Original Article

# The flow state scale for occupational tasks: development, reliability, and validity

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**Running title**

The flow state scale for occupational tasks

## Introduction

In rehabilitation, especially in the field of occupational therapy (OT), how deeply patients are absorbed in a task should be assessed because absorption may influence the therapeutic effect. The success of OT is thought to be affected by the content of tasks and the subjective experience induced. However, the degree of a patient's absorption in tasks in a study of rehabilitation effectiveness has yet to be studied.

Several studies have attempted to quantify absorption using physiological measures (Dockree et al., 2007; Fairclough et al., 2006; Matthews et al., 2010; Gevins et al., 1997; Tops et al., 2010). However, while these results reflect changes in attention, arousal, cognitive function, and the autonomic nervous system related to absorption, it remains unclear as to whether these studies have measured the actual state of absorption.

Other studies have investigated the role of patient motivation in the effectiveness of rehabilitation (Tasky et al., 2008; Choi & Medalia, 2010; Nakagami et al., 2010). While strong motivation may improve behavior or performance, it does not necessarily reflect subjective experience when subjects are performing a task. Therefore, the development of a scale that can measure the strength of a certain subjective experience (i.e., absorption) that actually occurs during a task is required.

The best theory for explaining the absorbed state is most likely flow theory, which is defined as “the holistic experience that people feel when they act with total involvement” (Chikszentmihalyi, 1975). Through a series of studies, Csikszentmihalyi (1990) and Nakamura & Csikszentmihalyi (2002) found nine universal factors of flow: (1) challenge-skill balance; (2) action-awareness merging; (3) clear goals; (4) unambiguous feedback; (5) concentration on the task at hand; (6) a sense of control; (7) loss of self-consciousness; (8) transformation of time; and (9) autotelic experience. Among these, one of the most important conditions for inducing flow is the challenge-skill balance. Flow is expected to occur when the perceived challenge and skill levels are balanced at a high degree of difficulty. If the challenge level exceeds the skill level, it may be a source of anxiety, while the converse may lead to boredom. When the challenge-skill balance is appropriate at a high degree of difficulty, it induces concentration on a task and disengages the resources spent on receiving and interpreting information unrelated to the task. As a result, a distorted sense of timing is experienced. When in flow, a person displays the maximum capacity at a controllable level of performance and feels an intrinsic reward (Nakamura & Csikszentmihalyi, 2002).

Jackson & Marsh (1996) developed a self-report instrument (Flow State Scale; FSS) to assess flow experience in sports based on the nine-dimensional conceptual flow model. Subsequently, Jackson & Eklund (2002) revised the FSS and developed the Flow State Scale-2 (FSS-2). The reliability and factor structure of these scales have been confirmed in sports samples, but they do not translate well to OT because they have too many items and are specific to sports. A nine-item Short Flow Scale was developed and the reliability and validity (i.e., factor structure and external validity) were examined using music and education samples in order to extend the measurement field (Jackson et al., 2008; Martin & Jackson, 2008). Additionally, Jackson (2010) introduced the LONG Flow State Scale-2 (FSS-2)-General as a measure to assess flow in general activities. Furthermore, the Activity Flow State Scale was developed in a study on aging (Payne et al., 2011). However, these scales also have some problems, primarily that they merely modified the wording of the items of the FSS that focused on sports. In addition, the retrospective approach made participants recall past flow experiences. Therefore, although scales to assess flow exist, their reliability and validity have not been adequately examined for use in psychological testing.

A person in flow can display maximum capacity with high but effortless attention (Csikzentmihalyi & Nakamura, 2010). Given this characteristic, it is presumed that flow is more effective in OT tasks that require relatively high attention/concentration. OT activities aimed at improving a patient’s cognitive and body functions are good examples. On the other hand, flow may have few effects in passive OT treatments that do not require as much attention/concentration (e.g. splinting in physical rehabilitation and ROM exercises). If we can set an appropriate task invoking a state of flow, the patient's maximum capacity can be induced. Consequently, a higher therapeutic effect of OT is expected.

Several studies have mentioned the idea of trying to incorporate the flow experience in OT (Larson & von Eye, 2010; Rebeiro & Polgar, 1999), but no study has been conducted to measure the actual flow experience for a comparison between the flow state and the therapeutic effect. Accumulation of evidence from this viewpoint is considered important for occupational therapists because they take psychological aspects of patients into account when designing individualized treatment plans. However, no scale presently exists to validly assess the flow experience in OT.

