker than its effects on complex task performance (Bond and Titus, 1983).

Hypothesis 2: Subjects in the interruption conditions will perform better on the simple task than those in the no interruption conditions

The personal visit involves the most salient medium measured by media richness (Daft et al., 1987). Therefore, this interruption is expected to raise participant arousal levels more than interruptions in other leaner mediums. All participants interrupted during the payroll task are expected to be at higher than ideal arousal levels. Therefore,

the increase in arousal associated with the personal visit is expected to lead to the greatest impairment in simple task performance. Moreover, primary tasks (typing and computing employee salaries) in this study resemble the tasks in the cognitive psychology literature, e.g., Latorella (1998) and Gillie and Broadbent (1989), more than decision-making tasks, such as those in Speier et al. (2003). Therefore, interruptions that require the same senses as the primary task are expected to cause potentially damaging cognitive conflicts. A personal visit is cognitively distracting since it involves both auditory *and* visual processing (Gillie and Broadbent, 1989). It is expected to have the largest detrimental effect on the payroll task (which is mostly visual). The phone interruption is predicted to be the least distracting due to intermediate richness and the weakest cognitive conflict. The participants working on the payroll task will suffer less from an audio only interruption, i.e., a phone call versus interruptions in the other two mediums.

Hypothesis 3: The "personal visit" interruption will impair complex task performance the most.

Hypothesis 4: The phone interruption will impair complex task performance the least.

Unlike interruptions of individuals during a complex task, interruptions of individuals during the typing task are not expected to lead to attentional demands exceeding participant's ideal arousal state. Depending on the typical individual's cognitive capacity, it is possible that simple task performance (speed and/or accuracy on the typing task) will be enhanced by all the intrusions. In that case the most salient

interruption, the personal visit, which contains the most information channels available (Daft et al., 1987; Daft and Lengel, 1986; Daft and Lengel, 1984), is expected to increase participant arousal levels and enhance simple task performance the most.

Hypothesis 5: The participants interrupted by a personal visitor will experience the largest enhancement in simple task performance.

Participants are working on the simple task on a computer. Therefore an instant message is expected to be very distracting and compete heavily for cognitive resources. In addition, instant messaging is also a lean (less salient) medium (Alge, Bradley, and Klein, 2003). Instant messaging is expected to cause the least increase in participant arousal and the weakest enhancement in simple task performance. Depending on the level of distraction, instant message interruptions might even be impaired since the level of distraction might be greater than the simple task enhancement as a result of the arousal from the IM interruption.

Hypothesis 6: The participants interrupted by instant message will experience the smallest enhancement in simple task performance (or even a slight impairment).

As was stated above, interruptions, especially unanticipated interruptions, can lead to information overload and therefore produce anxiety and annoyance (Carton and Aiello, In press; Bailey and Konstan, 2006; Thompson, 2005).

Hypothesis 7: The individuals interrupted by face-to-face visitors will not only suffer from the most impaired complex task performance, but will be also be the most anxious.

Method

Subjects

Seventy-three students enrolled in General Psychology courses at a major Northeastern University participated in the study as part of their course requirements. Participants included 34 males and 39 females. Thirty-eight of the participants were Caucasian, nine were African-American, three were Hispanic, 16 were Asian, and seven were other.

Research Design

Individuals were randomly assigned to 6 conditions. The participants were assigned to either interruption or non-interruption conditions. Participants were further assigned to conditions corresponding to one of three communication mediums: Face-to-Face, Phone, and Communication via Instant Message. Twice (once during each session) a confederate interrupted the participants assigned to interruption conditions. Depending on the medium to which they were assigned, participants were interrupted by face-to-face visitors, by telephone, or via instant message. The participants who were in non-interruption conditions were also contacted twice by IM, by phone, or in person as well, depending on the condition to which they were assigned. However, these control participants were contacted after completing the primary tasks rather than while executing primary tasks. Condition sample sizes ranged from 10 to 14 participants.

Materials and Procedures

After being welcomed by a supervisor and told to fill out a consent form, participants in all conditions were told they would be simulating the activities of a human resources employee. Participants were told that if they did an extremely good job in the

simulation they would be considered for an interview for a human resources internship at a fictional company in which the supervisor is an intern. Participants were also motivated by learning that the best performers would be given more chances to win prizes in a lottery.

Primary Tasks

All participants completed two primary tasks: first, a typing task (simple task) and then a payroll (complex) task. Both tasks were low equivocality tasks possessing distinct right and wrong answers. Before being introduced to these tasks, participants were asked by their supervisor to complete a one-minute online typing test assessing their typing speed and accuracy. After the online typing test, participants were ready to start the simple task. At the beginning of the simple task, participants were handed a printed copy of a fifteen-page fax report file consisting of company HR guidelines and told they would be given ten minutes to type the contents of the document in a word processor program. Participants were told they would be scored based on speed (# of words typed) and accuracy (% of words typed correctly). At the beginning of the complex task participants were given a sheet of paper listing employees login and logout times for a two-week period as well as their hourly wages. Participants were given ten minutes to add up fictional employees' hours and determine their bimonthly gross incomes taking into account company overtime policy where necessary. Again participants were told they would be scored based on speed (# of items completed) and accuracy (% of items completed correctly).

Interruptions Task

After hearing the pre-task instructions for both primary tasks, individuals in the interruption conditions were handed a sheet by their supervisors detailing company guidelines about company policy on vacation days and fringe benefits. Participants in interruption conditions were told that part of their job as a human resources officer was to answer employee Human Resources (HR) inquiries. Therefore they would possibly be interrupted while working on the typing and payroll task by employee questions about sick days, fringe benefits, etc. Participants were told interruptions would occur in the form of employee's personal visits, phone calls, or instant messages. They were also told that they must stop typing or working on the typing/payroll task while responding to HR inquiries. However, participants were also told that responding to HR inquiries would not count towards the ten minutes they were allotted to work on the two primary tasks. After participants received these HR inquiry instructions, supervisors signed participants onto AOL Instant Messenger and instructed them to begin typing/working on the payroll task. Immediately after giving these instructions, supervisors left the room and walked to an adjacent room.

