FLOW IN KNOWLEDGE WORK:

HIGH PERFORMANCE EXPERIENCE IN THE DESIGN OF NATIONAL SECURITY TECHNOLOGY

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Abstract:

Flow—the merging of situation awareness with the automatic application of activity-relevant knowledge and skills—is introduced, clarified, and re-positioned as a way to understand the experience of high performance. The definition and model of flow are examined in interviews with engineers and tested in a sample of experiences from knowledge workers at Sandia National Laboratories. A re-defined and repositioned flow construct improves our understanding of performance in open-form, knowledge-intensive work because a phenomenological perspective provides us with a consistent way to judge performance when activities have unique and/or changing standards of effectiveness. New reasons for why people might structure their work practices in particular ways are also suggested.

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Organizational scholars focus much of their research on performance—perhaps more than on any other construct (Walsh, Weber, & Margolis, 2003). At the individual level, scholars conceive of performance as the quality with which a person completes an activity according to standard measurements (e.g., Locke & Latham, 1990) or according to observer ratings of pre-specified categories (e.g., Kipnis & Schmidt, 1988). Approaches like these for studying performance mirror managerial approaches to measuring performance (e.g., piece-rate programs or 360-degree evaluations). Standard measures can often be effective for understanding work that has closed-form solutions (i.e., one best way to do the work), and observer ratings are often effective for understanding how people judge pre-specified categories. However, much of the work that people do in our "post-industrial society" (Bell, 1973) involves open-form, knowledge-intensive activity, where knowledge is "conceived as competent, goal-oriented activity rather than as abstract 'knowledge about'" (Spender, 1996: 57). Competent, open-form activity involves countless situated judgments using standards and skills that a person understands tacitly as much as explicitly (Orlikowski, 2002), which can make performance difficult to judge using externally-imposed categories and/or judges who may not be able to appreciate the situated nature of those judgments. To understand performance in open-form, knowledge intensive work activities, I argue that we need to understand how people experience performance.

One theory that examines how people experience performance is Csikszentmihalyi's (1990) theory of "flow." Csikszentmihalyi used the word flow to describe the high performance experiences people often have when engaged in challenging activities. For example, a software engineer describes his flow experiences this way:

> Programmers can tell if what they are writing is 'good code' or 'bad code,' and they get satisfaction out of doing it well, doing it right. It's a process of creation, and that [flow] state is important…for two or three days I'll focus, get the whole thing in my head…as soon as things come up you know what to do to fix it. You go and do those things quick and come back to where you are. …I try to work this way all the time.

This description has many of the elements that psychologists associate with flow experiences: a challenging activity, skillful and speedy response, clear goals, concentration, and intrinsic enjoyment. It is also a description of how a person uses tacitly understood standards and skills (i.e., "can tell if [it] is 'good code'") to perform well (i.e., "doing it right"). Psychologists have studied experiences like these for 30 years (e.g., Csikszentmihalyi & LeFevre, 1989; Jackson & Marsh, 1996; Stein, Kimiecik, Daniels, & Jackson, 1995), generating many insights into the flow experience. Further, organizational scholars often invoke the flow construct as a possible mechanism for explaining phenomena such as knowledge (Spender, 1996), performance (Spreitzer, Quinn, & Fletcher, 1995), motivation (Kanfer & Heggestad, 1997), or "intense" groups (Murninghan & Conlon, 1991) (although they seldom elaborate on these claims, and never conduct any empirical examinations). Nevertheless, the study of flow—including an understanding of why flow is a high performance experience—has been hampered by theoretical imprecision, lacking even a definition of the experience (Jackson, 1992). To understand why flow is a high performance experience, and to understand what this experience means for the practice of knowledge work, we need to conceptualize flow more precisely and to position flow more appropriately in a nomological network of antecedents and consequences.

I define flow as the experience of merging situation awareness with the automatic application of activity-relevant knowledge and skills. Flow is a high performance experience, then, because the better a person comprehends the unfolding circumstances of a situation and responds to those circumstances automatically and skillfully, the better that person is performing—within the constraints of his or her comprehension. In other words, performance in flow is limited by a person's intersubjective understanding—the degree to which the person has incorporated the thoughts, patterns, standards, and expectations of relevant constituents such as bosses, clients, and one's community of practice. Flow, then, is not necessarily "objective" (although Stein et al. (1995) found that people who experience flow conditions perform well in sports by "objective" standards) or "subjective" (although the experience is subjective, even if the performance judgments are not). Flow may also be only momentary (although it can also last for extended periods). There may also be other ways for people to achieve high performance. And flow does not always translate to better *organizational* performance (for example, the software engineer above may write code that accomplishes a prescribed goal, only to have his client change the requirements the next day). However, within the constraints of a person's intersubjective understanding and his or her ability to maintain awareness and respond skillfully, the more a person experiences flow, the better that person, by definition, is performing. If knowledge work involves practices in which standards of effectiveness—and the way these standards are applied—are adapted to some degree both within and between activities (Orlikowski, 2002), then "objective" or externally imposed methods for judging performance have limited utility. Flow, however, as the experience of adjusting and applying tacitly- and explicitly-understood standards of effectiveness skillfully within the bounds of one's intersubjective understanding, is consistent across activities in spite of their uniqueness. As such, flow may be one of the best lenses we have to understanding performance in our post-industrial society (Spender, 1996: 57).

A deeper understanding of the flow construct does more than unpack the nature of high performance experiences in open-form knowledge work, however. It also helps us understand performance from the perspective of performers—a phenomenological (Stablein, 2002) approach to the study of performance. By using a phenomenological approach, I assume that performance in the practice of knowledge work may be best "understood if we look at it directly as it was experienced," and that such an understanding will be "useful in the actual practice of everyday life" (Csikszentmihalyi, 1990: 26, 25). Thus, when we understand performance from the perspective of the performers, we also see how and why people might alter their work practices or organizational structures to experience flow more often (e.g., Wrzesniewski & Dutton, 2001). For example, if flow is the experience of merging one's situation awareness with the automatic application of activity-relevant knowledge and skills, then it may be that as work activities become more complex and dynamic (if these activities cannot be slowed down or simplified) flow becomes increasingly necessary to do the work (because situation awareness helps people comprehend complexity when it cannot be simplified and automatic application helps people adapt immediately when work cannot be slowed down). In situations like these, people may be motivated to alter practices or forms of organizing to make the experience of flow more likely.

My approach is not entirely phenomenological, however. I also integrate this approach with theories of situation awareness (Endsley, 1995), automatic cognitive processing (Bargh, 1984), and social practice (Bordieu, 1977). I use the concepts of situation awareness and automatic cognitive processing to conceptualize flow more precisely, and the concept of social practice helps me to position flow in the organizational literature. Flow is experienced in practices. Therefore, by studying flow, we learn how people might use their agency to “engage their structural environments” (Emirbayer & Mische, 1998), and consequently, to change or maintain the organizational practices and structures that make up those environments. As such, by studying flow we see that that forms of organizing in a post-industrial society may be affected not only by the nature of work (Barley & Kunda, 2001), but also by the way we experience it.

A more precise and positioned understanding of flow has the potential to contribute to our understanding of organizational behavior both because it is the experience of high performance in intersubjectively defined activities and because it can help us to understand ways in which the interplay of structure and agency affect the practice of professional work and forms of organizing. These contributions, however, depend on whether my clarifications and positioning for the flow construct are viable. Therefore, I begin clarifying and positioning by first reviewing the literature on flow and developing three models of the flow experience. I then use data from engineers, scientists, managers, and technicians at Sandia National Laboratories to test these three models, providing empirical justification for arguing that flow is the experience of merging of situation awareness with the automatic application of activity-relevant knowledge and skills. Then I discuss what this re-conceptualization means for the study of intersubjective performance, knowledge work practices, and forms of organizing.

WHAT IS FLOW?

Insights from and Problems in Flow Research

The study of flow has its roots in research on personal causation (deCharms, 1968; White, 1963), self-actualization (Maslow, 1964) and play (Huizinga, 1950). Csikszentmihalyi (1975), in an effort to understand why artists spent so much time creating art with little or no reward—only to lose interest in a piece of work as soon as it was complete—drew on and integrated these literatures to develop a model of the flow experience. The flow experience, as Csikszentmihalyi described it, was a "holistic sensation that people feel when they act with total involvement." And, as the enjoyment of the sensation seemed to come from involvement in an activity itself, rather than from the rewards or punishments that people received, it helped him to explain why the artists he examined (and later, chess players, rock climbers, dancers, and others) found so much interest in their work, and so little interest in its results.

Activities like sculpting, painting, dancing, chess, and rock climbing (as well as activities like software programming, building mathematical models, soldering, or computer assisted design) are examples of practices. Practices are "situated recurring activities of human agents" (Orlikowski, 2002), which are "done on the basis of what members learn from others, and [are] capable of being done well or badly, correctly or incorrectly" (Barnes, 2001). This point—that people learn how to perform and how to judge the performance of the practices that people can experience flow in—accentuates the fact that even though flow is a subjective experience, the performance of a flow activity is judged intersubjectively. Therefore, even when a person performs an activity in isolation, that person acts in ways that meet, fail to meet, or exceed the tacit or explicit standards of what other practitioners consider to be "good practice." These situated actions—and the situated, intersubjective judgments of these actions—can become elements of a flow experience. However, to understand these elements and the role that they play in the flow experience requires a more careful description of what flow is.

Three trends in flow research make it difficult to understand what flow is, and how it operates. First, there is no agreed-upon definition of flow (see Csikszentmihalyi, 1975: 11;

Csikszentmihalyi, 1992), which means that researchers conceive of and measure the construct differently—if they measure it at all. Second, there is no consistent approach to modeling relationships between elements of the flow experience; the same construct could be an indicator, and antecedent, or a consequence of flow, depending on an author's treatment in a particular manuscript (contrast Csikszentmihalyi, 1990, 2003; Ellis, Voelkl, & Morris, 1994; Jackson & Marsh, 1996; and Voelkl & Ellis, 1998). And third, there is very little quantitative research on flow in work contexts (the primary exception to this being Csikszentmihalyi & LeFevre (1989)), and none that focuses on knowledge work. Most of the research on flow focuses on sports and leisure, which means that the description of flow concepts are often constrained by the language of physical (rather than intellectual) activity.

In spite of these problems, researchers have made important strides in the study of flow. For example, Csikszentmihalyi states that in 30 years of research, the people he interviews always "mention at least one, and often [mention] all," of nine elements that capture the flow experience (1990: 49). These nine elements are (1) challenges and skills that are high and in balance, (2) clear goals, (3) clear feedback, (4) concentration, (5) the merging of action and awareness, (6) a sense of control, (7) an "autotelic" experience, (8) the loss of self-consciousness, and (9) the transformation of time. Csikszentmihalyi's (1990) definition for each element follows[1]:

- Challenges and skills that are high and in balance - an activity is difficult, but a person's skills are just equal to the activity's demands[2] (pp. 49-53).

- Goal clarity – the degree to which a person can tell (tacitly and/or explicitly) what the goal(s) of an activity are, including the standards used to gauge success (pp. 54-8).

- Feedback clarity – the degree to which a person can tell, from their perceptions of the activity, how well they are doing relative to their goals[3] (pp. 54-8).

- Concentration – the degree to which a person focuses attention on an activity (pp. 58-9).

- The merging of action and awareness – the degree to which an "activity becomes spontaneous, almost automatic; [people] stop being aware of themselves as separate from the activity they are performing" (p. 53).

- Sense of control – the degree to which a person stops worrying about the possibility of losing control (pp. 59-62).

- Autotelic (auto = self, telos = goal) experience – the degree to which a person enjoys an activity for its own sake, irrespective of rewards or punishments (pp. 67-70).

- Loss of self-consciousness – the degree to which people stop worrying about what others may be thinking about them (pp. 62-6).

- Transformation of time – the degree to which a person perceives time as having passed by quickly and unnoticed, or to which events seem to occur in slow motion (pp. 66-7).

The nine elements of flow that Csikszentmihalyi (1990) observes in his research may be common to most, if not all, flow experiences, but researchers describe the relationships between these elements in different ways. If we are to understand what flow is, its causes and consequences, and the role that it plays in the practices of knowledge work, we first need to sort out the relationships between these nine elements. Therefore, I now extract three models of these elements from the literature on flow: (1) a model that treats flow as a global experience encompassing all nine elements, (2) a model that separates the characteristics of the activity from the global but less inclusive experience of the remaining flow elements, and (3) a model that conceives of flow as the specific experience of merging one's situation awareness with the automatic application of activity-relevant knowledge and skills. Each model is based on different assumptions about what flow is. I contrast these models and their underlying assumptions both theoretically and empirically, providing support for a new conceptualization of flow.

Flow as a Global Experience

The most ambitious attempt to describe, measure, and model flow to date may be the work of Jackson and colleagues (Jackson & Marsh, 1996; Jackson & Eklund, 2002), who define flow as a psychological state in which a person experiences all nine of the elements of flow (see Figure 1). Thus, the nine elements of flow are <u>indicators</u> of the flow state, such that Jackson and colleagues model flow as an unmeasured second-order factor composed of nine first-order factors. This model does not, however, specify whether all nine indicators are necessary and/or sufficient for an experience to be a "flow" experience, it treats flow as an experience that is not directly measurable, and says nothing about how people achieve this state (although other scholars (e.g., Kowal & Fortier, 1999) who use combinations of these indicators have attempted to find antecedents). Further, it confounds conditions of the flow <u>activity</u> (e.g., goal clarity, challenge) with experiential states (e.g., autotelic experience, sense of control), and it leaves us uncertain about how the flow state is different from its indicators, which makes the much-needed explanation (Sutton & Staw, 1995) of why elements relate in this way difficult, as it requires scholars to explain any potential antecedents in terms of their effects on the <u>indicators</u> of flow.

Insert Figure 1 about here

Jackson and her colleagues tested this model of flow by developing the Flow State Scale (FSS: Jackson & Marsh, 1996; FSS-2: Jackson & Eklund, 2002), using survey scales to measure the nine elements of flow. Using data from sports participants, Jackson and her colleagues found appropriate levels of convergent and discriminant validity for each of the first-order factors (i.e., the nine elements of flow), but received mixed support at best for their overall model of flow—even with the improved scales in Jackson and Eklund's (2002) "Flow State Scale-2." Even so, survey scales that measure the nine flow elements alone are a contribution to flow research. Jackson and colleagues' nine-factor model should be tested in alternative settings (other than sports). However, given its existing lack of empirical support, its problems with confounding construct types, and the difficulty it poses for theoretical explanation, it is likely that there are more robust ways to conceptualize flow and the relationships between its elements.

