This is to certify that the

dissertation entitled

Individual Differences in Multi-tasking Ability: Exploring a Nomological Network

presented by

Kerry Allison Delbridge

has been accepted towards fulfillment
of the requirements for

PhD degree in Psychology

Major professor

Date 11-15-2000

INDIVIDUAL DIFFERENCES IN MULTI-TASKING ABILITY: EXPLORING A NOMOLOGICAL NETWORK

By

Kerry Allison Delbridge

A Dissertation

Submitted to
Michigan State University
in partial fulfillment of the requirements
for the degree of

DOCTOR OF PHILOSOPHY

Department of Psychology

2000

ABSTRACT

INDIVIDUAL DIFFERENCES IN MULTI-TASKING ABILITY: EXPLORING A NOMOLOGICAL NETWORK

By

Kerry Allison Delbridge

Multi-tasking is a requirement of many, if not most, modern jobs. While both practitioners and researchers have realized the importance of this topic, little attention has been paid to individual differences between people on their ability to engage in this type of activity. While practitioners have assumed that individuals differ in their ability to multi-task, researchers have mostly ignored this view and have focused on similarities across people. Their efforts have mostly been aimed at how multi-tasking is accomplished and the associated process losses. The current study begins to fill this gap by focusing on a deeper understanding of the multi-tasking process and investigating a nomological network around multi-tasking ability. Results support a model of multi-tasking that includes uncertainty, urgency and an increased awareness of task switching and leads to increased stress levels, withdrawal, process losses and lower performance levels. Results do not support any hypothesized individual differences as affecting the overall relationship between multi-tasking and performance.

To Mike - who puts up with insanity, talks librarians into giving out illegal books, and after 13 years, still makes my heart skip a beat.

ACKNOWLEDGEMENTS

I'd like to thank my committee members, Dr. Bruce Burns, Dr. Ann Marie Ryan, and Dr. Neal Schmitt who were supportive and helpful throughout this process. Neal and Ann Marie lent their years of practical wisdom to make sure my research was solid. My conversations with Bruce about interest and puzzles were particularly informative and enjoyable.

I'd like to especially thank my chair, Dr. Steve Kozlowski. It sounds so trite here in these acknowledgements, but I so thoroughly enjoyed having the chance to work with him. I'm very glad he was willing to be talked into leaping into the multi-tasking realm with me. Steve is always good for solid, constructive feedback, and his direct style and commitment to helping me get things done made this process one I can look back on fondly. My only regret is not getting to work with him more.

I could not have pulled off some of the technical aspects of this experiment without the help of Chip Shank, who was willing both to add software to our server, and to help me figure out why it wasn't behaving!

I also owe a great debt to Deidre Wasson, Catherine Clause, and Marisa Chapa. People underestimate the value of a supportive, understanding friend. I only hope I've been half as good to you.

Finally, I'd like to thank Mike Zaldivar – for listening to me fret over the programming, for keeping me motivated, for so many things – I don't think I could have done it without you, but more importantly, I'm so glad I didn't have to try.

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INTRODUCTION

Many occupations require individuals to perform multiple tasks that continually interrupt and preempt each other. In these cases, the employee must accomplish a multitude of tasks throughout the course of a day, and is often required to switch focus between these tasks with little or no notice. In fact, fewer and fewer jobs require the employee to perform just a single task. In this way, multi-tasking is an increasing part of daily job performance.

Multi-tasking, for the purposes of this study, is defined as accomplishing multiple-task goals in the same general time period by engaging in frequent switches between individual tasks. The individual may, at any given point in time, only be making progress towards meeting one of these goals (i.e. performing one task) but over the longer time period, makes progress towards all goals.

In this type of situation, the individual frequently switches from task to task as a combined result of high work load and interruptions. Each interruption temporarily re-prioritizes the current set of tasks. Interruptions are unpredictable and at least moderately frequent such that the individual is in a perpetual state of uncertainty and is generally unable to complete large portions of any particular task in a single uninterrupted attempt.

Using this definition, many jobs require multi-tasking. For example, a receptionist must handle multiple, simultaneous responsibilities: monitoring and assisting visitors as they come to the office, answering and routing phone calls, recording messages for employees, etc. While the receptionist is answering a visitor's question concerning the location of a particular office, the phone may ring, requiring her to re-

prioritize and switch focus from the visitor to the phone call. In a global sense, many tasks are ongoing, but the receptionist must switch her focus between them in order to accomplish them all.

Multi-tasking is particularly relevant for managers. Mintzberg (1973) performed a detailed investigation and analysis of managerial performance in order to determine the precise nature of the work performed. His data and observations lead to a view of managerial work characterized by time pressure and discontinuity. The manager balances a heavy workload consisting of many different tasks and is prone to many interruptions such as phone calls, questions from subordinates, and new requests from higher level managers. Mintzberg emphasizes that managerial work is characterized by "brevity, variety, and fragmentation" (p. 31). Most activities last only minutes or even seconds at any one time. The only activities lasting longer than an hour were scheduled meetings.

Managers engage in a great deal of multi-tasking. While working at their desks, they may at any moment be interrupted by a phone call, a knock at the door, or an urgent email redirecting their attentional focus in a different direction. Ideally, managers would perform all of these tasks simultaneously, but often this is not possible. A manager cannot simultaneously carry on a phone conversation and talk to a subordinate who has stopped by his office. Even in cases where performance of the different tasks do not require the same physical action (e.g. talking), the manager will often switch between them in order to conserve cognitive resources. It is thus not surprising that the ability to adapt to changing situations has been linked to managerial performance (Lassk, Kennedy, Powell, & Lagace, 1992).

The following study will define and investigate a gap in multi-tasking research, specifically the lack of information on the individual differences that distinguish good multi-taskers from poor multi-taskers. In this effort, the current research on multi-tasking will be examined and the gap will be discussed. Next, it is noted that despite the fact that multi-tasking is theorized to be different from task performance, researchers have not yet developed a model to of how the two differ. To address this, the current research on multi-tasking will be used to build a model of multi-tasking performance as it differs from task performance. The basic characteristics and outcomes of multi-tasking will then be used to generate a model targeting the individual differences associated with good multi-tasking performance.

In accordance with this, the focus of this study will be two fold. First, the paper will focus on distinguishing multi-tasking from single task performance. Second, the resulting goal of this study will be to determine the individual differences that specifically cause people to be good or bad multi-taskers by exploring the nomological network.

Application

Since multi-tasking is a common activity in many workplaces, it has not been completely ignored by researchers and practitioners. Both realms have realized the importance of the topic, although they have emphasized different aspects of it.

In line with the above discussion, practitioners have recognized multi-tasking as an integral part of job performance for many jobs. Because of this, multi-tasking

simulations have been used as a selection and promotion tool (Flin, Slaven & Stewart, 1996; Schmitt, DeShon, Clause, Chan & Delbridge,1996; Sacco, Delbridge, Scheu, Ellis, & Ryan, 2000). These selection tests are designed so the applicant performs several tasks and must switch between them, usually prompted by some cue. Performance on the test is defined by performance on each of the subtasks, but in order to perform well on these, the applicant must also switch effectively between tasks.

For example, one such test requires trainees to handle two tasks: an in-basket task and intermittent simulated telephone calls. The trainee works on the in-basket task by reading, researching and answering items until an auditory cue signals the beginning of a phone call. The trainee must switch to the call task immediately as the auditory information is only presented once. When the task associated with the call is completed, the trainee switches back to the in-basket task. The test is then used as part of a determination to allow promotion of the trainee, along with other information such as a knowledge test.

The use of multi-tasking as a selection and promotion tool is based on the fact that practitioners believe there are individual differences in the ability to perform under these conditions. That is, that there are stable characteristics which allow some people to multi-task better than others, and these tests are designed to measure these differences in order to select employees best able to multi-task.

Multi-tasking Research

While practitioners have used multi-tasking to tap *differences* between people, most researchers have focused on *similarities* across people in the multi-tasking process. These studies have focused on the characteristics of the multiple-task scenario and how people are affected by and handle these characteristics. Research in this area has come from several different vantage points, including dual-task performance, task switching, and applied research in settings with multiple task demands. Each of these bodies of literature will be discussed briefly as an introduction to the concerns of the current study.

Dual-task performance

Using a dual-task methodology is a popular way to assess the utilization and distribution of attentional resources (DeShon, Brown, & Greenis, 1995; Meyer & Kieras, 1997) Generally, subjects are asked to focus principally on one task (primary task) while attempting to maintain performance on a second. Thus, in cases where the subject's attentional resources are not large enough to perform both tasks, a deficit should appear in the secondary task. This paradigm is based on the belief that attention has some finite quality to it: that a person cannot attend to unlimited stimuli.

Some research in this field is similar to the multi-tasking scenario described above. Subjects are, after all, trying to accomplish more than one goal at a time. The difference is that instead of switching between the individual tasks as in multi-tasking, the dual-task performer is asked to execute them simultaneously. In the multi-tasking

situation, tasks also interfere with each other; however, instead of sharing attentional resources at one point in time, tasks receive these resources in turn.

The focus of dual-task research has been on processes that are the same across people. For example, a primary conclusion of dual task research is that performance on one task is generally detrimental to performance on a second, simultaneous task. Some research, though, has investigated individual differences such as strategies (e.g. Damos & Smist, 1982). This is similar to the current aim: to understand individual differences in multi-tasking performance.

Task switching

Asking individuals to switch between tasks represents a situation that is potentially very different from one in which tasks are performed simultaneously. Most task switching literature consists of a well-defined research paradigm: Individuals are asked to perform one simple task and are periodically cued to switch to another simple task.

Many researchers have built upon a task designed by Gopher and Kahneman (1971). These researchers created a dichotic listening task. In this task, individuals are presented with different auditory information in each ear, such as digits. They are asked to monitor one ear and recite the presented digits while ignoring the information presented to the other ear. Periodically, they are given a cue in the 'monitored' ear to switch ears and begin reciting the digits presented to the other ear.

While some experiments have varied this procedure to include different tasks or modalities, the tasks are almost always very simple, placing the research emphasis on the switch between them rather than on the tasks themselves. This literature has repeatedly demonstrated that there are process losses associated with switching between tasks (e.g. Baddeley, 1996; Guzy & Axelrod, 1972; Laabs & Stager, 1976; Rogers & Monsell, 1995; Weber, Blagowsky, & Mankin, 1982; Weber, Burt, & Noll, 1986). That is, performance in cases where individuals switch between tasks is worse than when they perform the same tasks individually.

Many studies have used reaction time in order to measure these process losses (e.g. Baddeley, 1996; Garcia-Ogueta, 1993; Weber, Burt & Noll, 1986). Others have used error rates for these simple tasks (e.g. Gopher, 1982; Gopher & Kahneman, 1971; Guzy & Axelrod, 1972; Weber, Burt & Noll, 1986). In either case, the premise is that the switch is associated with a cost, either in terms of the amount of time necessary to complete the task or in terms of the errors made during completion, or both. These basic studies do not postulate a defined mechanism for the loss, but have well documented the existence of it.

Task switching of this type may be fundamentally viewed as a type of attention switching. The individual focuses their attention on one task until requested to switch focus to another. Some researchers have examined attention switching using different paradigms. For example, Garavan (1998) investigated an experimental situation in which individuals had to switch their attention between two counting tasks. Subjects counted two different types of objects, presented one object at a time by keeping two distinct counts. Garavan used reaction time to verify the expected process losses.

Some manipulations have allowed a deeper understanding of the process losses associated with switching. For example, Garavan (1998) investigated the effects of practice. He found that through extensive practice, individuals were able to reduce the cost of switching, although they were unable to eliminate it.

Other researchers have focused on the unpredictability of switches as a potential source of the process loss. However, some decrement in performance exists, even when the switches are made completely predictable (Rogers & Monsell, 1995; Guzy & Axelrod, 1972). This type of unpredictability will be discussed further.

While most literature on multi-tasking has focused on similarities, there have been a few studies that have examined differences. For example, Hiscock and Kinsbourne (1980) investigated the ability of subjects to switch their attention between two auditory messages. They found that subjects were better able to perform this task as they matured. Pearson and Lane (1991) ran a similar study and made the additional note that while age was related to ability, there was a large degree of within age variance, suggesting that other factors distinguished people on this task.

Multi-tasking as an Individual Difference

As discussed above, success in real multi-tasking environments has been treated as a difference across individuals. Practitioners have used multi-tasking as a selection tool, and researchers have investigated it, but have concentrated on similarities in functioning rather than differences.

Despite this research emphasis, it is clear from some research that individual differences in attentional abilities play a role in performance. We therefore have an implied individual difference without a real understanding of the underlying mechanisms or related constructs. One exception to this is that some more complex research has taken place in applied settings, where multi-tasking takes on practical importance.

Applied Research

Applied research involving multi-tasking has generally focused on particular occupations involving multiple task demands. For example, researchers have been particularly interested in pilot performance. Pilots have an immense cognitive load placed on them while flying, and often perform under multi-tasking conditions requiring them to shift their attention frequently.

One example of this type of research was conducted by Gopher and Kahneman (1971). They used a selective listening task to predict flight training success. Cadets were presented with different strings of words and digit names in each ear. They were asked to switch focus between ears and to detect digit names in the ear they were focusing on. Errors on the task were found to be related to flight proficiency criteria. Gopher (1982) conducted a similar experiment using the dichotic listening task. The subjects' performance on this task was significantly related to success in flight training, reinforcing the idea that the multi-tasking environment allows the exhibition of individual differences in performance.

O'Hare (1997) also investigated pilot performance. Individuals performed a complex situational awareness and stress tolerance test which included an opportunity to switch between the main task and bonus tasks when time permitted. Performance on the test was again correlated with pilot performance. One weakness in this study, though, is that it is not clear which component of the task set was related to performance. It thus does not conclusively isolate task switching.

Another focus of applied research in this area has been on automobile accidents (e.g. Kahneman, Ben-Ishai, & Lotan, 1973; Mihal & Barrett, 1976). Driving is another activity which requires an individual to frequently switch tasks and attentional focus. For example, a driver shifts his attention from the road to the speedometer and back to the road. When making a lane change, she must shift attention from the road in front of her to checking her blind spot and back towards the front to change lanes.

In this situation, process losses and errors can cause accidents. An individual who takes too much time to refocus on the road after checking his speed may do so too late to avoid rear-ending a suddenly stopping car in front of him. In line with this reasoning, selective attention has been negatively related to real accident rates (Mihal and Barrett, 1976). Kahneman et al. (1973) investigated bus drivers' ability to perform Gopher and Kahneman's (1971) switching task. Rates of both omission errors and intrusion errors in the experiment were related to real accident rates, suggesting that differences in this ability are lasting and consistent over time.

Police dispatchers also face constant naturally occurring interruptions that force them to switch tasks. To investigate this, Kirmeyer (1988) examined the on the job behavior of police radio dispatchers. Observers recorded whether each task performed by

the dispatcher was completed before the next activity was begun, whether it was preempted by another activity, or whether the dispatcher attempted to perform it simultaneously with another task. Again, individual differences in performance were found.

These applied studies provide a link between switching (e.g. on the Gopher and Kahneman task) and real job performance on jobs that have a component of multi-tasking. They suggest that there are real differences between people in multi-tasking performance: That some people are less susceptible to the process losses or have an increased ability to handle them. What is missing from these studies is an explanation of why these differences exist or what characteristics these people possess that enable them to perform better.

Expanding the Current View of Multi-tasking

In order to understand individual differences in multi-tasking ability, it is necessary to get a better understanding of the multi-tasking process itself. What are the characteristics of the multi-tasking situation? What effects do these characteristics have on performance?

Because no comprehensive model of multi-tasking exists, the literature in the area will be used to build a conceptual model of the multi-tasking process as it differs from 'normal' task performance. The literature in this area points to three characteristics that separate multi-tasking from task performance: interruption or switch, time pressure, and

uncertainty. These characteristics have outcomes which are also different from task performance, including increased stress levels and process losses.

Existing literature on stress and two types of process losses will be used to elaborate the effect that multi-tasking has on task performance. A conceptual model (Figure 1) will then be proposed and will be used to hypothesize individual differences that will distinguish good multi-taskers from poor multi-taskers.

Characteristics of Multi-tasking

It is important at this point to clearly distinguish multi-tasking from task performance. By its nature, multi-tasking must be composed of individual tasks, and these tasks could be anything. They could thus require any existing skill or ability of an individual; however individual task performance is irrelevant to this discussion of multi-tasking. The current interest is in differences in the act of multi-tasking itself, not differences in people's performance of tasks. For example, one could create a multi-tasking situation in which a person is required to switch between playing the piano and playing the guitar. The current study, though, has no interest in whether musical ability plays a role in being able to perform this particular multi-tasking set but only in the effects of switching as they generalize across different tasks.

The individual who is multi-tasking is operating under different conditions than the person who is performing a single task. In this situation, there is a limit to the attentional resources an individual has, causing him to frequently need to switch attentional focus. The continuous switching between tasks is necessitated by the need to

meet many simultaneous goals, causing the individual to be pressed for time in completing them. The individual in a multi-tasking situation also does not generally know when they will be required to switch to a different task, creating uncertainty in any particular moment of performance. In support of this, Flavin et al. (1996) investigated the jobs of offshore installation managers, which require much multi-tasking and discussed the inherent time pressure and uncertainty associated with these types of activities. By its nature, multi-tasking in real situations is characterized by switch, time pressure and uncertainty. Each of these characteristics will be discussed individually below. They will then be used as the basis for a conceptual model distinguishing multi-tasking performance from simple task performance.

