

# EFFECTS OF STRESS VERSUS FLOTATION-REST RELAXATION ON CREATIVITY AND LITERACY SKILLS IN ADVANCED ENGLISH AS A SECOND LANGUAGE (ESL) COMPOSITION

by

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This study explores whether or not stress or relaxation (induced by flotation-REST) facilitates creativity and literacy skills, as measured by advanced English as a Second Language (ESL) composition. 60 students, 49 females and 11 males were recruited, all undergraduates in their first semester of advanced English studies. Participants were randomly assigned to three experimental groups, namely a Control group, a Flotation-REST group, and a Stress group. Results indicated that flotation-REST relaxation showed a positive effect on originality, and that the Stress group produced more social realistic compositions. These results were interpreted in terms of fluctuations on the primary-secondary continuum.

Key words: ESL, Flotation-REST, relaxation, stress.

## *Introduction*

Advanced second language writing is a complex task, where the writer has to deal with language correctness, first language interference, narrative and rhetorical fluency, and topic creativity (Linnarud 1986; Albrechtsen, Evensen, Lindeberg and Linnarud 1991; Isaksson-Wikberg 1996; Allwright, Woodley and Allwright 1988; Flower 1981; Raimes 1983; Silva 1990; McGinley and Tierny 1989; Kroll 1990). Assessing second language students' writing is equally difficult, and research on composition writing also needs to look into different methods of assessing student's writing skills. Implicitly, we need to look into the nature of writing and determine which aspects of language production that an essay exam is intended to measure. Does one method enhance language correctness but hamper the flow of original ideas, and does another miss out on assessing students' language proficiency by focusing solely on giving the writer enough time and tools to produce a creative text? What part do individual learner differences play, and how do the assessment context and setting affect the composition product? Some people thrive under

pressure, while others perform significantly worse and experience mental 'blackouts', when given time limits and controlled topics. These negative or positive effects of psychological stress on second language performance, often labeled debilitative vs. facilitative anxiety (Brown 1987), are especially evident in creative processes like composition writing.

Another important factor is the actual situation for assessing. The portfolio approach works on a take-home basis, allowing drafting and revision, (see e.g. White and Arndt 1991) whereas the direct approach, also called the snapshot approach, appears to measure the student's ability to plan, structure, and write quickly on a new topic (e.g. Kroll 1990a; 1990b; Hamp-Lyons 1994; Hamp-Lyons and Kroll 1996). The advantage of the snapshot approach in language testing may be that since the exam intends to measure linguistic as well as rhetorical competence, the approach is viewed as a more natural sample of the student's overall competence without the help of dictionaries and grammar books.

Also, learners are different (see e.g. McDonough 1992, Jensen and DiTiberio 1984). Psychological and pedagogical studies on test anxiety (e.g. Kurosawa and Harackiewicz 1995; Williams 1996; Deffenbacher, Deitz and Hazaleus 1981) have revealed that high anxiety is often related to low performance, especially in average and low-achieving students. Looking at research in sports psychology, we can see that amateur sportsmen or sportswomen perform significantly worse under psychological stress, while skilled athletes and professionals tend to perform better under pressure (e.g. Marchant, Morris and Anderson 1978). The classical study by Yerkes and Dodson (1908) showed that a low degree of anxiety and stress may have a facilitating effect on performance, while excessive stress results in lower performance.

Composition writing is generally taught as a creative process, although controlled with structural and syntactical guidelines, and the creativity aspect in assessment procedures is also worth taking into account. Freisinger (1978) claims that in order to summon forth the creativity of writing students, we must supply them with motives for developing their creative writing skills. We can help students increase their awareness of how writing can be 'an indispensable tool for shaping personal and professional identities' and a 'unique way of knowing' (Freisinger 1978:285).

An experimental study by Drwal (1973) investigated the effect of psychological stress upon creative thinking, and the results revealed that the subjects suffered negatively from stress induced by a threatening examination situation on all levels of creative output (ideational fluency, spontaneous flexibility, and originality in responses). Again, anxiety appears to be an important factor not only in assessment performance in general, but also for the creativity aspect, which constitutes a substantial part of English as a Second Language (ESL) composition writing.