The objective of this study was to develop a reliable and valid scale able to measure a patient's flow state in a clinical situation such as OT. This scale has the potential to confirm whether a state of flow actually enhances the effect of OT, and if it vastly increases the effectiveness of OT activities. Therefore, we are confident this scale will contribute to establishing the efficacy of OT intervention.

## Methods

The process of scale development was implemented using Gregory's (2010) procedure, namely, defining the test, selecting a scaling method, constructing the items, testing the items, revising the test, and examining the reliability and validity.

The study protocol was approved by the Ethics Committee of the Faculty of Health Sciences, Hokkaido University (approval number 11-9).

**Participants.** A total of 240 undergraduate and graduate Japanese students (49% female) participated in the preliminary study (age range, 18-32 years; mean age±standard deviation, 21.82±1.73 years). For the testing and validation, 240 undergraduate and graduate Japanese students (50% female) participated in the study (age range, 18-32 years; mean age, 22.14±1.75 years). Approximately 94% of participants in the preliminary experiment also participated in the validation experiment. The participants in this experiment gave written informed consent after receiving a sufficient explanation of the study.

### *Preliminary experiment*

**Tasks.** It is difficult to devise a task to induce the same psychological effects in all participants because absorption in a task is related to personal factors (i.e., interest and recognition of importance for a task). Keller & Bless (2008) have attempted to induce flow experimentally using a version of the Tetris® computer game. A computer game has some advantages as a task because it is easy to control the level and it can be conducted with many subjects at one time. Therefore, we also adopted this game for our experiment. In Tetris, blocks of seven different shapes fell at a constant speed in random order. Players were asked to align these blocks using keys on a computer keyboard. The arrow keys controlled the movement of the blocks and the space key controlled the rotation of the blocks. When the blocks stacked up to the top of the playing field, the game ended. We provided three variants of the task to induce the psychological states of flow, anxiety, and boredom.

*The Flow task* was designed to balance skill and challenge level. The falling blocks gained speed at the rate of 33 ms/line every 20 seconds from 980 ms/line. The playing field was 14 cells wide by 24 cells high. Participants were given the option to accelerate the falling speed of the blocks by pressing the down arrow key.

*The Anxiety task* was designed so that the challenge level largely exceeded the skill level. The falling blocks gained speed at the rate of 20 ms/line every 60 seconds from 100 ms/line. The playing field was 12 cells wide by 24 cells high. As in the Flow task, participants could accelerate the falling speed of the blocks by pressing the down arrow key.

*The Boredom task* was designed so that the challenge level was far below the skill level. The speed of the falling blocks was 1500 ms/line, and the playing field was 14 cells wide by 24 cells high. Participants had no option to accelerate the falling speed of the blocks.

**Procedure.** Participants played all three types of the game. Immediately after playing each task for a period of 10 minutes, participants completed our flow scale (preliminary experiment: 22-item pilot version; testing and validation experiment: 14-item final version) and the state anxiety scale of the State-Trait Anxiety Inventory (STAI). Participants were instructed to continue the task for 10 minutes, even if one game ended and another began. After we provided a sufficient explanation about the operation of the game, participants conducted the Flow task with 2 minutes of practice. Task order was counterbalanced to avoid possible order effects.

### *Instrument Development and Preliminary Experiment*

An initial pool of possible items was developed by surveying existing measures (Jackson et al., 1996, 2002, 2008; Martin et al., 2008; Csikszentmihalyi et al., 1987) and reviewing the literature on flow theory (Csikszentmihalyi et al., 1984). The items were classified according the nine proposed dimensions of flow and then evaluated by an expert on flow theory. Some items were modified or deleted based on the consensus reached by panels comprising an expert on flow theory, an expert on statistics, and three occupational therapists. A composite item was included in an initial pool of possible items. This composite item consisted of two distinct questions (i.e., “The task was doable / I was confident that I could handle the task”). The above process resulted in 22 items retained for the preliminary experiment.

### *Testing the items*

**Ceiling and floor effects.** For each item, we examined whether the average score plus or minus SD was within the scoring range (1-7). When the value of the average item score plus SD was higher than the upper limit, it was considered a ceiling effect. A floor effect was precisely the opposite of the ceiling effect.

