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A Holistic Work System Approach to Creating Flow During Transactional Work

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A HOLISTIC WORK SYSTEM APPROACH TO CREATING FLOW DURING TRANSACTIONAL WORK

by

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ABSTRACT

Psychological flow is a positive mental state where one is so fully concentrated in a challenging task that self-consciousness falls away, time seems to stand still, and the reward is the experience of meeting the challenge. Previous research on flow in the workplace has been performed on how to create conditions to promote its occurrence in workers, to describe its attendant individual and organizational benefits, and to measure it through self-reported means and physiologically. Such research has been focused on creative endeavors (such as the arts, sports, medicine, teaching), where individuals have high agency over the execution of activities needed to successfully complete the work. This research focuses on flow in back-office transactional work, which has been little studied to date. Transactional work are those tasks that are largely rote, repetitive, and prescribed by standardized procedures, leaving little room for agentic options. Examples of such work include data entry and bookkeeping A theory is next discussed that offers the notion of a holistic system of non-task variables working together with job tasks to create conditions conducive to increasing the likelihood of transactional workers experiencing flow. Flow will next be compared to similar constructs and their relatedness to flow will be discussed. Various flow measurement methods will be presented, along with their advantages and disadvantages. These discussions set the stage for the present set of qualitative and quantitative research efforts, whose objective is to offer support for the holistic work system approach to creating flow. First, a phenomenological study of flow in transactional workers is presented, where their lived experiences of flow are documented and the extent to which certain non-task work system variables support the occurrence of flow. Next, a proof-of-concept laboratory experiment is reviewed, where seat comfort (a non-task work system factor) is shown

to be a first-order influencer of flow in the study's participants. Finally, the results of a designed experiment incorporating multiple non-task work system factors are presented and the interaction of high seat comfort and low computer screen contrast are shown to directly impact the occurrence of flow in that study's participants. Flow is also shown to predict productivity improvements in participants when combined with high seat comfort and low computer screen contrast. Additionally, certain physiological functions thought to correlate to flow are selected and measured in the participants. Lower heart rate variation partially correlates to flow. The results are applicable to the design of holistic work systems in organizations employing back-office transactional workers. Recommendations for future research are presented that will strengthen and build on the current results.

ACKNOWLEDGMENTS

I thank my committee – Dr. Waldemar Karwowski, Dr. Peter Hancock, Dr. Ahmad Elshennawy, and Dr. Dag Naslund – for providing technical guidance in my research and invaluable advice on navigating the various channels of academia. I especially thank them for their unwavering support of my work all along the long road from the start to where I am now. I'm not saying "to the finish" because I hope to continue collaborating with these gentlemen for many more years.

I also thank the many participants who volunteered to participate in my three studies. Without them, my work and writing would be theoretical and of less practical use to my target population.

And so, I thank the thousands of loan collectors, document processors, quality control specialists, and the like, with whom I have collaborated during my professional career. They are part of my target population of millions of back-office transactional workers. Designing better work processes with them over the last 25+ years has informed my desire to help make their work lives more enjoyable through my doctoral studies and, hopefully, beyond.

Finally, I thank my mom Elaine, my children David and Rebecca, and countless friends and colleagues who have supported me by expressing undying interest in my academic work, cheered me on, and patiently listened to me go on about laboratory set-ups and statistical tests. Nevertheless, sorry, you cannot address me as "doctor" or "professor." I'll always be Steve.

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CHAPTER 1: INTRODUCTION

Background and Motivation for Research

"I don't want to work / I want to bang on the drum all day." So said Todd Rundgren two generations ago (Rundgren, 1983), and I have heard it countless times in various forms in my 25 years' experience as a process improvement management consultant. My work with financial institutions involved collaborating with such office workers as loan collectors, call center representatives, and data entry clerks to ostensibly make their work lives easier by streamlining their work and by judiciously employing enabling technology. However, many said things to me indicating their dissatisfaction with their livelihood, like, "I can't wait until it's Friday so I can enjoy the weekend" and "The work is OK, but it's not what I want to do much longer." They acted out their dissatisfaction through texting on their cell phones during the workday and frequently calling in sick (although some did not even notify their managers at all about their absences). They frequently bickered with and gossiped about each other. Why did these individuals express counterproductive work behaviors? Why did they appear to simply bide their time in the office and look forward to escaping it?

To answer that question, we must first identify what these individuals are *not* feeling. Mueller (2019), in his analysis of other researchers' work in employee engagement, summarizes the many definitions of employee engagement as the concurrent exertion of various personal energies on the work, toward the work team, and on behalf of the organization. Such energies fall along the physical, emotional, cognitive, and spiritual dimensions.

The office workers I have consulted with – who have quite openly expressed their desire to be elsewhere – feel the opposite of the definition of engagement. They have little to no energies to exert. They are not engaged at best and actively disengaged at worst. Gallup (2017, p. 63) defines these energetic levels as:

> Not engaged: the state of being psychologically unattached to one's work because the organization is not fully meeting one's needs; putting time but not energy or passion into one's work.
>
> Actively disengaged: visibly acting out one's unhappiness with the work and/or workplace because the organization is not meeting one's needs at all; purposefully undermining others' accomplishments.

There are real financial and non-financial costs associated with employees who are not fully engaged in their jobs. As of 2009, Gallup, Inc., estimated employee disengagement resulted in lost productivity worth between $250 billion and $350 billion yearly in the US (as cited in Attridge, 2009). In its follow-up 2016 study, Gallup, Inc., estimated that actively disengaged workers cost the US economy between $483 billion and $605 billion per year (Gallup, 2017). Clearly, disengagement in the workplace has been worsening.

Saks (2006) empirically identified a significant causal relationship between reduced job engagement and its consequences: diminished job satisfaction, organizational commitment, and organizational citizenship behaviors, and higher intention to quit. Lower job satisfaction leads to higher likelihood of stealing from the organization and increased absenteeism (Lau, Au, and Ho, 2003).

Engaged employees, on the other hand, have been shown to experience higher in-role and extra-role performance (for those with a high degree of conscientiousness; Demerouti, 2006). Stander, Mostert, and de Beer's research (2014) found a significant positive relationship between engagement and productivity (albeit self-reported). Gallup, Inc., (2017) documented that, when comparing top-quartile engaged organizations to bottom-quartile engaged organizations, those in the top quartile were 17 percent more productive, had 70 percent fewer employee safety incidents and 58 percent fewer patient safety incidents, and 41 percent less absenteeism.

Without question, engaged employees – those who are performing at their peak capabilities and enjoy what they do (Organizational Behavior, 2017, p. 33) – are more valuable to themselves, to their teams, and to their organizations. What can we do to minimize disengagement and create engaged employees? One way, which is the focus of this present research, is to create conditions in the workplace conducive to producing a positive psychological phenomenon termed "flow" in workers.

In the early 1970's, Mihaly Csikszentmihalyi (1975) explored the curious matter of artists becoming so engrossed in their paintings that they would forget about all other stimuli, like hunger and exhaustion. Although these artists were not guaranteed that their works would bring them financial gain, they intensely enjoyed creating their pieces. However, once they completed their work, the artists lost all interest in their paintings. The challenge of the creation of the art itself – finding the right blend of paint to create a flesh tone, balancing the play of light and shadow on the canvas – was the reward. Csikszentmihalyi studied rock climbers, open ocean sailors, sports players: all experienced this state of complete immersion in their work and joy in meeting the challenges of their chosen pastimes. Csikszentmihalyi named this positive

psychological construct "flow" after the descriptions some interviewees gave of the feeling of being caught up in a river of deep emotion while engaged in their hobbies (Csikszentmihalyi, 1990; Claremont Graduate University, 2000). He defined flow as "the state in which people are so involved in an activity that nothing else seems to matter; the experience itself is so enjoyable that people will do it at great cost, for the sheer sake of doing it" (Csikszentmihalyi, 1990, p.4).

According to Csikszentmihalyi (1990), flow consists of nine dimensions. These are: i) a balance between the challenge of the task and the skill of the performer; ii) clear goals; iii) immediate feedback; iv) a merging of action and awareness; v) the ability to concentrate solely on the task at hand; vi) a sense of being able to control the means to achieve the task's outcome; vii) a loss of self-consciousness; viii) a transformation of the sense of time passing (either faster or slower than normal); and ix) an autotelic (self-rewarding and enjoyable) experience. Csikszentmihalyi (1988), Chen, Wigand, and Nilan (1999), and Fullegar, Delle Fave, and Van Krevelen (2017) have proposed that these dimensions follow a time-ordered sequence, such that antecedents of flow lead to characteristics of flow, which in turn generate consequences of flow. Figure 1 illustrates this relationship:

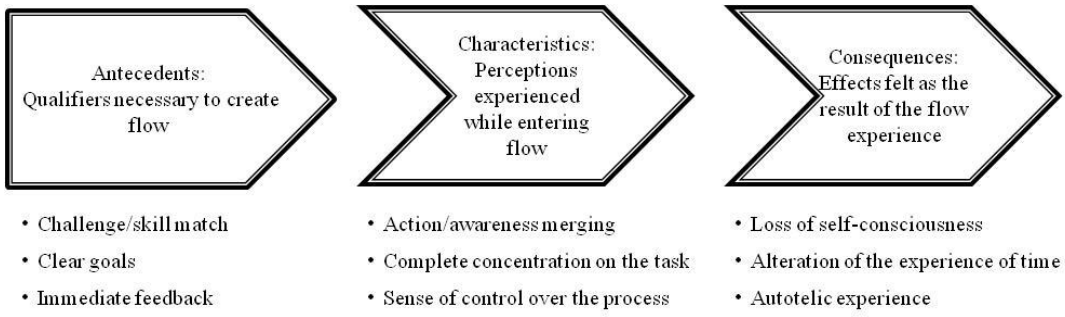

Figure 1. Flow state model showing time-ordered components of each phase of flow (Csikszentmihalyi, 1988; Chen, Wigand, and Nilan, 1999; Fullegar, Delle Fave, and Van Krevelen (2017).

Flow has been researched and measured in working adults (for example, Csikszentmihalyi, 2003; Bakker, 2008; Fullegar and Delle Fave, 2017). However, prior research has relied heavily on study participants recalling their experiences post-execution and documenting how they felt via questionnaires. Little empirical research has been performed, such as laboratory experiments. I have found relatively sparse research on flow specifically in office workers (for example, Bryce & Haworth, 2003; Eisenberger et al., 2005). Again, flow in this population has heretofore been identified and measured via recall-based questionnaires.

The aim of this present research is to qualitatively (interviews, survey instruments) and quantitatively (empirical study) determine how to create conditions ripe for the onset of flow in transactional office workers, a large population of employees in the U.S. (see the Scope of Research section below) where rote, repetitive work is the norm.

Problem Statement

Much research exists on flow in creative endeavors, identifying conditions that create the construct, describing what flow feels like during creative activities, and recommending organization-wide strategic improvements to promote flow. But a gap exists in understanding flow occurring during repetitive, procedure-driven work. Such activities are performed by transactional workers, numbering over 18.5 million individuals in the U.S. (Bureau of Labor Statistics, 2020). A gap also exists in identifying less strategic and more tactical (cheaper and faster) organizational improvements to make flow more likely to occur. In this present research, I will investigate the link between these tactical, non-task work system factors and flow, and the link between flow and productivity. The domain of this research will be in the realm of transactional work.

Research Objective

The objective of this research is to understand and document flow as experienced by transactional workers and to use this information, in conjunction with a novel theory of causes of flow and laboratory experimentation, to recommend a set of tactical organizational changes designed to engender flow in its transactional workers. Organizational benefits from successfully implementing these recommendations will be shown to include higher employee productivity and improved individual well-being.

Scope of Research

Transactional work. Transactional work is typically characterized by repetitive, assembly-line type work producing products (as opposed to experiences) with its employees paid for their work on an hourly basis (as opposed to a fixed annual salary) (Hunt, 2008). The scope of this present research covers transactional office work, which is typically sedentary, computer based, occurring amongst many individuals (to achieve scale), routine, subject to conformance with standardized steps, and measured with quantifiable production goals ("Transactional work," 2007; Power, 2012).

The population of individuals potentially affected by this present research is substantial. The Bureau of Labor Statistics category "43-0000 Office and Administrative Support" occupations very closely matches the definition of transactional office worker (Bureau of Labor Statistics, 2019). A sample of occupations in this group is shown in Table 1:

Table 1. Sample of transactional office worker descriptions

Occupation	Description
Billing and Posting Clerks	Compile, compute, and record data for billing purposes; prepare billing invoices.
Customer Service Representatives	Interact with customers in response to inquiries and to resolve complaints.
Cargo and Freight Agents	Expedite and route movement of goods through various modes of transportation; take orders from customers; prepare bills of lading.
Data Entry Keyers	Operate data entry device, such as keyboard, to place data into a system; duties may included verifying data.
Production, Planning, and Expediting Clerks	Coordinate and expedite the flow of work and materials within or between departments of an establishment according to production schedule.

Source: Bureau of Labor Statistics, 2019.

As of May 2018, 21.8 million individuals were employed in office and administrative support positions in the U.S., out of a total of 144.7 million U.S. workers. Although artificial intelligence, bots, and other technology are replacing some of this work, little change in employment levels is expected in this category through 2026 (Bureau of Labor Statistics, 2019).

The relationship between the work system and flow. Note that the nine dimensions of flow discussed above all center on the properties of the task alone being performed. For example: the challenge of the task must slightly exceed the individual's skill in executing the task; the task requires complete concentration by the individual; and there results a loss of self-consciousness while performing the task. The present research considers the assertion that a holistic work system is an enabler of flow, not solely the transactional activity (Clapp et al., 2018). The system under consideration in this present research consists of controllable factors that impact the employee on a tactical, daily basis. These factors include the task itself plus task-related communication (such as operating instructions), computer screen contrast, background

noise, and lighting levels, and seat comfort. See the section "Phase 1: Develop the Theory" in the Findings chapter for an elaboration on this theory of the holistic work system as an enabler of flow.

A holistic work system approach to the present study is supported by a wide range of prior research, including the holistic approach of contextual design (Beyer & Holtzblatt, 1999; Holtzblatt and Beyer, 2015), Norman's (2013) principles of the design of everyday things, and Bitner's (1992) concept of servicescapes. Contextual design states that the environment in which a task is performed and the artifacts used during task execution affect an individual's satisfaction with the tool utilized for the task and the individual's performance using the tool. Holtzblatt and Beyer (2015, pp. 8-10) state that successful holistic design touches on and enhances the human motives of:

- A sense of accomplishment, which maps to the flow antecedent of skill/challenge match, where the individual's skill supports his/her championing over the challenge presented;
- A feeling of connectedness, which relates to the flow antecedent of clear goals as individuals share one or more common purposes;
- The need for self-identity and for social conformity (although these concepts are contrary to the flow consequence of a loss of self-consciousness, where such needs fall away); and
- Sensual delight, supporting the flow antecedent of receiving feedback while executing a task and, if colors, sounds, and other environmental factors are combined

and presented correctly, reducing distractions to promote the flow characteristic of complete concentration on the task at hand.

Furthermore, contextual design should promote:

- An immediate link between thought of doing and a resulting action, synonymous with the flow characteristic of a merging between action and awareness, or the seeming elimination of thought while performing an activity;
- A removal of impedances to action, such as start-up steps and interface incompatibilities, which promotes the flow characteristics of complete concentration and of a sense of control over how the individual chooses to achieve a task goal; and
- As small a learning curve as possible so the individual can engage in action as quickly as possible, which supports a rapid entry into flow through a merging of action and awareness.

Norman (2013) writes about the design of physical objects, but his principles apply to non-tangible experiences as well. For example, his concept of "affordance" refers to a desired outcome designed into a physical object, such as a table affording a means of support to conduct some activity at a height comfortable for the individual to perform such activity. Work – a prime example of an everyday thing – affords the employee a way to earn a living at the most basic level; however, with humans devoting at least a third of their lived hours to work throughout a good portion of their existence, work should also afford the employee a sense of accomplishment through the right amount of challenge applied against his/her skills, through clearly stated goals to let the individual know what success looks like, and through real-time or near real-time feedback so he/she knows if progress toward the goal is being made or not.

A second analogy between the design of physical things and the design of work is regarding the aim of simplification of each. Make a physical object's components easy to recognize and simple to use, and less confusion occurs about how to use the object. Lowered confusion frees up cognitive resources to perform the desired task using the object. Similarly, design work holistically so the employee does not have to think about how to use work tools (e.g., computers, software, copier machines) or how to interpret work icons (e.g., door signs, software icons, organizational abbreviations and acronyms) and the employee has more cognitive resources to devote to meeting the challenge of the work task.

Bitner's (1992) "servicescape" concept centers on the researched relationship between environment and individuals' behavioral and physiological responses. Servicescapes consider the totality and interconnectedness of a work environment's ambient conditions (e.g., temperature, noise), utilization of space (e.g., layout, equipment, furnishings), and signs, symbols and artifacts (e.g., signage, personal effects, decor). Even though the work environment is composed of many different pieces, individuals react to the holistic sum of the parts. How these components are chosen and combined influence employees' performance, according to Bitner. For instance, the servicescape influences employees' beliefs about their fit within the organization: how the office is furnished and the size of the workspace affects workers' perceptions about the importance of their work. Adequate space, good ventilation, and sufficient lighting increase employees' feelings of control, which increase pleasure. Increases in pleasure help elicit positive work behaviors such as exploration of alternate solutions to business problems, staying longer during the workday, and commitment to the work and to the organization. Noise levels, temperature, and lighting intensity can contribute to physiological

comfort or discomfort (I happen to suffer from optical migraines when there is too much foreground-to-background contrast on the computer screen, and I lose concentration on my work). The longer the time spent in the workplace, the more important is the servicescape design to worker enjoyment. Transactional office workers typically spend extended periods of time working at their desks or stations, so the holistic design of work takes on more importance for this population.

In summary, factors for exploration in this present research include those that impact transactional office workers on a daily basis and that are easily modifiable by the organization.

The relationship between flow and productivity. General claims have been made that workers who experience flow at work are more productive (for instance, Csikszentmihalyi, 2003) and survey-based studies have shown a correlative link between flow and productivity (for example, Demerouti, 2006; Martin, 2005). This present research will incorporate a hands-on experiment to determine if participants who enter a flow state during the activity do produce results at higher levels than those who do not experience flow. Causation (or a lack of it) will be demonstrated. The hypothesized mediating relationship of flow between the work system design and productivity is shown in figure 3:

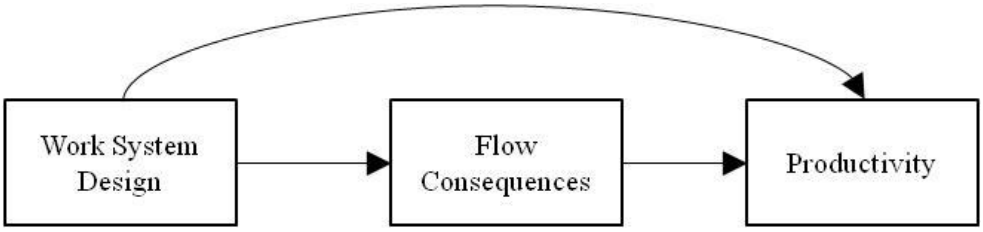

Figure 2. Model of flow as a mediator between work system design and employee productivity.

Physiological measures correlating to flow. A number of studies have linked various physiological functions to states of arousal and positive affect, including flow (for example, Keller et al., 2011; Longo et al., 2022; Steptoe and Wardle, 2005). This present research will identify a set of physiological functions that can be readily measured in subjects and attempt to correlate them to task productivity and to self-reported flow, as suggested by Longo and colleagues (2022).

Out of scope. Out of scope for this present research include distal organizational factors such as strategy and culture. While these work system components are important for long-term organizational health and individuals' alignment with the organization, the factors chosen for this study are those that most impact workers on a tactical level.

Also excluded are analyses of traits most likely to be open to experiencing flow. While studies of such traits are possible, investigating and recommending implementations of results (such as screening job candidates for desirable flow-leaning personality types) would unduly lengthen the time needed to complete this dissertation and is left for future research.

Contribution to the Body of Knowledge

As will be demonstrated in the literature review section of this dissertation, much research has been performed on flow experienced by workers in general, the link between flow and productivity, and on various physiological indicators that are theorized to occur in conjunction with flow. The present body of research, however, is the first to understand and document the means by which transactional office workers in particular experience psychological flow. This sub-population of workers was selected for two reasons. First, the

population size is substantial, comprising over 18 million workers in the US alone (Bureau of Labor Statistics, 2020). Even an incremental improvement in this cohort's work setting has the potential for improving these employees' well-being and organizational productivity. Second, since most of the extant flow research has been documented around creative endeavors, it can be assumed that the conventional wisdom is that non-creative activities, such as transactional office work, may not be fertile grounds for the launching of flow (for example, see Peifer and Wolters, 2021, for their citations of studies claiming as such, p. 299). I am attempting to prove that viewpoint wrong and to create interest in this understudied sub-population.

A substantial portion of this present research will consist of controlled laboratory studies simulating real office conditions to determine which of the studied non-task work system factors are most significant in engendering flow. These studies are supported by a separate effort documenting the lived experiences of transactional workers. Measurements will include participants' self-reported flow measures, quantitatively measured productivity, and physiological indicators purported to correlate to flow. An empirically driven model of flow and productivity will be derived. Organizations can readily incorporate the results of this qualitative and quantitative research into the design of their back-office transactional operations. Practical outcomes of such design efforts may include increased productivity, higher employee well-being, and improved pro-social behavior.

Research Questions

1. Which selected non-task work system factors will significantly contribute to achieving psychological flow while performing transactional work?

2. Does experiencing flow lead to higher productivity?

3. Which selected physiological measures are correlates to flow?

Research Hypotheses

Research Variables

Independent variables:

- Communication detail about the task. Clarity of purpose – what is to be done and why – is crucial to improving engagement of those executing the task (Csikszentmihalyi, 2003). Communication clarity will be varied in this present research by providing either a vague or a robust description of what is to be done and rationale for the experimental task. Note that this instructional communication does not include *how* the work is to be performed, as doing so may impinge upon the participants' sense of control over how to achieve the task's objective.
- Technology utilized: computer screen contrast. Technology comprises many tools – electronic, paper, and otherwise – needed to execute and support work. What is desired to be verified in this research is whether the quality of the technology used in executing the task has an effect on creating flow. Prior research by Chen, Wigand, and Nilan (1999) and by Triberti, Chirico, and Riva (2016) indicate that technology can be a conduit for the user to achieve a flow state. To keep the present analysis manageable, this variable will be limited to the quality of the visual representation of the work on a computer screen. This

quality will be further limited to the contrast ratio between the foreground information color and the background screen color, either high or low.

- Background noise. A review of the office and administrative support occupations the Bureau of Labor Statistics (2020) identifies as transactional reveals that substantially all of them describe work that is "sole actor" in scope; that is, workers in these fields perform tasks largely individually, although they may receive incoming data or materials from others to be able to fully execute their work. However, organizations believe they will achieve cost efficiencies in non-revenue producing functions (i.e., back-office transactional functions) by consolidating many of the employees responsible for these functions in consolidated departments (for example, Dranove, 1998; Schmitt, 2017). So, even though these workers toil alone, they are situated side by side with similar workers. The proximity of people leads to various forms of background noise, such as talking, ringing phones, and movement of matériel. The presence or absence of background noise will be analyzed for its impact on study participants' ability to achieve and maintain flow.
- Physical environment: seat comfort and lighting level. As has been described in the Scope of Research section, the design of the workspace influences workers' engagement with the task (Bitner, 1992; Norman, 2013; in addition, see Friedman, 2014, for numerous examples of how the design of the physical environment shapes individuals' behavior). Given the multitude of possible environmental variables one could manipulate, empirical studies could stretch on forever and require more participants than are readily available. This present

research will limit the variety to a more manageable subset: seat comfort and lighting level. These factors are frequently found in transactional settings and are easily manipulable in the laboratory. Seat comfort as an independent variable of the flow experience was first described in Clapp et al. (2021). Like the first study, the settings for this factor will be a backless, armless, non-adjustable padded bench (low comfort) and a five-way adjustable ergonomic office chair (high comfort). Lighting levels will be set at 500 lux (low level) and 1000 lux (high level), as recommended by the U.S. General Services Administration (GSA, 2019) and Moyano and Lezcano (2021).

Dependent variables:

- Psychological flow. The consequential flow dimension "autotelic experience" has been widely reported as the pinnacle outcome of one's psychological flow experience (Csikszentmihalyi, 1990; Jackson, 1996; Landhäußer and Keller, 2012; Panebianco-Warrens, 2014). Flow will be quantified in this present study through self-reported autotelic experience responses to a questionnaire.
- Productivity. This variable, measured as an outcome of two, ten-minutes rounds of a simple mathematical exercise as part of a designed experiment, is defined as either 1) the percentage difference in the number of correct scores from round 1 to round 2, if the participant required the entire allotted experimental time to complete each round (termed "score-difference productivity"), or 2) the percentage difference in the elapsed time from round 1 to round 2, if the

participant had correctly answered all mathematical sums in less than ten minutes over each of both rounds (termed “time-difference productivity”).

Physiological variables hypothesized to correlate with flow:

- Heart rate variability (HRV). Measured as the time variation (root mean square of successive differences) in milliseconds between a series of successive heartbeats, this physiological variable is thought be negatively correlated with flow; that is, variability will decrease as one experiences flow (Keller et al., 2011).
- Systolic blood pressure (BP). Measured as the arterial pressure when the heart contracts during a beat, this physiological indicator has been negatively associated with flow; that is, systolic BP decreases as one experiences flow (Steptoe and Wardle, 2005).
- Ratio of low-frequency HRV to high-frequency HRV (LF/HF). Low-frequency HRV is associated with activation of the sympathetic nervous system, as during states of arousal, and high-frequency HRV is associated with activation of the parasympathetic nervous system, as during states of relaxation. With flow being a state of optimal arousal, the ratio of LF/HF is thought to increase when one is experiencing flow (di Fronso et al., 2017; Gaggioli et al., 2013).

Hypotheses

The hypothesis relevant to research question 1 is:

H1: The independent variables predict the dependent variable psychological flow, measured as autotelic experience.

The hypothesis relevant to research question 2 is:

H2: The independent variables and psychological flow predict work productivity.

The hypothesis relevant to research question 3 is:

H3: One or more of the selected physiological measures are correlated to flow.

CHAPTER 2: LITERATURE REVIEW

Introduction

Productivity is classically defined as the value of outputs divided by the value of input resources (Krajewski, Ritzman, & Malhotra, 2013). Researchers and industry leaders have long looked for ways to improve the productivity of organizations' resources to produce more and better products and services. For example, in 1798 Eli Whitney invented the production of interchangeable parts in order to quickly fill an order of 10,000 muskets for the US government (Folaron and Morgan, 2003). In 1913, Henry Ford also introduced part consistency in his automobile factory (Folaron and Morgan, 2003), as well as the breakthrough manufacturing practices of the factory line (Williams, Haslam, & Williams, 1992). Traditional process improvement methods like Lean and Six Sigma have typically led to anywhere from five percent to 45 percent gains in organizational productivity (Creasy, 2014; Elsberry, 2000; Mandahawia, Fouad, and Suleiman, 2012). In my 25-plus years of experience as a process improvement professional, I have seen launches of Lean Six Sigma programs with similar productivity gains in the early years after implementation. However, from a profitability and employee satisfaction standpoint, the efforts to implement and maintain quality improvement programs may not be worth the gains achieved. In a survey administered by Myrick, Burkhardt, Nelms, Patch, and Yearout (2009) to 49 quality improvement leaders about their experience with launching Six Sigma in their organizations, responses to the statement "Since implementation, my organization's profitability has significantly improved" averaged 8.26 on a Likert scale of 1 (disagree) to 11 (agree), with a standard deviation of 2.29; responses to the statement "Since

implementation, job satisfaction has significantly increased at my organization" averaged 7.76 on the same Likert scale, with a standard deviation of 1.88. Survey summaries are below:

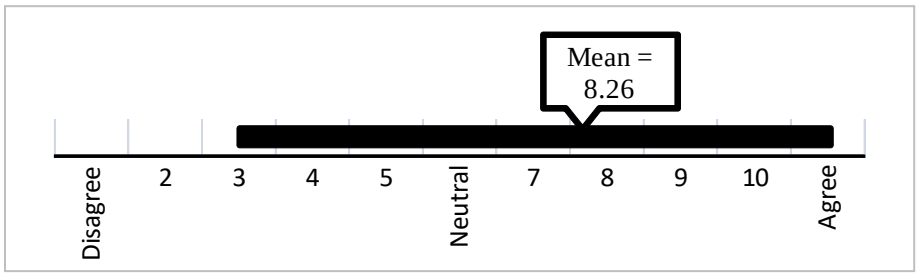

Figure 3. Survey responses for profitability improvement. Black bar represents range of survey responses, with mean of responses indicated. Based on Myrick, Burkhardt, Nelms, Patch, and Yearout (2009).

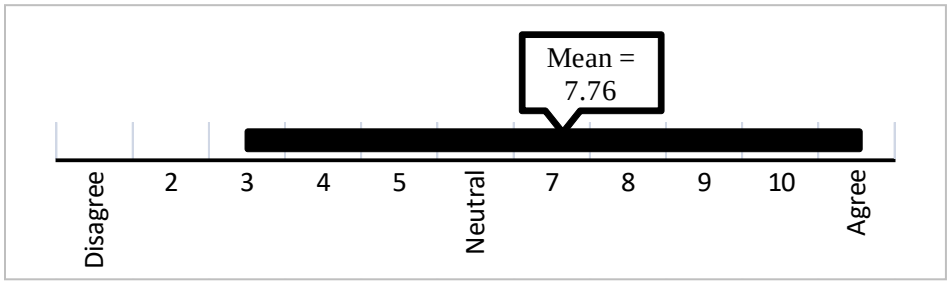

Figure 4. Survey responses for increase in job satisfaction. Black bar represents range of survey responses, with mean of responses indicated. Based on Myrick, Burkhardt, Nelms, Patch, and Yearout (2009).

The wide ranges of responses to these two measures of success suggest that, while quality improvement efforts like Six Sigma have been successful, a need to explore additional means of increasing organizational productivity is warranted.

Lean and Six Sigma are more process-oriented – in that they encourage the identification and analysis of waste and defects created by the process (Montgomery and Woodall, 2008; Pepper and Spedding, 2010) – and less inclusive of people-oriented factors like workers' intrinsic motivation for correctly performing the process. Even W. Edwards Deming, one of the pioneers of the quality movement, said "Improvement efforts should focus on systems, processes, and methods, not on individual workers. Those efforts that focus on improving the attentiveness, carefulness, speed, etc., of individual workers -- without changing the systems,

processes, and methods -- constitute a low-yield strategy with negligible short-term results." (Scholtes, 2014).

The purpose of this literature review, then, is to analyze to what extent a focus on improving human performance – specifically through increased engagement in the work to be performed – results in improved productivity. Special attention is then paid to an intense, short-term form of engagement called psychological flow. Flow is a condition experienced when the individual is so intensely concentrated on a challenging task that all sense of time seems to slip away, self-consciousness is forgotten, and enjoyment occurs simply from a sense of meeting the challenge (Csikszentmihalyi, 1990). The bulk of this entire present research is focused in creating conditions ripe for the inducement of flow at work because, as will be shown, the factors that can create flow conditions and the tactics for implementing them can be found at the day-to-day operational level of the organization and, therefore, may be more efficiently implementable than traditional employee engagement interventions conducted at the strategic level of the organization. Further, and in support of the flow focus of this paper, Peifer and Wolters (2021) discuss studies showing how flow supports employee long-term engagement.

I then identify several constructs that support the general theory of flow. Parts of these constructs were used to inform my theoretical and empirical research.

Various subjective and physiological means of measuring flow will then be discussed. Advantages and disadvantages of each will be presented.

Significance of This Review

Organizations are constantly looking for innovative ways to boost productivity, beyond traditional process improvement methods. With employees comprising the bulk of many organizations' assets (especially service organizations, in my experience), firms consider ways to improve the productivity of these resources with little to no additional cost incurred, such as through increasing employee engagement. To do nothing in this area is expensive. For instance, Rath and Conchie cite in their book, *Strengths Based Leadership: Great Leaders, Teams and Why People Follow*, a Gallup study that found employee disengagement has been estimated to cost the US between $250 billion and $350 billion per year in lost productivity (as cited in Attridge, 2009). Gallup's follow-up study in 2016 (Gallup, 2017) saw an increase in the cost of employee disengagement to between $483 billion and $605 billion.

Further, the ubiquity of human-computer interfaces in the workplace has fundamentally changed how work gets accomplished, from a hands-on experience with physical material to one where the worker is manipulating a digital representation of the material. The field of cognitive engineering recognizes that the human is the fragile link in information technology systems, so system designers must consider ways of optimizing human performance in this realm (Gersh, McKneely, & Remington, 2005). Increasing engagement while moving digital ones and zeroes is a challenge, but solving this challenge can lead to higher productivity. So, one question this literature review seeks to answer is:

- Are employees more productive when they are in a flow state than when not?
- Are employees more productive the more engaged they are in the work they are performing?

Various work domain factors may influence the ability to achieve flow. This literature review will address the question,

- What critical work domain factors create or influence flow in employees?

There may be interesting gaps in the research on flow and productivity, such as little evidence of a causal relationship or an incomplete understanding of the specific variables that create conditions for flow and productivity at the same time. This section will answer the question,

- What further research should be conducted on the link between flow and productivity?

Method

I conducted a literature review to identify research linking engagement to productivity, flow to engagement, and flow to productivity in the transactional work environment. Based on the methodology used by de Moura, Jr., and Bellini (2019) in their systematic literature review of flow, I employed a multi-step process to identify relevant research on the above topics. First, I used a snowball process to identify an initial set of popular studies related to the target topics and then, using these studies' references to identify additional research, I included a number of journal articles from researchers whose work was cited frequently by others. Initial references and authors were found in a bibliometric analysis of flow research conducted by Zhang and Wang (2022). Then, I developed a set of keywords from the initial group of works and employed a keyword search in Google Scholar (due to its comprehensive search capability across multiple publishers) and limited publishers to Emerald, Springer, and Wiley. These publishers have the greatest number of flow studies, per de Moura, Jr., and Bellini (2019) and, I

assumed by extension, the greatest number of studies on engagement and productivity. The search terms ("work engagement" or "employee engagement" or "job engagement"), ("productivity" or "efficiency" or "performance," limited to occurring in the title of works due to the overwhelming number of articles with these words in their bodies), ("work design" or "job design"), and ("flow" and "Csikszentmihalyi") produced the most useful results, with most references geared toward the workplace.

I also reviewed a selection of industry and academic books on engagement, flow, job design, and productivity. These books were selected based on their recommendations from fellow scholars and citations in the literature reviewed.

It should be noted here that none of the results of the above searches yielded research on engagement, flow, or productivity specifically targeted to transactional work. Because my present body of research is limited creating conditions likely to produce flow to this form of back-office, repetitive, standardized tasks, I conducted a separate search in Google Scholar using the terms ("transactional" or "office work") coupled with ("flow" and "Csikszentmihalyi") and again limited to the publishers Emerald, Springer, and Wiley.

Searches of the above keywords by publisher for references published in English with no filtering for publishing dates yielded the following number of scholarly references:

- "Work engagement" or "employee engagement" or "job engagement": 954;
- "Productivity" or "efficiency" or "performance," limited to occurring in the title: 983,600;
- "Work design" or "job design": 2,045
- "Flow" and "Csikszentmihalyi": 11,620; and
- "Flow" and "Csikszentmihalyi" and ("transactional" or "office"): 214

Given the extremely large data set of the first four categories of search terms above, I elected to review search results found in the first five pages of Google Scholar based on the search engine's algorithm of returning most relevant items nearer the top of the results list. Because the fifth category above is specifically associated with my current focus of research, I reviewed all 214 search results for relevance. Books were not reviewed if they were not downloadable. Through the review of the resources' titles and abstracts, a large number of articles were excluded for their focus on non-work activities (such as learning and hobbies), on non-transactional work (i.e., relationship-based, such as medical personnel, flight attendants, teachers, and executive leaders) or on behaviors, attitudes, and relationships (e.g., self-efficacy and worksite lifestyles). These dimensions are out of scope for the present research.

Findings

Engagement Defined, and the Drivers of Engagement

Various authors have developed their own definitions of engagement in the workplace, based on their backgrounds and areas of research. For example:

Table 2. Selected definitions of engagement in the workplace.

Definition	Source
"The extent to which employees are involved with, committed to, enthusiastic [about], and passionate about their work"	Macey and Schneider's The meaning of employee engagement, *Industrial and Organizational Psychology: Perspectives on Science and Practice,* as cited in Attridge (2009)
The level of energy; commitment; effort; and skill, experience, and creativity usage devoted to the organization	Adapted from Richman (2006)
Willingness to deliver using a combination of feelings and behaviors	Adapted from Frank, Finnegan, and Taylor (2004)

Definition	Source
The strength of the relationship between the self and the work role, demonstrated physically, cognitively, and emotionally	Adapted from Kahn (1990)
"An energetic state of involvement with personally fulfilling activities that enhance one's sense of professional efficacy," characterized by one's "energy, vigor and resilience; to promote their involvement and absorption with the work tasks; and to ensure their dedication and sense of efficacy and success on the job"	Leiter and Maslach's Burnout. In H. Friedman (Ed.), *Encyclopedia of Mental Health* (pp. 202–215), as cited in Maslach and Leiter (2008)
The extent that one finds enjoyable challenges, and that those challenges are in alignment with one's values	Adapted from Nakamura and Csikszentmihalyi (2005)
Checking in physically, mentally, and emotionally	Adapted from Bedarkar and Pandita (2014)
"The individual's involvement and satisfaction with as well as enthusiasm for work"	Harter, Schmidt, and Hayes (2002)
"The degree to which an individual is attentive and absorbed in the performance of [his/her] roles"	Saks (2006)

Engagement, therefore, appears to be the level of commitment one demonstrates based on a combination of 1) how one feels about oneself and the organization, and 2) how one acts toward the organization and the work. Factors that drive these feelings and behaviors are varied, but common themes do emerge. Attridge (2009) conducted a review of both research and business literature. He reports that an employee's good health, varied social relationships, organizational rank (the higher up the leadership chain, the more engaged the employee), completion of higher levels of education, acquisition and practice of deeper levels of skill, obtaining feedback and having a professional development plan all positively impact engagement. In addition, an organization's level of communication with its staff is a key driver of engagement; the clearer that leadership's articulation of the firm's goals and strategies is, the

more employees' can relate to those goals and strategies, which in turn generates employee commitment.

Richman (2006) cites her own experience and the results of polls conducted by the research firms Gallup, Watson Wyatt, and Hewitt. She asserts that an organization's leadership practices, support for work-life balance, and flexibility on how employees complete their work are factors critical to an increase in employee engagement. Richman (2006) goes on to state that employee age, gender, and other demographics do not contribute to engagement, nor does personality type. Her firm developed a "commitment pyramid," consisting of "threshold factors," "enablers," and "commitment drivers." Although Richman cites a national study her firm conducted, she does not provide empirical evidence for how the pyramid's components were derived. I see the commitment pyramid's levels, where lower levels need to be mastered before achieving the next higher level, as similar to Maslow's (1943) hierarchy of needs, where basic requirements like reasonable compensation and a safe working environment must be first met before higher-level drivers like communication and flexibility can be addressed.

Frank, Finnegan, and Taylor (2004), principals of an employee retention firm, cite their own experience, academic and governmental research, and business reporting as the basis for their conclusions about engagement drivers. They note various leadership traits (e.g., high levels of communication, open relationships, active partnering with employees to professionally develop them), communication enablers, team-building exercises, and job skills training as the most effective means of driving higher levels of engagement. The authors also make the case that these traits are also critical to retaining employees, and go so far as to imply that retention leads to engagement and vice versa.

Kahn (1990) conducted two qualitative studies -- one of summer camp employees and one of architecture professionals -- to identify significant psychological conditions that promote engagement. He developed a set of questions based on previous job-design research, including relations between workers and the characteristics of their work and interpersonal, workgroup, intergroup, and organizational factors. Interestingly, Kahn acts as both a counselor and a researcher in the summer camp study. He justifies this approach by using his own experience to help him understand others' feelings about engagement and to construct theories about what reinforces engagement. Kahn does disclose his awareness of personal biases as a participant, and he seeks counseling from a superior who has experience as a participant-researcher to help Kahn mitigate the impact of his biases. Kahn identified three conditions the organization and employees must jointly satisfy in order for those employees to be fully engaged:

- The meaningfulness of the task to be performed -- the extent to which the task makes the worker feel valued and made a difference. Factors contributing to meaningfulness include a proper mix of routine and challenging activities, the right level of autonomy and control (some direction and oversight is sought), clear and attainable goals, role characteristics that align with a worker's preferred self (e.g., analyst, supervisor, teacher, mentor), status in the organization and/or with the customer being served, and interpersonal interactions that promote relationships and synergies.
- Safety -- the extent to which workers feel secure in expressing their true feelings and contributions without fear of emotional harm. Safety drivers include the presence of nonjudgmental, give-and-take interpersonal relationships; the "flatness" of group dynamics (the less perceived hierarchical command-and-control interactions, the

better), management's willingness and ability to be supportive and open; and adherence to organizational expectations of behavior.