Separating Activity Characteristics from Experience

Jackson and Marsh (1996) came up with the idea to measure flow as a second-order construct based on Csikszentmihalyi's (1990; 1997) description of the flow elements. However, if we return to Csikszentmihalyi's descriptions of these elements, his language actually implies different relationships. Csikszentmihalyi does not propose an explicit model of relationships between elements, but his descriptions suggest two additional ways that we can conceive of these elements relating to each other. The first of these ways involves separating the characteristics of flow *activities* from the elements of a flow *experience*, which Csikszentmihalyi (1997: 31) implies when he writes that flow occurs "when" challenges and skills are high and in balance, and goals and feedback are clear. Thus, goal clarity, feedback clarity, and challenges and skills that are high and in balance are treated as antecedents of the flow experience, and flow is again conceived of as a second-order construct, indicated instead by the six remaining elements of the flow experience (Figure 2). It is not clear from Csikszentmihalyi's language, however, whether these six elements are necessary and/or sufficient indicators of the flow experience. Given his statement that people "mention at least one, and often [mention] all" (1990: 49), of the elements when they describe flow experiences, it is possible that he considers a subset of these indicators to be sufficient. I propose my own answer to this question when I present the third model.

Insert Figure 2 about here

Challenges and skills that are high and in balance as antecedent to flow. According to this second conceptualization of the flow experience, when a person's skills are just equal to a challenging activity, people are more likely concentrate on the activity because their full attention is necessary to ensure that the demands of the activity are met. This also makes the loss of self-consciousness and the transformation of time more likely because there is no attention left for worrying about what others think or about how much time has passed. People are also less likely to worry about losing control of an activity when their challenges and skills are in balance because their skills are sufficient—even if they are just sufficient—to meet the challenge. And because those skills are sufficient, a person can find enjoyment not only in performing the activity, but also in performing an activity that is challenging. Further, people whose skills are sufficient to the challenge of an activity are able to respond automatically to the circumstances of an activity as they unfold because part of what makes activity skillful is the ability to respond to cues without conscious guidance (Bargh & Chartrand, 1999). This unconscious ability to respond automatically and appropriately generally works for any situation where a person's skills are relevant, even up until the maximum point at which those skills are sufficient—but not past that point at which those skills become insufficient (Csikszentmihalyi, 1990)[4].

Goal clarity and feedback clarity. Goal clarity and feedback clarity each contribute directly to the experience of flow in this model. For example, goals and feedback give people a frame to concentrate through (i.e., “How close am I to achieving my goal?”) and cues to concentrate on (i.e., “What does that change in circumstance mean relative to my goal?”). Similarly, these frames and cues help people to exclude other, less relevant information—such as information about the passage of time or the opinions of others.[5]

Clear goals and feedback also make automatic responses to unfolding events more likely because they enable people to know how to respond: an immediate understanding of what a cue means for the situation makes a person more able to respond immediately to that cue. Similarly, the sense of control is also more likely because people can use their goals and feedback to identify issues that need to be dealt with so that they do not have to worry about losing control. And as people receive feedback that says that they are coming closer to achieving their goals, the enjoyment of the activity is also likely to become a part of the experience, because the positive feedback reinforces a person’s sense of personal competence (Ryan & Deci, 2000).

The fact that the feedback plays such an important role in the enjoyment of a flow activity suggests another question, however: Is enjoyment (or perhaps even flow itself) simply a byproduct of positive feedback? Perhaps people only say that they enjoyed their work, quit worrying about control, lost track of time, and so forth because they already know that they have succeeded. Although this is not likely for all of the elements (for example, concentration is not likely to be merely a byproduct of positive feedback), it can be difficult to assemble counterarguments for many of these elements, and perhaps even for flow as it is conceived in the current model. Flow, in this model, is an undefined, unmeasured second-order construct indicated by first-order constructs, some of which may only be experiences that people might have had anyway, or may only have when they know that they have succeeded. We know from research on goal setting (Locke & Latham, 1990) and job characteristics (Hackman & Oldham, 1980) that that the antecedents in this second model of flow—goal clarity (i.e., goal specificity, task identity), feedback, challenges (i.e., goal difficulty, skill variety), and skills—tend to increase people's motivation and performance. But the definition of flow in this second model is still not sufficient for us to use in developing a theoretical explanation sufficient to justify why flow might be more than an epiphenomenon in these types of activities (Sutton & Staw, 1995). The conceptualization of flow proposed in this second model has the advantages of separating activity characteristics from experiential states, but it still retains the disadvantages of not differentiating flow from its indicators, which makes it difficult to argue that flow is more than an epiphenomenon and requires us to explain the effect of flow antecedents in terms of their effects on the indicators of flow rather than in terms of their effects on flow itself.

Flow as the Merging of Awareness and Application

Each of the previous models have the same disadvantage: flow is treated as a second-order construct with no clear definition of what flow is, and this lack of definition makes theoretical explanation difficult—explanation that is needed both for modeling relationships between flow elements and for justifying the relevance of flow for organizational behavior (Sutton & Staw, 1995). However, if we analyze the descriptions of flow elements in Csikszentmihalyi's *Flow* (1990) and *Beyond Boredom and Anxiety* (1975), we can extract a model of the flow experience that overcomes these problems. The descriptions in these books are not sufficient to extract a complete model, but if we use these descriptions as a starting point, draw a few logical inferences, and supplement the theoretical development with relevant literature from other sources, we can develop a definition and model of flow that maintains its roots in the psychological literature on flow, overcomes the problems of flow as an undefined, second-order construct, and enables us to achieve theoretical explanation (Sutton & Staw, 1995).

The key to developing a model that we can use to explain relationships between flow elements and to describe the role that flow plays in organizational behavior lies in some of Csikszentmihalyi's (1975) early observations about the flow experience. "Perhaps the clearest sign of flow," he writes, "is the merging of action and awareness" (1975: 38). Csikszentmihalyi's (1990: 54) reason for suggesting that the merging of action and awareness is the clearest sign of flow is because his interviewees used the word "flow" to describe the experience of having actions and awareness merge. Flow, then, was a "native category—a word frequently used by the informants themselves to describe the experience" (1975: 36). However, rather than claim that the merging of action and awareness is the clearest sign of flow, if we also consider the problems that conceptualizing flow as a second-order construct create and Csikszentmihalyi's (1990) observation that people who describe their flow experiences do not always include all nine elements of the flow experience, it may make more sense to simply say that flow is the merging of action and awareness. If flow is the merging of action and awareness, then not only are we using the word in a way that is consistent with people's actual reported experiences, but we also understand why empirical analysis does not support a second-order flow construct, we can explain why all nine flow elements do not always occur simultaneously, and (as I explain later) we can explain why people consider flow to be a high-performance experience.

Construct definition. If flow is the merging of action and awareness, then we need to define the construct more clearly, distinguish it from related constructs, and explain how it is related to the other elements of flow. Csikszentmihalyi (1990: 53) defines the merging of action and awareness as the degree to which an "activity becomes spontaneous, almost automatic; [people] stop being aware of themselves as separate from the activity they are performing." Under this definition, flow is difficult to distinguish from automatic cognitive processing (Bargh, 1984). However, people also report investing significant effort into the activities that they experience flow in (Csikszentmihalyi, 1975; 1990). For example, the software engineer quoted at the beginning of this paper claimed that he "focused" and "got the whole thing in [his] head." These phrases suggest controlled cognitive processing. Flow, then, must be more than just automatic cognitive processing—although automatic cognitive processing certainly plays a role.

I propose that flow may be best defined as the experience of merging one's situation awareness with the automatic application of activity-relevant knowledge and skills. Situation awareness (or "having the bubble," as Bigley and Roberts (2001) call it) is "the perception of the elements in the environment within a volume of time and space, the comprehension of their meaning, and the projection of their status in the future"[6] (Endsley, 1995b). It is a degree of perception that comes from an explicit effort to be sufficiently aware of the circumstances involved in a particular situation, including when responses are needed and what a response should be (compare this with the programmer's quote: "I'll…get the whole thing in my head"). In dynamic situations—where circumstances change (and generate feedback) as a person acts within that system—situation awareness requires conscious—even vigilant—cognitive processing because a person must continually review the circumstances to remain aware of elements in time and space, their meaning, and their possible status in the future.

Situation awareness is not only an effortful accomplishment, but it is also an accomplishment that is achieved in practice. Therefore, even though a person—like the software engineer—may be working alone, that person's ability to perceive relevant elements of the activity, to comprehend their meaning, and to project their status into the future is also an intersubjective accomplishment (Barnes 2001). For example, when the software engineer begins writing new code, he brings to the activity the purpose for writing the code (which he probably received from his boss or his client), the knowledge of the language the code will be written in (which he learned from classes or manuals as well as personal experience), beliefs about what makes code "good" or "bad" (learned from classes, interaction with other programmers, and personal experience), as well as other relevant, socially-derived beliefs or information such as organizational norms or relationships to others working on the same or related projects. These norms, beliefs, knowledge, and information help the software engineer discern which cues are relevant in the programming project, interpret their meaning relative to the goals and standards, and make judgments about how the situation is changing—or might change—as he chooses to write the code in particular ways. The quality of the programmer's situation awareness, then, depends on the clarity of his goals and standards relative to this particular activity, on the programmer's knowledge of those aspects of the programming language and coding procedure that are relevant to the goal(s) of the activity, and on the effort the programmer puts into identifying and applying all of the appropriate interpretive frames for the unfolding circumstances as implied by these socially constructed goals and standards. As a result, situation awareness can be a tenuous accomplishment, as well as a social and an effortful one.

Flow is more than situation awareness, however. A person cannot achieve desired results with situation awareness alone (Endsley, 1995b). A person must also have the necessary knowledge and skills to move a situation toward desirable ends. When people's skills are honed sufficiently to apply them automatically (Bargh, 1984) they can move a situation toward desirable ends fluidly and deftly. And when people experience the merging of one's situation awareness with this automatic application of activity-relevant knowledge and skills—perceiving and acting in a way that is both advantageous and harmonious—they are experiencing flow. The "advantageous-ness" that people sense in their flow experiences is a matter of perception, though. People who experience flow think it is advantageous because they are moving a situation toward a desired result. But because situation awareness is intersubjective, the degree to which others (e.g., bosses, clients) find it advantageous depends on how closely the perspective of the person who is experiencing flow reflects the perspective of the people who interpret the results.

The perspective of the people who experience flow influenced my choice of the word "application" when I developed this definition of flow. "Application" refers to more than physical action (the focus of sports- and leisure-based studies of flow). For example, the knowledge and skill that the software engineer applies to his situation not only includes physical actions like typing, but also includes cognitive actions, such as conceptualizing the configuration of a software object or inferring the consequences of writing a segment of code in a particular way. And because changes in objects, parameters, commands, or databases can affect other objects, parameters, commands, and databases throughout the code, programmers must keep track of the program as a whole, as it is being written and as it would be executed under its current design, while writing each component of the program. This is probably why the software engineer quoted in the introduction described "getting the whole thing in his head" (situation awareness), knowing what to do to fix things as soon as they come up (situation awareness and automaticity), and doing those things quick and coming back to where he was (automaticity).

Much, if not most of this work is done in the software engineer’s head. Therefore, because the flow experience is about automatically applying knowledge and skills to the unfolding circumstances of the activity a person is participating in, and because people often think of the term “action” in terms of physical movement, an appropriate way to shorten this definition may be “the merging of awareness and application.”

If flow is the experience of merging one’s situation awareness with the automatic application of activity-relevant knowledge and skills, then we need explain how this revised definition of flow is different from other flow elements and from other constructs in organizational scholarship generally. We also need a model to show how flow interrelates with the other flow elements. Once we understand the unique nature of the flow experience and how it relates to the other elements commonly associated with flow, we can test these three models of flow and discuss the role that flow plays in the practice of work and organizing.

Differentiating flow from related constructs. I begin differentiating flow from related constructs by contrasting the merging of awareness and application with concentration, the sense of control, and the autotelic experience. I focus on these three flow elements because of their conceptual similarity to flow. Concentration is different from flow because concentration is cognitive effort, or exertion, while flow is an experience—a perception of undergoing particular psychological, biological, and contextual circumstances—specifically, situation awareness and automatic response. Subjective experiences like flow consist of cognitive processes like situation awareness and automatic cognitive processing (which are at least partially the result of cognitive effort). However, when we look at these constructs from a phenomenological point of view, we realize that people who experience flow can think of flow as a distinct experience rather than in terms of its component psychological processes and that they can distinguish this experience from the cognitive effort that they invest to make it happen.

In contrast to concentration, the sense of control and the autotelic experience are also experiences like flow. The sense of control is different from flow, however, because it is an experience that is defined in terms of what is missing from consciousness (worry about losing control), while flow is an experience that is defined, at least in part, by what is in consciousness (situation awareness). The autotelic experience, on the other hand, is more recognizably emotional than flow. Where flow is an experience of awareness coupled with an automatic sense of and enactment of appropriate responses, the autotelic experience is the experience of enjoyment that a person derives from experiencing that awareness and responsiveness.

The autotelic experience is distinct from the flow experience, but it is similar to (if not the same as) the concept of intrinsic motivation. Intrinsic motivation, according to Ryan and Deci (2000: 71) "refers to doing an activity for the inherent satisfaction of the activity itself"—a definition nearly identical to Csikszentmihalyi's (1990: 67) definition of the autotelic experience, which he says people have when they do activities "not with the expectation of some future benefit, but simply because the doing itself is the reward." These authors recognize this connection (Deci & Ryan, 1985; Moneta & Csikszentmihalyi, 1996), and other scholars have also empirically discriminated these constructs and explored relationships between them (Kowal & Fortier, 1999). However, because researchers were unclear as to how the autotelic experience is related to flow, the exact nature of the role that intrinsic motivation plays in the flow experience was somewhat murky. By defining flow as the merging of awareness and application, we can now see that flow and intrinsic motivation are separate but related constructs.