**Item discrimination.** If the participants scored the item at 5 points or more, they were considered to have answered the item correctly. The item discrimination index was compared in each of the following conditions: Flow task versus Anxiety task, Flow task versus Boredom task, and higher scoring 25% versus lower scoring 25% in the Flow task. A positive value for the item discrimination index is preferred, and the closer to +1.0 the better (Gregory, 2010). In our study, we excluded items with a discrimination index of less than 0.3 that were relatively worse than other items.

**Exploratory factor analysis.** We conducted exploratory factor analysis using the maximum likelihood method to examine the factor structure of our scale and select items to be removed. Factors with eigenvalues of less than 1 or items with factor loadings of less than 0.4 before rotation were excluded. After rotation, items deemed unsuitable, such as those with markedly lower values than other items, were excluded. Factor analysis was repeated multiple times to remove inappropriate items until a smaller set of dimensions was obtained.

The final items were determined from the comprehensive assessment of these item analysis results. Each factor was then named on the basis of exploratory factor analysis. We then checked the reliability of this scale using Cronbach's alpha coefficient as an indicator of internal consistency.

### *Experiment for evaluation of reliability and validity*

The procedure was similar to that in the preliminary experiment except that participants answered our flow scale (14-item complete version) rather than the preliminary 22-item scale. We calculated Cronbach's alpha coefficient for verification of reliability.

**Content validity.** Before starting this experiment, we thoroughly discussed all items of this scale with an expert on flow theory.

**Convergent validity.** The total score of our scale was compared to the total score and each subscore (anxiety-absent items and anxiety-present items) of STAI by calculating the Pearson's product-moment correlation coefficient. In addition, the scores of the anxiety-absent items were reversed because they reflected a positive emotional experience.

**Discrimination power of each psychological state.** We confirmed whether our scale could discriminate among task state (i.e., Flow, Anxiety, and Boredom task) by using multiple comparisons. Additionally, we calculated the difference in average values for each task and examined whether these values were adequate to discriminate between the tasks.

**Accuracy of the factor structure.** We conducted confirmatory factor analysis (CFA) by covariance structure analysis to confirm whether the same factor structure was obtained in this experiment and the preliminary experiment. To assess the goodness of fit of our model, we calculated the $\chi^2$ test statistic, the normed fit index (NFI), the nonnormed fit index (NNFI), the comparative fit index (CFI), the goodness fit index (GFI), and the root mean square error of approximation (RMSEA).

### *Occupational analysis*

We conducted an occupational analysis of various activities to confirm that our computer game task is representative of measurable activities. An analysis table, which consisted of items including motor ability, cognitive and perceptive abilities, communication, work characteristics, and control of tools, was made by referring to the description of occupational analysis (Crepeau et al., 2009). The items of the analysis table included activities of daily living, games, crafts, sports, learning, and music. Eight occupational therapists (mean years of clinical experience, 7.0±2.44) analyzed each activity of the analysis table. Correspondence analysis was performed to visually confirm the relationships among activities.

All statistical analyses were performed using PASW Statistics v.19.0 software for Windows (SPSS Software, IBM Co., Chicago, IL, USA). The significance level was set at 0.01 for both analyses (convergent validity and discrimination power).

## Results

### *Instrument development*

After we thoroughly discussed all items of this scale with an expert on flow theory, we determined 22 possible items. The actual number of questions was 23 because one was a composite item.

### *Preliminary experiment and testing the items*

**Ceiling and floor effects.** The ceiling effect was observed in two items, “I was completely focused on the task at hand” (average + SD 7.05) and “I was not worried about any of the people or things around me” (average + SD 7.04). We removed these two items. No floor effect was observed for any item.

**Item discrimination.** The discrimination index of two specific items (“I worried about my performance” and “I felt as if everything was going automatically”) did not exceed 0.3 in any comparison between tasks. Additionally, the index of two other specific items (“I was moving naturally without thinking deeply about the task” and “The task was doable / I was confident that I could handle the task”) did not exceed 0.5 in any comparison between tasks. The index of other items exceeded 0.5 in at least one comparison.

**Exploratory factor analysis.** Exploratory factor analysis was repeated five times while repeating the removal of inappropriate items until a smaller set of dimensions was obtained. These results are summarized in Table 1. Finally, 14 items and three factors were extracted. We named the factors "sense of control of the task" (six items), "experience of positive emotion" (four items), and "experience of absorption by concentrating on a task" (four items). We have completed our scale with these 14 items and the 3-factor model (Appendix 1). The Cronbach's alpha coefficient was 0.887 at the time of the determination of the items in the preliminary experiment.