- Psychological availability -- the extent to which workers are ready and willing to engage, given the distractions around them. Individuals' level of physical and emotional energies on hand and required to adequately perform a task affect psychological availability. Security about one's abilities and perception by others is another factor that influences the level of psychological availability. Finally, extra-organizational distractions contribute to employees' ability to psychologically engage; these distractions can be positive in nature, such as being in a new romantic relationship, or negative, such financial hardship.

Maslach and Leiter (2008) conducted a one-year longitudinal study to determine predictors of burnout (and its opposite, engagement). This study was based on two surveys given to employees of a large university; each survey was one year apart. The authors use three dimensions, based on their and others' previous research, to characterize burnout and engagement. The three dimensions are depicted below:

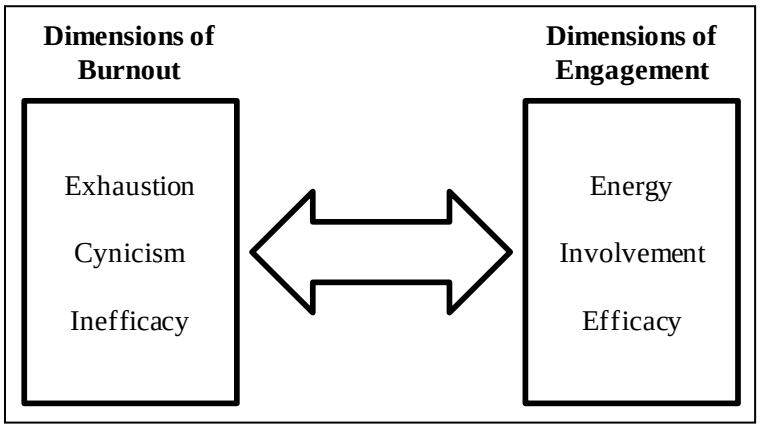

Figure 5. Burnout-engagement continuum. Ends of the continuum between burnout and engagement are depicted; employees can be placed anywhere along the range. Adapted from Maslach and Leiter, 2008.

The authors' research reveals that exhaustion and cynicism are the two most relevant dimensions of burnout as they appear most frequently together in workers experiencing burnout, with inefficacy appearing to be a less frequently occurring dimension. Their study focuses on where employees rate themselves on the exhaustion/energy scale and the cynicism/involvement scale. Contributing to where an employee might land in the range between burnout and engagement are six factors:

- Workload -- both the amount of work an employee is responsible for completing and the opportunity for the employee to recover from high levels of work before taking on new tasks are variables that can result in burnout or engagement.
- Control -- an employee's ability to manage and reconcile his/her different work roles (e.g., analyst, manager, teacher) and to participate in organizational course-setting influence where the employee rates him/herself on the burnout-engagement scale. To a lesser extent, role ambiguity is a factor, but the authors assert that some ambiguity can be a positive factor as it leads to latitude in how the employee accomplishes tasks.
- Reward -- the amount and type of compensation and recognition contribute to an employee's feelings of burnout or engagement. The person's perception of what constitutes a fair match between the task and the reward is a supporting factor.
- Community -- the formal and informal interactions between the employee and peers and supervisor. This factor appears similar to that of Kahn's (1990) safety element, which is also based on the strength of interpersonal relationships.
- Fairness -- the sense of equity an employee feels how organizational decisions are made; for instance, regarding compensation, job assignments, and execution of strategy. Interestingly, the authors assert that the outcome of a decision is less

important to an employee than the methods stakeholders use to arrive at the outcome. This concept of the process being more relevant than the outcome is analogous to research on customer effort done by the Customer Contact Leadership Council (Corporate Executive Board (2015)), regarding how the organization makes the customer feel about a decision regarding a transaction -- even one not in the customer's favor -- is more important to the customer's perception of effort he/she must expend than the actual effort of the transaction itself.

- Values -- the alignment of goals and the means to achieve them between the employee and the firm. Shared alignment promotes engagement, while incongruous goals and means contribute to burnout.

Maslach and Leiter's study had employees answer two sets of the same survey questions related to each of the three dimensions and six factors above; the researchers gave the employees each survey one year apart, and then measured changes in how employees rated themselves. Of the three dimensions, reductions in exhaustion and/or cycnism predicted engagement. Of the six factors, fairness was the one that, if perceived as present in the workplace, caused workers to migrate toward the engagement end of the continuum. However, if employees did not feel the workplace was fair, then they were more likely to experience burnout by the end of the study year.

Notable is this study's focus on predictors of burnout. Results of this study indicate that reductions in negative ratings of dimensions and factors predict engagement, not increases in positive ratings of those dimensions and factors. In other words, the presence of negative ratings predicted burnout while the absence of negative ratings predicted engagement. No mention is

made of positive correlations between dimensions or factors and engagement. However, the authors do say that engagement is the more natural state found in the employees studied.

A related study also looked at drivers of burnout and engagement, and specifically at whether an incongruence between an individual's values and the organization's values leads to burnout (Dyląg, Jaworek, Karwowski, Kożusznik, & Marek (2013)). In this study, 480 survey results from a sample of Polish white-collar workers were analyzed. Survey questions were in three categories: work values, occupational burnout, and work engagement. Results include a significant positive correlation between personal-organizational value dissonance and higher levels of cynicism, one of the burnout dimensions (Maslach & Leiter, 2008). The authors do note that one limitation of the study was that ratings of organizational values were reported by the employees studied, so there may be personal biases present in the findings.

Nakamura and Csikszentmihalyi (2005) conducted a qualitative set of interviews of 100 professors and administrators at a variety of US colleges and universities to cull from those individuals what creates engagement in their profession. The researchers found a number of engagement drivers: the employee's capabilities are fully utilized in meeting the challenges of the task; the challenges matter to the employee; clear rules exist; feedback closely follows action; the employee can exercise control over the process used to accomplish the task (i.e., autonomy); the task aligns with the employee's values; the employee's and employer's values align; and the employee sees him/herself as part of a larger system.

Two themes emerge to me from this analysis. One is task-oriented; the other is system-oriented. The task-oriented theme has to do with how the work is structured around the employee: challenge and capabilities are equal, rules for how the work gets done are clear, real-time feedback loops are present so the individual can either correct course or know he/she is

proceeding toward the goal, and the person can exercise some creativity in how the work gets done. The system-oriented theme is related to how the employee and external entities interact: post-task near-term feedback from leadership exists so the employee receives results-oriented assessment and recognition, values align between the employee and the organization, and the individual knows he/she is contributing to a societal benefit and the role he/she plays in doing so.

Bedarkar and Pandita (2014) conducted an extensive literature review on drivers of engagement. They highlighted a number of drivers other researchers had studied and documented (and are presented in this paper), with a focus on three factors they felt were critical but under-studied: organizational communication, a promotion of work-life balance, and positive leadership practices like employee development and possessing a performance-oriented mindset. The authors present no rationale for why they feel these factors are more critical than others.

According to Bakker and Demerouti (2008), engagement is driven by higher presence of job resources and personal resources. Job resources include social support (similar to others' notation of safety (Kahn, 1990) and community (Maslach & Leiter, 2008)), availability of feedback, skill variety, autonomy, and learning opportunities. These resources support both the accomplishment of the task and the betterment of the employee. Personal resources are a worker's ability to positively self-evaluate in the face of challenges and the use of resiliency to overcome the emotional weight of those challenges. Use of these resources helps the employee to stay focused on the goal of the task.

Bakker, Schaufeli, Leiter, and Taris (2008) wrote a literature review and termed it a position paper. They assert that the definition of engagement should be job-focused; however, while quoting other researchers' definitions, they did not propose one of their own. The authors did note that engaged workers bring a high level of energy to the task and identify strongly with

their work. This last descriptor implies that work has a meaning that the worker can relate to. I will discuss more about work as meaning in a section below.

Harter, Schmidt, and Hayes (2002) employed a meta-analysis of a large number of employee engagement surveys conducted by The Gallup Organization (of which Harter is a chief research employee) with over 198,000 workers. Industries represented include, in descending order of participation, retail, transportation/utilities, manufacturing, services, and financial. Such a large and varied sample size, the authors assert, averages out any variation due to individual employee traits. The purpose of the meta-analysis is to test the hypothesis that having engaged employees result in, among other outcomes, higher productivity. This paper will address the engagement-productivity link in another section. The survey was built on 12 engagement antecedents derived from previous focus group interviews, research, and other studies. Of note is that the factors surveyed are controllable by organizational leadership, so therefore are valid for empirical study. Most of the factors are similar to those of other studies: clear work expectations and organizational goals, availability of proper equipment, supportive management, and growth opportunities. Interestingly, one question asked whether the employee has a best friend at work. Although management is not expected to legislate or provide such a friend, the authors suggest that management can create an environment of collaboration. As with other studies (Bakker and Demerouti, 2008; Maslach & Leiter, 2008), this sense of socialization also promotes engagement.

Saks (2006) oversaw a study in which 102 Canadian workers from a variety of industries completed a survey on work experiences and attitudes. The survey contained questions related to job characteristics like skill variety, task significance, autonomy, and feedback; reward and recognition components like pay, praise from supervisors, and respect from peers; justice issues

like balance between work effort and results, and ability to express opinions and see their results; organizational and supervisor support for achieving growth and solving problems; commitment to the organization in terms of how the employee relates to the organization; intent to quit the organization; and organizational citizenship behaviors. Regression analysis found organizational support and job characteristics were significant drivers of job engagement. Saks further explained the relationship between the drivers of engagement and engagement itself via the concept of social exchange theory (SET). SET is defined as a set of reciprocal obligations between two parties. According to SET, when the organization supplies opportunities and demonstrates practices like the factors noted above to its employees, the employees in turn respond with higher levels of engagement.

Variations on Engagement

Of note are the terms a number of authors use as synonyms for engagement. Frank, Finnegan, and Taylor (2004) use "retention," quite possibly because they manage a consulting firm focused on teaching organizations how to retain top talent. Richman (2006) writes of "commitment" when describing engagement; she and her work-life consulting company developed a commitment pyramid to outline a hierarchical set of requirements for promoting engagement.

Saks (2006), however, puts forth examples of how certain supposed synonyms for engagement are in fact different from engagement. For instance, organizational commitment is related to how an individual feels about his/her organization, while engagement is related to the individual's work and role. Organizational citizenship behavior has components of voluntary and informal behaviors that support the organizational community, while engagement has to do more with the individual's own performance of his/her work.

Finding Meaning in Work

Positive psychology (Seligman & Csikszentmihalyi, 2000) is the branch of psychology dealing with exploring and bringing to the forefront in humans the traits and characteristics that lead to a more fulfilling life. Since people spend so much time at work and identify so closely with their work, research has been conducted on how employees find meaning in work, which leads to fulfillment; that is, the factors that make work an intrinsically positive part of their lives. Finding and developing what gives work meaning in employees have been linked to increased levels of employee engagement and productivity (Martin, 2005). This section of the paper explores what "meaning in work" means and the conditions needed to create such positivity in people.

Kinjerski and Skrypnek (2004) explored the concept of spirit at work and how it adds meaning to the work experience. They conducted a qualitative study of 14 professionals who both experienced spirit at work and promote this phenomenon. What these researchers uncovered was a set of dimensions that comprise this feeling of spirit:

- Physical experience -- interviewees reported being in a state of arousal and having a high level of energy;
- Affective experience -- participants noted feelings of love, joy, gratitude, and fun;
- Cognitive experience -- workers spoke of an ability to and comfort with bringing their "real" or authentic selves to work, of an alignment of personal values and work values, and of a sense that what they did was for a greater societal good;
- Interpersonal experience -- participants felt connected to others in the sense of a close-knit community;

- Spiritual experience -- those surveyed noted a feeling of being connected to and/or guided by a higher power; and
- Mystical experience -- interviewees described being in the moment and expending effortless energy.

Note that these dimensions are not only influenced by the work itself, but also by surrounding factors such as the closeness and trust of coworkers and the permission of the organization to feel these experiences.

One factor that can positively influence spirit at work is if the organization both expresses values that align with individuals' values and executes on those values; in other words, the firm talks the talk and walks the walk. Another factor is an organization that promotes creativity, supports expression of emotions, and values intelligence. A final way of developing spirit at work is through meaningful work (which appears to be circular thinking, if spirit at work is thought to add meaning to work) performed within and with a community.

Chalofsky (2003) conducted a literature review to define meaningful work, and found a number of factors related to what I call the whole person. He noted that "meaning in work" referred to how people defined themselves in terms of the work they did; the more they identified with their work, the more meaningful it became. Identification with work was comprised of three parts: sense of self, the work itself, and a sense of balance. A strong sense of self is driven by a positive state of mind, a clear purpose for why the work is to be done, a vision of how to accomplish the work, a link between what the work means to the individual and what the individual values, and a desire for the individual to make a difference in the world. Important to the work itself is the knowledge that the work makes a difference to the organization, and that enough autonomy exists so that the individual can accomplish the work in a creative fashion so

that learning and, ultimately, growth occur. Working autonomously does not imply working solely alone; rather, the availability to participate with others is also key to meaningful work. Finally, a sense of balance is the ability of the individual and the permission from the organization to make choices between the time and effort spent at work and not at work (rest, play, family, volunteering, etc.). Think of this balance as the link between the sense of self and the work.

On a counter note, Hackman (2009) suggested that the positive psychology movement substitutes fixing broken mechanisms in the organization -- managerial practices, job characteristics, the work environment -- for finding ways to cope with those poor situations. My response is that being able to cope with -- and even find the good in -- challenging situations is the first step to developing the positive attitude needed to make lasting, beneficial change in the organization. He also mentions that the direction of causality between a positive state and productivity is suspect: which one drives the other? Hackman suggests careful research should be conducted to establish causality.

"Flow State" as a Particular Type of Engagement

Positive psychology has led to research in finding meaning in work and, as shown above, individuals who find meaning in work because their necessary conditions are met experience cognitive, affective, and physical benefits. These benefits increase engagement in workers. A particular body of work within the positive psychology field has addressed an intense form of engagement called "flow" (Csikszentmihalyi, 1990). Flow is "the state in which people are so involved in an activity that nothing else seems to matter; the experience itself is so enjoyable that people will do it at great cost, for the sheer sake of doing it" (Csikszentmihalyi, 1990, p. 4). Flow is also known as being "in the zone" and "on a roll." Conditions required to enter into a

flow state are similar to those noted in the section above on finding meaning in work. When individuals feel intellectually challenged, the organization supports their efforts to succeed, a variety of tasks exist for them to execute, opportunities to learn are available, and occasions arise to tap their full capacity to perform, then these individuals are more likely to experience flow (Demerouti and Mäkikangas, 2017).

Flow has conventionally been divided into nine time-ordered dimensions (Bakker, 2008; Barthelmäs, M. and Keller, J., 2021; Clapp et al., 2018; Csikszentmihalyi, 1990; Csikszentmihalyi, 2003; Jackson and Marsh, 1996; Keller and Landhäußer, 2012; LeFevre, 1988). These dimensions are grouped into three categories: antecedents are the conditions required for flow to occur; characteristics are those feelings occurring while in flow; and consequences are observations made while reflecting upon the flow experience. A description of these dimensions follows.

Most studies follow Csikszentmihalyi's (1990) assertion that the balance between the challenge of the task and the skill or abilities of the performer is the most critical antecedent necessary to create flow (see, for example, Fullagar, Knight, and Sovern, 2013; Waterman et al., 2003)). "Balance" may be a misnomer, as the literature describes the need for the challenge to just exceed skills for flow to conditions to be ripe. Should the challenge greatly exceed the actor's skills to address it, anxiety will set in. Conversely, should one's skills greatly exceed the challenge of the task, boredom will occur. And, if both challenge and skill are too low, apathy is likely to take hold. Note that no quantifiable levels of "challenge" and "skill" have been promoted in the literature to determine a particular level of consequential flow (i.e., reported levels of challenge should exceed reported levels of skill by X points for flow to equal Y). What has been discussed is that flow lies on a continuum, depending on the perceived level of

challenge and skill and the balance between the two (see Barthelmäs and Keller's (2021) revised flow model (p. 79) and their discussion of the subjective assignation of challenge and skill "values" to the experience of an activity (p. 81)).

Also worth noting is the number of anecdotes Csikszentmihalyi (1990) relates of people who have achieved flow while in boring and even otherwise-depressing conditions, like incarceration. He asserts that as long as humans can find ways to challenge themselves with the skills they have at hand, and that they have a clear personal goal in mind, then they are able to enter into a flow state. I think the interesting point here is that even if working conditions are less than ideal, achieving flow is possible if employees are shown how to do so and the benefits of doing so.

LeFevre (1988) reported on a study of 107 skilled (managers and engineers) and unskilled (assemblers and clerical) workers from five Chicago factories. These individuals were given pagers that beeped randomly throughout the study time period, when they were to note the type of activity they were undertaking and a series of challenge-versus-skill questions plus a set of quality of experience questions regarding the activity noted. Results showed that those activities where the challenge was high and respondents' skills were also high were more likely to achieve a flow state during those activities. However, skilled workers were more likely than unskilled workers to encounter flow. The author theorized that skilled workers' activities were more challenging and needed higher levels of ability to successfully execute them than unskilled workers' activities.

A survey-based set of studies of retail workers (365 employees for the first study, 260 employees for the second) confirmed the theory that high skills and high challenges lead to flow, but only for those individuals who had a high need for achievement. Those with a low need for

achievement were not attracted to high skill/high challenge situations, and so did not experience flow as often (Eisenberger, Jones, Stinglhamber, Shanock, & Randall, 2005).

In the above two sets of studies, those who gravitated toward more challenging work and who had a high need for achievement were more self-motivated than the other workers. Csikszentmihalyi (1990) termed this type of personality as autotelic, meaning those people who derive pleasure from the challenge of undertaking the more difficult activities, rather than from any extrinsic reward or recognition. However, Engeser and Rheinberg (2008) argued that the importance of the work as perceived by the actor moderates the relationship between challenge/skill balance and the flow experience. They found through a number of empirical studies that when importance is high, individuals experienced flow even when the challenge of the activities was lower than the skills of the individual. Such a finding supports the concept of meaning-making discussed previously as an important consideration of engagement in general and flow in particular. Meaningfulness is addressed further in the discussion of the next antecedent of flow.

Knowing the goal of a task is the second critical antecedent. Task goals can range from tactical to strategic. Tactical goals answer the question, "What are the measurable outcomes from performing this work correctly?" and are related to the "how" of an activity. Responses may include business-focused time, volume, and cost objectives and customer-centered accuracy and attitude targets. Strategic goals answer the question, "Does the work align with my values?" and are related to the "why" of an activity. Components of such strategic goals include organizational mission statements, cultural communication with examples of cultural fit, and personalization of targeted customer groups (that is, they are real persons with names and lives, not simply a demographic). Aligning the goals of a work activity to an employee's values

creates meaningfulness for the employee (see the section preceding this one on finding meaning at work), an important condition for engagement in general (Csikszentmihalyi, 2003) and for flow in particular.

The third antecedent necessary for one to become immersed in flow is noted as clear and meaningful task feedback. Just as the mountain climber knows immediately if his/her hand has found a useful crack in the rock to use as a pull-up aid, workers should also be given performance information as close to the time of execution as possible so they can know if they are proceeding toward the goal or need to correct course along the way. Ideally, such communication would be given by the work system itself (Hackman, 1975). For example, data entry clerks can receive instantaneous feedback that the field in which they entered a numerical value was in fact numerical or if a non-numeric character was accidently keyed in. Checklists identifying the tasks to be completed in a queue and those that have been completed is a feedback mechanism (consider the email inbox as a work queue, with the items visually coded to denote unread correspondence, drafted responses in progress, and replies sent; one immediately knows how much "work" has been performed and how much remains). Feedback should be meaningful in that it should contain sufficient detail for the individual to know what is being done correctly or incorrectly. In this way, proper performance actions can either be maintained or modified.

Characteristics of flow include a merging of action and awareness. One seems to know without thinking each step to perform, and how to do so in the correct order. It is not the same as employing muscle memory, which is indicative of an activity low in challenge because it is largely comprised of recognized patterns (Betts, 2011). Rather, this feature of flow is

experienced as instantly understanding new challenges and reacting to them with immediate and confident knowledge of how to perform.

A deep sense of concentration on only the task at hand is a second characteristic of flow. All external, extraneous stimuli are ignored, such as sound or movement. The presence of such external stimuli may be desirable as an aid to concentration; some people prefer to work where a steady hum of background noise is present, such as at a coffee shop. Too quiet of an environment seems to allow the mind to fill the silence with extraneous thought. Internal stimuli, such as hunger and the need to void, are kept beneath the level of consciousness. Such a level of absorption fills the individual's cognitive resource capacity and there is no room to recognize and process any other impetuses. While one may consider that an extreme focus on a single, particular task may limit one's ability to see the sum, meaning, interaction, and future state of the relevant parts of the current situation (situational awareness, as defined by Endsley, 1995), some studies have advanced the notion that high concentration promotes flow, which in turn increases situational awareness (Beard and Hoy, 2010; Dixon, Weeks, Borland, and Perelli, 2017).

A third characteristic of flow is the sense of agency the actors feel in executing the steps needed to successfully complete the task's challenge. As individuals enjoy more autonomy over which steps they can take and how those steps are to be executed, they are more likely to experience flow more fully. Note that agency and autonomy refer to how one acts and reacts to the situation at hand, not to a feeling of or need to control others or even the outcome. Csikszentmihalyi (2003, pp. 50-52) describes the feeling of agency as one of not needing to be in autocratic control, but rather of focusing on what the self can accomplish and knowing the result will achieve the goal. While envisioning this dimension of flow might be easier to imagine in a

work setting where the practitioner is allowed and even expected to determine what and how to perform (e.g., a defense attorney cross-examining a witness, or a surgeon conducting a dangerous operation), individuals who perform routine and prescribed work (e.g., a data entry clerk entering a long list of payroll figures, or a scheduler assigning classrooms to class sessions) can also exercise agency. The order in which the items are worked, the number of items worked per time period (as long as production goals are met, of course), the intensity of the workplace lighting, and when work breaks are taken are examples of how these workers also exercise agency over their tasks.

With the antecedents sufficiently present, flow occurs and the characteristics of the construct are felt. Upon reflecting on the flow experience, the following consequences are observed. Individuals remark that their sense of self disappeared while in flow. That is, only the task needing to be performed and the actions required to perform them seem to exist. One is not thinking how their actions may be perceived by others, as there is no thought of "others." The person has merged with the task and its environment (for numerous examples of depictions of this kind of oneness – spirituals in some descriptions – see Csikszentmihalyi and Csikszentmihalyi, 1988).

Another consequence of flow is the realization that the perception of time while one was in flow was altered. Most individuals, having been in a flow state, felt in retrospect that a short time had passed relative to actual time ("time flew by"). A few, though, perceived that more time had passed than had actually occurred ("time seemed to stop") (Csikszentmihalyi and Csikszentmihalyi, 1988, p. 33). One possible reason for this alteration of perceived time is that as mental workload increases for certain time-bound tasks, one's awareness of their internal clock diminishes and, therefore, time perception becomes distorted; that is, the mind can only

attend to a finite amount of directives at the same time and, if the task is important enough (challenging, meaningful), then the capacity of the mind is taken up by the execution of the task (completely immersed in concentration) with little room left to comprehend the "ticking" of their internal clock (Hertzum and Holmegaard, 2013).

Interestingly, Hancock et al. (2019), in their meta-analysis of the perception of time while in flow, propose that because the perceived passage of time correlates significantly for the antecedent, characteristic, and consequence categories of flow – but not for flow as a whole – then this time perception may be more than a dimension of flow. Whether an altered perception of time is or is not deemed a flow dimension, getting lost in the job because individuals think only a short time has passed (see the phenomenological study documented later in this paper) and/or because they are submerged in deep, extended concentration is not physiologically or mentally beneficial. Special care should be taken for imposing required work breaks on those who are in flow.

The feeling of happiness or satisfaction one gets from successfully meeting an activity's challenge is the final consequence of flow. This feeling is termed an autotelic experience, derived from the Greek words for "self-rewarding goal." Knowing that one has brought all the necessary skills to the fore in order to achieve a desired result is the prize itself. Neither recognition nor recompense is required (as for the latter, beyond that which is needed to live comfortably), but only the intrinsic reward of one congratulating oneself for a job well done. In fact, one of the items in Bakker's (2008) WOrk-reLated Flow inventory (WOLF) asks the individual to rate the statement "I would still do this work, even if I received less pay."

Csikszentmihalyi (1990, 2003) relates many anecdotes of individuals who have lived this "optimal experience" – as this ultimate consequence of flow is also termed – who desire to return

to this feeling again and again. While the subjective feeling of happiness from performing at the peak of one's abilities is certainly a draw, there is also a physiological explanation for the desire to repeat the experience: as one works hard against a challenge and can see the successful end in sight, the brain releases the so-called happiness hormones dopamine, oxytocin, serotonin, and endorphins. Dopamine is released when making progress toward a goal. Oxytocin is secreted as human trust and closeness is increased, such as when a group begins to work cohesively and seamlessly to solve a difficult business problem. Serotonin is present to promote peacefulness and calm, as when one is deep in concentration and action proceeds seemingly without thought. Endorphins deliver a euphoric boost and reduce pain to aid in perseverance (Ghosh, 2018).

These positive feelings and beneficial hormones possibly result in a follow-on effect of flow. Demerouti and colleagues found that individuals reported a higher level of energy during their at-home (post-work) recovery period, for those individuals who were in flow at work and disconnected from work at the end of their shift (Demerouti, Bakker, Sonnentag, and Fullagar, 2012). It may be safe to assume that, with higher energy at the end of the day, the follow-on effect of flow may carry over even to the following day, with the benefit of providing an easier pathway to engaging in flow during that following day.

Flow Measurement Methods

Flow may be measured through subjective means, through physiological correlates, and through performance outcomes. Such a multitude of means of measurement is not surprising, given that flow is a psychological construct that cannot be directly measured like body temperature or blood pressure. In most of the literature reviewed for this present paper, flow has been measured subjectively; that is, through queries requiring retrospective responses. The first attempts to measure flow were conducted by Csikszentmihalyi in 1975 (Csikszentmihalyi, 1990;

Csikszentmihalyi and Csikszentmihalyi, 1988, pp. 252-259) via individual interviews and by employing an experience sampling methodology. This last was accomplished by having his subjects carry a pager that was programmed to beep at random times throughout the waking hours, each day over a few weeks. At the sound of pager, the individual was required to stop whatever current activity was taking place, access a questionnaire booklet given to him/her by Csikszentmihalyi and his research team, and answer a comprehensive series of questions about the activity. Example items include a description of the what the subject was doing; flow-specific questions about such dimensions as concentration, self-consciousness, and agency; a selection of mood choice ratings; and a rating on the perceived challenge of the activity and the perceived skills possessed by the individual to accomplish the activity. In this way a complete picture of the flow experience could be documented. Using this procedure, Csikszentmihalyi and his associates were able to determine for the first time that a balance between challenge and skills were the most likely and strongest determinant of flow occurring in an individual.

New self-reporting instruments were developed. Two of the most popular are the Flow State Scale (FSS, Jackson and Marsh, 1996) and the WOrk-reLated Flow inventory (WOLF, Bakker, 2008). The FSS was developed to investigate flow in athletes. Using the classic nine-dimensional flow construct, it asked the individual to recall a specific instance of a sports event where the person was completely absorbed in the moment and the activity was enjoyable. Then, for that instance, the individual was asked to rate the activity across the nine classic dimensions of flow. Four items comprised each dimension, with each item phrasing a statement about the dimension differently. The total count of items in the questionnaire numbered 36. The reason for the repeated items for each dimension was to improve the instrument's reliability by reducing

the chance of ambiguity of any one item. As an example, the challenge/skill dimension was addressed with the following items (two of the four are given here): "I was challenged, but I believe my skills would allow me to meet the challenge," and "My abilities matched the high challenge of the situation."

The WOLF was designed to measure flow at work. It was validated against the job demands-resources model (Bakker and Demerouti, 2007). I interpret this model as an analogy to flow's challenge/skill balance dimension, where job demands such as work pressure and emotional weights are counter-balanced by work resources such as autonomy, social support, and growth opportunities. Absorption, enjoyment, and intrinsic motivation were chosen as the indicators of flow, based on Bakker's literature review of factors leading to flow. The WOLF is an economical instrument with a total of 13 items: four related to absorption, four related to work enjoyment, and five related to intrinsic work motivation. Questionnaire participants were asked to reflect on their work experience over the previous two weeks and then answer items under each of the flow indicators. For example, under the category of absorption, individuals were asked to rate the item "When I am working, I think about nothing else." An example item under the category of work enjoyment is "My work gives me a good feeling." For intrinsic work motivation, one of the items is "I would still do this work, even if I received less pay."

The above two survey instruments attempt to measure the flow experience during specific events (a sports-related instance for the FSS, and the previous two weeks of work for the WOLF). These are state-related measurement tools as they require the individual to recollect about a particular situation at a particular time, and so the feelings associated with that occurrence are temporary. Trait-based questionnaires ask the individual to consider generalized

feelings across similar situations over greater lengths of time (based on Schmitt and Blum, 2020). An example of a trait-based flow-oriented survey instrument is the Swedish Flow Proneness Questionnaire (SFPQ, Ullén et al., 2012). The SFPQ was designed to measure the intensity of the flow experience across three general sets of activities: work, maintenance (chores), and leisure. Flow dimensions covered by the SFPQ include boredom (which is not a component of the classic nine-dimensional model), challenge/skill balance, clear goals, loss of self-consciousness, sense of control (agency), and enjoyment (autotelic experience). The level of self-reported flow experience was then compared to the personality traits of neuroticism and conscientiousness. Flow was found to be negatively correlated to neuroticism and positively correlated to conscientiousness. Neuroticism was hypothesized to be detrimental to the cognitive and emotional resources needed for flow to occur and sustain. Conscientiousness has been shown to correlate to such flow-supportive traits as active problem coping (applying skills to overcome a challenge) and intrinsic motivation (found in an autotelic personality).

Engagement Factors Not Included in This Literature Review

Much research has been done on linking personality types to engagement. For example, Akhtar, Boustani, Tsivrikos, and Chamorro-Premuzic (2015) regression tested survey results from over 1,000 employees (mainly in the educational field) who were asked to rate themselves on a number of emotional intelligence and personality trait dimensions. This study found that emotional intelligence, openness to experience, interpersonal sensitivity, ambition, extraversion, ability to remain calm under pressure, and conscientiousness were significant predictors of engagement. Bakker and Demerouti's (2008) personal resources theory is another example of personality characteristics. Personal resources are the skills one has to positively self-evaluate in

order to overcome obstacles. These skills include optimism, self-esteem, problem solving, and resiliency.

I have elected not to include these studies in the discussion and future research sections because I believe a goal of organizations should not be to change workers' personalities to fit the work, but rather to find workers with the appropriate personalities for the organization's culture and to execute the organization's strategy, and fit the work to them. However, at least one study has shown that the work experience can modify personality traits over time (Roberts & Mroczek, 2008). The scope of this literature review is limited to organization-controllable factors of engagement.

Linking Employee Engagement to Flow

Before discussing the relationship of engagement and flow, we must first distinguish between organizational engagement and job engagement. According to Saks, Gruman, and Zhang (2022), organizational engagement refers to how employees identify with the organization and to the extent which they express themselves during organizational role performance. Organizational role performance includes such activities as meetings, communicating about the organization to external parties, organizational citizenship behavior, and similar non-role actions. Job engagement is exclusively role-focused (Saks, 2006). It refers to such qualities as commitment to work activities, losing track of time, depth of concentration, and intrinsic motivation. Note how job engagement characteristics parallel those of flow. So, a link between flow and job engagement appears to be strong. Further, De Fraga and Moneta (2016) found that, under certain conditions, employees with high levels of flow were more likely to engage in their job. Peifer and Wolters (2021) cite a number of studies linking flow to task-oriented commitment, based on study subjects' diary entries and on interviews. Most tellingly and

clearly, Csikszentmihalyi (1990, pp. 143-157) presents numerous examples of various individual workers who describe their work activities as extremely enjoyable because they have invested so much of themselves – physically, cognitively, and emotionally, in the words of Kahn (1990) – into their respective trades. Their descriptions are those of an autotelic experience as well as an engaged one.

Linking Engagement and Flow to Productivity

Harter, Schmidt, and Hayes' meta-analysis (2002) did document a correlation between engagement and productivity. While they point out that correlation does not imply causation, their study showed that organizations with high employee engagement had productivity measures significantly higher than low-engagement organizations. Top quartile engaged organizations bettered lower quartile engaged organizations by between $80,000 and $120,000 per month in sales or revenue.

Actively managing engagement has been theorized to increase employee engagement (Gruman & Saks, 2010). However, the authors proposed an engagement management model based on their research and have not implemented and tested their model for results.

Csikszentmihalyi (2003) noted that those individuals who spend more time in flow spend much more time working rather than engaging in leisure activities at work. These individuals work for the joy of experiencing the journey of the task, from planning it to executing it, and derive less positive self-generated feedback in completing the task. This is not to say that these individuals are reticent to deliver results; rather, they are very goal-oriented but take more pleasure in getting to the goal rather than the goal itself.

Demerouti's (2006) survey-based study showed that those who were in a flow state performed better in their job-related activities and in their support activities (e.g., helping others,

getting along with colleagues) than those who were not in such a state, but only for individuals who were conscientious about their work. Conscientiousness is defined as being reliable, organized, and attentive to detail.

On a contrary note, Kinjerski and Skrypnek (2004) call into question claims by consultants that developing spirit at work results in increased productivity. A lack of a standardized definition of "spirit" and insufficient empirical research linking spirit and productivity are the bases for their caution.

Strategies for Increasing Engagement and Flow

Much of the research documented in this paper discusses which factors lead to engagement or flow. No discussion was found on empirical studies that manipulated these factors in long-term experiments to determine which factors or combinations of factors would lead to higher engagement, nor was there evidence of how much productivity would quantitatively improve from a given improvement in engagement. However, the literature did provide some limited qualitative suggestions.

Martin (2005) recommends customizing the work to match a worker's skill with the challenge of the work. He also promotes the idea of enabling employees to track their personal bests and for the organization to develop challenges to top these personal bests.

Demerouti (2006) suggests redesigning such job characteristics as task variety, autonomy, feedback, design of the task as it relates to the entire work process, and communication of how the task relates to the entire work process and its relationship to outcomes. These initiatives would positively influence flow in conscientious employees. For less conscientious employees, improving their acceptance of responsibility for outcomes may

drive them to become more conscientious and, therefore, become more likely to achieve flow at work.

Gruman and Saks (2011) took a different tack by suggesting that managing engagement, rather than managing performance, is a more effective way of building employee engagement. They argue that the usual survey method of gauging engagement levels in the organization and then developing organizational interventions to improve engagement are subject to self-bias in reporting; contain too-broad themes to be meaningful to all employees (e.g., communication frequency, or trust in leadership); does not incorporate enough sufficient organizational resources to change engagement over the long term; does not hold employees accountable for increasing their engagement; and focuses on feelings, rather than the behaviors that should change. The engagement management model the authors propose includes developing a performance agreement, negotiated between the employee and supervisor, that outlines job expectations and key performance measures; facilitating engagement through customizing the work, coaching and supervising, and development to resonate with each employee's specific needs; and appraisal and feedback, focusing on engagement drivers such as trust and fairness rather than employee performance relative to goals.

A potential example of the caution Gruman and Saks (2010) articulated about engagement programs being too broad to apply to all employees is found in Davidson's (2011) dissertation on engagement and workgroup productivity. Davidson's longitudinal study took place at a manufacturing defense contractor, whose sample include skilled workers (e.g., pipe fitters, electricians) and engineers. His analysis determined that skilled workers' engagement levels rose over the one-year study period, while engineers' engagement levels remained essentially flat. Davidson surmised that since the manufacturer had recently provided skilled

workers with newer tools and equipment more recently but less frequently than engineers, who had more frequently received hardware and software upgrades, then skilled workers felt the change in organizational caring more than the engineers did, and responded to the survey with a greater delta in engagement scores. I propose that a further possibility is that since skilled workers perceive they are more capable of producing results (Maslach & Leiter's "efficacy," 2008) and that they are on a more level playing field tool-wise (Maslach & Leiter's "fairness," 2008), they feel more engaged.

Support for the individualized engagement method also came from Richards' (2013) phenomenological study of 20 aerospace industry project managers. His survey questions revealed that one key driver of engagement was engagement plans customized to individuals' needs.

Discussion

Based on the literature reviewed, below is a summary of the most-referenced drivers of workplace engagement and flow:

Table 3. Commonly referenced drivers of engagement and flow throughout the literature (in alphabetical order).

Acquisition and practice of a variety of skills / fully utilized capabilities
Autonomy over / control over / flexibility in how the work gets done
Balance of work difficulty and the possession of the necessary worker skills to successfully overcome the challenge
Clear rules and goals
Fairness / justice
Feedback loops
Leadership support in employee development and expression
Meaningful tasks
Organizational communication about goals and strategy
Professional development planning and monitoring

Though not discussed in any of the aforementioned research, I surmise that basic needs must first be met before engagement can take place. As Maslow (1943) theorized, physiological and safety needs must first be satisfied before an individual can seek out and experience love and belonging, esteem, and self-actualization. These last three needs are analogous to engagement and meaningful-work factors like community (Attridge, 2009; Maslach & Leiter, 2008), positive self-evaluation (Bakker & Demerouti, 2008), and spirit at work (Kinjerski & Skrypnek, 2004), respectively. Other research postulates that an individual must first learn how to progress through stages of development, from the most basic and childlike to highly complex and emotionally mature (Harrigan & Commons, 2015). To be able to experience and appreciate the ability to collaborate with others (the sense of community expressed by Attridge, 2009; and Maslach & Leiter, 2008), one must first mature through earlier developmental stages where concrete things are replaced by conceptual constructs like appreciation for being part of a group and involving stakeholders in addressing an issue. However, knowing if the factors in Table 4 are hierarchical in nature, where certain ones must be satisfied for an individual before that worker can address others, would be helpful to organizations. Then organizations could better plan, execute, and monitor improvements in these factors in a more meaningful way.

This literature review examined studies performed across a wide range of industries and worker types. The studies' similarities in drivers of engagement indicate that those drivers are generalizable across industries and demographics. However, just as there are differences in how generations of workers -- Baby Boomers, Generation X, Generation Y, Millenials -- respond to being managed, there may be differences in how these generations respond to various engagement factors (see Moritz, 2014). In other words, the many factors documented in these

and other studies may have correlations that vary based on employee generational differences. Causality and direction may also differ.

Only one of the studies (LeFevre, 1988) in the reviewed literature had clerical employees as a targeted cohort. In a study of the quality of flow during work and leisure, her research showed, through subjective in-the-moment reporting, that these clerical employees experienced flow less often and of a lower intensity than the engineering managers who were also part of the study. The author surmised that the difference was due to the engineering managers' job roles requiring more flexibility (agency) and whose work was more complex (high challenge) than clerical workers' roles and work. Studying flow in clerical workers has not been a pursuit of researchers. As a result, this lack of information about this large subset of workers has motivated me to focus on this work group.

Much of the data in the studies cited in this paper are based on self-reported responses to surveys. Even though researchers promise anonymity and aggregation of results, individual respondents could introduce subconscious biases based on their self-perceptions or what they feel are expected responses, which could differ from reality. However, construct, convergent, and divergent validity, and inter-individual reliability efforts and measures were reported and were found to be satisfactory.

In the literature reviewed, no experiments were performed to purposefully manipulate factors to see what the resultant engagement levels would be. The examined studies in this literature review all commented that correlations between drivers of engagement and levels of engagement did not imply causality. Designed experiments would test the hypothesis of causality and, furthermore, the direction of causality. In other words, do certain factors cause engagement which drives productivity? Or does productivity drive engagement which enables

workers to be more communicative, find meaning in the work, and other factors? Or does a more circular relationship exist?

Stairs and Galpin (2010) point out that achieving flow at work, while an optimal state, is temporary and task-focused, as opposed to heightening engagement at work, which is more long-term and holistic in nature. However, Csikszentmihalyi (2003) noted that individuals who experience flow spend much more time working than in doing leisure activities, and LeFevre's study (1988) indicated that individuals are in a flow state more during work than when doing leisure activities. And if the desired organizational outcome is more productive employees, then is not a short-term all-in focus on work better than partial or no focus at all?

While a relationship has been repeatedly established between engagement (including its special case of flow) and productivity, no quantitative analysis has been conducted on how much more productive an engaged employee is versus a disengaged employee. The question here, then, is the effort to improve engagement in employees worth the impact of doing so?