Another concept that is related to, but different from, flow is self-efficacy. Self-efficacy is "the conviction that one can successfully execute the behavior required to produce particular outcomes" (Bandura, 1977: 193). Self-efficacy is similar to flow because it is a belief about a person's ability to perform, and flow is the experience of performing. Self-efficacy is different from flow, however, because the conviction that one *can* execute a set of behaviors (a future-oriented cognition) is not the same as the actual experience (in the present moment) of executing those behaviors—of merging one's situation awareness with the automatic application of activity-relevant knowledge and skills. Flow is an experience in which people make assessments/form beliefs about how capable they are proving to be in the present, while applying knowledge and skills developed in the past to achieve a desired future.

Another concept that bears some similarity to flow—especially when we examine flow in knowledge work settings—is the concept of insight. Insight is "the recognition or restructuring of a key feature of a problem that allows a solution to be found" (MacGregor, Ormerod, & Chronicle, 2001: 176). It is similar to flow because insight occurs in activities that have clear, challenging goals, and is accomplished with knowledge or skills that are inherent in a person, even if that person does not know what knowledge or skills are relevant to solving the problem at first. Insight, however, tends to be a cognitive event—the moment when recognition or restructuring occurs, rather than the experience of applying the skills to the problem. Thus, people may experience flow as they apply the skills necessary to achieve insight (relaxing self-imposed constraints and decomposing chunked items or applying maximization and progress-monitoring heuristics; Jones, 2003) and/or as they apply the skills necessary to achieve the solution that was made possible by insight. Insight, then, can be the result of and/or the instigation for a flow experience, but it is not the same thing as a flow experience.

The concept that overlaps most with flow is Schön's (1983) concept of reflection-in-action. Reflection-in-action is the process of "noticing how you have been [performing an activity] and how well it has been working, and, on the basis of those thoughts and observations, changing the way you have been doing it" (Schön, 1983: 55). This "noticing" means that a person is aware of the situation that he or she is acting in, and "changing" means that the person is using activity-relevant knowledge and skills to respond to the unfolding circumstances in that situation. Thus, reflection-in-action contains two of the same major elements of flow. However, flow also involves a temporal "merging" of reflection (situation awareness) and action (automatic application), to the point where reflection and action (where action can be cognitive as well as physical) are near simultaneous, or perhaps even simultaneous. Schön's description of reflection-in-action includes the possibility of merged reflection and action, but also includes reflection over long periods of sustained practice, such as years or months (e.g., a lawyer reflecting on a case in court), which would not constitute a flow experience. Therefore, we can consider flow to be a subset of the experiences that would be labeled "reflection-in-action." This is an important distinction, because people may (eventually) achieve high performance in episodes of reflecting-in-action that do not merge the reflection and the action, but these episodes will not likely be experienced as high performance episodes. It is through merging reflection and action that people are able to interpret and respond to an unfolding situation as it unfolds, and can determine whether they are, in fact, achieving high performance relative to their intersubjective standards. By studying flow as a distinct subset of reflection-in-action we can see how people adapt and perform during their activities, which is important in work that requires such adaptation.

Antecedent flow elements. Having established the distinct nature of the flow experience, I now develop a model of relationships between flow elements, focusing first on how goal clarity, feedback clarity, challenges and skills that are high and in balance, and concentration each increase the likelihood that a person will experience flow. I am able to offer explanations for why I propose that these elements are antecedent to the flow experience (as opposed to the first two models; see Sutton & Staw, 1995) because we now have a clear definition of what flow is. I propose that these flow elements are antecedent to the flow experience because they are characteristics of the activities that people experience flow in (in the case of goal clarity, feedback clarity, and the challenge-skill balance) or are the cognitive effort people put into activities (in the case of concentration). As such, they provide the structure and impetus for defining a situation, becoming aware of its unfolding circumstances, and responding to those circumstances automatically. Figure 3 is a depiction of the relationships I propose.

Insert Figure 3 about here

Flow activities begin with goals. In Csikszentmihalyi's (1990: 49) words, "the overwhelming proportion of optimal experiences are reported to occur within sequences of activities that are goal-directed," and "concentration is usually possible because the task undertaken has clear goals." Goal clarity, then, affects both a person's ability to concentrate and a person's ability to experience flow. Goal clarity should have a positive effect on concentration (Figure 3, arrow 1) because goals provide direction for the activities people participate in (Locke & Latham, 1990). This direction helps people to know what to concentrate on. Without direction, people cannot be certain about what kind of cues to pay attention to and the likelihood of getting distracted by irrelevant events increases. Goal clarity should also have a positive effect on flow (Figure 3, arrow 2), because people use the direction that goals provide to define the situations that they seek to be aware of, to interpret the meaning of the events that occur in that situation, and to come up with responses that are appropriate for moving the situation toward those goals.

Feedback clarity should also have a positive effect on concentration and on flow. In fact, Csikszentmihalyi (1990: 49, 54) claims that feedback clarity should have a similar effect on concentration and on flow as goal clarity. Feedback consists of the cues that a person can perceive and interpret in a situation, which emerge in response to the (physical or intellectual) actions a person takes. People are more likely to concentrate when feedback is clear (Figure 3, arrow 3) because they know whether their actions are affecting the system in desirable ways or not. Thus, in addition to being able filter out irrelevant cues, people with clear feedback are also likely to identify which cues contain information about potential problems and focus on those (people tend to focus on cues that threaten to interrupt desirable circumstances; see, for example, Mandler, 1984). People are also more likely to experience flow when their feedback is clear (Figure 3, arrow 4) because the clearer their cues are for interpreting the situation with, the better able they are to interpret how close (or far) the situation is from its desired state, to infer how the situation will continue to unfold, and to respond automatically and appropriately to the relevant cues (Klein, 1998). (Again, flow is more than just the interpretation of past success—particularly if it is to be sustained—it is also applying relevant knowledge and skills in the present and anticipating the future.) Thus, the less clear goals and feedback—the frames and cues that people interpret a situation with—are, the more difficult it should be for a person to experience flow.

The third and final activity characteristic that Csikszentmihalyi (1990) identifies as being antecedent to concentration and flow is challenges and skills that are high and in balance. With regards to concentration, Csikszentmihalyi writes, “When all a person's relevant skills are needed to cope with the challenges of a situation, that person's attention is completely absorbed by the activity" (p. 53). In other words, people concentrate when skills are just adequate to the challenge a person faces (Figure 3, arrow 5) because successful implementation demands a person's full attention: anything less than complete focus means that all of one's skill will not be applied to the activity, and therefore will be less than adequate for meeting the challenge. Similarly, when skills are just equal to a challenging activity, people have the ability they need to discern relevant cues, to interpret the meaning of cues, to imagine how the situation will unfold, and to respond to cues appropriately—even if those abilities are just equal to the task. Because their ability to discern, interpret, and respond to cues is equal to a task that requires their engagement, they are likely to develop an awareness of the task and apply those skills to their activity with automaticity. Thus, challenges and skills that are high and in balance should also increase the likelihood of experiencing flow (Figure 3, arrow 6).

Concentration is also antecedent to the flow experience (Figure 3, arrow 7). Goals and feedback help people to frame and interpret situations, and a balance of challenges and skills give people means to achieve and respond to their awareness of an engaging situation, but to have a flow experience people must actually make the effort. Concentration focuses people on an activity, gets them looking for relevant cues, and prepares them to respond to the cues that emerge. This effort to focus, scan, interpret, and be ready to respond improves both a person's situation awareness and the automaticity with which they respond to unfolding circumstances.

Consequences. The four remaining flow elements—the sense of control, the autotelic experience, the loss of self-consciousness, and the transformation of time—are all experiential constructs. Csikszentmihalyi's (1990) descriptions of these elements provides some guidance as to how they relate to the other elements in the model, but his descriptions are less clear, which limits the value that we can derive from this guidance. I position these elements as consequences in my model, in part because of Csikszentmihalyi's descriptions, but also in part because I assume that within a single episode, experience is more likely to be driven by activity characteristics and personal effort than the reverse. Experience can also affect how people construe their activities and the efforts people put into those activities, of course, as when a person increases the challenge of an activity to prevent being bored by it. However, when people re-construe their activities, they often consider the change to be a disruption in their experience, and consider subsequent experience to be the result of new activity conditions, which suggests that even when experience affects activity construal, people still bracket their experiences in ways that treat activity construal as antecedent to experience. Therefore, based on this assumption, and supplementing Csikszentmihalyi's "guidance" with my own logical extensions, I propose (1) the more a person experiences flow, the greater that person's sense of control and autotelic experience will be, and (2) that the more a person concentrates on an activity, the less they will worry about what others think of them or about how quickly time is passing.

Flow has a positive effect on the autotelic experience, or on the enjoyment of the activity (Figure 3, arrow 8), because flow brings order to a person's consciousness (Csikszentmihalyi, 1990). Order in one's consciousness, according to Csikszentmihalyi, occurs when people manage the perception and interpretation of the cues that life continuously bombards them with in a way that is in harmony with their intentions, while disorder (or entropy) occurs when the perception or interpretation of these cues conflicts with intentions or distracts people from carrying their intentions out. The ordinary state of a person's consciousness, according to Csikszentmihalyi,

> …involves unexpected and frequent episodes of entropy interfering with the smooth run of psychic energy. This is one reason why flow improves the quality

> of experience: the clearly structured demands of the activity impose order, and exclude the interference of disorder in consciousness (p. 58).

In other words, because a person who is experiencing flow has defined the situation, acts competently in that situation, and maintains awareness of that situation in such a way as to ensure that their personal intentions and the emerging cues remain in harmony, that person not only avoids disruptions in the consciousness and the negative feelings that accompany those disruptions, but also enjoys the experience of knowing that he or she is responding well to a situation as it is framed. Also, because people who experience flow also know that they are responding well to situations as they are framed, flow should also have a positive effect on a person’s sense of control—or, rather, on the lack of worry people feel about losing control (Figure 3, arrow 9). People who know that they are perceiving and acting automatically to seize opportunities that will establish or maintain control and to eliminate threats that might lead to losing control, after all, are less likely to worry about losing control.

Concentration, on the other hand, should have a positive effect on the loss of self-consciousness and the transformation of time. Concentration should have a positive effect on the loss of self-consciousness (Figure 3, arrow 10) because the more a person concentrates on performing an activity, the less attention that person has to devote to concern about what others may be thinking. Concentration should have a positive effect on the transformation of time for similar reasons: the more attention a person devotes to performing an activity, the less attention that person has for paying attention to the passage of time (Figure 3, arrow 11).

The model I propose does not include relationships between flow and the loss of self-consciousness or between flow and the transformation of time. Nor does it include relationships between concentration and the autotelic experience, between concentration and the sense of control, or between the three activity characteristics and the four experiential outcomes. I do not propose a relationship between flow and the loss of self-consciousness or the transformation of time first, because people can define the situation either in ways that include cues regarding other people's opinions about oneself or about how time is passing, and second, because some situations can be defined in ways that do not require all of a person's attention, leaving room for a person to think about others' opinions or the passage of time. I do not propose a relationship between concentration and the autotelic experience and the sense of control because it is possible to conceive of situations in which people concentrate intensely on an activity without achieving order in their consciousness, a sense of control, or any feelings of enjoyment. And I do not propose a relationship between the activity characteristics of flow and the experiential outcomes because without order in a person's consciousness and the knowledge that a person is responding well to an unfolding situation (flow), and the investment of a person's attention (concentration), it would be difficult for these characteristics to generate enjoyment or to free people from worry about control, the self, or the passage of time.

Implications of the model. When we define flow as the merging of situation awareness with the automatic application of activity-relevant knowledge and skills and model it as a first-order construct in relation to the elements that Csikszentmihalyi associates with flow, we overcome a number of the problems associated with the other two conceptualizations of flow. Namely, the definition I propose is now a tractable one that enables us to describe and explain relationships between flow elements, we cease to confound activity characteristics with experiential outcomes, and we no longer have to explain the effects of antecedents on flow by using its indicators. This model also makes it simpler for future researchers to introduce additional antecedents and outcomes without having to worry about whether or not the effects of the other flow elements have been accounted for. And, like the second model, this model is consistent with research on job design and goal setting.

Two issues regarding this definition and model need to be resolved before conducting an empirical comparison of these models, however. First, in the third model, where flow is defined as the merging of awareness and application, flow and concentration occupy similar conceptual space—both are influenced by the same activity characteristics, and both influence experiential outcomes. Why, then, do we need flow? Would it be sufficient to simply study concentration?

Flow, I argue, is a useful construct in addition to concentration because it is a performance-oriented construct. When people experience flow, they are engaged, by definition, in performing a practice to the best of their ability—automatically applying relevant skills in the most aware way they can to move the situation toward a desired end state, relative to their definition of the situation. People can concentrate with all of the attention that they have, and yet, if they are not aware of the situation and responding to it appropriately, they are not likely to perform well—even from their own perspective. Flow (and the accompanying performance) may be temporary: at any moment the situation could change in a way that exceeds a person's ability to comprehend it or to respond to it. But even if it only lasts for a moment, the greater a person's experience of flow is, the closer their performance should be to their best performance (relative to the intersubjective goals, rules, and standards that define the activity). Because this "best performance a person can achieve" is relative to the definition of the situation, if a person who is experiencing flow has developed his or her understanding of what the goals and standards are in a way that is different from relevant constituents (like one's boss or clients), then performance will not be optimal from the perspective of those constituents. However, because flow involves the experience of adjusting and applying all of the knowledge and skills that a person perceives to be relevant to an unfolding, open-form activity, the more people experience flow, the better they will perform relative to their understanding of the situation. Given that professional, knowledge work often has characteristics like these (Schön, 1983; Spender, 1996), flow should be a more consistent indicator of performance than any externally-applied category that fails to account for the situated, open-form nature of knowledge work.

A second issue is that some people tend to associate more than one of the flow elements to be "essential" parts of their flow experiences. Perhaps, in an ideal sense, every time a person experiences flow they would be swept away into the activity, forgetting about time and social pressure, feeling in control, and rapt in the enjoyment of the moment. However, there are many cases in which people consider themselves to have flow experiences even when they do not experience all nine flow elements simultaneously (Csikszentmihalyi, 1990: 49). For example, time is not likely to pass unnoticed when the activity a person is engaged in requires a person to keep track of the time. And a person is not likely to lose self-consciousness when the goal of a particular activity is to impress one's boss. And yet it is conceivable that a person trying to meet her deadline or to impress his boss could experience some or all of the other flow elements.