*Experiment for the evaluation of reliability and validity*

**Reliability.** The Cronbach's alpha coefficient of our scale was 0.918. The Cronbach's alpha coefficient of each factor was as follows: "sense of control of a task" = 0.871; "experience of positive emotion" =0.869; and "experience of absorption by concentrating on a task" =0.867.

**Content validity.** Deletion and modification of items and the naming of each factor were determined by discussion with an expert on flow theory. The expert deemed that the structure of our scale (14 items) was appropriate.

**Convergent validity.** The total score of our scale was significantly negatively correlated with the total score of STAI ($r=-0.537$, $p<0.01$) and the score of STAI's anxiety-absent items ($r=-0.611$, $p<0.01$). However, no significant correlation was observed between the total score of our scale and the score of STAI's anxiety-present items ($r=-0.088$, $p=0.175$).

**Discrimination power of each psychological state.** The results of the Dunnett's C multiple comparison test indicated significant differences between the Flow and Anxiety tasks, and between the Flow and Boredom tasks (Table 2).

**Accuracy of the factor structure.** The 3-factor model obtained in the preliminary experiment was tested by covariance structure analysis (Fig. 1). The measurements of model fit were $\chi^2=200.06$ (df=74), GFI=0.890, NFI=0.904, NNFI=0.922, CFI=0.937, and RMSEA=0.084.

### *Occupational analysis*

Figure 2 shows the results of the correspondence analysis for occupational analysis. The computer game task used in our experiment was closely related to games (mahjong and Othello), crafts (origami, pottery, and leather work), learning (reading and calculations), cooking, and playing an instrument.

## Discussion

We examined the reliability of our scale using Cronbach's alpha coefficient, which measures internal consistency. The overall reliability of our scale was found to be 0.918. In addition, all three factors were found to be reliable.

The validity of this scale was verified from various viewpoints. The content validity of the items was verified in discussions with an expert on flow theory. Moreover, construct validity was verified from three viewpoints: the correlation coefficient between this scale and STAI, the discrimination power of each psychological state (i.e., flow, anxiety, and boredom), and the accuracy of the factor structure. This scale was significantly negatively correlated with the total score of STAI and the score of the STAI's anxiety-absent items, but was not significantly correlated with the score of the STAI's anxiety-present items. The STAI's anxiety-present items consist of negative characteristics (e.g., "tense", "frightened", "upset", "worried") and an individual's perception of threat may raise the level of anxiety, while an individual's perception of safety may relatively reduce it (Spielberger, 1983). Because neither reward nor punishment was used in our task, we could not induce threat or fright when participants were not able to successfully perform the task. Therefore, we believed that the scores of STAI's anxiety-present items were irrelevant. The flow experience had a positive correlation with participants' positive psychological state and had a negative correlation with their negative psychological state, as expected. Therefore, the state of flow was different from anxiety and the results supported the measurement concept that the more anxiety increases, the more the state of flow decreases.

In the multiple comparison tests, we found significant differences between the task states (pairwise comparisons). This scale has sufficient discrimination power for each psychological state. Moreover, this study was consistent with the flow theory that the challenge-skill balance induced a flow experience. That is to say, one does not experience flow state when the challenge level exceeds the skill level or is less than the skill level; in these cases, the total score of this scale is reduced. In the confirmatory factor analysis, the results of covariance structure analysis indicated that the model fit index of the three factor structures showed an acceptable fit, except that the GFI and the RMSEA were below the reference values. It is generally accepted that the value of GFI fits better as the model become more complex and the sample size is larger. The RMSEA value is also affected by number of items and sample size. Jackson *et al*. (2008) reported similar results when the nine-item Short Flow Scale was developed; they suggested that the high value of the RMSEA was due to the small sample size and the small number of items. This reasoning applies to our scale as well due to the small number of items for clinical situations and the small sample size.

In the structure of our scale, the factor of "action-awareness merging" was discarded from the initial nine factors. This factor may be more likely to be induced by familiar tasks because it relates to automated action and effort (Csikzentmihalyi, 1990). The task used in our study was novel and required only a short time in the experimental environment. Therefore, automated action and effort were not elicited and this factor was discarded. However, because the final three-factor structure includes the other initial eight factors, we believe that our scale can measure flow comprehensively. The three-factor structure of this scale was consistent with the suggestion of Nakamura & Csikszentmihalyi (2002) that flow was most operationally and economically measured by combining three levels of concentration, involvement, and enjoyment with the challenge-skill balance.