In order to determine if the benefits of an examination form where the more spontaneous language skills are tested (the snapshot approach) are worth its disadvantages (performance anxiety, stress, lack of process-oriented development of a composition), it is important to investigate its different effects on individual ESL composition performance. The present study compares compositions produced under either stress or relaxation, and serves as an exploratory study in the area of optimal ESL writing assessment. Variables such as language originality, language correctness, composition structure, composition topic, creativity and personality differences were accounted for, and findings are applicable in the planning of ESL teaching and testing, in the understanding of the writing process, and in the body of research on stress, relaxation and creativity.

Relaxation research has generated a number of sub-fields, involving for example stretching and autogenic exercises (Smith 1993) and the benefits of mental and physical relaxation methods such as Tai Chi (Sandlund and Norlander 2000). Further examples would be relaxation with help of certain devices such as the flotation tank (Norlander, Bergman and Archer 1998) and the physioacoustic method (Norlander, Sandholm and Anfelt 1998). In the present study, a floating tank induced the relaxed condition. Flotation REST (Restricted Environmental Stimulation Technique) is a method whereby an individual is placed in a horizontally floating posture, immersed in salt water, in an environment (the floating tank) where all incoming stimuli are reduced to the barest minimum during a short period. The salt water in the floating tank is maintained at skin temperature while earplugs are used to minimize sounds; when the entrance to the tank is closed, complete darkness ensues. Flotation REST is a cost-effective and secure method with minimal or complete absence of adverse effects (Borrie 1993;

Suedfeld 1983). Previous reports concerning stimulus-reduction of the sensory organs (sensory deprivation) indicated several negative effects such as confusion, worry, and stress (Zubeck 1973). Recent research, especially in connection with flotation as practiced in REST, shows instead that meaningful positive effects may be obtained. Results indicate positive effects such as an increased well-being and relaxation (Mahoney 1990), mild euphoria (Schulz and Kaspar 1994), more ideas (Forgays and Forgays 1992; Suedfeld, Metcalfe and Bluck 1987), increased originality (Norlander, Bergman and Archer 1998), improved sleep at night (Ballard 1993), reduced stress, tension, and anxiety (Fine and Turner 1982; Schulz and Kaspar 1994; Suedfeld 1983; Suedfeld and Borrie 1995; Turner and Fine 1984), reduced pain (Mereday, Lehmann, and Borrie 1990; Kjellgren, Sundequist, Norlander, and Archer (in press)), reduced headache (Wallbaum, Rzewnicki, Steele and Suedfeld 1992), lowered blood pressure (Fine and Turner 1982), less muscle tension (Norlander, Bergman and Archer 1999); in addition, REST appears to be a suitable complement to psychotherapy (Jessen 1990; Mahoney 1990). It ought to be indicated that the method is experienced as pleasant, and that subjects are always ready to embrace it on further occasions (Norlander, Kjellgren and Archer (in press)).

Flotation-REST is a form of sensory deprivation that readily induces a state of altered consciousness. At the same time, individuals experience an elevated consciousness of inner, mental processes, changes in formal thought patterns, and reduced contact with reality (Ludwig 1990). This condition has been described as a cognitive shift, in the direction of primary process oriented cognition (e.g. Goldberger 1961; Martindale and Dailey 1996; Norlander 1999; Noy 1969). That is, more logical thinking and directed attention (secondary processes) are shunted aside in favor of more intuitive thinking and non-directed fantasy (primary processes).

The purpose of the present study was to explore whether or not stress or relaxation (induced by flotation-REST) facilitates creativity and literacy skills as measured in advanced English as a Second Language (ESL) composition.