In my research, I have elected to subjectively measure flow using both the Swedish Flow Proneness Questionnaire (SFPQ, Ullén et al., 2012) and the Flow State Scale (FSS, Jackson and Marsh, 1996). The SFPQ reveals research subjects' tendency to experience flow in general while the FSS indicates these subjects recalled flow experience during the experimental task. Should an individual show little propensity for flow in general via the SFPQ, I would not use his or her FSS or any other experimental results to mitigate the risk of skewing the experiential reporting data to the low end of the range. I chose to use the Flow State Scale as it covers all nine of the most studied dimensions of flow, and because it asks the participant to reflect on a particular event in which absorption and enjoyment was present. I did not select the WOLF instrument because it instructs the participant to reflect on the previous two weeks' worth of

events, some of which may be enjoyable and others not. Such ambiguity introduces the risk of uncertainty in responses. In addition, the WOLF spans only three flow dimensions, two of which – work enjoyment and intrinsic work motivation – appear to overlap each other (even though their factors loaded on separate constructs during Bakker's factor analysis).

Research Gaps

Although flow has been studied for decades, I believe the following questions must still be addressed.

- On what empirical or theoretical basis does Csikszentmihalyi assert that unskilled workers achieve flow states less frequently than skilled worker? If such as assertion is true based on historical evidence, then can we help these unskilled workers get into a flow zone more frequently? With a relatively high proportion of unskilled workers in transactional organizations -- clerks, processors, call center agents, administrative assistants -- understanding what antecedents to flow are relevant to this population of workers could help these workers become more productive and achieve higher well-being, at a great financial benefit to those organizations that employ them.
- What can we discover through experimentation? A designed experiment that carefully varies engagement factors while blocking noise factors, with analysis of variance and other appropriate statistical tests to measure the strength and direction of results, could shed light on causality. Cause-and-effect experiments would minimize self-reporting biases and measurement calibration errors. However, such experiments do require a greater investment of people, effort, and potentially funding to execute

than do survey methods. My belief is that the impact of knowing with more certainty the real drivers of engagement are worth the cost of finding these answers.

- Can subjective, physiological, and performance measures of flow be correlated with each other, to create a more comprehensive picture of how an individual in flow feels and acts?
- Can the organization increase the likelihood of employees achieving a flow state and, if so, can the organization extend the time that workers are in flow? If achieving flow is an optimal condition -- one that workers want to return to time and again -- even if working conditions are sub-optimal, and if being in flow leads to higher productivity, then the organization may find it needs to repair less broken factors to realize such productivity. Experimentation may uncover the means to achieve and stay in a flow state under various workplace conditions. For instance, one of the strongest precursors to achieving flow is when an individual's skills just match the challenge of the task. An empirical study might be to progressively increase the complexity of an individual's set of given tasks after he/she builds competencies to meet less complex tasks, with the desired outcome being longer periods spent in a flow state. Incorporated into this build-and-grow experiment would be immediate and relevant feedback on the individual's progress in moving up the skill-challenge staircase:

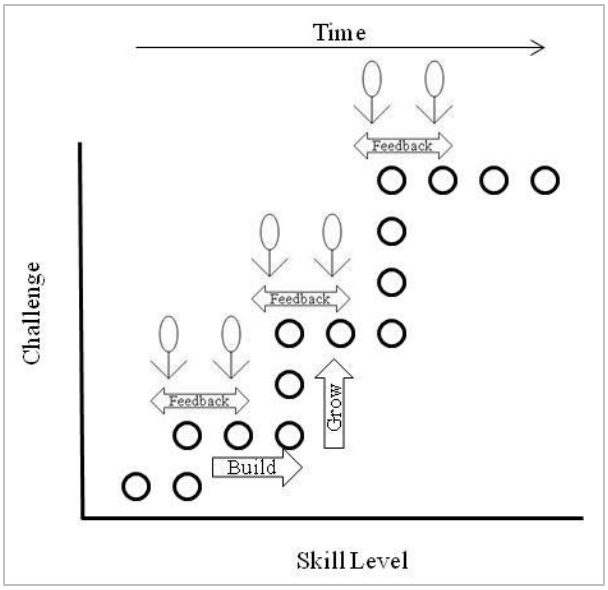

Figure 6. Build-and-grow model of facilitating flow. Circles represent tasks at a particular level of challenge, performed by the individual with a certain skill level. When an employee builds the skills needed to successfully execute the current level of task.

- What is the relationship between flow state and engagement? Does achieving flow lead to heightened engagement? Or does becoming more engaged in work make achieving flow more likely? Again, experimentation may hold the answer to causation, strength, and direction.

Conclusion

Enhancing employee engagement is a goal of many organizations. Survey research has shown that high levels of engagement do lead to high levels of employee productivity, among other benefits. Such research has uncovered a host of job design, leadership, and organizational culture factors that promote or hinder engagement. However, the research has been in the form of survey and interview administration and analysis, which is subject to bias and misinterpretation, and does not truly reveal the cause-and-effect relationship between factors and

outcomes. This literature review has taken a critical look at the present research and proposes to build on previous authors' findings by conducting experiments to determine the critical factors that actually do drive engagement, quantify the strength of those factors on engagement, and reveal feedback loops between factors and outcomes that either magnify or dilute engagement. These experiments should be conducted in a variety of real organizations' settings to identify where factor variations occur, which can lead to the ability to make generalizable conclusions about engagement drivers. The knowledge gained and incorporated into business practices will have a real impact on employee productivity and the resulting financial benefit.

CHAPTER 3: METHODOLOGY

This present research on designing a transactional work system to engender flow in employees consists of three phases. A model of the interdependency of these phases is shown below.

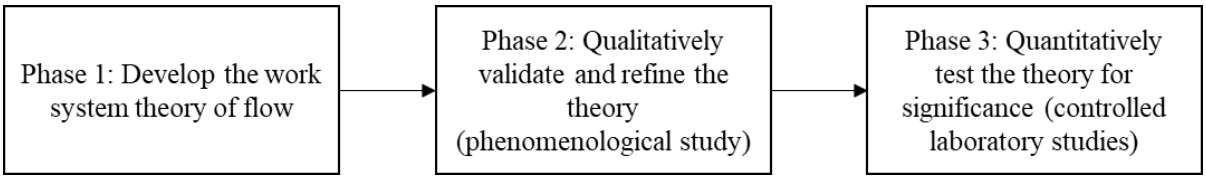

Figure 7. Linkage of phases of this present research.

Each phase builds on the previous one. The work system theory of flow and the idea to design for flow originated in my collaborative work with back-office transactional personnel as a result of my 25-year career as a process design consultant and during my nascent role as an academic researcher. I knew from the concept of designing for Six Sigma (for a practical overview of this methodology to create new products and services, see Tennant, 2002) that for customers to be happy to use a new kitchen gadget or software application, the organization must address multiple components; fit, functionality, ease of use, economic value, etc., may be critical-to-quality characteristics desired by the target market. A holistic design mindset is needed. In parallel, during my process design career, the thousands of clients with whom I consulted helped me build very efficient processes. Yet they were still not enjoying their work, even though less mistakes were made and resulting re-work avoided. Something within their work life was being ignored. Again, a holistic design mindset was needed in order to address not only efficiency but also such human needs as comfort and avoidance of distractions. And finally, coursework and research in ergonomics, human factors psychology, and work motivation

made obvious the need to holistically design for flow. The work system approach to designing for flow is presented in the Findings chapter, in the section "Phase 1: Develop the Theory."

Although the theory of a work system approach to flow had been largely developed during my professional career, it required academic rigor to validate and test it. Did flow even exist in a transactional work setting? If it did in fact exist, could variables exogeneous to the work influence whether flow occurred? I elected to conduct a phenomenological study as the second phase of the present research to provide answers to these questions. Seventeen transactional work volunteers, with roles such as classroom session scheduler, accounts payables clerk, and quality assurance analyst, related their lived experiences of flow at work. Results are presented in the Findings chapter, in the section "Phase 2: Phenomenological Exploration."

Based on the findings of Phase 2, I modified and/or more clearly specified the flow-inducing factors proposed in the Phase 1 work system approach to creating flow. For example, back-office environments are usually filled with co-workers sitting in proximity to each other, so including people as a controllable factor – as was done in the Phase 1 proposal of the work system approach – is not a viable choice. Instead, a related variable – background noise – was included as a controllable factor as this phenomenon is typically comprised of people talking, phones ringing, and the like. A number of individuals interviewed in the Phase 2 study indicated they listen to music on headphones while working, partly to mitigate the background noise distraction and partly to improve their ability to concentrate on their work. So, music-as-background-noise was introduced as a controllable variable in one of the two controlled laboratory studies in Phase 3.

The category of environment, proposed in Phase 1, is naturally a broad one. It includes quite a number of features, such as ambient temperature, office interior design and color, and external view options. Because much of back-office transactional work is performed while seated, I chose the comfort afforded by seating type as one of the two variables to manipulate in the Phase 3 controlled laboratory studies; office lighting brightness was a source of frustration for a number of the subjects in the phenomenological study, so it was the second environmental variable included in Phase 3. Seating comfort is the sole independent variable examined in a proof-of concept experiment; it and office lighting and three other variables are the independent variables in a larger designed experiment.

Similarly, the technology category, also proposed in Phase 1, is broad in scope. Hardware choices such as pointing device type (e.g., trackpad, trackball, mouse) and computer monitor size and placement as well as software application options such as commercially available spreadsheets versus server-based databases all could impact the likelihood of experiencing flow at work. Because a great deal of back-office transactional workers' work is computer-based, I chose computer monitor color contrast as the technology variable for the Phase 3 designed experiment.

Communications, identified as one of the design-for-flow factors in Phase 1, was clarified to include the work instructions needed by the employee to successfully complete the work task. Phase 2 participants agreed that clarity and completeness were important characteristics of work instructions. Work instruction detail was therefore included as an independent variable in the Phase 3 designed experiment.

The seat comfort proof-of-concept experiment and the five-factor designed experiment are presented in the Findings chapter, in the section titled “Phase 3: Laboratory Studies.”

CHAPTER 4: FINDINGS

Phase 1: Develop the Theory[1]

Design for Flow: A Work System Approach

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Abstract

Flow is a psychological state of intense engagement in a challenging task, where the doing of the task is its own reward. Flow has been well researched in the domains of games, sports, and the arts, and some research has been published on flow at work. These studies tend to focus on a small number of antecedents of or characteristics associated with achieving flow, such as the challenge of the work or the sensation of the slow passing of time. Drawing on previous research in human factors, positive psychology, and process design, the present paper takes a novel approach in theorizing how flow can be created in the workplace: by creating a well-designed work system comprised of interacting components, such as organizational support, technological infrastructure, environmental factors, and policies, in addition to the work itself. In placing the employee at the center of such a holistic work system, we propose he/she is more

[1] The article in this section was previously published by Steven R. Clapp, Nicolas Uszak, Ecem Olcum, and P.A. Hancock in Proceedings of the 2018 IISE Annual Conference (K. Barker, D. Berry, C. Rainwater, eds.), in 2018. Reproduced by permission for dissertation use only, "Design for Flow: A Work System Approach" in Proceedings of the 2018 Annual Conference, Institute of Industrial and Systems Engineers. The authors won a Best Paper Award at the conference for their contribution to the body of knowledge. My contribution to the paper included the ideation of the work system-as-flow-driver theory, drafting of all content except for Section 3, and integrating all content for seamless transitioning.

likely to achieve flow than if solely the work is optimized. We also present design cautions. Benefits of such a work system designed for flow include higher productivity, better output quality, and lower voluntary turnover.

Keywords: flow, design, productivity, well-being.

Introduction: Flow As An Imperative Design Principle?

Imagine engaging in an activity where you are completely immersed. Action seems naturally to follow perception. You know what you want to accomplish and, even though the task is challenging, you are confident in accomplishing it. The task itself is your reward, and you need no external, explicit reward structure to motivate you. In such conditions, you are most likely experiencing flow. As Csikszentmihalyi (1990, p. 4) describes it, flow is "*the state in which people are so involved in an activity that nothing else seems to matter; the experience itself is so enjoyable that people will do it at great cost, for the sheer sake of doing it*." This condition is variously referred to as "being in the zone" or "on a roll" and it connotes a state of perfect adjustment where the need for acute adaptation is obviated.

According to Csikszentmihalyi (1990, 2003) flow consists of nine dimensions. These are: i) challenge/skill balance; ii) clear goals; iii) immediate feedback; iv) merging of action and awareness; v) ability to concentrate on the task at hand; vi) ability to control the means to achieve the task's outcome; vii) loss of self-consciousness; viii) transformation of time; and ix) autotelic (self-rewarding) experience. These differing criteria need not ubiquitously be present for any activity to approach the flow state but some combination thereof connotes a set of

necessary precursors. Such states are not limited to specific forms of activity. Although they may be more frequent in some domains (e.g., sports) than others, in principle they can apply to any human pursuit. What we seek to address in the present work is the capacity to induce flow, and the potential and actual boundary conditions that frame its occurrence. But first we must answer the practical, "so what?" question. For, if flow is merely an addendum to an activity, is it really of fundamental interest to hard-headed businesspersons looking solely at bottom lines and profits? In short, what purpose does flow serve in our practical, everyday world?

We argue, quite readily and quite understandably, that flow is indeed a crucial dimension of productive work. Let us first look at costs of non-engaged states of working individuals, and work from the premises of loss-reduction. Attridge (2009) cites a Gallup study that found employee disengagement has been estimated to cost the US between $250 billion and $350 billion per year in lost productivity, and further it has been supported that higher workplace engagement drives higher worker productivity (Demerouti, 2006; Stander, Mostert, and de Beer, 2014). Such engaged individuals also experience higher positive affect (Bryce and Haworth, 2002; Eisenberger, Jones, Stinglhamber, Shanock, and Randall, 2005) If one of the outcomes of flow is engagement and if engaged workers prove more productive, then such states are not an appealing side effect to the work system but are, in our view, a fundamental design imperative for any such work system.

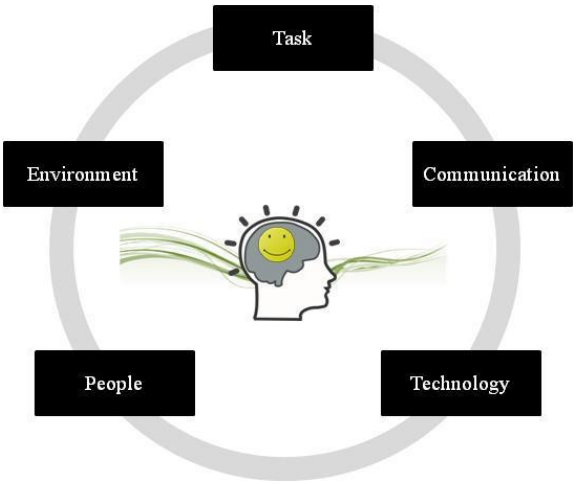

Figure 1. A systems approach supporting the design for flow.

On the Designing of Flow

Following the emerging systems perspective in human factors and ergonomic science, we have looked to adopt an over-arching descriptive framework for the design of flow, as illustrated in Figure 1. We purport that all components must interdependently function to create a successful work outcome, such as a functional physical component or a resolution to a customer's inquiry. Further, we maintain that organizations should develop each of the components to maximize the likelihood of generating and supporting flow in its employees.

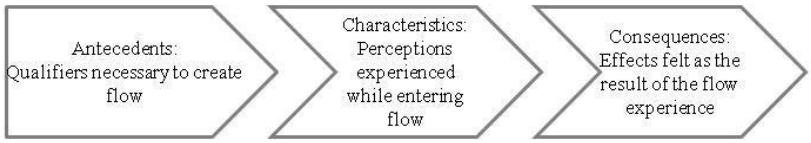

Figure 2. An ordering of the flow dimensions into three time-sequenced categories [8, 9].

The nine dimensions heretofore noted can be arranged in a time-sequence order, such that certain foundational dimensions must be present before subsequent dimensions can be realized (Csikszentmihalyi, 1988; Chen, Wigand, and Nilan, 1999). Figure 2 illustrates this ordering. Antecedents include challenge/skill balance, clear goals, and immediate feedback. These variables must be initially present before flow can occur. Characteristics occur as the individual enters flow and include a merging of action and awareness, complete concentration on the task, and a sense of control over the outcome of the effort. Finally, consequences are the outcomes realized after the individual has experienced flow. These are a loss of self-consciousness, a transformation of the experience of time, and an autotelic experience.

In the present paper, we examine methods to positively influence the antecedents of flow. We focus here because we consider these antecedents as independent variables or inputs, such that proper design of these drivers of flow leads to a higher likelihood of individuals achieving flow as an outcome. These inputs acting on the individual to create an output (flow) lead to such consequences as higher productivity (Harter, Schmidt, and Hayes, 2002) and well-being (Csikszentmihalyi, 2003). This input-outcome-consequence model is supported by Rummler and Brache's (1995, 64-66) research on individuals' work performance. These proposals for manipulating antecedents are not exhaustive but rather we present them as examples of our systems approach to creating flow and to illustrate that a comprehensive set of actions is needed to robustly influence a desired outcome. These design ideas can be implemented at little to no cost and are applicable to organizations whether large or small, for-profit or not-for-profit, newly formed or well established.

Challenge/Skill Balance

Many studies have indicated that a match between a high-challenge task and an individual's ability to be able to just to meet the challenge is the most important driver of flow (Bakker, 2008; Csikszentmihalyi, 1990; LeFevre, 1988). What has not been explicitly stated in prior research is that workers with different tenures, experiences, and capabilities present with different skill levels. New employees may not have the same organization-specific skills as more seasoned employees in the same job family. Each individual's perception of what constitutes a high-challenge task therefore differs from every other individual's perception. So, organizations should pair people to the task, matching the work to the worker. For instance, new recruits should be assigned relatively easier work tasks and/or lower volumes of work. As these new employees become habituated to their current skill set and task challenges, organizations should make additional required skills available to learn and practice. Then, organizations should increase the challenge of the work assigned to these individuals so they are pushed to make maximum use of their new knowledge. Ceja and Navarro (2012) posit that to fully experience flow, one needs to execute alternating series of challenging tasks and mastered tasks. Doing so optimizes the self's need to experience opposing pairs of feelings, in this case excitement and relaxation. Organizations should adapt this research into its matching of work to workers by dynamically allocating appropriate quantities of alternating high-challenge tasks and lesser-challenge tasks. As noted earlier, "high-challenge" and "lesser-challenge" are unique for individual employees in the same job family; for example, veteran workers possess deeper levels of experience than newly hired employees. What may be deemed a high-challenge task for a new hire may be a low-challenge task for a seasoned employee.

Clear Goals

Professional development plans, a communication component in the systems approach, are a frequently used means to track and increase the skill competencies of workers (Lejeune, Mercuri, Beausaert, and Raemdonck, 2016). Based on assessments of employees' current job capabilities and desired job capabilities for their current roles and/or future roles, they are roadmaps to close the gap between present and future: what skills the employees are to acquire, how they are to do so, how they are to demonstrate competency, and by when. In the context of helping workers achieve flow, managers should keep close track of new skills their employees acquire and the degree to which they are capable of performing those new skills, and use this information to match the assignment of more challenging tasks to increased skill levels.

Clear goals, another systems factor, will clarify why a task is to be done a certain way and set performance targets individuals should aim for. To the extent possible, leaders should construct organizational goals so they align with individual goals. In this way, the employee can more readily "buy in" to the appeal of the "why," or the purpose, of the work (Csikszentmihalyi, 2003; Dyląg, Jaworek, Karwowski, Kożusznik, and Marek, 2013). For example, one of the authors of this paper led a process excellence program for a consumer automotive account collections function within a bank. Working with the leaders and front-line agents of this function, we transformed the goal of the organization from "maximize dollars collected and minimize financial loss to the organization" to "keep the customer in the vehicle for as long as practical." The organization metamorphosed from a business-first philosophy to a more customer-focused one. This new organizational goal was part of a cultural transformation that empowered collectors to find mutually beneficial payment solutions with delinquent borrowers, such as loan modifications and loan transfers. These loss mitigation tools were always available,

but now the focus was on using them as a customer advocate and advisor to stem involuntary vehicle repossessions. Collection agents could more readily accept this collaborative philosophy than the previous adversarial tack, and create individual development goals such as improving their proactive listening and counseling skills.

Clear, Real-Time Feedback

This paper's authors define feedback as the process of providing information to the worker about the effectiveness of his/her performance relative to goals previously set. The more relevant the feedback is to the task being performed and the closer in time the feedback occurs relative to the performance, the more meaningful is the information to the worker (Hackman, Oldham, Janson, and Purdy, 1975). Organizations can do much to improve the performance feedback loop to their employees to enhance the likelihood of achieving flow. If relevance and timeliness are critical components of feedback, then constructing feedback loops (part of the technology perspective of the systems approach) so that one or more components of the work system provide performance information to the worker as the tasks are being performed will be the most powerful feedback method. For example, if the worker's goal is to process between 50 and 70 online customer requests per work shift, then the computer system can display a running count of the number of requests completed throughout the day. In this way, the worker can easily see if his/her production rate is on track or not.

Workers' progress toward goals should be reviewed on a set, periodic basis with workers' supervisors (Csikszentmihalyi, 2003). These review sessions should include reinforcement of what the employee is doing well, identification of gaps between expected performance and actual performance, and the development and review of action plans to close any such gaps.

Supervisors should reference scorecard measures and any other factual information (e.g., outputs produced by the employee, recordings of calls between the employee and customers) to mitigate risk of subjectivity in the coaching sessions. This recommendation spans the communication, technology, and people components of the systems approach to designing for flow.

Cautions in Designing for Flow

States of Imbalance: Anxiety and Apathy

We now discuss a sample of conditions that limit the possibility of achieving flow. The first two conditions are anxiety and apathy. Such states occur due to an imbalance between task challenge and performer skill (Csikszentmihalyi, 1990). Anxiety, or over-arousal, arises from a high-challenge demand without the accompanying skills to meet it. The possibility of flow can decrease when task demand is too high (Engeser and Rheinberg, 2008). In addition, emotions such as anxiety or frustration can disrupt concentration, which is essential to maintaining flow (Csikszentmihalyi, 1990, 2003). Alternately, the work itself may lead to anxiety if goals change too rapidly, or the worker's standing in the company is unclear. If a worker does not know where to direct his or her energy, flow is impossible. Anxiety leads to physiological changes and a reduction in cognitive capacity during anxiety, which combine to limit the ability to concentrate (Larson, 1988). Refer to the above discussions on task/skill matching, goal setting, and coaching to close performance gaps for recommendations in this area.

Alternately, someone whose abilities have exceeded the challenge for their situation may become quite bored and experience apathy, or under-arousal. This state can also detrimentally affect concentration. Associated with this state are low levels of physiological function, decreased cognitive capacity, and little emotional affect (Larson, 1988). Apathy can occur in

workers when their skill levels far outpace the challenges of the tasks they perform or when they are unaware of the challenges they can impose on themselves to make such tasks more exciting.

Refer again to the sections above on task/skill matching, goal setting, and coaching for recommendations in this area. In addition, encouraging employees to create self-imposed challenges can create excitement and mitigate apathy. Flow is supported through these challenges because they are internalized, heightening buy-in and meaning (Csikszentmihalyi, 2003). Finally, pairing high-skill/low-challenge seasoned employees with newer employees as mentors and mentees, respectively, can form a symbiosis between the two sets of individuals by helping junior employees lessen anxiety, while giving bored-but-capable veteran employees an opportunity to alleviate their apathy.

Mental Fatigue

Fatigue is the mental and/or physical state of feeling exhausted, sleepy, and weak, which leads to a diminution in the ability to function efficiently on a task (Dittner, Wesely, and Brown, 2004). Mental fatigue can be described as the experience of tiredness and failure to use cognitive resources effectively. Although the task can be completed under high mental fatigue conditions, the quality of outcome performance has been reported to decrease (Langner et al., 2010). For instance, it was found that an increase in mental fatigue is correlated with an increment in reaction times, missed and false alarms, and time-on-task in an attention-dependent task (Boksem, Meijman, and Lorist, 2005).

The detrimental impact of mental fatigue on performance can be observed especially during highly demanding cognitive tasks (Matthews and Desmond, 2002). Cognitive load (mental workload) is experienced when a task requires using cognitive resources excessively

(Plass, J., L., Moreno, R., and Brünken, 2010). The demand of a task greatly influences the ability to allocate the limited cognitive resources. Boksem, Meijman, and Lorist (2005) found that individuals voluntarily fail to control their attentional systems during a highly demanding task. They showed that the ability to inhibit the irrelevant stimuli during a highly demanding task decreased with an increase in mental workload (Boksem, Meijman, and Lorist, 2005). Therefore, managing the level of cognitive demand of a task in human-controlled systems is important to perform successfully and effectively.

Although technology makes our lives easier in many ways, it can also lead to an increase in cognitive workload (as cited in Block, Hancock, and Zakay, 2010), because the operator is performing a task while simultaneously trying to control a complex system. According to Hancock and Chignell (1988), complex systems required to perform multiple tasks simultaneously increase mental workload because of the variations in the demands of different tasks. In such cases, even though the individual has the required skills, those factors could give rise to a decrease in performance.

Designing work systems to foster flow experiences is important to boost workers' performance (Harter, Schmidt, and Hayes, 2002). In this present paper, we argue that the perceived mental workload should also be taken into account in the design of flow-desired work tasks. Hancock and Chignell (1988) proposed a mental workload model highlighting three components contributing to the perceived workload in complex systems: time, distance, and effort. Based on this model, the perceived distance between the objective and one's current status relative to that objective, and the amount of effort and time needed to reach that point, are crucial for successful performance. It is argued that there is a positive relationship between the

perceived distance, time, and mental workload (Hancock and Chignell, 1988). If the perceived distance exceeds some maximum point (perceived maximum distance threshold (Hancock and Chignell, 1988)), then effectiveness decreases. This idea is similar to the skill/challenge balance referenced in the flow theory literature (e.g., Csikszentmihalyi, 1990)). One of the main components of flow theory is to balance one's skill level and the task's challenge level in order to be able to achieve and maintain flow (Csikszentmihalyi, 1990). On the other hand, we argue that the perceived distance proposed by Hancock and Chignell (1988) would work as a mediator in this relationship. Here, the main focus is on "the desire and belief of the operator that the task at hand is amenable to physical and/or cognitive accomplishment, within the time frame established for successful problem resolution" (Hancock and Chignell, 1988). If the perceived distance is high, then the operator can put more effort to complete the task successfully in a certain amount of time, which would increase mental workload and fatigue, leading to a decrease in performance. In other words, we argue that regardless of the balance between the level of skill and challenge, perceived cognitive load has a considerable impact on performance and the flow experience.

Besides designing tasks considering the skill/challenge levels of the workers and optimization of the cognitive demands, cognitive restoration should be used as a way of achieving the flow state, reducing cognitive load, and increasing performance in complex human-controlled systems. Cognitive restoration theory proposes that engaging in natural environments has restorative influences on human attention (Berman, Jonides, and Kaplan, 2008). Considering the disruption in the top-down attentional processes, which refers to the voluntary control of attention and inhibition of the irrelevant stimuli caused by mental fatigue

(Boksem, Meijman, and Lorist, 2005), including mental breaks in the design of a task would help restore the cognitive efficacy of the workers. On the other hand, although studies showed that natural scenes and sounds have a restorative impact on performance in tasks requiring sustained attention (Berman, Jonides, and Kaplan, 2008), the literature on cognitive restoration effect presents conflicting results (Emfield and Neider, 2014). Therefore, further research investigating the effects of mental breaks aiming for cognitive restoration on attentional processes and mental workload, and the possible outcomes of its application to flow-desired workplaces, are needed.

Conclusion

Flow is a desirable emotional/cognitive state which results in, among other benefits, high worker productivity and well-being. In this present paper, we propose a holistic, systems approach as a new and comprehensive means of designing for flow in the workplace. Within this systems approach, we focus on the antecedents of flow, and suggest a number of recommendations organizations can follow relative to these antecedents to increase the likelihood of its employees achieving flow at work. We also present a number of cautions when designing a work system; mitigating these cautions will aid employees in achieving and maintaining flow.

Phase 2: Phenomenological Exploration[2]

Simplicity and Predictability: A Phenomenological Study of Psychological Flow in Transactional Workers

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Keywords: Psychological flow, motivation, work system factors, work system design, qualitative methods

Abstract

Psychological flow is a positive experience achieved through a near-balance of task challenge and skill capability, creating a merging of awareness and action and leading to an intrinsically rewarding feeling. Flow has typically been documented in persons who participate in work and leisure activities where they can exercise a large degree of creativity and agency over their actions in pursuit of their goals. The objective of the present study is to explore the lived experiences of flow in workers in roles where creativity and agency are typically not expected. An interpretative phenomenological analysis approach was employed to attain this

[2] The article in this section has been accepted for publication, with reviewer modifications to be made, in Frontiers in Psychology in 2023. Authors are Steven R. Clapp, Waldemar Karwowski, and P.A. Hancock. My contribution to the paper included the design and execution of the phenomenological study, the initial thematic grouping of interview responses, and the initial drafting of the paper.

objective. Semi-structured interviews were conducted with 17 adults whose role is to perform transactional work, which by its nature affords less opportunity for creative execution. Two broad types of flow are described and a connection is made that the present study's participants achieve one of those flow types while working. Participants' feelings, preferences, and actions are mapped to the nine conventional dimensions of flow. Specific non-task work system factors are discussed relative to their influence on participants' attainment of flow. Limitations of the present study and recommended future research are discussed.

Introduction

The Flow Experience

Psychological flow is the state where one is so immersed in an activity that all other sensations seem to fall away; the passage of time feels altered and even the sense of self is subordinated to the completion of the task. Csikszentmihalyi (1990) describes this state as an "optimal experience." The feeling of being in flow at work has been described as being completely immersed in a rich and demanding task; of being in harmony with the work and the people working with you; of not wanting to stop what you are doing, even when tired; and of enjoyment and fun (Csikszentmihalyi, 2003, pp. 39-41). Greguras and colleagues (2014; p. 153) equate flow at work to what happens when one expends just the right amount of effort and engagement on a task of sufficient challenge; when the skills of the person fit the challenge of the job, employees are absorbed in their work and autonomous motivation occurs. According to Csikszentmihalyi (1990) and adopted by others (for example, Jackson and Marsh, 1996), flow consists of nine dimensions. These dimensions are time-sequenced (Csikszentmihalyi, 1988; Chen et al., 1999; Fullagar et al., 2017), such that antecedent dimensions lead to characteristic dimensions, which in turn lead to consequential dimensions. Antecedents form the foundation of

the flow experience and must be initially present for flow to occur. Challenge/skill balance is considered the most critical antecedent (LeFevre, 1988; Csikszentmihalyi, 1990; Bakker, 2008; Keller and Landhäußer, 2012). If the challenge of the work, hobby, or chore task just exceeds the skill level of the one performing the task, flow is more likely to occur. However, if the challenge far exceeds skill level, worry and anxiety are more likely to be the actor's mental state. And if the challenge is far below the individual's skill level, apathy and boredom are apt to occur.

The second antecedent is having a clear goal to accomplish. This flow dimension answers the questions, "Do I know why am I performing this task?", "Can I expect to execute this task well, in terms of the goal to be achieved?", and "Does this goal align with my own values?" These questions relate to understandability, achievability, and relatability, respectively. Positive-oriented answers are more likely to lead to high task engagement (Csikszentmihalyi, 2003; Clapp et al., 2018).

The third antecedent dimension is immediate feedback. Knowing if current performance is leading the actor toward or away from a goal will help the individual stay on track or course correct, respectively. The narrower the time gap between task execution and feedback, the faster the performer can know to maintain his/her level of performance or if some adjustment is needed and the more relevance that can be attached to it. Such performance information can be generated internally (such as comparing one's own results to a standard or to previous results), from other individuals (for example, post-sale customer feedback surveys and daily Agile scrum team meetings), and by the organization (for example, employee performance monitoring systems; Hackman et al., 1975; Csikszentmihalyi, 2003).

Characteristic dimensions are those aspects that occur while one is experiencing flow. One of these dimensions is the merging of action and awareness. That is, an individual in flow seems to know without consciously thinking the correct steps to perform and in which order; action is described as taking place instinctively (Csikszentmihalyi, 1990, 2003).

Being completely immersed in deep concentration is a second feature of flow. All external stimuli fade away and even internal, physiological needs such as hunger and fatigue may not be recognized while in the state of flow (Csikszentmihalyi, 1990). Of course, the long-term effects of ignoring physiological signals can be deleterious to one's health and may be a sign of behavioral addiction; for a deeper discussion of the dark side of flow, see Schüler (2012).

A third characteristic of flow is the sense of control (or agentic power) experienced by the individual over how the task at hand is to be accomplished. Self-directed decisions such as the order of items to process, the speed at which to execute task steps, and when to take work breaks (Csikszentmihalyi, 2003). The authors of the present study will show later in this paper that even the arrangement of the work environment contributes to the feeling of control over how the work is performed.

As a consequence of these previous six dimensions, persons who have experienced flow comment that they experienced a loss of ego, of self-consciousness. Thoughts of how others might perceive their task execution fall away. Maybe that is why we see some musicians making odd facial expressions while they are playing a passage, seemingly oblivious to the audience's perception of said contortions. Or why we may hear our workmates talking to themselves while working on a challenging task. The person disappears; only the activity and the performance remain (Csikszentmihalyi, 1990).

Another consequence of flow is a perceived alteration of the passage of time experienced by some. For example, individuals who have experienced flow have commented that they thought they had been immersed in a task for a short period of time when in fact a much longer period of time had elapsed. For others, the opposite is true (Csikszentmihalyi, 1990; see also Hancock et al. (2019) for a discussion on the relationship between flow components and the experience of the passage of time).

The third consequence of flow is the feeling of enjoyment associated with accomplishing or even making progress toward completing or mastering a task. Csikszentmihalyi (1990) describes this enjoyment stemming from an intrinsic reward mechanism (as opposed to receiving compensation, recognition, or some other external reward) as an autotelic experience. This internal reward system is what encourages individuals to return to the activity again and again. For a sample of activities provide individuals intrinsically-rewarding experiences, see Chen and Chen (2011; motorcycle riding at high speeds) and Seger and Potts (2012; video game playing to satisfy the need to learn.

Experiencing flow in the workplace has been linked to greater well-being, positive affect, and greater commitment to the organization (Bryce and Haworth, 2002; Eisenberger, Jones, Stinglhamber, Shanock, and Randall, 2005; Demerouti, 2006). Research has also correlated flow to increased worker productivity (Martin, 2005; Demerouti, 2006 (for workers with high levels of conscientiousness)).

Understanding Flow from a Holistic Work System Perspective Within Transactional Work

Flow has been long studied in the context of work, hobbies, sports, and other domains where paths to attaining desired outcomes can take many forms. For example, university classroom teaching of a subject can be executed by instruction with a textbook, with instructor-developed slide presentations, with guided experimentation, with free-form exploration, or with any combination thereof. The instructor is able and may be expected to, within prescribed institutional guidelines, create the curriculum of his/her choosing based on his/her level of experience and expertise. In other words, the instructor has much agency over how the course outcomes are to be met (Csikszentmihalyi and LeFevre, 1989).

But what about those who must perform rote, repetitive work in an office setting (some of which are colloquially referred to as "cubicle farms") with little opportunity for creative control over the execution of tasks or over outcomes? Think data entry clerks, accounts payable staff, and schedulers. These workers are in transactional roles ("Transactional Work", 2007; Hunt, 2008; Power, 2012) and comprise over 18.5 million members of the U.S. workforce (Bureau of Labor Statistics, 2020). We label these individuals as "transactional workers" who perform "transactional work." Can this large workforce also experience flow and enjoy its concomitant benefits?

We chose to perform a phenomenological study since our objective was to "understand [the] phenomenon [of flow] from the point of view of the lived experience in order to be able to discover the meaning of it" (Englander, 2012). Specifically, we chose to employ an interpretive phenomenology analysis to be able to map participants' descriptions of their flow experiences to well-known dimensions of flow as described in the introduction section of this present paper

(Smith and Osborn, 2004; Finlay, 2009). Our study took the form of semi-directed one-on-one interviews of 17 transactional office workers to document their lived experience of flow at work. These persons conduct their daily activities largely seated at a desk and perform their tasks via a computer and software. Most of their tasks are performed with no or limited interaction with internal or external customers. We attempted to understand what flow feels like to these individuals what triggers their immersion into flow, and what causes the feeling of flow to end. Our interpretive framework is the extent to which certain non-task work system factors influence their attainment of flow. Non-task work system factors and an illuminating example are documented below.

The work system theory of flow (Clapp et al., 2018) proposes that both the task and non-task variables must combine to create a flow-supportive environment. In the present study, non-task work factors identified for further study to support this theory include work-supportive technology, background noise presence, clarity of task communications, and physical environment. These variables were chosen for study as they are typically found in office environments.

Technology was defined for the current study's participants as the total set of tools needed to complete or aid in completing their work tasks. Such tools could be electronic in nature, such as computer networks and photo-copiers, and non-electric, such as written work instructions and writing instruments.

Transactional work environments are also referred to as back offices and shared service centers. They are typically characterized by collocating workers in functional groups, the goal of which is to achieve work efficiencies and reduce expenses (for examples, see Howcroft and

Richardson, 2012; and Priote, 2020). Such locations can be populated by anywhere from one or two employees (as in the university department settings of some of the present study's subjects) to hundreds sharing an open floor separated by low walls (colloquially known as a "cubicle farm," as in the financial services firm of others in the present study). Although there can be many individuals sitting in proximity to each other, each is executing his or her own tasks alone, with typically little interaction with others.

A constant babble of background noise can typically be found in these environments. Talking, rustling paper, and playing recorded music are examples of such background noise. The authors wanted to explore the influence of the presence of co-workers and the background noise they generate on participants' ability to achieve flow at work.

The present study defined task communication as the level of detail contained in instructions 1) given by a supervisor to the subject, regarding what tasks to perform, the priority of those tasks against each other, and/or how to perform them; or 2) found in training that taught and standard operating procedures that documented the step-by-step actions needed to complete the tasks. The authors wanted to gain insight into whether the quality of such communication affected the participants' ability to achieve flow.

In addition to typically sitting in proximity to other workers with this factor's attendant effects from noise, offices also include physical environment variables such as ambient temperature ranges, various lighting levels, noise from a number of non-human sources, and seating and work desk influences like height, depth, and comfort. This list is not comprehensive but serves to illustrate the variety of potential influences on the achievement of flow the present study's authors wished to explore.

As a test of the work system theory of flow, a proof-of-concept empirical study was conducted to determine if and to what extent seat comfort was an influence on the attainment of flow. The study found that seat comfort is in fact a main effect predictor of flow (Clapp et al., 2021). In this experiment, an ergonomically adjustable chair was quantitatively found to contribute to a higher achievement of a flow state in participants than an armless, backless bench did, for participants performing a computerized set of tasks in an office setting.

Methods

Participants

Purposive sampling was employed to select candidates for the study. Seventeen transactional workers were recruited through personal communications by one of the authors (SRC) of this present study and through social media. Screening criteria included confirmation in writing by the participants prior to their appointed interview time of 1) working in an office-type setting, performing repetitive, well-defined, and routine tasks (transactional work as defined by "Transactional Work", 2007; Hunt, 2008; and Power, 2012); 2) working at least 20 hours per week in the said role; 3) attaining at least 18 years of age at the time of the study; and 4) experiencing the following feeling while at work (adapted from Csikszentmihalyi, 1990; and Bakker, 2008):

> The task is so demanding and rich in its complexity and pull. I get so immersed in what I'm doing, in the actions that are involved, that I lose consciousness of my own body and melt into the activity. My daily work challenges me, but I feel I have the skills to excel at those tasks. I know exactly what actions I must do to complete my work. I clearly know if I am achieving success in my work. I am so immersed in my work that I am not

concerned about how others perceive me. I don't notice how much time passes during my work. I feel a sense of enjoyment from a job well done and want to experience that feeling again.

None of the candidates approached refused to participate or were disqualified because of the screening criteria. Of the 17 participants, 13 were female. The average age was 41.4 years (SD = 18.1 years); median age was 47 years, and interquartile range was 27 years. The average time in role was 7.5 years (SD = 8.7 years); median time in role was 4 years, and interquartile range was 6 years. Occupations included office/administrative assistant, office manager, bookkeeper, accounts receivable clerk, lab analyst, database entry clerk, quality assurance associate, production support specialist, and space utilization coordinator.

This research complied with the American Psychological Association Code of Ethics. The institutional review board of the University of Central Florida approved this research. Written informed consent was provided to each person who expressed interest in participating in the research. Each participant was compensated US $20 upon completion of his/her interview, in line with local average hourly wages for roles represented by the participants. We do not believe this amount of remuneration was of a size that would have biased the participants' input. Duration of the interview sessions were approximately 45 minutes. No personally identifiable information was collected during the interview sessions to preserve subjects' anonymity.