Our scale has several limitations. First, this scale is specialized to measure comparative change in flow, rather than absolute flow. Because flow is operationally defined as experienced when both challenge and skill are above average levels for the individual (Massimini & Carli, 1988), the level at which flow is experienced varies among individuals. Second, the correspondence analysis for occupational analysis suggests that this scale may be suitable primarily for leisure tasks with low physical activity, which is referred to in a classification of Kazs (2003) and may be not suitable for highly physical activities. It remains unclear whether this scale is suitable for measuring flow in the activities of daily living with high physical activity because a definitive boundary has yet to be determined. Third, the sensitivity of this scale was not validated. It remains unclear whether this scale is sensitive to small changes in flow. Finally, the reliability and validity of our scale were examined in a Japanese sample with items written in Japanese. Appendix 1 has been forward- and back-translated into English. Before using an English version of our scale, it may first be necessary to reexamine the reliability and validity.

The objective of this study was to develop a valid and reliable scale that could measure a patient's state of flow in a clinical setting such as during OT. The scale has not yet been tested in persons with disabilities. If the range of application of our scale can be determined from further research, we will be able to verify quantitatively whether the occupational tasks used in OT effectively invoke a flow experience for patients. Eventually, this scale will contribute to the establishment of evidence in OT practice.

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Table 1

| | **Factors** | | |
|---|---|---|---|
| Items | 1 | 2 | 3 |
| I had a sense of great control over everything I was doing. | **.906** | -.198 | .053 |
| I felt that I could deal with whatever might happen next. | **.805** | -.051 | .027 |
| I was aware of how well the task was going. | **.777** | .064 | -.133 |
| I knew clearly what I wanted to do or what I should do at every moment. | **.688** | .105 | -.074 |
| I knew how well I was dealing with the task. | **.661** | -.034 | .139 |
| My abilities matched the challenge of what I was doing. | **.483** | .165 | .045 |
| I had a meaningful time. | .110 | **.858** | -.065 |
| I really enjoyed what I was doing. | .089 | **.748** | .069 |
| I wanted to do it again. | -.046 | **.693** | .108 |
| The task was really boring. | -.144 | **.673** | .000 |
| I lost track of time while doing the task. | -.095 | -.065 | **1.005** |
| I lost myself in doing the task. | .100 | -.017 | **.759** |
| It felt like time passed quickly. | -.043 | .221 | **.622** |
| It was easy to concentrate on what I was doing. | .104 | .126 | **.508** |
| % of variance explained | 37.23 | 15.00 | 6.39 |

Note: Factor loadings >0.40 are bolded.

Table 2

| | Task(I) | Task(J) | Mean difference (I-J) | | SE | 99% CI | |
|---|---|---|---|---|---|---|---|
| | | | | | | Lower limit | Upper limit |
| Dunnett's C | Flow | Anxiety | 20.733 | ** | 1.258 | 17.03 | 24.43 |
| | | Boredom | 24.633 | ** | 1.139 | 21.28 | 27.98 |

**p<.01

Abbreviations: SE, standard error; CI, confidence interval.

Table 1

Exploratory factor analysis using the maximum likelihood method after rotation.

Table 2

Comparisons of the scores between flow, anxiety, and boredom.

Figure 1.

Results of confirmatory factor analysis by covariance structure analysis.

The arrows from factors to items indicate factor loadings and the arrows among the factors indicate factor correlations.

Figure 2.

