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An Empirical Comparison of the Four Channel Flow Model and Adventure Experience Paradigm

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The objective of this study was to conduct empirical comparisons between two models of optimal experience within an on-site whitewater kayaking setting using a modification of the Experience Sampling Method. Four concerns are examined: (1) differences in explanatory power between the four channel flow model and the Adventure Experience Paradigm, (2) convergent validity among measures used to determine conditions within these models, (3) differences among measures of perceived challenge and risk between test times of Class I–V river difficulty, and (4) differences among measures of perceived skill and competence between test times of Class I–V river difficulty. Questionnaires were administered in the Cheat River Canyon in West Virginia to 52 whitewater kayakers at eight sites of various levels of river difficulty. Data were analyzed at the experience level, rather than between subjects, using 409 experience sampling observations. Hypothesis testing, performed with statistical analyses (stepwise regression, correlations, and repeated measures ANOVA), suggested that the explanatory powers of the four channel flow model and Adventure Experience Paradigm were similar and indicated support for convergent and ecological validity of measures used to determine conditions within each of the two models.

Keywords convergent validity, ecological validity, flow, peak adventure, river recreation

Introduction

Efforts to empirically examine the construct of optimal experience in the adventure setting have been an emerging concern within the leisure behavior literature (Csikszentmihalyi &

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Csikszentmihalyi, 1990; Ewert & Hollenhorst, 1989; Ewert & Hollenhorst, 1994; Freeman, 1993; Martin & Priest, 1986; Priest & Bunting, 1993). Although a variety of empirical and conceptual approaches have attempted to explain the construct of optimal experience, the predominant approaches to assessing this construct have included empirical models originating from the flow theory (Csikszentmihalyi, 1990; Martin & Priest, 1986; Massimini & Carli, 1988).

Csikszentmihalyi attributes the origin of the optimal experience construct to those psychological frameworks that recognized the importance of intrinsic motivation. He describes the construct of optimal experience as being rooted in Maslow's (1968) conception of "peak experiences," defined as a process of self-actualization achieved through unconventional rewards from intense and intrinsically motivating activities. Csikszentmihalyi's notion of optimal experience was also influenced by the intrinsic motivation behavior research programs of Lepper and Greene (1978), Deci (1975), deCharms (1968), and others. Going beyond their behavioral approaches to understanding intrinsic rewards, Csikszentmihalyi (1988, p. 7) proposed the concept of "flow" to address the previously unanswered question of, "How do intrinsic rewards feel?" In addressing this question, he conducted interviews of adventurists who coined the term "flow" as illustrating the vivid details of being intensely immersed in the activity (Csikszentmihalyi & Csikszentmihalyi, 1988). Csikszentmihalyi states that flow is most readily experienced in autotelic activities, often containing elements of adventure, which contain rewards within themselves and do not rely on scarce material incentives. In developing the flow theory, he defined flow as a state of being determined by a balance of challenge and skills without any indication of anxiety, boredom, or worry.

According to flow theory, the balance of challenge and skill is theorized to predict a number of flow indicators. The most commonly employed sets of flow indicators have been selected from Csikszentmihalyi's (1990) elements of the flow experience. He discusses six elements as being dependent on the challenge-skill balance:

(1) Merging of action and awareness in which complete attention is given to the activity at the present moment and actions become automatic.
(2) Clear goals and feedback in which the goals of the activity are clearly defined and feedback is immediate, allowing the individual to assess the potential of meeting their goals and, thus, become completely involved in the activity.
(3) Concentration on the task at hand in which an individual specifically focuses on the activity with total concentration.
(4) Sense of control over actions and the environment where there is no conscious awareness of control but rather a lack of worry about loss or lack of control.
(5) Loss of self-consciousness in which an individual becomes one with the activity to the degree that concern for the self disappears (i.e., lack of awareness of physical pain or appearance).
(6) Transformation of time where time is altered by the rhythm of the activity rather than the reference of time of day (i.e., time can be perceived to speed up, slow down, or stand still).

Beyond the above elements of flow, Csikszentmihalyi (1975, 1988) and others have conceptualized and tested additional indicators of the flow experience. In a study of daily leisure experiences conducted by Kubey and Csikszentmihalyi (1990), the flow indicators of positive emotion, cognition, affect, activation, cognitive efficiency, and intrinsic motivation have been assessed to represent the respondent's daily subjective experience. In addition, the construct validity of flow has been tested by Mannell, Zuzanek, and Larson (1988) with eight indicators including positive mood, tension, freedom of choice, intrinsic motivation, concentration, competence, physical awareness, and potency.