This being a qualitative study, no statistically valid sample size calculations were appropriate. Sampling was purposive and followed the guidance of Smith and Osborn (2004): the sample size was determined on an ongoing basis throughout the interview process, finally

reached when the authors felt the topics had been saturated with respondents' feedback and insights, and duplication of responses began occurring with some frequency.

Setting

The study was performed in person for roughly one-third of the participants and via video conferencing for the remainder. Interviews were conducted with fifteen of the individuals located in their offices; two were held away from the participants' work locations due to the lateness of the day (one via video conferencing and one in person). Interviews at work locations promoted a sense of ease by being in a familiar setting and helped participants better recall their flow experiences where they occurred.

Procedures

Author SRC conducted each of the interviews. At the time of the study, he was a doctoral candidate in industrial engineering, with a concentration in human factors psychology (he has since earned his doctorate). In addition, SRC had been a process design management consultant for over 25 years and has collaborated with various back-office transactional functions to streamline operations. He is well-versed in interviewing techniques aimed at establishing rapport, eliciting open dialogue, and probing for relevant information. Participants in the current study were either well known to SRC – having worked together on one or more process design projects – or were well known to individuals who referred the participants to SRC. The interviewer made the participants aware of the purpose of the research and of his academic and professional background. None of the participants had at the time of the study any type of professional relationship with SRC. Informed consent was obtained from each participant prior to the beginning of the interview. After some demographic information was collected, the

interviewer read the above paragraph pertaining to typical feelings of flow out loud once again to the participant to focus the discussion on the phenomenon of flow. Then, the following questions guided the discussion, employing the phenomenological interview practices recommended by Lester (1999) and Smith and Osborn (2004):

Describe a work situation in which you experienced a feeling similar to the one just described.

What did that experience feel like?

What triggered that feeling?

To what extent did the challenge of the task influence how you felt?

To what extent did the technology you used influence how you felt?

To what extent did the people you worked with or who were near you influence how you felt?

To what extent did the communication about the task influence how you felt?

To what extent did the physical environment in which you work influence how you felt?

What caused the feeling to end?

For how long do you think the experience lasted?

The participants offered details about each of the topics. The interviewer minimized intruding on the participants' descriptions of their experiences so as to not interrupt their

recollections, nor to introduce interviewer bias into the respondents' stories. If some aspect of the discussion appeared novel or needed more details to be fully documentable, the interviewer prompted the participants with questions such as, "Can you describe [insert topic] more fully?" and "What else do you think about [insert topic]?" Each interview lasted approximately 45 minutes.

Interviews were digitally recorded, with permission given by the participants prior to beginning the interviews. Recording allowed the interviewer to be more fully present for the discussion and able to better sense when to move on to another topic or to delve deeper into the current one; and it facilitated an accurate capturing, word for word, of the participants' experiences for later analysis. The recording device was an Olympus WS-853 Digital Voice Recorder (Olympus Corporation of the Americas, 2021) chosen for its unobtrusive size and sharp recording quality. Once all the interviews were completed, the researcher transmitted the recorded files to a professional transcription company. This company employed human transcriptionists fluent in the language in which the interviews took place (all were in American English). Neither follow-up interviews nor participant reviews of their transcripts were employed in this study.

Data Analysis Methods

Interview transcripts were analyzed using the methods recommended by Lester (1999), Smith and Osborn (2004), and Leedy and Ormrod (2013). For each question asked of the participants, common themes were identified. Identification of themes was performed by having one of this paper's authors perform the following steps, as recommended by Belotto (2018). To aid in the search for common themes among the almost 13 hours of transcripts, all the

transcribed interview files were combined into one master text file (first removing the paragraph beginning with "The task is so demanding and rich in its complexity and pull" since this lengthy text was read by the interviewer at the beginning of each interview and, therefore, should not be included in the transcript text to be analyzed). One of this study's authors then read through the entire response set. Common descriptions were grouped into themes through a recursive method suggested by Saldaña (2009, pp. 16-19): from the initial transcriptions, themes of flow contributors were identified; as subsequent transcriptions were read, these themes were modified and additional themes were added to more thoroughly and deeply capture the thoughts and feelings being communicated. All transcribed interviews were next re-read to ensure pertinent themes were not missed and those that had been captured were fully documented with all applicable participants' data.

Although this study is qualitative in nature and no statistically valid sample sizes were used nor were generalized results deduced, the authors decided to adopt a guideline for when to create a particular theme from participant feedback. The heuristic used to affinitize responses into common themes was that three or more participants had to comment similarly on a topic before a theme could be created. The authors believe this requirement lends strength to the method used to generate themes.

The author who performed the initial coding of themes (SRC) then had the other two authors review this categorization to comment on the extent to which the participants' responses "fit" into the themes suggested by the first author. Changes to themes were agreed upon by all three authors. This method of ensuring reliability is similar to that documented by Belotto (2018).

The investigators were careful not to interpret individuals' responses during the interview sessions, which may have led to inadvertent insertion of the interviewer's own beliefs. Rather, the researchers grouped common experiences into themes that captured overall essences of the topics being discussed. Finally, thematic interpretation took place after all interviews were completed in order to match – to the extent possible – these grouped observances with the nine classic dimensions of flow.

Microsoft Excel (Redmond, WA) was used to give structure to participant responses. This application was chosen for its ease of data entry and its use of free-form text boxes in which to enter response data. Responses were grouped into color-coded text boxes according to their common themes. The research questions and dimensions of flow were the themes; there was no exploratory search for themes needed. Therefore, coding systems such as concept maps and coding trees were not used to further identify and arrange the themes, as the researchers determined that the data captured for each theme were self-contained and not hierarchical in nature. The thematic map developed from analyzing the responses is shown in Figure 8.

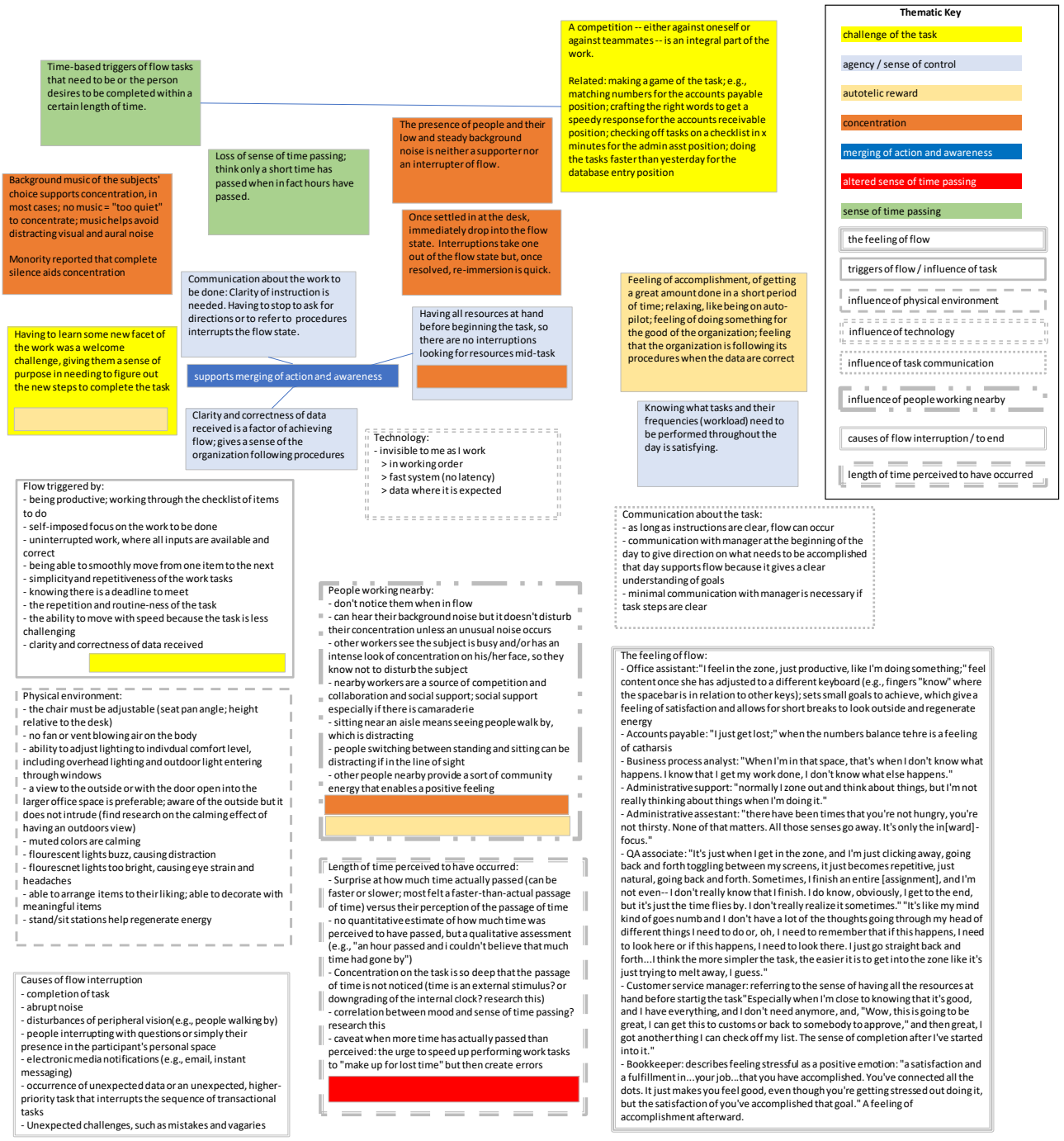

Figure 8. Thematic map of interview responses categorized into flow dimensions (color-coded boxes) and/or interview themes (gray outline boxes).

Results

The interviewee responses documented in this section correspond to the items presented in the interview guide. Prompts about the flow experience and triggers of flow are described in sections 3.1 and 3.2. Since the literature describes the flow dimension of challenge/skill balance as the most critical antecedent for creating flow-inducing conditions, section 3.3 is devoted to better understanding the type of challenge presented to the individuals. We especially felt understanding the job challenge was important given the paradigm we were operating under of relatively straightforward work that was being performed. Sections 3.4 through 3.7 discuss the participants' flow experience under the framework of the four types of non-task work system factors under consideration for the present study. We were interested in documenting the conditions under which the "spell" of flow could be broken; participants' feedback in this area is documented in section 3.8. One of the present researchers (PAH) has studied perceptions of elapsed time while in flow (Hancock et al., 2019) and so we were particularly keen on understanding the present set of individuals' descriptions of the passing of time while in flow; this matter is covered in section 3.9. A thematic map, a portion of which is shown in figure 8, was used to document and categorize the findings of this section.

The Flow Experience Described

In discussing the prompts "Describe a work situation in which you experienced a feeling similar to the one just described" and "What did that experience feel like?", one common theme was that once the subjects sat at their workstations and began their transactional activities, nearly all of them quickly sank into the immersive state they describe as "flow." That is, once they turned on their desktop computers, arranged their workspaces (to be discussed in a later section), identified the work tasks to be accomplished, and began said work tasks, they easily became

deeply focused on their transactions, with particular emphasis on completing them all before their work shifts ended. As a database entry clerk noted when asked to estimate the length of time she needed to achieve a feeling of flow similar to the passage read to her at the beginning of the interview, she responded "Oh, that's pretty immediate getting into it. It's pretty immediate."

Work tasks were transactional in nature: entering data, updating document content, and balancing accounting entries are some examples of the activities performed. According to the participants, this type of work typically requires the quick succession of completing the following sub-tasks:

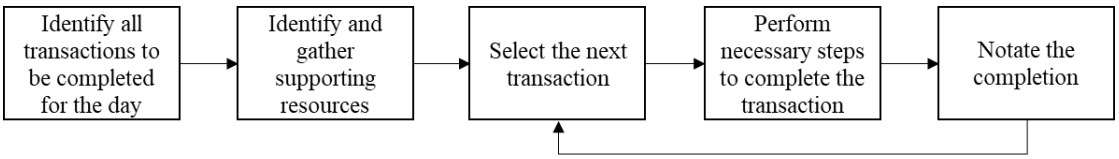

Figure 9. Decomposition of a set of transactional work items into sub-tasks

Identifying all transactions to be completed typically occurs at the beginning of the work shift. This queue of transactions may consist of a set of awaiting emails, a list of items in a database to be processed, a stack of paper documents, or some similar mass of work to be addressed. The office manager, customer service manager, and administrative assistant created paper-based lists of their work-to-be-done; they would pencil through or draw check marks next to their complete items during the day.

The subjects described identifying and gathering resources needed to perform the task as, for instance, gathering all the necessary instructions and operating procedures; accessing the proper computer applications; and gathering test equipment. These resources need to be at hand and functioning properly before performing the steps needed to complete the work task can

begin. For example, in the case of instructions and operating procedures, participants indicated these tools must be available, current, and importantly, so familiar that they do not need to be referenced. Likewise, computer applications must work smoothly (including no operating system or network glitches) and intuitively. Test equipment must be fully functional and calibrated to produce accurate results.

Acquiring the next transaction consists of identifying the next task on which to devote time and effort to resolve. Identification occurs through such vehicles as lists of transactions (accounts payable clerk; bookkeeper), an author's edits on a document (office assistant), and queues of bills of lading (customer service manager). One can think of these items as work orders arranged in a first-in, first-out basis.

Only after identifying the transaction to be completed and ensuring all resources needed to complete that transaction were available and functional were the participants ready to execute the steps to complete said transaction. Once they completed the current transaction, the individuals checked off the task – either mentally noting completion or physically notating the list of transactions – and began the work activity for the next transaction. An office manager (OM), responsible for updating customer payments received by her organization into the general ledger system, described the steps of identifying the transactions to be completed and of notating the completion of those transactions:

> *OM: …I can print out that whole set [of payments received for] that week.*
>
> *Interviewer: To what extent does the [printed list of payments] help you get into flow or not?*

OM: The paper does…because I can actually mark on the paper, "Okay, so this payment's been completed," mark. "This one's been completed," mark.

According to the subjects interviewed, steps one and two in figure 2 had to occur for each transaction before those individuals could begin to become immersed in their work activities.

One of the subjects, a customer service manager (CSM) who is responsible for shipping products to overseas customers, described the above set of steps in terms of a sense of completeness when all necessary resources are available for her to execute the shipping order:

CSM: After I put everything all together is when I have everything in front of me that I need. If I have it, I looked at it, and I'm like, "Okay, what do I need for this?" I might have to walk around and get different things or talk to someone about it or make a phone call. It would be after I started working on it, and then I know [I can begin smoothly and without delay]. Especially when I'm close to knowing that it's good, and I have everything, and I don't need anymore, and, "Wow, this is going to be great, I can get this to customs or back to somebody to approve," and then great, I got another thing I can check off my list. The sense of completion after I've started into it.

Interviewer: Tell me if I'm hearing this right. It sounds like when you have all your resources together at hand, that's when you get into that deep immersion state?

CSM: Exactly.

And then, as the CSM completes each shipping order, she stated “In my head, I'm clicking off ‘Done. Done. Done.’ It's my drive for a sense of accomplishment. It makes me feel really accomplished and valuable.”

Others similarly described flow in terms of a sense of accomplishment. A database entry clerk, responsible for documenting donors' monetary gifts to a non-profit organization, commented, "It feels fulfilling, satisfying because I'm getting it done. I'm helping us work towards a goal and it's a good pace." An office assistant noted, "I feel in the zone, just productive, like I'm doing something." A bookkeeper related she feels stress while doing her job, but she couched the sentiment in positive terms: "A satisfaction and a fulfillment in...your job...that you have accomplished. You've connected all the dots. It just makes you feel good, even though you're getting stressed out doing it, but the satisfaction of you've accomplished that goal." A production support specialist, responsible for assigning and tracking the progress of incoming insurance claims, noted, "It makes you feel accomplished because you're like, 'Oh sweet. My numbers are really high. I'm really not in doubt. I'm making a difference today.'" An accounts payable clerk described the phenomenon as "I just get lost" in comparing lists of numbers; and when the numbers balance there is a feeling of "catharsis."

The sensation of feeling "lost" was repeated by others, in terms of becoming unaware of time passing or forgetting the self. A business process analyst, whose responsibility is to manage employee access to her organization's systems, related her description of being in flow as, "When I'm in that space (being in flow), that's when I don't know what happens. I know that I get my work done, I don't know what else happens." An administrative assistant described her flow experiences as, "There have been times that you're not hungry, you're not thirsty. None of that matters. All those senses go away. It's only the in[ward]-focus." A quality assurance associate, who is responsible for checking that customer service representatives in her firm are interacting

with clients professionally and within policy, also noted a loss of self-consciousness as well as performing without consciously thinking of which actions to execute:

> *It's just when I get in the zone, and I'm just clicking away, going back and forth toggling between my screens, it just becomes repetitive, just natural, going back and forth. Sometimes, I finish an entire [assignment], and I'm not even-- I don't really know that I finish. I do know, obviously, I get to the end, but it's just the time flies by. I don't really realize it sometimes." "It's like my mind kind of goes numb and I don't have a lot of the thoughts going through my head of different things I need to do or, oh, I need to remember that if this happens, I need to look here or if this happens, I need to look there. I just go straight back and forth...I think the more simpler the task, the easier it is to get into the zone like it's just trying to melt away, I guess.*

Triggers of Flow

When asked what factors helped immerse themselves into the work, most of the participants described their sense of productivity with a linked desire for completing the work as the trigger. For example, one of the office assistant's (OA) responsibilities was to update journal articles with the author's edits. She related that setting and accomplishing short-term goals gave her the deep satisfaction of a rewarding experience:

> *Interviewer: What do you think triggers [flow]?*
>
> *OA: …the fact that I'm getting something done, that I'm being productive, it's not for nothing. I have some type of goals set and it's to finish this page. Since I'm working toward that, I don't want to get distracted by anything.*

Interviewer: Interesting. It sounds like you set short term goals, finish a paragraph, finish a page.

OA: I do. Yes, I have to.

Interviewer: Then once you achieve the short-term goal, do you set another short-term goal?

OA: Yes, I do.

Interviewer: Talk about that.

OA: Typically, I look at a task, so he'll have a lot of pages, maybe 16 pages of revisions. I don't know how I managed to do it in a short period of time, but I do. I look at the pages and I get-- It looks daunting. It's like, "Oh my gosh, I don't want to do all of this." Then I think about it in increments, and with the way I work is in breaks, I have to take breaks. I can push myself but it's not as-- I don't know. I feel like I need smaller goals just to make it more pleasant, the experience more pleasant, so I'll take a couple of pages.

An administrative assistant offered this take on production as her flow trigger: "Scratching off [completed items on a checklist]. I had written things on a piece of paper. As I did five at a time, just the feeling of accomplishment, of being able to cross off a name, because I did that one, and I did that one, and I did that one, and I did that one." A customer service manager commented, "In my head, I'm clicking off 'done, done, done.' It's my drive for a sense of accomplishment. It makes me feel really accomplished and valuable." The database entry clerk noted, "A trigger that gets me, I think it's just my own personal work ethic of got to get the

job done and get it done right and get it done fast and don't want anybody complaining." And an office manager, responsible for paying the company's bills, contributed to the theme of productivity and completion: "I think it's just going from one thing to the next because it's not just one little section of it. There is probably, say, 50 payments that I'm having to take care of, and it's just from one to the next, to the next, to the next. I think that's how I can lose myself in it just because you just finished one, you go on to the next…"

The space utilization coordinator, responsible for assigning physical classroom space to university course sessions, commented on his triggers of productivity/accomplishment as well as having a quiet workspace in which to concentrate:

> *Once I have [the course offerings and instructor names], it's almost as though that's a peaceful thing for me. Because as soon as I have the list, it's a sense of calm because then I know, this is what I'm doing, this is what I have to accomplish. The data is right here. All I have to do is get the data from point A to point B. You're just going through a smooth flow and you just enter it. As long as there's no interruptions, no one coming into your zone and interrupting that flow, I've been known to go for hours at that point.*

Others also commented that when they are able to concentrate on the work to be done, they experience flow. The accounts payable clerk said, "Okay, at twelve o'clock I've got this meeting, so it's a little bit hard to get in that zone, but it's like if I know [that the work is] what I'm concentrating on, I'll jump right in and just sit there."

The Challenge of the Task

When asked to discuss the challenge of their work as a proponent of flow, many participants commented on the relative ease of executing their tasks. The lab analyst, whose role was to analyze chemical components of a consumer product line, noted, "I like the pace, so I didn't want a big job." The administrative support clerk, responsible for a number of tasks, responded to this prompt, "For this (timesheet entry task), because I already know, and it was going to be pretty easy, and I know who to email, that there's no stress with it, so it's kind of, not necessarily relief, but kind of like a break almost because I need to do this (task) every … other week, but that's time where I know it's going to be fine really."

Also, for many of the participants – and related to the theme of execution ease – was the theme of each task item being similar to the previous one, resulting in a lower level of task challenge. The office manager responsible for fulfilling customers' shirt orders, said, "It's pretty automated. I get into a routine, I put the stuff in the bag, and then I weigh it and I write it down and then I go onto the next one. There's like a process." The business process analyst echoed the theme of sameness regarding her work on updating system access permissions for hundreds of employees:

> *…even though there are a lot of steps to it, it's not necessarily challenging… (each work item's steps are) one, two, three. There is no deviation. There are steps that have to happen in order. I made it my job to learn all of these different steps in order so that way I can focus. It's not challenging. In the very beginning, it was challenging but I got it to where I know everything that I have to do and I think that made it easier for me to get into*

flow state because now, it's kind of autonomous. It's automatic in exactly what I need to do. It's very easy for me to complete it.

The space utilization coordinator echoed the theme of repetitiveness:

> *...if it's a new task that I have not performed, I do not have my general* modus operandi. *If I don't have that all set up in my head, it's more stressful, so therefore I don't feel as though I relax and get into that flow as quickly. The first time that I'm doing something, or if it's a new job function, I would not say that I get into a flow. Once this is something that I've done before, I have seen the result of it, and that the result was correct, because you have to actually be able to see that what you did the first time was a correct action or result, and that means you can keep repeating that same work and come to the same conclusion. As long as I am not doing something that's new, I can get in the flow, but if it's something new, that I find that stressful and I don't get into the flow as quickly, until I repeat that, say once, twice, three times until I'm comfortable.*

A quality assurance associate, who has the responsibility to check customer service representatives' recorded calls for compliance with company, state, and federal regulations, responded to the question of task challenge as a combination of ease and repetition:

> *I feel like maybe it's the simplicity of [the work] and the repetitiveness of it because it's just very simple repetitive tasks. I just go to one screen, get the information I need, see if they did it (completely complied with regulations), and then I go to my database, write a document if they passed or failed, and then hit complete and I do it all over again. I just go back and forth…I feel like if it's simple, I don't really have to think*

about much. It's like my mind kind of goes numb and I don't have a lot of the thoughts going through my head of different things I need to do or, oh, I need to remember that if this happens, I need to look here or if this happens, I need to look there. I just go straight back and forth. Did it happen or did it not? I think the more simpler the task, the easier it is to get into the zone like it's just trying to melt away… If it's complex, I have to use my brain. [laughs] If I do that, then I'm triggering memories and conversations…thinking about the emails that I've read to make sure that I'm doing what I'm supposed to do. Like those what-if scenarios because our tests are like that or they're more complex. If they did this, but it's wrong, but it may not be wrong if this applies or this applies or this applies. Trying to think back to conversations I had and if it's applicable in emails or communications that might have come up.

A second quality assurance associate, working in the same organization and with the same responsibilities as the first associate above, commented similarly: "…because if you're flowing along, and you're doing your daily routine, and you're not necessarily having to get out of the box, so to speak, and you could lose track of time there, too, because things are flowing, you're trying to (meet your productivity goals), and you're going along."

Another theme described by the workers was in creating goal-oriented challenges for themselves. For example, the administrative assistant said,

I'm not allowed to be here after five, and I find myself looking and it's 4:49, and I'm like, "How much can I get done in 11 minutes?" And you challenge yourself, but you need to be careful and mindful, so you're not creating errors, because then, of course, that's time taken away that you need to fix. But I challenge myself. I look at the time…or set an alarm,

or something, or if someone says, "Goodbye." I know it's that time of the day (to leave). So, I guess I like to challenge myself in a timeframe. "How much can I get done? Can I get to this part of the (task) list?"

The database entry clerk also described a time-based goal-oriented trial: "I challenge myself. I know how fast I may have done the same task the day before, I try to do it even faster. It's like I play games with myself and I change it up for myself. It's a competitive thing against myself." The business process analyst stated that when she enters lists of newly hired employees' system information into a database, she challenges herself to perform the data entry as fast as possible:

...if I get…a list of say 30 employees that I'll have to hire on as a new hire. I'll have to log into a system and I know how many clicks, how many steps it takes to get into that system. I know exactly where on the computer screen that my mouse will need to hover over, so I know exactly what to do to (complete) that whole process. If I can onboard 30 people in the most amount of time, and so what I like to do is make it a game. I'll try to get very precise each time that I click on somebody because it's the same repetitive motion over and over again 30 times until I get through all of each person one. I'll have to do all of these different steps to get to person two, so I'll try to make it a game to see how quickly I can get through that. Just going back and clicking and just kind of losing that sense. Getting through as many of them to make sure that I don't miss anybody and that all 30 people had everything that they need by X amount of time.

A similar sentiment was offered by the space utilization coordinator:

In terms of if you can challenge yourself mentally…you can say, "I can complete this by X time of day," or, "I think I can do this in three days. You know, last time I did this list, I did this in three days, maybe I can do it in two." Sometimes I set up little goals for myself mentally. I don't always hit them, but it's just a point of having them or giving yourself a goal to strive for, so basically a temporary little goal you set up within your mind, so that instead of, "Well, I've got 140 different entries to make today." It's more of an aspect of, "How quickly can I get those done?" It becomes (an) efficiency sort of equation in my mind, versus, "Here we go, it's a drudgery," kind of a thing. It's a mental mindset.

While the above challenges were inward-focused, other study participants created outward-focused challenges. These challenges took the form of competitions against other teammates. For example, the production support specialist strove to "have the higher numbers (completed work items)" than her co-workers, and where almost everyone would "stay two or three minutes longer just to get the higher number." The lab analyst stated that her site was continually challenging itself against another site to complete more chemical assays: "…we're doing more (work assignments than) even done in (the other work location).…we need to be better, yes, it was a competition with (the other work location)."

Many of the interviewees listened to music while working. Although most of these individuals used music as a means of tuning out distracting office sounds to support their ability to concentrate on their work tasks, two engaged their musical preferences in a novel, self-imposed, and inward-directed challenge to perform their task steps in time to the musical beat. As the accounts payable clerk noted,

"…I make it into a game. I try and make it fun as much as I can…with the music and the cadence…It was like The Cars could be on or some other group could be on, Lynyrd Skynyrd or ZZ Top and I'll sit there with the music and the beat will be one, two, three, four or something. I'll be like, five, six, seven. Two, three, four, and I'll just go to the beat and just see if I can do little tempos and beats to make (balancing the accounting numbers) a little bit more fun."

The business process analyst likewise recounted, "(I) put my music in and get into a rhythm and get all of my tasks done."

Technology's Influence on the Achievement of Flow

Non-task variables, or work system factors, have been hypothesized to combine with the challenge of the task and other task-centric flow antecedents to create the conditions for an optimal experience, as described earlier as the work system theory of flow (Clapp et al., 2018). Sections 3.4 through 3.7 document the influence of the present study's selected non-task work system factors on participants' ability to achieve flow.

The common technology theme from the interviewees was that the set of work tools had to become invisible while using them: the tools were expected to work well each time they were accessed so that no thought was expended on wondering if those tools were performing as needed. For example, one of the office assistants interviewed discussed her desire to use a comfortable keyboard:

If I have a keyboard that's more comfortable to use, it makes it easier on my hands so that I can spend more time focusing on the work, on the words. I'll use my dad's

computer to do some other work, but his keyword is very old, and you have to press the buttons really hard, and so you're focusing more on, "Did I type that correctly?" versus when you're typing…you're not really looking at the keyboard (but you're) looking at the paper, because you can feel, "Okay, I know I'm typing this correctly." It's less broken up. The process is less interrupted by, "Did it [the key press] really go all the way in for the letter to show up on the screen?"

The business process analyst described a task that requires copying data from spreadsheets into a computer system. Various personnel in her organization email her these spreadsheets. If one of the spreadsheet's columns of data are not in the expected order of occurrence – which should match the order of copying and pasting – she must first rearrange the columns to comply with the correct sequence. Only then she can perform her work task with rhythmic ease:

Sometimes, whenever a spreadsheet comes over and it's not exactly in the order that I need it to be, I'll be able to quickly recognize what order it needs to be in. Shift some stuff around, a couple of things around, and then I can toggle back and forth, copy-paste all of the information. It's a lot of copy-paste from the keyboard. It's a lot of the keyboard shortcuts that I know…. I'll take the information from the Excel spreadsheets, toggle to the other system, pasting information where I need to. I know exactly how many times that I need to hit the tab key to [arrive at the fields where I paste the data].

The space utilization coordinator, whose responsibility is to assign university classes to physical and virtual classrooms, commented on how slow-moving technology prevented him from achieving a data entry rhythm and precluded him from experiencing flow:

The system pauses for a second. If it takes longer than… three or four seconds, then my routine is messed up, because then I hit the tab key because then the next thing I'm doing is I'm entering the start time, and then I'm entering the end time. I normally have a flow. You get a flow going. I know that this takes about this amount of time. My muscles remember and they say, "Okay, we're going to hit that tab key at this point in time, you're going to then go to your number keys, you're going to type in your time. You're going to hit the tab key again, you're going to enter your end time, and you're going to tab out. Then you're going to move down to instructor, you're going to click." You have your muscle routine there…. If you then have your software, where it decides that's going to be slow, or the servers are down, or what have you, then it takes five, seven, God forbid, it used to take sometimes up to a minute, just to load what you did. You can't proceed until you enter one thing, it does this little swirl and then it says basically done, and then you can move on, because if you enter other stuff, it just wipes out (the previously entered data) when it updates.

Co-Workers' (Background Noise) Influence on the Achievement of Flow

According to a few of the subjects interviewed, the nearby presence of co-workers can support the achievement of flow under certain circumstances. The low background noise generated by an office full of people helped the present study's subjects concentrate on their own tasks; the bookkeeper noted that because she raised five children with their attendant noise, a silent office "…[is] too quiet…and I can't sync as well. The background noise is helpful." Another condition where co-workers' presence aids in the acquisition of flow is when those working nearby share a sense of camaraderie with each other. Such amity helped create a sense of ease, belonging, and community energy and community productivity according to many of

those interviewed, and the relaxed atmosphere supported their ability to concentrate on work tasks.

Nearby co-workers can hinder the occurrence or continuation of flow if they create unexpected clatter, noticeable above the low thrum of background noise. Loud laughter or the scraping of a chair can contribute to interrupting concentration, which the interviewees described as contributing to an interruption in their immersion. Being in the line of sight of others moving about also interrupts concentration. The quality assurance associate noted that when she was located in a cubicle adjoining an aisle, noticing those who walked past her interrupted her focus on the work and prevented her from experiencing flow. However, the playing of music in headphones described in section 3.3 mitigated to some extent those interviewees who used this device from losing concentration.

Task Communication and its Influence on Flow

With an average in-role tenure of over seven years, supervisor instructions on what, when, and how to perform the work was not required from the study's subjects. Referring to standard operating procedures was also generally not needed. However, when some aspect of their work changed – say, a technology upgrade that modified the workflow or a newer set of customer requirements was introduced – then this study's individuals commented that they needed to consult with their resources for a period of time to ensure understanding of the modified work. As the quality assurance associate remarked, "I would have a lot of stopping points to go and ask questions like, '[Am I] I really looking at this right or how do I do this, where do I go to find this?'" Until they could once again become comfortable with the new steps and any work system changes, they found experiencing flow difficult.

Thorough and sensible training and operating procedures were remarked upon as critical for one to become comfortable with work tasks, which then supported flow. As an administrative assistant commented upon learning she had not been fully trained on all steps needed to compete a particular repetitive work assignment, “Being taught something and not 100% knowledgeable on what you're doing isn't a good feeling.” Thinking she had successfully completed this work assignment, only to be informed that she had left out a crucial step, “brought my happy high down.” The customer service manager commented how a lack of communication proffered when procedures change results in anxiety, which prevents flow from occurring: “I can sometimes get frustrated with the lack of communication because the sales department isn't talking with the operations department. Then I've already done something, and because they've made some changes that I wasn't aware of because they didn't inform me, I either have to redo something, or it affects what I've already done. That can be frustrating for me.” The database entry clerk (DEC) offered nearly the same feedback on the question of the influence of communication on achieving flow:

> *DEC: I think sometimes part of the problem for me with the lack of communication, that does occur a lot, is that sometimes I don't know if I'm doing it right and I don't like doing something and then having to go back and change it on a regular basis because I would rather be told properly the first time or communicated with, which that doesn't always happen so then I get very frustrated if I have to go back and redo things.*
>
> *Interviewer: If communication is not forthcoming, does that take you out of that flow feeling?*

DEC: Yes, because then I got to stop and go back and redo.

Physical Environment's Influence on Flow

This study's participants commented that a number of physical environment factors did deter from or contribute to their achievement of flow while working. For example, the office assistant, whose responsibilities include incorporating edits into her supervisor's journal article drafts, related how sitting in her supervisor's office chair while working on his document is not comfortable. She will swap his seat for hers (they share a physical office space) so she does not have to spend time making seating adjustments. She also shuts off a portable fan on her supervisor's desk, which makes her cold. Then, "the physical side of things doesn't get in the way because…I'm not cold, I'm not scooting in. I'm really just focusing on typing."

Seating discomfort was mentioned by a number of participants. The customer service manager and the database entry clerk utilized a sit-stand workstation, where the desk could be raised to a height comfortable for use while standing, to alleviate back pain and support concentration on the work tasks. The database entry clerk also noted that switching from a seated to a standing position "wakes me right up to be able to stand up. I start getting my energy back when I can stand." The administrative assistant echoed this sentiment.

Many of the participants noted how a view of the outside and its attendant natural light provided a calming effect. As the lab analyst described the feeling:

When you have access to see outside, you don't feel like you are like in four walls….I was seeing… the trees, the garden, sometimes some birds in the lake. I don't know why, but...I [felt] less stress. Just seeing how sometimes the [scenery] moves. It was

like I [felt] relaxed. Everything was so white, so bright. I [felt] like I [saw] the sun. [Another time, it] was raining, I saw the rain. I think that makes me feel like you're working, but you have a view.

The quality assurance associate also commented on how being able to see outside supported a feeling of well-being: "I love the view because it makes me feel relaxed and comfortable. It's like if I could see like pretty blue skies or a storm going by or whatever, I don't feel like I'm trapped in a box. The view's a huge thing for me to feel comfortable."

Two cautionary characteristics of an outside view noted by a few of the interviewees were that at certain times of the day, sunlight streaming through windows caused glare on computer screens and raised ambient temperatures to uncomfortable levels. Such phenomena contributed to eyestrain and drowsiness, respectively, both of which hindered concentration. The presence of blinds allowed these individuals to control such conditions and create a more comfortable physical environment.

Also supporting a feeling of relaxation and comfort was being able to decorate and customize one's work space. Such freedom to personalize one's workspace and provided a sense of the familiar. The accounts receivable manager hung family pictures and awards on his wall to personalize his space. He found being able to see such meaningful items while working gave him comfort. The customer service manager had a number of green plants around her office. She stated the flora served to bring the outside to the inside and provided a relaxing view.

Fluorescent lighting was a topic addressed by a number of participants. For some, these light fixtures produced a brightness – in the words of the production support specialist, "the light

of a thousand suns" – that caused eye strain which led to fatigue. The accounts payable clerk also was susceptible to the buzzing sound her fluorescent light fixtures made; she found the noise extremely distracting and used music played through headphones to overcome this disrupting phenomenon.

Interruptions to the Flow Experience

Factors that caused participants in the present study to exit flow were almost exclusively centered in three areas. Two of those factors were considered undesirable: distractions and unexpected changes in work tasks. The natural conclusion to the queue of work tasks was considered a desirable conclusion of the flow experience. Distractions included co-workers entering one's workspace to chat or ask a question, email notifications, and loud noises either inside or outside the office. Unexpected changes in work tasks included the appearance of a more difficult item in the work queue, requiring the individual to stop executing and perform some type of research on how to proceed; and the reprioritization of work tasks, usually by one's supervisor.

However, once those interruptions were resolved, most participants reported being able to re-enter their flow states almost immediately as they resumed their work tasks. The restarting of their personal work cadences helped them regain the feeling of immersion into their work.

Perceptions on the Length of Time of the Flow Experience

Most of the present study's participants did recall their perceptions of time passing were altered. They thought less time had expired than had actually occurred, and expressed surprise when they made themselves aware of the actual passage of time ("I lost track of time" was a commonly repeated experience). For example, the accounts payable clerk remarked,

“Sometimes I think it's only maybe, five or ten minutes, maybe 20 at the most. There have been a couple times where I'll think, ‘I've done three pages of checking [numbers in a ledger]. It's probably only been 30 minutes or something.’ The next thing I know, it's been almost an hour.”

The administrative support clerk said of this topic while describing a proofreading task, “…I'm just focused on the next sentence, the next sentence I'm reading. I lose track of time a lot. …you get lost in what you're reading…”

Discussion

The preceding section documented the participants’ lived experience of flow. Now we interpret these findings according to the classic nine dimensions of flow. The thematic map shown in figure 8 was employed to translate the themes identified in section 3 into the flow antecedents, characteristics, and consequences.

Low-Challenge Simplicity and Predictability Lead to Flow

We can compare the transactional worker participants’ descriptions of their flow experiences to descriptions similar to others engaged in more creative endeavors cited in previous research (Csikszentmihalyi, 1990; Csikszentmihalyi, 2003; Csikszentmihalyi and Csikszentmihalyi, 1998; and Csikszentmihalyi and LeFevre, 1989).

The extant research on flow deems the challenge/skill balance – that is, the demands of the task should just exceed the knowledge and abilities of the task performer – as the primary driver in creating flow in individuals (LeFevre, 1988; Csikszentmihalyi, 1990; Bakker, 2008). In the present study, where the rote and repetitive nature of the work being performed seemed to

constitute low-challenge activities, the researchers were interested in understanding the role of the tasks' demands in fomenting flow.

Most of the interviewees commented that the repetitiveness and routineness of the work are their flow triggers. The fact that their work tasks are less challenging, which permits a relatively quick pace, is what facilitates the immersive feeling in these individuals. This expectation of task sameness appears to be in contrast to descriptions of flow of those in more creative exercises (e.g., rock climbers and solo trans-ocean sailors; Csikszentmihalyi and Csikszentmihalyi, 1988; Csikszentmihalyi, 1990). In these descriptions of flow experiences, the challenge of reading a never-before-climbed rock face to find the right fissure onto which to insert fingertips and of constantly interpreting changing weather conditions to determine how to correctly set the sails were what triggered flow in these individuals.

One possible explanation for how flow can be experienced with low-challenge and continually repeated tasks may be found in the research on the differences between so-called "exciting flow" and "relaxing flow" (Apter, 1992; and Chang, Chiu, and Hwang, 2020). These researchers propose that behavior-oriented individuals prefer excitement of and the journey through the task, rather than the predictability and results orientation of goal-oriented individuals. Behavior-oriented individuals tend to enjoy exciting flow, while goal-oriented individuals gravitate toward relaxing flow. As the participants in this present study repeatedly spoke of their desire for similar, repeatable work tasks and their enjoyment in the checking off their completed work, the theory of relaxing flow in transactional workers may be supported.

Ceja and Navarro (2017) describe a smooth pathway to achieving flow as part of their cusp-catastrophe model. Here, low-challenge tasks requiring low skills to competently execute

them are the requirements for attaining a flow state. The present study's transactional workers consistently described their desire for familiar work items in which they knew from much experience how to complete, supporting this theory of flow achievement. We contend that this smooth entry into flow results in the relaxing flow previously described.

Fun Constructs Support Goal-Setting and Performance Feedback

Introducing a dimension of fun into their work appeared to aid at least some of the present study's individuals in experiencing flow. Self-created and -directed games noted by the participants included challenging themselves to produce a higher quantity of work outputs than other teammates, or to improve on their own productivity from the day before, or to complete each work task faster than the previous one(s), or to execute keystrokes in time to the rhythm of a song that happened to be playing at the time, or to even employing checklists from which they could cross off completed work (this last mechanism provided a means to "keep score"). In addition to creating fun at work, these game-like mechanisms also served to create goals to meet and to provide immediate performance feedback to the workers (e.g., "How many keystrokes can I enter in a row in time to this song playing in my earbuds?" and "Does the rhythm of my pressing of the keys match the beat of the song?"). Unknowingly, these workers were creating flow conditions. As Schaffer (2013) noted, "Designing for flow is important for internal business applications, like a system used by bank tellers or people working in a call center. Finding meaningful challenges and getting clear feedback about progress on those challenges is the best way to make even boring or repetitive work more like an enjoyable game."

