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Piano playing reduces stress more than other creative art activities

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Abstract
Few studies have been conducted on the physiological effects of creative art activities. In this study, the effects of creative art activities on human stress were investigated, and their effects were compared in 57 healthy college students (27 males and 30 females). Subjects were divided into four groups, each of which participated in 30-minute sessions of one of the following creative activities or a control activity: (1) playing the piano; (2) molding a piece of clay; (3) calligraphy (writing using a brush and ink); and (4) remaining silent (as a control activity). Cortisol levels and the State-trait Anxiety Inventory (STAI-I) were measured before and after each session. Post-session cortisol levels were markedly decreased for piano playing, clay molding and calligraphy, indicating a reduction in stress due to participation in creative activities; the effect of piano playing was significantly greater than clay molding and calligraphy. Post-session STAI scores decreased significantly in all groups other than the control group, indicating a reduction in anxiety induced by engaging in creative activities. The psychological and physiological stress-reducing effects of creative activity, particularly playing the piano, were demonstrated. In addition, the role of music education in school in mental health is discussed.

Keywords
creative art activities, music therapy, piano playing, purpose of music education, stress

Introduction

The writer Oscar Wilde once said cynically, "All art is quite useless." However, we are empirically aware of and use the effects of art, from fostering unity through patriotic songs to the calming effects of classic films. Furthermore, arts enrichment provides varied channels for acquiring school readiness skills and may offer important educational opportunities for students (Brown, Benedett, & Armistead, 2009; Kefi, 2009). It has been said that arts education enhances the

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artistic skills and development of children (Zigler & Bishop-Josef, 2006) and develops cognitive skills (Rauscher, 2002; Schellenberg, 2001); for example, music instruction develops specific spatiotemporal skills (Hetland, 2000). Furthermore, art therapy has also been applied in the medical field (Joye, 2006). However, research on the physiological-biological effects of art in humans has not yet progressed.

Although music educators have tried to address the question of why every child should study music in school (Hodges, 2005), there is no definite answer regarding the purpose and meaning of music education. One of the reasons for this is that the biological study of music and music education has been insufficient. However, brain imaging techniques such as fMRI or PET scans have been used to determine brain activity while listening to music (Zatorre, Evans, & Meyer, 1994). Moreover, the effect of music training on the brain has been reported (Pantev et al., 1998). However, compared with the brain imaging research in music, the investigation of the relationship between music and biochemical substances in the body, that is, the behavioral-endocrinological study of music, is in its infancy.

The effects of art appreciation (passive activity), such as listening to music, on human physiology and psychology are gradually becoming clear. There is research in music therapy (Knight & Rickard, 2001; Kreutz et al., 2004), music education (Hodges, 2003), the psychology of music (Fukui, & Yamashita, 2003; Gerra et al., 1998; Khalfa, Bella, Roy, Peretz, & Lupien, 2003; Shenfield, Trehub, & Nakata, 2003; Yamamoto, Naga, & Shimizu, 2007), and other similar fields (Nilsson, 2009; Nilsson, Unosson, & Rawal, 2005).

Most of these studies have been on the stress-reducing effects of listening to music, and listening to music has been reported to cause a reduction in the levels of cortisol (C), a major stress hormone. C is a vital hormone involved in functions such as glucose metabolism and immune function, but in cases of chronic stress, it has been known to induce symptoms such as hypertension and impaired cognitive function (Lundberg, 2005). In addition, increasing C levels with age may lead to a decline in memory or progression of Alzheimer's disease (Huang et al., 2009). Thus, the reduction of C through the passive activity of listening to music may be useful for the treatment and prevention of diseases and disabilities. However, few studies have been conducted on the effects of creative art activities, such as playing musical instruments and other creative activities, on the mind and body. Also, no research has compared the effects on stress.

The purpose of this study was to evaluate the effects of creative art activity (piano playing, clay molding, calligraphy) on human psychology and physiology and to examine whether the different activities had different effects.