All participants in interruption conditions were interrupted three minutes after they started working on the primary tasks. Confederates, posing as employees, contacted participants twice: once during each primary task. Each time confederates contacted participants, by phone, by IM, or in person depending on the medium to which they were assigned. In phone conditions participants suddenly heard the voice of a confederate through a speaker phone. The speaker phone in the participants' room and the phone in the confederate's room were networked into an "intercom system." Individuals could not send or receive calls to other phones. The two phones were permanently connected

therefore no dialing or ringing was required for the phone connection to be made. In instant message conditions, without warning, participants received text coming from the confederate. The volume was turned off. In face-to-face conditions, confederates entered the participant's room from the hallway without knocking or providing other cues that they were entering.

To accurately respond to employee questions, participants needed to reference the HR guidelines and apply the guidelines by making simple calculations. Interruption participants were contacted with the following inquiries:

> While working on the typing task-"Hi, I am Jamie Miller, a full time employee. I have a question about health insurance policies. How much more per month would it cost me (Not the company) to switch to the Employee & Spouse and Partner MMSI Medical Tradition PPO Plan from the Open Choice PPO Plan?"
>
> While working on the payroll task-"Hi, its me again. I have another question. I am a 24 year-old and would like to buy short-term disability coverage for $400 per Week as well as $50,000 supplemental life insurance for myself as well as $10,000 supplemental life insurance for my son. How much would that cost per month?"

Confederates were able to interrupt participants three minutes into their primary tasks because confederates were signed onto AOL Messenger on a different screen name in the adjacent room. Confederates watched when participants' screen name signed on; this alerted them when the participants started the primary tasks. Confederates recorded participants' answers to HR inquiries as well as the time it took them to arrive at those answers. HR Inquiries were designed to be challenging yet not so challenging that participants were not motivated to perform well. Investigation of interruption task performance was planned for exploratory purposes. However, interruption task performance was not one of primary dependent variables of investigation in this study.

Confederates also notified supervisors about how long the interruption took so they knew how long to add to the ten minutes before returning to the participants. This was possible because confederates spent most of their time in the adjacent room (only in Face-to-Face conditions and only during the HR Inquiry did confederates leave the adjacent room). If a participant did not have an answer to the inquiries after four minutes and 30 seconds, confederates warned them they had to "go" soon to attend a meeting. After 30 more seconds, confederates told participants it was their last chance to respond to the inquiries before they had to leave and prompted them to give their best answer given the time constraints. This limited interruptions to a maximum of five minutes.

Confederates contacted non-interruption participants with the same two inquiries after the completion of both the simple and complex tasks. Participants were simply given instructions after finishing each of the primary tasks that they would be working on a separate task (which was no longer an interruption), where they were going to respond to an employee personnel question. After receiving these instructions participants were contacted 20 seconds later. Again confederates knew when to interrupt participants based on when they signed onto AOL Instant Messenger. In addition, again the HR inquiries lasted up to five minutes and confederates warned participants that they had a meeting to go to and would need to answer 30 seconds before that. These crucial non-interruption control conditions were used to measure differences in the affective measures for individuals based on whether they had been interrupted and in what medium they had been contacted.

Debriefing and Questionnaires

After the completion of the tasks, participants were debriefed about the purpose of the experiment and the fact that XYZ was not a real company. Paper questionnaires were administered after the completion of the typing task and one HR inquiry (the typing session) as well as after the payroll task and another HR inquiry (the payroll session). Questionnaire responses (*See Appendices 1 and 2*) were designed to determine the role of the medium of interruption on stress and annoyance. Annoyance was measured after each session using a modified 25-point scale previously used to measure annoyance caused by noise in computer rooms (Mital, McGlothlin, and Faard, 1992). The questionnaires were also designed to measure stress based on modified items from a previously validated stress scale (Aiello and Kolb, 1995). In addition to the questionnaires given to participants after each session, participants also completed (Y-1) the State Trait Anxiety Inventory (STAI). This scale measured participant's anxiety levels at the conclusion of each session (Spielberger, Gorusch, and Luschene, 1970). A score of 20 on the STAI indicates the lowest possible anxiety level and a score of 80 indicates the highest state anxiety level.

Results

The participants were randomly assigned to six conditions made up of combinations of two interruption conditions (whether or not they were interrupted) and three mediums (Face-to-Face, Phone, Instant Message). Many of the questionnaire items including items measuring stress, anxiety, and annoyance were analyzed with 2 X 3 ANOVAs. However, 2 X 3 ANOVAs were not appropriate for all the dependent variables. Although the basic design for the study was a 2 X 3 design, typing and payroll task performance were analyzed using 1-way 4-level ANOVAs conducted to compare performance for personal visit, phone call, IM interruption, and non-interruption participants. 2X 3 ANOVAs were not used for primary task performance because individuals in non-interruption conditions were not expected to significantly differ on any of the primary performance measures. Therefore, 2X 3 ANOVAs were not expected to reveal any interaction between interruption and medium for any of the primary task performance measures. This was because non-interruption participants were not contacted in the medium to which they were assigned until *after* they completed the typing and payroll tasks. As was expected, one-way ANOVAs comparing the performance of the non-interruption participants revealed no condition effects[1]. Moreover, 2X 3 ANOVAs of the performance measures did not reveal any interactions[2]. However, 2X 3 ANOVAS were conducted for HR inquiry task performance for exploratory purposes. There were differences expected between individuals responding to others contacting them via the different mediums as well as individuals responding to an interruption versus a stand-alone task. Finally, 2 X 3 [X2] repeated measures

ANOVAs were run to compare questionnaire responses after the typing session with items after the payroll session.

Primary task Performance

Performance on each of the primary tasks (typing and payroll tasks) was divided into three categories: speed, accuracy, and net speed (combining speed and accuracy). There was no significant difference in speed, accuracy, or net speed on the online (baseline) typing test for any of the assigned conditions. Participant's average typing accuracy was 96.8%. Therefore, the correlation between typing speed and net speed was extremely high *(r=. 997, p<.001).* On the payroll task, the complex task, participants were only 64% accurate on average. The correlation between payroll speed and net speed was a great deal lower (r=.785).

Hypothesis 1: Subjects in the no interruption conditions will perform better on the complex task than those in the interruption conditions.

Hypothesis 1 was supported. There was a main effect for interruption on payroll task speed (number of items completed on time sheet), net speed (items correctly completed) and accuracy (items correctly completed divided by items attempted). Individuals completed significantly more items in the no interruption conditions than in the interruption conditions *F (1, 72)=8.426, p<.05.* Individuals correctly completed significantly more items in the no interruption conditions than in the interruption conditions *F (1, 72)=9.753, p<.05.* In addition, individuals were more accurate in no

interruption conditions than in conditions where they were interrupted *F (1,72)=4.316, p<.05 (See Table 1).*

Hypothesis 2: Subjects in the interruption conditions will perform better on the simple task than those in the no interruption conditions.