Interruption and Switch

One of the more obvious characteristics of multi-tasking is that there is a switch from one task to another. The individual must react to some cue in the environment which interrupts whatever task the individual is currently performing and directs him to switch from that task to another.

Morris and Perez (1972) define interruption as "temporarily blocking execution of [a] response sequence" (p 559). This is precisely what occurs during multi-tasking. Execution of the first task is blocked by a need to change focus to a second task.

The act of interrupting the original task includes an element of distraction. That is, the cue (and switch) distracts the individual's performance on the current task. Even if the individual were free to continue to pursue the original task rather than switching to

the second, the distraction alone would be important to the multi-tasking process as distraction has previously been found to affect performance (Wright, 1974).

Along with this interruption is the actual switch between tasks. In order to switch tasks the individual must a) register the cue directing him to switch, b) cease performance of the current task, and c) commence performance of the new task. These components mean that switching between the tasks should require more resources than the sum of those required by each task separately, as supported by the previously discussed research.

As the research based on the Gopher and Kahneman (1971) task illustrates, switching between tasks is costly, even when the two tasks are very similar and are both very simple. In contrast, on the job, multi-tasking involves tasks that are more complex than reciting digits, and the costs associated with switching may be greater as well.

Examining the three steps listed above reveals several mechanisms through which this may take place. If the original task is cognitively engaging, it may take longer for the individual to register the cue to switch. It may also take longer to cease performance of the first task. If the individual is thinking about a complex task when asked to switch, it makes sense that she may not be able to abruptly stop thinking about that task, and that these thoughts may persist to some degree even when the individual has begun determining the appropriate steps for the second task or has even begun performance of that task.

It is also possible that some individuals spend time ruminating and engaging in other cognitive behavior not related to the individual task they are performing (but perhaps related to multi-tasking). This may be a source of some loss in multi-tasking

performance. They may spend resources trying to predict the next switch or contemplating tasks they are not currently performing.

Thus, interruption and switching play crucial roles in multi-tasking and will help point towards important related constructs, as will be discussed further. In addition, interruptions cause the performance environment to be less controllable and predictable (Kirmeyer, 1988). This uncertainty comprises another key component of the multi-tasking situation.

Uncertainty

The multi-tasking situation includes a degree of uncertainty and unpredictability. For example, the individual does not know when switches will occur, and often does not know the task to which they will be required to switch. Similarly, most multi-tasking tests mimic this uncertainty by giving applicants no information about when switches will occur.

Salthouse, Fristoe, McGuthry, and Hambrick (1998) researched multi-tasking at a minute level. By using a simple, repetitive task, they were able to not only reinforce the fact that there were process losses, but were also able to attribute these losses to particular sub-components of multi-tasking. Their basic experiment required subjects to repeatedly perform simple operations on presented digits such as addition and subtraction. Subjects would perform the same operation for a few trials and then be asked to switch to a different operation. The researchers measured the reaction time for each trial and whether or not an error was made on that trial.

In order to compute the precise amount of process loss in each switch, the researchers computed a baseline reaction time and error rate for each task by tracking the average of each on several trials before each task-switch. They tracked these same measures on each trial after each switch to see how large the increase in reaction time and error rate were.

For example, in some cases, the subjects were adding the two presented digits and switched to subtracting them. The researchers noted the average reaction time and error rate for the third trial prior to the switch, the second trial prior to the switch, the trial just prior to the switch, the trial on which the switch took place, and then each of the three trials afterwards. The researchers noted the expected result that subjects made more errors and had a larger reaction time on the switch trial. That is, the subjects took longer and make more mistakes on the first trial of the new task.

More interestingly, the researchers noted that it took several trials for the subjects to return to baseline (pre-switch) levels. In other words, there continued to be process losses even after the subjects had successfully made the switch. Obviously, on these trials, the subjects were no longer switching, but they appeared to still be adversely affected by the switch they had already made. The researchers attributed this continuing cost to uncertainty, but did not perform further investigation of this uncertainty.

Lipshitz and Strauss (1997) differentiate between several different types of uncertainty, including inadequate understanding, undifferentiated alternatives, and incomplete information. According to this categorization, the unpredictable switch associated with multi-tasking would be classified as incomplete information. The participant has incomplete information concerning when switches will be made. At any

given moment, they may be asked to switch to a different task, and each switch serves to underscore this fact in the mind of the participant. They know at any moment that they may need to stop the current task to make a switch. This may be unnerving to the individual, and may also explain the uncertainty effect found by Salthouse et al. (1998).

Uncertainty is a potentially important factor in performance and decision making (Johnson, 1988). Uncertainty in task performance changes the nature of performance and affects how task performance can be predicted. Research has found that perceived uncertainty not only reduces performance levels, but also reduces the ability of otherwise good predictors to account for performance (Anderson & Kida, 1985). In other words, uncertainty changes the characteristics that make a person able to perform well, a key idea to keep in mind when investigating predictors of multi-tasking performance.

Time Pressure and Urgency

Another set of characteristics of the multi-tasking situation are time pressure and urgency. In part, time pressure is a necessary condition for multi-tasking. Under conditions where there is no time pressure of any sort, the individual may complete tasks one at a time, giving complete attention to the first task before moving to the second. It is only under conditions where the second task (at least) has some time pressure associated with it that the individual must switch. Therefore, without time pressure, it is unnecessary for the individual to reprioritize and switch tasks.

In addition multi-tasking tends to develop naturally in situations where there is a high workload. Managers, receptionists, telephone support personnel and other such

occupations all engage in multi-tasking in part because there are periods of time in which they experience a high workload. They must learn to prioritize individual tasks based on some criteria which enable them to adjust to changing environmental conditions (e.g. giving highest priority to working on a budget until the phone rings, then re-prioritizing).

There is also an additional aspect of urgency that may be *caused* by the multi-tasking rather than leading to it. Individuals may experience a sense of urgency created by being unable to complete any one task. That is, the interruptions may cause the individual to become increasingly aware of the high workload and time constraints. The implication is that the individual might perceive a higher stress level. This possibility will be discussed further, below.

Time pressure has important effects on task performance. It changes manner in which people perform tasks and make decisions (Ben Zur & Breznitz, 1981; Wright, P. 1974). For example, time pressure increases the amount of attention people pay to negative information (Ben Zur & Breznitz, 1981). Thus, time pressure is an important component of multi-tasking and may play a role in identifying individual differences in multi-tasking performance.

These characteristics, interruption and switch, uncertainty, and time pressure and urgency are a part of the multi-tasking process itself, and are independent of the specific individual tasks. Regardless of whether the tasks are writing reports or taking tests or performing physical activities, these characteristics are present and make the multi-tasking situation fundamentally different from one in which one task is being performed. Further, it is postulated that as these components of multi-tasking are independent of the tasks, a person's level of ability on the individual task plays no role in their ability to

handle the switch, uncertainty and time pressure inherent in multi-tasking. That is, assuming that individuals are at least somewhat capable to perform the tasks, as is true in both the existing task-switching literature and in the work settings to which this literature is to be generalized, they will be detrimentally affected by being asked to multi-task. It is this detriment that the current study hopes to explore and further explain.

Outcomes

These characteristics of multi-tasking situations and related experiments drive several outcomes. These outcomes must be understood in order to theorize the individual differences related to multi-tasking performance . The following section will define and explore these outcomes and investigate the ways in which they relate to performance levels. A conceptual model of multi-tasking performance will be postulated to incorporate the literature on reaction process losses, uncertainty process losses, and the consequences of urgency. Finally, the literature in these areas will be used to determine the important individual differences.

Reaction process losses

From the literature, the most clear outcome of multi-tasking is that there are process losses. The most apparent of these is the process loss associated with making the actual switch between tasks. Inspection time and reaction time are thus likely key sources of variability in multi-tasking performance.

Inspection time is the time it takes a person to register a stimulus. An understanding of this construct is perhaps best gained through a description of an inspection time experiment. Deary and Stough (1996) describe the typical inspection time experiment. It is conducted by presenting subjects very briefly with simple visual stimuli and then asking them questions about those stimuli. The questions are easy enough so that every person would answer them correctly if the stimuli were present for a longer period of time. For example, the experimenters might present two lines of obviously different length and then ask the subject which line was longer. If the subject was able to register the visual stimulus, he would answer correctly. In this way, inspection time can be determined for different people by repeatedly presenting the stimuli for different brief amounts of time and determining the shortest amount of time each individual must be presented with the stimulus in order to reliably answer the question correctly.

Switches in multi-tasking take place because the individual registers some cue which signals the timing of the switch, and which task to switch to. Individuals who register these cues more quickly would be at an advantage in terms of making the switch.

Along the same lines, another important factor to consider is reaction time. Since task-switching requires the individual to react to incoming signals to switch tasks, reaction time should be a key factor in successful task switching. Individuals who are able to react faster should also be able to switch between tasks more quickly. Salthouse et al. (1998) investigated reaction time as part of their task switching investigation. They found significant positive correlations between measures of reaction time and switching costs.

Thus inspection time and reaction time comprise a key component of multi-tasking performance. Individual differences in these abilities will determine performance levels, as will be discussed.

Uncertainty process losses

The task-switching literature also dictates process losses associated with uncertainty. In support of this, there is evidence that switching between tasks is facilitated by the predictability of the switches (De Jong, 1995). Individuals tend to take less time to make the switch and to make fewer errors when they know when the switch will take place.

In other words, removing this aspect of uncertainty improves performance. This reinforces the idea that unpredictability is the cause of at least some of the process losses, although as previously discussed, eliminating this type of uncertainty does not eliminate all of the loss.

A comparable effect could be achieved if individuals were less susceptible to uncertainty. In other words, while removing this aspect of uncertainty improves average performance levels, some individuals may operate at this level naturally by their very nature. These individuals would perform better in the multi-tasking situation. Thus, individuals who have smaller process losses associated with uncertainty will perform better in the multi-tasking situation. These individual differences will also be explored below.

Stress, Coping and Withdrawal

As discussed, time pressure and urgency are an integral part of multi-tasking. These characteristics are postulated to lead to increased stress levels in multi-tasking situations. An individual with many tasks to complete who is continually interrupted and asked to switch between them is likely to experience more stress than an individual allowed to complete one task at a time. Stress is a highly probable outcome in a task situation with high workload and interruptions, and time pressure has previously been cited as a significant source of stress (e.g. Mann, 1992).

In addition, the individual may find stressful the continued disruption and failure to complete individual tasks before being forced to switch to another. He is continually presented with a reminder that he is not completing tasks.

Stress is important to multi-tasking because it has an impact on the way the individual performs tasks. It qualitatively changes the way decisions are made (Nygren, 1997). In accordance with this, it is important to determine whether there are particular individuals who might react differently to the urgency of multi-tasking. Specifically, there may be individuals predisposed to viewing this environment as more stressful.

Successful performance in the multi-tasking situation also depends greatly on how the individual handles the stress she perceives. For example, individuals who spend too much time thinking about how frustrated they are or trying to find ways to escape from the situation will not be high performers.

Stress has a wide base of research associated with it that indicates how it affects performance and the mechanisms through which this effect takes place. For example,

research has extensively explored coping mechanisms as one factor that differentiates between individuals dealing with and performing under stress (Carver, Scheier & Weintraub, 1989; Latack & Havlovic, 1992). While there have been many definitions of coping, coping for the purposes of this study is defined as "efforts, both cognitive and behavioral, to manage environmental and internal demands and conflicts affecting an individual that tax or exceed a person's resources" (Coyne, Aldwin & Lazarus, 1981).

There is some literature that links multi-tasking, as a stressful situation, with coping behavior. For example, interruptions and task switching have been linked to general increases in coping behavior (Kirmeyer, 1988). Other insights can be gained by taking the components of multi-tasking into account.

Lipshitz and Strauss (1997) discuss several types of mechanisms that individuals use in order to cope with uncertainty, including reducing uncertainty, assumption based reasoning, weighing pros and cons, suppressing uncertainty, and forestalling. Using this framework, only some of these coping mechanisms best apply to the multi-tasking scenario. There is no way for the participant to reduce the inherent uncertainty in the situation. There are no pros or cons to be weighed. The individual is also unable to truly forestall or eliminate the uncertainty.

It is possible, perhaps even likely that the individual might try to use assumption based reasoning. That is, he might try to guess when switches will take place, despite the fact that such switches are unpredictable. In fact, the researchers found that under conditions where uncertainty was operationalized as a lack of information, this was the most common tactic used of those examined. The individual may also try to suppress the uncertainty by ignoring or denying it. Avoidance of this type will be addressed further.

A predominant distinction made in coping literature is that between problem-focused coping and coping mechanisms that focus on something external to the problem, such as emotions, or avoidance (Blanchard-Fields & Irion, 1988; Carver, Scheier, & Weintraub, 1989; Latack & Havlovic, 1992; Muris, Merckelbach, & Bogels, 1995).

Coping literature generally dictates that problem-focused coping is the most effective type of coping mechanism in task performance; however, most researchers note the importance of taking the particular situation into account (O'Brien & DeLongis, 1996). That is, particular coping strategies may be more or less effective depending upon the context in which they are employed.

What actions should help a person perform well in the multi-tasking situation? One important factor is whether the individual reacts to this stressful situation with continued effort, or whether he withdraws at least part of his effort in frustration. Persistence should thus play a key role in multi-tasking performance. Under the taxing conditions imposed by multi-tasking, the difference between good performance and poor performance may largely be found in determining who is willing to stick with the overarching goal rather than giving up, or withdrawing from the task. By the nature of the multi-tasking situation, the individual must continually renew their efforts at each switch. Thus, it is important to distinguish between individuals who cope effectively and those who do so ineffectively or not at all.

While it is true that there may be coping mechanisms that promote effective performance of particular sub tasks, this is not the current focus, as discussed. The focus remains on coping with the additional demands created by multi-tasking. Thus, coping

strategies that facilitate persistence and prevent the individual from withdrawing are particularly important.

Of the types of coping mechanisms, the one most clearly linked to withdrawal or a lack of persistence is avoidance. Avoidant coping includes aspects such as avoiding stressful situations, separating oneself from the cause of the perceived stress, and exhibiting learned helplessness attitudes such as accepting the situation as something that cannot be changed (Havlovic & Keenan, 1991). Some researchers have included avoidant coping as one type of emotional coping, but this component has particular relevance to the current discussion.

While being asked to multi-task, a person who is attempting to avoid the stress (i.e. engaging in avoidant coping strategies such as denial) will be more likely to engage in behavior that indicates withdrawal. This would include taking breaks, daydreaming, or otherwise withdrawing effort.

Problem focused coping also has implications for withdrawal. Problem focused coping is aimed at problem solving or altering the source of the stress (Carver et al., 1989). A person engaging in problem focused coping is likely to cope in more active and planful activities (Carver et al., 1989).

By focusing their energy on the activity itself, people engaging in problem focused coping are unlikely to behaviorally withdraw. Thus, avoidant coping should be positively related to behavioral withdrawal while problem focused coping should be negatively related to it.

Thus, the literature on stress indicates that coping mechanisms play a large role in the way in which stress impacts performance. Two commonly discussed coping

strategies: problem focused coping and avoidant coping may have an effect on multi-tasking performance through their association with withdrawal.

Conceptual Model

Multi-tasking research has yet to adopt any coherent theoretical perspective; however, the research does provide support for some underlying mechanisms. According to this research, the characteristics of multi-tasking drive several factors which are important to successful performance. Based on the above discussion, a conceptual model of multi-tasking performance is presented in Figure 1.

According to this model, the multi-tasking situation includes three inherent characteristics: switch, urgency and uncertainty, and these characteristics lead to process losses (stemming both from the switch itself and the associated uncertainty) as well as to increased stress levels. Stress then leads to some degree of withdrawal, and the extent of this withdrawal depends in part upon whether the individual utilizes coping mechanisms and the effectiveness of these coping mechanisms. Both the process losses and withdrawal then account for variance in task performance.

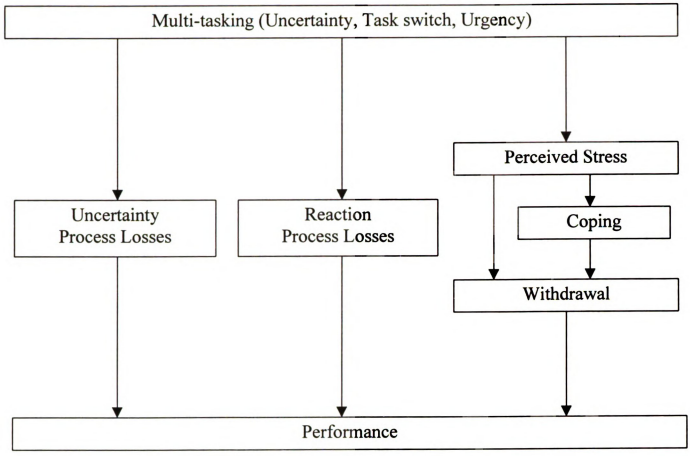

Figure 1
Conceptual Model

Some effort has been made to begin investigating the components of multi-tasking and to investigate differences between people. For example, Salthouse et al. (1998) postulate a task switching ability construct. However, they do not theorize all the other variables that ability might be related to. The current study will begin to fill this gap.

The primary aim of the current study is to further understanding of multi-tasking by building a nomological network around multi-tasking performance: to determine the individual differences between people that allow for good or poor performance under multi-tasking conditions. To this aim, the characteristics of the multi-tasking situation will next be used to specifically target the relevant individual differences.

Individual Differences

There are several places in the conceptual model that allow for differences in performance. First, individual differences that will minimize the process losses associated with uncertainty will increase performance. If the individual is less disrupted or distracted by the lack of certainty surrounding switches, his performance will be closer to that he would have exhibited by performing the tasks serially (i.e. without any uncertainty).