Invisible Technology Supports Action/Awareness Merging

Using job-supporting tools need to be without thought, similar to the flow concept of merging of action and awareness. The present study's interviewees were more inclined to be able to work without interruption of thought or action if all the technological and non-technological resources were available and fully functional. This condition supported the ability to deeply concentrate on the work. Upgrades to technology hindered achieving flow until the individuals learned the changes well enough that the technology could once again be used without thought.

Thorough and clear training and standard operating procedures obviated the need for constant communication from supervisors and other resources on what and how to perform transactional work. The less that transactional workers needed to stop their work to confer with others on how to execute task steps, the easier they found themselves getting into and maintaining a work rhythm. Gaining full knowledge of task execution requirements supported workers' ability to work without conscious thought.

An Ability to Maintain Focus

Participants in the present study described themselves as being able to focus exclusively on their work tasks and as accomplishment oriented. Once the participants readied the resources needed to complete their work items and began to execute, achieving flow was nearly immediate. Even when interrupted by co-workers wanting to talk or by unexpected work tasks, re-immersion into a flow state was quick once the interruptions were resolved. This ability to maintain focus over relatively long periods of time are covered in the state-based versus trait-based theories of flow (see Moneta, 2021, for an overview). That the subject individuals consistently reported

their ability to concentrate on their tasks at hand rather quickly and to maintain such focus until their tasks were completed, the trait-based explanation of flow seems to be reinforced. Further, the concept of individuals possessing an action-state orientation – an individual's ability to maintain focus on a task until its completion (see Barthelmäs and Keller, 2021, for a summary) – is amply described in the present study's interviews and also supports the trait-based bias toward flow.

Agency in a Transactional Work Setting

One might conclude that a minimal "feeling of control over actions and their consequences" (agency defined, Moore, 2016) exists in workers in a transactional environment, where the work tasks are routine and their execution codified in numbered steps. While individual work steps were in fact standardized, the individuals taking part in the present study offered a number of ways in which they could exercise agency at a more macro level. Choice of seating and the ability to sit or stand while working were two examples of ergonomic control the individuals applied. Individuals could also choose to an extent their office décor – photographs and plants, for instance – to suit their tastes. Work breaks, allowing the individuals to recharge physically and mentally, were self-scheduled. The playing of music through headphones was their choice (more on music playing in section 4.6). These personalized choices may help prime these individuals to feel as if they have some measure of control over their work – or at least their non-task work system (as described in Clapp, 2018) – when they arrive at their offices each day, and provide a sense of free will in performing their work roles. Per Moore (2016), both of these variables support the feeling of agency.

Losing Oneself in the Work

Interviewees in the present study commented how they found themselves working through lunch and biological breaks. Hunger and the need to eliminate were subordinated to the task at hand. Similar behavior has been described by Csikszentmihalyi (1990) of artists completing their works without pausing. Of course, such behavior may be harmful and microbreaks should be encouraged.

These individuals also noted how, while listening to music when working, they would tap their feet or dance, actions they may not perform if they realized at the time their neighboring workmates could see and hear them. The authors surmise that although the simplicity and repetitiveness of the work permits an easy submersion into the task, music may play a role for some in elevating mood (see Wesseldijk, Ullén, and Mosing (2019) for an overview of the relationship between music and mental health), which may be expressed via rhythm-keeping actions. Since flow has been correlated with positive mood (Fullagar and Kelloway, 2009), music playing as described in the present study may serve to enhance the flow experience.

An Altered Experience of Time

Some of the present study's participants commented on unknowingly working through lunch or breaks. These workers found this altered perception of time pleasurable as the occurrence of the phenomenon usually resulted in more time passing than expected, which helped them feel as if they accomplished more work in a shorter period of time.

Simplicity and Predictability are Components of an Optimal Experience

Participants in the present study translated the quick pace enabled by the simple and predictable tasks into a feeling of being productive, which they indicated was a flow trigger.

They offered that they felt a sense of accomplishment as they checked off each work item as complete. The authors propose that the flow-triggering feeling generated by being productive may have been conflated with what has been described in the literature as an autotelic experience by Csikszentmihalyi (1990), especially since productivity is an outcome of the various factors the interviewees noted as necessary for such an experience. For example, the work items must be reliably similar to each other and easy to perform; all supporting resources must be available and functional; and non-work system factors must be at acceptable settings. Relatedly, the autotelic experience is an outcome of the antecedents and characteristics described in the introduction to this present paper.

Comparisons to Conventional Flow Dimensions

This paper has deeply delved into the transactional flow experience as lived by the 17 interviewees. We now want to map aspects of these experiences to the nine conventional dimensions of flow developed through the study of individuals acting in more creative endeavors (Csikszentmihalyi, 1990; Jackson and Marsh, 1996; Chen et al., 1999; Csikszentmihalyi, 2003; Fullagar et al., 2017; Clapp et al., 2018). We make this comparison to demonstrate that the relaxing flow of transactional workers is similar in construct to the exciting flow of those who can exercise more creative agency in their task execution ((Apter, 1992; Chang, Chiu, and Hwang, 2020).

Table 4. A mapping of interviewees' described characteristics of their transactional flow experiences to conventional flow dimensions.

Time-Ordered Position	Flow Dimension	Examples of Characteristics Provided in Present Study
Antecedent (pre-flow)	Challenge/skills match	Simple and predictable tasks support the goal-oriented-challenge (that is, "relaxing flow") needs of transactional workers.
	Clear task goals	Workers establish game-like targets to meet (e.g., creating task lists of work items to be accomplished each day; setting productivity targets, either to improve one's own productivity from a previous work session or to execute more tasks than another team; attempt to work to the beat of music currently playing on headphones).
	Immediate feedback	Workers physically checked off task list items as they were completed, providing a running source of feedback. Productivity targets were checked against actuality using these checklists.

Time-Ordered Position	Flow Dimension	Examples of Characteristics Provided in Present Study
Characteristic (in flow)	Action/awareness merging	Supporting the ability to execute without conscious thought are clear instructions, complete and correct data, and all tools needed to complete the task available to the individual.
	Intense concentration	Once settled in at their desks with all resources at the ready, the interviewees were able to deeply focus on their work. Passersby and ambient noise did not interrupt their concentration, unless such factors were overly loud. For many of the subjects, background music of their choice supported concentration by masking distracting noise. A trait-based propensity for deep concentration until a task is completed may also support the ability to concentrate for long periods of time.

Time-Ordered Position	Flow Dimension	Examples of Characteristics Provided in Present Study
	Control/sense of agency	Macro-level agency over non-task work system factors, rather than control over how the work is to be performed: individuals elected when to take work and lunch breaks; chose to sit or stand while working; chose the most comfortable seats available in the building for their office; played mood-enhancing music; and had the latitude to decorate their workspaces much to their liking to create a pleasurable surrounding.
Consequence (post-flow)	Loss of self-consciousness/sense of self	Workers forgot to take meal breaks or to take bathroom breaks until they emerged from their flow states. They danced or tapped their feet in time to the music they were playing with seeming disregard for their neighboring workmates watching.
	Altered sense of time passing	Many individuals noted that more time had actually passed during the day than they had

Time-Ordered Position	Flow Dimension	Examples of Characteristics Provided in Present Study
		sensed. Some worked through their lunch breaks without realizing they had done so.
	Autotelic motivation	Intrinsic motivation included a feeling of self-accomplishment when a great amount of work was completed in a short period of time, and when more work was accomplished than on the previous day or faster than during the previous day; and a feeling of relaxation.

Limitations and Directions for Future Research

This study does have some limitations. As phenomenological studies are by nature qualitative, the sampling purposive, and the sample size relatively small, no generalizations about flow in transactional workers have been or should be made. However, the present research uncovered some interesting aspects about the transactional worker flow experience revealed in multiple participants' responses. These factors and feelings should be quantitatively studied through controlled laboratory studies. The objective of such research should be to incorporate

non-task work system factors into the overall design of work to encourage the onset and maintenance of flow, given its well-documented beneficial results.

A related limitation of the present phenomenological research is that the interviews were guided based on the research problem the researchers are addressing. The present study attempted to understand what flow feels like for the interviewed transactional workers in the context of the influence of five work system variables thought to be commonly extant in transactional office settings on the occurrence of flow: the challenge of the work tasks; the technology (resources) employed to support the execution of the work; the background noise generated by the people typically co-located with the participants in the office; the level of detail inherent in the communication given about the work tasks; and the physical environment in which the individuals work. Discussion was limited by this scope (and by the time considered reasonable to ask individuals to postpone their work and participate in this study). There certainly can be other factors not introduced in this present research but ultimately important to the launch and sustainment of flow. Future studies may include additional work system factors, with the results broadening the understanding of the transactional work flow experience.

It has been said that interpretive phenomenological analysis (IPA) attempts to deeply understand a particular experience with open-ended questions and little prompting by the interviewer, in order to get at the complete who/what/when/where/why/how of a thing (Belotto, 2018; Finlay, 2009; Smith and Osborn, 2004). An argument may be made that the present study's interview items that asked participants to comment on the prompts "To what extent did xxx influence how you felt?," where "xxx" was the challenge of the task or the non-task work factors being researched, may have violated this principle of openness and expansiveness by

restricting the conversation to particular topics. Belotto (2018) discovered, however, that the interpretive approach permits the researcher to explore certain specific suspicions and theories that support the overall research question. Smith and Osborn (2004) support this expanded view of IPA: "Do I have a sense of something going on here that maybe the participants themselves are less aware of?" Finlay (2009) expressed support for a number of phenomenological approaches along a continuum between description and interpretation, and that flexibility in how a thing is to be understood is encouraged. We contend that, while we began the interview with open-ended prompts ("Describe a work situation…" and "What did that experience feel like?), we were particularly interested in the impact that the holistic work environment played in creating flow conditions, so we necessarily had to direct the conversation so the interviewee could reflect on and discuss specific non-task work dimensions. However, the dimensions were broad in nature – technology, people, communication, and physical environment – that we feel comfortable in our elicitation approach that we did not limit the interviewees' ability to talk at length about their flow experience.

The interview responses, once transcribed, were manually reviewed for common themes. As thorough as the researchers believed they were, it is possible that themes were missed. Future researchers may want to analyze the transcripts of the present study and new studies using language processing software. Such tools can quickly extract meaning and identify keywords in context to create a rich dataset.

Once the interviews were transcribed, no further contact with the participants by the researchers were made. Additional experiential information may have been able to be gleaned by having the participants review their transcripts and the authors' findings, and provide

comments, amplification, and correction, as recommended by Tong, Sainsbury, and Craig (2007). Future phenomenological studies should consider using this second-interview approach to potentially gain additional insights into the study topic.

Only those transactional workers who experienced flow were interviewed for the present research. Future studies should attempt to discover the proportion of the transactional worker population who regularly enjoy the flow state, as it is presently unknown to what extent this phenomenon occurs in the subject population. These future studies should also investigate why some transactional workers may not experience flow. This knowledge about flow-ers and non-flow-ers may assist organizations in designing non-task work system factors to support the occurrence of flow in its workforce.

Summary

This study attempted to document the lived experience of psychological flow in transactional workers through in-depth interviewing of 17 of these individuals and careful analysis of their responses. Although their work tasks are rote and repetitive, the study participants appeared to experience relaxing flow. A possible explanation for their enjoyment of this type of flow (as opposed to exciting flow) may be due to these individuals' expressed desire for accomplishment (as opposed to the process of the journey). Participants found ways to create their own challenges supplemental to the work itself through devising games for themselves that would help make the work more fun. Check-off lists; competitions against others or against themselves to produce more or to produce faster; and entering data in time to music all supported an enjoyable experience.

Relaxing flow shares the same concepts as traditionally studied exciting flow. Portions of the experiences described in the participant interviews were easily mapped to the classic nine flow dimensions described in the literature. This mapping supports the present study's contention that flow can be and is experienced by transactional workers. Further research should be aimed at creating working conditions that are conducive to engendering flow in transactional job roles.

Conflict of Interest

The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

Author Contributions

SRC, WK, and PAH contributed to conception and design of the study. SRC conducted the study and prepared the first draft of the manuscript. All authors contributed to manuscript revision, read, and approved the submitted version.

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Phase 3: Laboratory Studies

Proof-of-Concept Laboratory Study[3]

The following paper details the findings from my initial laboratory study where I examined the impact of only one non-task work variable on the attainment of flow. I wanted to ensure I had addressed good experimental design methods, execution, and analysis on a small scale before launching a more complex multi-factor study.

The Seat of Happiness? The Effect of Seat Comfort on the Achievement of Psychological Flow During Transactional Work

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Abstract

Psychological flow is highly pleasurable, time-limited form of engagement in a task which has been shown to produce benefits in the workplace. Flow has historically been studied in the context of the interaction between the task and the performer. However, in work settings such as an office, many other factors may contribute to or hinder the achievement of flow. This present study broadens the research on flow to test the extent to which seating comfort while

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executing a challenging task influences an individual's ability to achieve flow. Fifty-four participants in this study were randomly assigned to one of two seat types and given a set of tasks to perform via a computer simulation. Seat comfort, coupled with participants' perceptions of their ability to concentrate on the simulation's set of tasks, was found to predict participants' flow experiences. Implications and future directions are discussed.

Keywords: Psychological flow, comfort, concentration, causal analysis, scale comparison

Introduction

Psychological flow is the state where "[one is] so involved in an activity that nothing else seems to matter at the time; the experience is so enjoyable that [one] will do it even at great cost, for the sheer sake of doing it" (Csikszentmihalyi, 1990, p. 4). Flow is experienced at work more than during leisure activities, and is frequently associated with creative work; e.g., surgery, dancing, and creating music (Csikszentmihalyi and LeFevre, 1989). Relatively little research has been published on flow experienced by office workers (for example, LeFevre, 1988), who typically perform transactional work (see Bureau of Labor Statistics, 2019). Transactional work is classified as a series of well-defined, repetitive, routine tasks to produce a product or outcome (as opposed to an experience) ("Transactional Work", 2007; Hunt, 2008; Power 2012). Of interest is whether individuals performing transactional work can and do experience flow. Important benefits to the individual, the team, and the organization (Bryce and Haworth, 2002; Eisenberger, Jones, Stinglhamber, Shanock, and Randall, 2005; Demerouti, 2006;) include improved well-being, positive affect, and greater extra-role performance (e.g., helping others, promoting the organization).

The current body of literature on flow tends to link the phenomenon of flow solely to the interaction between the individual and the task the individual is performing (for example, Csikszentmihalyi, 1990; Bakker, 2008) and rarely considers that the holistic experience influences the individual's ability to achieve flow (for example, Csikszentmihalyi, 2003). Clapp et al., (2018) proposed a theory that the task plus non-task elements (the "work system") are critical factors to the achievement of flow and must be optimized together. The present study is a first step in determining the validity of this theory, and it examines one component of the work system: seating comfort.

Much transactional work takes place while seated; for example, interacting with customers in a call center, entering data into computer systems, and performing bench work on equipment. Seating is known to be one of the most important factors influencing occupational comfort (Lueder, 1983; Gadge and Innes, 2006). According to the Cambridge Dictionary (2017), comfort is "the pleasant and satisfying feeling of being physically or mentally free from pain and suffering, or something that provides this feeling". The meaning of the term comfort in ergonomics research has been widely discussed (for example, see De Looze, et al. 2003). Vink & Hallbeck (2012) defined comfort as "a pleasant state or relaxed feeling of a human being in reaction to its environment". Many studies indicate that poor seat design and posture contribute to discomfort, fatigue, and low back pain (Helander et al., 1987; Helander and Zhang, 1997; De Looze, et al. 2003; Carcone & Keir 2007). If flow is a pleasurable experience while performing a task, to what extent does the introduction or reduction of physical comfort from seating influence an individual from entering and maintaining a flow state? The goal of the present

study is to understand the hypothesized influence of seating comfort on the relationship between performing challenging tasks and achieving flow.

Flow

Flow has been described as being "in the zone" and "on a roll" by those who experience it. It can occur while performing leisure activities and work activities. One of the authors of this present paper achieves flow while playing a set of tennis against experienced opponents and while creating spreadsheets solving particularly sticky analytical problems. According to Csikszentmihalyi (1990), flow consists of nine dimensions. Csikszentmihalyi (1988), Chen, Wigand, and Nilan (1999), and Fullegar, Delle Fave, and Van Krevelen (2017) have proposed that these dimensions follow a time-ordered sequence, such that antecedents of flow lead to characteristics of flow, which in turn generate consequences of flow (see Figure 10).

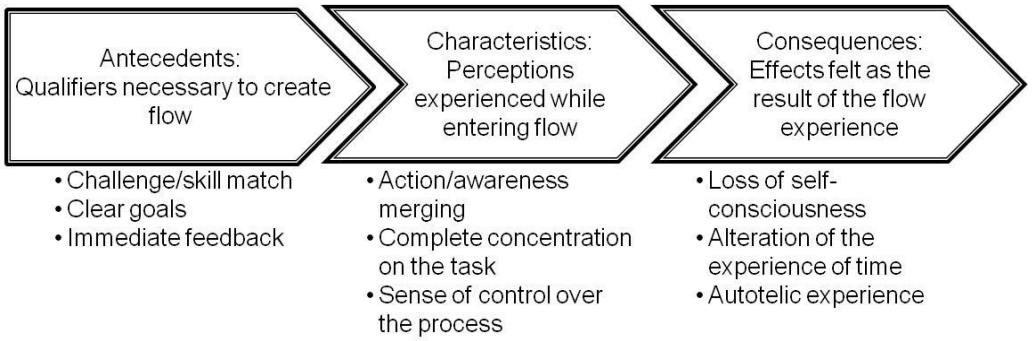

Figure 10. Flow state model showing time-ordered components of each phase of flow (based on Csikszentmihalyi, 1988; Chen, Wigand, and Nilan, 1999; Fullegar, Delle Fave, and Van Krevelen, 2017).

Antecedents must be present at the outset of an activity before flow can occur. Challenge/skill match refers to the relative relationship of the difficulty of the task to the individual's ability to overcome the challenge. If the challenge of the task far exceeds the ability of the performer, then the individual is likely to experience anxiety. If the ability of the actor far exceeds the challenge of the task, then this individual is likely to experience boredom. Only when the challenge of a task just exceeds an individual's skill in performing that task can flow occur (Csikszentmihalyi, 1990; 2003). Research on flow purports that challenge/skill balance is the most critical factor required to promote achievement of flow (LeFevre, 1988; Csikszentmihalyi, 1990; Bakker, 2008).

Clear goals refer to the task's objective being known and achievable and relatable. For what purpose is this activity required? What is the desired outcome? How does performing the task align with the performer's values? If the organization can answer these questions for its work staff, then its employees are more likely to engage in the work to be done and in the organization itself (Csikszentmihalyi, 2003; Clapp et al., 2018).

The third necessary ingredient in creating flow is immediate feedback on the individual's performance of the task. Individuals must receive real-time direction on whether their actions are moving them closer or further away from their goals. The closer in time this feedback is to the actions on which the feedback is based, the faster the individual can correct any deficiencies and the more relevance any positive messaging has on proper performance. This feedback can be internally generated, such as comparing one's own efforts to some standard and making needed adjustments, or externally communicated, such as from customers (or other ultimate

receivers of the task's outcome) or an organizational dashboard of performance metrics (Hackman, Oldham, Janson, and Purdy, 1975; Csikszentmihalyi, 2003).

Characteristics reported while in flow include the merging of action and awareness. That is, the steps needed to successfully complete the task seems to be known and executed without conscious thought. Actions happen naturally and feel instinctive (Csikszentmihalyi, 1990; 2003).

Another characteristic while in flow is the ability to completely concentrate on the task at hand. All thoughts not related to the activity under way recede, and physiological stimuli, such as hunger and fatigue, appear forgotten by those in flow (Csikszentmihalyi, 1990). Of course, one must be afforded the opportunity to concentrate. Interruptions by others (whether in person or by electronic means), sudden loud sounds (the ding of incoming email), and even unpleasant smells (the odor of a co-worker's lunch) can break one's ability to concentrate and the feeling of flow is lost (Csikszentmihalyi, 2003).

Those in flow report they feel a sense of control over the how the task is to be accomplished. "Control" does *not* mean an individual can exert his or her will over every aspect of an operation, as there exist a multitude of non-controllable factors that can influence the outcome of any endeavor. But individuals who have agency over the steps they choose to successfully complete an activity are more likely to experience flow (Csikszentmihalyi, 2003).

Upon reflecting on their immersion in a flow state, individuals report one consequence of their experience is a loss of self-consciousness. Because they are so absorbed with the task at hand – fully concentrating on action and feedback – they cease caring about how others might

perceive how they perform or present themselves. The ego falls away (Csikszentmihalyi, 1990). A second consequence of flow is the apparent alteration of the passage of time experienced by those in flow. The individual in flow experiences the passage of time as either faster or slower than normal. For example, a data entry clerk may begin entering a virtual stack of records into her computer at 9:00 in the morning, challenging herself to process the data faster than the previous workday and, when she is finished with the task, is surprised to learn the time is now noon; she thought only an hour had passed while she was working. The opposite may also occur, where the passage of time appears slower than normal (Csikszentmihalyi, 1990; see also Hancock et al. (2019) for a discussion on the relationship between flow components and the experience of the passage of time). Finally, a consequence of achieving flow is the positive feeling one experiences from successfully overcoming a challenge. This feeling of achievement – of a job well done or knowing that one rose to the challenge – is the reward, rather than expecting recognition or remuneration. Csikszentmihalyi (1990) defines such positive response to intrinsic motivation as an autotelic experience.

There is some debate over whether being able to experience flow is due to having an autotelic personality (Csikszentmihalyi and Csikszentmihalyi, 1988), which implies that flow is trait-based (see also Eisenberger, et al., 2005, for a discussion on whether flow is experienced only by those with a high need for achievement), or that such enjoyment is dependent on the activity being performed, thereby implying a state-based construct (Fullegar, Della Fave, and Van Krevelen, 2017). Evidence of flow being experienced more when the "right" work conditions are present – including high challenges, high levels of skill, and availability of resources – support the argument for state-based flow (Llorens, Salanova, and Rodríguez, 2013;

Nielsen and Cleal, 2010). Although no definitive trait-versus-state answer exists, the current study is based on the theory that flow can be created based on certain combinations and settings of work-related factors (Clapp et al., 2018). These work-related factors combine to form a work system and this topic will be discussed next.

Beyond a Task-Oriented Approach to Flow

The factors outlined in section 1.1 [the previous section] are task-oriented; that is, each of the factors are at least partly defined in terms of the activity being performed. For example, each of the antecedents to flow are dependent on the interaction between the individual and the task: the balance between activity's challenge and the performer's skill; the clarity and achievability of the goals of the activity; and the frequency and closeness to real-time of the activity's feedback to the individual. The authors believe that the entire work experience influences the individual's likelihood of achieving flow; that is, the holistic set of physical and non-physical components within which the individual performs a task combine to create an environment in which flow is more or less likely to occur (Clapp et al., 2018).

Such a systems approach to work design is supported by a wide-ranging set of research. For example, the artifacts used to execute a task and the environment in which the task is performed combine to create a contextual design, affecting an individual's performance within that system – reflected by an individual's ability to match skills against the challenge of the task – and the individual's satisfaction with the system – which relates to the construct of an autotelic experience (Beyer & Holtzblatt, 1999; Holtzblatt and Beyer, 2015). Also, it can be argued that Norman's (2013) principles of the design of everyday tangible things apply to the non-tangible concept of work: while work at its most basic level affords the person a means of earning at least

a living wage, such activity must also afford a sense of accomplishment – an autotelic experience – for the individual to desire to return to perform that same work over and over. Finally, Bitner's (1992) concept of servicescapes illustrates the combination of many sensual influences – such as color, sounds, odors, textures, and ambient temperature – combine to influence individuals to stay or leave a physical space in the immediate term, and employee performance and job satisfaction in the long term. Clearly, humans become engaged not just by performing an activity in a vacuum, but through the interdependent combination of the activity and surrounding influences.

The present study is centered on one hypothesized work system factor: seating comfort and its effect on flow. The rationale for examining this variable follows. Much transactional work occurs while seated; examples include entering data into a computer system and responding to customer inquiries via online communication services (Bureau of Labor Statistics, 2019). Seating is known to be one of the most critical factors influencing occupational comfort (Lueder, 1983; Gadge and Innes, 2006; De Looze, et al. 2003; Vink & Hallbeck, 2012). Studies indicate that poor seat design and posture contribute to discomfort, fatigue, and low back pain (Helander et al.,1987; Helander and Zhang, 1997). If flow is an optimal experience (Csikszentmihalyi, 1990), to what extent does the manipulation of the physical sensations derived from seating affect one's likelihood of entering and maintaining a flow state? That is, if seat design impacts to a large extent occupational comfort and discomfort, can such design also be an enabler or a barrier to the achievement of flow?

Hypothesis

The present study proposes that perceived seat comfort influences the achievement of flow. Therefore, it is hypothesized that seat comfort has a significant effect on the relationship between at least one of the flow antecedents and the flow consequences of autotelic experience (moderating or mediating effect) or that seat comfort directly significantly affects achieving flow (main effect). This paper examines all three relationships to determine which, if any, are extant.

Methods

The experimental design was a randomized controlled trial with one pre-test and two post-tests. The study was approved by the University of Central Florida's Institutional Review Board and performed in a university laboratory.

Participants

Participants were recruited via an online recruitment system and flyers posted throughout the university campus. A total of 54 undergraduate students (29 female) were recruited and participated (satisfying the sample size requirement of a 95% confidence level and a power of 0.90 (G*Power; Faul, Erdfelder, Buchner, & Lang, 2009). Ages ranged from 18 to 27 years; mean M = 19.6, SD = 2.0. Informed consent was secured from the participants prior to engaging them in the procedure. Participants were screened for age (at least 18 years of age at the time of participation); familiarity with basic personal computer operations, including the use of a mouse, keyboard, and joystick; confirmation they had not previously participated in the use or administration of the Multi-Attribute Test Battery (MATB-II; Santiago-Espada, Myer, Latorella,

and Comstock Jr, 2011); and attest that they had have no medically diagnosed chronic back pain at the time of the study.

Laboratory Settings

The study was performed in the university's ergonomics laboratory, selected for its insulation from external noise, uniform lighting, controlled temperature (72 – 74 degrees F), and lack of windows to eliminate glare and distractions. The study space within the room was designed to resemble a typical office cubicle, with a table, computer, monitor, seat, and walls on three sides; the walls were bare, to eliminate distractions. See figures 2 and 3 for the experimental layout of the space.

Procedures

The study design was a randomized controlled trial with one pre-test and two post-tests. After confirming consent to participate, subjects were given the Swedish Flow Proneness Questionnaire (Ullén, et al., 2012) to complete. This instrument measures a participant's likelihood to achieve flow at work, while performing household or routine chores, and during leisure activities. A sample question is "When you do something at work, how often does it happen that it feels as if your ability to perform what you do completely matches how difficult it is?" Responses are given on a five-point Likert scale ("never" to "every day, or almost every day"). The questionnaire was utilized in the present study to determine if controlling for flow propensity was required when analyzing the relationship between seat comfort and flow. For example, the possibility existed that certain individuals who are less likely to experience flow in most activities may not have experienced flow in the present study, regardless of the type of

seating; knowing this non-flow propensity would minimize the possibility of an ambiguous correlation between seat comfort and flow.

Participants then were randomly assigned to one of two test groups: 1) an office cubicle arrangement with a five-wheel, ergonomically designed and adjustable (seat pan height, recline angle, armrest height and lateral placement) office chair for seating, or 2) an office cubicle arrangement with an armless, backless, non-adjustable padded bench for seating. Floor-to-seat pan heights were within the optimal ranges suggested by Kroemer, Kroemer, & Kroemer-Elbert (2001). See the depictions of the cubicle/office chair and cubicle/bench configurations in figures 11 and 12, respectively.

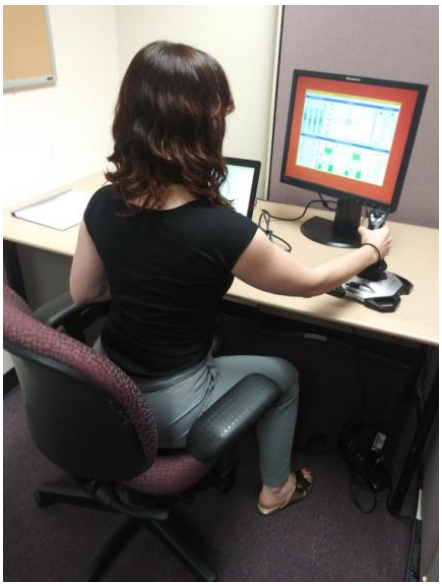

Figure 11. Office cubicle and ergonomic chair arrangement.

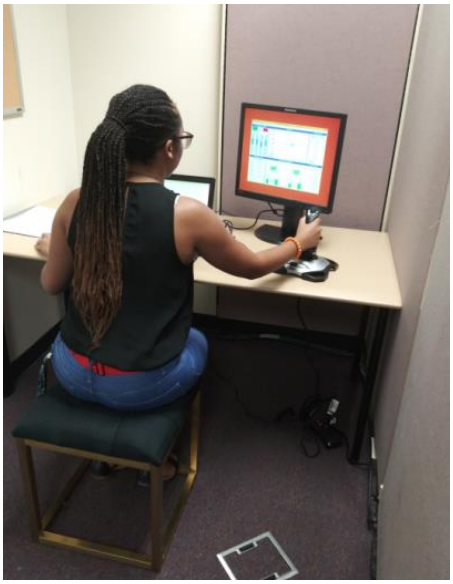

Figure 12. Office cubicle and bench arrangement.

The activity assigned to the participants was a 12-minute set of multiple tasks designed as a simulation of airline piloting routines using the Multi-Attribute Task Battery-II (MATB-II; Santiago-Espada, Myer, Latorella, and Comstock Jr, 2011). This computer-based simulation was developed by NASA to assess human performance during multitasking and interfacing with automation. The tasks consist of monitoring various gauges on a computer screen and making adjustments to them as audio and visual indicators warrant. Figure 13 depicts the four types of tasks comprising the MATB-II simulation:

- System monitoring: keeping the four dark blue bars centered in their columns;
- Tracking: maintaining the dark blue cursor centered in the cross hairs;
- Communications: responding to audio cues to enter correct radio frequencies in the correct fields; and
- Resource management: adjusting valves to maintain a balance of fuel between the left and right side of the aircraft.

Subjects make such adjustments using a combination of computer keyboard, mouse, and joystick input devices. Figures 11 and 12 illustrate the placement of the input devices (the mouse is in front of the participants). Each participant was seated in the office cubicle after completing the Swedish Flow Proneness Questionnaire. The subjects were informed that they were taking part in a computer monitor study within the context of a commercial flight cockpit simulation, and were asked to act as a member of the flight crew. The main task of the subject was to observe and adjust the gauges as needed to keep the aircraft aloft.

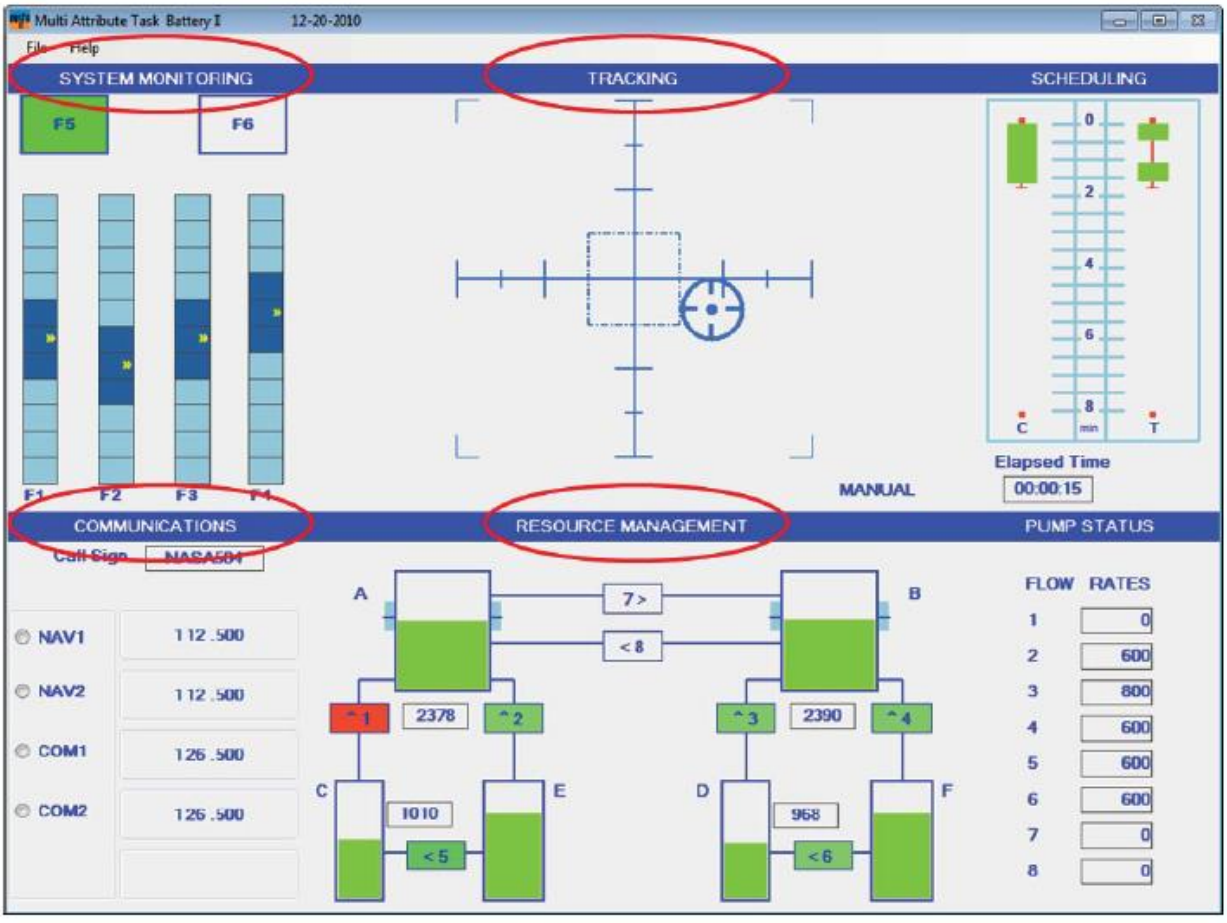

Figure 13. The task screen of the MATB-II simulator. The scheduling window is a dynamic countdown timer. (Santiago-Espada, Myer, Latorella, and Comstock Jr, 2011).

Once seated at the workstation, the participant was given a MATB-II instruction manual to review. The instruction manual is a highly condensed version of the MATB-II user guide (Santiago-Espada, Myer, Latorella, and Comstock Jr, 2011), providing only the essential information needed to conduct the flight simulation. Subjects were given as much time as necessary to understand the instructions.

The participant was then instructed to adjust the seat, keyboard, mouse, joystick, and monitor as needed to the most comfortable positions. In the case of the ergonomic office chair, the participant could adjust seat pan height, recline angle, armrest height, armrest forward/backward position, and distance from seat to the table on which the activity interface equipment was placed. For the non-adjustable bench, the individual could only adjust the distance between the seat and the table or laterally to achieve a centering between the body and the workspace.

Next, a one-minute training version of the MATB-II simulator was conducted to allow the subject to familiarize him/herself with the simulator's operation. The training version allowed the individual to serially experience each of the simulator tasks in a time-abbreviated manner. The researcher was present to answer any questions the participant had about the simulator in particular and about the study in general. The researcher also assisted the participant in making any further necessary adjustments to the ergonomic chair or to the bench (see previous paragraph).

The experimental trials began once the participant confirmed sufficient familiarity with the simulator's operations, and with seat adjustments and interface equipment. A customized XML script was developed and applied using the MATB-II program that gradually increased the

challenge level over the activity's 12-minute life. During the activity, the participant was presented with tasks in varying frequencies, sometimes serially and at other times in parallel with other tasks. All tasks were accompanied by a countdown timer designed to create a sense of urgency to complete the task. The simulator provided real-time feedback to the participant in the form of visual displays. In this manner, the MATB-II simulation provided the antecedents deemed necessary for the introduction of flow in the individual: an overarching goal to complete; an increasing challenge over time for which the subject built up his/her skills to address the challenge; and immediate feedback so the subject could modify or maintain his/her performance (Csikszentmihalyi, 1988; Chen, Wigand, and Nilan, 1999; Fullegar, Delle Fave, and Van Krevelen, 2017).

The simulation automatically ended at 12 minutes, at which point the subjects remained seated at the workstation and were presented with the Flow State Scale questionnaire (Jackson and Marsh, 1996). This instrument asked the participant to reflect on a recent experience (the MATB-II simulation in the present study) and answer statements relevant to each of the nine flow state dimensions discussed in section 1.1 above. A sample question is "I was not concerned with what others may have been thinking of me." Responses were given on a five-point Likert scale ("strongly disagree" to "strongly agree"). The purpose for administering the Flow State Scale questionnaire was to determine if the participant felt as if he/she experienced flow while performing the flight simulation activity. The key determinant of whether flow was experienced or not was how the participant answered the flow consequence statement related to having an autotelic experience (for example, "I loved the feeling of that performance and want to capture it again.") on the above mentioned five-point Likert scale.

In the final step in the study, the subjects completed the Chair Evaluation Checklist (Helander and Zhang, 1997) while still seated at the workstation. This instrument is designed to elicit the subject's assessment of the comfort of the seat. Helander and Zhang determined that the construct of seating comfort can be parsed into three distinct components: comfort in terms of design aesthetics (example: "The seat looks nice."); comfort in terms of well-being (example: "I feel relaxed."); and discomfort (example: "I have sore muscles.") Subjects rated these statements on a nine-point Likert scale ("not at all" to "extremely"). Upon the completion of this questionnaire, the researcher concluded the experiment.

A summary of the experimental setup is depicted in figure 14. Times shown for certain steps indicate the average length or range of time the participant was settled in the seat. The present study was designed with a target of 30 minutes for each participant to be in either the ergonomic office chair or the backless, armless bench. Actual total seated time for each participant ranged from 27 to 32 minutes. Previous studies on the length of time required for subjects to reliably evaluate seat comfort and discomfort (Lueder, 1983; Helander and Zhang, 1997) drew no conclusions, with seat evaluation periods ranging from five minutes to two hours to four hours. Given this range of empirical time lengths, 30 minutes certainly is a reasonable amount of time for the study subjects to evaluate their perceptions of seat comfort and discomfort.

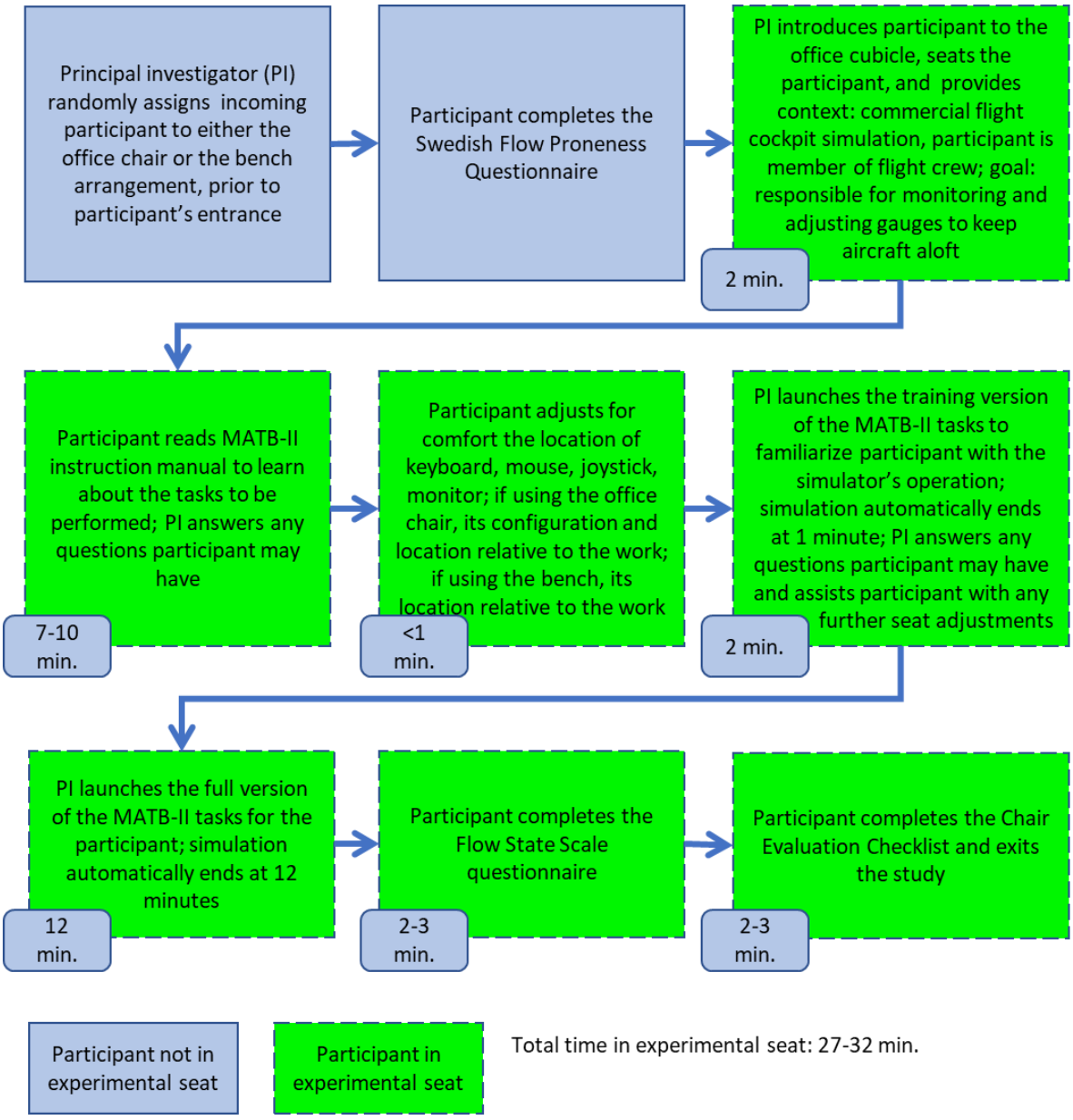

Figure 14. Experimental procedure flowchart, including participants' averages or ranges of time in the experimental seat.