The Four Channel Flow Model

Csikszentmihalyi and others have attempted to validate an original model of flow which assumed that the flow experience, as represented by a series of flow indicators, was dependent on the literal match of challenge and skill. However, a multitude of studies have failed to significantly predict the majority of flow indicators with the literal match of challenge and skill (Csikszentmihalyi, 1990; Ellis, Voelkl, & Morris, 1994; Massimini & Carli, 1986). In order to address this issue of prediction, Massimini & Carli (1986) developed a four channel flow model. This model operationalized the following four channels of flow: (1) flow occurs when challenge and skill are above one's personal mean, (2) anxiety occurs when challenge is above the personal mean and skill is below, (3) boredom occurs when skill is above the personal mean and challenge is below, and (4) apathy occurs when both challenge and skill are below the personal mean (see Figure 1).

Testing of the four channel flow model has been conducted in daily settings using the Experience Sampling Method (ESM; Csikszentmihalyi & Csikszentmihalyi, 1988). Applications of the ESM typically involve randomly prompting subjects to complete an Experience Sampling Form (ESF), a brief series of mostly single item measures, eight times a day for one week in order to capture their immediate conscious experience. When applying the ESM, the four channel model has been shown to predict small but significant differences in varying types of flow indicators (Carli, DelleFave, & Massimini, 1988; Massimini & Carli, 1986). For example, a weakness of the ESM, when applied to the daily setting, is that it is inherently difficult to sample subjects involved in challenging adventurous or autotelic activities and even more difficult to sample them in what Csikszentmihalyi (1992) refers to as the elusive flow state. Csikszentmihalyi argues that the elusiveness of the flow state is created by the infrequency and difficulty of predicting the flow event. Perhaps, because of these types of sampling difficulties, ESM studies using the flow model have, more often than not, explained very little of the variance in flow indicators. For example, daily studies by Voelkl (1990) and Ellis et al. (1994) have indicated that only 4.4% and 6%, respectively, of the variance in effect was predicted by the flow model.

Challenge and Skill in the Whitewater River Setting

Considering the aforementioned weaknesses of the ESM in daily settings and the origins of flow concept in the adventure setting, the flow model should be, theoretically, well designed to assess its intended construct in adventure settings (Csikszentmihalyi, 1975). When evaluating the four channel flow model in a whitewater river setting, it is important to understand how different meanings of challenge and skill that occur during the activity of kayaking are conceptually linked to the model. Csikszentmihalyi (1990) theorizes that these meanings are related to the type of setting and activity which influences how perceptions of challenge and skill are formed. He states that challenges during the adventure experience mean more than just the physical challenge within the setting. For example, the challenge of interpreting the symbolism of a piece of art may be less physical in nature than the challenge of kayaking over a Class V waterfall, yet both may be stimulating and have the potential to induce a flow state.

Csikszentmihalyi further states that, similar to challenge, skills may have a physical, cognitive, or emotional meaning. For example, without a balance in physical challenge and skill that can be found when "play boating" (e.g., side surfing in a hole), a kayaker could experience a state of apathy or boredom and the flow indicator of activation (e.g., excitement) could be less positive. Similarly, kayaking only standing waves, rather than intricate turns through a gauntlet of rocks and ledges, may require less cognitive skill. Thus, an imbalance in the perceptions of cognitive challenge and skill may also lead to an apathy or boredom state on a whitewater river requiring the kayaker to concentrate less on the task