Second, performance will be affected by individual differences that minimize the time lost due to perception and reaction times. Individuals who take less time to perceive the cue to change tasks or who are able to make the switch more quickly will exhibit

fewer of the process losses associated with multi-tasking and will therefore perform better.

Finally, individual differences that affect the way a person perceives or handles stress will affect their performance. Particular attention will be paid to individual differences determining the likelihood of withdrawing effort.

By examining the current literature on reaction, uncertainty, and stress, we can identify potential individual differences related to multi-tasking performance.

Differences in Reaction Process Losses

As discussed above, individuals who minimize the process losses associated with inspection and reaction times will perform better in the multi-tasking situation. The literature on these concepts points most clearly to one important individual difference: intelligence.

Reaction time and inspection time have been investigated by many researchers as aspects of a larger intelligence construct. A generalized theory of intelligence standpoint dictates that these are not distinct constructs, but rather different ways of measuring the same larger construct encompassing many specific abilities. In support of this, correlations between these measures and other measures of intelligence tend to be very high (Deary and Stough, 1996; Nettelbeck & Lally, 1976; Salthouse et al., 1998. Nettelbeck (1987) examined the research in this area and concluded that the correlation between traditional measures of intelligence and inspection time in the general population

is -.5. Salthouse et al. (1998) found uncorrected correlations between reaction time and intelligence tests that also averaged to -.5.

Thus, intelligence presents a potential source of variability in multi-tasking performance because reaction process losses may be minimized. Further investigation into intelligence research confirms the likelihood of this relationship.

For example, the relationship between intelligence and multi-tasking is supported by research related to performance. First, intelligence is related to increased performance on a wide variety of tasks. Those with higher intelligence levels tend to perform better on tasks, especially complex tasks (Hunter, 1986; Ree & Earles, 1992). In addition, the multi-tasking situation has characteristics make it even more dependent upon an individual's intelligence level.

Literature has supported the idea that individuals who are more intelligent are more likely to make mental strategy switches during a task (Haygood & Johnson, 1983). That is, they are more likely to abandon their current strategy in favor of another they perceive to be more useful. If more intelligent individuals are prone to such switches and thus have more practice, they may be at an advantage in a multi-tasking situation similar to those who have practiced it, as discussed above.

Another source of information comes from research on attention. Multi-tasking requires that the individual continually redirect their attentional resources. At each switch, the individual must stop performing the first task, and refocus their attention on the new task. Many components of attention have been related to intelligence, including the attention switching necessary for performing tasks simultaneously (Stankov, 1983). Cornelius, Willis, Nesselroade, and Baltes (1983) also investigated the relationship

between attention and intelligence and found that many attention variables were positively correlated with intelligence, including performance on attention switching tasks similar to those discussed above.

Stankov (1988) also researched the relationship between intelligence and attention. As one component of attention, he measured performance on a switching task based on Gohper and Kahneman's (1971) dichotic listening task. Subjects were presented with visual stimuli and were asked to switch between two simple recitation tasks when cued. Performance on this switching task was correlated with many different measures of intelligence, including several components of the WAIS-R.

Salthouse et al. (1998) examined multi-tasking as a construct and attempted to relate it to intelligence as part of their investigation. They used reaction time on three different task-switching scenarios to measure the costs associated with switching, and three different measures of intelligence: a matrix reasoning test resembling Raven's Progressive Matrices (Raven, 1962), a cube-assembly test, and a free-recall test. They found significant correlations for each of the nine possible combinations of switching costs and intelligence.

Thus, intelligence should be related to successful multi-tasking performance. Those with high intelligence should exhibit fewer process losses associated with multi-tasking and should therefore be able to focus more time and energy on actual task performance.

Differences in Uncertainty Process Losses

Similarly, individuals who are able to minimize the process losses associated with uncertainty should also be at an increased advantage in the multi-tasking situation. While the uncertainty inherent in multi-tasking creates process losses for participants, some personality traits may affect the severity of these process losses. That is, while some subjects may be uncomfortable with uncertainty, others may be better able to tolerate it, or even may even desire it.

Researcher on uncertainty reveals that researchers have investigated a personality trait specifically aimed at this concept. Tolerance of ambiguity targets differences in people's ability to deal with uncertainty or ambiguity.

People with this trait perceive ambiguous situations as desirable (Judge, Thoresen, Pucik, & Welbourne, 1984). They are also willing to tolerate and cope with new experiences (Judge, Thoresen, Pucik, & Welbourne, 1984). Tolerance of ambiguity has been shown to have an effect on how well individuals perform tasks (Ebeling, 1980). It has also been linked to individual's preferences for particular tasks (Burgoon, 197).

As discussed above, the process losses associated with multi-tasking stem, in part from the way the individual handles the uncertainty and unpredictability associated with multi-tasking. A person with low tolerance of ambiguity is likely to be especially susceptible to these aspects of the task. The continued interruptions will be more likely to disrupt him and it may take him more time to recover from them. Being particularly bothered by the uncertainty, he may be more likely to engage in the ruminating discussed above, spending more mental resources contemplating the switches themselves. In

contrast, a person high on tolerance of ambiguity would, by that logic, exhibit fewer process losses and therefore be better able to perform the multi-tasking.

Thus tolerance of ambiguity presents a likely source of variability in the individual's ability to minimize uncertainty losses. Those high on this trait will be buffered from the otherwise deltrious effects of uncertainty.

Literature on uncertainty also leads to another individual difference, openness to experience. Openness to experience is one of the Big Five personality factors. It is also called intellect or culture (Sackett & Wanek, 1996), but should not be confused with intelligence.

People high on openness to experience tend to be imaginative, curious, and original (Barrick & Mount, 1991; Mount & Barrick, 1995). In general, these people are more 'open' to new experiences, and change. This is important because the multi-tasking situation is based in changing between tasks. More importantly, openness includes a component of behavioral flexibility (McCrae, 1996), suggesting that those high on openness to experience might be particularly well suited to multi-tasking.

Individuals high on openness to experience might also be better able to emotionally handle the inherent uncertainty of the multi-tasking situation. Because they value newness and change, they may not perceive as much uncertainty in the multi-tasking situation or may be less bothered by the uncertainty.

Hodson and Sorrentino (1999) confirmed this relationship by investigating the relationship between the Big Five personality traits and the way people handle uncertainty. They found that openness to experience was negatively correlated with people's need to have uncertainty resolved.

Because of this, people high on openness to experience may exhibit fewer of the process losses associated with multi-tasking. The difficulty people experience due to multi-tasking's uncertainty should be minimized.

Differences in Perceived Stress

As discussed, stress is a key outcome of multi-tasking. In order to determine who will be successfully able to perform in this situation, the relevant individual differences must be evaluated to determine which individuals will be most and least likely to experience this stress and therefore withdraw and perform poorly.

Some individuals may be better equipped to deal with the feeling of urgency associated with multi-tasking. These individuals would perceive a lower level of stress, even under these stressful conditions. Research on stress points towards individual differences in this tendency.

Stress researchers investigating differences in individuals' predisposition towards perceiving situations as stressful have identified a personality trait called trait anxiety or arousability. Sometimes this trait is investigated in a testing environment and is referred to as testing anxiety. In general, this refers to a person's predisposition towards worrying or being anxious.

Worry and anxiety are important to task performance. They have been related to decreased performance (Morris & Perez, 1972). More relevant, though, are the ways in which trait anxiety might interact with the characteristics of the multi-tasking situation.

First, anxiety is particularly relevant when the individual is subject to distraction. Coren and Aks (1991) investigated the relationship between arousal and distraction. They found that those high on arousability showed a greater change in arousal under conditions of distraction than did those low on arousability. In other words, these individuals are more susceptible to the effects of distraction. These individuals may therefore perceive the multi-tasking situation as particularly stressful.

Anxious people are more self-preoccupied (Carver, Peterson, Follansbee, & Scheier, 1983; Wine, 1971). The anxious person divides his attention between the task and himself, devoting a larger portion of their attentional resources to worry (Wine, 1971). Not surprisingly, this increased worry has been linked to decreased performance (Carver et al., 1983).

Thus, people who are high on trait anxiety may experience higher stress levels under multi-tasking conditions than those who are low on trait anxiety. In support of this, it has been found that highly anxious people exhibit lower persistence, especially on difficult tasks (Carver et al., 1983).

Stress research has also pinpointed neuroticism as a potentially important individual difference. People high on neuroticism tend to be anxious, insecure, emotional, nervous and apprehensive (Barrick & Mount, 1991; McCrae & Costa, 1997; Mount & Barrick, 1995)

Because of this, highly neurotic individuals will be particularly susceptible to the urgency of the multi-tasking situation, and will perceive the situation as more stressful. Research supports the relationship between neuroticism and stress. For example, Boland and Cappeliez (1997) found that those high on neuroticism reported higher levels of

perceived daily stress and psychological distress. Neuroticism also plays an additional role in the model, as will be discussed.

Thus stress is a likely outcome of multi-tasking, and trait anxiety and neuroticism are likely candidates for accounting for individual differences in perceived stress. Those high on these traits will perceive the multi-tasking situation as more stressful.

Differences in Coping

In order to assess who will be more successful at multi-tasking, it is necessary to determine the characteristics which cause people to use particular coping mechanisms and thereby cope more or less constructively. While there is some controversy over whether people have set coping patterns (Carver et al., 1989), coping mechanisms have frequently been investigated with respect to individual differences.

One of the most common relationships studied in the coping literature is that between coping styles and various personality variables (e.g. Blanchard-Fields & Irion, 1988; Carver, Scheier, & Weintraub, 1989; Gomez, 1997). Different personality variables have been associated with particular aspects of coping and with the success of coping efforts. Three of the most commonly studied personality variables in this literature are locus of control, Type A personality and Neuroticism.

Locus of control centers around an individual's belief of personal control over their life events (Gomez, R., 1997; Newton & Keenan, 1990; Rotter, 1966). People with an internal locus of control place an emphasis on internal characteristics such as their own behavior and abilities. They believe that they have control over their lives. People

with an external locus of control place an emphasis on external factors such as luck, chance, and fate. They believe they have little control over the events in their life.

Research has supported the fact that locus of control is related to the way people cope with stress. Newton and Keenan (1990) found that an external locus of control was positively related to many types of psychological strain, including anger and frustration. This affects the types of coping strategies these individuals are likely to engage in.

Blanchard-Fields and Irion (1988) found that adults with an internal locus of control were less likely to engage in avoidant coping. Gomez (1997) found similar results. Those with an external locus of control were more likely to use avoidant coping strategies and less likely to use "approach" coping strategies: those that directly confront the source of the problem.

Of the 13 different types of coping investigated by Carver et al., most were non-significantly related to Locus of control, but tended in the same direction as discussed above. Further, Carver et al. (1989) included disengagement (i.e. withdrawal) as a coping strategy, rather than an outcome. They found that an internal locus of control showed a tendency towards negative correlations with several types of disengagement, but none of these reached significance.

Thus research supports the idea that people with an internal locus of control will use different coping strategies than those with an external locus of control. Specifically, under stressful conditions, those with an internal locus of control will be more likely to engage in problem focused coping and less likely to engage in avoidant coping.

Another personality trait that has been linked to coping mechanisms is the Type A behavior pattern. Type A is characterized by ambitiousness, aggressiveness,

competitiveness, and impatience (Lee, Ashford, & Jamieson, 1993). Most literature on Type A is focused on the negative physical or health outcomes more commonly witnessed in these people (e.g. Hendrix, Steel & Leap, 1991); however some researchers have focused on constructs relevant to task performance, especially coping mechanisms.

Because of the emphasis on the negative aspects of Type A personality trait, one might be tempted to assume that they will withdraw and perform poorly under multi-tasking conditions. Researchers have documented the fact that the relationship between stress, Type A and various outcomes can be complex.

Research supports the idea that Type A's actually enjoy and prefer a faster paced task with time constraints. In fact, much of the negativity associated with performance for Type A's may be due to their being better suited to fast paced tasks rather than slower paced tasks (Glass, Snyder & Hollis, 1974).

A significant number of researchers have investigated the relationship between Type A and coping (e.g. Greenglass & Burke, 1991; Newton & Keenan, 1990). Type A individuals are more likely to engage in coping mechanisms in general (Kirmeyer, 1988), and some researchers have found that coping is more effective for Type A's than it is for Type B's (Greenglass & Burke, 1991).

Relevant to the above discussion of coping and withdrawal, Type A has been linked to particular coping mechanisms. The strongest of these is its association with problem focused coping (Hart, 1988; Lee, Ashford, & Jamieson, 1993). For example, Carver et al.'s (1989) investigation of coping mechanisms revealed that Type A was positively correlated with problem focused coping mechanisms including active coping, planning, and suppression of competing activities.

Havlovic and Keenan (1991) found that Type A individuals were more likely to engage in a coping mechanism they termed positive thinking. It is difficult to see, however, how this particular type of coping mechanism would relate to withdrawal and multi-tasking performance. It is possible that these individuals might successfully 'cheer themselves up' and be therefore less likely to become frustrated and withdraw however, the act of engaging in positive thinking might be considered a type of withdrawal all of its own.

There is mixed information on whether Type A's will be likely to engage in avoidant coping. Gomez (1997) found that women high on Type A were *more* likely to engage in avoidant coping, but this relationship did not hold for men. Carver et al.'s (1989) research showed that Type A's were *less* likely to engage in denial, an aspect of avoidant coping.

By the above logic Type A individuals should engage in problem solving coping and therefore be less likely to behaviorally withdraw from multi-tasking and should thus be better performers. This is supported by some research linking Type A with persistence. Carver et al. (1989) found that Type A personality trait was negatively correlated with behavioral disengagement, and showed a tendency towards a negative relationship (non-significant) with other types of disengagement. Similarly, Strube and Boland's (1986) research illustrated that Type A's persisted longer at tasks with low information (i.e. uncertainty).

Finally, neuroticism has been linked to coping mechanisms. That is, not only has it been associated with differing levels of perceived stress, it has also been studied with respect to how individuals cope with that stress.

Neuroticism is positively correlated with what are generally considered to be maladaptive coping styles and negatively correlated with adaptive coping styles (Boland and Cappeliez, 1997; O'Brien & DeLongis, 1996).

Specifically, O'Brien and Delongis (1996) found that those high on neuroticism were less likely to engage in problem-focused coping. They are also more likely to engage in avoidant coping mechanisms (O'Brien & DeLongis, 1996) If these relationships between neuroticism and coping are correct, this should lead to greater withdrawal. Research provides some support for this outcome. Those with lower emotional stability and who view life negatively are more likely to exhibit withdrawal behaviors such as forming intentions to quit and to engaging in voluntary turnover (George, 1989; Judge, 1992).

Thus, the stress literature provides three personality traits that will affect the types of coping strategies employed in stressful situations. In keeping with the conceptual model, these will partially moderate the relationship between perceived stress and withdrawal.

Difference in Withdrawal

In the multi-tasking paradigm, persistence is a key component. If one presumes to have isolated the ability to multi-task from the ability to perform the individual tasks, all individuals possess enough ability to perform. That is, every individual is capable of switching from one task to another. The process losses in terms of reaction time are

important, but might be small when compared to the losses an individual would exhibit if they lost the motivation to switch.

Characteristics that make an individual more or less likely to persist thus have key importance. There has been significant research in this area, and several personality traits have been identified.

One set of such characteristics can be found in goal orientation. Goal orientation is composed of two traits, or needs, mastery orientation and performance orientation. Each of these characteristics has been linked with persistence.

Dweck (1986) defined a learning (mastery) orientation as those where "individuals seek to increase their competence, to understand or master something new," and a performance orientation as those where "individuals seek to gain favorable judgments of their competence or avoid negative judgments of their competence." More recently, Dweck (1992) conceptualized learning (mastery) as "seeking to improve one's competence," and performance as "seeking to prove one's competence." Thus, each orientation represents a preference for particular possible outcomes from task performance (i.e. needs).

Performance orientation is based on an individual's heightened concern over his ability level, and a desire to avoid negative judgments of competence (Button, Mathieu, & Zajac, 1996; Dweck, 1986; Elliot & Dweck, 1988). Performance oriented people derive satisfaction from displaying their ability, and prefer tasks that maximize competence judgments (Dweck, 1986; Dweck & Elliot, 1983). When they choose tasks, they try to avoid challenge, and if possible, will choose a task that appears difficult to outsiders but is easy for them (Button, Mathieu, & Zajac, 1996; Dweck, 1986; Dweck &

Leggett, 1988; Dweck & Elliot, 1983). Thus the reasons they approach tasks and the motivation behind their performance are different from people who are low on performance orientation.

For the current study, the most important characteristic of performance oriented people is how they perform under duress. When faced with obstacles or difficulty during a task, highly performance oriented people exhibit low persistence, negative affect and self-cognition, withdrawal of effort, and deterioration of performance (Button, Mathieu, & Zajac, 1996; Dweck, 1986; Dweck & Leggett, 1988; Elliot & Dweck, 1988). They have a tendency to evaluate negative outcomes in terms of ability (Button, Mathieu, & Zajac, 1996; Dweck, 1986). They evaluate their competence by using normative standards, do not believe that success is repeatable, tend to over estimate their failures, and have difficulty remembering their successes (Diener & Dweck, 1980; Dweck & Elliot, 1983).