### *Method*

#### Participants

The experiment was conducted at the Flotation-REST Laboratory at Karlstad University, Sweden. 60 students, all undergraduates in their first semester of advanced English studies, participated, and they were recruited at the course introduction. Participation was voluntary, but the students taking part were treated with a lunch coupon for the campus cafeteria. Participants were randomly assigned in equal numbers to each of three experimental groups (see 'Design'). The mean age for the entire population was 24.02 years ( $SD = 5.93$ ,  $range = 19$  to 47). There was (Chi-Square, goodness of fit) a significant difference in respect to gender ( $p < 0.001$ ) with 49 females and 11 males. However, there were no differences between groups (Kruskal-Wallis,  $p = 0.896$ ). There were no (one-way ANOVA) significant differences between groups with regard to age, number of academic terms spent at Karlstad University, or scores on VOCMCT (two diagnostic tests measuring English proficiency in terms of grammar and vocabulary, administered at the beginning and at the end of their first semester, see *Instruments*) ( $ps > 0.25$ ). There were no (Kruskal-Wallis) significant differences between groups with regard to previous education, native language, experiences of living abroad, marital status, cultural and national background, health status, nicotine consumption, exercise habits, or spare time interests. Neither did the groups differ on the menstrual status for the women ( $ps > 0.05$ ).

Two personality inventories were administered to all participants in order to provide further background information. One test measured Attitude-to-Creativity with respect to aptitude for change and stability, namely the FS (Change and Stability) test (Holmquist, 1986). A one-way ANOVA showed no differences between groups ( $p = 0.473$ ). The FS scoring results were transformed into stanine scores after a norm established among industrial employees, both workers and officials (Holmquist, 1986), thereby making comparisons to a broader population possible. The mean FS stanine score for the entire group was 4.45 ( $SD = 1.44$ ) and a one-sample  $t$ -test showed a significant difference in comparison to the norm group ( $p = 0.005$ ).

Another test measured Dispositional Optimism, namely the Life Orientation Test – LOT (Scheier and Carver 1985). A one-way ANOVA showed no differences between groups ( $p = 0.178$ ).

### Design

Participants were randomly assigned in equal numbers to each of three experimental groups, namely a Control group, a Flotation-REST group, and a Stress group. In the Control group, participants were instructed to sit in an armchair for 45 minutes, during which time they were allowed to read magazines which were laid out for them. Afterwards, they were instructed to write an essay in English, based on the four words ambition, choice, ring and disappointment. The Flotation-REST group received exactly the same treatment as the Control group before and after the experimental manipulation, but instead of sitting in an armchair, participants spent 45 minutes in the floating tank. Likewise, the Stress group received the same treatment as the Control group, but here subjects spent 45 minutes with paper-and-pen tests designed to generate stress.

### Instruments

During the experiment, three instruments were applied before the manipulation as background variables (FS, LOT, and VOC/MCT); one after the manipulation (ESL composition task); and a modified version of a test (the CWT color test) was applied as a manipulative step (for the Stress group). Finally, the flotation tank was used to induce relaxation in one of the experimental groups (viz., the Flotation-REST group)

FS - Change and Stability. An attitude to change and stability test (Holmquist 1986), which correlates high with several creativity tests, was applied. The test consists of 20 items of the type: 'Risk-taking is necessary for success', and each subject was asked to respond on a 4-point scale, ranging from agree to disagree. There was no time limit for the FS test.

LOT - Life Orientation Test. The test (Scheier and Carver 1985) consists of eight items, plus four filler items. The task of each subject is to indicate whether or not one is in agreement with each of the

items described, on a scale of 0 - 4, where 0 indicates 'strongly disagree' and 4 indicates 'strongly agree'. The test measures dispositional optimism, defined in terms of generalized outcome expectancies.