Hypothesis 2 was not supported. Individuals did not type faster or more accurately in interruption conditions as was hypothesized *(See Table 2).* In fact, the trend was that individuals in no interruption conditions actually typed about 30 words more in non-interruption conditions *F (1,72)=2.711, p>.10*. However, simple task enhancement occurs a great deal less often than complex task impairment (Bond and Titus, 1983).

Hypothesis 3: The "personal visit" interruption will impair complex task performance the most.

Hypothesis 4: The phone interruption will impair complex task performance the least.

Hypothesis 3 and 4 were not supported. There was a significant main effect for condition for number of items correct *F (3,72)=3.639, p<.05* as well as net speed *F (3,72)=4.316, p<.05 (See Table 3)*. Although interrupted individuals were impaired on the payroll task overall, individuals who were interrupted by in-person visitors were not significantly more impaired than non-interruption participants. In fact, post-hoc (Tukey)

tests showed that only participants interrupted by phone performed significantly slower and significantly less accurately than individuals who were not interrupted.

Hypothesis 5: The participants interrupted by a personal visitor will experience the largest enhancement in simple task performance.

Hypothesis 5 was not supported. There was a significant main effect for condition for typing speed $F(3, 72)=2.738, p<.05$ *(See Table 4).* Participants interrupted by the personal visit were the only individuals who scored higher than participants who were not interrupted at all. However, Tukey post-hoc analysis showed that individuals interrupted by the personal visit did not perform significantly better than those not interrupted at all.

Hypothesis 6: The participants interrupted by instant message will experience the smallest enhancement in simple task performance (or even a slight impairment).

Hypothesis 6 was supported. A one-way 4 level ANOVA followed by a post hoc Tukey test demonstrated that the instant message participants' simple task performance was significantly impaired by being interrupted, $F(3,72)=2.738, p<.05$ *(See Table 4).* The participants in other interruption conditions did not type significantly slower/faster than those who were not interrupted.

Anxiety, Annoyance, and Stress

Hypothesis 7: The individuals interrupted by face-to-face visitors will not only suffer from the most impaired complex task performance, but will be also be the most anxious and annoyed after the payroll session.

Hypothesis 7 was not supported. There was no main effect or interaction for interruption and/or medium for typing task annoyance or the typing session stress scales. There also was no main effect or interaction for payroll task annoyance or the payroll session stress scales. Stress scales were created by combining similar dependent variables into the following scales, all with high inter-item reliability: typing test stress scale *(See Appendix 3),* HR inquiry #1 stress scale *(See Appendix 4),* overall typing session stress scale *(See Appendix 5),* payroll task stress scale (See *Appendix 6)*, HR inquiry #2 stress scale (See Appendix 7) and overall payroll session stress scale (*See Appendix 8).* Moreover, there was no main effect for medium or interruption for the overall score for either of the administrations of the State Trait Anxiety Inventory (STAI). However, there were significant correlations between overall state anxiety levels after the payroll session and payroll gross speed *($r=-.25$, $p<.05$)* as well as net speed *($r=-29$, $p<.05$).* Thus, payroll session performance diminished as individual's stress related arousal increased. Significant correlations were not observed between overall state anxiety levels after the typing session and typing gross speed or net speed.

Differences between Typing and Payroll Session:

Individuals' responses differed on affective measures during the typing session (which included the simple task) versus during the payroll session (which included the complex task). Other than the tasks the two sessions consisted of similar HR Inquiries—individuals correctly answered HR inquiry #1 at about the same rate as inquiry #2 (see below). Individuals self-reported the payroll session *(M=3.808)* as significantly more challenging than the typing session (*M=3.255*), *F(1,72)=8.608, p<.05.* Individuals were also more anxious overall (according to the overall score on the STAI) during the payroll session *(M=44.113*) as compared to during the typing session *(M=41.211), F=(1 72)=3.973, p<.05.* Not surprisingly, participants enjoyed the payroll session (M=*4.346*) significantly less than the typing session *(M=3.674), F (1, 72)=11.333, p<.01*. They also felt more overworked *(M=3.172)* during the payroll session versus during the typing session (M=*2.580*) *F (1,72)=8.674, p<.05.*

HR Inquiry Performance

Individuals were contacted in all conditions and given five minutes to answer the following HR inquiries from the fictional Jamie Miller. Individuals correctly answered HR inquiry #1 at about the same rate (20/74=27.0%) as inquiry #2 (21/74=28.4%). There were no main effects for interruption or medium in terms of performance. However, individuals in IM Conditions tended to answer more of the HR inquiries correctly *F (3,72)=2.834* , *05<p<.10*. Individuals contacted by IM answered on average .39 questions out the two HR inquiries they were given. Individuals only answered about .25 when contacted face-to-face, and .18 when contacted via telephone. Interestingly enough there was no main effect for interruption or medium on the time it took to answer

HR inquiry #1. However, there was a significant main effect for medium for the time it took to answer HR inquiry #2. Individuals responding to inquiry #2 in person answered it in the shortest amount of time (*M=108 seconds*), whereas individuals responding by phone answered it an intermediate amount of time (*M=135 seconds*) and individuals responding via computer mediated communication took the longest (*M=170 seconds*), $F(2, 72)=4.044$, $p<.05$. A Tukey post-hoc test determined that the IM interruption took significantly longer than the in person one on HR Inquiry #2. However, no other significant differences were observed.

Discussion

Prior to this study, only a flawed study by, Storch (1992), has examined the effects of social interruptions occurring in different mediums. It is also the only one to compare the effects of interruptions in different mediums on a task more complex than data entry. The current study applies the distraction-conflict theory of social facilitation in a new way--to compare distractions occurring in different communication mediums. Distraction-conflict theory predicts different effects depending on the "salience" of a distraction (e.g. low salience distractions produce simple task enhancement, high salience intensive distractions divert too much attention away from the simple task causing impairment). Interruptions occurring in different communication mediums differ in salience due to the number of cues involved and the distinct characteristics of each medium (Daft et al., 1987; Daft and Lengel, 1986; Daft and Lengel, 1984). Furthermore, this study tests a previously studied, yet often overlooked, effect of presence, the "carryover" effect of task performance occurring after presence has already dissipated (Cantor et al., 1975; Sanders and Baron, 1975).