The multi-tasking situation offers a unique setting for performance orientation. For example, goal orientation literature dictates that performance oriented people withdraw from tasks when they have difficulty or fail. The implication of this is that if the performance oriented individual performs a task without trouble, she will not withdraw. A multi-tasking situation, however, presents a source of frustration and possibly a source of failure to every person. The individual is unable to complete any individual task without being interrupted and forced to switch to another. This may lead to frustration for the individual, especially an individual who values performance. Literature supports the idea that being forced to stop tasks may be viewed as a type of failure (Morris & Perez, 1972), and that perceived helplessness may cause withdrawal

from task performance (Carver, Blaney, & Scheier, 1979). Thus, the highly performance oriented person may be naturally inclined to withdraw from exerting effort in the multi-tasking scenario.

The counterpart to performance orientation is mastery orientation. Mastery orientation is based on a desire to learn from and master tasks. People with high mastery orientation enjoy exerting effort while mastering tasks, increasing ability level over time, striving to understand something new, attempting to acquiring knowledge or skills, and seeking of tasks that maximize learning (Button, Mathieu, & Zajac, 1996; Dweck, 1986; Dweck & Elliot, 1983; Elliot & Dweck, 1988). Mastery oriented people also tend to seek challenge, and derive satisfaction from exerting effort (Button, Mathieu, & Zajac, 1996; Dweck, 1986; Dweck & Leggett, 1988).

Again, theory on mastery orientation pays particular attention to how highly mastery oriented people handle stressful situations. When faced with obstacles or difficulty during a task, mastery oriented people tend to exhibit persistence, continued positive affect, optimism about future outcomes, and maintenance of effective efforts (Button, Mathieu, & Zajac, 1996; Diener & Dweck, 1980; Dweck, 1986; Dweck & Leggett, 1988; Elliot & Dweck, 1988). They treat failure as useful feedback, and have a tendency to use difficulty as a sign that strategies should be changed or effort should be increased (Button, Mathieu, & Zajac, 1996; Dweck, 1986; Elliot & Dweck, 1988). They will also place some value on partial attainment of a goal (Dweck & Elliot, 1983). Mastery oriented people base judgments of their competence on their own performance, attribute success to effort and are optimistic about future outcomes (Diener & Dweck, 1980; Dweck & Elliot, 1983).

The automatic reaction to this information might be that those high on mastery orientation will persist in the multi-tasking situation; however it is important to take this particular situation into account. Multi-tasking is unique when compared to the situations under which these theories developed. Mastery oriented people are hypothesized to persist because they value learning and improvement. It is therefore important to consider the learning and mastery opportunities present.

As mentioned, practice leads to some improvement in multi-tasking performance, suggesting learning opportunities. Also, the highly mastery oriented person may view multi-tasking as a particularly challenging activity. In this case, he should persist in the task and will be less likely to withdraw effort.

Another characteristic related to an individual's likelihood of withdrawing effort is conscientiousness. People high on conscientiousness tend to be dependable, organized, and oriented towards achievement (Barrick & Mount, 1991; Barrick & Mount, 1996; McCrae & Costa, 1997).

More importantly for current considerations, conscientious people tend to be persistent (Barrick & Mount, 1991). This is borne out in organizational research. For example, Mount and Barrick (1995) conducted a meta-analysis including the relationship between conscientiousness and workplace outcomes. Conscientiousness was significantly and positively related to measures of effort which included persistence.

Conscientiousness has also been negatively related to voluntary turnover (Barrick & Mount, 1996). In other words, people low on conscientiousness are more likely to withdraw from the work context entirely, while highly conscientious individuals are more likely to persist.

This is directly relevant to the multi-tasking situation in which many people might be tempted to disengage from the task or to reduce the effort they invest. Despite the stress of the multi-tasking situation, highly conscientious people should persist and not engage in behavioral withdrawal.

Thus while the increased stress of the multi-tasking situation will lead to withdrawal, literature in this area indicates that some individuals will be less likely to withdraw. Individuals high on mastery orientation, low on performance orientation, and high on conscientiousness will be less likely to withdraw then their counterparts.

Model and Hypotheses

Earlier a conceptual model of multi-tasking performance was presented and used to determine relevant individual differences. The hypotheses stemming from this research are organized in Figure 2. This model represents the relationships between multi-tasking and the individual differences that should lead to increases or decreases in performance.

Process losses in this area of research are measured by examining the degree to which performance under multi-tasking conditions is worse than that under unitary task performance conditions. As such, they are represented in the model by the link between multi-tasking and performance.

Three variables, Tolerance of Ambiguity, Openness to Experience, and Intelligence moderate the effects of multi-tasking on task performance. In a similar

manner, Trait Anxiety and Neuroticism moderate the amount of stress the individual perceives in the multi-tasking situation.

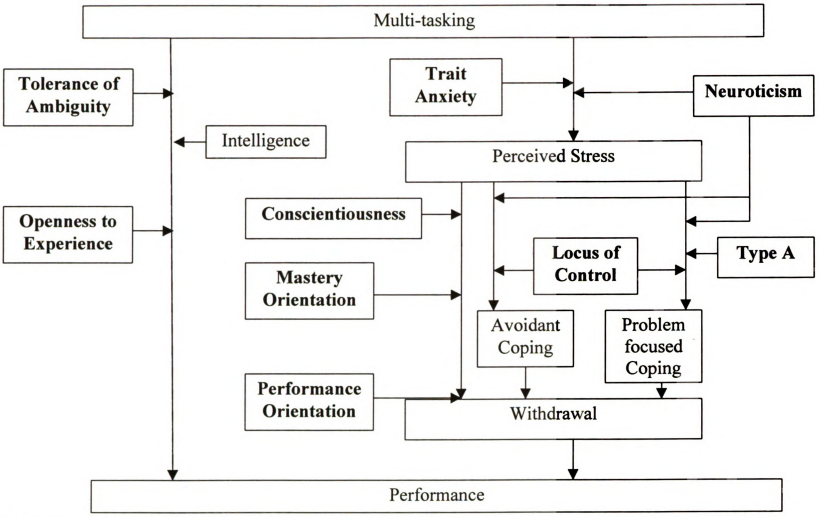

Figure 2
Hypothesized Nomological Network

The perceived stress is then acted upon differently according to several other individual differences. Locus of Control, Type A and Neuroticism affect coping strategies the individual uses to deal with the stress, specifically avoidant coping and problem focused coping. These coping strategies have direct relationships with the individual's tendency to engage in withdrawal behaviors. Conscientiousness, Mastery Orientation, and Performance Orientation directly affect the way the stress is handled by the individual in terms of whether the individual engages in these withdrawal behaviors. In turn, withdrawal has a direct effect on how well the individual performs on the subtasks used for multi-tasking.

Below are nine propositions representing the general theoretical implications discussed above. Each represents one link between multi-tasking and its major outcomes: Process losses, stress, coping, withdrawal and performance. These are then operationalized by one or more hypotheses that incorporate the individual differences which are most like to comprise the nomological network. The structure of these hypotheses is illustrated in Table 1.

People performing under multi-tasking conditions experience a higher degree of uncertainty and are asked to switch tasks frequently. These characteristics lead to process losses not present when performing tasks individually. Because of this, people working under multi-tasking conditions are at a disadvantage in terms of performance.

Proposition 1: Multi-tasking will cause decreased performance levels when compared with individual task performance on the same tasks.

Proposition 1 will be tested with one hypothesis:

Hypothesis 1: Individuals will perform better when performing tasks one at a time than they will under multi-tasking conditions.

Uncertainty has been associated with process losses in the multi-tasking situation. Some individuals may be less susceptible to these process losses by being less affected by uncertainty. These individuals will exhibit higher performance levels.

Proposition 2: Individual differences that minimize uncertainty process losses will increase multi-tasking performance.

Proposition 2 will be tested with two hypotheses:

Tolerance of Ambiguity is a personality trait aimed at distinguishing those best able to deal with uncertainty. Individuals possessing this trait will be less disturbed by the uncertainty inherent in multi-tasking. Thus, while multi-tasking, these individuals will perform better than those not possessing this trait.

Hypothesis 2a: Multi-tasking will interact with Tolerance of Ambiguity to determine performance. While multi-tasking, those with a high tolerance for ambiguity will perform better.

Openness to Experience includes components of flexibility and enjoying change. Because of this, individuals possessing this trait will be less affected by multi-tasking's uncertainty. Thus, these individuals will also perform better under multi-tasking conditions than will individuals who do not possess this trait.

Hypothesis 2b: Multi-tasking will interact with Openness to Experience to determine performance. While multi-tasking, those who are more open to experience will perform better.

One of the best documented outcomes of multi-tasking is the process loss associated with reacting and switching tasks. These reaction process losses may be minimized for some people, leading to better multi-tasking performance.

Proposition 3: Individual differences that minimize reaction process losses will increase multi-tasking performance.

Proposition 3 will be tested with 1 hypothesis:

Individuals with higher intelligence levels tend to perceive stimuli more quickly and react more quickly. Thus these individuals will experience fewer reaction process losses and will perform better in the multi-tasking situation than will individuals with lower intelligence.

Hypothesis 3: Multi-tasking will interact with intelligence to determine performance. While multi-tasking, those with higher intelligence will perform better.

The multi-tasking situation is characterized by time pressure and urgency. These characteristics make it a more stressful one than one in which the same tasks are performed individually. Some individuals may be less susceptible to these stressors and will experience less stress.

Proposition 4: Multi-tasking will increase stress levels and this increase will be moderated by individual differences.

Proposition 4 will be tested with three hypotheses:

Hypothesis 4a: Multi-tasking will be positively correlated with perceived stress. Thus, subjects will perceive higher stress levels under conditions of multi-tasking than when asked to perform tasks individually.

One personality trait designed to capture differences in perceived stress levels is trait anxiety. Individuals high on this trait are more likely to perceive situations as stressful. Thus, they will perceive higher stress levels under the urgent multi-tasking conditions while those low on this trait will be less likely to interpret the multi-tasking situation as stressful.

Hypothesis 4b: Multi-tasking will interact with Trait Anxiety to determine perceived stress levels. Subjects who are high on trait anxiety will be more affected by the stressors inherent in the multi-tasking situation and will perceive more stress.

Neuroticism has also been associated with increased susceptibility to stress. Neurotic individuals will thus be more sensitive to the urgency of the multi-tasking situation and will perceive higher stress levels.

Hypothesis 4c: Multi-tasking will interact with Neuroticism to determine perceived stress levels. Subjects who are neurotic will be more affected by the stressors inherent in the multi-tasking situation and will perceive more stress.

Stress tends to lead to withdrawal from the stressful situation. In the current paradigm, this translates to withdrawing from task performance. Differences in the tendency to withdraw will be caused by the characteristics of the individual.

Proposition 5: Perceived stress will lead to increased withdrawal from the task. Individual differences will have an impact on the strength of this relationship.

Proposition 5 will be tested with four hypotheses:

Hypothesis 5a: Perceived stress will be correlated with withdrawal. Individuals who perceive higher stress levels will be more likely to engage in withdrawal behaviors.

Conscientiousness has been linked to persistence. Individuals with this trait are less likely to withdraw from situations, despite their stressful nature.

Hypothesis 5b: Conscientiousness will interact with perceived stress to determine withdrawal. Conscientious people will be less likely to react to perceived stress by withdrawing.

Goal orientation has also been linked to differences in withdrawal. Mastery oriented individuals are likely to be resistant to high stress levels and thus persist.

Hypothesis 5c: Mastery orientation will interact with perceived stress to determine withdrawal. People who are mastery oriented will be less likely to react to perceived stress by withdrawing.

The other component of goal orientation, performance orientation, has also been linked to withdrawal. Performance oriented individuals tend to withdraw from difficult situations, especially when they experience failure.

Hypothesis 5d: Performance orientation will interact with perceived stress to determine withdrawal. People who are performance oriented will be more likely to react to perceived stress by withdrawing.

Stress literature has consistently documented the fact that coping mechanisms help or hinder a person in dealing with stressful situations. An individual may choose adaptive or maladaptive coping styles in a stressful situation.

Proposition 6: Stress will lead to increased coping.

Proposition 6 will be tested with two hypotheses.

Coping styles are utilized to deal with stressful situations. Thus, stress leads to an increase in coping mechanisms across the board. The two types of coping mechanisms relevant to the current study are avoidant coping and problem focused coping.

Hypothesis 6a: Perceived stress will be correlated with avoidant coping. Those who perceive more stress will be more likely to engage in avoidant coping.

Hypothesis 6b: Perceived stress will be correlated with problem focused coping. Those who perceive more stress will be more likely to engage in problem focused coping.

Individuals differ in the extent to which they prefer particular coping mechanisms as a way to endure stressful situations. This extends to the two particular coping mechanisms most relevant to the current paradigm.

Proposition 7: Individual differences will affect the type of coping style used.

Proposition 7 will be tested with five hypotheses:

People with an internal locus of control feel they have control over their lives. Coping literature has investigated the types of coping mechanisms these individuals use, and have found that they are less likely to engage in avoidant coping and more likely to engage in problem focused coping.

Hypothesis 7a: Locus of control will interact with perceived stress to determine avoidant coping. People with an internal locus of control will be less likely to react to perceived stress by engaging in avoidant coping.

Hypothesis 7b: Locus of control will interact with perceived stress to determine problem focused coping. People with an internal locus of control will be more likely to react to perceived stress by engaging in problem focused coping.

Neuroticism has also been linked to avoidant and problem focused coping. Specifically, people who are neurotic tend to try to deny the stressful situation and tend not to focus on solving the source of the stress. Thus, neurotic individuals are more likely to engage in avoidant coping and less likely to engage in problem focused coping.

Hypothesis 7c: Neuroticism will interact with perceived stress to determine avoidant coping. Neurotic people will be more likely to react to perceived stress by engaging in avoidant coping.

Hypothesis 7d: Neuroticism will interact with perceived stress to determine problem focused coping. Neurotic people will be less likely to react to perceived stress by engaging in problem focused coping.

Finally, Type A behavior pattern has frequently been examined in relation to coping. While no clear relationship to avoidant coping has developed, Type A has been linked with problem focused coping.

Hypothesis 7e: Type A will interact with perceived stress to determine problem focused coping. People high on Type A personality trait will be more likely to react to perceived stress by engaging in problem focused coping.

Different coping mechanisms are associated with different outcomes, including the tendency to withdraw from task performance.

Proposition 8: The coping mechanisms chosen by individuals will affect their likelihood of withdrawal.

Proposition 8 will be test with two hypotheses:

Coping mechanisms that involve avoiding or denying the stressor suggest an attempt to escape. Because of this, they are likely to be associated with withdrawal behaviors.

Hypothesis 8a: Avoidant coping will be correlated with withdrawal. Individuals who engage in avoidant coping will be more likely to exhibit behavioral withdrawal.

Coping mechanisms involving a direct attack on the problem are referred to as problem focused coping. These coping mechanisms suggest a desire to take constructive action towards good performance. Thus, individuals using these mechanisms are less likely to withdraw.

Hypothesis 8b: Problem focused coping will be correlated with withdrawal. Individuals who engage in problem focused coping will be less likely to exhibit behavioral withdrawal.

Under these conditions, withdrawal of effort is a likely outcome. When individuals withdraw, they will have less success on the tasks and will perform more poorly.

Proposition 9: Withdrawal will partially determine performance levels.

Proposition 9 will be tested with one hypothesis:

Hypothesis 9: Withdrawal will be correlated with performance. Individuals who exhibit behavioral withdrawal will perform more poorly than those who do not.

Table 1

Propositions and Hypotheses

Proposition	Hypothesis	Analysis
1: Decreased Performance under MT	1: MT main effect on Performance	Correlation
2: ID's minimize uncertainty process losses	2a: MT by TA interaction on Performance	General linear equation
	2b: MT by OE interaction on Performance	
3: ID's minimize reaction process losses	3: MT by Intelligence interaction on Performance	General linear equation
4: MT causes stress, moderated by ID's	4a: MT main effect on Stress	General linear equation
	4b: MT by AX interaction on Stress	
	4c: MT by N interaction on Stress	
5: Stress causes withdrawal, moderated by ID's	5a: Stress main effect on withdrawal	General linear equation
	5b: Stress by C interaction on withdrawal	
	5c: Stress by MO interaction on withdrawal	
	5d: Stress by PO interaction on withdrawal	
6: Stress causes avoidant coping, moderated by ID's	6a: Stress main effect on AC	General linear equation
	6b: Stress by LC interaction on AC	
	6c: Stress by N interaction on AC	
7: Stress causes problem focused coping, moderated by ID's	7a: Stress main effect on PC	General linear equation
	7b: Stress by LC interaction on PC	
	7c: Stress by N interaction on PC	
	7d: Stress by TABP interaction on PC	
8: Coping causes withdrawal	8a: AC main effect on withdrawal	General linear equation
	8b: PC main effect on withdrawal	
9: Withdrawal causes performance	9: Withdrawal main effect on performance	Correlation

ID = Individual Difference, MT = Multi-tasking, TA = Tolerance of Ambiguity, OE = Openness to Experience, AX = Trait Anxiety, N = Neuroticism, C = Conscientiousness, MO = Mastery Orientation, PO = Performance Orientation, AC = Avoidant coping, PC = Problem focused coping, LC = Locus of Control, TABP = Type A

Method

Subjects

Subjects were 232 psychology students at a large mid-Western university who received partial course credit for their participation in the study. Seventy two percent of the sample was female. The racial makeup of the subject sample was 80.2% white, 6.5% African American, 3.4% Asian, 2.6% Hispanic, 4.3% reporting another race or multiple races and 3.0% choosing not to report a race. Due to missing personality data, some analyses include only 228 subjects.

Measures

Prior to participation, subjects completed individual difference measures including Type A, Locus of Control, Intelligence, Mastery Orientation, Performance Orientation, Tolerance of Ambiguity, Trait Anxiety, and the Big Five personality traits.