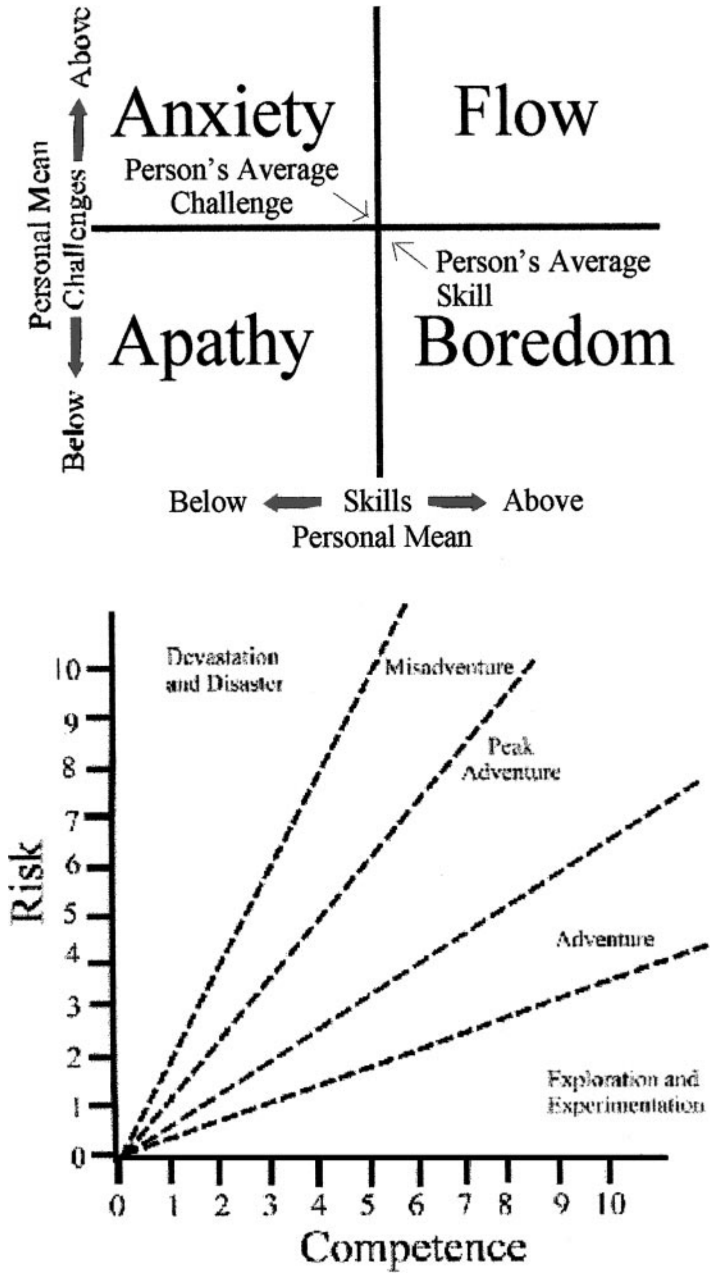

FIGURE 1 The four channel flow model and Adventure Experience Paradigm (adapted from Massimini & Carli, 1986 and Priest & Bunting, 1993, respectively).

at hand. Furthermore, Csikszentmihalyi states that emotional skills, required to engage the fear of real risks in the whitewater river setting, can lead to the flow state because risk-takers experience flow not from the danger itself but from their ability to minimize it by exerting control of these risks (Csikszentmihalyi, 1975). Thus, a potential anxiety state can be transformed into a more optimal experience, suggesting that the four channel model may be somewhat limited in describing states of mind during the activity of adventure. Despite

Csikszentmihalyi's assertion that perceptions of challenge and skill can be dependent on setting differences, previous studies have not empirically examined how real-life challenges in the adventure setting (e.g., a series of Class V rapids) influence these perceptions (Ellis et al., 1994).

The Adventure Experience Paradigm

An alternative but similar model of optimal experience is the Adventure Experience Paradigm (AEP) developed by Martin and Priest (1986). In the AEP, the perceived challenge-skill measures in the flow model have been modified using a balance of perceived risk and competence to assess a state of peak adventure, which Martin and Priest liken to the flow state. Thus, depending on the balance of perceived risk and competence, the AEP theorizes five conditions: (1) devastation and disaster, (2) misadventure, (3) peak adventure, (4) adventure, and (5) exploration and experimentation (see Figure 1). Priest and Baille (1987) describe the condition of devastation and disaster as a condition where the risks overwhelm the competence of the individual to the point of having a perception of there being a likelihood of injury or even death. Misadventure is described as a condition that occurs when competence does not quite match a risk, possibly created by an incident such as tipping a kayak. They state that the construct of peak adventure is the "razor's edge," where the individual is intensely concentrating and experiencing a state of euphoria. Priest and Baille state that the adventurist will seek a level of optimal arousal and attain a state of peak adventure when there is a close match between their perceived risk and competence. The condition of adventure is stated to occur when there is slightly lower risk giving participants a chance to put their competence to the test. Last, Priest and Baille describe the condition of exploration and experimentation as occurring when risk is low and competence high which provides a more relaxed setting for practicing skills.

The above conditions of the AEP have been examined in a whitewater river (Class I–III) study conducted by Priest and Bunting (1993). They examined 25 university students in an outdoor education class who completed questionnaires while sitting alone on the river bank in sight of four rapids. This procedure occurred over two days for a total of six test times: Pre trip, immediately before (Pre 1) and immediately after (Post 1) the first major rapid (Class III), immediately before (Pre 2) and immediately after (Post 2) the second major rapid (Class III), and Post trip (Priest, 1987). Priest and Bunting used the intersection of raw scores taken from perceived challenge and skill measured at each of the above test times to determine conditions of the AEP. Specifically, peak adventure experiences occurred immediately after encountering the first rapid (Post 1) and before the second major rapid (Pre 2) when perceptions of risk and competence were in balance. Pre trip and pre first rapid (Pre 1) evaluations revealed that perceived risks exceeded competence and these experiences were characterized as misadventure. Post trip and Post 2 (after the second major rapid) intervals were classified as being an adventure where competence was somewhat higher than the risk. Thus, risk and competence perceptions used to determine conditions within the AEP were significantly dependent on overcoming "real-life" difficulties on the river. While the Priest and Bunting study reveals that, perhaps, the AEP has ecological validity, they did not attempt to determine whether these models actually predict their intended construct of "peak adventure." Thus, previous research has not reported the AEP's ability to predict an optimal experience construct.