Data Analysis

Multivariate regression was used to determine factors significant in predicting autotelic experience (dependent variable DV). Autotelic experience was chosen as the outcome based on the previous studies. The autotelic experience (also known as "optimal experience," which is

sometimes used interchangeably with the term "flow") relates to the culmination of all of the other flow factors and is the rewarding feeling one wants to return to (Csikszentmihalyi and Csikszentmihalyi, 1988, p. 8; Csikszentmihalyi, 1990).

The independent variables introduced into the regression analysis included challenge/skill balance; merging of action and awareness; clear goals; clear feedback; deep and focused concentration; a sense of control over the activity; loss of self-consciousness; a sense of time transformation (slowing down or speeding up, relative to reality); chair discomfort; seat comfort in terms of seat design; and seat comfort in terms of well-being. One-way ANOVA was used to determine the significance of the entire model. Significance was determined at the 0.05 alpha level. Additional analyses were performed to determine if seat comfort, if it was a significant predictive factor of flow, was either a main effect, moderating factor, or mediating factor. These analyses were done since the authors could not find any extant reference of non-task factors related to flow (see section 1.1 and figure 1). If seat comfort can be considered a novel factor related to achieving flow, a thorough understanding of this construct's place – main, moderating, or mediating variable – amongst the classical factors is required.

Results

Propensity for Experiencing Flow

The Swedish Flow Proneness Questionnaire (Ullén, et al., 2012) was administered to determine participants' tendency to experience flow during work, while engaged in recreation, and performing daily chores. The self-reported results of this instrument were compared to the self-reported results of the Flow State Scale questionnaire (Jackson and Marsh, 1996) –

specifically, the response to the questions regarding achievement of an autotelic experience – for each participant. A correlation analysis was then performed to determine if low or high flow propensity was related to low or high autotelic experience achievement, respectively. Correlation between these two factors was not statistically significant, as noted in the graph and summary statistics shown in figure 15. Therefore, there was no need to control for flow proneness.

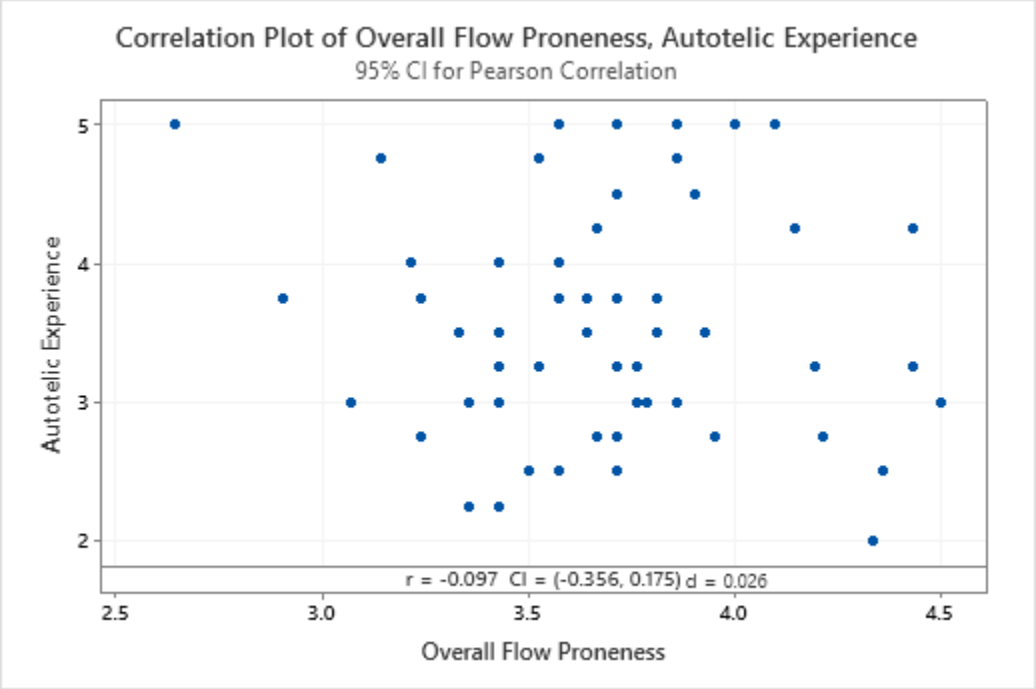

Figure 15. Correlation plot and summary statistics (r: Pearson's r; CI: 95% confidence interval for r; d: Cohen's d) for the relationship between Overall Flow Proneness and Autotelic Experience.

Seat comfort

Helander and Zhang (1997) determined that comfort and discomfort are two separate constructs. That is, comfort is based on one's feelings of well-being and on the aesthetics of the seat, while discomfort is based on physical sensations of pain, tiredness, and the like. In

addition, discomfort has been shown to increase over time, while comfort has not been shown to change over time. The Chair Evaluation Checklist (Helander and Zhang, 1997) measures individuals' evaluations of these constructs. Participants in the present study expressed significant differences in comfort and discomfort between the chair and the bench used in the study (See Table 5). Reliability in the results of the responses were confirmed in the present study with Cronbach's alpha.

Table 5. Summary of participants' evaluations of the seats used in the study.

Comfort and Discomfort Construct	Cronbach's alpha	Bench (N = 28) Mean (SD, Range)	Chair (N = 26) Mean (SD, Range)	t-value	p-value
Comfort-Design	0.89	4.89 (1.83, 6.50)	7.10 (1.18, 5.75)	-4.96	<0.001
Comfort-Wellbeing	0.90	5.16 (1.64, 6.00)	6.62 (1.90, 7.00)	-3.02	0.004
Discomfort	0.85	2.99 (1.46, 5.50)	1.81 (1.19, 5.50)	3.24	0.002

A two-sample t-test was employed to determine if a statistically significant difference existed between the bench and chair samples. The t-test is robust to non-normality (Box, 1953; for further information on non-normality, namely measures of skewness and kurtosis, see Newell and Hancock, 1984) and is considered the workhorse comparative statistic between two sample means. A statistically significant difference ($p < 0.05$) was noted by the participants in their

responses to questions about their particular seat type's comfort related to the design of the seat, comfort relating to feelings of wellbeing about the seat, and discomfort experienced with the seat. As expected, participants rated the ergonomically adjustable chair higher than the bench on the design and well-being dimensions of comfort, and lower on discomfort.

Autotelic experience

With the study showing that participants felt a significant difference in comfort and discomfort between the bench and the chair, the next step was to determine if comfort and discomfort were important predictors of flow, either directly (first-order factors in a prediction model) or indirectly (moderating or mediating factors in a prediction model). Table 6 below depicts the results of running a regression model using all available predictive factors against the dependent variable autotelic experience. It should be noted that autotelic experience was cited by Csikszentmihalyi (1990) as the pinnacle of the flow state, or optimal experience.

Table 6. Descriptive statistics of all predictive factors in the full regression model.

Term	B	Mean (SD, Range)	t-Value	F-Value	p-Value
Challenge/Skill	0.105	4.00 (0.68, 3.00)	0.39	0.16	0.696
Action/ Awareness	-0.025	3.59 (0.82, 3.00)	-0.13	0.02	0.895
Clear Goals	0.360	4.28 (0.61, 2.50)	1.29	1.65	0.205
Clear Feedback	0.097	3.88 (0.70, 2.75)	0.35	0.12	0.732
Concentration	0.441	4.40 (0.61, 2.75)	1.51	2.29	0.137
Control	-0.170	4.33 (0.58, 2.00)	-0.47	0.22	0.640

Term	B	Mean (SD, Range)	t-Value	F-Value	p-Value
No Self-Consciousness	-0.245	4.14 (0.58, 2.00)	-0.88	0.77	0.386
Time Transformation	0.032	3.82 (0.65, 3.00)	0.16	0.03	0.872
Discomfort	-0.012	2.43 (1.45, 5.50)	-0.13	0.02	0.897
Comfort - Chair Design	-0.062	5.95 (1.96, 8.00)	-0.77	0.60	0.445
Comfort - Well-Being	0.135	5.86 (1.90, 8.00)	1.59	2.53	0.119

None of the factors in the full model were significantly predictive of achieving an autotelic experience at the alpha = 0.05 level. A two-part analysis was then performed to identify a meaningful predictive model with a parsimonious set of terms. In step one, a backward stepwise regression analysis was performed to identify the most significant individual terms at an initial alpha = 0.10 level. In step two, combinations of interaction terms using the factors found during the search for significant individual terms were analyzed to determine if any of those terms were moderating variables (Frazier, Tix, and Barron, 2004) at alpha = 0.05. Iterations of step one yielded the following results depicted in Table 7. The results of step two, combining concentration and comfort-well-being into an interaction term, yielded the results shown in Table 8.

Table 7. Significant independent variables found through backward stepwise regression.

Term	B	t-Value	F-Value	p-Value
Concentration	0.479	2.80	7.83	0.007
Comfort - Well-Being	0.133	2.42	5.87	0.019

Table 8. Results of interaction (moderator) analysis.

Term	B	t-Value	F-Value	p-Value
Concentration	1.690	0.65	0.42	0.519
Comfort - Well-Being	0.239	-0.32	0.10	0.753
Concentration*Comfort – Well-Being	-0.102	0.74	0.54	0.464

The interaction term Concentration*Comfort – Well-Being is not significant (at $p < 0.05$), indicating Comfort-Well-Being does not moderate the relationship between one's ability to concentrate and achievement of an autotelic experience (Frazier, Tix, and Barron, 2004). The interaction plot of Concentration*Comfort – Well-Being in figure 16 also indicates that Comfort – Well-Being does not moderate the effect of Concentration on Autotelic Experience:

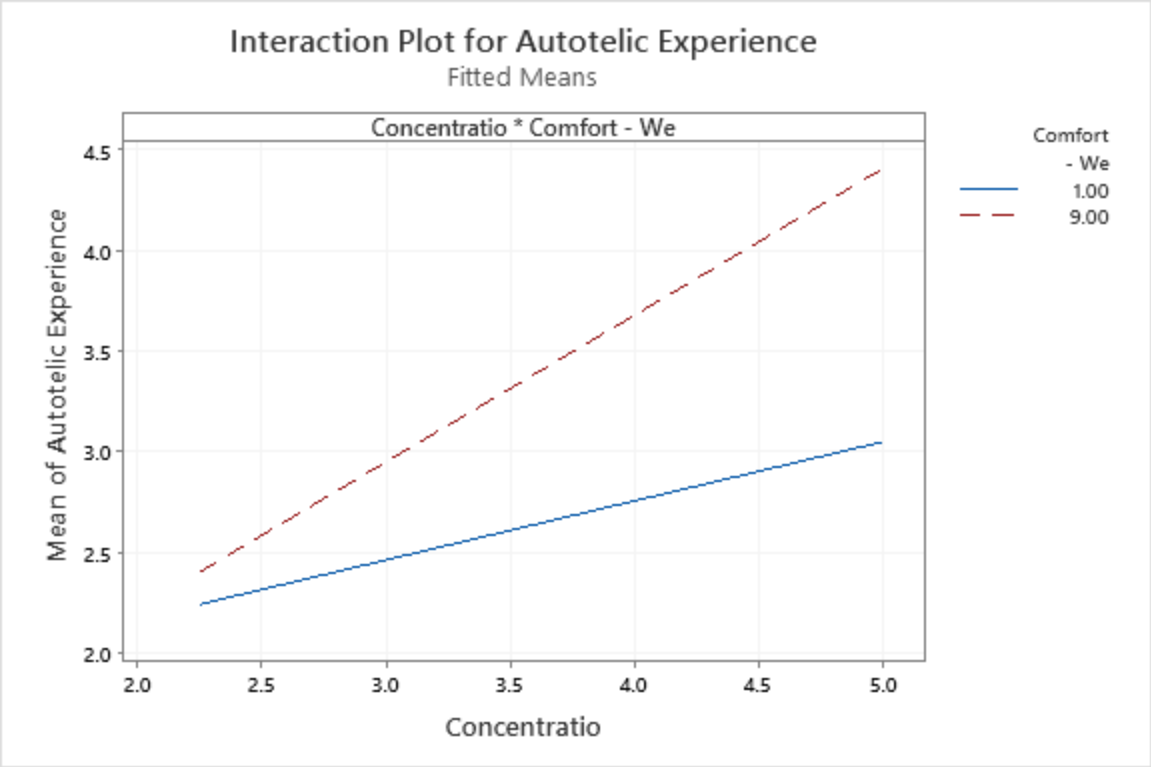

Figure 16. Plot of Concentration against Autotelic Experience at low and high levels of Comfort - Well-Being.

A possible relationship between a predictor variable, a mediating variable, and an outcome was also investigated. Significant independent variables in the preceding stepwise regression were Concentration and Comfort – Well-Being. According to Frazier, Tix, and Barron (2004), for a mediator to be valid, the predictor must precede it in time. Since concentration does not logically precede comfort, comfort appears more likely to aid in concentration. Therefore, the next step in the analysis was to examine if concentration mediates the relationship between comfort and autotelic experience; i.e., if comfort influences concentration and, in turn, if concentration influences the onset of an autotelic experience (see Table 9).

Table 9. Data for the mediation analysis.

Mediation testing step	B	SE B	t-Value	F-Value	p-Value
A. Total Effect					
Outcome: Autotelic experience					
Predictor: Comfort – Well-Being	0.1702	0.0564	3.02	9.09	0.004
B. Predictor -> Mediator Effect					
Outcome: Concentration					
Predictor: Comfort – well-being	0.0786	0.0430	1.83	3.34	0.073
C. Mediator -> Outcome Effect (controlling for each variable)					
Outcome: Autotelic experience					
Mediator:	0.4790	0.1710	2.80	7.83	0.007
Concentration	0.1326	0.0547	2.42	5.87	0.019

Predictor: Comfort

– well-being

Step A showed that Comfort – Well-Being was a significant predictor of attaining an Autotelic Experience, with an unstandardized regression coefficient of 0.1702 significant at a p-value of 0.004. Step B established that the predictor Comfort – Well-Being was not significantly related to the mediator Concentration (at $p< 0.05$; the unstandardized regression coefficient is 0.0786) In other words, Comfort – Well-Being did not significantly influence Concentration expressed by the study participants. Step C indicated that Concentration (after controlling for Comfort – Well-Being) and Comfort – Well-Being (after controlling for Concentration) both individually significantly predicted Autotelic Experience, with unstandardized regression coefficients of 0.4790 and 0.1326 and p-values of 0.007 and 0.019, respectively. Step B's failure to establish a predictive relationship between Comfort – Well-Being and Concentration confirms that there was no significant mediation effect. The significance of the mediation (the drop from the total effect B = 0.1702 to the mediated effect B = 0.1326) can be computed with a Z-score. If the computed Z-score is greater than the alpha = 0.05 Z-score of 1.96, then the mediating variable is a meaningful intervening factor (Frazier, Tix, and Barron, 2004). The computed Z-score for the present study was 1.47, indicating no significant effect (at $p<0.05$).

Furthermore, Table 8 (related to step C and table 9) shows that both Concentration and Comfort – Well-Being were main effects, each predicting Autotelic Experience reported by the study's participants. Figure 7 demonstrates that Comfort – Well-Being provides an additive effect in influencing the feeling of flow. When the study participants rated Comfort – Well-

Being high (dashed line), then the same level of Concentration led to a higher Autotelic Experience than when Comfort – Well-Being was rated low (solid line). The final predictive model for Autotelic Experience is as follows:

$$\text{Autotelic Experience} = 0.670 + 0.479*(\text{Concentration}) + 0.133*(\text{Comfort – Well-Being}) \quad (1)$$

The model is significant ($p < 0.001$) with an R-squared value of 0.23, meaning 23% of the variation in the study participants' autotelic experience can be explained by Concentration and Comfort – Well-Being.

Because participants completed two paper-and-pencil questionnaires in sequence post-trial – one on seat comfort and the other on flow experience – some common method variance in their responses may be present (see Podsakoff, MacKenzie, Lee, and Podsakoff, 2003). Because of the nature of the study, querying the same participant for his/her evaluation of the seat comfort and flow constructs is necessary. And these queries had to occur temporally proximate to the experiment just experienced, while memories about comfort and feelings were fresh. However, the authors believe the risk of CMV to be low. The participant consent form discloses that the study attempts to link seat comfort with flow; this form is emailed to the participant at the time the participant volunteers to participate in the study. The time between sign-up and participation is approximately one to two weeks. When the participant arrives at the lab per his/her scheduled appointment, the investigator does not mention the term "flow" to the participant at any time during the experiment. Neither the Chair Evaluation Checklist nor the Flow State Scale use the term "flow." The authors assert that participants are not biasing their ratings of seat comfort,

discomfort, or design toward or away from flow, nor are participants biasing their responses to the Flow State Scale items toward or away from flow.

The Flow State Scale asks the participant to rate his/her feelings about the event just experienced, while the Chair Evaluation Checklist asks the participant to rate his/her physical comfort and physical discomfort arising from the time spent in the seat, and attraction to the design of the seat. That is, the former questionnaire is task-focused and the latter is seat-focused. The item anchors also differ: anchors in the Flow State Scale are "extremely disagree" and "extremely agree" while those in the Chair Evaluation Checklist are "not at all" and "extremely." In addition, the physical layout of each questionnaire differs from the other. The Flow State Scale has numbered statements and asks the participant to circle numbers corresponding to the degree of agreement or disagreement with the statements. The Chair Evaluation Checklist consists of unnumbered statements and asks the participant to place an ""x" on a line marked with numbers corresponding to the degree of agreement or disagreement with the statements. The authors argue that the two questionnaires' aims and appearances are dissimilar enough that common method variance based on item context and characteristics is of little risk.

A correlation analysis was performed to compare the responses between the two scales. Results are shown in Table 10.

Table 10. Correlation matrix showing relationships (r-values) between Flow State Scale items and Chair Evaluation Checklist items.

Instrument	Scale Item	Challenge/ Skill	Action/ Awareness	Clear Goals	Clear Feedback
Flow State Scale	Action/ Awareness	0.627**			
	Clear Goals	0.482**	0.587**		
	Clear Feedback	0.698**	0.555**	0.689**	
	Concentration	0.369**	0.485**	0.465**	0.384**
	Control	0.64**	0.514**	0.517**	0.654**
	No Self-Consciousness	0.494**	0.482**	0.4**	0.557**
	Time Transform	0.060	0.198	0.246*	0.188
	Autotelic Experience	0.258	0.317*	0.457**	0.319*
Chair Evaluation Checklist	Discomfort	0.145	-0.021	-0.064	-0.041
	Comfort - Chair Design	-0.131	-0.109	0.137	-0.013
	Comfort - Well-Being	0.098	0.184	0.345*	0.176

Instrument	Scale Item	Concentration	Control	No Self-Consciousness	Time Transform
Flow State Scale	Action/ Awareness				
	Clear Goals				
	Clear Feedback				
	Concentration				
	Control	0.705**			
	No Self-Consciousness	0.519**	0.661**		
	Time Transform	0.232	0.193	0.398**	
	Autotelic Experience	0.421**	0.304*	0.130	0.059
Chair Evaluation Checklist	Discomfort	-0.197	0.028	-0.022	0.168
	Comfort - Chair Design	-0.105	-0.125	-0.155	-0.002
	Comfort - Well-Being	0.246	0.183	-0.006	-0.086

Instrument	Scale Item	Discomfort	Comfort - Chair Design
Flow State Scale	Action/ Awareness		
	Clear Goals		
	Clear Feedback		
	Concentration		
	Control		
	No Self-Consciousness		
	Time Transform		
	Autotelic Experience		
Chair Evaluation Checklist	Discomfort		
	Comfort - Chair Design	-0.387**	
	Comfort - Well-Being	-0.411**	0.635**

* $p < 0.05$
** $p < 0.01$

The r-values reveal very little significant correlation overall between the scales (Flow State Scale independent variable items are in the unshaded portion of the matrix; Chair Evaluation Checklist items are in the shaded portion). A sole significant relationship ($p < 0.05$) is seen between the Flow State Scale item "clear goals" and the Chair Evaluation Checklist item "seat comfort – well-being." This lack of general overlap between the two constructs further demonstrates little risk of CMV.

Further, participant anonymity is disclosed as guaranteed and, for the Flow State Scale items, the introduction to the instrument states there are no right or wrong answers (no statement exists in the Chair Evaluation Checklist introduction and is therefore a shortcoming of this instrument). The authors are confident that psychological contributors to CMV have been addressed.

Discussion

One concern was that participants who did not have a propensity for experiencing flow in everyday life would also not experience flow in the present study, no matter which seat type they occupied and, therefore, confound the results of the experiment. As discussed in section 3.1, there was no significant correlation between reported flow proneness and reported autotelic experience. However, further research into trait-based differences in the likelihood of individuals experiencing flow is warranted in order to discover the extent to which these individuals might realize an autotelic experience based on performing different activities in varying work system configurations (that is, state-based influences).

Interestingly, the results of this study showed that seat comfort did not provide a moderating or mediating effect between flow antecedents and the autotelic experience, but rather it was a main effect. It seems plausible that if a task is absorptive enough on the individual, then concentration will be present whether the available seat feels comfortable or not, and the individual will have experienced at least some level of flow. However, with the presence of both concentration on an absorptive task and a comfortable seat, the individual could experience an even greater level of flow.

The results of this study reveal that concentration and physical (well-being) seat comfort explain almost one-quarter of the variation in participants' flow experience. With only two variables having this much explanatory power, the above results should be considered in the design of workplaces that aim to improve a host of desired personal and organizational outcomes. For instance, if the sole task design variable present in the work setting is the choice of seating, then individuals should be given different seating options to determine the type of seat

most physically comfortable to them. While granting such a choice implies that organizations may need to invest funds in more than one seat type, the payback may be high given that seat comfort contributes to flow, and flow has been shown to improve individuals' well-being, affect, and extra-role performance (Bryce and Haworth, 2002; Eisenberger, Jones, Stinglhamber, Shanock, and Randall, 2005; Demerouti, 2006;). As well, such employee participation in workspace design – as part of a larger participatory ergonomics program – has been shown to contribute to successful continuous improvement programs and a higher sense of internal ownership of change within the organization (Haims and Carayon, 1998).

Finally, this study found further evidence of individuals experiencing flow based on the unsolicited comments captured at the end of experimental sessions. While not all subjects provided such comments, those who did so provided positive feedback such as: "[The exercise] was so much fun;" "I found myself completely into it;" "When I saw the timer counting down, I wanted to go faster;" and "I found it fun because I wasn't thinking about anything else."

Limitations and Directions for Future Research

This study was conducted in a laboratory on a university campus using undergraduate students as subjects. Such an artificial environment was arranged to reflect a real office setting but was controlled to eliminate potentially distracting factors such as loud noises, uncomfortable temperatures, and sunlight reflecting on computer screens. Therefore, translating results of this study to an actual industrial setting should be approached with caution, since these distractions are typically present outside the lab. Also, the study participants (average age is 19.6 years) do not necessarily reflect the general transactional office worker population. A related limitation is the lack of transactional office experience of the participants, which may influence their

propensity for experiencing flow. Since the exercise is a new one for them, their natural curiosity about the flight simulation may be a hidden influencer of flow antecedents such challenge/skill balance, concentration, and loss of self-reflection. Veteran transactional workers, on the other hand, may be more habituated to the repetitive nature of transactional work and, therefore less prone to experiencing flow during work. Also, the nature of the study exercise – a gamified set of tasks, where the failure to properly execute them has no real-world consequences – may not adequately translate to the transactional work environment where accountability for success and failure is typically an influencing factor in worker performance. Finally, while the study size (N=54) provides for adequate analytical power, larger-scale studies may be needed to provide a more confident translation to typical transactional office settings, where worker populations can number in the hundreds and even thousands per employer. Future research should focus on conducting flow-inducing seat comfort studies in real office settings with actual transactional workers. The combination of uncontrollable (noise) factors usually present in office environments, controllable environmental factors (e.g., monitor brightness, density of adjacent co-workers), tasks that more closely reflect actual transactional work, and participants who are experienced performing the target work would most likely create a more robust set of responses than that provided by the present study. Such office settings typically also offer larger samples of subjects, which will also result in a higher confidence in the study results. Cross-role studies (e.g., participants segmented by roles, such as quality assurance, data entry, and customer communication) could also result in a beneficial tuning of factor settings to more reliably predict flow at work. And, as previously noted, identifying types of activities and work system designs that can promote flow in individuals otherwise not prone to flow would strengthen the overall design of the work system.

The amount of time given to instructing the participants seated in the ergonomic chair exceeded that given to those seated in the non-adjustable bench. Although the reason for this disparity is the higher quantity of adjustable components of the chair than the bench – necessitating lengthier instruction – the greater amount of instructional attention provided to the chair participants may have contributed to their achievement of higher levels of flow than the bench participants' reported levels of flow. Future studies should consider more balanced training between the two groups to lessen the risk of disparate effects on outcomes.

The authors make no claim that the ergonomic chair used in the present study is the "most" or "best" ergonomic chair available to users, but it is a chair typically found in office settings. As such, participants did rate the ergonomic chair as being statistically more comfortable than the non-adjustable bench after a 30-minute period, so there is evidence that at least some of the ergonomic chair's features matter in the present study. Future research should be undertaken to determine if variations in office chairs result in variations in flow states experienced. For example, more degrees of freedom in seat pan adjustment may result in discovering seat pan settings that lead to higher levels of comfort, which in turn support a deeper level of flow. Relatedly, further studies on how individuals sit in such seats (e.g., forward, backward, leaning to one side, amount of fidgeting) may also shed light on whether seating position affects the attainment of flow.

The authors did not observe and document participants' settings of the ergonomic chair's adjustable features during the present study. Participants may have made one, many, or no adjustments before they engaged the simulation task. Future studies involving comfort and

adjustable chairs should track the adjustments made by participants to possibly identify the chair's features that contribute to comfort and the extent they influence comfort.

Recent attention has been placed on the deleterious health effects of long-term sedentary work, and the benefits of sit-stand workstations to improve the health of workers in typically seated roles (for example, Commissaris et al, 2014). Future studies may also demonstrate that some combination of sitting and standing (and even ambulation) may contribute to or impede the attainment of flow.

Summary

The present study explored whether seat comfort influenced the relationship between a challenging transactional task and the experience of flow in an individual. Through a number of analyses, it was determined that the well-being experienced from seat comfort is a main effect and not a moderating or mediating effect on the likelihood of experiencing flow. That the physical feeling of seat comfort is a main effect is somewhat surprising, given the vast amount of literature on flow consistently refers to nine dimensions of flow (for example, Csikszentmihalyi, 1988; Chen, Wigand, and Nilan, 1999; Fullegar, Delle Fave, and Van Krevelen, 2017) and all of these dimensions are task-related. The results of the current study indicate that non-task factors also influence flow. We term these variables work system factors. Future studies involving additional work system factors may reveal additional influencers of flow attainment.

The present study has meaningful implications for further research and for industrial applications. Further experiments should be performed to determine if other work system factors, alone and in combination with each other and with task-related factors, influence the likelihood of achieving flow in the workplace. Flow has been linked to personal, team, and

organizational benefits. If further work system factors are found to exist, organizations that employ transactional workers should design their work systems to improve the likelihood of their associates achieving flow and accruing these benefits.

Multi-Factor Laboratory Study[4]

The following article details the results of a multi-factor designed experiment I designed and conducted. The study had three objectives: 1) to determine if any of the flow dimensions and five non-task work system factors, alone or in combination, resulted in self-reported flow in the study participants; 2) to determine if flow and the five non-task work system factors, alone or in combination, resulted in higher productivity in the study participants; and 3) to determine if a relationship existed between self-reported flow and certain physiological indicators thought to correlate with flow.

Lights, Sound, Action! The Effect of Non-Work System Factors on the Achievement of Flow and Productivity During Transactional Work

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Keywords: psychological flow, productivity, work system factors, physiological correlates to flow; designed experiment

[4] The article in this section was authored by Steven R. Clapp, Waldemar Karwowski, and P.A. Hancock and was submitted for publication in Applied Ergonomics in 2023. My contribution to the paper included the design and execution of the study and the preparation of the initial draft.

Abstract

Psychological flow at work is a desirable feeling that has been linked to positive personal and organizational outcomes, including increased productivity. Through a designed experiment where certain non-task work system factors were manipulated during a repetitive mental math exercise, the present study identifies the flow antecedent of challenge/skill balance and the non-task work system factors of seat comfort and low computer screen color contrast as predictors of flow. The experiment also identified higher levels of flow and the same two non-task work system factors as predictors of higher productivity. Finally, the experiment found a partial correlation between lower heart rate variation (HRV) and flow, confirming this link identified in previous research; however, no such correlation was found between systolic blood pressure and flow or between the ratio of low-frequency HRV to high-frequency HRV and flow, as has also been documented in previous research on physiological correlates of flow. To the best of the authors' knowledge, this study is the first to empirically examine the role of workplace factors on flow and productivity. Researchers and organizational leaders can use this study better design the holistic work system to improve the likelihood of flow creation and realize its attendant benefits. Limitations of the present study and recommended areas of future research are also discussed.

Introduction

The Phenomenon of Flow

If you have ever found yourself so deeply immersed in a work task, a hobby, or even a household chore where you exerted effort to complete it that you lost track of time and enjoyed the experience so much you wanted to do it again, then you have probably experienced psychological flow. Csikszentmihalyi and colleagues termed flow an "optimal experience"

(1988), partly because the reward was in the satisfaction or joy from performing a challenging task. Flow at work, in particular, has been described as the feeling one gets from expending just the proper amount of effort and engagement on a sufficiently stimulating task so that one is completely absorbed in the task and self-motivation occurs without thought (Greguras et al., 2014).

Csikszentmihalyi (1990) developed nine dimensions of flow, and this multi-dimensionality has been supported and measured by others (for example, Jackson and Marsh, 1996; Bakker, 2008). Further, these dimensions are time-ordered, where antecedent dimensions are necessary for characteristic dimensions to be felt, which in turn result in consequential dimensions (Barthelmäs, M. and Keller, J., 2021; Chen et al., 1999; Csikszentmihalyi, 1988; Fullagar et al., 2017). Table 11 summarizes each of the nine dimensions.

Table 11. Flow dimensions (based on Bakker, 2008; Barthelmäs, M. and Keller, J., 2021; Clapp et al., 2018; Csikszentmihalyi, 1990; Csikszentmihalyi, 2003; Jackson and Marsh, 1996; Keller and Landhäußer, 2012; LeFevre, 1988).

Time-Ordered Position	Flow Dimension	Description
Antecedent (necessary for flow to occur)	Challenge/skills match	The difficulty of the task just exceeds the abilities of the performer; considered the most important trigger of flow.
	Clear task goals	Expected results – what is to be accomplished and why those results are important – are known to the performer.

Time-Ordered Position	Flow Dimension	Description
	Immediate feedback	Information that tells the individual if his/her performance is moving toward or away from the goal; the timeframe between execution and feedback should be as small as practical.
Characteristic (felt while in flow)	Action/awareness merging	Steps are performed instinctively, seemingly without conscious thought.
	Intense concentration	Neither internal (e.g., biological) nor external (e.g., ambient noise) intrude into the performer's consciousness; all of the individual's resources are focused on the activity alone.
	Control/sense of agency	The performer feels empowered to determine how the activity is to be performed.
Consequence (felt upon reflecting on the flow experience)	Loss of self-consciousness/ego	The individual loses him/herself into the task; there are no thoughts of self or how others perceive the performer or the performance.
	Altered sense of time passing	The passage of time appears altered; either more or less time has actually passed than was felt to transpire while executing the activity in flow.
	Autotelic motivation	The performer feels energized by the activity and desires to return to the activity to re-capture the

Time-Ordered Position	Flow Dimension	Description
		pleasurable feeling; progressing toward or meeting the goal is the intrinsic reward, rather than expecting some extrinsic reward like recognition or compensation; considered the optimal experience.

Flow at work has been correlated with personal and organizational benefits, including improved well-being, positive affect, and promotion of the organization to others (Bryce and Haworth, 2002; Demerouti, 2006; Eisenberger, Jones, Stinglhamber, Shanock, and Randall, 2005). Productivity has also been shown to increase when workers experience flow (Martin, 2005; Demerouti, 2006 (for high-conscientiousness workers)).

Physiological Indicators Correlating with Flow

Historically, flow has been measured via self-reported tools, asking the individual to reflect on a recently occurring experience. For example, the experience sampling method randomly pings study participants throughout the day over a number of days via an electronic device, at which time the individuals are to report on the activities they are performing and their states of mind during the performance. Over the decades since the ESM was developed, it has been used to study flow on hundreds and hundreds of participants across many studies. While surveys and questionnaires are designed to target a large sample of individuals, readily yielding a large number of responses, the surveying process itself fraught with biases. Sources of bias include the instrument, the interviewer, and the respondent. For example, the wording of the

instrument's items and the order in which they are presented can influence the respondent's answer. The interviewer can create bias through choice of wording, affect toward the respondent, and interpretation of results. The respondent can introduce bias through, for instance, a desire to please the interviewer, or because of fatigue over the length of the instrument, or because of a lapse of memory about the event in question (this last usually caused by responding after a long time has elapsed between the event and the taking of the survey or questionnaire) (Bogner and Landrock, 2016; Deming, 1944; Suchman, 1962).

For these reasons, the authors of the present study explored more objective methods of measuring the occurrence of flow in the study's participants. One method that has received much attention is employing certain physiological indicators that have a correlation with flow or with arousal and increased mental workload. As Csikszentmihalyi (1990) has noted, an optimal level of arousal and mental workload are conditions for the launch and maintaining of flow. Examples of such indicators are noted in Table 12.

Table 12. Examples of physiological indicators associated with flow.

Physiological Indicator	Description	Attributed Research Team(s)
Systolic blood pressure (BP)	The arterial pressure when the heart contracts during a beat; higher happiness is associated with lower systolic BP; flow as an optimal experience can be equated to happiness.	Steptoe and Wardle, (2005)

Physiological Indicator	Description	Attributed Research Team(s)
Heart rate variability (HRV)	The time variation (in milliseconds) between the R-to-R intervals in a heartbeat, measured as the root mean square of successive differences between heartbeats; higher levels of flow are associated with lower HRV.	Keller et al., (2011)
Cortisol	Flow is associated with higher levels of cortisol production.	Keller, et al., (2011)
Low-frequency HRV/high-frequency HRV (LF/HF)	The balance between sympathetic (low-frequency HRV, "fight or flight") and parasympathetic (high-frequency HRV "rest and digest") tone; arousal associated with the sympathetic nervous system; higher LF/HF ratios indicate the occurrence of flow.	di Fronso et al., (2017); Gaggioli et al., (2013)
Electrodermal activity (skin conductance)	Increased skin conductance may be associated with either 1) higher attentional resources and effort, or 2) stress and emotions.	di Fronso et al., (2017)

Physiological Indicator	Description	Attributed Research Team(s)
Respiratory rhythm	Breathing frequency is associated with HRV; however, the individual can consciously choose to modify his/her respiratory rhythm, and this rhythm can also be influenced by stress and anxiety.	di Fronso et al., (2017)
Brain waves	Beta waves increase and alpha waves decrease as mental workload increases; higher theta wave/alpha wave ratio indicates higher mental workload, but theta wave and alpha wave output decrease with age.	di Fronso et al., (2017); Longo et al., (2022)
Ocular measures (e.g., blink rate, pupil dilation)	Higher blink rates and pupil dilation are associated with higher mental workload; however, these indicators are sensitive to emotional states, surrounding illumination, and mental overload.	Longo et al., (2022)

Transactional Work

Much of the extant research on flow focuses on the phenomenon stemming from performing activities in which the individual can exercise much creative control (agency) over

the execution of the activity's process. Piano players (de Manzano, et al., 2010) and IT managers and researchers (Ceja and Navarro, 2012) are three examples of roles where individuals can and are expected to learn and adopt new ways of conducting their work and, within their day-to-day activities, have some latitude over what to execute and how to do so. The investigators of the present research are interested in flow occurring in less-creative roles. Of particular interest is work activities that are standardized, documented by (sometimes keystroke level) procedures, and is repetitive throughout the day. These activities are known as transactional work ("Transactional Work", 2007; Hunt, 2008; Power, 2012) and are comprised of roles such as accounts payable clerks, university classroom schedulers, and database entry personnel. Transactional workers are typically located away from customers (since their responsibilities do not require in-person customer interaction), seated at desks behind computer screens, and in large organizations may be collocated in so-called back offices and shared service centers to achieve economic scale. The term "cubicle farm" has been used to describe these types of work settings. These work environments are characterized by a constant low volume of background noise generated by neighboring co-workers' voices and ringing phones, various lighting levels, and seating arrangements that may or may not be ergonomically sound. Employees largely structure their day around completing a set of work prioritized in first-in, first-out order, either in physical or electronic form.

The Work System Theory of Flow

Also found in the current body of work on flow is a focus on the activity as the fomenter of flow. Indeed, all of the flow dimensions in table 1 are based on the task being performed. The work system theory of flow, proposed by Clapp, et al. (2018), posits that the entire system of work – including the task as well as the non-task factors – exert forces upon the individual to

create or limit conditions for flow. All significant work system factors must be considered and optimized for flow to occur. For example, the work task might be just challenging enough to accomplish with sufficient effort (skill/challenge balance) but, if the workspace temperature is too cold or the chair in which the individual is seated while performing the task is uncomfortable, flow and its attendant benefits may not occur. In an initial empirical study on the work system theory of flow, Clapp, et al. (2021) showed how higher seat comfort was a direct contributor to a deeper flow experience in participants while performing a transactional computer-based set of tasks. The present research expands on the seat comfort experiment by including background noise, task instruction level of detail, room lighting level, and computer monitor contrast to the study. These factors will be examined empirically as independent variables to determine if any of them, singly or interactively, are statistically significant drivers of flow in the study's participant. They were selected for this study because they are typically present in transactional work settings.

Hypotheses

A summary of the experimental model is illustrated in Figure 17.

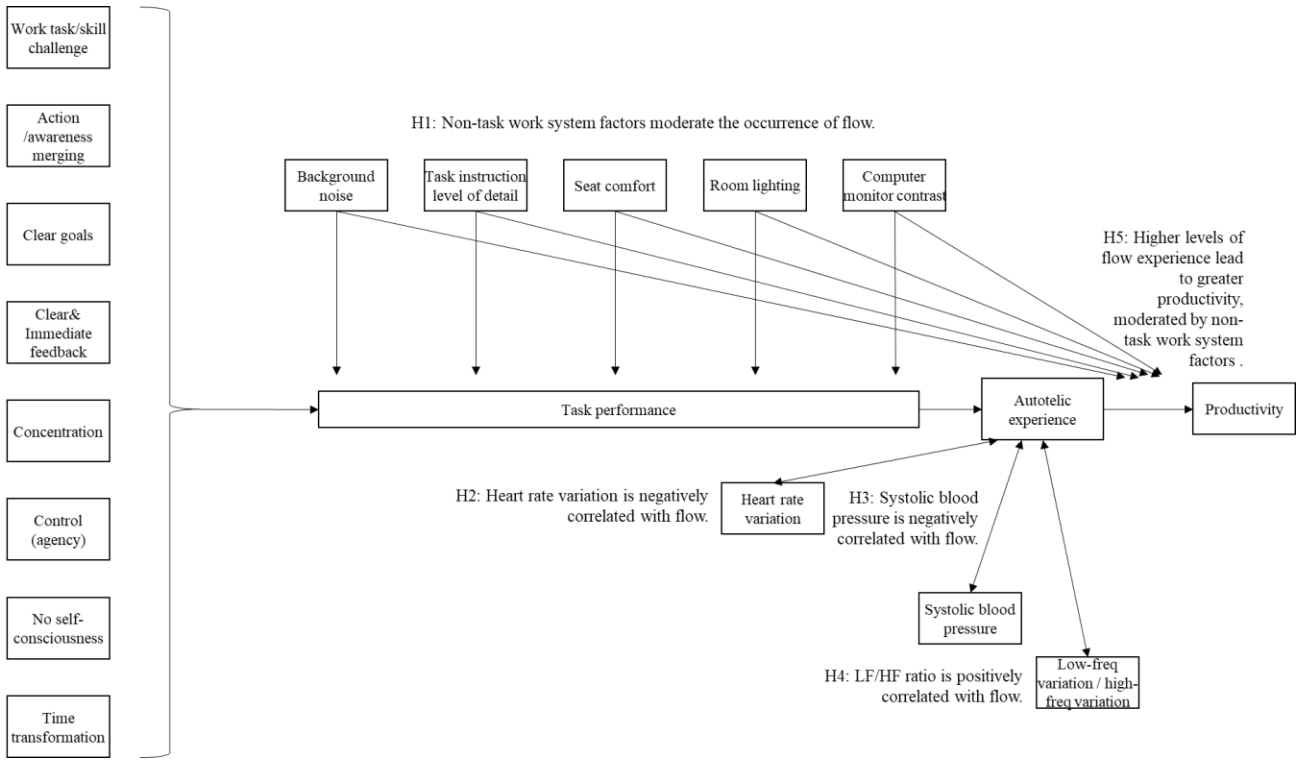

Figure 17. The present study's model. Independent variables are shown on the left-hand side (flow components) and across the top (non-task work system factors). Dependent variables are autotelic experience, productivity, heart rate variation (HRV), systolic blood pressure, and the ratio of low-frequency HRV to high-frequency HRV.