Methods

The experiments were conducted using a between-subject design. Fifty-seven healthy college students (range, 19–26 years) took part in the experiments, including 27 males (mean age, 22.3 years) and 30 females (mean age, 20.7 years). Subjects were divided into four groups, each of which participated in a 30-minute session of one of the following creative activities and a control activity: (1) piano playing: playing a piano tune specified by a university teacher (8 males and 10 females); (2) clay molding: molding a shape using clay (4 males and 7 females); (3) calligraphy: writing a Chinese poem using a brush and ink (5 males and 8 females); and (4) remaining silent (as a control activity) (10 males and 5 females). Subjects were assigned to groups based on their background in each field. Although they were not professional performers, they had the following mean years of experience in each field: piano playing (13.5 years), clay molding (12.7 years), calligraphy (15.7 years). Subjects in the control group come from other students. Subjects playing

the piano performed their favorite sonata from Mozart, Beethoven, or Chopin. Subjects who molded clay produced a statue of an arbitrary person that the teacher had selected. Subjects doing calligraphy reproduced a favorite work from among the Chinese poems that the teacher presented. The control group was directed to be seated and remain silent. Only females reporting regular menstrual cycles were selected.

The indicators measured were endocrine secretion (salivary C levels) and psychological test scores (State-trait Anxiety Inventory (STAI-I)). C is an adrenocortical hormone that increases during periods of temporary stress (Sapolsky, Romero, & Munck, 2000). We chose to use saliva samples because taking a saliva sample is a less invasive and less stressful procedure compared with drawing blood. Saliva C concentrations are highly correlated with serum concentrations and represent the free and biologically active steroid fraction (Poll et al., 2007). STAI-I was initially conceptualized as a research instrument for the study of anxiety in adults and is a questionnaire consisting of 20 questions that measure anxiety (Spielberger, Gorsuch, & Lushene, 1970).

Directions were given to the male and female subjects by a male and female research assistant, respectively. The experiments were conducted separately by sex at specified hours (14:00 to 17:00) bearing in mind that C levels have been reported to undergo diurnal variation in males and females (Pollard, 1997; Edwards, Evans, Hucklebridge, & Clow, 2001). The piano was played in a separate room and calligraphy, clay molding and control were done at the same time, separately by sex, in a quiet room. All subjects gave informed consent to participate, and the study was approved by the ethical committee. Before signing the consent form, each subject was given an explanation of the procedures of the experiments but not informed of its goals.

Each subject provided a 7-ml saliva sample at the beginning of the experiment for baseline levels. Females with a normal menstrual cycle of 28–32 days provided saliva samples during the luteal phase. Subsequently, subjects were given a questionnaire consisting of a psychological test (STAI-I). After each session (three creative activities and control), saliva samples and STAI-I scores were obtained again.

Saliva samples were immediately frozen at −20°C after collection, and hormone levels were measured using an enzyme-linked immunosorbent assay (Levine, Zagoory-Sharon, Feldman, Lewis, & Weller, 2007; Poll et al., 2007). Inter- and intra-group variation coefficients for C were 3.92% and 6.7%, respectively.

Results

Subjects' mean C level prior to participation in the creative activities was 0.160 μg/dL (0.153 μg/dL in men and 0.166 μg/dL in women). To investigate the effect of C level on changes in endocrine secretion, an analysis of variance (ANOVA) was performed using factors of change in pre- and post-session C levels, sex, session type (piano playing, clay molding, calligraphy, and remaining silent as a control activity). As a result, the main effects for changes in C level were significant ($F1,113 = 5.57$, $p = 0.0202$). Post-session C levels were markedly decreased for piano playing, clay molding, and calligraphy, indicating a reduction in stress due to participation in creative activity sessions (Figure 1). The Bonferroni post-hoc test revealed that piano playing was significantly more effective than other activities at lowering C levels ($p < 0.0000$). To assess the effects of each session on anxiety, an ANOVA was conducted using factors of pre- and post-session STAI-I scores, sex and session type (four types: piano playing, clay molding, calligraphy and remaining silent). There was an omission in the STAI score of one subject, and we excluded this subject from the analysis. A significant main effect was observed for STAI-I score variation ($F1,111 = 10.74$, $p = 0.0014$). Post-session STAI-I scores decreased significantly in creative activity sessions other than

