



A computer system for art therapy assessment of elements in structured mandala

Seong-in Kim, Ph.D. *, Hyung-Seok Kang, B.A., Youn-Hee Kim, M.A.

Division of Information Management Engineering, Korea University, 5-1 Anam-dong, Seongbuk-ku, Seoul 136-701, Republic of Korea

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ABSTRACT

This paper delineates the development of a computer system designed to automatically rate elements of art assessment in structured mandala, provide the results in the form of quantitative data, and thus facilitate the decision making process of human experts. Based on the analysis of the color-related basic elements by computerized digital image processing, the system deduces information on the color-related applied elements from an appropriately constructed knowledge base. Also, the system rates the degree of concentration involved in the activity of structured mandala coloring: the degree of concentration is suggested as a new element which is believed to determine the effectiveness of structured mandala as an art therapy tool. In this study, we devise an algorithm to objectively rate the completeness and accuracy of the coloring, and formulate a regression model whose dependent variable is the degree of concentration rated by human experts and whose independent variables are the color-related elements, completeness, and accuracy. Some important variables are selected by stepwise regression, and their relative effects on the degree of concentration are determined by standardized regression. The proposed system is validated by showing the consistency between the results obtained by human experts and those obtained by the system through examples.

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Introduction

Mandala as a tool of art therapy

Mandala is a Hindu word derived from Sanskrit meaning circle or center. Jung believed mandala to be an archetype of the “Self,” which he defined as an organizing center where psychic growth comes from. This inner center was a guiding factor different from the conscious personality that enabled a person to become a more complete human being (Jung, 1963; Slegelis, 1987). The mandala serves a conservative purpose – namely, to restore a previously existing order. But it also serves the creative purpose of giving expression and form to something that does not yet exist – something new and unique (Jung, 1964). Bush (1988) reported that through mandalas, imagery reflecting the unconscious dynamics of a client could be accessed at several levels of consciousness. Fincher (1991) stated:

We can attend to the language of the unconscious and we can honor and cultivate our relationship with the Self by creating mandalas. Mandalas contain and organize archetypal energies from the unconscious in a form that can be assimilated by consciousness. (pp. 23–24)

The concept of mandala’s centering contributed to the development of the Family-Centered Circle Drawings by Burns (1990).

The mandala has been widely accepted as an effective art therapy tool for the diagnosis and treatment of emotional or psychological status, symptoms, and disorders. There have been many studies showing that the mandala can be utilized as an efficient art therapy tool, which can provide an understanding of the psychological and emotional status of a patient and an added source of information and guidance in therapy. Slegelis (1987) stated that art psychotherapists today often employ the mandala as a basic tool for self-awareness, conflict resolution, and as a basis for various other art psychotherapeutic techniques in a variety of situations. DiLeo and Kellogg (1977) demonstrated a case where the art therapist was able to derive remarkably accurate psychological information even from relatively meager graphic responses. For example, mandala drawing was useful for the purpose of initial diagnosis, and as a means of recording the pattern of treatment (DiLeo & Kellogg, 1977), as a valuable source of diagnostic information and a better understanding of a mentally handicapped person’s dynamics (Frame, 1982), and also for assessing the compatibility of a couple in a committed relationship (Frame, 2006).

There have also been many studies showing that the mandala is an effective tool for therapeutic purposes. Bonny and Kellogg (1977) reported a case where mandala therapy was effective for a patient complaining of anxiety, guilty feelings, and various socially crippling phobias who felt inadequate, unable to make decisions, experienced sudden shifts of mood, nightmares, and felt frigid.

* Corresponding author. Tel.: +82 18 223 7777; fax: +82 2 428 7772.
E-mail address: tennis@korea.ac.kr (S.-i. Kim).

They hoped that the mandala would be used more and more frequently as a concomitant therapy to other modes of treatment. For children with attention-deficit disorder (ADD) or attention-deficit hyperactivity disorder (ADHD), mandala exercises had the effect of increasing attentional abilities and decreasing impulsive behaviors over time, allowing for better decision making, completion of tasks, general growth in developmental levels, and interest in personal aesthetics (Smitheman-Brown & Church, 1996).

The use of the mandala as an art therapy tool is classified into two types: drawing free figures in a circle (unstructured mandala), or coloring a given pattern in a circle (structured mandala). The mandalas mentioned above refer to unstructured mandala. Given that these two techniques involve exercises concentrated within a circle, similar effects may be expected from both of them. Curry and Kasser (2005) reported that coloring structured mandalas reduced the anxiety of undergraduate students. We selected structured mandala as an art therapy tool in this paper. The main reason for this is that structured mandala is much simpler than unstructured mandala from the viewpoint of developing a computer system. Also, the structured mandala coloring group experienced a greater reduction in anxiety than the unstructured mandala drawing group (Curry & Kasser, 2005). Moreover, the structured mandala is an art therapy tool widely used for all age groups including children, adolescents and elderly persons. Especially, Couch (1997) stated that the mandala drawing is an appropriate art therapy tool for people with notably diminished functions. In this study, elderly persons with suspected dementia were selected as subjects.