As noted in the previous section, hypothesis 1 theorizes that the non-task work system factors selected for the present study influence the experience of flow in the study's participants. The occurrence of flow is measured as autotelic experience, which is considered as one of the main indicators of self-reported flow (Csikszentmihalyi, 1990; Jackson, 1996; Landhäußer and Keller, 2012; Panebianco-Warrens, 2014).

Hypotheses 2, 3, and 4 are related to the aforementioned physiological correlates to flow. Flow is considered a state of arousal (Csikszentmihalyi, 1990), and moderate levels of arousal trigger the sympathetic nervous system to lower heart rate variation (Peifer et al., 2014).

Hypothesis 2 postulates that a lower heart rate variation is correlated with a higher self-reported experience of flow.

A study conducted by Steptoe and Wardle (2005) found that systolic blood pressure decreased as individuals reported higher levels of happiness. With flow having been equated with happiness (Lefevre, 1988), the present study's authors posit as hypothesis 3 that lower systolic blood pressure is correlated with a higher self-reported experience of flow.

Analysis of heart rate variation reveals the low-frequency portions of such variation are associated with the regulation of blood pressure, while high-frequency variations are associated with respiratory changes in respiratory function (di Fronzo et al., 2017). Low-frequency variations are also considered reflective of sympathetic nervous system activation; this portion of the autonomic nervous system engages during arousal (Shaffer and Ginsberg, 2017). So, as systolic blood pressure decreases during activities that arouse, it is proposed that the ratio of low-frequency variation to high-frequency variation should increase during times of flow, and is hypothesis 4.

While there exists some research linking flow to increased productivity (Demerouti, 2006; Martin, 2005), such studies have been performed using retrospective, self-reporting means such as with questionnaires. While beneficial, such reflective declarations are subject to biases as discussed in section 1.2 above. The authors of the present study desired to measure productivity in an empirical setting in real time and then correlate those results with post-experiment self-reported flow measures, as recommended by Schipe-Tiska and Engeser (2017, pp. 40-41). Hypothesis 5 theorizes that productivity is positively correlated with flow.

Methods

Participants

Sourcing of candidates for the present study was through social media and word of mouth. Upon expressing interest in participating, recruitment letters were sent, providing details of the study's screening criteria, procedures, and participant requirements. Screening criteria included a minimum age of 18 years at the time of participation; ability to fluently communicate in English; familiarity with basic personal computer operations, including the use of a mouse and keyboard; familiarity with the basic operations of Microsoft Excel, including data entry, clicking on buttons, and moving the cursor; and attestation of not having recurring back pain or cardiac issues which require professional medical treatment at the time of participation. A total of 32 participants (17 males) were recruited for the present study, the number required to run all experimental trials of the study (further explained in section 2.3). Average age was 50.3 years, ranging from 19 years to 73 years, with a standard deviation of 14.9 years. Industries represented included information technology, sales, fitness/sports coaching, and finance; and some participants were retired from work. Informed, written consent was secured from the participants prior to engaging them in the procedure. These individuals were paid $15 for their participation of approximately one hour.

Laboratory Setting

The lab study took place in a conference room located at the Jewish Community Alliance, a non-profit community center of cultural learning, social involvement, and physical exercise located in Jacksonville, Florida. The conference room was outfitted to resemble a typical one-person office, which included a desk, seat, computer, and monitor. The room was selected for its characteristics of requiring reservations to use the room, which eliminated the

possibility of interruptions from the arrival of staff; controlled lighting; and constant temperature (~72 degrees Fahrenheit). The room did have windows along one wall facing the outside, which permitted viewing of passers-by; however, participants in the present study were seated so they did not directly face the windows and external sound intrusion was limited by the thick glass.

Procedures

Experimental Design

The study was approved by the University of Central Florida's Institutional Review Board. The experimental design was a randomized, controlled set of 32 trials with one pre-test and one post-test. The trials and their randomization were constructed as a one-half fractional factorial designed experiment, whose purpose is to screen for potentially significant independent variables that, in the case of the present study, support the occurrence of flow in the study's participants. A major advantage of designed experiments is their ability to test for such cause-and-effect relationships very efficiently by varying each of the independent variables at the same time. As a result, another major advantage of employing designed experiments is their ability to test whether such independent variables act singly or interact with each other to cause an outcome of interest, as measured by a dependent variable (see Montgomery, 2013; and Wheeler, 1990). For the present study, five independent variables, described in the introduction to the present paper, were tested: background noise; seat comfort; task instruction level of detail; room lighting level; and computer monitor contrast level. Each variable was set at so-called "low" and "high" levels. With five independent variables tested at two levels, 32 combinations of variables settings (each combination constituting a trial) could be run. However, practitioners of designed experiments support the notion that higher-order interactions are typically negligibly impactful on a dependent variable and so, therefore, trials of such higher-order interactions can be safely

eliminated (sparsity of effects principle). Such smaller, screening experiments can then be used as a basis for conducting future experiments where additional replicated trials can be run to produce stronger statistical results (projection property) (Montgomery, 2013, pp. 320-321; Wheeler, 1990, pp.184-185). For the present study, such a screening design was selected because of the long length of time required to recruit and vet participants versus the relatively short length of time in which the donated conference room would be made available to the experimenters.

Based on Montgomery's (2009) and Wheeler's (1990) recommendations, the authors of the present study decided to eliminate the fifth-order trial run, which would have tested the likely negligible interaction of all five independent variables. This factor removal resulted in 16 runs.

The present study's investigators also decided to replicate each of the 16 trials, resulting in two runs for each of the 16 remaining independent variable combinations. Replication permits measuring experimental error and a more precise estimate of the important variables' best settings required to produce a desired outcome (Montgomery, 2013, p. 12). Therefore, a total of 32 experimental runs were needed, requiring 32 different participants. A summary of the logic supporting the 32 runs is shown in Figure 18.

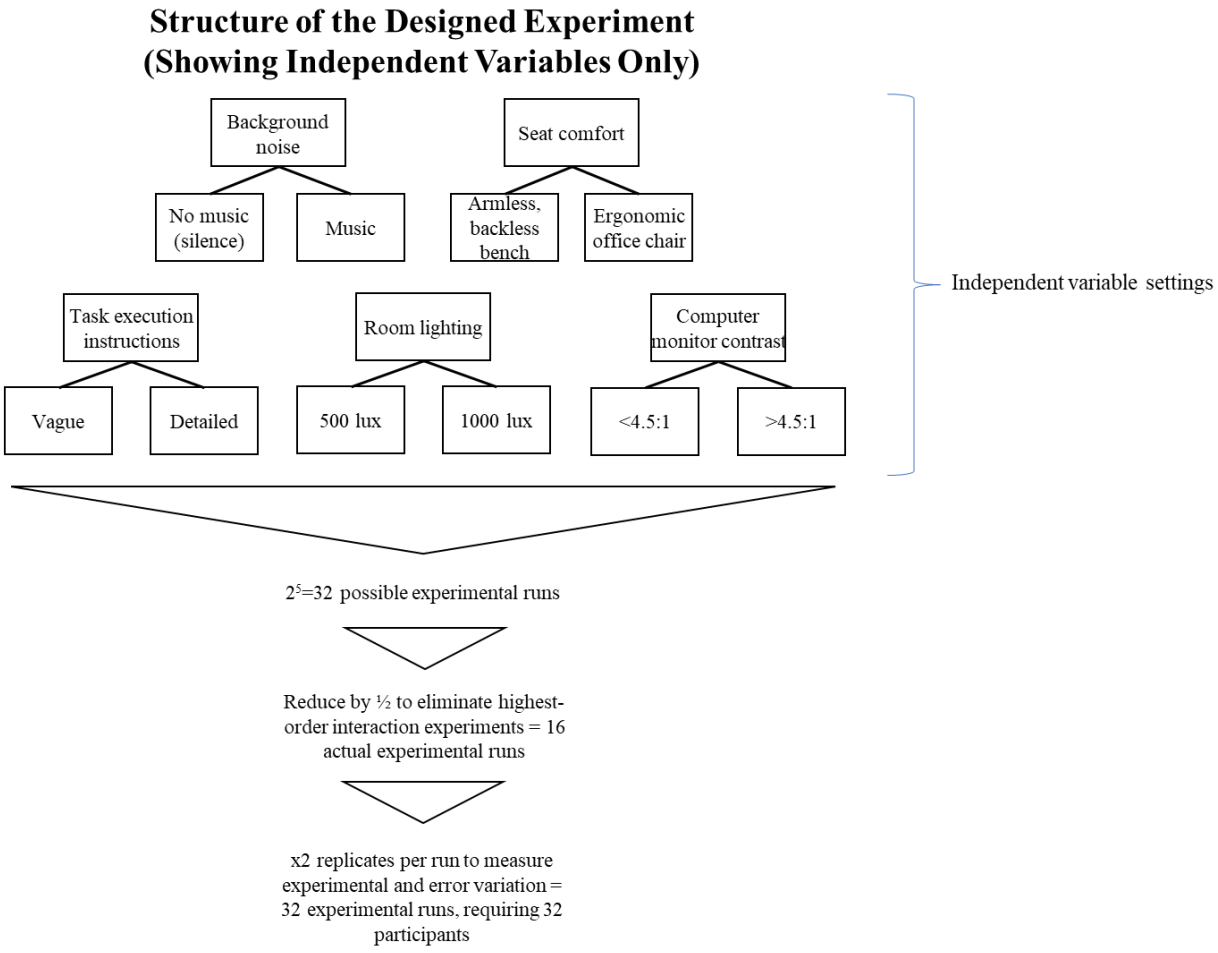

Figure 18. The logic supporting the 32-run experimental design.

All experiments took place between 1 pm and 5 pm local time, to reduce the possible influence of circadian rhythms of the participants on their experience of flow. The order of the runs was randomized to eliminate any influence of lurking variables, such as external noise levels occurring at or near certain times of the day (the laboratory setting was at a community center, which was populated with children and adults) and external (natural) lighting levels. Participants were randomly assigned to one of the 32 experimental conditions.

The Experiment's Transactional Task

The activity the study volunteers performed was a simple math exercise in which they added two one- and two-digit numbers between 1 and 49 and entered the result on a computer screen. This activity is similar to the rote, repetitive tasks transactional workers perform. Also, the arithmetic exercise was modeled after other studies performed to measure certain physiological correlates while in flow (Katahira et al., 2018; Ulrich et al., 2014). Two rounds of this exercise were presented, each round containing 130 addition tasks and all items were displayed in rows for the participant to see. For each round, all tasks were displayed at the same time in keeping with the findings of an earlier study (Clapp et al., 2023), where transactional workers achieved flow by seeing to-do lists of all their work tasks throughout the day, and being able to check them off as workers completed them. Each round was timed at ten minutes each, with a five-minute resting period between rounds. A ten-item practice round was given before the two timed rounds so the individuals could familiarize themselves with the layout and level of difficulty of the task, as well as the feel of the mouse and keyboard used to navigate the screen and enter responses.

All participants received the sets of numbers to be summed, so there was no within- or between-participant variation in difficulty (or "challenge," in flow parlance). The level of difficulty was held constant as the objective of the study was to determine if any of the non-task work system factors influenced the occurrence of flow, not whether varying the challenge of the task influenced the occurrence of flow. Rather, the challenge was to either to achieve more correct answers in the second round than the first or, if all 130 responses were correct, to complete the second round in less time than the first round. This within-person type of challenge was used rather than comparing performance to other volunteers because, in the Clapp et al.

study of 2023, many of the transactional workers documented how they challenged themselves to perform more or faster than they had on previous days, rather than attain better results than their peers.

In keeping with one of the desired flow conditions, real-time feedback was given and was done so in three ways: first, as each sum was entered a note below the answer displayed the words “correct” or “incorrect;”, second, a running total of the number of correct responses was displayed at the top of the screen and was always visible; and third, a countdown timer was displayed next to the computer so the participant could always see how much of the ten-minute round was remaining. Such feedback is also recommended by Peifer et al. (2020) and Spreitzer and Porath (2014) as a means to encourage autonomous motivation and self-efficacy (both related to the flow dimension of “control” or “agency”).

In the paragraphs below, the non-task work system factors employed as independent variables are described. Two of these variables – task execution instructional detail and computer monitor color contrast – required that the simple math exercise be (randomly) presented to participants in one of four versions: high detail/high contrast; high detail/low contrast; low detail/high contrast; and low detail/low contrast. Two of these versions are illustrated below:

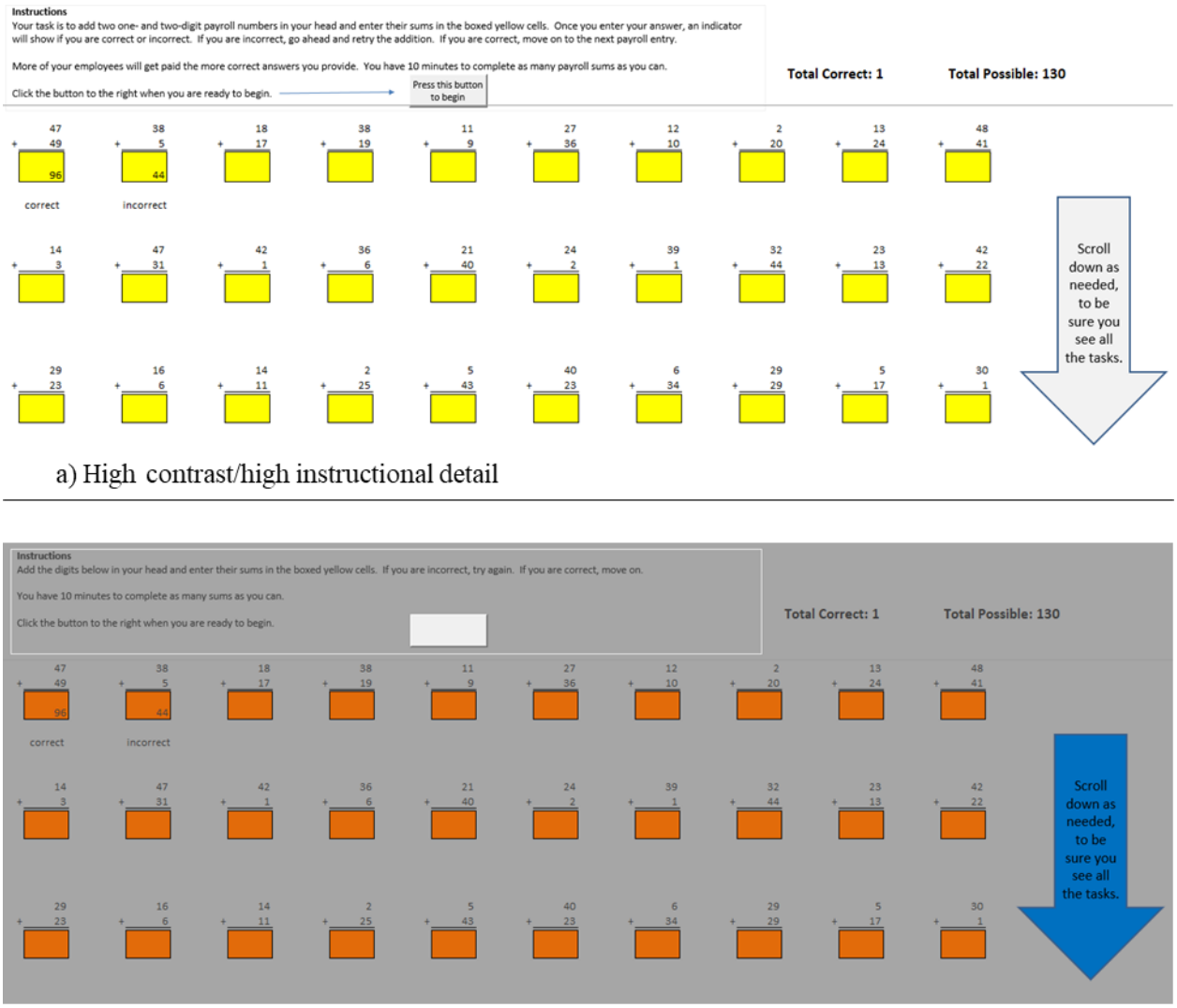

Figure 19. Two versions of the simple math exercise, with two problems solved to show real-time feedback at the top ("Total Correct" running count) and beneath the solved problems ("correct" and "incorrect" indicators).

The Non-Task Work System Factors (Independent Variables)

The non-task work system factors chosen as the independent variables for the present investigation were background noise, seat comfort, task execution instructional detail, room lighting level, and computer monitor color contrast. Two levels of settings were chosen for each factor. For background noise, the low setting was "none" (near silence) and the high setting was

"music." Music was selected as a background noise factor based on previous research by Clapp, Karwowski, and Hancock (2023), where office workers listened to music to improve their task concentration by reducing external office noise interference. The type of music used for the 16 experimental runs that called for background noise is known as ambient music. This genre was chosen for its support of concentration by subjects exposed to it during learning and studying (Bossaller, et al., 2020; Popa, 2019) and is characterized by its emphasis on tone and atmosphere; lack of musical structure and rhythm; and absence of lyrics. The piece of music used in the present experiment is titled "Ambient Study Music to Concentrate - 4 Hours of Music for Studying, Concentration and Memory" (Quiet Quest, 2019). The music was played over a pair of stereo speakers at an average volume of 56 dB, about the level of conversation. The non-music (no background noise) setting was measured at an average of 22 dB, below the level of a whisper.

The second independent variable was seat comfort. Study participants were seated in either an armless, backless bench or an ergonomic, adjustable office chair. A previous study (Clapp, et al., 2021) showed a significant difference in comfort and discomfort between these two seats, so they were chosen as the two settings for this factor. The ergonomic chair was rated higher in comfort and lower in discomfort than the bench; therefore, the bench was assigned the low setting and the chair was assigned the high setting. The bench was not adjustable in any way, save for being able to move it closer to or further away from the office desk by sliding it by hand. The chair had an adjustable armrest height, seat pan height, seat pan tilt, and seat back tilt; in addition, it rested on five rollers and so was easily moveable.

The task which participants were asked to perform was a simple math exercise shown on a computer monitor; the third independent variable in the experiment was task instruction level of detail. Based on the concept of meaning-making as a necessary ingredient for creating flow conditions in workers (Csikszentmihalyi, 2003, p. 154.; Delle Fave and Bassi, 2017, pp. 159-160), the present study's investigators sought to determine if adding a sense of purpose for the task within the task instructions would be a significant factor in creating flow. Two versions of task instructions were created: a low-setting set of instructional details, with minimal meaning-making content; and a high-setting set of instructional details, with a richer level of meaning-making content. The low-setting instructions read, "Add the digits below in your head and enter their sums in the boxed yellow cells. If you are incorrect, try again. If you are correct, move on. You have 10 minutes to complete as many sums as you can." The high-setting instructions read, "Your task is to add two one- and two-digit payroll numbers in your head and enter their sums in the boxed yellow cells. Once you enter your answer, an indicator will show if you are correct or incorrect. If you are incorrect, go ahead and retry the addition. If you are correct, move on to the next payroll entry. More of your employees will get paid the more correct answers you provide. You have 10 minutes to complete as many payroll sums as you can." Figure 3 illustrates these two levels of instructional detail.

The fourth independent variable was room lighting level. According to the U.S. General Services Administration (n.d.) and Moyano and Lezcano (2021), recommended lighting levels for offices should be between 500 lux and 1000 lux. In the present study, the low-setting lighting level of 500 lux was achieved by using a sole floor lamp to the side of the participant, placed far enough away from the keyboard to register 500 lux at the keyboard. The high-level

setting of 1000 lux at the keyboard was achieved by employing the office suite's in-ceiling lighting. The lamp was equipped with a shade that prevented light from shining directly onto the computer screen, limiting glare.

Computer monitor color contrast was the fifth independent variable. Color contrast was defined as the difference between foreground color hue and background color hue, measured as a ratio of foreground hue to background hue. According to the World Wide Web Consortium's Web Accessibility Initiative set of color contrast requirements, normal size text (12-point font like that used in the present experiment) should be of a color such that when it is placed on a background, the color contrast ratio should be at least 4.5:1 (Web Accessibility Initiative, 2019). One set of the present experiment's math exercises was displayed onscreen with a contrast ratio averaging 3.0:1, which was the low setting. The other set of exercises was displayed onscreen with a contrast ratio averaging 10:1. Colour Contrast Analyzer version 3.1.4 (The Paciello Group) was used to determine contrast ratio. Figure 3 shows the two levels of color contrast.

The Selected Physiological Correlates to Flow

The researchers in the present study wanted to employ a set of physiological measures that, in conjunction with self-reported qualitative measures, would correlate with levels of flow attainment by the participants. The criteria for selecting the study's physiological measures were that they 1) had an empirical basis for use; 2) were as unobtrusive as practical to the participant, to mitigate undue influence on the study's objectives; and 3) were cost-efficient. Based on these criteria, the research noted in Table 2, and a personal conversation with Dr. G. Hancock (August 12, 2021), the present study utilized three physiological measures as correlates of flow.

Systolic blood pressure was chosen as the first measure. It was monitored at three points during the experiment: 1) just after the participant providing written consent and completes the Swedish Flow Proneness Questionnaire, which allows for approximately 15 minutes of seated resting time before taking the initial measure (BPbaseline); 2) at the conclusion of the first round of the experiment (BP1); and 3) at the conclusion of the second round of the experiment (BP2). Data were collected utilizing a Samsung Healthy Living Digital Blood Pressure Monitor (model BT-412S; Samsung America, Inc., Ridgefield Park, NJ), a popular consumer-market wrist-strap device. Wrist-cuff monitors have been validated to be as accurate as arm-cuff monitors (Komori et al., 2013), and the present study's researchers appreciated the unobtrusiveness of this model. The Samsung device was calibrated against a professional-grade arm-cuff Omron Blood Pressure Monitor (model BP5100; Omron Healthcare, Inc., Lake Forest, IL) used by a medical service provider. The Samsung monitor was strapped to the participants' left wrist, as recommended by Samsung, only during the three measurement periods; the monitor was not attached during any other time to eliminate any distraction caused by tactile sensation.

Heart rate variation (HRV) and the ratio of low-frequency HRV to high-frequency HRV (LF/HF), two related measures, were chosen as the remaining measures. HRV was calculated as a time-domain measure of the root mean square of successive inter-beat-interval distances (ms). LF/HF was calculated as a frequency-domain measure of the Fast Fourier transform of power (ms^2) ratio of low-frequency HRV to high-frequency HRV. The Polar H10 Heart Rate Sensor (Polar Electro Oy, Kempele, Finland) was selected as the measuring device because the sensor is attached to a flexible chest strap worn under clothing, making it much less intrusive than monitors with electrodes that must be affixed to three or more points on the body with adhesive

and conductive gel. After the baseline BP was taken, the laboratory investigator assisted the participant with wrapping the strap around the chest so that the sensor was positioned just under the sternum for ideal signal capture. The Polar H10 has a Bluetooth interface that sends its data to a data collection tool; the present study's researchers chose the Elite HRV app (Asheville, NC) running on an Android smartphone for its compatibility with Polar and its clear user interface. The investigator ensured the sensor was properly placed and the Bluetooth signal was clear by running a one-minute pre-experiment collection of HRV data (not used in any subsequent analysis). This exercise also helped to acclimate the participant to the wearing of the chest strap and reduce anxiety. HRV and LF/HF were monitored on each participant throughout the experiment, from the beginning of round one to the end of round two; however, the data were grouped and analyzed across three discrete timeframes to allow for comparisons: during the first minute of round one (baseline HRV and baseline LF/HF); during the final five minutes of round one (HRV1 and LF/HF1); and during the final five minutes of round 2 (HRV2 and LF/HF2). Although Keller et al. (2011) employed a three-minute HRV baseline in their study, a one-minute baseline measure was felt to be of sufficient length in the present study because of the aforementioned pre-experiment signal test and acclimation period and has been supported by prior research (Shaffer and Ginsberg, 2017). Five-minute measurement intervals are very common in research (as documented by Shaffer and Ginsberg, 2017). After each participant's round two of the experiment concluded, the chest strap was removed. The investigator then uploaded the data collected by the Elite HRV app to Kubios HRV Standard version 3.5, an HRV analysis set of PC-based software (Kubios Oy, Kuopio, Finland) for further processing. Data cleaning and analysis are discussed in section 2.4 below.

The remaining physiological indicators in Table 2 were not chosen for the present study mainly due to the intrusiveness of their data collection methods, such as swabbing saliva for cortisol analysis and affixing an electrode cap to the participant for brain wave monitoring. Such intrusiveness was felt to negatively affect concentration in participants and, subsequently, their experience of flow.

Pre- and Post-Experimental Tests

After gaining informed consent, each participant was given the Swedish Flow Proneness Questionnaire (Ullén, et al., 2012) to complete. This instrument gauges an individual's likelihood of experiencing flow while working, performing routine chores, and engaging in leisure or hobby activities. A sample question is, "When you do something at work, how often does it happen that what you do feels extremely enjoyable to do?" This question correlates to the flow dimension of autotelic experience. Responses are given on a five-point Likert scale ("never" to "every day, or almost every day"). The authors in the present study utilized the questionnaire as a control for those participants who are less likely to experience flow in everyday life and, therefore, may not experience flow in the present study, regardless of the settings of the experiment's independent variables.

At the conclusion of round 2 of the simple math exercise, and after the heart rate monitor strap is removed, the Flow State Scale questionnaire (Jackson and Marsh, 1996) is administered to the participant. This instrument's objective is to measure the individual's self-reported level of flow experienced during an event; in this case, the event is the experiment's simple math exercise. A sample question is, "I loved the feeling of that performance and want to capture it

again." This question correlates to the flow dimension of autotelic experience. Response options are on a five-point Likert scale ("strongly disagree" to "strongly agree").

A summary of the experimental procedure conducted in the laboratory with the participants is shown in Figure 20.

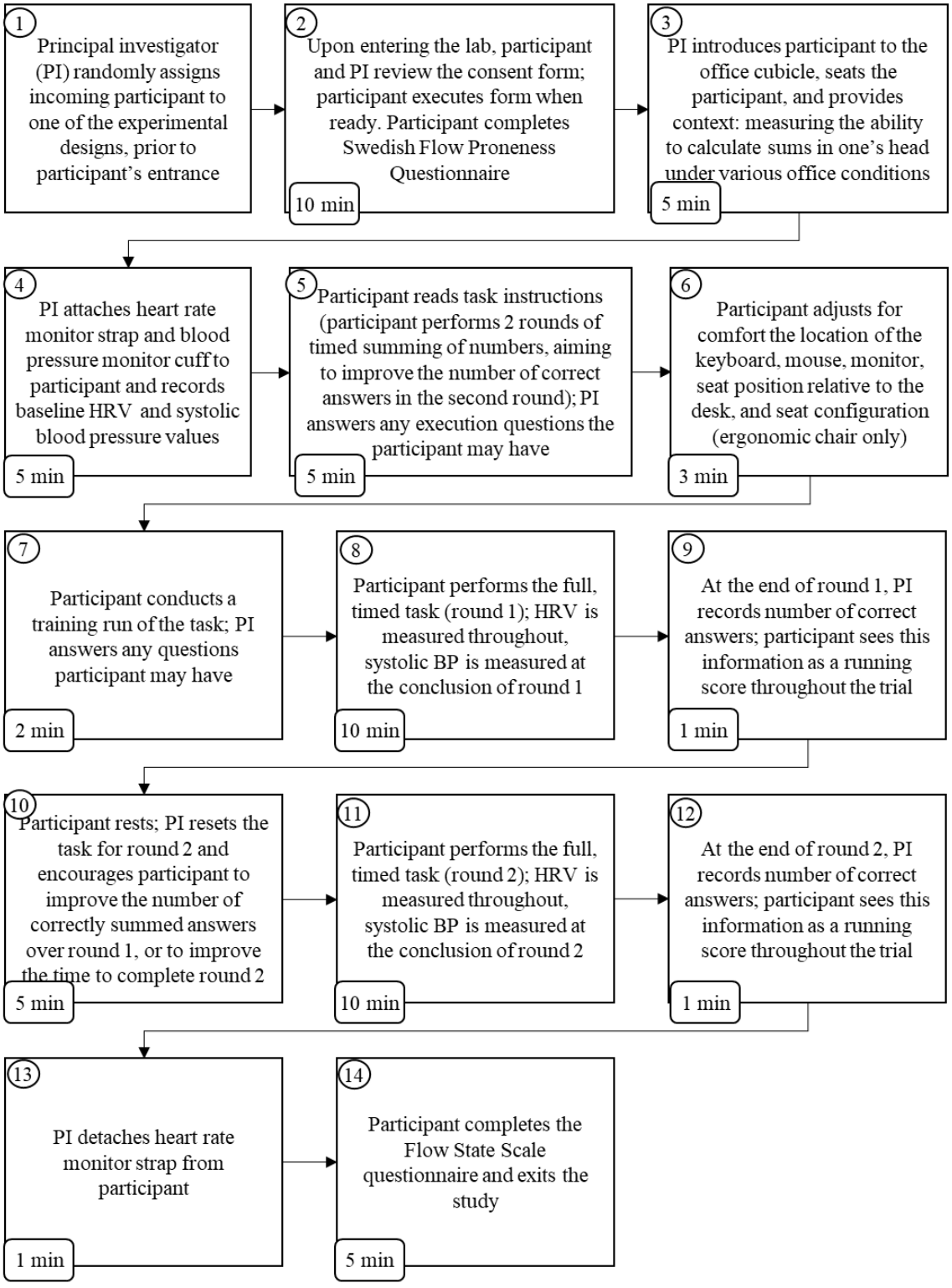

Figure 20. Experimental procedure with the study participants, with approximate lengths of time for each step.

Data Analysis

Analysis of variance (ANOVA) was employed to determine independent variable significance and overall regression model strength on the prediction of flow. Flow was measured as an average of the responses to the four autotelic experience questions in the Flow State Scale (Jackson and Marsh, 1996). Csikszentmihalyi (1990), Jackson (1996), Landhäußer and Keller (2012), and Panebianco-Warrens (2014) support the present researchers' choice of autotelic experience as the study's dependent variable, describing the feeling of self-reward as the peak or optimal experience of being in flow. Multi-variate regression was used in tests of variable moderation, similar to the Clapp et al. (2021) pilot study on seat comfort's relationship to flow. Analysis of covariance (ANCOVA) was employed to determine if an interaction relationship existed between continuous and categorical independent variables and dependent variables. Correlation analysis was utilized to determine the significance of non-causal relationships between flow and certain physiological measures. Significance for all statistical tests was determined at the 0.05 alpha level.

Heart rate variability (HRV) and low-frequency variation/high-frequency variation ratios (LF/HF) were analyzed using Kubios HRV Standard, version 3.5 (Kubios Oy, Kuopio, Finland). The software has built-in support for cleaning the collected heart rate data and calculating HRV and LF/HF measures. Cleaning refers to removing unusual inter-beat interval (IBI) times and replacing them with local average intervals. Unusual IBI times can be attributed to measurement system error (for example, the heart rate monitor strap moving, causing a beat to be missed) or to physiological aberrations (such as premature ventricular contractions and other arrhythmias). The cleaning method employed was to select a threshold time and compare it to each IBI, and the software would automatically replace any outlier IBI with a local average IBI (Tarvainen et al.,

2021). Alcantara and colleagues (2020) suggested using a very low threshold for young adults and any threshold for middle-aged adults when processing short-term HRV data (as compared to overnight HRV data collection). Tarvainen et al. (2021) and Alcantara et al. (2020) recommend that any artefact correction be capped at five percent of all HRV data points. The present study's researchers selected a very low threshold (0.45 seconds) for young adult participants and a medium threshold (0.25 seconds) for middle-aged and older adults. The five percent artefact correction cap was violated for only one participant, most likely caused by a poor fit of the heart monitor strap. However, the correction rate for this individual was 5.79% and the present study's investigators felt this excess over the recommended cap was minimal, so this person's HRV data was included in the analysis.

HRV and LF/HF measures were summarized across three discrete time periods for each experimental trial, as described in section 2.3.4 above. To normalize the summarized data within and between participants so that comparisons across experimental conditions could be made, the percentage difference of summarized HRV measures was calculated for three time periods: 1) between the baseline and HRV1 (HRVbaseline-1); 2) between HRV1 and HRV2 (HRV1-2); and 3) for the entire experimental time period between the baseline and HRV2 (HRVbaseline-2). For example, the percentage difference of summarized HRV measures for HRVbaseline-1 was calculated as Equation 1:

$$((HRV1 - HRVbaseline) / HRVbaseline) * 100 \quad (1)$$

The same calculation logic and equations apply to the LF/HF measures. Correlation analysis was then employed to determine if there was a relationship between any of the above

three HRV measures and autotelic experience, and if there was a relationship between and of the similar three LF/HF measures and autotelic experience.

Systolic blood pressure was measured at three points in time: before the experiment commenced (BPbaseline), at the end of round one (BP1), and at the end of round two (BP2). Percentage differences were calculated between BPbaseline and BP1, between BP1 and BP2, and between BPbaseline and BP2. The calculation equation is similar to Equation 1 above. Correlation analysis was then employed to determine if there was a relationship between any of the above three BP measures and autotelic experience.

Productivity was defined as either 1) the percentage difference in the number of correct scores from round 1 to round 2, if the participant required the entire ten minutes to complete each round (termed score-difference productivity), or 2) the percentage difference in the elapsed time from round 1 to round 2, if the participant had correctly answered all 130 sums in less than ten minutes over both rounds (termed time-difference productivity). The score-difference productivity and the time-difference productivity calculations are shown in Equations 2 and 3, respectively:

((correct score round 2 – correct score round 1) / correct score round 1) * 100 (2)

((time to complete round 2 – time to complete round 1) / time to complete round 1) * 100 (3)

Results

Propensity to Experience Versus Actual Experience of Flow

To determine if the tendency to experience flow was related to the actual experience of flow during the experiment, each participant's response to the Swedish Flow Proneness Questionnaire (Ullén et al., 2012) was compared to his/her response to the average of the autotelic experience response items of the Flow State Scale questionnaire (Jackson and Marsh, 1996). Through correlation analysis, it was determined there was no significant relationship between the two variables ($r = 0.103$, $p = 0.576$). Therefore, there was no need to control for flow proneness in the experiment.

Non-Task Work System Factors' Influence on Flow

The analysis for hypothesis 1 was performed in three stages. In stage 1, regression and ANOVA were performed on the predictive power of the Flow State Scale's responses to the items for challenge/skill balance, merging of action and awareness, clear goals, clear feedback, complete concentration, sense of control, no self-consciousness, and sense of time transformation (first eight flow dimensions) on the dependent variable autotelic experience. In stage 2, regression and ANOVA were performed to determine the predictive power, individually and interactively, of the experimental model's five non-task work system factors on autotelic experience. Stage 3 combined the findings of the first two stages to determine if the significant flow dimensions of stage 1 and the significant non-task work system factors of stage 2 were predictive of autotelic experience, either alone or interactively; in addition, a moderator analysis was performed on the significant non-task work system factors to assess if they were first-order predictors of flow or if they were moderators of the significant flow dimension predictors of flow.

The present study's researchers offer this rationale for the three-stage analytical approach: The designed experiment's purpose is to determine the impact of manipulating independent variables' settings on some outcome of interest. Because the study participants' responses to the Flow State Scale dimensional items were of course not manipulated by the researchers, they certainly could not be included in the analysis of the designed experiment and were, therefore, analyzed separately from the non-task work system factors for their influence on autotelic experience (stage 1). The non-task work system variables were manipulated (via so-called low and high settings) and their impact on the participants' stated autotelic experience could be and was analyzed (stage 2). Finally, because all of the participants' stated Flow State Scale responses were possibly influenced by the settings of the non-task work system factors (which is the model illustrated in Figure 1), the significant independent variables from stage 1 and from stage 2 were combined in the stage 3 analysis to determine if those factors acted independently (that is, first-order factors) or interacted with each other (that is, the significant non-task work system factors were acting as moderators between the significant flow dimension variables and autotelic experience). This moderator analysis methodology is recommended by Frazier and colleagues (2004).

Participants' Flow State Scale responses for the first eight flow dimensions were regressed against the participants' responses to the autotelic experience item. Table 13 summarizes the results.

Table 13. Descriptive statistics of all predictive flow dimension factors on autotelic experience in the full regression model.

Term	B	Mean (SD)	T-Value	F-Value	P-Value
Challenge/Skill	0.961	4.16 (0.72)	3.64	13.23	0.001
Action/ Awareness	-0.002	3.78 (0.82)	-0.01	<0.01	0.994
Clear Goals	-0.032	4.63 (0.54)	-0.08	0.01	0.937
Clear Feedback	-0.209	4.25 (0.87)	-0.90	0.81	0.377
Concentration	0.205	4.05 (0.88)	0.76	0.58	0.455
Control	0.322	4.38 (0.82)	0.82	0.68	0.418
No Self-Consciousness	-0.169	3.68 (1.06)	-1.07	1.15	0.295
Time Transformation	0.209	2.73 (0.91)	1.19	1.42	0.246

Only challenge/skill balance was a significantly predictive factor at the alpha = 0.05 level. The adjusted r-squared value of the model using all of the above factors was 43.07%. Removing all of the non-significant factors left only the challenge/skill balance variable in the regression model with $t = 5.08$, $F = 25.80$, $p < 0.001$, and partial $\eta^2 = 0.46$. The resulting model's single-factor r-squared value improved slightly to 46.24%.

Next, the five non-task work system factors were regressed against the participants' responses to the autotelic experience item, controlling for challenge/skill balance response (as a covariate). These factors were analyzed singly and as two-factor interactions. Three- and four-factor interactions were not analyzed because they were aliased (confounded) with the one- and two-factor effects. Table 14 summarizes the results.

Table 14. Descriptive statistics of all non-task work system factors on autotelic experience in the full regression model.

Term	B (coded)	T-Value	F-Value	P-Value
InstrucDetail	-0.068	-0.40	0.16	0.692
BkgrndNoise	-0.079	-0.50	0.25	0.623
Lighting	0.049	0.30	0.09	0.767
SeatComfort	0.126	0.80	0.64	0.437
ScreenContrast	-0.110	-0.69	0.47	0.503
InstrucDetail*BkgrndNoise	0.072	0.43	0.18	0.674
InstrucDetail*Lighting	-0.124	-0.77	0.59	0.453
InstrucDetail*SeatComfort	0.095	0.59	0.35	0.565
InstrucDetail*ScreenContrast	0.004	0.02	0.00	0.984
BkgrndNoise*Lighting	0.115	0.74	0.55	0.468
BkgrndNoise*SeatComfort	-0.173	-1.07	1.15	0.300
BkgrndNoise*ScreenContrast	-0.001	-0.01	0.00	0.995
Lighting*SeatComfort	0.117	0.75	0.57	0.463
Lighting*ScreenContrast	0.019	0.12	0.01	0.910
SeatComfort*ScreenContrast	-0.281	-1.76	3.11	0.098

Through backward stepwise regression, it was determined only the interaction of seat comfort and screen contrast was significant at the alpha = 0.05 level. Rerunning the model with only this interaction factor resulted in $t = -2.11$, $F = 4.43$, $p = 0.045$, and partial $\eta^2 = 0.14$. The adjusted r-squared value of the model was 39.22%.

Figure 21 depicts the interactional impact of seat comfort and screen contrast on autotelic experience. For the present study, the highest average self-reported autotelic experience occurred when the participants were subjected to the experimental condition of ergonomic seating and low screen contrast.