VOC/MCT, the Vocabulary and Multiple Choice Test, was developed by Gårdmark and Wright (1970) of Gothenburg University, Sweden, as a diagnostic instrument for testing English language proficiency among undergraduate students of English as a second and foreign language. It has been widely used as a standard measure of English proficiency at several Swedish universities. The vocabulary part tests the student's vocabulary, asking him/her to identify the correct meaning of 120 words, when given five closely related suggested meanings for each word. The MCT (Multiple Choice Test) consists of a text in English, in which parts of the text (words and phrases) are highlighted; the student is to make a choice between four alternatives. The MCT part tests grammar, vocabulary, phraseology, and stylistics; it has been pre-tested on native speakers and has been used at Karlstad University for many years, diagnostically at the beginning of the first semester, and as a test at semester end. Several studies (e.g. Linnarud and Sandlund 1998) have shown strong correlations to exist between the VOC/MCT and performance in other areas of language proficiency (e.g. grammar and composition writing), as shown by the subjects' high school grades in English.

ESL composition task. Participants were instructed to write an essay in English, based on the four words: ambition, choice, ring and disappointment. The compositions were evaluated in several ways. (a) A panel of three experienced evaluators of creative production judged the essays on a scale from 1 to 10 for Elaboration, Language Vividness, Originality, Fantasy, and Social Realism. Consensual definitions (Amabile 1983) of Elaboration, Language Vividness, Originality, Fantasy, and Social Realism were used. (b) The compositions were also processed in WordSmith (Scott 1997) for length (number and length of words, sentences, and paragraphs), errors of various types, and word variation (type/token ratio). (c) A method for assessing one's own writing, developed by Daley (1983), was modified and used in further assessing the compositions. Here, the essays were evaluated on a scale from 1 to 5 on the variables Organization, Tempo, Interest, Clarity, Forcefulness, and Mechanics. (d) The narrator (1<sup>st</sup> or 3<sup>rd</sup> person, singular or plural) as well as

the topic of the essay (personal fantasy, personal life story, fairytale or fantasy) and its tone (positive or negative) were also registered.

Stress generators. The stress condition was created by combining two different stress-generating tasks. The CWT, the Serial Color-Word Test (Smith and Nyman 1964; 1972) was used three times during the 45 minute manipulation. It was altered with a word search stress test (Modéus, Ståhlbröst, Wester and Ögren 1987) so that each participant was subjected to five stress generating instruments during the manipulation sequence. In the CWT test, the subject is asked to read the color of series of typed names of colors (blue, green, yellow, red) aloud as fast as possible, on a sheet containing 100 words printed in different colors. The stressor is that the color of the clusters does not match the words, and thus, the participant is to say 'red' although the typed word (in red letters) may be 'yellow'. The color-word technique was introduced by Stroop (1935) and the reading aloud of colors not matching the printed word at a speed rate (with the experimenter carefully pretending to time and score the subject's performance) was perceived as very stressful.

The word test, used in between the CWT's, consists of a 300 word text containing instructions designed as a one-page text where subjects are instructed to follow certain instructions as they read. Throughout the text, the subject is asked to underline, cross out or circle words or parts of words if certain requirements are met. Since the instructions are embedded in the text, completing the task requires extreme attention and focus on each word and sentence to get each instruction correct while completing the task under time pressure. The test was translated and back-translated from Swedish to English, and the first few lines contain the following instructions: 'If the letter Z occurs somewhere before this comma, underline it and if not, underline it in the following word: Zoo. Now draw, unless the word 'word' is a part of the word 'murder', a dotted line here, otherwise, draw a cross'. (The word 'murder' is 'mord' in Swedish, and 'word' translates as 'ord', so the reader's task is to avoid drawing a dotted line here, since 'ord' indeed is part of the word 'mord'). The remaining instructions throughout the text are of a similar type. The participant is once again instructed to do the test as fast as possible and signal to the note-taking experimenter when finished. Thorough manipulation checkups (see below) checked the ex-

perienced level of stress, tension, and pain before and immediately after this and the other manipulations.