Application of computer technologies

Art therapists usually examine the form, symbols, lines, color, and movements in unstructured mandala. Kellogg (1977) interpreted mandalas on the basis of symbols, color, and movements. Cox and Cohen (2000) explored the compositional patterns and thematic imagery in mandala made by a large group of patients who were diagnosed with multiple personality/dissociative identity disorder (DID). However, in structured mandala, the client does not draw any forms or symbols, but only colors the given patterns. Thus, color is expected to be one of the most important elements. As an interdisciplinary study incorporating art assessment and digital image processing, computer systems have been developed to rate the color-related elements (Kim, Bae, & Lee, 2007), to judge the main color (Kim, 2008b), to determine the unusual placement (Kim, Kang, & Kim, 2008), and to rate the variety of color (Kim & Hameed, *in press*) in a drawing. Though for the time being a computer system cannot be expected to detect and analyze the forms, symbols, lines, and movements in unstructured mandala, the above three systems are able to do most of the work necessary in the analysis of structured mandala.

Also, there have been several interdisciplinary studies incorporating art therapy and artificial intelligence. Expert systems, a promising field of artificial intelligence (Giarratano & Riley, 2005), have been proposed as an approach to find solutions to problems encountered in art therapy, such as decision making based on personal subjectivity and experience. Kim, Ryu, Hwang, and Kim (2006) developed an expert system for art therapy. This system can process characteristics of drawings, psychological symptoms, individual environments and psychological disorders, and is expected to allow significant progress to be made in systemizing the knowledge of art psychotherapy. Kim, Kim, Lee, Lee, and Yoo (2006) improved the system by increasing its capabilities of consistency maintenance, reliability evaluation and machine learning. Kim, Yoo, Kim, and Lee (2007) presented a framework for expert system knowledge base in art psychotherapy. The ultimate purpose of these studies is to develop a computer system that is completely

applicable as an art therapy tool. However, these studies are in the preliminary stage. Thus, in this study, as an art therapy tool, we selected structured mandala which is one of the simplest art therapy tools. For the analysis of color-related elements, the method of Kim, Bae, et al. (2007) can be applied. For the completeness, accuracy, and degree of concentration involved in the activity of coloring, which are the other important elements in structured mandala, appropriate methods for the analysis and rating are developed in this paper.

In most previous studies, the color-related elements that were considered are the number and list of colors used (Gantt & Tabone, 1998; Gantt, 1990, 2001, 2004; Hacking, 1999). Kim, Bae, et al. (2007) developed a computer system to automatically analyze basic color-related elements such as the number and list of colors used, the area painted for each color, the number of clusters, the color edges, and the length of edges. Based on the analysis of these basic elements, we develop a system by constructing an appropriate knowledge base to deduce information about color-related applied elements such as the main and subsidiary colors, the primary and secondary colors, the warm and cool colors, and the complementary colors, and to provide accurate and objective information on these elements in the form of quantitative data.

Also, we suggest the degree of concentration involved in the activity of structured mandala coloring as a new element. The basic function of mandala coloring is to provide order and balance for the person who completes and concentrates on coloring it. Bell and Robbins (2007) examined the long-held claim that art making reduces stress and elevates mood. The results of their study demonstrated that the simple act of creating a work of art can produce dramatic reductions in negative mood and that these reductions can be attributed specifically to the production of art rather than to its viewing. Riedel (1999) reported that patients participating in mandala art therapy produced clearer drawings and exhibited increased concentration. Cornell (1994) stated that in coloring a mandala, a patient forgets his or her everyday work, worry, and anxiety, and becomes comfortable, calm, and concentrated on coloring. Thus, the degree of concentration involved in coloring determines the effectiveness of the art therapy tool. The degree of concentration has not been considered in previous studies. The reason for this is not that it is not important, but that there has been no appropriate method of measuring it objectively and quantitatively in numbers. Actually, it has been verified to be an important variable explaining the degree of dementia (Kim, Betts, Kim, & Kang, 2008).

In this study, we developed a computer system designed to provide accurate and objective information in the form of quantitative data after analyzing and rating these elements. The Jungian school of thought is often criticized for being too mystical and unscientific (Slegelis, 1987). Reitman (1951) challenged Jung's universal quality of symbols and claimed, "The Jungian method is a priori and not empirical." Jung's theory is often criticized for being too vague. The reason why the projective technique and interpretation of art are placed under doubt is their lack of reliability and validity, due to the subjectivity associated with the personal decisions of an art therapist. We admit that there are difficulties for human raters such as rater fatigue, excessive time taken during the rating process, and lack of agreement among raters due to subjective or intuitive rating. As a solution to these problems, an approach using computer technologies can be useful. In the case where a large number of drawings need to be analyzed, for example, 471 drawings (Couch, 1997) and about 4000 drawings (Cox & Cohen, 2000), the reduction of fatigue, time or effort of human raters can be one of the great merits of such a system. The computer system can rate elements objectively and quantitatively. Moreover, the system can provide results in numbers, which is more detailed information than what the Likert type gives. We hope this kind of computer system can not

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