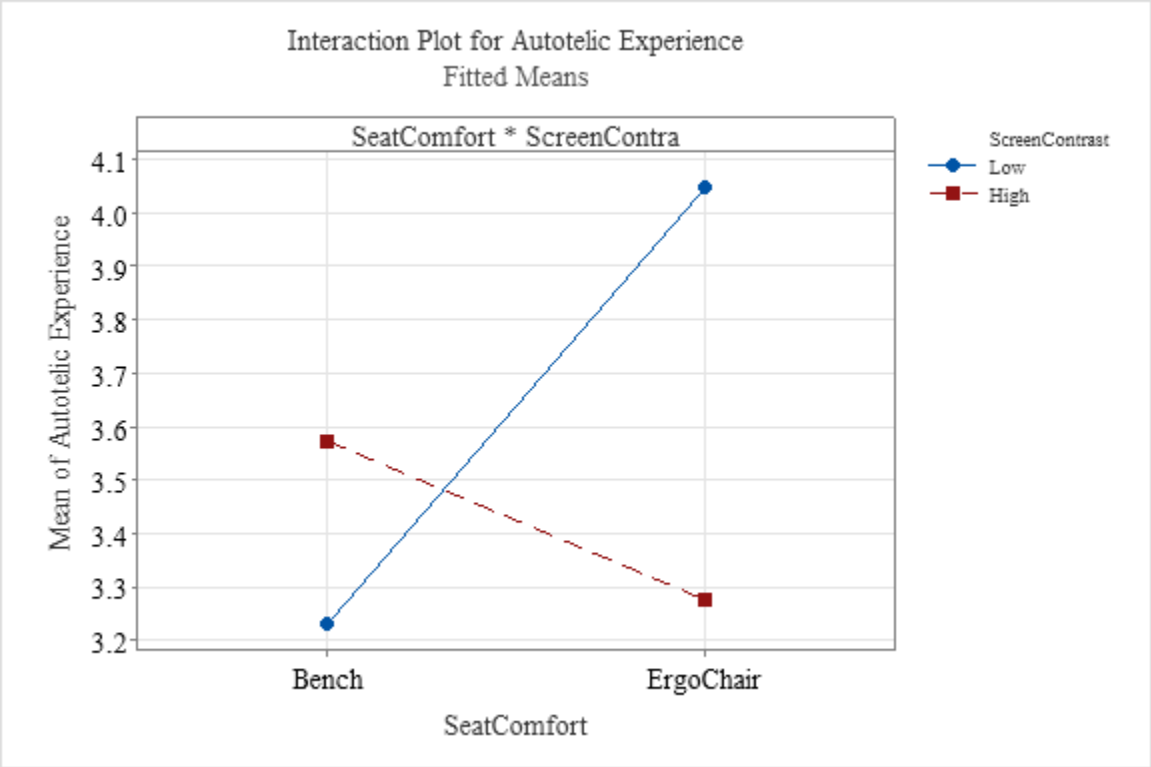

Figure 21. Impact of the interaction of seat comfort and screen contrast on autotelic experience.

Finally, the investigators combined the results of stages 1 and 2 to determine if the significant independent variables challenge/skill balance and seat comfort*screen contrast acted together as significant predictors of autotelic experience, with seat comfort*screen contrast as the moderating variable between challenge/skill balance and autotelic experience. The experimental model was rerun using the factors challenge/skill balance, seat comfort, and screen contrast

singly and as interactions (singly to preserve hierarchy in the model when using interaction factors). Results are shown in table 15.

Table 15. Moderator analysis of challenge/skill balance and seat comfort*screen contrast on autotelic experience.

Term	B (coded)	T-Value	F-Value	P-Value
Challenge/skill	1.271	4.34	18.86	<0.001
SeatComfort	2.59	1.33	1.76	0.197
ScreenContrast	-0.010	0.00	0.00	0.998
Challenge/Skill*SeatComfort	-0.438	0.364	0.86	0.364
Challenge/Skill*ScreenContrast	0.083	0.881	0.02	0.881
SeatComfort *ScreenContrast	1.19	0.738	0.11	0.738
Challenge/Skill*(SeatComfort*ScreenContrast)	-0.499	0.550	0.37	0.550

Results of the moderator analysis indicate that the potential moderator of interest – the seat comfort*screen contrast interaction – is not significant at the alpha = 0.05 level, and therefore is not a moderator but rather a direct influencer of autotelic experience. That is, challenge/skill balance is an independent variable and the interaction of seat comfort and screen contrast can be considered a combined independent variable; both independent variables significantly create conditions that support the experience of flow. In the case of the interaction variable, the highest reported autotelic experience was found in the present study when self-reported challenge/skill balance was high and the ergonomic chair was used in combination with low screen contrast. Support for hypothesis 1 is warranted.

Heart Rate Variation and Flow

Correlation analyses were conducted between HRVbaseline-1 and autotelic experience, between HRV1-2 and autotelic experience, and between HRVbaseline-2 and autotelic experience. Only the correlation between HRVbaseline-1 and autotelic experience was significant at the alpha = 0.05 level, with p = 0.047. Figure 22 depicts this relationship.

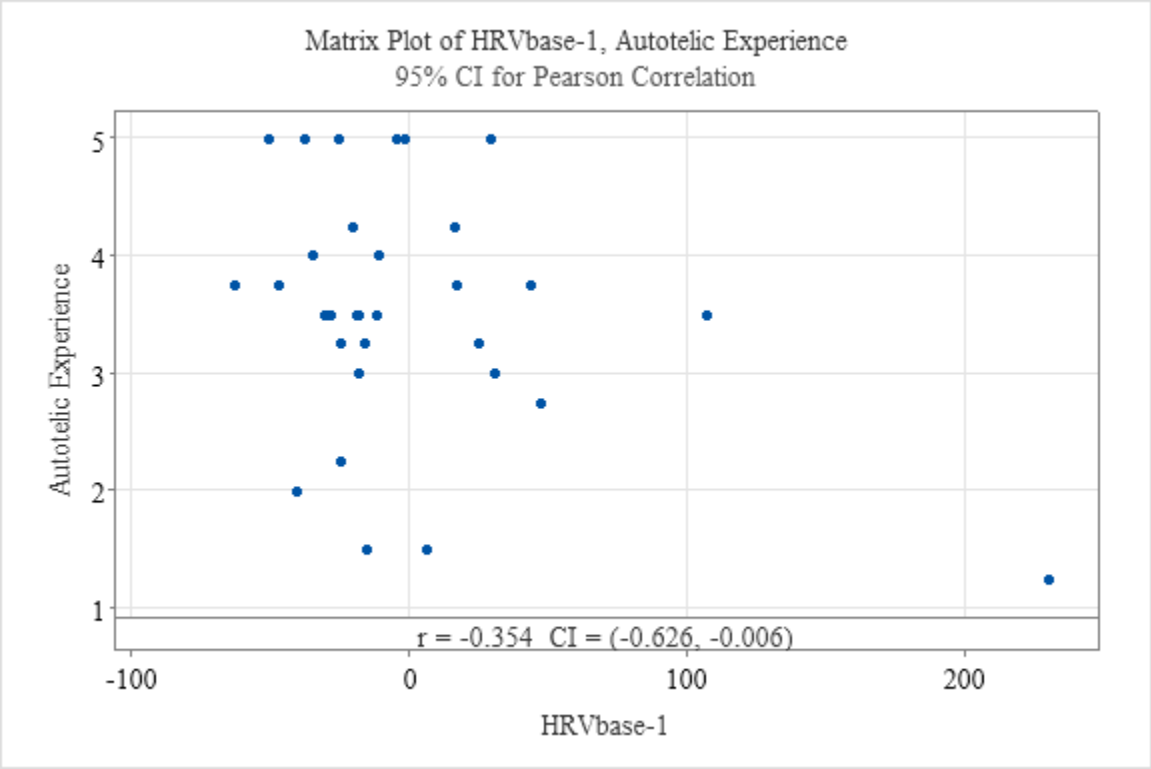

Figure 22. Correlation plot and summary statistics (r: Pearson's r; CI: 95% confidence interval for r) for the relationship between HRVbaseline-1 and Autotelic Experience.

For the time period between the baseline of the experiment (first minute) and the final five minutes of round 1, HRV declined as autotelic experience increased. For this time interval, hypothesis 2 is supported.

Systolic Blood Pressure and Flow

Similar to the HRV correlation analysis presented above, systolic blood pressure (BP) was analyzed for a relationship to autotelic experience over three timeframes: percentage change in BP between the baseline and the end of round 1 (BPbaseline-1); percentage change in BP between the end of round 1 and the end of round 2 (BP1-2); and percentage change in BP between the baseline and the end of round 2 (BPbaseline-2). No significant relationship was found between any of these three BP measures and autotelic experience at the alpha = 0.05 level; therefore, hypothesis 3 is not supported. However, it should be pointed out that there existed a marginal relationship between BP1-2 and autotelic experience ($r = -0.257$, $p = 0.156$).

Low-Frequency HRV/High-Frequency HRV and Flow

Recall that low-frequency HRV has been associated with the engagement of the sympathetic nervous system, which in turn has been associated with arousal (di Fronso et al., 2017; Gaggioli et al., 2013). Flow is considered an aroused state. The present study's authors hypothesized that there is a relationship between higher ratios of LF/HF as reported autotelic experience increases. As was performed in the HRV analyses, correlation analyses were conducted between LF/HFbaseline-1 and autotelic experience, between LF/HF1-2 and autotelic experience, and between LF/HFbaseline-2 and autotelic experience. No significant relationship was found between any of these three LF/HF measures and autotelic experience at the alpha = 0.05 level; therefore, hypothesis 4 is not supported.

Productivity and Flow

Following the example of Demerouti (2006), flow is predicted to influence productivity. Similar to the predictor/moderator analysis performed above between the flow dimensions, the

non-task work system factors, and flow (section 3.2), a three-stage approach was undertaken to determine if a predictor/moderator relationship existed between the flow dimensions, the non-task work system factors, and productivity. In stage 1, a regression analysis was performed to determine to what extent any, all, or some of the nine flow dimensions predicted productivity in the present study. The full set of regression statistics is presented in Table 16.

Table 16. Descriptive statistics of all nine flow dimension factors' impact on productivity in the full regression model.

Term	B	Mean (SD)	T-Value	F-Value	P-Value
Challenge/Skill	-7.48	4.16 (0.72)	-2.28	5.19	0.033
Action/ Awareness	-2.42	3.78 (0.82)	-0.99	0.98	0.332
Clear Goals	5.91	4.63 (0.54)	1.47	2.17	0.155
Clear Feedback	-1.03	4.25 (0.87)	-0.44	0.19	0.665
Concentration	-5.82	4.05 (0.88)	-2.15	4.64	0.042
Control	6.03	4.38 (0.82)	1.54	2.37	0.138
No Self-Consciousness	3.44	3.68 (1.06)	2.15	4.63	0.043
Time Transformation	2.78	2.73 (0.91)	1.55	2.41	0.135
Autotelic Experience	2.26	3.53 (1.04)	1.09	1.20	0.286

It was determined no significant predictive relationship existed in the present study between productivity and autotelic experience, the paradigm proxy for flow. However, through backward stepwise regression it was determined a significant relationship existed between productivity and the "no self-consciousness" dimension of flow ($t = 2.18$, $F = 4.77$, $p = 0.037$, and partial $\eta^2 = 0.14$). (Although the initial model shown in Table 6 indicated a significant relationship between challenge/skill balance and productivity and between concentration and

productivity, subsequent reductions of the model resulted in these factors becoming non-significant.) The "no self-consciousness" dimension has been identified in previous research as a consequence of flow, as has been autotelic experience.

In the next stage of the analysis, non-task work system factors were examined for their ability to predict productivity, controlling for the "no self-consciousness" factor (as a covariate) found to be significant in stage 1. The results of the initial regression analysis are shown in Table 17.

Table 17. Descriptive statistics of all non-task work system factors on productivity in the full regression model.

Term	B (coded)	T-Value	F-Value	P-Value
InstrucDetail	-0.53	-0.43	0.18	0.674
BkgrndNoise	0.17	0.14	0.02	0.893
Lighting	-0.23	-0.18	0.03	0.863
SeatComfort	1.04	0.74	0.55	0.471
ScreenContrast	0.03	0.02	0.00	0.981
InstrucDetail*BkgrndNoise	-0.55	-0.44	0.20	0.664
InstrucDetail*Lighting	-0.59	-0.48	0.23	0.641
InstrucDetail*SeatComfort	-2.25	-1.80	3.25	0.091
InstrucDetail*ScreenContrast	0.44	0.35	0.13	0.728
BkgrndNoise*Lighting	0.31	0.25	0.06	0.806
BkgrndNoise*SeatComfort	-0.74	-0.58	0.33	0.573
BkgrndNoise*ScreenContrast	1.48	1.19	1.41	0.253

Lighting*SeatComfort	2.42	1.89	3.56	0.079
Lighting*ScreenContrast	-2.39	-1.75	3.06	0.101
SeatComfort*ScreenContrast	-4.05	-3.27	10.69	0.005

Through backward stepwise regression, it was again determined that only the interaction of seat comfort and screen contrast was a significant predictor of productivity at the alpha = 0.05 level. Rerunning the model with only this interaction factor resulted in $t = -3.25$, $F = 10.54$, $p = 0.003$, and partial $\eta^2 = 0.28$. The adjusted r-squared value of the model was 31.09%.

Figure 23 depicts the interactional impact of seat comfort and screen contrast on productivity. For the present study, the highest productivity (13.14% improvement between round 1 and round 2) occurred when the participants were subjected to the experimental condition of ergonomic seating and low screen contrast.

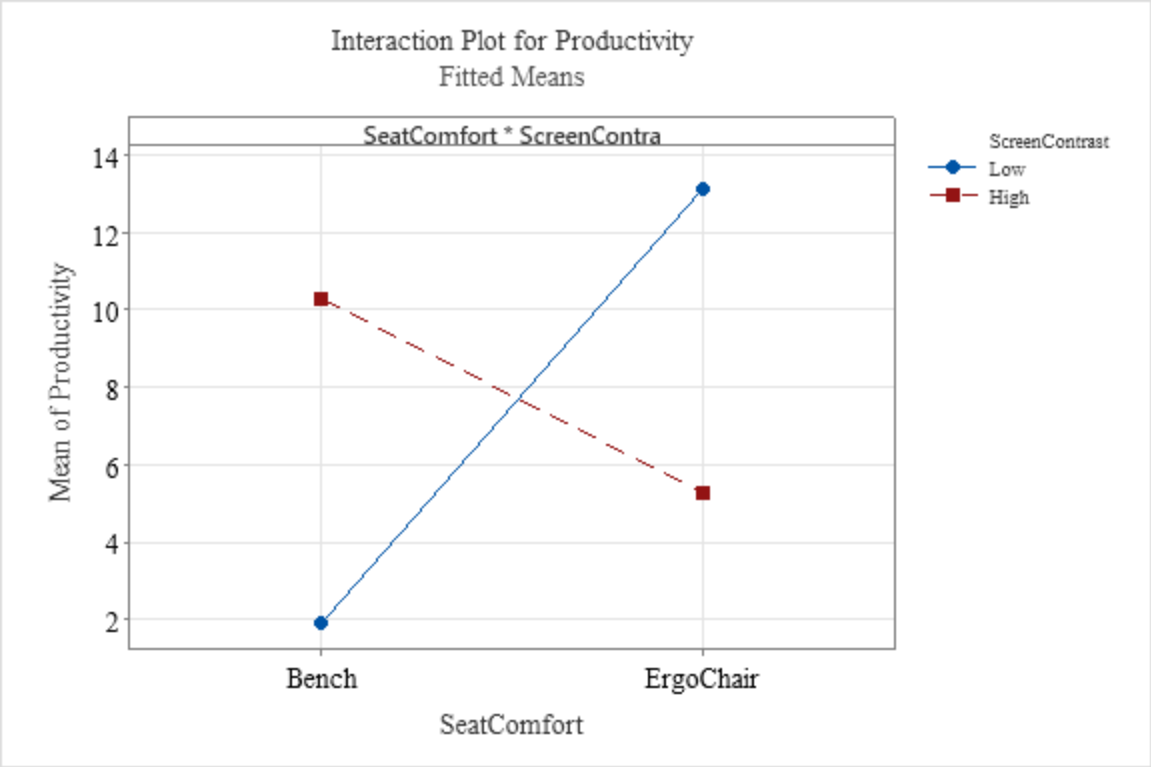

Figure 23. Impact of the interaction of seat comfort and screen contrast on productivity.

The third stage of this analysis was to determine if the interaction term seat comfort * screen contrast was a moderator between "no self-consciousness" and productivity. The results of stages 1 and 2 were combined to determine if the significant independent variables "no self-consciousness" and seat comfort*screen contrast acted together as significant predictors of productivity. The experimental model was rerun using the factors "no self-consciousness," seat comfort, and screen contrast singly and as interactions (singly to preserve hierarchy in the model when using interaction factors). Results are shown in table 18.

Table 18. Moderator analysis of "no self-consciousness" and seat comfort*screen contrast on productivity.

Term	B (coded)	T-Value	F-Value	P-Value
No Self-Consciousness	3.00	1.01	1.01	0.324
SeatComfort	3.10	0.19	0.04	0.848
ScreenContrast	10.60	0.52	0.27	0.610
No Self-Consciousness*SeatComfort	2.29	0.57	0.32	0.576
No Self-Consciousness*ScreenContrast	-0.58	-0.12	0.01	0.907
SeatComfort*ScreenContrast	-11.70	-0.49	0.24	0.626
No Self-Consciousness*(SeatComfort*ScreenContrast)	-1.45	-0.24	0.06	0.813

Results of the moderator analysis indicate that the potential moderator of interest – the seat comfort*screen contrast interaction – is not significant at the alpha = 0.05 level, and therefore is not a moderator but rather a significant independent variable influencing productivity. That is, "no self-consciousness" is an independent variable and the interaction of seat comfort and screen contrast can be considered a combined independent variable; both independent variables significantly create conditions that improve productivity. In the case of the interaction variable, the highest reported productivity was found in the present study when self-reported lack of self-consciousness was high and the ergonomic chair was used in combination with low screen contrast. Based on the results of this analysis, partial support for hypothesis 5 is asserted, with "no self-consciousness" as the proxy for flow rather than autotelic experience.

Discussion

To summarize the present research, the investigators sought to answer three questions. First, could certain non-task work system variables, combined with one or more predictive flow dimensions, have an effect on subjects' experience of flow while performing a set of transactional tasks (hypothesis 1)? Second, could certain physiological measures be identified to determine if they correlated with flow (hypotheses 2, 3, and 4)? Third, could the organizational-leadership question be answered of whether flow led to more quantity produced or at a faster pace (hypothesis 5)? Using ANOVA, regression, ANCOVA, and correlational analysis, the research team found that challenge/skill balance and the interaction of seat comfort and screen contrast positively influenced participants' flow experience (hypothesis 1); during round 1 of the math exercise, HRV declined as autotelic experience increased (hypothesis 2); and the "no self-consciousness" consequential component of flow, combined with the interaction of seat comfort and screen contrast, positively influenced productivity (hypothesis 5). There was no significant correlation found between systolic BP and flow (hypothesis 3) nor between LF/HF and flow (hypothesis 4). These results are now discussed in more detail.

Hypothesis 1 was verified. Not surprising was the link between challenge/skill balance and autotelic experience. Previous research (see Table 1) considers the challenge of the task being just above the skill of the performer as the most critical antecedent leading to flow. The present study's experiment was structured so the challenge was found in the round-1-to-round-2 competition with the self, either improving on the quantity of sums answered correctly or on the time required to answer all sums correctly; round 1 quantity or time scores were communicated to the participants at the end of that round, and this information became the target for round 2. Since the experiment was novel to all participants, they could not know with certainty if they

could improve on their scores and so a challenge was created. In addition to the skill/challenge link to autotelic experience was the interaction of seat comfort and screen contrast, where the combination of the ergonomic chair and low screen contrast boosted participant's flow experience. Seat comfort has been previously found to predict flow in a proof-of-concept study performed by Clapp and colleagues (2021), where participants completing a computer-based task while seated in an ergonomic chair experienced higher self-reported flow than those seated at a non-adjustable bench. Low screen contrast – where the computer screen's foreground text color is less than the 4.5:1 recommended contrast to the background screen color (Web Accessibility Initiative, 2019) – seems counterintuitive as a positive predictor of flow.

A possible explanation for low screen contrast contributing to flow in the present experiment may originate in the task's on-screen layout; blank spacing was included between lines of the instructions, and between each of the summation task items horizontally and vertically. Combined with a low-contrast dark grey/light grey color combination, the overall layout of the on-screen task may have been more flow inducing than a high-contrast black-on-white color combination. Other researchers have found that low-contrast computer screen content may be a preferred user experience in some cases (Colley et al., 2021). And Anshel (2007) cited the recommendation of the Illuminating Engineering Society of North America that the task area (the computer screen, in the present case) should be no more than three times as bright as the immediately adjacent area and ten times brighter than the remainder of the workspace; the low-contrast screen setting may have met this recommendation, while the high-contrast screen setting may have violated this recommendation. Further, the interaction plot in Figure 5 shows it is possible that the high-contrast screen layout may have been too bright for the

participants and negatively impacted their flow experience. It should be noted, however, that four of the 16 participants subject to the low-contrast setting offered unsolicited comments about having difficulty reading the information contained on-screen (average age 68.5 years, SD = 1.73 years), although their average self-reported autotelic experience was 3.44 (SD = 1.23) versus an average of 3.53 for the entire sample set (SD = 1.04). The present study's researchers recommend that computer screen contrast should be a user-customizable variable in the workplace ("dark mode" is one such setting) so that individuals can create a contrast to their visual liking (as an example, see Hemphälä and Eklund, 2012).

Correlations between the selected physiological measures and flow were partially confirmed. HRV was negatively correlated to autotelic experience (hypothesis 2), but only during the first round of the experiment. There was no significant negative correlation between systolic BP and flow (hypothesis 3) nor a positive correlation between LF/HF and flow (hypothesis 4). One potential explanation for the partial or no correlations may be that the challenge of improving participants' quantity or time scores may not have been sufficient to trigger the sympathetic and parasympathetic nervous systems to modify HRV, systolic BP, and the LF/HF HRV ratio; however, the challenge, seat comfort, and lighting level were sufficient to create an enjoyable, immersive experience to a degree where participants responded in the affirmative to the Flow State Scale items. Another possible explanation may be due to the small sample size in the present study (N = 32). This sample size was selected to satisfy the requirements of a screening experiment (a study where a subset of significant independent variables is identified from a larger set of possible independent variables, after which more strenuous testing of the subset is required to validate the findings) and because of the limited

time available to use the laboratory space in the community facility. The present study's sample size of 32 participants may have been too small to adequately discern physiological correlation signals from the noise of natural variation. By contrast, Shaffer and Ginsberg (2017) identified three studies by other researchers with participants sizes ranging from 145 to over 21,000, and the Steptoe and Wardle study (2005) engaged 216 participants. Another possible explanation for the non-significant correlations may be because participants in the present research were not explicitly screened for medications that could raise or lower heart rate or BP (although they were screened for heart-related issues currently being medically treated) which, if being taken at or near the time of the experiment, could certainly skew the results by keeping heart rate or BP relatively constant throughout the trial.

It was shown that a significant predictive relationship exists between productivity and flow (the "no self-consciousness" consequential component), when the seat type was the ergonomic chair and the screen contrast level was low (hypothesis 5). It can be theorized that "no self-consciousness," rather than autotelic experience, predicts productivity using the following proposal: if, as Csikszentmihalyi elaborates (1990, pp. 62-66; 2003, pp. 55-56), engaging in an activity is challenging enough, there is no cognitive room to think about the self's presentation to others, but instead only the activity's next steps in relation to its goal. Then, if the individual is only cognizant of the task at hand and nothing (and no one) else, the mind has the capacity for absorbed concentration and action seems to happen without thought. And so, if the individual has no concern over others' perception of how the self is executing the task, and concentration is high, and action occurs seemingly immediately upon receiving a stimulus signal, then it certainly follows that productivity would increase. In fact, correlations were significant

between “no self-consciousness” and concentration ($r = 0.472$, $p = 0.006$) and between “no self-consciousness” and action/awareness merging ($r = 0.396$, $p = 0.025$).

In the previous study on seat comfort’s positive influence on flow (Clapp et al., 2021), the same two seating options were utilized as in the present study. In that earlier study, participants stated the ergonomic chair was notably more comfortable than the non-adjustable bench, and self-reported flow was higher for those participants who were seated in the ergonomic chair. While participants in the present experiment were not asked to rate the comfort of their randomly assigned seat, it can be confidently argued that, as was the case in the previous study, the ergonomic chair’s higher comfort contributed to a stronger feeling of flow. As the present study’s analysis demonstrates, flow plus seat comfort, under the condition of low screen contrast, additively increased productivity. By contrast, Gadge and Innes (2007) noted a negative relationship between seat discomfort and productivity.

Low screen contrast, in conjunction with seating using the ergonomic chair, was also a significant contributing factor to increased productivity. The rationale documented in the discussion above on why low screen contrast predicts flow can and should be used in the discussion on productivity: the task’s on-screen layout – use of blank space and a comforting dark grey/light grey color combination – and the sufficient contrast between the screen workspace and surrounding environment promoted higher productivity than a bright, black-on-white contrast did (which may have been too bright for comfort and performance). In summary, given the strong predictive link of flow on productivity in the present study, it should not be surprising that the same non-task work system factors of seat comfort and screen contrast should also be significant predictors of productivity, as they were with predicting flow.

Limitations and Directions for Future Research

The present study, rigorous in its development and execution, sheds new light on factors other than the task that predict flow. However, future researchers seeking to build on the results found here may want to keep the following limitations and recommendations in mind. As stated previously, this study was purposefully constructed as a screening experiment to identify potentially significant non-task predictive factors of flow and productivity. Therefore, the sample size of 32 (with two replicates for each of the 16 experimental combinations) is likely too small to support generalization of results. Future studies should examine with larger participant samples at least the significant factors identified in the present study to more confidently draw generalizable conclusions.

Another limitation may be that because the recruitment population was the general public and not the transactional workforce, results of the present study may not be generalizable to this target population. Even though some of the participants expressed a feeling of fun and joy in the mental math exercise, they may not be inclined to select transactional work such as payroll entry (the setting for the present experiment) as their career. Rather, the novelty of the experiment and of the change of work activity in which they usually partake may have had a hidden impact on flow and productivity. Future research in transactional flow should recruit from the affected population in order to reduce the novelty aspect.

More thorough medical screening should have been addressed. Two of the non-task work system factors, screen contrast and room lighting, were vision related. Additional screening of the volunteers may have been necessary to eliminate those with vision problems, such as chronic eye dryness, glaucoma, and macular degeneration. And, because cardiac

measurements were being taken and assessed for their relationship to flow, screening to eliminate individuals currently taking medications that could modify or regulate HRV or BP should have been employed.

The present study's lead investigator was in the laboratory with each participant during the experiment. It was observed that there existed different levels of participant proficiency in using Microsoft Excel. Because challenge/skill balance is such a critical predictor of flow, and because Excel was the medium in which the experimental activity was performed, the self-rated Flow State Scale items for challenge/skill balance may have been influenced by the ease or difficulty in using this computer application. Future research employing Excel – or any type of technology, for that matter – should employ some type of proficiency rating system for that tool to control for differences in proficiency.

The improve-score and improve-time challenges were devised by the researchers. Participants may perceive more meaning-making if they could choose for themselves their challenge, which may lead them to experience more intense levels of flow. Such personal challenge creation was expressed in the phenomenological study of flow in transactional workers conducted by Clapp and colleagues (2023), which was a cornerstone of those subjects' ability to immerse themselves in their work.

Although Web Accessibility Initiative success criteria recommend at least a 4.5:1 foreground-to-background color contrast ratio so content can be easily read, participants in the present study experienced higher self-reported flow and had higher productivity scores with the low-contrast 3.0:1 computer screen setting. Future research into flow and productivity conditions at work should address optimal computer screen contrast settings in relation to the

brightness of the immediately adjacent area and the remainder of the workspace, as suggested by Anshel (2007).

A covariate in the present study that was not documented but may have an impact on creating conditions for flow is the weather. Sunny conditions, soft rain, and thunder and lightning, for example, may each influence certain moods in individuals which, in turn may relate to flow state level (see Tyagi et al., 2016, for an example). Although weather, of course, is not a non-task work system factor modifiable by humans (at least not yet!), future controlled studies attempting to link non-task work system factors to flow should measure this lurking variable to account for any influence it may have on results.

Summary

Building on previous research, this study attempted to quantify the predictive relationship of certain non-task work system factors on flow and productivity, and the correlation between certain physiological measures and flow. Through a laboratory experiment, it was empirically demonstrated that challenge/skill balance and the interaction of seat comfort and screen contrast significantly predicted flow, with the ergonomically adjustable chair and a 3:1 foreground-to-background contrast ratio being the optimal settings for this particular study. A more comfortable seating arrangement; a task layout with sufficient blank space between important content to reduce eye strain; and an optimal contrast ratio between the workspace, adjacent space, and surrounding environment was theorized to be the reasons these work system factors were significant.

The loss of self-consciousness, a consequence of flow, was shown to be a significant predictor of productivity. In addition, the same non-task work system factors of ergonomically-driven seat comfort and low screen contrast were significant drivers of productivity in the present experiment. It was surmised that the rationale for why these factors were significant predictors of flow would be the same rationale for their ability to predict productivity.

To attempt to add a quantitative dimension to the experience of flow, certain physiological measures were collected and analyzed for a correlation to the self-reported, qualitative flow measures. Only HRV correlated with autotelic experience, and then only for the period between the start and end of the first round of the simple math exercise; there was no relationship between flow and HRV during the second round of the exercise. Other research has found significant links between HRV and flow, between systolic BP and flow, and between the LF/HF ratio and flow. Possible reasons for the lack of strong correlations in the present study may be attributed to the simple math exercise not providing enough of a challenge to trigger physiological changes; to a small sample of participants providing an insufficient signal-to-noise ratio; and/or to a lack of participant screening for cardiac function-modifying medications.

Organizations with transactional workers can benefit from this study. Leaders in these firms should design their non-task work components such as those addressed in the present research with some customizability in mind in order to promote flow in their workers, which in turn will improve output performance. As this experiment demonstrated, when participants experienced flow during the present experiment, seat comfort and computer screen contrast combined to promote a 13.14% increase in productivity.

Organizations with transactional workers can benefit from this study. Leaders in these firms should design their non-task work components such as those addressed in the present research with some customizability in mind in order to promote flow in their workers, which in turn will improve output performance. As this experiment demonstrated, when participants experienced flow during the present experiment, seat comfort and computer screen contrast combined to promote a 13.14% increase in productivity.

Conflict of Interest

The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

Author Contributions

SRC, WK, and PAF contributed to conception and design of the study. SRC conducted the study and prepared the first draft of the manuscript. All authors contributed to manuscript revision, read, and approved the submitted version.

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CHAPTER 5: GENERAL DISCUSSION

Summary of the Research Methodology

The set of studies documented within this paper attempted to answer the previously noted research questions:

Which selected non-task work system factors will significantly contribute to achieving psychological flow while performing transactional work? An initial phenomenological study qualitatively provided confirmation that the categories of non-task work system factors including technology, people (specifically, co-workers collocated with the participants), task communications, and surrounding physical environment all had an influence on the participants' ability to experience flow at work. I used these elements to then inform two controlled laboratory experiments with non-task work system factors manipulated to determine their quantitative significance on achieving flow. In the first laboratory experiment, seat comfort and concentration were each significant independent variables predicting flow, as measured via the flow consequence autotelic experience. In the second laboratory experiment, it was empirically demonstrated that challenge/skill balance and the interaction of seat comfort and screen contrast significantly predicted flow, with the ergonomically adjustable chair and a 3:1 foreground-to-background contrast ratio being the optimal settings for this particular study. A more comfortable seating arrangement; a task layout with sufficient blank space between important content to reduce eye strain; and an optimal contrast ratio between the workspace, adjacent space, and surrounding environment was theorized to be the reasons these work system factors were significant.

Does experiencing flow lead to higher productivity? In the second laboratory experiment, the loss of self-consciousness, a consequence of flow, was shown to be a significant predictor of productivity. In addition, the same non-task work system factors of ergonomically-driven seat comfort and low screen contrast were significant drivers of productivity in the present experiment. It was surmised that the rationale for why these factors were significant predictors of flow would be the same rationale for their ability to predict productivity.

Which selected physiological measures are correlates to flow? To attempt to add a quantitative dimension to the experience of flow, certain physiological measures were collected and analyzed for a correlation to the self-reported, qualitative flow measures. Only HRV correlated with autotelic experience, and then only for the period between the start and end of the first round of the simple math exercise; there was no relationship between flow and HRV during the second round of the exercise. Other research has found significant links between HRV and flow, between systolic BP and flow, and between the LF/HF ratio and flow. Possible reasons for the lack of strong correlations in the present study may be attributed to the simple math exercise not providing enough of a challenge to trigger physiological changes; to a small sample of participants providing an insufficient signal-to-noise ratio; and/or to a lack of participant screening for cardiac function-modifying medications.

My studies contributed to the body of knowledge regarding flow at work in three ways. First, transactional work had not been extensively researched to the same degree as more creative, agentic activities had been to date; such rote, repetitive, less creative work was the focus of all of my studies and supports the theory that actors can achieve flow across a spectrum of activities, albeit via different paths (exciting flow via an indirect path versus relaxing flow via

a smooth path) and for different reasons (enjoyment of negotiating the journey versus enjoyment of completing the journey).

Secondly, extant studies on flow revolved around the activity – such as work, chores, sports, hobbies – as the anchoring variable in examining how, why, and the extent to which flow occurs. My studies added the novel dimension of non-task work system factors to create a larger and more holistic discussion of the causes of flow.

Thirdly, my research incorporated qualitative and quantitative methods to more thoroughly attempt to answer the research questions. This triangulation approach was used to more robustly link flow, productivity, and physiological methods than if any one method had instead been used. To the best of my knowledge, such a mixed-methods approach to understanding how to create flow at work has not occurred to date.

At the time of this writing, two of my four manuscripts can be found in peer-reviewed publications, one has been recommended for publication in a peer-reviewed journal by the two reviewers assigned to comment on my manuscript, and one is still awaiting reviewer feedback. The first article, "Design for flow: A work system approach," was published in the 2018 IIE Annual Conference Proceedings. The manuscript won a best paper award at the conference. It has been citied once.

The second article, "The seat of happiness? The effect of seat comfort on the achievement of psychological flow during transactional work," was published in 2021 in the Journal of Applied Ergonomics. This publication has 2022-2023 impact factor of 3.94. The article has been cited five times.

The third article, “Simplicity and predictability: A phenomenological study of psychological flow in transactional workers,” is in press at the time of this writing. It has been accepted for publication by the journal Frontiers in Psychology. This journal has a 2021 impact factor of 4.23.

As will be detailed in the next section below, my research methodology permitted findings that are of a practical contribution to the study of flow at work. For all types of work, whether more creative in nature or less, identifying relevant non-task work system factors through observation and confirming interviews and then testing the impact of those factors in either a controlled laboratory setting or in a pilot study with a subset of employees will broaden organizations’ abilities to create flow conditions for their employees. Higher employee well-being, pro-social behavior, and productivity are results that should accrue.

Summary of the Research Findings

Flow in numerous previous studies has been linked to many benefits, including well-being (Csikszentmihalyi, 2003), organizational pro-social behavior (Organizational Behavior, 2017, p. 33), job engagement (De Fraga and Moneta, 2016; Saks, 2006), and productivity (Csikszentmihalyi, 2003; Demerouti, 2006; Stander, Mostert, and de Beer; 2014). All of this previous research was based on interviews with individuals who experienced flow and on self-reported responses to questionnaires. These individuals were engaged in hobbies, sports, and work that provided them wide breadth of creativity and control. To the best of my knowledge, my present studies are the first to exclusively focus on transactional work and those that perform it, to incorporate non-task work system factors into the flow-inducing discussion, and to employ laboratory experiments to quantitatively identify independent variables with significant impact

on creating flow. The studies documented in this dissertation support the theory of non-task work system factors. The interviewed transactional workers who have experienced flow confirmed that variables such as self-imposed challenges, like improving on their own completion rates, create fun at work and inspire flow; that technology must be seamlessly integrated with the work (that is, invisible) to support concentration and action/awareness merging; and that certain background noise can be distracting while other background noise (specifically, music) can aid in concentration. These lived experiences helped inform the two laboratory experiments detailed in this paper. Results showed seat comfort (plus the flow dimension concentration) significantly predicted flow in the single-factor controlled experiment, and the interaction of seat comfort and computer screen contrast (plus the flow dimension challenge/skill balance) also predicted flow in the multi-factor designed experiment. It should be noted that both of the experiments employed transactional activities as the experimental task and, even though none of the studies' subjects were transactional workers (save one), flow was significantly experienced in both studies. Based on these results and on the phenomenological study, I can conclude that those who perform transactional tasks can and do experience flow. Further, their dimensions of flow appear to mirror those who perform more creative, agentic work. In other words, flow is flow, no matter who experiences it.

The designed experiment also showed a causal link between flow and productivity, confirming the previously mentioned qualitative research's assertion of the relationship. For the present study, a loss of self-consciousness – a consequence of flow, as is autotelic experience – was a significant variable predicting productivity, along with the interaction of the non-task work system factors seat comfort and computer screen contrast. As a professional management

consultant, I must state that being able to link flow to productivity is a "holy grail" in the business world. Higher productivity equates to more efficient business process execution which should equate, *ceteris paribus*, to lower business costs. And, with flow being linked to personal and organizational behavioral benefits, flow-ing transactional workers could be expected to deliver more customer-pleasing outcomes.

Only one significant correlation was found in the present research between the selected physiological measures and flow: with heart rate variation and only during the first round of the designed experiment. There are many reasons why the present experiment was not able to more strongly link flow to systolic blood pressure, heart rate variation, and the low-frequency/high-frequency heart rate variation ratio. Mood, medications, and technology's measurement resolution insufficiency are three possible explanations. However, the hypothesis that flow can potentially be signaled through physiological measures invites a discussion about identifying flow while working. If protocols and technology advance so that physiological indicators can be more accurately measured using low-cost, inobtrusive devices such as the ones I employed, workers could self-monitor for flow and use this biofeedback to regulate cardiac function (for example, see Climov et al., 2014). Organizations could exploit flow-related physiological measures to create work breaks for employees so they return mentally and physically refreshed. Of course, personal privacy protection must be first addressed if organizations are to employ such monitoring, to ensure the data are only used for workers' benefit.

Earlier in this dissertation, a comparison was made between organizational engagement and job engagement. The results of my present studies indicate that flow can be supported by certain non-task work system factors, and flow is linked to higher job engagement.

Organizations who administer annual employee engagement surveys would do well to include items that address non-task work system factors in addition to items that gauge employee reactions to organizational competence. For example, Gartner, a well-known global management consultancy, has published "9 Questions That Should Be in Every Employee Engagement Survey" (Gartner, Inc., 2022). Seven of the nine recommended questions only relate to organizational engagement, asking about practices such as business decision making, communication, collaboration, and business structure. Two questions are job engagement-focused, asking about team performance. None of the items ask employees to rate the availability or quality of non-task work system items such as those discussed in my present research. On the other hand, in Stoneman's (2013) assessment of the globally ubiquitous Gallup Corporation's 12-item employee survey (the Gallup 12 or the Q12®), which was created after years of Gallup's research with hundreds of organizations about variables most important to employee productivity, I find that the second item is directly related to the non-task work system factors the present research has already shown to support flow: Do I have the materials and equipment I need to do my work right? I applaud the inclusion of such a foundational engagement question in such a venerable survey. I would include, in addition to this question, a means by which employees can also be queried on specific non-task work system factors needed to successfully support their role, such as lighting, noise, seat comfort, and the like.

Very little capital need be spent to customize non-task work system factors for transactional workers' benefit. For example, instructions can be prepared showing employees how to adjust their computer screen monitors for optimal contrast (it is a native setting for Windows and Apple devices). Criteria are already extant for digital-media color contrast (Web

Accessibility Initiative, 2019) and can be made mandatory in organizations. Offices with ergonomically adjustable seats only need to publish instructions on how to adjust them to individual's comfort. Seats that do not have built-in adjustable features can be equipped with lumbar bolsters for better spinal posture and with floor blocks so feet are resting flat. Overhead lighting can be dimmed, if too bright, by removing bulbs; giving those workers desktop lights with proper shades to eliminate computer screen glare can provide more lighting when needed.

Transactional work, low in creative possibilities itself, can be given a creative boost by showing individuals how to create their own personal challenges while they work, such as improving on their productivity scores or working to a musical beat or noticing patterns in the data they are entering. Encouraging these individuals to decorate their spaces and rearrange layouts – within organizational reason – provides a sense of agency over their personal environment.

Transactional, back-office workers can and do enjoy the optimal experience of flow. Firms can easily create conditions to promote flow for these individuals. Both workers and organizations benefit from deeper job engagement, improved well-being, and higher productivity. Turn on the flow!

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