Flotation tank. A flotation tank (Flytarium Norden AB, Sweden) measuring 2620 mm x 1670 mm x 950 mm was used. The depth of the fluid (salt water) varied from 200 to 300 mm. The flotation tank was insulated, partly to maintain a constant fluid temperature (in the water and in the air), and partly to isolate each subject from incoming light and noise. The temperature of the fluid was maintained at 34.4° C. The water in the tank was saturated with magnesium sulfate (density: 1.3 g/cm<sup>3</sup>). The tank was equipped with a horizontally hinged lid that was easy to open and close (from the inside and outside) by the subject. Between flotations a hydrogen peroxide solution was regularly poured in, and after this the salt water was filtered and sterilized with UV-light.

### Procedure

Participants were instructed to bring swimwear and a towel, in case they had been assigned to the Relaxation condition. On arrival, each subject was instructed by the test leader to fill out (in randomized order) the two personality tests and background data. Then, the experimental manipulation took place for 45 minutes, and afterwards the participants were given the writing task. The compositions were collected after one hour. The students were also asked to fill out scales relating to health, pain, and experience of stress immediately before and after manipulation, and also immediately after writing.

### Results

#### Interjudge Reliability

Regression analysis (enter-method) was used for calculating the multiple correlation coefficient ( $R$ ), which showed significant correlations between the three judges for  $R$  concerning Elaboration ( $R = 0.78$ ,  $p < 0.001$ ), Language Vividness ( $R = 0.79$ ,  $p < 0.001$ ), Originality ( $R = 0.85$ ,  $p < 0.001$ ), Fantasy ( $R = 0.96$ ,  $p < 0.001$ ), Social Realism ( $R = 0.83$ ,  $p < 0.001$ ). Since the regression analysis showed acceptable  $R$ -values, it was considered meaningful to average the

results from the three judges for Elaboration, Language Vividness, Originality, Fantasy, and Social Realism.

#### Creativity related dependent variables

A Pillais' MANOVA with Group as independent variable and Elaboration, Language Vividness, Originality, Fantasy, and Social Realism as dependent variables was used. The analysis showed an overall significant group difference ( $p = 0.001$ ). For means and standard deviations, see Table 1.

	Control	Flotation-REST	Stress
Elaboration	4.57 (2.13)	5.10 (2.00)	4.10 (1.97)
Language Vividness	4.95 (1.94)	5.18 (2.04)	4.22 (1.92)
Originality	3.30 (2.11)	5.45 (2.53)	4.12 (2.28)
Fantasy	2.08 (2.01)	3.25 (3.04)	1.85 (1.40)
Social Realism	5.62 (2.41)	4.40 (2.42)	6.32 (2.35)

Table 1. Means and (standard deviations) regarding Elaboration, Language Vividness, Originality, Fantasy, and Social Realism with respect to Group (Control, Flotation-REST, and Stress).

A univariate F-test showed no significant differences between groups for Elaboration, Language Vividness, and Fantasy ( $ps > 0.1$ ).

The univariate F-test showed a significant difference between groups for Originality [ $F(2,57) = 4.41$ ,  $p = 0.017$ ]. A post hoc test (Scheffe, 5% level) indicated that the Flotation-REST group produced more original compositions as compared to the Control group. Further, the univariate F-test showed a significant difference between groups for Social Realism [ $F(2,57) = 3.28$ ,  $p = 0.045$ ]. A post hoc test (Scheffe, 5% level) indicated that the Stress group scored higher on Reality compared to the Flotation-REST group.

#### Linguistic dependent variables

A Pillais' MANOVA was used with group as independent variable and number of Words, Bytes, Types, Sentences, Paragraphs, Type/token ratio, Word length, Sentence length, Paragraph length, Number of errors, Number of specific errors (Verbs, Nouns, Other, Real spelling error, and Minor spelling error) as dependent variables. The analysis showed no overall significant group difference ( $p = 0.467$ ).

A univariate F-test showed no significant differences between groups in respect of Words, Bytes, Types, Type/token ratio, Word length, Sentences, Paragraphs, Errors, Verbs, Nouns, and Spelling ( $ps > 0.25$ ). There was however a significant difference between groups for Other errors [ $F(2,57) = 4.43$ ,  $p = 0.016$ ], where a post hoc test (Scheffe, 5% level) indicated that the Control group had more miscellaneous errors ( $M = 3.20$ ,  $SD = 2.48$ ) as compared to both the Flotation-REST group ( $M = 1.50$ ,  $SD = 1.70$ ) and the Stress group ( $M = 1.70$ ,  $SD = 1.63$ ).