We could claim that my third model is an input-process-output map of the flow experience, rather than limit flow to the merging of awareness and application. However, it is also reasonable to treat flow as the merging of awareness and application because the merging of awareness and application appears is the one variable most capable of explaining why people claim to perform their best in flow, is the one variable directly affecting the autotelic experience (thus explaining the enjoyment of flow), and is the experience that people invented the word "flow" to describe. If we claim that all nine flow elements are necessary conditions for flow, then not only are we violating the idea that the word "flow" is a native category that people use to describe the merging of awareness and application, but we also limit flow to being an experience that may only occur on the rarest of occasions, with minor implications—if any—for organizational behavior. In contrast, if we accept the merging of awareness and application as an appropriate definition of flow, treat the simultaneous occurrence of all nine elements as an "ideal" state of flow, and treat the other eight elements as important, closely related, but distinguishable constructs, then we have a definition and model that corresponds well to previous research, matches people's descriptions of their flow experiences, and may have significant implications for organizational behavior. This approach seems most compelling to me.

STUDYING FLOW IN KNOWLEDGE WORK

Subjective Experience

Flow is a subjective experience. As such, the study of flow presents two challenges. First, it is not currently possible to measure subjective experiences directly. We can not truly know another person's subjective experience. And if we can not truly know another's subjective experience, how can we know that experience is anything more than an epiphenomenon? This question may never be fully settled, but a growing and converging literature on subjective experiences (such as flow, or emotions) in both psychology (Moneta & Csikszentmihalyi, 1996) and organizational science (Brief & Weiss, 2002) suggests that these experiences can be consequential behaviorally and biologically as well as experientially, and that survey and interview research, while imperfect, can at least help us to glean insights into the nature of this experience.

The second challenge that the subjective nature of flow presents to my research is the impossibility of testing a causal model with data that I collected on flow elements concurrently.

Because I collected data on all of the elements of people's flow experiences at the same time, I cannot make any strong claims about causality. However, I can use survey data (1) to establish that people do experience the flow elements in their work (acknowledging the imperfect measurement discussed above), (2) to rule out as unlikely any relationships that are proposed in the literature and are not supported by my analysis, and (3) to provide support for the plausibility of the proposed relationships that are supported by this research. These three objectives, as well as describing flow in knowledge work practices, are the goals of my empirical work.

Population

I tested the three models of flow using data from the experiences of engineers, scientists, technicians, and technical managers. These people are skilled professionals whose work often involves clear, challenging goals. They report performing well and enjoying their work when they are able to concentrate (Perlow, 1999). In fact, some engineers such as DeMarco and Lister (1999: 63) even argue that "for anyone involved in engineering…flow is a must. …It's only when you're in flow that the work goes well." I interviewed engineers to ensure that they were an appropriate population, to learn about their flow experiences, and to get feedback on my research methods. I now describe my interviews, sampling procedure, measures, and analysis.

Interview Procedures

I interviewed 13 engineers from different fields of engineering about their flow experiences in 24 different jobs, who had worked in 14 different organizations (see Table 1). I asked them what their daily activities consisted of. I asked them if they experienced flow in their work, and if so, how often. I showed them the elements of flow and asked them to use their personal experience to critique these elements. I asked them what factors they believe make a difference in experiencing flow. And I presented the methodology I was planning to use and asked them to critique it. The quote at the beginning of this paper is a description of flow that one of my interviewees provided.

Insert Table 1 about here

The engineers all recognized the flow experience—even if they used different names for the experience (e.g., "in the zone"). Further, almost all of the engineers volunteered that they believe that flow is both a consequential and a desirable part of their work—even though the importance and desirability of flow was <u>not</u> one of my interview questions. This was important, because, by focusing exclusively on flow experiences, I lost the opportunity to see if the concept would emerge as a theoretical entity distinct from other, similar concepts in their experience. Although I cannot, from the interview data, ascertain such differences, the respondents' spontaneous comments about the desirability and consequential-ness of their flow experiences contributed nonetheless to my understanding of their experience, and to the realization that flow may play an important role in complex, dynamic work. Engineers also reported experiencing flow—some to a great degree, and some only occasionally (see Table 1, "% of time in flow"). Some engineers may have inflated their claims about how often they experience flow, but they all claim to experience flow in their work. The engineers also helped plan my data collection—particularly with regards to the items used to measure the merging of awareness and application.

Sample and Sampling Procedure

The population that I sampled from is knowledge worker *experiences*. In other words, even though I surveyed individuals, my unit of analysis was not individuals, but individuals' experiences. I used the experience sampling method (ESM) (Csikszentmihalyi & Larson, 1987). The ESM involves giving individuals a signaling device (such as a pager) and a booklet of surveys. The researcher signals participants a pre-specified number of times each day at random intervals. After participants complete the activity that they were doing when they received a signal, they open the survey booklet and fill out a survey. I was careful to instruct participants to fill out their surveys after completing the activity that they were engaged in (rather than immediately upon receiving the signal) for practical, safety, and research reasons. Filling out the survey after the activity is practical and safe because there are some activities that would be devastating to a person or to their work if they are interrupted. Having people fill out surveys after the activity also enables us to ensure that we do not lose important data. The engineers I interviewed were emphatic that if they we having a flow experience and their pager emitted a signal, they would probably just ignore the signal. Therefore, in order to make sure I did not lose data on high-flow experiences, I told survey respondents to complete the surveys after completing their activities—but to do so immediately after completing the activities, so as to minimize the distance between the experience and the reporting of the experience. Previous research suggests that this approach to the ESM is valid for capturing subjective experiences when subjective experience varies across time, psychological processes that need to be studied in real time, and experiences that need to be recorded as soon after the activity as possible (Beal & Weiss, 2003; Csikszentmihalyi & Larson, 1987).

The engineers, research scientists, technicians, and technical managers who participated in my study were employees of Sandia National Laboratories (SNL). SNL employees conduct research to find “solutions to the problems that threaten peace and freedom,” including nuclear weaponry, energy, infrastructure, computing, arms control, and “emerging threats.” SNL is a laboratory established by the United States Government and run by Lockheed Martin Corporation. It is an ideal setting for studying the subjective experience of knowledge work because its employees focus entirely on the creation and refinement of knowledge (rather than on manufacturing products or providing services). SNL is run by a for-profit firm, and at the time of my research, had a mandate from the U.S. Department of Energy to improve its productivity.

I recruited participation from SNL technical staff (mostly engineers and scientists), technical managers, and technologists (mostly technicians) with the help of SNL employees. SNL management required that employees only be asked to participate on a voluntary basis. Therefore, we sent invitations to approximately 910 technologists, 260 technical staff, and 130 technical managers (reflecting the proportions of each in the organization's population) to participate in an ESM survey using a random sample of names provided by the Human Resources department. 145 people agreed to participate. 120 people received their survey booklets and pagers and returned usable booklets a week later, including 1715 experiences from at least 81 technical staff, 11 managers, and 16 technologists (12 did not indicate their job category). This level of participation is similar to that of other ESM studies (e.g., Csikszentmihalyi & LeFevre, 1989). The participation rate across job categories is roughly equal in proportion to the number of people in each category that we requested participation from. SNL policy prohibited me from being able to collect other non-participation data.

I gave each participant a survey booklet and a pager four days before the study began. Participants attended meetings in which I instructed them on survey procedures, had them fill out a practice survey, and allowed them to ask questions. During the week of the study, I paged the participants at four randomly selected times each day. Participants filled out their surveys after completing the activities they were doing when they received a signal. Participants used the internal mail system to return the surveys and pagers to my contact person in SNL at the end of the week. Participation was anonymous.

Participants filled out surveys for an average of 14.3 out of the 20 signals they received from their pagers. The most common reason for non-response (as participants reported to me on their booklets or independently) was that they received the signal at lunch, at home, or driving to and from work. SNL employees work on staggered schedules (e.g., 5 a.m. to 2 p.m.), and often have every other Friday off from work. I eliminated 190 experiences that did not occur at work, which left 1525 experiences—an average sample of over 12.7 experiences per person.

Measures

The survey booklets that I used in this study each contained one page of instructions, one page of questions about the individual participating in the study, one practice survey, and 20 surveys to be used to assess the individual's experiences during the assigned week. The items in the survey booklet come primarily from Jackson and Marsh's (1996) Flow State Scale (FSS). I used a seven-point Likert-type scale with a response format ranging from 1 ("disagree strongly") to 7 ("agree strongly") to measure each of these items.

Flow elements. I measured eight of the flow elements using three items from the FSS (Jackson & Marsh, 1996) for each element (see Table 2 for the list of items). I also planned to use items from the FSS to measure the merging of "action and awareness." However, the engineers I interviewed claimed that the items on the FSS did not capture their experience of the merging of "action and awareness" because the FSS (which focuses on sports) treats "action" as thoughtless physical movement, as in these survey scales:

- I made the correct movements without thinking about trying to do so.
- Things just seemed to be happening automatically.
- I performed automatically.
- I did things spontaneously and automatically without having to think.

As one engineer that I interviewed argued, “That’s not right. That’s what I do, is think!”

I conducted a focus group with five engineers to develop items for this construct that matched their experience. These engineers argued that “awareness” is the perception of a problem, and “action” is the (often mental) application of engineering principles and skills to the problem. I proposed items to the group that reflected this way of thinking. They critiqued my items, which I then re-worded again and again until we arrived at five items that they agreed describe their flow experiences both at work and in their leisure activities:

- I could tell how to respond to things that came up.
- I could sense why the decisions I made were correct.
- I knew what to do as each circumstance occurred.
- I kept coming up with ideas of things to do.
- I could sense how to perform this activity well.

Using reliability and factor analyses, I dropped the third and fourth items to maximize reliability, convergent validity, and discriminant validity[7] for this factor (see final reliability and factor loadings in Table 4 below). The final wording of these items is consistent with the idea that the construct of “the merging of action and awareness” may be better conceptualized as “the merging of awareness and application.”

I measure “the merging of awareness and application” as a single, experiential construct, and do not measure the individual components of situation awareness and automatic cognitive processing. I do this because even though researchers conceive of situation awareness and automatic cognitive processing as separate cognitive processes, flow is what occurs when these two processes merge into a single experience. People describe this merging of cognitive processes as a single experience, and that is the experience I am trying to tap. One could argue that I should also measure the two processes as antecedent to the flow experience as well. However, measuring situation awareness is problematic because people often overestimate their situation awareness in survey research—particularly when feedback is unclear (Endsley, 1995a). And, as my interviews with the engineers revealed, they may not acknowledge the automaticity of what they are doing if their primary activity is thinking. These are parts of the reasons why scholars generally study situation awareness and automatic processing in controlled settings: they can manipulate variables and infer the cognitive processes from people’s reactions. The measurement of flow as a single construct is less likely to encounter the problems of measuring situation awareness and automaticity alone because the experiential nature of temporally merging awareness and application enables people to sense the quickness of their actions and of the resulting changes in the structural environment. Nevertheless, future work should examine flow in controlled settings where accepted methods for tapping into situation awareness and automatic processing can be compared to experiential survey measures.[8]

I also measured perceived challenge (e.g., “The activity was challenging”) and perceived skill (e.g., “I was capable at doing this activity”) separately from “challenge-skill balance,” following the pattern in earlier flow studies (e.g., Moneta & Csikszentmihalyi, 1996). Tables 2 through 4 contain means, standard deviations, correlations, reliabilities, and confirmatory factor loadings for the variables. These statistics suggest that the distributions of the variables are adequate for analysis—with responses ranging from 1 to 7 on a seven point scale for all items—and that the variables represent their respective constructs well. I also conducted confirmatory factor analyses in which I compared flow elements with Thayer's (1989) subjective measures of energetic arousal and tense arousal to distinguish flow from other commonly studied and subjective experiences. Table 5 contains correlations between the flow factors and the two arousal factors, all of which fall below Kenny's (1998) 0.85 threshold for discriminant validity, which provides at least some evidence for flow elements as unique, distinct constructs.

Insert Tables 2-5 about here

Open-ended questions. I also included three open-ended questions about each experience, which asked participants: (1) "What was the MAIN thing you were doing when you received the signal from the pager? Please be specific." (2) "What other things were you doing?" (3) "What goal (if any) were you trying to accomplish when you received the signal from the pager?" I used the answers to these questions to code all of the experiences into 15 activity categories. I then hired a research assistant to use those categories to code the activities, who independently achieved 88% agreement with me on the activity codes.

Analytical Strategy and Preliminary Analysis

I tested my three models using structural equation modeling. Before analyzing my data, I centered all of the variables to have means of zero—a standard convention in structural equation modeling. Thus, from this point forward, the means of all variables are zero, and the values of the variables range approximately between -3 and 3.

I used two-stage least squares (2SLS) with clustering to estimate model parameters and compare the three models. 2SLS is a data analysis technique that Bollen (1996) has applied to structural equation modeling. It is a non-iterative, equation-by-equation approach to structural equation modeling, which involves first generating instrumental variables from the observed variables, and then using the instrumental variables to represent the latent variables in the model. It is robust in handling deviations from normality, does not allow bias in one area of a model to spread throughout the system of equations, and has methods for dealing with the second-order factors in Models 1 and 2 (Bollen, 2002) and methods for dealing with the possible interaction effects I explored with the separate perceived challenge and perceived skill factors (Bollen & Paxton, 1998). I chose 2SLS, as opposed to a hierarchical linear modeling package (such as HLM) because of the need to model latent variables with second-order factors and interactions in the latent variables. I chose 2SLS over a full information structural equation modeling package (such as LISREL or AMOS), because the observations in my dataset (experiences) are nested hierarchically in individuals. By using 2SLS in Stata (2001), I was able to use the "cluster" command to account for the non-independence of my data (see Mizruchi & Stearns, 2001).

The disadvantage of using 2SLS is that we cannot be as sure of the accuracy of the estimates of the standard error as we would be if we used a full-information estimator. This means that we cannot conduct omnibus tests of the fit of the structural model as a whole. I addressed this issue by first using 2SLS with clustering to account for non-independence and to test individual equations. Then, if the individual equations met the modeling standards of 2SLS, I used a full-information estimator without controlling for non-independence to see if the results were similar and to conduct an omnibus test of model fit.