Risk and Competence in the Whitewater River Setting

When attempting to evaluate the appropriateness of the AEP in a whitewater river setting, it is important to understand how different meanings of risk and competence are related to the activity of kayaking. Within the setting of adventure, the concept of risk has often been defined as the "uncertainty of loss" (Priest & Gass, 1997, p. 19). Furthermore, Priest (1994, p. 4) defines competence as the "ability to deal effectively with the demands created by" the adventure setting. Priest and Baille (1987) note that there are absolute, perceived, and real forms of risk and competence. They state that absolute risk and competence occur at the most extreme limits of risk in a situation that the individual can be pushed to match with competence. For example, the absolute risk could be the potential of drowning in a Class V hole while the perceived risk could be that rolling the kayak is probable. Priest and Baille further state that individual values of absolute risk and competence are weighed in forming a perception of risk and competence in order to be psychologically prepared for worst case scenarios on the river. Real risk and competence are discussed as representing the levels that occur at a given point in time as a result of individual and setting interactions. For example, the real risk could be that there is little chance of rolling the kayak or being held in a hole.

The way in which an individual defines their perception of risk and competence in the whitewater river setting is also theorized to be influenced by the process of competence-effectance. White (1959) and Deci (1975) describe this process as a need to demonstrate an ability to influence or control the environment. Consistent with their definition, Iso-Ahola (1980) reports that competence-effectance is defined by the motivation of individuals to seek out optimally arousing situations which depend on their ability to conquer challenges in the environment through control of risks. Schuett (1991) further comments that to avoid states of anxiety and gain an optimal experience, a structural boundary in the whitewater river setting (i.e., a Class V rapid), defined by the degree of risk of injury and failure, must be overcome through the control of risk. Thus, through the process of competence-effectance, perceived risks appear to be dependent on the feelings of control gained by predicting whether competence will overcome uncertainty. Those who are at a minimal level of control will perceive more danger on the river than those with high levels of control. For example, while approaching a Class V rapid and anticipating the danger of losing control, it could be expected that a beginning kayaker would form a perception of high risk, because of his or her uncertainty of successfully navigating the rapid without swimming.

Relative to the process of forming perceptions of competence in the whitewater river setting, the competence-effectance process assumes that perceived competence is closely linked to the mental control one maintains when presented with a high risk situation. Schuett (1991) states that the formation of competence perceptions can be described in terms of "edgework skills," which refer to a unique ability much more complex than basic hard skills such as those needed for riding a mountain bike or maneuvering a kayak. He explains that these edgework skills refer to the ability to exert cognitive control over a potentially disastrous situation which most individuals would perceive as uncontrollable. Similar to the cognitive skills discussed in the aforementioned discussion of the flow theory, these cognitive skills are a type of mental stamina that allow an individual to avoid being overcome by fear and to focus attention and actions on critical moments of survival.

Similarities and Differences between the Four Channel Flow Model and AEP

The above discussion of challenge-skill and risk-competence demonstrates that measures used to determine conditions of the four channel flow model and AEP have a somewhat similar conceptual basis in the context of whitewater kayaking. Further conceptual similarities between these models are indicated by the fact that the conditions of the AEP appear to be in close correspondence to the four channels within the flow model. This correspondence is logical given Martin and Priest's (1986) discussion that the AEP is a modification of the four channel flow model. For example, the condition of misadventure could be construed to represent the anxiety channel, while the condition of peak adventure could be construed to represent the flow channel. However, the parameters for operationalizing these conditions and channels are less similar (see Methods section). For example, within the four channel model, flow is operationalized when *z* scores of perceptions of challenge and skill are above the individual's average *z* scores for challenge and skill while the AEP operationalizes peak adventure to occur when data points, formed by the intersection of raw scores for perceived risk and competence, are within a central linear condition (see Figure 1). Thus, the method of operationalizing conditions of the AEP resembles a combination of techniques used in the original model of flow (i.e., the match of raw scores to form a linear condition) and the four channel model (i.e., the similarities in labeling channels and conditions). However, while the four channel model has been shown to predict flow indicators, previous studies of the AEP have simply evaluated the AEP by assessing how the literal match in perceptions of risk and competence, over a series of test times in the setting, satisfies the conditions of the AEP (Priest & Bunting, 1993; Priest & Carpenter, 1993). Because these studies have not attempted to predict "indicators of peak adventure," there remains a lack of empirical evidence to support whether the AEP is capable of predicting any type of optimal experience. Therefore, with less understood about the validation of both models, it is important to empirically examine differences in their ability to predict measures of optimal experience.

Purpose

Within the above review of literature, conceptual differences were outlined between the four channel flow model and AEP. Despite the AEP's modification of the measures and methodology used in assessing flow, an empirical comparison of these models has not been established. Thus, the purpose of this study is to conduct empirical comparisons among variables used to assess the four channel flow model and AEP. To address this purpose, four a-priori hypotheses are predicted as described below.