Intelligence was measured using a shortened version of Raven's progressive matrices (Ablard & Mills, 1996). The Ravens requires individuals to examine a set of simple figures, determine a pattern, and choose the missing figure from a set of alternatives. The internal consistency reliability of this measure was found by Ablard and Mills to be .66. They also found the correlation between this 12 item version and the longer 36 item version created by Raven to be .88.

Goal orientation was measured using Button et al.'s (1996) 8-question mastery scale and 8-question performance scale. (See Appendix 1.) Button et al. (1996) found that the internal consistency reliability of the mastery scale ranged from .79 to .85 and the reliability of the performance scale ranged from .68 to .81. Items for these scales are listed in Appendix 1. Each item was measured on a Likert Scale from Strongly disagree to Strongly agree.

Tolerance of Ambiguity was measured using Major's (1990) scale, adapted from items by Rydell and Rosen (1966) and Budner (1962). Major reports a reliability of .77 for this scale. Items for this scale are listed in Appendix 2. Each item was measured on a Likert Scale from Strongly disagree to Strongly agree.

Locus of Control was measured using 10 items from Rotter's (1966) scale. Rotter reports internal consistency reliabilities for this scale ranging from .65 to .79. Test retest reliabilities for this scale range from .49 to .83. Items for this scale are listed in Appendix 3. Each item was measured on a Likert Scale from Strongly disagree to Strongly agree.

Type A was measured using Forgays, Forgays, Bonaiuto, and Wrzesniewski's (1993) scale. Minor modifications were made to some items. The scale includes five theoretical components of Type A personality. Items for this scale are listed in Appendix 4. Each item was measured on a Likert Scale from Strongly disagree to Strongly agree.

Trait Anxiety was measured using Coren's (1988) Arousability Predisposition Scale. Split half reliability for this scale was found by Coren to be .83. Items for this scale are listed in Appendix 5. Each item was measured on a Likert Scale from Strongly disagree to Strongly agree.

The Big Five personality traits were measured using the NEO-FFI (Costa & McCrae, 1995). Cost and McCrae report reliabilities of .86 for neuroticism, .81 for conscientiousness, and .73 for openness to experience using this scale. Items for these scales are listed in Appendix 6. Each item was measured on a Likert Scale from Strongly disagree to Strongly agree.

Tasks

The multi-tasking scenario consisted of three simple tasks. In order to more closely emulate real job performance and to expand the relevance of the study, the tasks chosen for this study were more complex than the dichotic listening tasks frequently used. Task A was a reference task. Subjects were asked questions requiring them to look up numbers or other information in a chart. Subjects were scored on the number of questions they answer correctly. An example question for this task is included in Appendix 7. Task A also functioned as a measure of performance, as discussed below.

Task B consisted of questions from a situational judgment test (SJT). These questions came from an SJT designed to tap managerial performance, and were used in a manufacturing setting. Questions required the individual to determine the correct course of action in typical situations experienced on the job. See Appendix 8 for an example item. Scoring for these items was developed using subject matter experts, who determined the appropriateness of each response. Based on this information, each possible response option has been assigned a positive, negative or neutral weight (-1, +1, or 0). Final scores are calculated by adding the values for the response options chosen by

the subject. Thus, large positive scores indicate better performance and large negative scores indicate worse performance. Validity of this measure has been found to be .27 (Wiechmann, Schmitt, and Plamondon, 2000). Task B also functioned as a measure of performance, as discussed below.

Task C was composed of logic puzzles that contain organizational and job oriented content. Subjects were scored on the number of puzzles they solved correctly. Example logic puzzles are included in Appendix 9. Task C was used in the process measurement of withdrawal and was not be used as a measure of performance. As explained below in the procedure, subjects were allowed to work on Task C during their free time, making it a less appropriate measure of performance. It was therefore not used in this capacity.

Procedure

Subjects were first given an overview of the experiment format. Subjects participated in the experiment at a computer. First, subjects completed all individual difference measures. Next, subjects engaged in the task performance portion of the experiment based on the three tasks described above. Execution of these tasks was controlled by a computer program. Subjects were informed that they had a total of 15 minutes to spend on each task and had the task presentation scenario described to them. Subjects were divided into two groups: a multi-tasking group, and a serial performance group.

Half of the subjects used a program that mimicked multi-tasking conditions (multi-tasking group). The program presented one task to the subjects for a set period of time lasting between one and three minutes. The subjects did not know how long they had to spend on each task. After the predetermined time, the program switched without warning to one of the other two tasks. The program continued to cycle in this manner for a total of 45 minutes, and 15 minutes were devoted to each task. Twice during the task performance portion of the experiment, the subjects were allowed a 5 minute break. During this break, they were allowed to continue working on Task C, the logic puzzle task, if they desired. The computer program allowed each subject access to this task during the break period and recorded whether or not subjects chose to access it. After each break, subjects were asked to complete interim stress, coping and withdrawal measures concerning the previous 15 minute period.

The remaining subjects comprised the serial performance group. They also completed the tasks as directed by the computer; however the tasks were presented such that the individual spent 15 continuous minutes on each task. They were also allowed the two breaks, and were asked to complete coping, stress and withdrawal measures after each break.

Upon completion of the task performance portion of the experiment, subjects completed self-report measures of stress, coping and withdrawal and also completed some manipulation checking items. Finally, subjects were fully debriefed and thanked for their participation.

Outcome Measures

Perceived stress was measured using Cohen, Kamarck and Mermelstein's (1983) Perceived Stress Scale (PSS). Cohen et al. found internal consistency reliabilities ranging from .84 to .86 in three different samples. Items for this scale are listed in Appendix 10. Each item was measured on a Likert Scale from Not at all to Much of the time.

Avoidant coping was measured using a combination of items from Carver et al.'s (1989) Denial scale and from Havlovic & Keenan's (1991) Avoidance/Resignation scale. Problem focused coping was measured using a combination of items from Carver et al.'s (1989) Active Coping, and Planning scales and from Havlovic & Keenan's (1991) Direct Action scale. Some items were slightly altered to better fit the current study. Items for these scales are listed in Appendix 11. Each item was measured on a Likert Scale from Not at all to Much of the time.

Withdrawal was assessed both through self-report (See Appendix 12) and through the computer's recording of participation on Task C during the break. The self-report measure was based in part on items from Carver et al.'s (1989) behavioral disengagement scale and was supplemented with items specifically targeted at the current task situation. Each item was measured on a Likert Scale from Not at all to Much of the time. Participation on Task C served as a second measure of withdrawal (or persistence). Subjects who are engaging in withdrawal are unlikely to work on Task C during the break, and therefore measuring such participation can serve as a supplementary process measure of (a lack of) withdrawal.

Since multi-tasking necessitates the use of multiple tasks, more than one measure of performance is available. Task A and B were chosen, in part, for their different performance emphases. Task A, the reference task, serves as a measure of performance focused on quantity. Most subjects should be able to answer each attempted question correctly due to the simple nature of the task. On the other hand, Task B, the situational judgment test, serves as a measure of performance focused on quality. Subjects should differ in their ability to answer questions correctly. Although the discussed theory does not lead to differing hypotheses for these two types of performance measures, they are evaluated separately in the interest of furthering our understanding of multi-tasking. Thus, all hypotheses involving performance are tested twice, once with each measure.

Results

A pilot study was conducted in order to ensure subjects perceived the multi-tasking condition in accordance with the predicted theory: that they perceived it as more uncertain, more urgent and that they perceived the increased switching over the control condition. T-test results of the pilot study are presented in Table 2, indicating that each of these t-tests is significant.

Table 2

Pilot Results

DV	df	t
Uncertainty	28	-2.28*
Switch	28	-5.20**
Urgency	28	-2.19*

Table 3 presents the summary information for each of the scales used in the hypotheses, including the number of items, mean, standard deviation and internal consistency reliability. Since perceived stress, avoidant coping, problem-focused coping, and self-reported withdrawal were assessed at three times, a separate reliability is calculated for each measurement. Most of the scale scores were created by computing a mean of the scale items. Thus each could range between 1.00 and 5.00. Exceptions to this are the intelligence measure, in which each item was scored as correct or incorrect (1 or 0), and the persistence measure, in which each subject either persisted or didn't (1 or 0). Thus, for these scales, scores ranged between 0 and 1. For the performance measures, scores for the Reference task indicate the number of correctly answered items while scores for the Situational Judgment Test were computed using a key which assigns values of +1, -1 and 0 to each response option. Correlations between these variables are presented in Table 4.

Table 3

Scale Information

Scale	Items	Mean	SD	Reliability Time 1	Reliability Time 2	Reliability Time 3	Reliability
MO	8	3.87	.50				.83
PO	8	3.87	.54				.78
TAmb	6	2.99	.48				.63
LC	10	3.21	.57				.60
TyA	10	3.30	.57				.63
Anx	12	3.22	.52				.80
N	12	2.81	.68				.87
E	12	3.68	.56				.82
O	12	3.48	.56				.79
A	12	3.63	.43				.80
C	12	3.49	.57				.85
Intelligence	12	.60	.17				.60
Stress	7	2.40	.68	.85	.86	.87	
Avoid	7	1.67	.58	.75	.76	.77	
Problem	7	3.67	.60	.75	.86	.89	
SR WD	10	1.53	.55	.89	.92	.92	
Persist1	N/A	.81	.40				N/A
Persist2	N/A	.81	.39				N/A
Perf SJT	25[a]	3.45	3.26				.71[b]
Perf Ref	50[a]	25.29	4.60				.64[b]

[a] Value indicates the maximum number of items answered.

[b] Test-retest reliability

MO = Mastery Orientation, PO = Performance Orientation, TAmb = Tolerance of Ambiguity, LC = locus of control (internal), TyA = Type A, Anx = Trait Anxiety, N = Neuroticism, E = Extraversion, O = Openness, A = Agreeableness, C = Conscientiousness, Stress = Perceived Stress, Avoid = Avoidant Coping, Problem = Problem Focused Coping, SR WD = Self-report Withdrawal, Persist 1 = Persistence During Break 1, Persist 2 = Persistence During Break 2, Perf SJT = Performance on the situational judgment test, Perf ref = Performance on the reference task.

Table 4

Correlations

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
1. MO																				
2. PO	.11																			
3. TAmb	.04	-.19**																		
4. LC	.19**	-.13	.18*																	
5. TyA	.07	-.22**	-.02	-.10																
6. Anx	-.09	.32**	-.15	-.31**	.21**															
7. N	-.27**	.32**	-.23**	-.35**	.12	.59**														
8. E	.20**	.02	.18**	.12	.24**	.03	-.27**													
9. O	.26**	-.08	.14*	.11	-.08	-.02	-.17*	-.01												
10. A	.27**	.08	.03	.15*	-.28**	-.07	-.32**	.24**	.22**											
11. C	.40**	.03	.08	.26**	.02	-.11	-.32**	.25**	-.06	.28**										
12. Int	.06	-.03	.03	.00	.03	-.12	-.03	-.12	.13	-.09	-.12									
13. Stress	-.14*	.20**	-.18*	-.14*	.03	.29**	.36**	-.06	-.21**	-.01	-.12	-.23**								
14. Avoid	.02	.11	-.18	-.15*	.11	.27**	.25**	.06	-.28**	-.07	.09	-.15*	.29**							
15. Problem	.31**	.11	.00	.01	.08	.00	-.06	.16*	.01	.08	.32**	.09	-.04	-.04						
16. SR WD	-.13	.17*	-.18**	-.07	.01	.29**	.24**	-.11	-.12	-.01	-.10	-.19**	.36**	.45**	-.39**					
17. Persist1	.09	.06	.06	.00	-.04	.11	.02	.00	.14*	.07	.00	.00	-.01	.01	.02	.07				
18. Persist2	.01	.04	.12	.02	-.08	.03	.02	-.06	.16*	.02	-.06	.08	.05	-.17**	.05	-.05	.68**			
19. Perf SJT	.12	.11	-.04	.05	.09	-.02	-.04	.01	-.01	.03	.10	.00	-.04	.03	.12	-.21**	-.09	-.05		
20. Perf Ref	.02	-.02	-.01	-.05	.06	-.01	.06	-.01	.01	-.06	-.02	.32**	-.13	-.03	.02	-.17*	.01	.11	.33**	
21 MT	-0.11	0.06	-0.03	.00	-0.01	0.08	.14*	-0.03	.00	-0.03	-0.1	-0.14	.32**	0.1	-0.12	.19**	0.11	.19**	0.02	-.18**

* = $p < .05$, ** = $p < .01$

MO = Mastery Orientation, PO = Performance Orientation, TAmb = Tolerance of Ambiguity, LC = locus of control (internal), TyA = Type A, Anx = Trait Anxiety, N = Neuroticism, E = Extraversion, O = Openness, A = Agreeableness, C = Conscientiousness, Int = Intelligence, Stress = Perceived Stress, Avoid = Avoidant Coping, Problem = Problem Focused Coping, SR WD = Self-report Withdrawal, Persist 1 = Persistence During Break 1, Persist 2 = Persistence During Break 2, Perf SJT = Performance on the situational judgment test, Perf ref = Performance on the reference task, MT = Multi-tasking

Also, in order to more fully explain the phenomenon, several supplementary variables and manipulation checks were measured, including the subjects' perceptions of uncertainty, switch and urgency, their interest in each of the three tasks, and their affect and motivation. Scale information for these variables is presented in Table 5. Also computed was the total number of items completed on each of the performance tasks. Correlations for these variables are presented in Table 6.

Table 5

Scale Information for Manipulation Checks and Supplementary Variables

Scale	Items	Mean	SD	Reliability
Uncertainty	4	3.42	.85	.83
Switch	4	3.66	.82	.73
Urgency	4	3.51	.76	.62
Int SJT	5	2.85	.95	.90
Int Ref	5	3.21	.85	.83
Int Puz	5	3.53	1.07	.92
Affect	5	3.05	.79	.89
Mot	4	4.25	.66	.89

Int SJT = Interest in Situational Judgement Test, Int Ref = Interest in Reference Task, Int Puz = Interest in Logic Puzzle Task, Mot = General Motivation Level

Table 6

Correlations for Manipulation Checks and Supplementary Variables

	22.	23.	24.	25.	26.	27.	28.	29.	30.	31.
1. MO	-0.08	-0.06	-0.05	.15*	0.09	.23**	-0.06	0.04	0.01	0.1
2. PO	.15*	.17*	.17**	-0.07	0.06	-0.1	0.02	-0.03	-0.14	0.07
3. TAmb	0.02	-0.07	-0.02	-0.04	-0.01	0.07	0.05	-0.01	0.06	0.01
4. LC	-0.02	0.01	.00	0.12	-0.07	0.01	-0.05	-0.04	0.06	-0.03
5. TyA	-.19**	-0.08	0.02	-0.05	-0.05	-0.05	.13*	0.11	-0.06	0.01
6. Anx	0.05	.13*	.12*	-0.09	-0.04	-.21**	-0.02	-0.02	-0.22	0.01
7. N	0.11	.19**	0.05	-0.09	0.02	-.15*	0.01	0.04	-0.25	-0.03
8. E	-.18**	-0.03	-0.02	0.07	.18**	.00	-0.07	-0.06	-0.03	0.12
9. O	-0.06	-0.08	-.20**	0.07	-.16*	.22**	-0.11	-0.06	0.11	0.02
10. A	.00	0.05	-0.01	0.08	0.02	.00	-0.11	-0.11	-0.03	0.03
11. C	-0.05	.00	-0.1	0.11	.19**	-0.13	0.03	0.01	0.07	0.1
12. Intelligence	-0.07	-0.12	-0.1	-0.08	-0.12	.36**	-0.01	.22**	.15*	.15*
13. Stress	.25**	.36**	.34**	-0.11	0.03	-.31**	-0.05	-0.07	-.46**	-0.09
14. Avoid	-0.02	0.1	0.02	-0.12	0.11	-0.12	0.06	0.13	-0.08	-.13*
15. Problem	-.15*	0.02	0.03	.30**	.35**	.19**	-0.05	-0.03	0.11	.45**
16. SR WD	.14*	.15*	.18**	-.21**	-.25**	-.35**	0.04	0.03	-.30**	-.51**
17. Persist1	0.08	0.08	0.07	-0.02	-0.07	.14*	-0.01	.00	-0.07	0.03
18. Persist2	.15*	0.12	.19**	.00	-0.09	0.09	0.02	.00	-0.08	0.12
19. Perf SJT	.01	.00	.04	.12	-.01	.02	.43**	.33**	0.13	.16*
20. Perf Ref	-.07	-.15*	-.08	.02	-.05	.20**	.42**	.80**	.17*	.17**
21. MT	.38**	.53**	0.16	-0.12	0.07	-0.12	.19**	-.13*	.00	-0.05
22. Uncertainty										
23. Switch	.43**									
24. Urgency	.28**	.24**								
25. Int SJT	-.25**	-0.08	-.19**							
26. Int Ref	-0.04	0.06	-0.1	.28**						
27. Int Puz	-0.02	-0.14	-0.07	-0.05	0.02					
28. Ans SJT	0.02	0.08	-0.06	-0.07	-0.1	-.14*				
29. Ans Ref	-0.08	-0.11	-0.08	-0.08	-0.15	0.06	.50**			
30. Affect	-0.13	-.15*	-.39**	0.08	0.06	.16*	.14*	.15*		
31. Motivation	0.02	0.04	-0.06	.22*	.28**	.28**	-0.02	-0.01	.22**	

* = $p < .05$, ** = $p < .01$

MO = Mastery Orientation, PO = Performance Orientation, TAmb = Tolerance of Ambiguity, LC = locus of control (internal), TyA = Type A, Anx = Trait Anxiety, N = Neuroticism, E = Extraversion, O = Openness, A = Agreeableness, C = Conscientiousness, Stress = Perceived Stress, Avoid = Avoidant Coping, Problem = Problem Focused Coping, SR WD = Self-report Withdrawal, Persist 1 = Persistence During Break 1, Persist 2 = Persistence During Break 2, Perf SJT = Performance on the situational judgment test, Perf ref = Performance on the reference task, MT = Multi-tasking, Int SJT = Interest in the situational judgment test, Int Ref = Interest in the reference task, Int Puz = Interest in the logic puzzle task, Ans SJT = Number of Situational Judgment Test items answered. Ans Ref = Number of reference task items answered

In order to examine the relationship between multi-tasking and the measured process variables, three MANCOVA's were run: One examining the relationship between Multi-tasking on the three hypothesized components, one examining multi-tasking's relationship to the hypothesized mediators, and one examining the relationship between multi-tasking and the performance measures. In each case, the variance due to all measured personality variables was removed. Results are presented in Table 7. All three relationships were significant.