RESULTS

The “Global Experience” Model

The results for the first model of flow are in Table 6. Table 6 contains three diagnostic columns. The column labeled “Estimate” shows estimates of coefficients and their significance. The column labeled “First-stage R-squared” shows the degree to which the observed variables explain an adequate amount of the variance in the instrumental variable—i.e., whether or not the observed variables load on to the instrumental variable adequately (Bollen, 1996). The second column, “Hansen’s J,” is a statistic with a chi-squared distribution in which the joint null hypothesis is that (a) the un-instrumented variables are valid (i.e., uncorrelated with the error term), and (b) it is correct to exclude them from the estimated equation (Hayashi, 2000). This is the problem with seven of the eight estimated equations in this model: all of them—with the exception of the relationship between flow and feedback clarity—have significant Hansen’s J statistics, meaning that the un-instrumented variables are not valid and/or it is incorrect to exclude them from the equation. Thus, the “Global Experience” model of flow is suspect as an appropriate way to model the relationships between flow elements, even though the estimates of the relationships appear to be significant in the predicted directions.

Insert Table 6 about here

The “Activity-Experience” Model

The results for the second model of flow are similar to those of first model, even if those results are less severe (see Table 7). Although the estimates are significant in the predicted directions, four of the eight estimated equations have significant Hansen's J statistics, again meaning that the un-instrumented variables in this equation are not valid and/or are not correct for inclusion in the equation. The fact that these invalid equations all occur in the second-order factor model of flow, rather than in the independent variables, suggest that it is probably incorrect to use a second-order factor to model the relationship between these constructs.

Insert Table 7 about here

The "Merging Awareness and Application" Model

The results for the third model can be found in Table 8 and Figure 4. Table 8 contains statistics for judging the appropriateness of model equations, path coefficients, and their significance. Figure 4 provides a visual image of the results of the structural model, including R-squared statistics for each of the endogenous variables. All Hansen's J statistics are non-significant, all first-stage R-squared values are sufficiently large, and all relationships between flow elements are significant in the directions predicted with the exception of feedback clarity on concentration and challenge-skill balance on flow. While this does not prove that the merging of awareness and application is the "correct" way of defining flow, it fails to refute such a conceptualization and suggests that it is a better conceptualization than either of the models that treat flow as a second-order factor. The R-squared statistics in Figure 4 suggest that even though this analysis supports the model as conceptualized, much of the variance in the endogenous flow elements remains to be explained by constructs other than the flow elements alone.

Insert Table 8 and Figure 4 about here

2SLS with clustering provides compelling evidence for giving preference to a conceptualization of flow as the merging of awareness and application over the second-order factor models of flow. However, the disadvantage of 2SLS is that we cannot estimate the fit of the model as a whole. Therefore, I also computed the third model in Amos (1999). Amos does not account for the fact that the experiences I measured were nested in individuals, though, so the results of this analysis should be treated with caution.

The estimates for the relationships in the model can be found in Table 8, in the column labeled "Amos," and the fit indices can be found in the bottommost row of the table. The estimates generated by Amos are similar to those generated with 2SLS, but all 11 of the proposed relationships are significant. Also, although the chi-squared statistic was significant, the other three measures each suggest acceptable model fit (Hu & Bentler, 1998; Cudeck & Browne, 1983). Therefore, these results provide further support for the model as a whole.[9]

Exploratory Analysis

Data from knowledge workers in SNL support most of the relationships in the model of flow as the merging of awareness and application. However, a review of the correlation table reveals that other relationships, not included in the model, also have relatively large correlations. Therefore, I also conducted exploratory analyses and found four changes that could be made to the model and that are significant in my data, and would be worth testing in future research. For example, it appears that "challenges and skills that are high and in balance" and "the transformation of time" could both have a positive and significant effect on the autotelic experience. People may find activities to be more enjoyable when time passes without them noticing because the awareness of time can be a source of worry or concern in contemporary life that people are glad to do without from time to time. Further, when I use my “perceived challenge” and “perceived skill” measures to separate the effect of challenges and skills out of the “challenges and skills that are high and in balance measure, it appears that what people—or at least the knowledge workers in my sample—really enjoy is work that is challenging. People may find challenging work to be enjoyable beyond the mediating effects of concentration and flow because “challenge” is a way to frame a difficult activities in a positive way, or because challenging work may be an organizational signal that an individual is considered capable.

Two other possible changes include a relationship between concentration and control and a relationship between goal clarity and feedback clarity. People who concentrate may experience an increased sense of control based on their increased effort, irrespective of whether or not that concentration enables them to merge awareness and application. For example, if an activity is not very dynamic, then people may be able to respond to emerging cues slowly and deliberately, making the automatic application of knowledge and skills less important. Also, there appears to be a significant relationship between goal clarity and feedback clarity. This makes sense because people derive feedback from activities by using their goals to discern which cues provide information about progress toward the goal, and therefore should be treated as feedback. The clearer a goal is, the more a person can discern feedback in a situation. I found support for this explanation by conducting mediation analyses (Baron & Kenny, 1986). I found that feedback clarity mediates most of the effect of goal clarity on the merging of awareness and application.

Flow by activity.

The goal of my research is to develop a more precise and better-positioned conceptualization of the flow construct. To do this, I developed a refined definition and model of flow, and established their plausibility through theoretical argument and empirical analysis in a knowledge work context. However, my intent is not only to position flow relative to other flow elements, but also to position flow relative to the practice of work. Therefore, having established some plausibility for defining flow as the merging of awareness and application, it is now useful to look for trends in the kinds of work practices that people are more or less likely to experience flow in. I used activity categories and job types to examine what types of employees experience flow in what types of activities. The results of this analysis can be found in Table 8. Based on this analysis, I make the following observations:

- 66.3% of the activities that the participants were doing when signaled involved writing/written communication, individual analytical activity, conversations about work, and formal meetings.[10]

- The lowest average flow scores occurred in activities in which people are not engaged in regular work activities: "training/receiving training," "other activities not related to work," "other/uncodeable activities," and "conversations unrelated to work".

- The highest overall average flow score occurred when people were doing "individual physical activity," such as soldering, calibrating equipment, or assembling prototypes. This was also the highest flow score for technical staff (the engineers and scientists).

- The highest average flow score for managers was "between activities" (i.e., walking someplace, waiting). However, analysis of survey responses reveals that in five of these six events, managers were engaged in serious conversations or were thinking about an issue, even though they listed walking or waiting as their primary activity.

- The highest average flow score for technologists (and second-highest for managers) was fixing things—either physical hardware or computer software.
- Technologists had the highest average flow score of the three job categories.

Insert Table 9 about here

Based on the results of this analysis, we can begin to identify types of practices in which people may be more or less likely to experience flow. One characteristic that distinguished activities in this sample is that people experienced flow more often in work activities than in non-work activities. This result provides further support Csikszentmihalyi and Lefevre’s (1989) observation that people appear to experience flow more often in work than in leisure, perhaps because it offers clearer goals and more challenge, and requires more skills than many of the leisure activities people engage in. Further, the highest average flow scores occurred in activities that involved interaction with physical objects (soldering, building prototypes, fixing things), and for technicians, whose work generally involves interacting with physical artifacts (Barley, 1996). It may be that activities that involve interaction with the physical world may be easier to achieve flow in because physicality—with the visual, auditory, and tactile data it provides may make it easier for people to achieve clarity in their goals, feedback, and awareness. However, given that managers experienced flow most often in conversations or in thinking, it may be that this physicality/non-physicality distinction has more to do with the interests or disposition of the individual than the nature of the activity itself—a question that can be settled in future research.

DISCUSSION

My purpose has been to establish a theoretical and empirical case for re-defining flow. I argued that the existing definitions and models of flow have not been supported empirically, confound activity characteristics and experiential outcomes, and do not differentiate flow from its indicators. This makes it difficult to argue that flow is more than an epiphenomenon, and makes it difficult to explain relationships among flow elements and relationships between flow and other constructs of interest to organizational scholars. In contrast, if we define flow as the experience of merging of situation awareness with the automatic application of activity-relevant knowledge and skills, we eliminate the problems associated with the other definitions and models, we can understand why flow elements do not always occur simultaneously, and we define flow in a way that matches people's descriptions of their experiences and opens up possible explanations for organizational behavior. My empirical analysis supported my assertions about the implausibility of existing models and about the plausibility of the new definition and model. Therefore, I now explore the implications of this definition for both the psychological study of flow and for the role of flow in work practices and organizing.

The Psychology of Flow

I use this research to make three contributions to the psychological study of flow. My first contribution is to show that people experience flow in domains that flow researchers have left relatively unexplored. I do this by conducting what may be the first study that measures flow in knowledge work. (It may even be the first study that measures flow in work, as Csikszentmihalyi and LeFevre (1989) did not measure flow as a distinct construct.) My interviews and survey data suggest that people can and do experience flow in knowledge work, that the measures I used appear to capture these experiences relatively well, and that there is at least some evidence that these experiences are consequential in their effects.

My second contribution is a definition of flow that helps us to better understand the flow experience. The experience of merging situation awareness with the automatic application of activity-relevant knowledge and skills even enables us to explain why people use paradoxical terms to describe flow experiences, such as: a “sense of aimless aiming” (Barrett, 1998: 614), “a balance between surrender and active participation” (Eisenberg, 1990: 147), or “surprising, yet nothing would surprise me” (Russell & Branch, 1979: 157). If people are using controlled cognitive processing to establish and maintain a complete awareness of the circumstances involved in the activity they are participating in, then they will have a sense of consciously “aiming,” “actively participating,” and scanning for potential and real “surprises.” However, if people also have knowledge and skills that are sufficiently honed to deal with the surprises that may and do arise, they respond spontaneously and effortlessly, experiencing a sense of “aimlessness,” “surrender,” and lack of surprise in their experience of the situation.

This definition of flow also enables a third contribution, which is a theoretically and empirically defensible model of Csikszentmihalyi’s (1990) nine flow elements. This model treats the nine flow elements as interrelated, but not as indicators of a second-order psychological state. A new definition of flow makes this model possible because, with a specific description of what the flow state consists of, we are now able to explain how and why flow elements act as antecedents or consequences of the merging of awareness and application.

The model was not supported perfectly, however. Three issues are worth noting in particular. First, the relationships between feedback clarity and concentration, and between the challenge-skill balance and flow were not supported in the 2SLS analysis. Feedback clarity may actually be a result of goal clarity—because clear goals help people determine which cues to treat as feedback—and as such, much of the variance that might have been explained by feedback clarity was explained by goal clarity. In fact, exploratory analyses also suggest that the lack of effect of the challenge-skill balance on flow may also be attributable to the fact that goal clarity and feedback explain so much variance—perhaps the most important skill in achieving flow is knowing how to develop clear goals and use them to extract clear feedback so that a person is fully aware of a situation and able to respond automatically. Second, exploratory analyses suggest four additional relationships that could be added to the model, which I discussed previously. And third, the effects of concentration on the loss of self-consciousness and on the transformation of time are weak, explaining two percent and less than one percent of the variance in each construct, respectively. These relationships are probably only significant because of sample size. I propose that these relationships are largely insignificant because some activities require people to be cognizant of time and of the opinions of others, making time and opinions a part of situation awareness, and some do not. Future research should examine these possibilities.

Relationships in this revised model of flow also make a fourth contribution possible. We can now explain that Csikszentmihalyi’s (1990: 49) interviewees do not always include all nine of the flow elements in their descriptions of their flow experiences because these nine elements are only imperfectly related. We should not expect all of them to be part of the flow experience every time. In fact, the variance explained in endogenous flow factors suggests that other constructs are also needed to truly understand the experience of flow in knowledge work. And scholars can easily bring new organizational, social, and psychological constructs into the study of flow now because they no longer have to explain how constructs affect a psychological state that is only understood in terms of its indicators. Thus, scholars may propose that people are more likely to concentrate when an activity is interesting or meaningful to them, or that people are more likely to experience the merging of awareness and application when they have local (versus general) knowledge for the activity they are engaged in. The possibilities are exciting—especially when we bring the flow into the study of work practices and organizing.

Flow in Work Practices and Organizing

My arguments, evidence, and discussion thus far focus primarily on establishing the plausibility of my revised definition and model of flow in the study of knowledge work. I now explain why we can consider flow to be a high performance experience, and suggest ways in which flow can affect the practice of knowledge work and post-industrial forms of organizing. The claims I make are, of course, subject to further empirical examination. However, we could not make these claims or any like them without first having developed a clearer definition and model of flow.

Performance and complex, dynamic work. I have argued that flow is an experience of performing well within an open-form, intersubjectively-judged situation. This performance is subject to a number of constraints, including the definition of the situation, the perceptions of relevant constituents, the effort of the person performing, and the possible tenuousness of situation awareness. However, I also argued that if knowledge work practices involve situated, intersubjective applications of performance standards—altering the meaning of ideas like innovation, learning, or communication variable from activity to activity—then flow, because it is the experience of making these applications in an aware and automatic way, provides us with a consistent way of understanding performance within and across work practices.

The practices in which flow occurs are important for other reasons as well. For example, the definition of flow suggests that flow may be especially important in practices that are both complex (because situation awareness enables the comprehension of complexity) and dynamic (because automatic application enables quick response). In fact, it may be that the more complex and dynamic an activity is—assuming that the activity cannot be simplified or slowed down—, the more necessary flow becomes. The justification for this assertion is clearest if we begin by considering complexity and dynamism separately. For example, if activities are complex, people can complete activities by ignoring the complexity (which would usually lead to low quality results), by simplifying the activity (e.g., breaking it into components, which moves some of the complexity to the activity of coordination between components), or by developing an understanding of the activity in its full complexity (situation awareness). Similarly, if activities are dynamic, people can respond slowly (and likely perform poorly or fail completely), do something to slow the activity down (e.g., get the deadline extended), or respond automatically to emerging cues (automatic application). Therefore, if a situation is complex and dynamic, and it cannot be simplified or slowed down, then it appears by definition that a person must be able to achieve situation awareness and respond automatically and skillfully—i.e., experience flow— to be able to perform the activity. Some knowledge work may be irreducibly complex and dynamic, such as developing mathematical models to represent actual complex, dynamic systems, or conducting an experiment on irradiated material in a treated room within a specified amount of time. Complexity and dynamism are not binary constructs, however, which is why changes in the way we define an activity can make flow more or less necessary, and also why I claim that *as* an activity increases in complexity and dynamism (and cannot be slowed or simplified), flow becomes *increasingly* necessary to complete the work.