This study is first concerned with differences in the ability of the four channel flow model and AEP to predict flow indicators. Since both the four channel flow model and AEP are theorized to predict a construct of optimal experience (i.e., flow and peak adventure), it is assumed that both models will be capable of predicting flow indicators. As previously mentioned, while the four channel model has been shown to significantly predict flow indicators, a number of studies have demonstrated a lack of explanatory power of this model. In contrast, the AEP has not been validated by predicting indicators of peak adventure and little is known about the explanatory power of this model. However, because the AEP is a modification of the four channel model, theoretically we should expect that these two models will perform similarly in the whitewater river setting. Thus, the first hypothesis (H_1) predicts that the explanatory power of the four channel model will not be significantly different from that of the AEP.

This study is also concerned with establishing the validity of measures that indicate conditions within these models. The validity of these measures is evaluated by considering the issues of convergent and ecological validity. Churchill (1979) states that convergent validity should be analyzed to determine the extent to which the measure correlates highly with other measures designed to evaluate the same construct. Therefore, the second hypothesis (H_2) predicts that measures of perceived challenge and risk as well as perceived skill and competence will be significantly correlated.

The concept of ecological validity has been defined as the association between the experimental design and "real-life" contexts (Hull & Stewart, 1992). The ESM, generally used to assess measures of flow experiences in daily life, is said to be ecologically valid because it is assumed to capture a full range of challenges and experiences throughout a week's time as would occur in the natural setting (Csikszentmihalyi & Larson, 1987). Consistent with the results of Priest and Bunting (1993), when evaluating ecological validity it is expected that perceptions of challenge, risk, skill, and competence will depend on the "real-life" difficulties encountered on a whitewater river. Thus, it is hypothesized (H_3) that perceptions of challenge and risk will be significantly higher at each of the Class V rapids than at test times with a difficulty level of Class I–III. In an opposite direction, it is hypothesized (H_4) that perceptions of skill and competence will be significantly higher while paddling Class I–III than while paddling Class V rapids.

Methods

The study was conducted on the Cheat River Canyon in West Virginia from 8 a.m. to 5 p.m. on May 3, 1997, during Cheatfest, an annual celebration and a national attraction to kayakers. A single day was chosen because of a number of constraints. These constraints included weather, coordination of multiple research assistants with Class V kayaking skills to paddle down canyon, and a wide range of water levels on a free-flowing river, which, according to previous studies, would have influenced perceptions of risk on the river (Whisman, Hollenhorst, & Jones, 1998). Furthermore, the Cheatfest event occurring on this particular day is known to attract a wider range in ability levels often difficult to capture on a Class V river.

Private whitewater kayakers were initially contacted at the put-in and offered a $20 certificate from a local outfitter if they agreed to participate in a study of their river experience. Participants were cued by research assistants to respond at the put-in, take-out, and immediately below six rapids of varying difficulty level (Class I–V, according to the International Scale of Whitewater Difficulty) where questionnaires were immediately placed on the deck of the kayaks while briefly anchored by waiting research assistants. Test times on the river included the following locations: New Wave Rapids (Class III), Big Nasty Rapids (Class V), a flatwater section (Class I), High Falls Rapids (Class V), Pete Morgan's Rapids (Class V), and Fossil Falls (Class II). These test times were specifically designated to capture the wide range of variation in the level of challenge and risk that occurs in the Cheat Canyon.

Questionnaires instructed kayakers to respond to the specific activity at each of the eight locations: (1) "While preparing to put on the river a moment ago . . . ," (2) "While paddling through New Wave Rapids a moment ago . . . ," (3) "While paddling through Big Nasty Rapids a moment ago . . . ," (4) "While paddling through flatwater a moment ago . . . ," (5) "While paddling through High Falls Rapids . . . ," (6) "While paddling through Pete Morgan's Rapids a moment ago . . . ," (7) "While paddling through Fossil Falls Rapids a moment ago . . . ," (8) "While preparing to leave the take-out . . . " The sample consisted of 409 experience observations collected from the 52 subjects (98% compliance rate).

For the purpose of determining conditions which represent the independent variables in H_1 and to determine correlates for testing H_2, four 10-point scales were employed to measure perceived challenge and skill (low = 0 to high = 9) as well as perceived risk and competence (none = 0 to extreme = 9): "Challenges of the activity," "Your skills in the activity," "Inherent Risk in Paddling New Wave Rapids" (or a substitution of the remaining locations), and "Your personal competence in paddling New Wave Rapids," respectively. These measures were assessed with single items as consistent with the preponderance of past studies of the four channel flow model and AEP. Responses to these items were converted to within-subject *z* scores to control for individual response bias. To determine the independent variables used to assess H_1, The challenge and skill measures were used to determine channels (flow, anxiety, boredom, and apathy) operationalized when *z* scores of these measures were above or below the personal mean *z* score for each measure as consistent with aforementioned studies assessing the four channel flow model. The conditions of the AEP (devastation and disaster, misadventure, peak adventure, adventure, and exploration and experimentation) were operationalized according to whether the data points formed by pairs of raw scores for perceived risk and competence fell within the linear conditions as indicated in Figure 1 (Priest & Carpenter, 1993). The four channels within the flow model and the five conditions of the AEP, each converted to dummy coded variables, represent the independent variables for purposes of assessing H_1.