Table 7

MANCOVA: Effects of Multi-tasking on Components, Mediators, and Performance

DV Set	Pillai's Trace	Wilks' Lambda	Hotelling's Trace	Roy's Largest Root	F	df	Eta Squared
Components[a]	.31	.69	.44	.44	31.90**	3, 213	.31
Mediators[b]	.10	.90	.11	.11	5.72**	4, 212	.10
Performance[c]	.04	.96	.04	.04	4.19*	2, 214	.04

[a] - Uncertainty, Urgency, and Switch
[b] - Stress, Coping, and Withdrawal
[c] - Situational Judgment Test and Reference Task

Each individual proposition was tested with either a simple correlation or a general linear equation (i.e. an ANOVA or regression equation). For ease of understanding, these analyses are presented in Table 1.

Proposition 1 predicted a negative correlation between multi-tasking and performance. A correlation of -.18 was found ($p < .01$) for the reference task and a correlation of .02 was found for the situational judgment test. Thus, Proposition 1 was partially supported.

Proposition 2 predicted that individual differences would minimize uncertainty process losses. This proposition was tested with a general linear equation using multi-tasking, Tolerance of Ambiguity, and Openness to Experience as independent variables

and performance as the dependent variable. Two interactions were predicted: Multi-tasking by Tolerance of Ambiguity and Multi-tasking by Openness to Experience. No main effects were hypothesized for these traits. The results of these analyses are presented in Tables 8 and 9. Neither of the interactions was supported for either performance measure.

Table 8

Proposition 2 – Effects on Reference Task

Source	Sum of Squares	df	Mean Square	F	Eta Squared
Multi-tasking	102.49	1	102.49	4.89*	.03
Tolerance of Ambiguity	82.91	12	6.91	.33	.02
Openness	615.50	31	19.86	.95	.14
MT by Ambiguity	352.24	11	32.02	1.67	.11
MT by Openness	673.36	25	26.93	1.40	.19
Error	2823.03	147	19.20		

Table 9

Proposition 2 – Effects on Situational Judgement Test

Source	Sum of Squares	df	Mean Square	F	Eta Squared
Multi-tasking	.00	1	.00	.00	.00
Tolerance of Ambiguity	170.24	12	14.19	1.35	.08
Openness	268.51	31	8.66	.83	.12
MT by Ambiguity	97.51	11	8.87	.91	.06
MT by Openness	408.26	25	16.33	1.68	.22
Error	1432.03	147	9.74		

Proposition 3 predicted that individual differences would minimize reaction process losses. This was tested with a general linear equation using multi-tasking and Intelligence as independent variables and performance as the dependent variable. One

interaction was predicted: Multi-tasking by Intelligence. No main effects were hypothesized for these traits. The results of these anslyses are presented in Tables 10 and 9. The results indicate a significant interaction for the reference task, but not for the Situational Judgment Test.

Table 10

Proposition 3 – Effects on Reference Task

Source	Sum of Squares	df	Mean Square	F	Eta Squared
Multi-tasking	75.51	1	75.51	4.05*	.02
Intelligence	623.88	9	69.32	3.72**	.13
MT by Intelligence	295.36	8	36.92	2.06*	.07
Error	3821.78	213	17.94		

Table 11

Proposition 3 – Effects on Situational Judgement Test

Source	Sum of Squares	df	Mean Square	F	Eta Squared
Multi-tasking	2.17	1	2.17	.20	.00
Intelligence	24.55	9	2.73	.25	.01
MT by Intelligence	50.59	8	6.32	.57	.02
Error	2379.06	213	11.17		

In order to more carefully examine the nature of this interaction, it is presented in Figure 3. The interaction hypothesis was based on a belief that intelligence would buffer some individuals against the process losses of multi-tasking. That is, while all subjects would perform worse under multi-tasking conditions, the discrepancy for subjects of lower intelligence would be greater than that for subjects of higher intelligence. Figure 3 indicates that this is not the nature of the interaction. Thus, while the interaction was significant, this hypothesis was not supported.

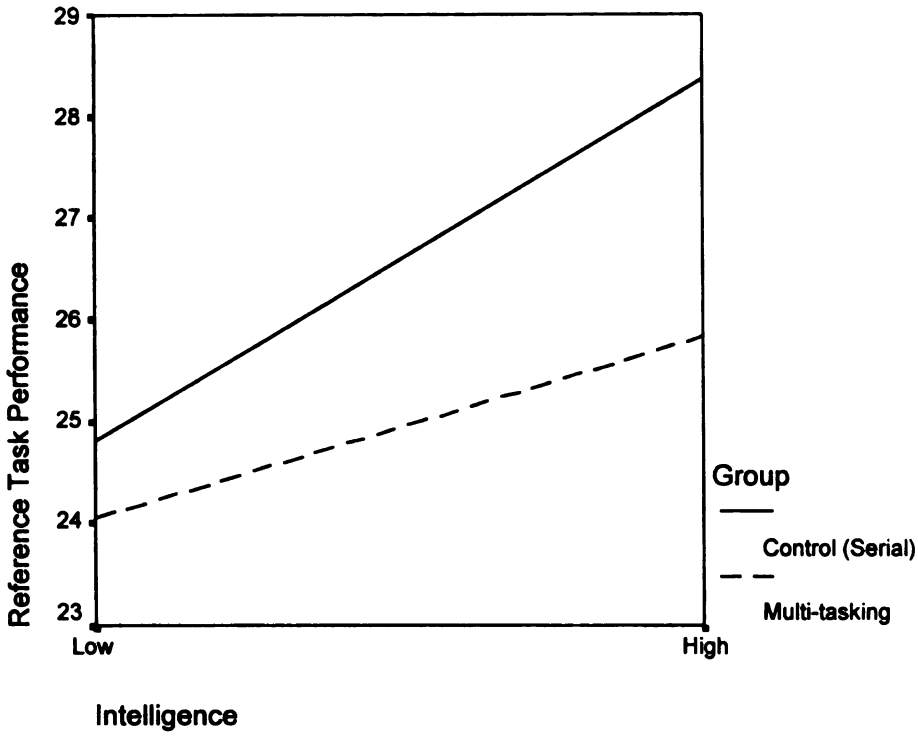

Figure 3
Effect of Multi-tasking by Intelligence Interaction on Performance

Proposition 4 predicted that multi-tasking is stressful, and that this stress could be minimized by individual differences. This proposition was tested with a general linear equation using multi-tasking, Trait Anxiety and Neuroticism as independent variables and perceived stress as the dependent variable. One main effect was hypothesized for multi-tasking on perceived stress. Two interactions were predicted: Multi-tasking by Trait Anxiety and multi-tasking by Neuroticism. The results of this analysis are presented in Table 12. The results indicate that multi-tasking was more stressful, but the individual differences did not have an effect on this relationship.

Table 12

Proposition 4: Effects on Perceived Stress

Source	Sum of Squares	df	Mean Square	F	Eta Squared
Multi-tasking	1.98	1	1.98	5.21*	.02
Trait Anxiety	15.96	28	.57	1.50	.06
Neuroticism	10.93	37	.30	.78	.81
MT by Anxiety	5.38	21	.26	.68	.84
MT by Neuroticism	11.55	26	.44	1.18	.27
Error	42.86	114	.38		

Proposition 5 predicted that stress would lead to behavioral withdrawal, and that this relationship would be moderated by individual differences. This proposition was tested with a regression equation using perceived stress, Conscientiousness, Mastery Orientation, and Performance Orientation as independent variables and withdrawal behavior as the dependent variable. One main effect was hypothesized for stress on withdrawal. Three interactions were predicted: perceived stress by Conscientiousness, perceived stress by Mastery Orientation, and perceived stress by Performance Orientation. The results of this analysis are presented in Table 13. The results indicate that perceived stress was related to withdrawal, and that the Mastery Orientation interaction was significant.

Table 13

Proposition 5: Effects on Withdrawal

Source	Beta	t	R Square	R Square Change	F Change	df
Step 1:			.15	.15	10.16**	4,223
Perceived Stress	.33	5.19**				
Performance Orientation	.11	1.77				
Mastery Orientation	-.08	-1.12				
Conscientiousness	-.04	-.52				
Step 2:			.19	.03	2.84*	3,220
Stress by Conscientiousness	.01	.01				
Stress by Mastery Orientation	1.29	2.33*				
Stress by Performance Orientation	.56	1.02				

In order to examine the perceived stress by mastery orientation interaction, it is presented in Figure 4. Contrary to the hypothesis, this graph illustrates that under high levels of perceived stress, mastery oriented subjects were *more* likely to withdraw.

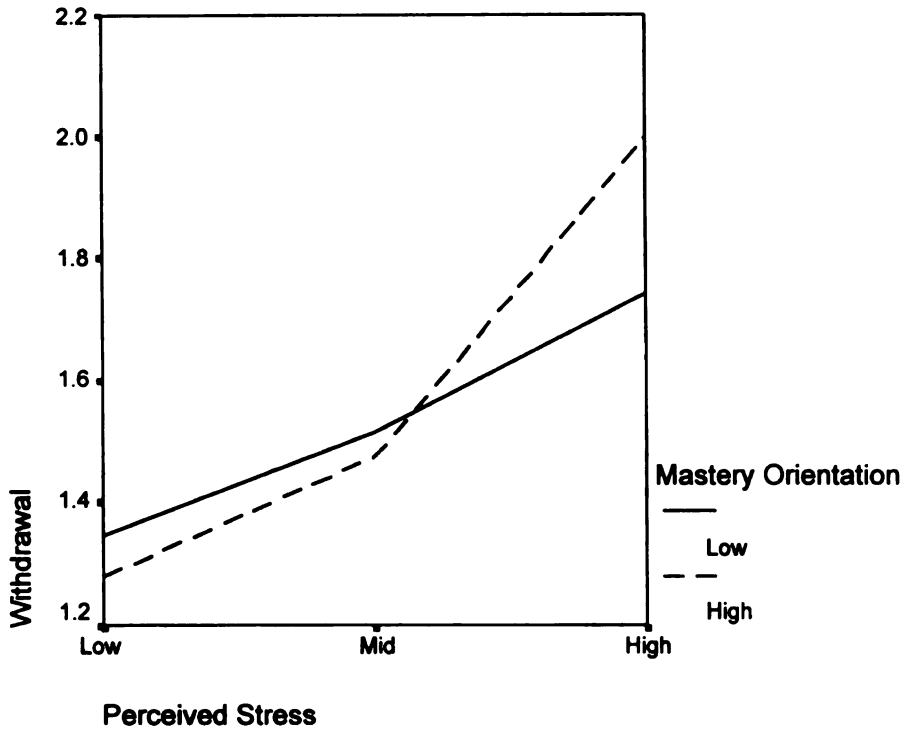

Figure 4
Effect of Perceived Stress by Mastery Orientation Interaction on Withdrawal

Proposition 6 predicted that stress would cause avoidant coping, and that this relationship would be moderated by individual differences. It was tested with a regression equation using perceived stress, Locus of control, and Neuroticism as independent variables and avoidant coping as the dependent variable. One main effect was hypothesized for perceived stress. No main effects were hypothesized for Locus of control or Neuroticism. Two interactions were theorized: perceived stress by Locus of control and perceived stress by Neuroticism. Results are presented in Table 14. For this analysis, the main effect was supported, but none of the interactions were supported.

Table 14

Proposition 6: Effects on Avoidant Coping

Source	Beta	t	R Square	R Square Change	F Change	df
Step 1:			.12	.12	.10.17**	3,224
Perceived Stress	.25	3.7**				
Neuroticism	.13	1.86				
Locus of Control	-.07	-1.08				
Step 2:			.13	.01	1.64	2,222
Stress by Locus of Control	-.73	-1.72				
Stress by Neuroticism	-.42	-1.01				

Proposition 7 predicted that stress would be related to problem-focused coping and that this relationship would be moderated by individual differences. This proposition was tested with a regression equation using perceived stress, locus of control, Neuroticism and Type A as independent variables and problem focused coping as the dependent variable. One main effect was hypothesized for perceived stress. No main effects were hypothesized for Locus of control, Neuroticism or Type A. Three interactions were hypothesized: perceived stress by Locus of control, perceived stress by Neuroticism, and perceived stress by Type A. The results of this analysis are presented in Table 15. The Neuroticism interaction was supported. The main effect was not supported, nor were the other hypothesized interactions.

Table 15

Proposition 7: Effects on Problem Focused Coping

Source	Beta	t	R Square	R Square Change	F Change	df
Step 1:			.01	.01	.63	4,223
Perceived Stress	-.03	-.36				
Neuroticism	-.06	-.81				
Locus of Control	-.01	-.06				
Type A	.08	1.25				
Step 2:			.03	.02	1.6	3,220
Stress by Locus of Control	-.20	-.43				
Stress by Neuroticism	.87	1.98*				
Stress by Type A	-.47	-.95				

In order to examine the perceived stress by mastery orientation interaction, it is presented in Figure 5. This hypothesis indicated that under higher stress levels, those high on Neuroticism would be less likely to engage on problem focused coping than those low on Neuroticism. Examining the line indicating high perceived stress shows that this hypothesis was supported. While for the low perceived stress group, the trend indicates that highly neurotic people were more likely to engage in problem focused coping, the reverse is true under high stress conditions.

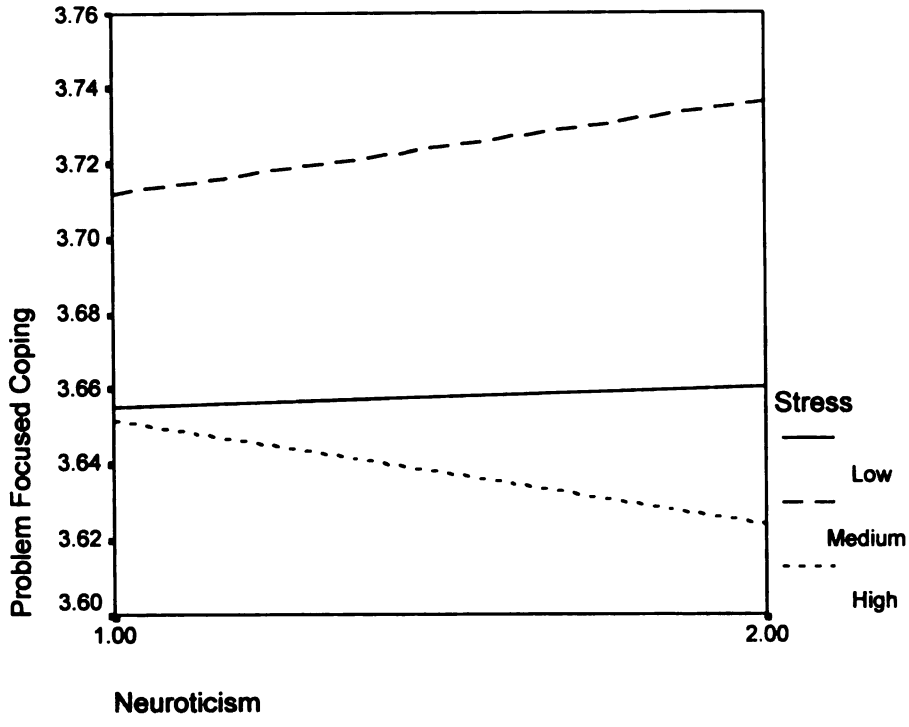

Figure 5
Effect of Perceived Stress by Neuroticism Interaction on Problem Focused Coping

Proposition 8 hypothesized that avoidant and problem-focused coping would be related to withdrawal. This proposition was tested with a regression equation using avoidant and problem focused coping as independent variables and behavioral withdrawal as the dependent variable. Main effects for both independent variables were evaluated. No hypothesis was made for the possible interaction. Results for this analysis are presented in Table 16, indicating that both main effects were supported.

Table 16

Proposition 8: Effects on Withdrawal

Source	Beta	t	R Square	F	df
			.34	59.75**	2,229
Avoidant Coping	.43	8.09**			
Problem Focused Coping	-.38	-7.02**			

Proposition 9 hypothesized that withdrawal would lead to decreased performance. The proposition was tested with a simple correlation between behavioral withdrawal and performance. For the reference task, this correlation was -.17 ($p<.05$). For the situational judgment test, it was -.21 ($p<.01$). Thus, this proposition was supported.

A summary of these results is shown in Table 17. The final column indicates whether each hypothesis was supported. Overall, the basic structure of the multi-tasking situation was upheld. Multi-tasking was associated with increased stress and withdrawal, an increase in avoidant coping and decreased performance. The interactions involving individual differences, however, were not supported.