Flow in work practice and organizing. We can use the concept of flow not only to understand high performance experiences and the completion of complex, dynamic work, but also to help us understand the evolution of work practices and organizing. I have been careful to note, as I have described the role that flow plays in work settings, that flow is most likely to occur as people engage in work practices. This is because practices are situated (i.e., unique, different from previous experiences, but bounded in time and space), recurring (thus giving people opportunities to develop skills), and have intersubjectively defined performance standards (Barnes, 2001; Orlikowski, 2002)—characteristics typical of flow activities (Csikszentmihalyi, 1990). However, practices are also activities in which people exercise their individual agency as the "engagement of structural environments" (Emirbayer & Mische, 1998). As a result, practice theorists will see many similarities between flow and the study of organizational practices, as in Feldman and Pentland's (2003) observation that people who perform organizational routines show evidence of both a flexible awareness of the unique circumstances involved with each individual performance of the routine, but also an ability to perform the abstract structure of those routines automatically and skillfully. When people merge this awareness and automaticity, they are using their agency to enact the structures embedded in their repertoire of activity-relevant knowledge and skills. If agency is "the temporally constructed engagement by actors of different structural environments," where the temporality of the engagement comes from applying the habits of past experience (automatically-applied knowledge and skills) to the activity of judging how to act now in ways that will bring about an imagined future (an awareness of current meanings and a projected future) (Emirbayer & Mische, 1998), then there is no experience that would involve more temporal engagement than flow.

If flow is a way of expressing a person's agency as maximally as a person can, and it is through the expression of agency that people create, alter, or maintain structure (Giddens, 1984), then we should expect flow to have a significant effect on the structure of work practices and forms of organizing. For example, some people, including engineers in my study, cooks in Fine's (1996) research, and musicians in Eisenberg's (1990) research claim that they engage in their practices again and again because of the opportunity it gives them to experience flow. This happens in part because of the enjoyment that people derive from the flow experience: people tend to continue doing things they enjoy and, when possible, tend to discontinue activities they do not enjoy. However, people may also create, maintain, or change work practices in order to experience flow because their work is complex and dynamic, or because they are trying to improve their performance. If this is the case, then each time a person engages in a particular practice, then he or she may use the degree to which they experience flow and their perceptions about what made flow possible to adapt their approach in ways that will make flow more likely in the future.

If people perform well when they experience flow in their work, need flow to complete some work, derive enjoyment from experiencing flow, and even adjust their work practices in order to experience more flow or to experience flow more often, then we should not be surprised to also find people organizing their work in ways that will help increase their experience of flow. If this is the case, then the experience of flow in work may also help us to understand some of the new forms of organizing in a post-industrial society (Barley & Kunda, 2001). And, in fact, there is some evidence to suggest that this is the case. For example, if flow is necessary to complete some forms of work, as engineers both in and out (DeMarco & Lister, 1999) of my study claim, then we should find people orchestrating work arrangements that make flow experiences more likely. For example, some engineers claim that they organize their work temporally in order to experience flow in work, coming in early or leaving late. In organizations where frequent interruptions are a cultural norm, the ability to concentrate on a clear, challenging goal long enough to achieve situation awareness may require formal intervention of work before or after regular hours to get work done (Perlow, 1999). Or people could arrange to work in different spaces—e.g., telecommuting—to create the circumstances they need for flow.

Flow would not be the only motivation for unique temporal or geographical working arrangements, and may often not be a consideration at all. Claims that flow is a consideration in such arrangements are common, however, with some people claiming that flow plays a major role in career decisions. For example, I interviewed one engineer, working on his MBA, who told me a story about doing research on compensation at a design house in Italy. He and his partners interviewed the CEO, who was surprised at the questions the MBAs were asking him. Finally, he told the MBAs that he paid his people well, but that they did not have fancy benefits because the reward that his people got for working there was that they got to do work that they could experience flow in. The MBA I was interviewing was confused at first, but then said, "When I took off my management hat and put on my engineering hat, I realized, 'Oh yeah, that's why I became an engineer in the first place!'" His story suggested that flow can motivate career choices—years of a person's life, if not their entire adult work experience. And even if people end up in jobs in which flow is more difficult to achieve than expected, it appears that it is not uncommon for people to craft their jobs in ways that will both increase their flow experiences and, consequently, affect the way work is organized (Seligman, 2002).

Limitations

A more precise and better positioned flow construct opens many opportunities for organizational scholars. Before I conclude, however, I need to address some theoretical and methodological limitations in my research.

Healing the "spirit" of flow. Csikszentmihalyi (1992) has expressed concerns that a precise definition might over-objectify flow and "break its spirit." If so, then I am guilty of just such an accusation. After all, when people describe their flow experiences, they often do so with a sense of awe or wonder—awe and wonder that people are not likely to feel when they read a definition like "the experience of merging of one's situation awareness with the automatic application of activity-relevant knowledge and skills."

Any effort to make a concept like flow more theoretically and empirically defensible is likely to lose something in the process. Fortunately, we can now step back and ask what we are missing. While we may not ever be able to answer that question fully, we can answer with some certainty—given my observation that people often describe their flow experiences with a sense of awe or wonder—is that at least one piece missing from this conceptualization of flow is affect. People may not be conscious of their emotions during their flow experiences (Csikszentmihalyi, 1997), but people must, nevertheless, be affectively aroused in order to have such intense experiences. Some scholars even suggest a relationship between optimal arousal and flow (Jones, Hollenhorst, Perna, & Selin, 2000). Future research should examine this relationship, as well as the relationship between flow and affective arousal generally.

Methodological limitations. We could also improve on this study by conducting similar research in controlled settings or in other organizations. Research in controlled settings would make it possible to examine flow with "objective" measures of challenge and skill, to include an examination of situation awareness and/or automaticity separate from flow, and to examine the effect of flow on “objective” measures of performance. Research in other organizations would expand the external validity of my findings, and could also address this study’s problem of a low participation rate. Future research could address these issues, and begin to explore the possibility of using flow to help explain other organizational phenomena.

Conclusion

Organizational scholars often argue that flow is consequential in organizations, but we have never clarified what it is or why it matters until now. I argued that flow matters because it is a high performance experience, consistent within and across work activities—even when externally-imposed performance standards are not. In a world where performance standards shift or take on different meanings, problems have open-form solutions, and knowledge as competent activity is central to competitive advantage, flow gives us new insight into the meaning of high performance. Certainly, this is worthy of our continued attention as organizational scholars.

Footnotes

1. These elements are closely related to each other. As such, some readers have suggested that some of these elements seem similar conceptually. I will distinguish these elements shortly, after I discuss the conceptual models, because I redefine the “merging of action and awareness” as I describe the third model.

2. This does not mean that people know in advance whether or not their challenges and skills will be in balance—although they may have opinions. It may often be something that people can only learn in practice—diving in, making adjustments as they go, redefining the task in situ until they intuit (from how aware they perceive themselves to be and how automatically they are responding) that their challenges and skills are in balance. Further, the condition of challenges and skills that are high and in balance can exist, even if people cannot tell for sure whether or not they will meet the condition ahead of time.

3. Feedback, then, is more likely to an interpretation of cues derived from the unfolding activity than verbal feedback from bosses or co-workers.

4. Some readers may be interested in the similarity between Csikszentmihalyi’s (1990) claim that people are more likely to experience flow when challenges and skills are high and in balance, and McClelland’s (1958) observation that people with a high need for achievement predisposes people to take moderate risks rather than extremely speculative or safe risks. The explanation that McClelland offered for his observation was that a person with high need for achievement would find little satisfaction in low risk activities, and would either fail to satisfy achievement needs or would have to attribute some of the achievement to circumstances beyond his or her control. Thus, according to McClelland’s research, people

with a high need for achievement are more likely to engage in activities where there is a relative balance between challenge and skill. This should, according to the research on flow, make people with a high need for achievement more likely to experience flow than people who are not high in their need for achievement, but to my knowledge, no one has ever tested this proposition.

5. Although people may not be worried about what others think of them during a flow experience, they still use standards that they learned at least in part from others to know how to construct the goals that define the activity and interpret the feedback that indicates its quality. Thus, people may not be thinking about others' opinions during a flow experience, but the influence of others on the activity exists nonetheless.

6. The fact that people who achieve situation awareness project the status of elements in the environment into the future does not mean that these people are focusing on the future; they are focused on acting in the present. However, action in the present requires at least some anticipation of the one's own behavior, and of the behavior of elements in the environment.

7. The items for the merging of awareness and application may seem similar to self-efficacy. This should be expected, as I discussed previously, because of the similarities in the constructs. The wording of the items for the merging of awareness and application, however, also maintain the distinctions between efficacy and flow, and I worked closely and extensively with engineers to develop items that also closely mirrored the experiential distinction between flow as the merging of awareness and application and constructs like efficacy. Nevertheless, future research should also be devoted to further clarifying the empirical distinctions between these constructs.

8. Not only did I treat flow as a single experience of merging awareness and application, but I measured it, like the other flow elements, as a continuum. In other words, I assume that rather than there being only two states, “in flow” and “out of flow,” that people can experience greater or lesser degrees of merging situation awareness with the automatic application of activity-relevant knowledge and skills.

9. I also tested models in which I treated challenge and skill as separate constructs, rather than use Jackson and Marsh’s (1996) items for “challenges and skills that are high and in balance.” These tests included both direct effects as well as interaction and quadratic effects. Separate measures of challenge and skill did not improve model performance in any case, and made construct validation more difficult. This may be because terms such as “challenge” and “skills” are relative—the challenge of a task or the skills of a person are high or low *depending on what they are compared to*. Presumably, this relative nature of the challenge and skill constructs created the problems with convergent and discriminant validity.

10. Conversations (including meetings) are among the most common flow activities (Csikszentmihalyi, 1990), as people can comprehend and respond automatically to conversations, and because people often have skills, clear, challenging goals, and clear feedback in conversational activities.

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Figure 1. Flow as a psychological state indicated by nine flow elements.

Flow

- Challenge-skill balance
- Goal clarity
- Feedback clarity
- Concentration
- Merging of action and awareness
- Sense of control
- Autotelic experience
- Loss of self-consciousness
- Transformation of time

Figure 2. Flow as a psychological state indicated by six flow elements.