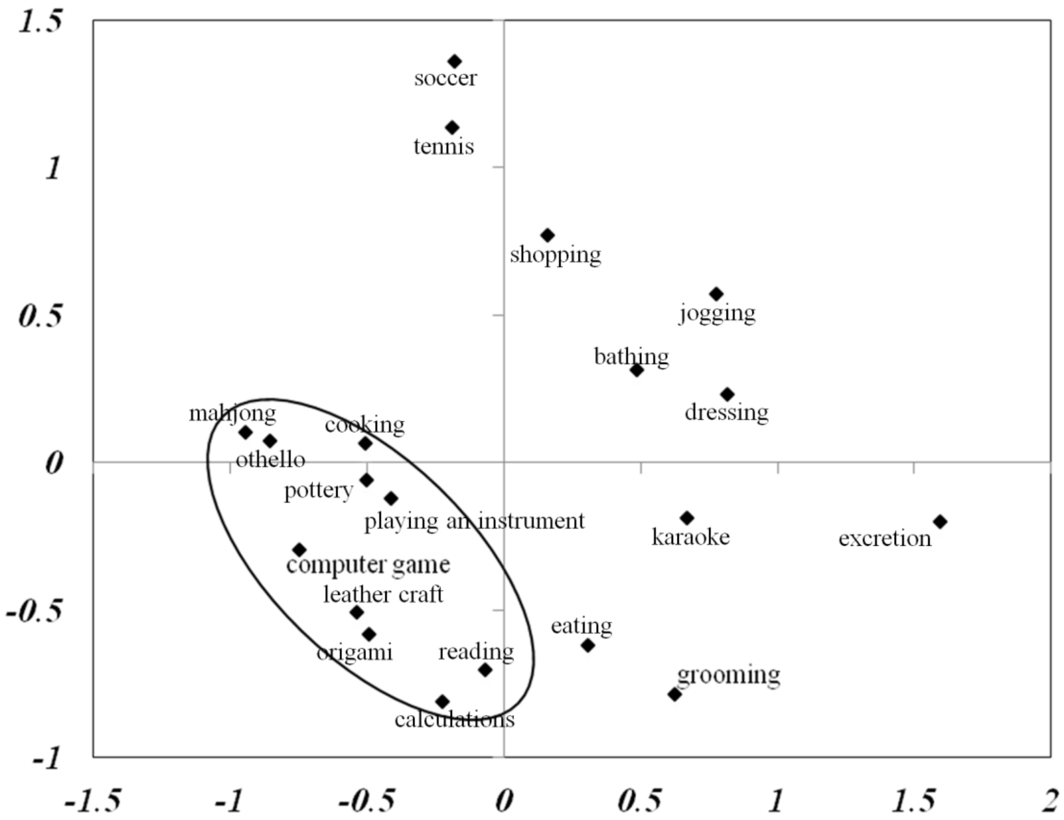
Results of correspondence analysis for occupational analysis.

The distance between the plots represents the size of differences in the characteristics of the activity. Similar activities are plotted near each other and different characteristics are plotted further apart. Activities enclosed within the ellipse are extremely similar to computer games.

Fig 1.

I knew clearly what I wanted to do or what I should do at every moment
My abilities matched the challenge of what I was doing
I felt that I could deal with whatever might happen next
I knew how well I was dealing with the task
I had a sense of great control over everything I was doing
I was aware of how well the task was going
I had a meaningful time
I really enjoyed what I was doing
The task was really boring
I wanted to do it again
It felt like time passed quickly
It was easy to concentrate on what I was doing.
I lost track of time while doing the task
I lost myself in doing the task
Sense of control
Positive emotional experience
Absorption by concentrating
.72
.51
.77
.73
.79
.86
.74
.91
.70
.84
..82
..70
.89
.78
.61
.59
.74

Fig 2.


1.5
1
0.5
0
-0.5
-1
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-1
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0.5
1
1.5
2
soccer
tennis
shopping
jogging
bathing
dressing
mahjong
cooking
othello
pottery
playing an instrument
karaoke
excretion
computer game
leather craft
eating
origami
reading
grooming
calculations

# The flow state scale for occupational tasks

Please recall your experience of the task or activity you just completed and answer the following questions. There are no right or wrong answers, so please answer intuitively. For each question, circle the number (1-7) that best matches your experience.

Name task/activity ______________________

| | | Strongly disagree | | | Undecided | | | Strongly agree |
|---|---|---|---|---|---|---|---|---|
| 1 | I had a meaningful time. | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
| 2 | I knew clearly what I wanted to do or what I should do at every moment. | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
| 3 | I really enjoyed what I was doing. | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
| 4 | My abilities matched the challenge of what I was doing. | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
| 5 | I felt that I could deal with whatever might happen next. | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
| 6 | It felt like time passed quickly. | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
| 7 | It was easy to concentrate on what I was doing. | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
| 8 | I was aware of how well the task was going. | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
| 9 | The task was really boring. | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
| 10 | I had a sense of great control over everything I was doing. | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
| 11 | I lost track of time while doing the task. | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
| 12 | I lost myself in doing the task. | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
| 13 | I wanted to do it again. | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
| 14 | I knew how well I was dealing with the task. | 1 | 2 | 3 | 4 | 5 | 6 | 7 |