Table 17

Result Summary

Proposition	Hypothesis	Supported
1: Decreased Performance under MT	1: MT main effect on Performance	Yes[a]
2: ID's minimize uncertainty process losses	2a: MT by TA interaction on Performance	No
	2b: MT by OE interaction on Performance	No
3: ID's minimize reaction process losses	3: MT by Intelligence interaction on Performance	No[b]
4: MT causes stress, moderated by ID's	4a: MT main effect on Stress	Yes
	4b: MT by AX interaction on Stress	No
	4c: MT by N interaction on Stress	No
5: Stress causes withdrawal, moderated by ID's	5a: Stress main effect on withdrawal	Yes
	5b: Stress by C interaction on withdrawal	No
	5c: Stress by MO interaction on withdrawal	No[b]
	5d: Stress by PO interaction on withdrawal	No
6: Stress causes avoidant coping, moderated by ID's	6a: Stress main effect on AC	Yes
	6b: Stress by LC interaction on AC	No
	6c: Stress by N interaction on AC	No
7: Stress causes problem focused coping, moderated by ID's	7a: Stress main effect on PC	No
	7b: Stress by LC interaction on PC	No
	7c: Stress by N interaction on PC	Yes
	7d: Stress by TABP interaction on PC	No
8: Coping causes withdrawal	8a: AC main effect on withdrawal	Yes
	8b: PC main effect on withdrawal	Yes
9: Withdrawal causes performance	9: Withdrawal main effect on performance	Yes

[a] - Supported for reference task only.

[b] - Significant, but not in line with hypothesis

Supplementary Analyses

As indicated, the above results indicate a lack of success in finding the expected relationships for individual differences. In order to further explore this, several additional post hoc analyses were run. First, the simple correlations between personality variables and reference task performance were examined. As can be seen in Table 4, no significant correlations were found. Second, interactions between multi-tasking and each of the personality variables were examined. The results of these general linear models are presented in Table 18. None of the interactions were significant.

Table 18

Multi-tasking by Personality Interactions on Reference Task Performance

Source	Sum of Squares	df	Mean Square	F
Multi-tasking	141.64	1	141.64	6.81**
Tolerance of Ambiguity	125.64	12	10.47	.50
Tolerance of Ambiguity by MT	272.457	11	24.77	1.20
Error	4181.80	203	20.60	
Multi-tasking	91.36	1	91.63	4.37*
Locus of Control	185.66	16	11.60	.56
Locus of Control by MT	132.56	15	8.84	.40
Error	4261.68	195	21.86	
Multi-tasking	195.82	1	195.82	9.41**
Type A	397.54	25	15.90	.76
Type A by MT	446.40	18	24.80	1.22
Error	3735.96	183	20.42	
Multi-tasking	120.03	1	120.03	5.69*
Trait Anxiety	402.89	28	14.39	.68
Trait Anxiety by MT	216.364	22	9.84	.44
Error	3960.65	176	22.50	

Table 18 Cont'd

Source	Sum of Squares	df	Mean Square	F
Multi-tasking	133.50	1	133.50	6.41**
Neuroticism	646.95	37	17.49	.84
Neuroticism by MT	380.28	26	14.63	.88
Error	3552.67	163	21.80	
Multi-tasking	147.84	1	147.84	6.82**
Extraversion	308.92	29	10.65	.49
Extraversion by MT	581.08	24	24.21	1.13
Error	3689.90	173	21.33	
Multi-tasking	96.00	1	96.00	4.77*
Openness	658.23	31	21.23	1.06
Openness by MT	635.96	25	25.44	1.32
Error	3285.71	170	19.33	
Multi-tasking	81.09	1	81.09	4.11*
Agreeableness	649.70	27	21.06	1.22
Agreeableness by Multi-tasking	325.60	19	17.14	.86
Error	3604.60	180	20.03	
Multi-tasking	165.71	1	165.71	8.38**
Conscientiousness	785.07	34	23.09	1.17
Conscientiousness by Multi-tasking	411.98	25	16.48	.81
Error	3382.85	167	20.26	
Multi-tasking	133.27	1	133.27	6.46*
Mastery Orientation	371.05	22	16.87	.82
Mastery Orientation by MT	148.02	13	11.39	.54
Error	4060.84	191	21.26	
Multi-tasking	95.47	1	95.47	4.62*
Performance Orientation	343.64	21	16.36	.79
Performance Orientation by MT	277.09	18	15.39	.73
Error	3959.17	187	21.17	

In light of these findings, a post hoc structural equation model was run to summarize the relationship between multi-tasking and performance. This model represents two modifications from the originally proposed conceptual model. These changes were based on the fact that significant results were not found in two areas. First, problem focused coping has been removed in light of the lack of relationship between stress and this type of coping. Second, reference task performance is used as the performance measure. Thus, only significant hypothesized results were used in this model. The standardized model is presented in Figure 6. Fit indices for this model are high. The chi-square was not significant (χ^2 (4, N = 232) = 2.98, ns). Other fit indices support the conclusion that the model is a good fit (AGFI = .98, NFI = .97, and RMSEA = .00). In explaining the relationship between multi-tasking and performance, it is important to note the more specific nature of the relationship as reflected in this model. While the direct effect of multi-tasking on performance was -.15 ($p < .01$), the findings for indirect effects were much less positive. As can be seen in Figure 6, multitasking had significant direct effects on perceived stress. It also had significant indirect effects on avoidant coping (.09, $p<.01$) and withdrawal (.12, $p<.01$), but the indirect effect on performance was estimated quite low (-.02) and just missed significance.

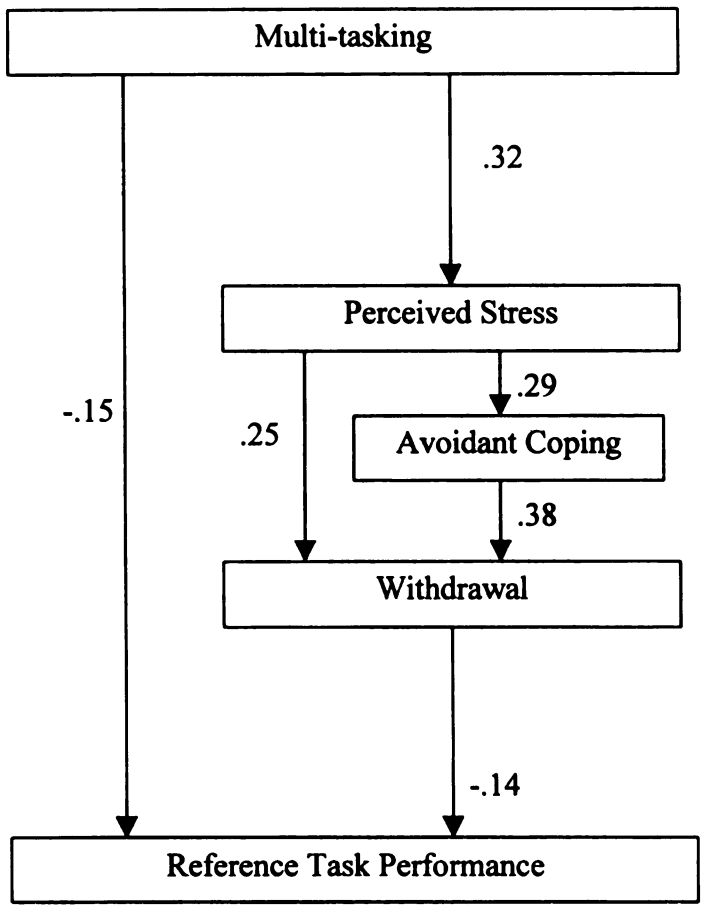

Figure 6
Standardized Model

Discussion

Purpose

The purpose of the current study was twofold: first, to build a model of the multi-tasking process, and second, to identify the individual differences that determined which people multi-task well or poorly.

The proposed model emphasizes the fact that performance under multi-tasking conditions is qualitatively different than performance under single task conditions where one task is completed at a time. The increased uncertainty, urgency and the switches themselves create a different environment, and lead to process losses, increased stress levels and withdrawal from the task. These characteristics all work to decrease individuals' performance levels in comparison to how they could perform if not switching between tasks. This conceptual model was presented in Figure 1: multi-tasking leads to uncertainty process losses, reaction process losses and increased stress; stress causes the individual to engage in avoidant and problem focused coping mechanisms which affect the extent to which the individual exhibits withdrawal behaviors; and finally the uncertainty process losses, reaction process losses and withdrawal negatively affect the individual's performance level. Building and testing this conceptual model is the first of the two goals of this study.

The second goal centers around individual differences. Each of the links in this basic conceptual model present an opportunity for individual differences to alter a person's performance level. For example, while the multi-tasking situation increases

stress levels, some people may be less susceptible to this than others. Those better able to handle the stress will be at an advantage in terms of performance. Similarly, other individual differences were hypothesized to affect the degree to which subjects experienced process losses and exhibited coping strategies and withdrawal. In this way, some individuals were hypothesized to be better equipped to handle the multi-tasking situation.

Findings

The results described above suggest that while the components and outcomes of multi-tasking were predicted, the extension to individual differences proved problematic. The manipulation checks confirmed that subjects perceived the three key characteristics of multi-tasking and the original conceptual model held up fairly well; however, the predicted individual differences were almost completely unsuccessful in affecting these relationships.

Hypothesis 1 predicted that performance would be lower under multi-tasking conditions. This hypothesis was supported for the reference task, but not for the situational judgment test. Because the multi-tasking paradigm is built on the premise that individuals perform worse under multi-tasking conditions, this latter finding is problematic, and will be discussed in detail below.

Hypotheses 2a, 2b, and 3 predicted that Tolerance of Ambiguity, Openness to Experience, and intelligence would minimize some of the process losses associated with multi-tasking. That is, while performance under multi-tasking conditions would be

generally lower, each of these traits would affect the severity of this decrement through an interaction. No interaction was found for Tolerance of Ambiguity or Openness to Experience. While the intelligence interaction was significant, it did not represent the hypothesized relationship. Therefore, these hypotheses were not supported. These individual differences did not buffer the detrimental effects of multi-tasking for the reference task.

Hypothesis 4a predicted that subjects would find the multi-tasking condition more stressful than the control condition. This hypothesis was supported. In addition, it was predicted that Trait Anxiety and Neuroticism would moderate this relationship. Neither of these interactions was found. Therefore, hypotheses 4b and 4c were not supported.

It was then predicted that this increased stress level would lead to withdrawal (Hypothesis 5a). This proved true for this study. Subjects who perceived more stress were more likely to report withdrawal from the task. Hypotheses 5b, 5c, and 5d predicted that Conscientiousness, Mastery Orientation and Performance Orientation would moderate this relationship. These moderating effects were not found, so none of these interactions were supported by this study.

Hypothesis 6a predicted that higher perceived stress levels would lead to increased avoidant coping. The results support this hypothesis. Individuals who perceived more stress were more likely to report using avoidant coping strategies. Hypotheses 6b and 6c predicted that Locus of Control and Neuroticism would moderate this relationship. These moderating relationships were not supported.

Hypotheses 7a – 7d predicted that a similar relationship would exist between perceived stress and problem focused coping. The results indicate that the increased

stress levels did not lead to the expected increase in problem focused coping. The hypothesized interaction with Neuroticism was supported, but the interactions with Type A and Locus of Control were not.

Hypotheses 8a and 8b predicted that both avoidant coping and problem focused coping would have direct effects on withdrawal. Specifically, it was predicted that avoidant coping would be positively related to withdrawal and that problem focused coping would be negatively related to withdrawal. Both relationships were supported. Likewise, Hypothesis 9 predicted that withdrawal would have a main effect on performance, also supported. Subject who reported withdrawing from the task performed worse.

Trends

Some general trends are apparent in these data. First, the basic characteristics of and effects of multi-tasking were generally supported. Subjects perceived the uncertainty and urgency in the multi-tasking situation and were cognizant of the switching. The subjects in the multi-tasking condition experienced higher stress levels, engaged in more avoidant coping, were more likely to report withdrawal and performed worse on the reference task. The supplementary analyses support the revised conceptual model first presented in Figure 1, providing a first peek into the effects of multi-tasking and the reasons it affects performance. It is important to note that the strength of this model is partially achieved by the removal of problem focused coping from the model and the choice made to use the reference task as the measure of performance. Both of these

decisions were made post-hoc, and therefore represent areas in which more support would be desirable.

The individual predicted hypotheses, though, represent a significant step forward in multi-tasking research. Prior to this, the only documented outcome of multi-tasking was the decrease in performance. We now have support for the fact that subjects do, in fact, perceive uncertainty and urgency in the multi-tasking situation. We also have support for the fact that they find multi-tasking more stressful than single task performance, and that this stress is associated with an increase in withdrawal behaviors. In short, we know more about what happens to individuals performing under multi-tasking conditions.

Disappointingly, though, the hypotheses involving individual differences were by and large not supported. While one of the hypothesized interactions was significant, supplementary analyses indicate that none of the measured personality variables were related to performance, and none yielded significant interactions with multi-tasking on performance. Therefore, these personality variables were neither helpful in predicting performance nor in predicting the decrement in performance associated with multi-tasking.

It appears from the results found that the Situational Judgment Test proved problematic for this study. Performance on this task failed to exhibit the expected process losses normally associated with multi-tasking. Also, performance on this task was generally quite low (See Table 3). It is possible, then, that this student population may not have been well equipped for the task. Their performance levels may have been too low to exhibit the decrease normally associated with multi-tasking, causing a floor

effect. Because the expected results were found for the reference task, the remainder of this discussion centers around that measure of performance.

Also, it is important to note that for two places where significant interactions were found for individual differences, they were not of the nature that was predicted. First, there was a multi-tasking by intelligence interaction on performance. In this case, the interaction is pretty clear. From the graph (See Figure 3), both expected main effects can be observed: the control group performed better than the multi-tasking group, and more intelligent subjects performed better than less intelligent subjects. The interaction, however, was not the expected one. The interaction indicates for those of low intelligence, there was only a small performance difference between conditions whereas for highly intelligent subjects, this difference was larger. Thus, high intelligence levels were not enough to buffer subjects from the deleterious effects of multi-tasking. These subjects, in fact, appear to suffer an increased difference in performance under these conditions than did those of low intelligence. One reasonable interpretation would be that a floor effect is exhibited: that subjects of low intelligence were not as greatly impacted by multi-tasking because their performance levels were already generally low.

A second interaction was found between stress and Mastery Orientation on withdrawal. From the graph (See Figure 4), it appears that under low and moderate levels of perceived stress, mastery oriented subjects were about as likely to withdraw from the task as were non-mastery oriented subjects. In contrast, under higher levels of perceived stress, mastery oriented subjects were *more* likely to report withdrawal. This is an unexpected result.

In order to understand this result, it is important to note that what is measured is *perceived* stress. Mastery Orientation was actually negatively correlated with perceived stress. Thus, it may be necessary for Mastery Oriented subjects to be subjected to increased stressors in order for them to perceive the same level of stress that individuals low on this trait do. The interaction presented in Figure 4, then, does not represent a difference in high and low mastery oriented subjects' reaction to actual stress. With this in mind, it is easier to reconcile this apparent conflict with the Mastery Orientation literature. Mastery Oriented subjects may not be protected against the stress they perceive, the may merely be less likely to perceive the stress in the first place. In either case, the expected interaction was not supported. Mastery Orientation did not buffer subjects against withdrawing.

Implications

What are the implications of the results of this study? First, the conceptual model originally presented in Figure 1 appears to be supported. As evidenced by the structural model (Figure 6), multi-tasking has effects on perceived stress, avoidant coping, withdrawal and performance. The data support the belief that performing under multi-tasking conditions is stressful and causes both avoidant coping and withdrawal from the tasks. As mentioned previously, despite the fact that the direct links between multi-tasking, stress, withdrawal, avoidant coping and performance were significant, the indirect effects of multi-tasking on performance did not reach significance. As will be

discussed below, there were some experimental factors which may have caused these relationships to be too weak to exert the overall expected effect.

The existence of the relationships between multi-tasking, stress, avoidant coping, withdrawal and performance as well as the success in discovering that subjects find the multi-tasking uncertain and urgent and notice the task switches represents a large step forward in multi-tasking research. Previous literature has failed to document these effects. These results thus leave the task for future research a little more concrete, and provide a basis through which the multi-tasking situation can be explored. For example, by expanding upon the relationships between multi-tasking and its outcomes (stress, uncertainty, withdrawal, etc.), future research may explore more fully what happens to an individual when they multi-task.

A major non-finding is the failure of the hypothesized individual differences. As discussed above, only one of the hypothesized individual difference hypotheses were supported. This begs the question of *why* these differences failed. Why were these differences not found?

One possibility is that individual differences are unrelated to the multi-tasking process. Perhaps individuals all respond to multi-tasking, stress, uncertainty and withdrawal in the same way. This interpretation presents some difficulty in light of the presented past research indicating expected relationships between these personality variables and the mediating variables. That is research has documented that in other situations individuals have differentially responded to stress, uncertainty, etc.

A second possibility is that the experimental conditions were problematic. We have already discussed the fact that the situational judgment test appears to have been

somewhat troublesome, but there are other factors that indicate something larger may be a problem.

First, while multi-tasking was significantly related to the stress and withdrawal reported by the subjects, the mean values for these variables remain quite low (see Table 3). That is, while the control group and the multi-tasking group differed significantly on these variables, even the multi-tasking group reported relatively low levels of stress and withdrawal. The theories upon which the individual difference hypotheses were based, however, are aimed at higher levels of stress. This suggests that the multi-tasking situation in this experiment may not have been stressful enough for this literature to be relevant. The multi-tasking conditions to which this study was to generalize also include high levels of stress. Thus, while the current conditions induced some stress, it may not have been enough stress to adequately simulate realistic conditions, causing a failure of the related individual difference hypotheses.