#### Dependent variables related to the modified Daley criteria

A Pillais' MANOVA was used, with Group as independent variable and Organization, Tempo, Interest, Forcefulness, Mechanics and Clarity as dependent variables. The analysis showed no overall significant group difference ( $p = 0.208$ ).

The univariate F-test showed no significant differences between groups in respect of Tempo, Interest, and Clarity ( $ps > 0.1$ ). There was, however, a non-significant trend for Organization ( $p = 0.07$ ), where a post hoc test (LSD, 5% level) indicated that the Stress group ( $M = 2.75$ ,  $SD = 0.91$ ) had better text organization as compared to the Control group ( $M = 2.10$ ,  $SD = 0.91$ ). The flotation-REST group came in between ( $M = 2.65$ ,  $SD = 0.99$ ).

#### Dependent variables related to essay topic and narrator person

A statistical method (Kruskal-Wallis) was used to determine Topic, Tone, and Narrator Person. There were no significant group differences ( $ps > 0.2$ ).

### The gender factor

Since the distribution of gender in the sample did not meet the ANOVA requirements, the gender factor was analyzed with non-parametric statistics. A Mann-Whitney U-test yielded no difference between sexes in regard to VOC/MCT results ( $p = 0.237$ ). Further analyses showed no significant differences between sexes in regard to Elaboration, Fantasy, Language Vividness, Social Realism, Number of words, Type/token ratio, Word length, Sentence length, Paragraph length, Errors, Verb, Noun, Other errors, Minor spelling errors, Organization, Tempo, Interest, Clarity, Topic, and Person ( $ps > 0.06$ ). There were, however, significant differences (Mann-Whitney U-test) between the sexes in regard to (a) Originality ( $u = 147.00$ ,  $p = 0.019$ ), where men were more original ( $M = 5.85$ ,  $SD = 2.43$ ) as compared to women ( $M = 3.94$ ,  $SD = 2.33$ ); (b) Bytes ( $u = 165.00$ ,  $p = 0.046$ ), where men produced more bytes ( $M = 2442.18$ ,  $SD = 1410.35$ ) as compared to women ( $M = 1726.08$ ,  $SD = 506.07$ ); (c) Types ( $u = 164.50$ ,  $p = 0.045$ ), where men produced more types ( $M = 205.55$ ,  $SD = 86.23$ ) as compared to women ( $M = 159.16$ ,  $SD = 37.88$ ); (d) Number of sentences ( $u = 154.00$ ,  $p = 0.027$ ), where men produced more sentences ( $M = 32.09$ ,  $SD = 19.26$ ) as compared to women ( $M = 22.02$ ,  $SD = 8.38$ ); (e) Spelling ( $u = 166.00$ ,  $p = 0.045$ ), where men had fewer spelling errors ( $M = 1.36$ ,  $SD = 1.50$ ) as compared to women ( $M = 3.02$ ,  $SD = 2.80$ ).

### Manipulation checks

For manipulation checks, split-plot ANOVAs were used with Group as Between-Subject Factor and degree of relaxation, stress, experience of pain, and experience of fatigue (before treatment, after treatment, and after the writing assignment) as Within-Subject Factors. The statistical analyses did not indicate any group differences ( $ps > 0.08$ ). Described below are the results for each variable from the repeated measurements and the interactions in regard to the Between-Subject Factor and the Within-Subject Factors.