Participants were also asked to rate 12 items used to compute an index of 10 flow indicators which served as the dependent measure employed in assessing H_1. The selection of these ten indicators was derived from Csikszentmihalyi's (1975, 1990) elements of flow, flow indicators adopted by Kubey & Csikszentmihalyi (1990), and Mannell et al.'s (1988) components of flow. These items were selected based on their relevance to the whitewater kayaking setting and the fact that the above studies have confirmed these items to be reliable indicators of flow. Furthermore, in order to minimize interruption time, single and double items were used to represent flow indicators because lengthy questionnaires have been demonstrated to cause attrition and nonresponse in repeated measure designs in river and sports settings (Borrie, 1995; Stein et al., 1995). The following seven indicators were measured with 10-point Likert-type scales: perception of the transformation of time ("Time was passing:"), intrinsic motivation ("Did you wish you had been doing something else?"), involvement ("How interested were you in what you were doing?"), merging of action and awareness ("Did you perform the activity spontaneously and automatically without having to think?"), concentration on the task at hand ("How well were you concentrating?"), paradox of control ("Were you in control of the situation?"), and (lack of) physical awareness ("Did you feel any overall pain or discomfort?"). With the exception of time perception anchored from "slowly" to "fast," these seven items were anchored from "not at all" to "very much." The remaining three indicators were assessed with 7-point semantic differential scales composed of five bipolar adjective pairs (each anchored with very, quite, somewhat, neither/not sure, somewhat, quite, very). Responses to these semantic differential scales were cued by a statement directed to the location. An example of these statements included "Describe how you felt while paddling through New Wave Rapids a moment ago." The indicator of affect was represented by the single item, happy-sad, activation was represented by the items of energetic-tired and excited-bored, and tension was represented by the items of worried-carefree and relaxed-tense.

With regard to assessing H_3, the dependent variables consisted of perceived challenge and risk. The dependent variables for purposes of testing H_4 consisted of perceived skill and competence. For testing both of these hypotheses, the treatment consisted of test times which varied in difficulty from dry land to Class V whitewater.

In addition to the repeated questionnaires used to address the above hypotheses, a post-trip questionnaire was administered that contained a series of items concerning the background characteristics of the participants. To assess measures of ability level, items consisted of "What difficulty class do you usually kayak?" and "During the past 12 months what is the most difficult class you have kayaked successfully?" Participants were asked to rate these items on the International Scale of Whitewater Difficulty (Class I–VI). In addition, these measures of past experience with paddling the Cheat Canyon were assessed with "How many total times have you kayaked the Cheat Canyon in the past 12 months?," "How many years have you paddled the Cheat Canyon?," and "How many total years have you been whitewater kayaking?"

Analyses reported in this study were performed with the Statistical Package for the Social Sciences (Version 6.0). The 409 experience observations were the unit of analysis rather than each individual subject. Consistent with similar repeated measures designs, the sample size obtained in this study was adequate to perform each of the following analyses (Priest & Carpenter, 1993; Priest & Bunting, 1993; Larson & Delespaul, 1990). Results of the analyses conducted in this study were interpreted to be significant at the $p < .05$ level. Internal consistency reliability was assessed for the ten flow indicators as a whole as well as the multiple items representing the measures of activation and tension. Test-retest reliability was estimated for measures of challenge-skill and each of the ten flow indicators. To determine test-retest reliability, correlations between two of the same items were evaluated across two consecutive test times at Class V rapids (High Falls and Pete Morgan's Rapids). The background characteristics were analyzed by examining each of the two measures of ability level and the three measures of past experience. Because of constraints of cell sizes, two categories were operationalized for these measures using a median split and each of the four measures were assessed separately. A series of one-way ANOVAs was conducted with each of the five measures of background characteristics predicting measures of challenge, skill, risk, and competence.

H_1 was tested with two separate stepwise regression analyses and the computation of an F-statistic (Pedhazur & Pedhazur-Schmelkin, 1991, p. 432) to determine the difference in explanatory power between the four channel flow model and AEP. Principal components analysis (PCA) was used to compute a factor score of flow indicators (% = .52) which represented the dependent variable for the two stepwise regression equations. Using an unrotated factor matrix, an extraction of factors was determined by eigenvalues $\geq$1. Flow indicators were assigned to a specific factor if they displayed a factor loading $\geq$.30. Because eigenvalues were less than one for the second factor, a single factor score was generated to conduct subsequent analyses. H_2 was tested with Pearson's product moment correlations among measures of challenge-skill and risk-competence. Correlations were interpreted as consistent with interpretation guidelines given by Best and Kahn (1998). For example, they state that correlations of .20 to .40 represent low correlations and only a small relationship, .40 to .70 represent a moderate correlation and substantial relationship, and .70 to .90 represent a high correlation and a marked relationship. H_3 and H_4 were evaluated with repeated measures ANOVA and post-hoc comparisons [modified Fisher's LSD (Bonferroni)].