As was expected based on distraction-conflict theory, performance on a complex task was impaired by interruptions. Surprisingly, the impairment was the most dramatic for participants interrupted by phone. One would expect based on multiple resource theory and related resource interference phenomena that using extra visual resources during a face-to-face or instant message interruption would make it more difficult to resume working on a payroll task, which requires visual neural circuitry (Latorella, 1998). However, unlike many of the experiments where sensory resource competition

conflicts have been theorized to cause performance impairment, this experiment did not involve primary tasks that were memory-intensive.

It was particularly surprising that the phone interruption impaired participants more on the complex task than the face-to-face interruption delivered in a richer medium. One explanation for the strong complex task impairment caused by the phone interruption is that the participants perceived phone communication with a confederate as more urgent and novel than communicating in person. Participants had communicated in person with their supervisors throughout the experiment. Although communication by IM was also more novel than face-to-face communication, IM communication is a much leaner medium than phone communication which is of an intermediate richness. The novelty and urgency of being contacted on the phone must have raised arousal levels higher for the participant than those during the face-to-face interruption even though face-to-face is a richer medium. These arousal levels must have carried over into the last 7 minutes of the complex task. It has been shown in previous studies that the unique position of the phone on the richness continuum, as compared to face-to-face and computer mediated communication, can lead to some more extreme attributes to phone communication (Glushakow and Aiello, 2006; Connell et al., 2001). The effects described here are an example of that phenomenon.

In conflict with what was hypothesized, participants who were interrupted did not perform better overall on the typing task than participants who were not interrupted. Simple task enhancement was only observed for participants interrupted in person and this difference was not statistically significant. More surprisingly, the simple task performance of IM interruption participants was significantly impaired. It was predicted

that face-to-face interruption participants would experience the greatest arousal and therefore the greatest enhancement in simple task performance, since face-to-face was the richest communication medium. It was also predicted that interruptions in the leaner mediums would enhance simple task performance as well.

Although simple task enhancement was expected for interruption participants, the failure to observe this is not all together surprising. As was stated above, complex task impairment is observed a great deal more often in social facilitation studies than simple task enhancement (Bond and Titus, 1983). According to distraction-conflict theory, attentional conflict, resulting from a distraction, increases drive which has the potential to increase simple task performance. However, for simple task enhancement to occur, the increase in performance associated with drive must be strong enough to outweigh the disruptive aspects of diverting attention away from the primary task (Baron, 1986). This apparently was not the case here especially for IM interruption participants.

Studies in the past (e.g., Speier et al., 2003; Burmistrov and Leonova, 2003) have provided conflicting evidence as to whether or not interruptions increase or decrease simple task performance. These studies have differed based on a number of factors (e.g., including temporal urgency, interruption tasks). These factors along with the medium of the interruption tend to contribute to whether or not the participant's arousal reaches a high enough point to produce a task enhancement. The performance of the phone interruption participants was higher than that of participants interrupted by instant message and lower than that those interrupted by a personal visitor. Moreover, the simple task performance of individuals in the phone interruption condition was not significantly different to that of the other participants. More research is needed to

determine which situations, if any, a phone interruption occurring during a simple task might enhance an individual's performance more than a personal visitor due to the special characteristics of the telephone as a communication medium.

Surprisingly there were no differences among conditions for anxiety, annoyance, or stress. The interruption and medium manipulations were both strong enough to elicit effects on performance. However, individuals did not self-report major differences on affective measures. The only major differences on these measures were seen when comparing the typing task to the payroll task, which made them feel more anxious and overworked. The main difference in experience between participants assigned to different conditions was their two experiences with a confederate, which averaged slightly over two minutes (about 127 seconds). Perhaps the experimental manipulation was not a strong enough manipulation to change participant's affective states. It is predicted that significant effects would be seen for affective measures if the interruption manipulations were more salient. It is also predicted that more significant effects would have been observed had the desired sample size of 20 participants per condition been achieved.

In addition to lack of power, there were other limitations to this study. There was no control condition where individuals did not have to deal with HR Inquiries at all. The phone interruption did not occur in the way phone interruptions typically occur in offices. The phone was also not set up in the way most participants were used to using it. The phone did not ring and participants all the sudden were connected via speaker phone with a confederate. The payroll task was reported to be significantly more challenging than the typing task. However, both tasks were perceived as being closer to being tasks of

neutral difficulty. The payroll task could have been a great deal more difficult so it would be perceived as more "complex." The study took place at what was called a "stimulated" office environment. In reality this "stimulated" office environment was made up of a few rooms in an academic building and was not a real workplace. The incentive structure also was very different from one in a regular job setting. Participants were all told that they could be entered in a drawing where they could win prizes if they scored well. Although participants were told they had a shot at scoring an interview at a real company, it is assumed that not all participants had the same interest in securing such an interview to work in an HR department. Furthermore, individuals had absolutely no way to anticipate or control for interruptions (as participants had in Carton and Aiello, in press) which was unrealistic.

In this study, the timing of the interruptions was completely unexpected. Individuals had no control over the interruptions or way to predict them. However, in the workplace, individuals can often control and/or predict interruptions. McFarlane and Latorella (2002) discuss four basic strategies for delivering interruptions to employees: immediate, negotiated, mediated, and scheduled. Interruptions can be delivered to the user immediately, support can be given so an individual could control when they handle the interruption on their own (negotiation), a "broker" can decide when a user should best deal with interruptions (mediated), or all interruptions can be held until a prearranged time (scheduled). Drawing from the four strategies discussed above, corporations, such as Microsoft, are in the beginning stages of developing attention aware systems (also known as attention user systems) to help manage interruptions. The results of this study should be applicable because these systems, designed to manage attentional processes,

are just now being developed. Developers are hopeful that these systems will be able to help combat information overload problems that are common for employees in the present day. Systems currently being developed use mechanisms such as gesture tracking to determine individuals' current state. These systems are also being designed to determine which information to bring to an individual's attention at a given time and which information to hide until a later time (Roda and Thomas, 2006). Perhaps the information gleaned from this study and/or future studies comparing interruption mediums can provide some valuable information for developers of attention aware systems. It could be useful for developers of these systems to be aware of the performance impairment individuals suffer after resuming a complex memory non-intensive task after a phone call interruption, for example. It also could also be useful for developers to be aware of the performance impairment individuals suffer after resuming a simple task such as typing after an IM interruption.