(a) Degree of experienced relaxation. A significant difference regarding Degree of relaxation was found [ $F(2,114) = 6.61$ ,  $p = 0.002$ ]. Post hoc tests (Bonferroni Paired Samples t-tests, 2% level) showed a significant difference between the degree of relaxation

experienced before and after the experimental treatment [ $t(59) = 3.92$ ,  $p < 0.001$ ], where participants experienced a higher degree of relaxation after treatment ( $M = 2.22$ ,  $SD = 1.89$ ) as compared to before the experiment ( $M = 3.22$ ,  $SD = 1.61$ ). There were no other significant differences in regard to relaxation ( $ps > 0.1$ ). Further, the split-plot ANOVA showed a significant interaction between relaxation and Group [ $F(4,114) = 4.91$ ,  $p = 0.001$ ]; post hoc procedures (one-way ANOVA, Scheffe 5% level) indicated that the Stress group were significantly more tense and thus less relaxed after treatment ( $M = 3.50$ ,  $SD = 2.14$ ) as compared to the Flotation-REST group ( $M = 1.45$ ,  $SD = 1.39$ ) and the Control group ( $M = 1.70$ ,  $SD = 1.38$ ). There were no significant differences between groups in regard to degree of relaxation before the experiment or after the writing task ( $ps > 0.6$ ).

(b) Degree of experienced stress. A split-plot ANOVA showed a significant interaction between Stress and Group [ $F(4,114) = 18.16$ ,  $p < 0.001$ ]; post hoc procedures (one-way ANOVA, Scheffe 5% level) indicated that the Stress group were significantly more stressed after treatment ( $M = 5.60$ ,  $SD = 1.54$ ) as compared to the Flotation-REST group ( $M = 1.40$ ,  $SD = 1.70$ ) and the Control group ( $M = 1.95$ ,  $SD = 1.93$ ). There were no other significant differences ( $ps > 0.6$ ).

(c) Degree of experienced pain. A split-plot ANOVA showed no significant result regarding interaction and there was no significant difference in regard to Pain ( $ps > 0.2$ ).

(d) Degree of experienced fatigue. A split-plot ANOVA showed a significant interaction between Fatigue and Group [ $F(4,114) = 3.27$ ,  $p = 0.014$ ]; post hoc procedures (one-way ANOVA, Scheffe 5% level) indicated that the Control group were significantly more tired ( $M = 4.60$ ,  $SD = 2.28$ ) as compared to the Flotation-REST group ( $M = 2.85$ ,  $SD = 2.46$ ) and the Stress group ( $M = 3.45$ ,  $SD = 1.82$ ). There were no other significant differences ( $ps > 0.2$ ).

### Discussion

Flotation-REST relaxation showed a positive effect on originality, which is in line with previous research on creativity (Norlander, Bergman and Archer 1998). Further studies using other relaxation techniques are needed in order to apply these findings to the writing assessment context, since the type of deep relaxation occurring in the

tank is not directly comparable to the relaxed mind state of a person being tested for composition writing. In this particular material, stress did not appear to have a deteriorating effect on writing mechanics (errors, paragraphing, sentences etc.). However, the stress group produced more social realistic compositions as compared to the flotation-REST condition, and their essays also tended to be better textually organized. Stress might thus hinder the flow of fantasy-related composition topics and keep the writer in the present, personal situation when composing.

Another way of interpreting the main results of the study could be that the sensory deprivation in the flotation tank hampered the secondary process and gave more room for the primary process, resulting in the production of more original ideas and solutions. The stress condition on the other hand appeared to enhance the secondary process, as seen from the increase in realistic traits and an improved text organization.

One explanation for the fact that stress did not affect the students' language significantly (errors, paragraphing, sentences etc.) could be the type of stress generated in the stress manipulation. The various paper-and-pen tests could create more fatigue than the type of stress present in an examination situation, where the student has grades and other personal goals at stake. It is difficult to create an experimental situation where the true stress of a student wanting to perform well on a test is recreated, but perhaps some type of quasi-experiment in a real test situation would be possible. Nevertheless, such experiments suffer from the fact that many other random factors that have to be taken into consideration.

The relationship between stress/relaxation and the specific type of creativity involved in ESL writing also needs further testing. The results of the present study are intriguing enough to call for additional work; in addition, there still is a need to find optimal writing assessment contexts for the advanced ESL student.

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