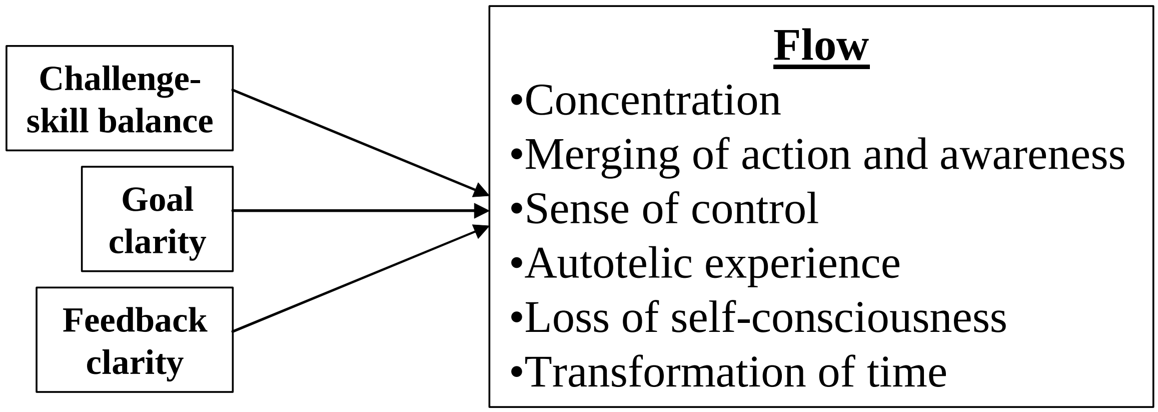

Figure 3. Flow as the Experience of Merging of Awareness and Application

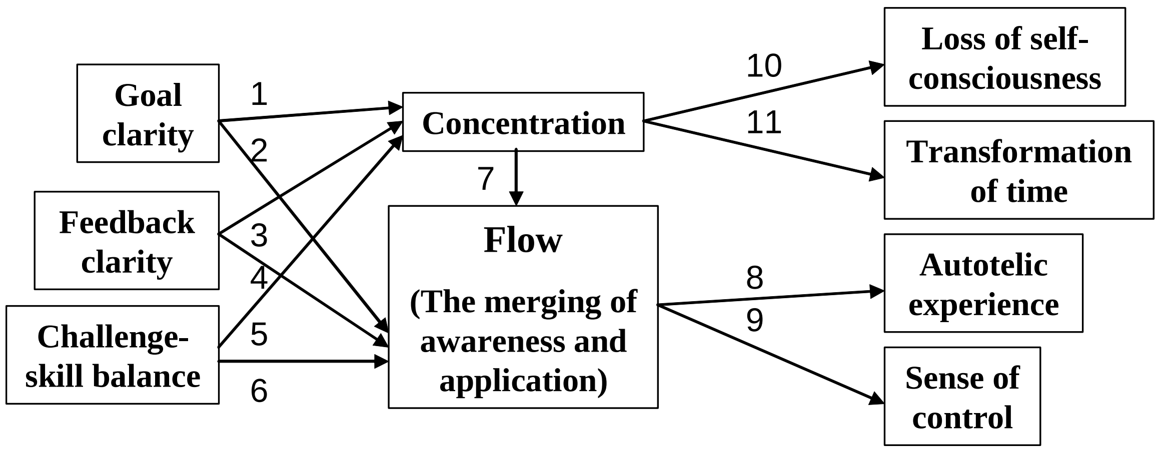

Figure 4. Flow as the Experience of Merging Awareness and Application: Results

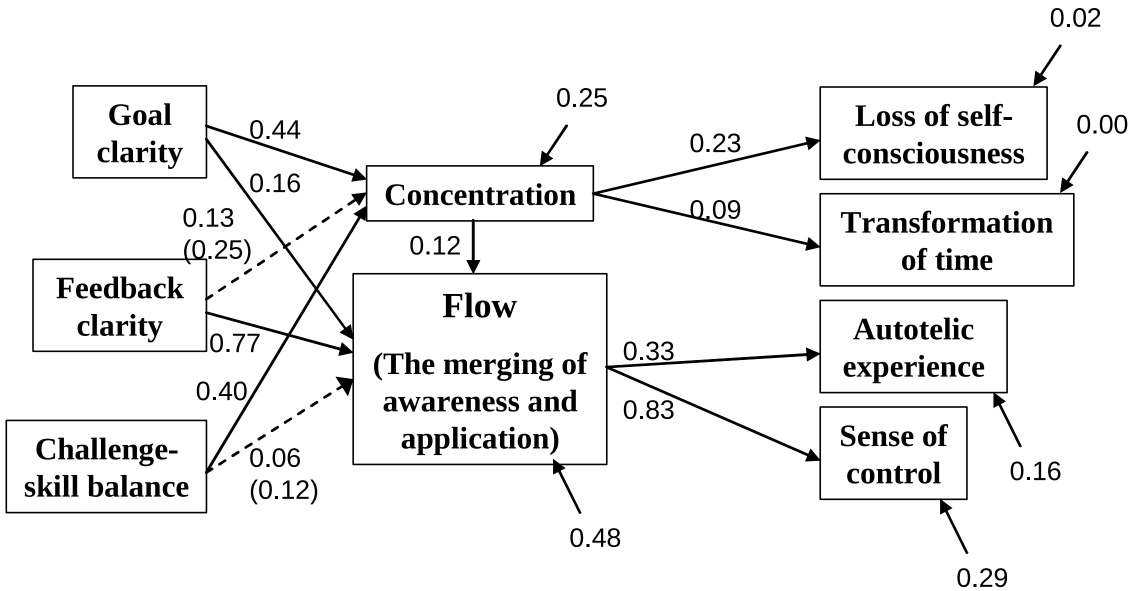

Table 1. Engineers and reports of time spent in flow

Engineer	Sex	Company	Training	Job description	% of time in flow
1	M	Allied Signal	Electrical	Software testing	30%
				Hardware testing	36%
				Test equipment designer	50%
		IBM	Electrical	Research scientist	50-60%
2	M	Visteon	Mechanical	Lead systems engineer - climate control	25-30%
3	M	Hughes Aerospace	Mechanical	Antennae modification	20-25%
			Mechanical	Systems lead	30%
4	M	Not reported	Mechanical	Engineering lead, design	"Often, but usually before 8 or after 5"
5	F	Visteon	Not reported	Systems engineer, Escape current model, climate control	80-90%
				Forward model design	40%
				Process engineer	80-90%
6	M	Visteon	CAD	Design	50-67%
7	M	Ford	Mech./ Biomech.	Consultant	5-10%
		Allied Signal	Mech./ Biomech.	Consultant	30%
		Work Group Technology	Mech./ Biomech.	Assistant to VP of NPD	30%
8	M	Schlumberger	Mechanical	Software engineer	25%
		GM	Mechanical	Senior analyst	25%
		MDI	Mechanical	Advisory engineer	80%
9	F	Hughes Aerospace	Mechanical		25-30%
		Lockheed	Mechanical		25-30%
10	M	Xactware	Software	Software programmer	30-40%
11	M	Balance Dynamics	Mechanical	Researcher/ product design	5-10%
12	F	Boeing	Mechanical	Senior design engineer	5%
13	M	Sandia Nat'l Labs	Mechanical	MEMS mechanical designer	40%

Table 2. Means and Standard Deviations

Variable	Obs.	Mean	Std. Dev.
Perceived Challenge: "The activity was challenging"	1504	4.48	1.65
Perceived Challenge: "This is a demanding activity"	1501	4.26	1.67
Perceived Challenge: "This activity is difficult"	1500	4.06	1.73
Perceived Challenge: "This is a challenging activity"	1502	4.32	1.68
Perceived Skill: "I was skilled"	1505	5.43	1.07
Perceived Skill: "I was capable at doing this activity"	1498	5.78	0.94
Perceived Skill: "I was competent"	1502	5.63	0.96
Perceived Skill: "I was skillful"	1501	5.41	1.04
Challenge-Skill Balance: "I was challenged, but I believed my skills would allow me to meet the challenge"	1504	4.68	1.54
Challenge-Skill Balance: "My abilities matched the high challenge of the situation"	1495	4.85	1.40
Challenge-Skill Balance: "I felt I was competent enough to meet the high demands of the situation"	1498	5.31	1.24
Goal Clarity: "I knew clearly what I wanted to do"	1507	5.73	1.11
Goal Clarity: "I had a strong sense of what I wanted to do"	1502	5.73	1.08
Goal Clarity: "I knew what I wanted to achieve"	1503	5.84	0.99
Feedback Clarity: "I was aware of how well I was performing"	1504	5.21	1.08
Feedback Clarity: "I had a good idea about how well I was doing"	1504	5.40	1.06
Feedback Clarity: "I could tell by the way I was performing how well I was doing"	1499	5.13	1.09
Energetic arousal: "I felt active"	1487	5.16	1.36
Energetic Arousal: "I felt energetic"	1503	4.75	1.37
Energetic Arousal: "I felt full of vitality"	1499	4.24	1.44
Tense Arousal: "I felt anxious"	1498	3.29	1.64
Tense Arousal: "I felt intense"	1504	4.04	1.60
Tense Arousal: "I felt tense"	1500	3.17	1.51
Merging: "I could tell how to respond to things that came up"	1496	5.38	1.14
Merging: "I could sense why the decisions I made were correct"	1498	5.36	1.15
Merging: "I knew what to do as each circumstance occurred"	1502	5.41	1.06
Merging: "I kept coming up with ideas of what to do"	1495	4.96	1.29
Merging: "I could sense how to perform this activity well"	1499	5.10	1.27
Concentration: "My attention was focused entirely on what I was doing"	1505	5.17	1.47
Concentration: "I had total concentration"	1501	4.90	1.40
Concentration: "I was completely focused on the task at hand"	1500	4.92	1.43
Sense of Control: "I felt in total control of what I was doing"	1497	5.13	1.44
Sense of Control: "I had a feeling of total control"	1496	4.80	1.41
Sense of Control: "I felt in total control"	1497	4.77	1.45
Autotelic Experience: "I loved the feeling and want to capture it again"	1499	3.75	1.45
Autotelic Experience: "The experience left me feeling great"	1498	3.99	1.42
Autotelic Experience: "I found the experience to be extremely rewarding"	1499	4.14	1.49
Loss of Self-Consciousness: "I was *not* concerned with what others may have been thinking of me"	1503	5.27	1.53
Loss of Self-Consciousness: "I was not concerned with how I was presenting myself"	1495	5.15	1.50
Loss of Self-Consciousness "I was not worried about what others may have been thinking of me"	1496	5.22	1.46
Transformation of Time: "Time seemed to alter (either slowed down or sped up)"	1500	3.76	1.33
Transformation of Time: "The way time passed seemed to be different from normal"	1496	3.65	1.32
Transformation of Time: "It felt like time stopped"	1498	3.29	1.32
Goal Importance: "To what extent do you think that this goal is a good goal to shoot for?"	1314	5.99	1.03
Reasonable Risks: "The system allowed me to take necessary, feasible risks"	1487	4.77	1.21
Contribution: "This activity contributes to the productivity of SNL"	1502	5.41	1.46

Table 3. Correlations.

	Variables	1.	2.	3.	4.	5.	6.	7.	8.	9.	10.	11.	12.	13.	14.	15.	16.	17.	18.	19.	20.	21.
1.	Perc. Chall. 1	1.00																				
2.	Perc. Chall. 2	0.74	1.00																			
3.	Perc. Chall. 3	0.74	0.75	1.00																		
4.	Perc. Chall. 4	0.79	0.78	0.79	1.00																	
5.	Perc. Skill 1	0.36	0.28	0.19	0.31	1.00																
6.	Perc. Skill 2	0.13	0.08	-0.09	0.09	0.61	1.00															
7.	Perc. Skill 3	0.16	0.13	0.00	0.13	0.72	0.74	1.00														
8.	Perc. Skill 4	0.27	0.21	0.12	0.24	0.78	0.66	0.78	1.00													
9.	P. Ch.-Sk. Bal. 1	0.74	0.67	0.55	0.65	0.45	0.24	0.31	0.37	1.00												
10.	P. Ch.-Sk. Bal. 2	0.46	0.42	0.32	0.50	0.55	0.45	0.51	0.56	0.52	1.00											
11.	P. Ch.-Sk. Bal. 3	0.33	0.25	0.23	0.31	0.61	0.55	0.63	0.66	0.41	0.68	1.00										
12.	Goal Clarity 1	0.15	0.10	0.07	0.10	0.49	0.49	0.51	0.46	0.23	0.37	0.47	1.00									
13.	Goal Clarity 2	0.24	0.17	0.14	0.18	0.53	0.52	0.58	0.51	0.31	0.45	0.52	0.77	1.00								
14.	Goal Clarity 3	0.16	0.12	0.11	0.14	0.48	0.53	0.58	0.48	0.24	0.42	0.50	0.74	0.78	1.00							
15.	Fdbk Clarity 1	0.21	0.12	0.16	0.17	0.47	0.36	0.45	0.47	0.27	0.40	0.48	0.53	0.55	0.53	1.00						
16.	Fdbk Clarity 2	0.15	0.07	0.10	0.11	0.49	0.44	0.50	0.50	0.24	0.38	0.48	0.58	0.59	0.61	0.78	1.00					
17.	Fdbk Clarity 3	0.32	0.20	0.23	0.26	0.57	0.43	0.53	0.60	0.37	0.47	0.57	0.53	0.57	0.53	0.72	0.72	1.00				
18.	Energ. Arsl. 1	0.50	0.42	0.35	0.42	0.47	0.34	0.40	0.38	0.56	0.41	0.41	0.34	0.44	0.37	0.29	0.31	0.40	1.00			
19.	Energ. Arsl. 2	0.48	0.34	0.36	0.44	0.39	0.27	0.25	0.33	0.42	0.43	0.38	0.35	0.40	0.36	0.39	0.39	0.41	0.61	1.00		
20.	Energ. Arsl. 3	0.49	0.41	0.40	0.48	0.42	0.25	0.31	0.39	0.48	0.51	0.41	0.31	0.36	0.32	0.37	0.33	0.46	0.56	0.71	1.00	
21.	Tense Arsl. 1	0.31	0.26	0.38	0.28	-0.07	-0.20	-0.17	-0.11	0.20	0.01	-0.04	-0.07	-0.05	-0.07	-0.03	-0.10	-0.03	0.08	0.06	0.09	1.00
22.	Tense Arsl. 2	0.48	0.44	0.51	0.47	0.22	0.04	0.10	0.17	0.42	0.30	0.24	0.16	0.22	0.17	0.17	0.14	0.21	0.41	0.48	0.54	0.41
23.	Tense Arsl. 3	0.25	0.26	0.36	0.31	-0.06	-0.21	-0.19	-0.09	0.18	0.04	-0.02	-0.10	-0.08	-0.10	-0.07	-0.15	-0.09	0.03	0.06	0.13	0.70
24.	Merging A&A 1	0.24	0.16	0.13	0.18	0.61	0.49	0.53	0.54	0.31	0.42	0.52	0.57	0.54	0.51	0.56	0.59	0.60	0.35	0.37	0.34	-0.08
25.	Merging A&A 2	0.21	0.13	0.15	0.17	0.52	0.45	0.45	0.52	0.27	0.41	0.52	0.57	0.61	0.54	0.66	0.69	0.64	0.34	0.46	0.37	-0.09
26.	Merging A&A 3	0.13	0.05	0.05	0.08	0.51	0.52	0.57	0.57	0.21	0.44	0.54	0.59	0.61	0.63	0.61	0.69	0.61	0.29	0.38	0.30	-0.15
27.	Merging A&A 4	0.44	0.36	0.40	0.41	0.46	0.28	0.36	0.44	0.44	0.47	0.47	0.36	0.43	0.41	0.46	0.47	0.58	0.41	0.44	0.47	0.08
28.	Merging A&A 5	0.22	0.22	0.05	0.19	0.59	0.61	0.65	0.65	0.39	0.49	0.55	0.49	0.54	0.50	0.52	0.58	0.64	0.41	0.36	0.41	-0.20
29.	Concentration 1	0.37	0.32	0.32	0.37	0.34	0.25	0.29	0.29	0.37	0.37	0.34	0.39	0.44	0.40	0.37	0.38	0.41	0.48	0.47	0.42	-0.01
30.	Concentration 2	0.40	0.32	0.34	0.36	0.34	0.21	0.27	0.27	0.39	0.36	0.32	0.35	0.41	0.36	0.40	0.40	0.43	0.48	0.48	0.48	0.01
31.	Concentration 3	0.40	0.32	0.32	0.38	0.34	0.25	0.30	0.29	0.39	0.39	0.35	0.35	0.43	0.38	0.39	0.40	0.46	0.47	0.49	0.48	-0.01
32.	S. of Control 1	0.16	0.09	0.04	0.12	0.42	0.45	0.45	0.40	0.23	0.38	0.43	0.51	0.49	0.48	0.49	0.55	0.51	0.39	0.40	0.38	-0.22
33.	S. of Control 2	0.21	0.11	0.08	0.15	0.45	0.40	0.47	0.44	0.25	0.40	0.43	0.43	0.45	0.43	0.50	0.56	0.56	0.39	0.40	0.44	-0.16
34.	S. of Control 3	0.19	0.09	0.06	0.14	0.44	0.40	0.47	0.44	0.24	0.39	0.43	0.43	0.45	0.43	0.51	0.56	0.58	0.38	0.39	0.45	-0.19
35.	Auto. Exp. 1	0.43	0.38	0.35	0.40	0.29	0.16	0.22	0.25	0.42	0.44	0.32	0.22	0.28	0.23	0.31	0.28	0.37	0.43	0.52	0.64	-0.00
36.	Auto. Exp. 2	0.43	0.40	0.33	0.42	0.35	0.25	0.31	0.33	0.45	0.48	0.38	0.28	0.34	0.30	0.34	0.33	0.45	0.50	0.55	0.70	-0.02
37.	Auto. Exp. 3	0.52	0.41	0.46	0.48	0.33	0.15	0.20	0.27	0.46	0.46	0.36	0.31	0.36	0.32	0.43	0.39	0.44	0.47	0.60	0.66	0.04
38.	Loss Slf Cons 1	-0.03	-0.07	-0.06	-0.02	0.19	0.23	0.27	0.24	-0.00	0.15	0.20	0.24	0.23	0.26	0.25	0.25	0.23	0.07	0.11	0.11	-0.22
39.	Loss Slf Cons 2	-0.00	-0.04	-0.08	-0.01	0.21	0.23	0.30	0.27	0.01	0.17	0.23	0.23	0.22	0.24	0.25	0.25	0.26	0.05	0.07	0.11	-0.25
40.	Loss Slf Cons 3	-0.01	-0.06	-0.08	-0.01	0.23	0.25	0.31	0.28	0.01	0.18	0.23	0.24	0.24	0.26	0.28	0.29	0.30	0.06	0.08	0.10	-0.27
41.	Tran. Time 1	0.17	0.12	0.23	0.15	0.01	-0.14	-0.12	-0.06	0.10	0.04	0.08	0.05	0.06	0.03	0.10	0.03	0.05	0.09	0.17	0.18	0.25
42.	Tran. Time 2	0.23	0.20	0.24	0.22	0.09	-0.06	-0.03	0.01	0.20	0.11	0.12	0.05	0.06	0.04	0.08	0.01	0.07	0.16	0.18	0.23	0.25
43.	Tran. Time 3	0.19	0.11	0.24	0.13	-0.05	-0.22	-0.18	-0.12	0.09	-0.00	-0.00	-0.03	-0.02	-0.04	0.09	0.04	0.06	0.08	0.15	0.18	0.21

$p < 0.05$ for correlations greater than 0.05
$p < 0.01$ for correlations greater than 0.08
$p < 0.001$ for correlations greater than 0.09

Table 3. Correlations (continued).