This study is a good starting point for investigating the effects of interruptions of different mediums on simple and complex task performance. However, there are many future directions that would be useful not only for applied purposes, but also to help establish a tighter theoretical link between the theory of social facilitation and the effect of distractions and their saliencies, on performance. For example, it would be useful to run a similar study where participants are given control and able to manage the interruptions (as in Carton and Aiello, in press). It would be very helpful to use physiological instruments to measure arousal in order to find out more at the factors at work here, e.g., how much arousal is too much. It has been argued as a weakness of distraction-conflict theory, that it is impossible to tell whether the theories are incorrect or

whether in each situation there just happened to be too much or too little attentional conflict (Feinberg and Aiello, 2006). Perhaps physiological measurements would shed some light on this.

It would also be useful to learn more definitively about why the phone interruption impaired participants the most on the complex task. This result was unexpected. Perhaps questionnaire items could probe whether or not the phone was seen as more urgent or novel than a face-to-face inquiry. An experiment using more precise timing techniques could measure the resumption lag and determine how long after the interruption the carryover effects of the interruption continue to impair/enhance performance in each medium. In addition, future studies should also investigate if the effects of interruptions in various mediums stay consistent across other contexts, e.g., multitasking situations, different temporal urgencies, situations where there are multiple interruptions during the same primary task. Moreover, different types of primary and interruption tasks should be used in the future such as more memory-intensive tasks, tasks higher in equivocality etc. One day perhaps a more comprehensive framework could be developed to illustrate the affects of distractions of various saliencies effecting employees' performance and emotional well being, working on a variety of tasks in a variety of contexts.

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Footnotes

[1]An analysis of variance comparing conditions 4-6 produced no condition main effects for payroll task gross speed $F\ (1,39)=.309$, $p>.10$, net speed $F\ (1, 39)=.388$, $p>.10$, and accuracy $F\ (1, 39)=1.279$, $p>.10$. One- way ANOVAs comparing performance among participants in the three non-interruption conditions also revealed no effect for typing gross speed $F\ (1,39)=.050$, $p>.10$, net speed $F\ (1,39)=.163$, $p>.10$, and typing accuracy $F\ (1,39)=.076$, $p>.10$.

[2]A 2 X3 ANOVA produced no interactions between communication medium and interruption for typing task gross speed $F\ (2, 72)=1.132$, $p>.10$, net speed $F\ (2,72)=1.043$, $p>.10$, and accuracy $F\ (2, 72)=.274$, $p>.10$.. Moreover, a 2 X 3 analysis of variance revealed no medium by interruption interactions for payroll task gross speed $F\ (2\ 72)=.275$, $p>.10$, net speed $F\ (2, 72)=.265$, $p>.10$, and accuracy $F\ (2, 72)=.301$, $p>.10$.

TABLE 1: Payroll (Complex) Task Performance in Interruption and Non-Interruption Conditions

	Interruption Conditions	No Interruption Conditions
Payroll Task Gross Speed [1]	25.6	33.4
Payroll Task Net Speed [2]	15.2	23.6
Payroll Task Accuracy [3]	59.4%	70.7%

Note. [1] Payroll items completed [2]Payroll items typed correctly [3] Percentage of payroll items completed correctly

TABLE 2: Typing Task (Simple) Performance in Interruption and Non-Interruption Conditions

	Interruption Conditions	No Interruption Conditions
Typing Task Gross Speed[1]	230	264
Typing Task Net Speed[2]	224	256
Typing Task Accuracy[3]	97.4%	97.0%

Note. [1] Words completed [2]Words typed correctly [3] Percentage of words typed correctly

TABLE 3: Payroll (Complex) Task Performance for individuals interrupted in different mediums and individuals in no interruption conditions

	FTF Interruptions	Phone Interruptions	IM Interruptions	No Interruption
Payroll Task Gross Speed[1]	27.6*ab*	22.1*a*	27.1*ab*	33.4*b*
Payroll Task Net Speed[2]	15.9*ab*	11.3*a*	18.4*ab*	23.6*b*
Accuracy[3]	57.6%	51.1%	67.9%	70.7%

Note. Means sharing the same subscript do not differ according to Tukey post-hoc test

[1]Payroll items completed [2]Payroll items completed correctly [3] Percentage of payroll items completed correctly

TABLE 4: Typing (Simple) Task Performance for individuals interrupted in different mediums and individuals in no interruption conditions

	FTF Interruptions	Phone Interruptions	IM Interruptions	No Interruption
Typing Task Gross Speed [1]	273*ab*	233*ab*	194*b*	264*a*
Typing Task Speed[2]	263	227	189	256
Typing Task Accuracy[3]	96.3%	97.4%	97.4%	97.0%

Note. Means sharing the same subscript do not differ according to Tukey post-hoc test

[1]Words completed [2]Words typed correctly [3] Percentage of words typed correctly

Appendix 1:

The following should be answered after the typing session:

Participant Name _____

A number of statements which people have used to describe themselves are given below. Read each statement and then make your selection by circling the appropriate number to indicate how you felt while performing during the typing session (includes typing task and one HR inquiry). There are no right or wrong answers. Do not spend too much time on any one statement but give the answer which seems to describe how you felt while you were performing.

		Not at all	Somewhat	Moderately so	Very much so
1.	**I felt calm**…….	1	2	3	4
2.	**I felt secure**……..	1	2	3	4
3.	**I was tense**……	1	2	3	4
4.	**I felt strained**……	1	2	3	4
5.	**I felt at ease**……..	1	2	3	4
6.	**I felt upset**…….	1	2	3	4
7.	**I was worrying over possible misfortunes**	1	2	3	4
8.	**I felt satisfied**…….	1	2	3	4
9.	**I felt frightened**…….	1	2	3	4
10.	**I felt comfortable**……..	1	2	3	4
11.	**I felt self-confident**……	1	2	3	4
12.	**I felt nervous**…….	1	2	3	4
13.	**I was jittery**……	1	2	3	4
14.	**I felt indecisive**……..	1	2	3	4
15.	**I was relaxed**…….	1	2	3	4
16.	**I felt content**……..	1	2	3	4
17.	**I was worried**…….	1	2	3	4
18.	**I felt confused**…….	1	2	3	4
19.	**I felt steady**…….	1	2	3	4
20.	**I felt pleasant**……..	1	2	3	4

Circle the value which best corresponds to the level of annoyance you experienced during the typing session(1 =not annoying, 7=somewhat annoying, 13=annoying, 19=very annoying)

1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25

For all items below circle the number corresponding to the most appropriate response.

1: I am good at tasks such as the typing task.