Results

Reliability of Measures

Internal consistency reliability was supported by moderate correlations between two items used to compute the flow indicator of activation ($r = .51$, $p < .000$) as well as the two items used to compute the flow indicator of tension ($r = .54$, $p < .000$). With regard to test-retest reliability, results of averaging correlations across two test times at consecutive Class V rapids revealed a moderate to high range of significant correlations among measures of optimal experience and flow indicators. These correlations are supportive of the reliability of the following measures: challenge ($r = .76$, $p < .000$), skill ($r = .80$, $p < .000$), risk ($r = .66$, $p < .000$), competence ($r = .70$, $p < .000$), time ($r = .69$, $p < .000$), intrinsic motivation ($r = .51$, $p < .000$), involvement ($r = .85$, $p < .000$), merging of action and awareness ($r = .50$, $p < .000$), concentration ($r = .82$, $p < .000$), control ($r = .71$, $p <$ .000), physical awareness ($r = .72$, $p < .000$), affect ($r = .71$, $p < .000$), activation [excited-bored $r = .68$, $p < .000$); energetic-tired ($r = .60$, $p < .000$)], and absence of tension [relaxed-tense ($r = .77$, $p < .000$); worried-carefree ($r = .63$, $p < .000$)].

Background Characteristics

Before testing the hypotheses of this study, it was first important to establish the homo/heterogeneity of the sample. Thus, ability levels and the past experience of the sample were examined. The highest difficulty class that the participants had kayaked without swimming in this past year averaged nearly Class V ($M = 4.73$, SD = .67), while this sample usually kayaked an average of nearly Class IV ($M = 4.02$, SD = .73). The kayakers sampled had an average of 6.97 (SD = 6.28) years of whitewater paddling experience, paddled the Cheat Canyon section an average of 5.81 years (SD = 7.01), and kayaked this section an average of 3.5 (SD = 2.47) times per year. Results of a series of one-way ANOVAs revealed that neither the two measures of ability level nor the three measures of past experience were significantly different among measures of perceptions of challenge, risk, skill, or competence on the river.

Differences in Explanatory Power between the Four Channel Flow Model and AEP

H_1 stated that the four channel flow model and the AEP would perform similarly in their ability to predict flow indicators and were tested with two stepwise regression analyses and the computation of an F-statistic to test the differences between the explanatory power of the two models.

First, to determine the explanatory power of the four channel flow model, the factor score of flow indicators was regressed on dummy coded variables representing each of the four channels. The final regression equation revealed an adjusted R^2 of .14. The flow channel was the most important contributor in predicting the factor score of flow indicators ($\exists = .39$, $p < .000$) followed by the anxiety channel ($\exists = .32$, $p < .000$). However, the apathy and boredom channels were not significant predictors of the factor score of flow indicators.

To determine the explanatory power of the AEP, the factor score of flow indicators was regressed on dummy coded variables representing each of the five conditions of the AEP. The final regression equation revealed an adjusted R^2 of .14. The exploration condition was the only significant contributor in predicting the factor score of flow indicators ($\exists = -.36$, $p < .000$). Thus, the conditions of peak adventure, adventure, misadventure, and devastation and disaster were not significant predictors of the factor score of flow indicators.

After the R^2 values were obtained from the above regression equations, the computation of an F-statistic [$F\ (1, 329) = 0.00$, $p > .05$] confirmed H_1, revealing that the explanatory power of the four channel model was not significantly greater than that of the AEP.

Convergent Validity

To assess convergent validity, H_2 stated that measures of perceived challenge and risk as well as perceived skill and competence would be significantly correlated. Indeed, a moderate correlation ($r = .68$, $p < .000$) existed between perceived risk and challenge. Similarly, a moderate correlation ($r = .53$, $p < .000$) also was observed between the perceived skills and competence measures. Overall, these correlations support the notion of convergent validity among measures used to determine the conditions of the four channel flow model and AEP.

Ecological Validity

H_3 was concerned with ecological validity and stated that perceptions of challenge and risk would be significantly higher at each of the Class V rapids than at test times with a difficulty level of Class I–III. The results of hypothesis testing confirmed H_3, supporting the ecological validity of the risk and challenge measures (see Table 1). A repeated measures

TABLE 1 Repeated Measures Analysis of Variance for Measures of Challenge, Risk, Skill, and Competence by Test Times ($n = 48$ Repeated at 8 Test Times, Cheat Canyon, May, 1997)