In further support of this idea is the fact that the effect sizes for these effects are quite small. For example, the eta squared value for the effect of multi-tasking on stress was only .02. Multi-tasking in this experiment had a significant effect on stress levels, but not a large one, indicating that multi-tasking did not increase the stress level of this particular situation very much. A similar small effect size can be found between multi-tasking and performance. While multi-tasking decreased reference task performance enough to be statistically significant, this effect was small. These small effects lead to the conclusion that while this experiment successfully emulated some characteristics of multi-tasking, it may not have done so at a level high enough for the individual differences to play a significant role.

If this latter possibility, small effect sizes of multi-tasking in this experiment, is the cause for the failed results, it is important to determine what characteristics of the experimental design may have contributed to it to determine how to improve future experimental conditions. One possibility is that the student sample used in this experiment was unsuitable. Student subjects, by nature, may be less motivated than other sample populations, especially the manager population to which this research is to be generalized. Managers accomplishing real tasks upon which their livelihoods depend are bound to be more motivated than are students performing those same tasks for the purposes of an experiment.

This lower level of motivation would explain why the effects on performance and stress were not large. If the subjects were operating at less than full capacity under the control condition, one could expect that multi-tasking might create less of a hazard than normally expected. The subjects in the multi-tasking condition might increase their effort levels to compensate, and they might be less stressed by these more difficult conditions because they haven't yet reached full capacity.

A second possible problem may have been the inclusion of two breaks in the experiment. These breaks were designed to allow a process measure of withdrawal, but they may have had other, less desirable effects. Instead of one large block of time, which may have been more stress-inducing, the subjects experienced three shorter blocks of time, during which their stress levels may have been reduced back to starting levels. Thus, the difference between the multi-tasking condition and the control condition might be reduced. Without this difference in conditions and with the lower level of stress, the predicted interactions would be unlikely.

Similarly, experimental constraints necessitated a short, contained time frame and tasks that were only relevant to the subjects for the short duration of the experiment. In other words, subjects only had a limited investment in their performance on these tasks, and did not have the time to develop any further attachment to their performance. This lack of attachment may also have reduced their motivation levels.

While subjects generally reported high levels of motivation (See Table 5), the scale used was aimed at searching for subjects who were completely uninvolved in the experiment. That is, the scale was used to determine whether there were subjects who disregarded the instructions and merely 'went through the motions.' The items, presented in Appendix 13, reflect this specific scope. Thus, while the subjects reported that they were motivated to participate in the experiment, they were more correctly indicating a lack of disinterest. This level of motivation may fall far short of the motivation experienced by real employees engaged in multi-tasking.

Under these conditions, the tasks were not relevant to the subjects beyond the scope of the experiment. That is, they had no vested interest in their performance on the situational judgment test or the reference task beyond earning a chance at the monetary prize associated with the experiment or their own intrinsic interest, which might be assumed to be small. This may have decreased the subjects' emotional investment in the tasks and therefore reduced the extent to which they experienced the predicted reactions.

Also to be considered are the tasks themselves. The multi-tasking literature has traditionally focused on very simple, discrete tasks such as reciting digits or performing simple mathematical operations. Switches are made between discrete portions of the task. For example, subjects are repeatedly adding digits, and then are signaled to subtract

the next pair. They are not interrupted in the middle of adding the digits. The current study uses tasks that require a little more continuous performance. Subjects were asked to perform tasks that required somewhat more continuity, causing a situation in which they may be interrupted in the middle of answering a question. For example, an individual may be in the process of looking up a profit value in a table for the reference task when the switch is made. This is in contrast to previous literature in which switches were generally only made between task components.

The situation to which this experiment is to be generalized, though, is even more continuous. Real work tasks often require extended attention to complete any concrete portion. Thus, interruptions in these sorts of tasks might cause a larger period of disorientation and increase the multi-tasking process losses. If one is interrupted during a reference task, it may take a few seconds upon return to the task to determine what one was doing and to return to that point. In a more complicated, more continuous task, such as creating a budget this lag may be much more severe. This type of multi-tasking situation might therefore have larger effects on performance levels and may create a larger opportunity for individual differences to play a role. For example, many individuals may be able to rather easily shrug off the short losses in time associated with multi-tasking on discrete tasks. When they experience the larger losses associated with continuous tasks, though, their ability to remain emotionally unaffected by them may depend on their natural tendency to perceive stress (i.e. Trait Anxiety).

All of these potential problems reflect some lack of realism in the current multi-tasking situation. A real work environment in which multi-tasking takes place should evoke higher stress levels, a more complete motivation, and would have further reaching

consequences. While any lab study falls short in this regard, it is possible that in this case, this lack of realism is a larger problem. These potential problems may also explain why the structural model shows that the indirect path from multi-tasking to performance was non-significant.

Future Directions

The natural question to ask at this point, then, is what should be done in future experiments. One goal should be to eliminate some of the potential problems of the experimental design discussed above. The easiest and most straight forward of these changes should be to eliminate the breaks from the experimental design. The benefit in terms of allowing an additional measure of withdrawal was not borne out for the current experiment, and the costs are apparently high. A continuous multi-tasking situation would significantly contribute to the realism of the experimental setting. It will reduce the chances that subjects' stress levels are reduced artificially.

Second, future research should consider incorporating more realistic and more meaningful tasks. As discussed above, some potential problems with this type of multi-tasking research may stem from the lack of connection subjects feel with the tasks, the short duration of their association with them, and the discrete nature of the tasks. Additionally, it was noted that the situational judgment test may have been too difficult for this particular subject population. An attempt to choose tasks that avoid these pitfalls should increase the chances that realistic stress and withdrawal levels are achieved.

The most obvious way to increase the duration and association with the tasks would be to run a field study. One may be able to create multi-tasking conditions out of real tasks that must be achieved by the subjects, or may be able to tap into an existing multi-tasking scenario. For example, it would be more realistic to create multi-tasking conditions out of the real budgeting, report writing, and performance appraisal tasks the subjects already need to accomplish. These tasks have the additional advantage of being more continuous than the tasks previously used in multi-tasking research. While it might be more difficult to simulate this in an experimental setting, one might still be able to find a way to focus on the tasks already important to the population being studied, rather than attempting to induce this motivation externally.

In sum, this study proved moderately successful. Some relationships between multi-tasking and other variables were found, and a preliminary overall model of the multi-tasking process was achieved. The results support a view that multi-tasking increases stress, avoidant coping and withdrawal. Thus, the multi-tasking process has been more clearly defined, and this may lead to increased understanding in later studies.

In terms of the goal of finding individual differences, future research will have to be conducted that increases the realism of the multi-tasking situation and the component tasks. The supported conceptual model should still provide a basis through which some of this research could progress provided that the recommended changes are considered.

APPENDICES

APPENDIX A

Goal Orientation Items (Button, Matheiu and Zajac, 1996)

I prefer to do things that I can do well rather than things that I do poorly
I'm happiest at work when I perform tasks on which I know that I won't make any errors.
The things I enjoy the most are the things I do the best.
The opinions others have about how well I can do certain things are important to me.
I feel smart when I do something without making any mistakes.
I like to be fairly confident that I can successfully perform a task before I attempt it.
I like to work on tasks that I have done well on in the past
I feel smart when I can do something better than most other people.

The opportunity to do challenging work is important to me.
When I fail to complete a difficult task, I plan to try harder the next time I work on it.
I prefer to work on tasks that force me to learn new things.
The opportunity to learn new things is important to me.
I do my best when I'm working on a fairly difficult task.
I try hard to improve on my past performance.
The opportunity to extend the range of my abilities is important to me.
When I have difficulty solving a problem, I enjoy trying different approaches to see which one will work.

APPENDIX B

Tolerance of Ambiguity Items (Major, 1990)

I'm uncomfortable when I'm not sure what is expected of me.
I dislike people who expect me to figure out my work assignments on my own.
Jobs that have a lot of change and uncertainty are more desirable than jobs with little change and uncertainty.
It is impossible to do a good job when the requirements keep changing.
A good job is one where what is to be done and how it is to be done are always clear.
I prefer work assignments with specific directions to those with vague directions that require my own interpretation.

APPENDIX C

Locus of Control (Rotter, 1966)

In the long run, people get the respect they deserve in this world.
Without the right breaks, one cannot be an effective leader.
Becoming a success is a matter of hard work, luck has little or nothing to do with it.
When I make plans, I am almost certain I can make them work.
In my case, getting what I want has little or nothing to do with luck.
Who gets to be the boss often depends on who was lucky enough to be in the right place first.
As far as world affairs are concerned, most of us are the victims of forces we can neither understand, nor control.
Most people don't realize the extent to which their lives are controlled by accidental happenings.
How many friends you have depends upon how nice a person you are.
Many times I feel that I have little influence over the things that happen to me.

APPENDIX D

Type A (Forgays et al., 1993)

Selected items (revised to eliminate 'always' 'never') Removed multi-component items.

Situations provoke me into competition.
I try to get my way.
I do most actions quickly.
I perform daily activities such as eating more quickly than others I know.
When someone speaks slowly or 'rambles,' I often have the urge to hurry them up or complete their sentences.
When something has to be done, I start in right away to get it done.
When someone or something makes me angry, I let everyone know about it.
I like to participate in competitive games or sports.
Others view me as even-tempered.
I give in easily to the will of others.

APPENDIX E

Trait Anxiety (Coren 1988)

I am a calm person.
I get flustered if I have several things to do at once.
Sudden changes of any kind produce an immediate emotional effect on me.
Strong emotions carry over for one or two hours after I leave the situation which caused them.
I am restless and fidgety.
My mood is quickly influenced by entering new places.
I get excited easily.
I find that my heart keeps beating fast for a while after I have been "stirred up."
I can be emotionally moved by what other people consider to be simple things.
I startle easily.
I am easily frustrated.
I tend to remain excited or moved for a long period of time after seeing a good movie.

APPENDIX F

Big Five – NEO- PI

Neuroticism
I am not a worrier.
I often feel inferior to others.
When I'm under a great deal of stress, sometimes I feel like I'm going to pieces.
I rarely feel lonely or blue
I often feel tense and jittery
Sometimes I feel completely worthless.
I rarely feel fearful or anxious.
I often get angry at the way people treat me.
Too often, when things go wrong, I get discouraged and feel like giving up.
I am seldom sad or depressed.
I often feel helpless and want someone else to solve my problems.
At times, I have been so ashamed I just wanted to hide.

Extraversion
I like to have a lot of people around me.
I laugh easily.
I don't consider myself especially light-hearted.
I really enjoy talking to people.
I like to be where the action is.
I usually prefer to do things alone.
I often feel as if I'm bursting with energy.
I am a cheerful, high-spirited person.
I am not a cheerful optimist.
My life is fast paced.
I am a very active person.
I would rather go my own way than be a leader of others.

Openness
I don't like to waste my time daydreaming.
Once I find the right way to do something, I stick to it.
I am intrigued by the patterns I find in art and nature.
I believe letting students hear controversial speakers can only confuse or mislead them.
Poetry has little or no effect ton me.
I often try new and foreign foods.
I seldom notice the moods or feelings that different environments produce.
I believe we should look to our religious authorities for decisions on moral issues.
Sometimes when I am reading poetry or looking at a work of art, I feel a chill or wave of excitement.
I have little interest in speculating on the nature of the universe or the human condition.

I have a lot of intellectual curiosity.
I often enjoy playing with theories or abstract ideas.

Agreeableness
I try to be courteous to everyone I meet.
I often get into arguments with my family and co-workers.
Some people think I'm selfish and egotistical.
I would rather cooperate with others than compete with them.
I tend to be cynical and skeptical of others' intentions.
I believe that most people will take advantage of you if you let them.
Most people I know like me.
Some people think of me as cold and calculating.
I'm hard headed and tough minded in my attitudes.
I generally try to be thoughtful and considerate.
If I don't like people, I let them know it.
If necessary, I am willing to manipulate people to get what I want.

Conscientiousness
I keep my belongings clean and neat.
I'm pretty good about pacing myself so as to get things done on time.
I am not a very methodical person.
I try to perform all the tasks assigned to me conscientiously.
I have a clear set of goals and work towards them in an orderly fashion.
I waste a lot of time before settling down to work.
I work hard to accomplish my goals.
When I make a commitment, I can always be counted on to follow through.
Sometimes I'm not as dependable or reliable as I should be.
I am a productive person who always gets the job done.
I never seem to be able to get organized.
I strive for excellence in everything I do.

APPENDIX G

Task A – Example Reference Item

Please look at the following table and indicate how much profit was earned by Company F in 1995.

Profit

	Year		
Company	1995	1996	1997
A	3876	3821	3865.75
B	15504	15449	12586.75
C	23256	23201	18400.75
D	7752	7697	6772.75
E	31008	30953	24214.75
F	174420	174365	131773.8
G	27132	27077	21307.75
H	1364352	1364297	1024223
I	174420	174365	131773.8

a) 30953
b) 31008
c) 174420
d) 174365

APPENDIX H

Task B – Example SJT Item

Pretend that you are the manager of a manufacturing plant team. Below, you will find a set of potential work situations. Assuming that you would like to perform as well as possible, please choose the alternative that **best** indicates how you would respond to each situation.

Associates from different departments have started to congregate in your work area, disrupting your team's activity. How would you handle this situation?

Ask the associates to leave the area, but explain that they could come back on their break or at lunch.
Tell the associates to leave and explain that they can talk during non-work times
Tell associates to move out of the work area and to meet during lunch in the cafeteria.
Allow associates a 'courtesy minute' to finish discussing their business, then politely ask them to discuss the matter later.
Discuss the matter with your associates and explain to them your expectations. You should also contact the team leaders of the other associates and ask their assistance in resolving the problem.
Ask the associates to discuss any personal matters on their own time. If this approach does not resolve the problem, speak with the associates' or team leaders.

APPENDIX I

Task C – Example Logic Puzzles

Some letters have been omitted from this alphabet. Use the missing letters to form the name of an occupation.

BCDFGHIJKMNOPQSTUVXZ

What letter does the occupation begin with?
A
E
L
Y

In a certain bank the positions of cashier, manager, and teller are held by Brown, Jones and Smith, though not necessarily respectively. The teller, who was an only child, earns the least. Smith, who married Brown's sister, earns more than the manager.

Who is the teller?
Brown
Jones
Smith

APPENDIX J

Perceived Stress (Cohen et al., 1983)

(Minor wording revisions & changes to make it focused on study rather than global)
Removed items – coping
One new item

Please rate the extent to which you each of the following was true of you during this portion of the experiment.

1	2	3	4	5
Not at all		Occasionally		Much of the time

During this session, I was _____

Upset because of something happening unexpectedly.
Unable to control the important things.
Felt nervous and 'stressed.'
Felt confident in my ability to handle problems.
Felt things were going my way.
Was able to control irritations.
Felt I was on top of things.
Felt pressured.

APPENDIX K

Coping Items

Please rate the extent to which you engaged in each of the following behaviors during this portion of the experiment.

1	2	3	4	5
Not at all		Occasionally		Much of the time

During this session, I dealt with stressful feelings by _____

Avoidant Coping

Trying not to get concerned about it.
Pretending it hasn't really happened.
Telling myself that time takes care of situations like this.
Refusing to believe that it has happened.
Accepting this situation because there is nothing I can do to change it.
Acting as though it hasn't happened.
Saying to myself, "this isn't real"

Problem Focused Coping

Trying to work harder and more efficiently.
Giving it my best effort to do what I think is expected of me.
Doing what has to be done, one step at a time.
Making a plan of action.
Thinking hard about what steps to take.
Thinking about how I might best handle the tasks.
Devoting more energy.

APPENDIX L

Behavioral Withdrawal – Self Assessment

Please rate the extent to which you engaged in each of the following behaviors during this portion of the experiment.

1	2	3	4	5
Not at all		Occasionally		Much of the time

During this session, I _____

Withdrew some of my effort.
Stopped working as hard as I could.
Took small breaks when asked to switch to a new task.
Spent time looking around the room.
Thought about other activities such as my plans for the rest of the day.
Daydreamed.

Behavioral disengagement (Carver et al., 1989)
Gave up the attempt to get what I wanted.
Gave up trying to reach my goals.
Admitted to myself that I couldn't deal with it, and quit trying.
Reduced the amount of effort I was putting into solving the problem.

APPENDIX M

Pilot and Manipulation Check Items

For each statement, please indicate the degree to which it applies to you:

Uncertainty
I was able to predict when I'd have to switch between tasks.
While I was answering questions, I knew how much longer I'd be able to spend on that task.
I was uncertain about when I'd have to switch to a new task.
I knew when the next task would begin.

Switch and interruption
I was interrupted while in the middle of thinking about questions.
I had to stop thinking about one task in order to begin the next.
I was frequently interrupted while in the middle of questions.
I was required to switch between the three tasks frequently.

Urgency
Performing these tasks quickly is important.
I had plenty of time to complete the tasks.
In order to do well on these tasks, a person would need to work quickly.
I would need more time to perform well on these tasks.

Affect
I am satisfied with my overall performance on this task.
I am pleased with how I am doing.
My current performance satisfies me.
I am happy with my performance at this point.
I would be happier if I were performing better than I am now.

Motivation
I put forth effort to answer questions accurately and honestly.
I tried to do well while performing these tasks.
Overall, I was motivated to do well on all parts of the experiment.

Interest

For each question, please indicate whether it is true about each of the three tasks:

I liked these types of questions.
While answering these questions, I enjoyed trying to find the answers.
These questions were very interesting to me.
For tasks like this, I don't need a reward. They are lots of fun anyhow.
I would work on questions like this in my free time.

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