1	2	3	4	5	6	7
Strongly disagree			Neutral			Strongly agree

2: How challenging was the typing task?

1	2	3	4	5	6	7
Not challenging			Neutral			Challenging

3: While working on the typing task, I felt

1	2	3	4	5	6	7
Calm			Neutral			Uptight

4: While working on the typing task, I felt

1	2	3	4	5	6	7
Not stressed			Neutral			Stressed

5: What degree of stress did you experience while working on the typing task?

1	2	3	4	5	6	7
No stress			Neutral			Quite a lot of stress

6: How frustrated were you while working on the typing task?

1	2	3	4	5	6	7
Not frustrated			Neutral			Frustrated

7: How overworked did you feel during the session (this includes both the typing and the personnel inquiry)?

1	2	3	4	5	6	7
Not a lot			Neutral			A lot

8: How much stress did you feel as a result of the time constraint throughout this session?

1	2	3	4	5	6	7
No stress			Neutral			Quite a lot

9: The overall environment made me feel

1	2	3	4	5	6	7
Calm			Neutral			Uptight

10: The entire session that I was involved in (including typing task and personnel inquiry) made me feel

1	2	3	4	5	6	7
Not stressed			Neutral			Stressed

11: Overall, the session I was involved in and the environment made me feel

1	2	3	4	5	6	7
Calm			Neutral			Uptight

12: Overall, the session I was involved in and the environment made me feel

1	2	3	4	5	6	7
Not distressed			Neutral			Distressed

13: Overall, this session was

1	2	3	4	5	6	7
Not frustrating			Neutral			Frustrating

14: Overall while working throughout the session on both tasks (typing and personnel inquiry) I felt

1	2	3	4	5	6	7
Calm			Neutral			Uptight

15: Overall what degree of stress did you experience during the session?

1	2	3	4	5	6	7
No stress			Neutral			Quite a lot of stress

16: While responding to the personnel inquiry I felt

1	2	3	4	5	6	7
Calm			Neutral			Uptight

17: While responding to the personnel inquiry I felt

1	2	3	4	5	6	7
Not stressed			Neutral			Stressed

18: How frustrated were you while responding to the personnel inquiry?

1	2	3	4	5	6	7
Not frustrated			Neutral			Frustrated

19: I felt progressively more stressed during this session.

1	2	3	4	5	6	7
Strongly agree			Neutral			Strongly disagree

20. I was overwhelmed by the pressure I felt when responding to the personnel inquiry.

1	2	3	4	5	6	7
Strongly agree			Neutral			Strongly disagree

21: I felt the goal (doing as much as possible) was attainable in the time allotted.

1	2	3	4	5	6	7
Strongly agree			Neutral			Strongly disagree

22: In general, how well do you concentrate?

1	2	3	4	5	6	7
Very well			Neutral			Not well at all

23: I could predict exactly when someone was going to contact me.

1	2	3	4	5	6	7
Strongly agree			Neutral			Strongly disagree

24: If anyone contacted me they made me feel (1=Calm, 7=Uptight, 8=Nobody Contacted Me)

1	2	3	4	5	6	7	or 8
Calm			Neutral			Uptight	Not contacted

25: I feel (1=little stress, 7=quite a lot of stress) when I have to perform a task with a deadline.

1	2	3	4	5	6	7
A little stress			Neutral			Quite a lot of stress

26: If anyone contacted me while I was helping them out I felt (1=annoyed 7=not annoyed, 8=I was not contacted during the employee payroll task)

1	2	3	4	5	6	7	or 8
Annoyed			Neutral			Not Annoyed	Not contacted

27: To what extent did you feel pressure from anyone who contacted you? (1=not a lot 7=quite a lot, 8=I was not contacted)

1	2	3	4	5	6	7	or 8
Neutral			Quite a lot				Not contacted

28: To what degree did the person who contacted you cause you anxiety? (1=very little 7=quite a lot, 8=I was not contacted)

1	2	3	4	5	6	7	or 8
Very little			Neutral			Quite a lot	Not contacted

29: To what degree did anyone who contacted you detract from your ability to perform the typing task to the ability you desired? (1=very little 7=quite a lot, 8=nobody contacted you during the typing task)

1	2	3	4	5	6	7	or 8
Very little			Neutral			Quite a lot	Not contacted

30: The interaction with the individual(s) who contacted me went smoothly. (1=strongly disagree, 7=strongly agree, 8=I was not contacted)

1	2	3	4	5	6	7	or 8
Strongly disagree			Neutral			Strongly agree	Not contacted

31: I felt rushed during the typing session. (1=strongly disagree, 7=strongly agree)

1	2	3	4	5	6	7
Strongly disagree			Neutral			Strongly agree

32: Overall I enjoyed the session.

1	2	3	4	5	6	7
Strongly disagree			Neutral			Strongly agree

Appendix 2:

The following should be answered after the payroll session:

Participant Name _____

A number of statements which people have used to describe themselves are given below. Read each statement and then make your selection by circling the appropriate number to indicate how you felt while performing during the payroll session (includes payroll task and one HR inquiry). There are no right or wrong answers. Do not spend too much time on any one statement but give the answer which seems to describe how you felt while you were performing.

	Not at all	Somewhat	Moderately so	Very much so
1. I felt calm……	1	2	3	4
2. I felt secure……..	1	2	3	4
3. I was tense……	1	2	3	4
4. I felt strained……	1	2	3	4
5. I felt at ease……..	1	2	3	4
6. I felt upset…….	1	2	3	4
7. I was worrying over possible misfortunes	1	2	3	4
8. I felt satisfied…….	1	2	3	4
9. I felt frightened…….	1	2	3	4
10. I felt comfortable……..	1	2	3	4
11. I felt self-confident……	1	2	3	4
12. I felt nervous…….	1	2	3	4
13. I was jittery……	1	2	3	4
14. I felt indecisive……..	1	2	3	4
15. I was relaxed…….	1	2	3	4
16. I felt content……..	1	2	3	4
17. I was worried…….	1	2	3	4
18. I felt confused…….	1	2	3	4
19. I felt steady…….	1	2	3	4
20. I felt pleasant……..	1	2	3	4

Circle the value which best corresponds to the level of annoyance you experienced during the payroll session(1 =not annoying, 7=somewhat annoying, 13=annoying, 19=very annoying)

1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25

For all items below circle the number corresponding to the most appropriate response.

1: I am good at tasks such as the employee payroll task.

1	2	3	4	5	6	7
Strongly disagree			Neutral			Strongly agree

2: How challenging was the payroll task?