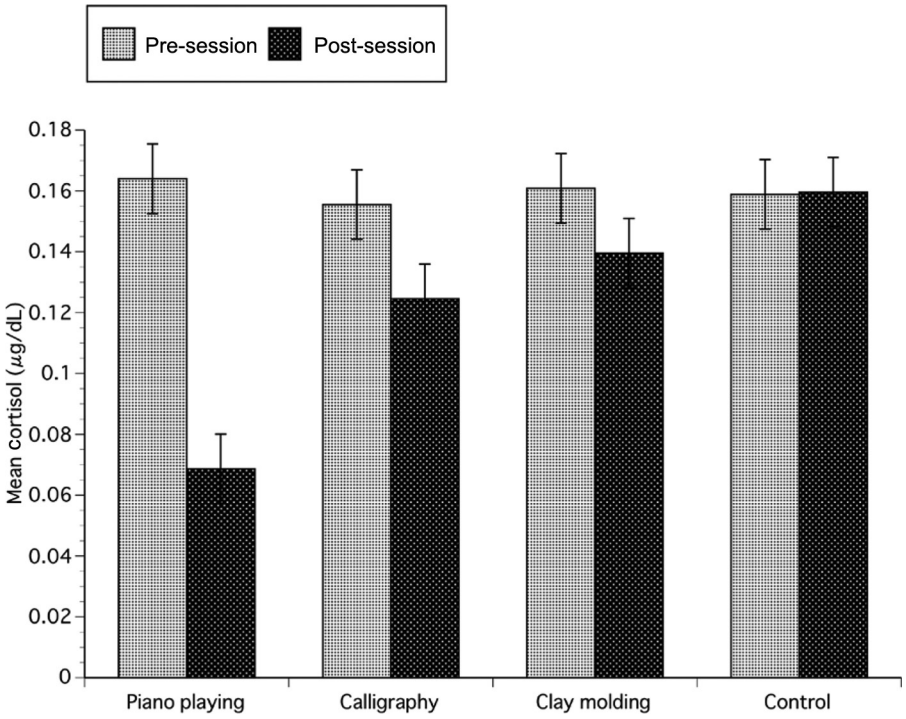

Figure 1. C levels of 57 subjects sampled before and after activities. An ANOVA revealed that the main effect of C changes was significant ($F1,113 = 5.57$, $p = 0.0202$). A post-hoc test revealed that piano playing was significantly more effective than other activities ($p < 0.0000$)

the control group, indicating a reduction in anxiety induced by engaging in a creative activity. No differences in STAI-I results were observed among the creative activity groups.

Discussion

Few studies have been conducted on the effects of creative active art activities compared with passive appreciation of the arts. This is the first study to evaluate the effects of creative art activities (piano playing, clay molding, calligraphy) on human psychology and endocrinology and to examine whether the different activities have different effects. The psychological and physiological stress-reducing effects of creative activity, particularly the marked effects of music performance (piano playing), were demonstrated in this study. Because C plays a major role in the maintenance of homeostasis (reward and emotion), artistic creative activities, especially music (performance and listening), may play a crucial role in sustaining human life. We consider this an important factor when considering the value of music education. Until now, the purpose of music education has been said to be the transmission of cultural heritage or to help students to achieve their potential. Although concerns regarding the purpose or meaning of music education continue to be raised, the results of this study showed that there is a psychological and behavioral-endocrinological meaning to playing music. Though music has philosophical and aesthetic meanings, this study confirms its biological value as well. In previous research, listening to music was

shown to have a particularly high stress-reducing effect. In this study, music performance showed the same effect as listening to music. With all the stresses of modern society, music education in school has a new purpose: the improvement of mental health. Moreover, artistic activities have been reported to reduce the risk of dementia onset (Verghese et al., 2003); music therapy is particularly effective (Fukui & Toyoshima, 2008; Guétin et al., 2009). Music facilitates expression, communication and relationships in a non-verbal context. It may become an innovative, low-cost option for use in preventive medicine and alternative medicine in a modern society burdened with escalating medical costs due to a low birthrate and aging population. The results of this research demonstrate the possibility of musical training as part of school and social education for stress management and dementia prevention.

At the same time, the results obtained in the present study suggest the biological value (function and meaning) of music and other arts. In other words, creative activities, particularly music, may regulate personal psychological and physiological states and have a vital function in enhancing mental fitness. If art is a by-product of evolution that does neither harm nor good (Pinker, 1997), there is no need for humans to devote themselves to art to the extent that they have. The "survival value" of music and arts education truly lies in its "capacity to help the person." Although we cannot yet find a definite answer for the necessity of music education in school, this research provides further evidence of the value of music education.

In the era of brain science, the behavioral-endocrinological study of music is still in its infancy compared with the research that has involved imaging techniques such as fMRI or PET. The purpose and meaning of music education will be clarified by further biological research.

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