	Variables	22.	23.	24.	25.	26.	27.	28.	29.	30.	31.	32.	33.	34.	35.	36.	37.	38.	39.	40.	41.	42.	43.
22.	Tense Arsl. 2	1.00																					
23.	Tense Arsl. 3	0.44	1.00																				
24.	Merging A&A 1	0.16	-0.10	1.00																			
25.	Merging A&A 2	0.19	-0.11	0.63	1.00																		
26.	Merging A&A 3	0.11	-0.16	0.68	0.69	1.00																	
27.	Merging A&A 4	0.35	0.07	0.51	0.51	0.47	1.00																
28.	Merging A&A 5	0.12	-0.17	0.56	0.54	0.58	0.43	1.00															
29.	Concentration 1	0.28	-0.03	0.36	0.37	0.37	0.35	0.37	1.00														
30.	Concentration 2	0.34	-0.01	0.36	0.38	0.37	0.37	0.37	0.77	1.00													
31.	Concentration 3	0.32	-0.03	0.37	0.40	0.40	0.40	0.41	0.79	0.86	1.00												
32.	S. of Control 1	0.10	-0.22	0.52	0.51	0.56	0.35	0.53	0.54	0.50	0.52	1.00											
33.	S. of Control 2	0.14	-0.20	0.50	0.48	0.55	0.37	0.55	0.50	0.58	0.56	0.77	1.00										
34.	S. of Control 3	0.11	-0.22	0.50	0.48	0.54	0.38	0.56	0.49	0.55	0.57	0.77	0.88	1.00									
35.	Auto. Exp. 1	0.38	0.05	0.30	0.27	0.26	0.40	0.37	0.35	0.42	0.40	0.36	0.41	0.40	1.00								
36.	Auto. Exp. 2	0.38	0.00	0.35	0.35	0.31	0.42	0.44	0.38	0.43	0.43	0.40	0.46	0.45	0.78	1.00							
37.	Auto. Exp. 3	0.42	0.03	0.38	0.40	0.35	0.50	0.34	0.47	0.51	0.51	0.43	0.47	0.46	0.68	0.71	1.00						
38.	Loss Slf Cons 1	-0.03	-0.21	0.23	0.24	0.30	0.12	0.23	0.17	0.16	0.19	0.36	0.32	0.33	0.07	0.07	0.10	1.00					
39.	Loss Slf Cons 2	-0.06	-0.23	0.22	0.24	0.28	0.13	0.24	0.12	0.13	0.16	0.31	0.32	0.31	0.07	0.08	0.08	0.77	1.00				
40.	Loss Slf Cons 3	-0.08	-0.26	0.26	0.27	0.31	0.16	0.27	0.15	0.16	0.18	0.33	0.34	0.33	0.07	0.09	0.08	0.78	0.79	1.00			
41.	Tran. Time 1	0.32	0.28	0.07	0.08	-0.01	0.17	-0.07	0.11	0.12	0.11	0.01	0.03	0.02	0.21	0.17	0.27	-0.06	-0.07	-0.10	1.00		
42.	Tran. Time 2	0.34	0.28	0.08	0.06	-0.01	0.19	-0.01	0.10	0.13	0.12	-0.00	0.03	0.02	0.27	0.24	0.21	-0.09	-0.09	-0.10	0.77	1.00	
43.	Tran. Time 3	0.28	0.23	0.01	0.07	-0.01	0.16	-0.09	0.09	0.16	0.13	0.01	0.07	0.06	0.24	0.19	0.29	-0.06	-0.06	-0.06	0.69	0.63	1.00

$p < 0.05$ for correlations greater than 0.05
$p < 0.01$ for correlations greater than 0.08
$p < 0.001$ for correlations greater than 0.09

Table 4. Factor weights and reliabilities.

	Relationship	Estimate		Reliability
Measurement Item Loadings	Goal Clarity -> cleargoal1	1.00	--	0.77
	Goal Clarity -> cleargoal2	1.04	***	
	Goal Clarity -> cleargoal3	0.91	***	
	Feedback Clarity -> clearfeedback1	1.00	--	0.91
	Feedback Clarity -> clearfeedback2	0.97	***	
	Feedback Clarity -> clearfeedback3	0.98	***	
	Challenge-skill balance -> balance1	1.00	--	0.89
	Challenge-skill balance -> balance2	1.39	***	
	Challenge-skill balance -> balance3	0.94	***	
	Loss of Self-Consciousness -> loseself1	1.00	--	0.92
	Loss of Self-Consciousness -> loseself2	0.98	***	
	Loss of Self-Consciousness -> loseself3	0.97	***	
	Concentration -> conc1	1.00	--	0.80
	Concentration -> conc2	1.04	***	
	Concentration -> conc3	1.09	***	
	Merging of Awareness and Application -> MAA1	0.98	***	0.93
	Merging of Awareness and Application -> MAA2	0.98	***	
	Merging of Awareness and Application -> MAA5	1.00	--	
	Transformation of Time -> transtime1	1.00	--	0.89
	Transformation of Time -> transtime2	1.05	***	
	Transformation of Time -> transtime3	0.81	***	
	Autotelic Experience -> auto1	1.00	--	0.91
	Autotelic Experience -> auto2	1.07	***	
	Autotelic Experience -> auto3	1.04	***	
	Sense of Control -> control1	1.00	--	0.87
	Sense of Control -> control2	1.09	***	
	Sense of Control -> control3	1.12	***	

Table 5. Discriminant Validity: Factor Correlations between Energetic Arousal, Tense Arousal, and Flow Elements

Flow Elements	**Energetic arousal**	**Tense arousal**
Flow (Merging)	0.64	-0.12
Challenge-skill balance	0.70	0.13
Clear goals	0.52	-0.07
Clear feedback	0.57	-0.11
Concentration	0.51	-0.01
Sense of control	0.45	-0.15
Autotelic experience	0.70	0.05
Transformation of time	0.22	0.22
Loss of self-consciousness	0.05	-0.21

Table 6. Results for the “Global Experience” Model

Relationship	Estimate	Hansen's J	First-stage R-squared
Flow -> Goal clarity	1.18 ***	23.87 *	0.64 ***
Flow -> Feedback clarity	1.15 ***	11.85	0.55 ***
Flow -> Perceived challenge-skill balance	0.64 ***	57.74 ***	0.64 ***
Flow -> Merging of awareness and application	1.00 --	-- --	-- --
Flow -> Loss of self-consciousness	1.28 ***	24.75 *	0.64 ***
Flow -> Concentration	0.86 ***	40.63 ***	0.64 ***
Flow -> Transformation of time	0.46 *	54.83 ***	0.64 ***
Flow -> Autotelic experience	0.73 ***	49.63 ***	0.64 ***
Flow -> Sense of control	0.84 ***	38.75 ***	0.63 ***

* p < 0.05; ** p < 0.01; *** p < 0.001; two-tailed tests
2SLS tests with robust standard errors and clustering

Table 7. Results for the "Activity-Experience" Model

Dependent Variable	Independent Variables	Estimate	Hansen's J	(df)	First-stage R-squared
Flow	Goal clarity	0.20 **	2.92	(3)	0.66 ***
	Feedback clarity	0.77 ***			0.67 ***
	Perceived challenge-skill balance	0.10 *			0.36 ***
First-Order Factors	**Second-Order Factor**	**Estimate**	**Hansen's J**	**(df)**	**First-stage R-squared**
Concentration	Flow	0.84 ***	14.42 *	(7)	0.45 ***
Sense of control	Flow	0.72 ***	6.90	(7)	0.35 ***
Merging of action and awareness	Flow	1.00 --	--	--	-- --
Autotelic experience	Flow	0.76 ***	27.53 ***	(7)	0.43 ***
Loss of self-consciousness	Flow	1.17 ***	16.61 *	(7)	0.45 ***
Transformation of time	Flow	0.64 **	45.80 ***	(7)	0.45 ***

* p < 0.05; ** p < 0.01; *** p < 0.001; two-tailed tests

2SLS tests with robust standard errors and clustering

Table 8. Results for Flow as the Experience of Merging Awareness and Application

	Relationship	Estimate	Hansen's J (df)	First-stage R-squared	Amos
Path Model Relationships	Goal Clarity -> Concentration	0.44 ***	0.32 (3)	0.66 ***	0.21 ***
	Feedback Clarity -> Concentration	0.13		0.67 ***	0.25 ***
	Challenge-skill balance -> Concentration	0.40 ***		0.36 ***	0.45 ***
	Goal Clarity -> Merging of Awareness and Application	0.16 **	0.37 (3)	0.66 ***	0.20 ***
	Feedback Clarity -> Merging of Awareness and Application	0.77 ***		0.67 ***	0.79 ***
	Concentration -> Merging of Awareness and Application	0.12 **		0.70 ***	0.05 **
	Concentration -> Autotelic Experience	0.38 ***	2.56 (2)	0.68 ***	0.39 ***
	Merging of Awareness and Application -> Autotelic Experience	0.33 ***		0.55 ***	0.42 ***
	Concentration -> Sense of Control	0.28 ***	3.45 (2)	0.68 ***	0.37 ***
	Merging of Awareness and Application -> Sense of Control	0.83 ***		0.55 ***	0.67 ***
	Concentration -> Loss of self-consciousness	0.23 **	1.31 (1)	0.68	0.21 ***
	Concentration -> Transformation of Time	0.09 **	0.09 (1)	0.68 ***	0.13 ***

* p < 0.05; ** p < 0.01; *** p < 0.001; two-tailed tests
2SLS tests with robust standard errors and clustering

Full Information Fit Indices (In AMOS, no controls for nested experiences)**:**

Chi-squared (df)	TLI	CFI	RMSEA
2129.81*** (309)	0.935	0.943	0.065

Table 9. Average flow scores by type of activity and job.

Activity Categories	Frequency	Percentage	High Performance State Scores			
			Overall	Staff	Technologists	Managers
Writing/written communication	291	19.1%	5.36 (N=274, S.D.=0.92)	5.33 (N=145, S.D.=0.90)	5.66 (N=40, S.D.=1.01)	5.20 (N=29, S.D.=0.94)
Individual analytical activity	283	18.6%	5.46 (279, 0.93)	5.33 (136, .977)	5.63 (48, 0.93)	5.00 (4, 1.33)
Conversations about work	223	14.6%	5.25 (216, 0.90)	5.22 (97, 0.97)	5.33 (30, 0.93)	5.13 (43, 0.86)
Formal meetings	213	14.0%	5.18 (208, 0.92)	5.14 (109, 1.07)	5.60 (15, 1.22)	5.11 (45, 1.26)
Routine/bureaucratic activities	145	9.5%	5.33 (133, 1.02)	5.21 (79, 1.08)	5.68 (20, 1.01)	5.44 (19, 1.13)
Planning/preparation	107	7.0%	5.62 (104, 1.04)	5.48 (53, 1.09)	6.03 (20, 1.11)	5.88 (13, 0.88)
Fixing	71	4.7%	5.34 (69, 1.02)	5.13 (43, 1.02)	6.11 (12, 0.99)	6.00 (1, 0)
Between activities (e.g., waiting, in transit)	61	4.0%	5.19 (58, 1.02)	4.98 (28, 0.96)	4.90 (10, 0.69)	6.11 (6, 0.86)
Training/receiving training	40	2.6%	4.76 (39, 0.99)	4.43 (21, 0.97)	5.07 (5, 0.80)	5.60 (5, 0.98)
Individual physical activity	23	1.5%	5.65 (23, 0.85)	5.79 (8, 0.87)	5.88 (8, 1.02)	0
Other activities unrelated to work	22	1.4%	4.87 (21, 0.73)	4.89 (12, 0.57)	4.33 (2, 1.41)	4.33 (1, 0)
Security precautions	20	1.3%	5.39 (17, 1.33)	5.07 (10, 1.04)	6.00 (3, 0)	5.00 (1, 0)
Other/uncodeable activities	15	1.0%	4.84 (15, 1.25)	4.63 (9, 0.99)	0	4.11 (3, 1.17)
Public relations activities	8	0.5%	5.54 (8, 0.40)	5.67 (6, 0.37)	0	5.17 (2, 0.24)
Conversations unrelated to work	3	0.2%	4.50 (2, 0.71)	4.50 (2, 0.71)	0	0
TOTAL/Average	1476	100.0%	5.32 (1476, 0.99)	5.22 (758, 1.00)	5.62 (213, 1.01)	5.25 (172, 1.06)