1	2	3	4	5	6	7	
Not challenging			Neutral				Challenging

3: While working on the payroll task, I felt

1	2	3	4	5	6	7	
Calm			Neutral				Uptight

4: While working on the payroll task, I felt

1	2	3	4	5	6	7	
Not stressed			Neutral				Stressed

5: What degree of stress did you experience while working on the payroll task?

1	2	3	4	5	6	7	
No stress			Neutral				Quite a lot of stress

6: How frustrated were you while working on the payroll task?

1	2	3	4	5	6	7	
Not frustrated			Neutral				Frustrated

7: How overworked did you feel during the session? (the session includes both the employee payroll task and personnel inquiry)

1	2	3	4	5	6	7	
Not a lot			Neutral				A lot

8: How much stress did you feel as a result of the time constraint throughout this session?

1	2	3	4	5	6	7	
No stress			Neutral				Quite a lot of stress

9: The overall environment made me feel

1	2	3	4	5	6	7	
Calm			Neutral				Uptight

10: The entire session that I was involved in (including payroll task and personnel inquiry) made me feel

1	2	3	4	5	6	7	
Not stressed			Neutral				Stressed

11: Overall, the session I was involved in and the environment made me feel

1	2	3	4	5	6	7	
Calm			Neutral				Uptight

12: Overall, the session I was involved in and the environment made me feel

1	2	3	4	5	6	7	
Not distressed			Neutral				Distressed

13: Overall, this session was

1	2	3	4	5	6	7	
Not frustrating			Neutral				Frustrating

14: How frustrating was it to work on the payroll task?

1	2	3	4	5	6	7	
Not frustrating			Neutral				Frustrating

15: Overall while working throughout the session on both tasks (payroll task and responding to the personnel inquiry) I felt

1	2	3	4	5	6	7
Calm			Neutral			Uptight

16: Overall what degree of stress did you experience during the session?

1	2	3	4	5	6	7
No stress			Neutral			Quite a lot of stress

17: While responding to the personnel inquiries I felt

1	2	3	4	5	6	7
Calm			Neutral			Uptight

18: While responding to the personnel inquiries I felt

1	2	3	4	5	6	7
Not stressed			Neutral			Stressed

19: How frustrated were you while responding to the personnel inquiries?

1	2	3	4	5	6	7
Not frustrated			Neutral			Frustrated

20: I felt progressively more stressed during this session.

1	2	3	4	5	6	7
Strongly agree			Neutral			Strongly disagree

21: I was overwhelmed by the pressure I felt when responding to the personnel inquiries.

1	2	3	4	5	6	7
Strongly agree			Neutral			Strongly disagree

22: I felt the goal (doing as much as possible) was attainable in the time allotted.

1	2	3	4	5	6	7
Strongly agree			Neutral			Strongly disagree

23: In general, how well do you concentrate?

1	2	3	4	5	6	7
Very well			Neutral			Not well at all

24: I could predict exactly when someone was going to contact me.

1	2	3	4	5	6	7
Strongly agree			Neutral			Strongly disagree

25: If anyone contacted me they made me feel

1	2	3	4	5	6	7
Not stressed			Neutral			Stressed

26: I feel (1=little stress, 7=quite a lot of stress) when I have to perform a task with a deadline.

1	2	3	4	5	6	7
Little stress			Neutral			Quite a lot of Stress

27: If anyone contacted me while I was helping them out I felt (1=annoyed 7=not annoyed, 8=I was not contacted during the employee patrol task)

1	2	3	4	5	6	7	or 8
Annoyed			Neutral		Not Annoyed		Not contacted

28: To what extent did you feel pressure from anyone who contacted you?

1	2	3	4	5	6	7
Not a lot			Neutral			Quite a lot

29: To what degree did the person who contacted you cause you anxiety?

1	2	3	4	5	6	7
Very little			Neutral			Quite a lot

30: To what degree did anyone who contacted you detract from your ability to perform the employee payroll task to the ability you desired? (1=very little 7=quite a lot, 8=nobody contacted you during the employee payroll task)

1	2	3	4	5	6	7	or 8
Very little			Neutral			Quite a lot	Not contacted

31: The interaction with the individual(s) who contacted me went smoothly.

1	2	3	4	5	6	7
Strongly disagree			Neutral			Strongly agree

32: I felt rushed during the payroll session.

1	2	3	4	5	6	7
Strongly disagree			Neutral			Strongly agree

33: Overall I enjoyed the session.

1	2	3	4	5	6	7
Strongly disagree			Neutral			Strongly agree

34. The person who contacted you during the main tasks made you feel

1	2	3	4	5	6	7
Not distressed			Neutral			Distressed

35: In what communication medium did an individual(s) with a personnel inquiry contact you?

1= In person 2=By Phone 3=IM

36: Throughout both sessions, the communication conditions helped myself and the individual(s) who contacted me communicate quickly.

1	2	3	4	5	6	7
Strongly disagree			Neutral			Strongly agree

37: What medium would be most disruptive for an individual(s) to contact you about a personnel question ***while*** **working on a task similar to the payroll task?**

1= Face-to-Face communication 2= Communication by phone 3=Communication by IM

38: What medium would be most disruptive for an individual(s) to contact you about a personnel question ***while*** **working on a task similar to the typing task?**

1= Face-to-Face communication 2= Communication by phone 3=Communication by IM

39: What medium would be least disruptive for an individual(s) to contact you about a personnel question ***while*** **working on a task similar to the payroll task?**

1= Face-to-Face communication 2= Communication by phone 3=Communication by IM

40: What medium would be least disruptive for an individual(s) to contact you about a personnel question ***while*** **working on a task similar to the typing task?**

1= Face-to-Face communication 2= Communication by phone 3=Communication by IM

41:I liked the lead experimenter

1	2	3	4	5	6	7
A lot			Neutral			Not at all

42: I liked the individual(s) that contacted me and asked me personnel questions.

1	2	3	4	5	6	7	
A lot			Neutral			Not at all	8=I was not contacted.

43: Overall I procrastinate

1	2	3	4	5	6	7
Very little			Neutral			Quite a lot

44: In general feel I am good at resuming tasks after having switched tasks?