	Test Times									
Dependent variables	Put-in	Class III	Class V	Class I	Class V	Class V	Class II	Take-out	*F*	*p*-Value
Challenge	$-.38_{acfg}$	$-.06_{afg}$	$.32_{b}$	$-.78_{c}$	$.60_{de}$	$.60_{e}$	$-.11_{fg}$	$-.20_{g}$	9.72	.000
Risk	n/a	$-.40_{a}$	$.37_{b}$	$-.22_{c}$	$.83_{d}$	$.67_{de}$	$-.24_{af}$	n/a	31.33	.000
Skill	$-.61_{a}$	$-.34_{ab}$	$-.14_{bc}$	$.25_{cd}$	$-.14_{abcde}$	$.31_{df}$	$.25_{dfg}$	$.43_{dfg}$	6.68	.000
Competence	n/a	$-.32_{a}$	$.02_{ab}$	$.47_{c}$	$-.25_{abd}$	$.12_{bce}$	$.41_{cf}$	n/a	5.77	.000

Notes: Values represent mean *z* scores. Row means with disparate subscripts are significantly different [Fisher's LSD (modified Bonferroni), $p < .05$].

ANOVA revealed that, for perceived challenge, there was a statistically significant difference [$F(7, 301) = 9.72$, $p < .000$] in test time z scores between low and high difficulty levels on the river. Results of post hoc comparisons revealed that perceptions of challenge were significantly higher at each of the Class V rapids than at Class I–III test times. A second repeated measures ANOVA revealed that, for perceived risk, there was also a statistically significant difference [$F(5, 200) = 31.33$, $p < .000$] in test time z scores between high and low difficulty levels on the river. Thus, perceptions of risk also varied according to the "real-life" difficulty encountered on the river. Post hoc comparisons revealed that perceptions of risk at each of the Class I–III test times were significantly lower than at each of the three Class V rapids including Big Nasty, Highfalls Rapids, and Pete Morgan's Rapids.

H_4 stated that perceived skill and competence would be significantly higher at test times with a Class I–III difficulty level than at test times occurring at Class V rapids. The results of hypothesis testing confirmed H_4. A repeated measures ANOVA revealed that, for perceived skill, there was a significant difference in the test time scores between high and low difficulty levels on the river [$F(7, 301) = 6.68$, $p < .000$]. As predicted, post hoc comparisons revealed that perceptions of skill were significantly higher at Class I–III test times than at each of the three Class V rapids.

A second repeated measures analysis of variance revealed that, for perceived competence, there was also a significant difference in test time scores between high and low difficulty levels on the river [$F(5, 200) = 5.77$, $p < .000$]. H_4 was supported by post hoc comparisons which demonstrated that perceptions of competence at each of the Class I–III test times were significantly higher than at two Class V rapids including Big Nasty and Highfalls Rapids. However, less supportive of H_4, there was no significant difference between levels of perceived competence at Pete Morgan's Rapids and the flatwater section and Fossil Falls.

Discussion

The overall pattern of results in this study supported each of the four hypotheses. The four channel flow model and AEP performed similarly in their ability to predict flow indicators, and convergent and ecological validity were supported for measures used to determine conditions in these models. In addition, hypothesis testing among this sample of whitewater kayakers revealed new insight into the empirical evaluation of the four channel flow model and AEP.

The moderate correlations among measures used to determine conditions within the four channel flow model and AEP and the similarity in the ability to predict flow indicators suggest that both models predicted a similar construct. Furthermore, because results which addressed the first hypothesis demonstrated that both models explained only a small proportion of the variance in the factor score of flow indicators, statistically neither of these models performed strongly in explaining the optimal experience construct. However, it should be noted that the explanatory power of the flow model in this whitewater river setting was higher than that reported in the majority of flow studies conducted in the daily setting (Csikszentmihalyi & Csikszentmihalyi, 1988; Ellis et al., 1994).

Criticism of the lack of explanatory power among daily studies of the flow model has been addressed by Csikszentmihalyi (1992), who states that flow is an elusive concept that is often difficult to empirically capture. Thus, the task of quantitative researchers who are intent on precisely measuring optimal experience appears to be one of minimizing this "elusiveness." To address this task, several approaches should be considered by future researchers. The first of these approaches concerns the issue of operationalizing the channels and conditions assumed within the four channel flow model and AEP. For example, according to the four channel model, every individual is likely to experience flow at least once while paddling the Cheat Canyon or in the case of daily studies at least once a day. Csikszentmihalyi (1992, p. 183) states that these everyday occurrences mainly represent microflow events and that “truly memorable occasions” of deep flow occur less often. This conceptual difference in flow intensity may provide a partial explanation for the lack of explanatory power of the two models and suggests that “deep levels” of optimal experience should be predicted with a much more complex set of parameters than above average challenge-skill or the literal balance of risk-competence. To resolve this issue, prospective researchers should focus their efforts on the development of valid scales of multiple items representing dimensions of challenge-skill and risk-competence and attempt to use the interaction of these dimensions to define models of optimal experience. Finally, attempts should be made to replicate this study with additional experimentally accessible populations in order to generalize results to target populations within the adventure setting.

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