1	2	3	4	5	6	7
Strongly disagree			Neutral			Strongly agree

45: To what degree did anyone contacted you about personnel inquires affect your performance on the primary tasks (e.g., payroll task, typing task)

1	2	3	4	5	6	7
Very little			Neutral			Quite a lot

46: Throughout both sessions, the communication condition that I communicated with the person who contacted me slowed down our communication (i.e., Face-to-Face, phone, or IM)

1	2	3	4	5	6	7
Strongly disagree			Neutral			Strongly agree

47: Were you contacted while typing? 1= Yes 2=No

48: Were you contacted while working on the payroll task? 1=Yes 2=No
f you answered Yes for #**47** and #**48**, answer #**49a-54a**. All others, answer **#49b-52b**.

49a: How disruptive was being contacted with a personnel inquiry *while* you were working on the payroll task (1=not very disruptive, 7=very disruptive)

1	2	3	4	5	6	7
Not very disruptive			Neutral			Very disruptive

50a: How disruptive was being contacted with a personnel inquiry *while* you were working on the typing task (1=not very disruptive, 7=very disruptive)

1	2	3	4	5	6	7
Not very disruptive			Neutral			Very disruptive

51a: How much less frustrating would working on the typing task had been had you been contacted with the personnel inquiry after the task instead of before?

1	2	3	4	5	6	7
A great deal			Neutral			Not much

52a: How frustrating would working on the payroll task have been had you been contacted with the personnel inquiry after the task instead of before?

1	2	3	4	5	6	7
A great deal			Neutral			Not at all

53a: Which of the following describes your ability to switch tasks throughout the two sessions?

1=I was more successful at switching tasks during the session with the typing task
2=I was more successful at switching tasks during the session with the employee payroll task
3=I was equally successful switching tasks during both sessions

54a: Which of the following describes your ability to work on the primary task (e.g., payroll task, typing) in spite of being contacted?

1=I was more successful during the session with the typing task
2=I was more successful during the session with the employee payroll task
3=I was equally successful during both sessions

49b: To what degree do you think someone contacting you with a personnel inquiry while you were working on the payroll task would have been disruptive? (1=not very disruptive, 7=very disruptive)

1	2	3	4	5	6	7
Not very disruptive			Neutral			Very disruptive

50b: To what degree do you think someone contacting you with a personnel inquiry while you were working on the typing task would have been disruptive? (1=not very disruptive, 7=very disruptive)

1	2	3	4	5	6	7
Not very disruptive			Neutral			Very disruptive

51b: How frustrating would working on the typing task have been had you been contacted with the personnel inquiry during the task instead of after?

1	2	3	4	5	6	7
Not at all			Neutral			A great deal

52b: How much more frustrating would working on the payroll task have been had you been contacted with the personnel inquiry during the task instead of after?

1	2	3	4	5	6	7
Not much			Neutral			A great deal

Appendix 3:

Scale -- Stress from typing task

Cronbach's α =.904

Question
While working on the typing task, I felt (1 -- calm; 7 -- uptight)
While working on the typing task, I felt (1 -- not stressed; 7 -- stressed)
What degree of stress did you experience while working on the typing task? (1 – no stress; 7 – quite a lot of stress)
How frustrated were you while working on the typing task? (1 – not frustrated 7 -- frustrated)

Appendix 4:

Scale -- Stress from HR inquiry #1

Cronbach's α =.877

Question
While responding to the personnel inquiry I felt (1 -- calm; 7 -- uptight)
While responding to the personnel inquiry I felt (1 -- not stressed; 7 -- stressed)
How frustrated were you while responding to the personnel inquiry? (1 -- not frustrated; 7 -- frustrated)
(Reversed) I was overwhelmed by the pressure I felt when responding to the personnel inquiry. (1 – strongly agree; 7 –strongly disagree)

Appendix 5:

Scale – Overall stress from typing session

Cronbach's α =.934

Question
How much stress did you feel as a result of the time constraint throughout this session? (1 – no stress; 7 – quite a lot)
How much stress did you feel as a result of the time constraint throughout this session? (1 – calm; 7 – uptight)
The entire session that I was involved in (including typing task and personnel inquiry) made me feel (1 – not stressed; 7 – stressed)
Overall, the session I was involved in and the environment made me feel (1 – calm; 7 – uptight)
Overall, the session I was involved in and the environment made me feel (1 – not distressed; 7 – distressed)
Overall, this session was (1 – not frustrating; 7 – frustrating)
Overall while working throughout the session on both tasks (typing and personnel inquiry) I felt (1 – calm; 7 – uptight)
Overall what degree of stress did you experience during the session? (1 – no stress ; 7 – quite a lot of stress)

Appendix 6:

Scale -- Stress from payroll task

Cronbach's α =.949

Question
While working on the payroll task, I felt (1 -- calm; 7 -- uptight)
While working on the payroll task, I felt (1 -- not stressed; 7 -- stressed)
What degree of stress did you experience while working on the payroll task? (1 – no stress; 7 – quite a lot of stress)
How frustrated were you while working on the payroll task (1 – not frustrated 7 -- frustrated)
How frustrating was it to work on the payroll task (1 – not frustrating 7 -- frustrating)

Appendix 7:

Scale – Stress from HR inquiry #2

Cronbach's α =.888

Question
While responding to the personnel inquiries I felt (1 -- calm; 7 -- uptight)
While responding to the personnel inquiries I felt (1 -- not stressed; 7 -- stressed)
How frustrated were you while responding to the personnel inquiries? (1 – not frustrated 7 -- frustrated)
(Reversed) I was overwhelmed by the pressure I felt when responding to the personnel inquiries. (1 – strongly agree; 7 –strongly disagree)

Appendix 8:

Scale – Overall stress from payroll session

Cronbach's α =.954

Question
How overworked did you feel during the session? (the session includes both the employee payroll task and personnel inquiry) (1 – not a lot; 7 –a lot)
How much stress did you feel as a result of the time constraint throughout this session? (1 – no stress ; 7 – quite a lot)
The overall environment made me feel? (1 – calm ; 7 – uptight)
The entire session that I was involved in (including typing task and personnel inquiry) made me feel (1 – not stressed ; 7 – stressed)
Overall, the session I was involved in and the environment made me feel (1 – calm ; 7 – uptight)
Overall, the session I was involved in and the environment made me feel (1 – not distressed; 7 – distressed)
Overall, this session was (1 – not frustrating; 7 – frustrating)
How frustrating was it to work on the payroll task? (1 – not frustrating; 7 – frustrating
Overall while working throughout the session on both tasks (payroll task and responding to the personnel inquiry) I felt (1 – calm ; 7 – uptight)
Overall what degree of stress did you experience during the session? (1 – no stress ; 7 – quite a lot)