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A computer system using a structured mandala to differentiate and identify psychological disorders

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ABSTRACT

The Computer System for the Structured Mandala (CSSM) has been developed to quantitatively and automatically evaluate color-related elements in a structured mandala, find the statistically significant elements that differentiate the four groups of non-patients, anxious patients, depressed patients, and schizophrenic patients, and identify which of the four groups drew the mandala. A total of 495 samples of structured mandalas were obtained from the four groups. The system applied the statistical methods of factor analysis and regression analysis. The system found 67 statistically significant elements and successfully identified the group based on only a structured mandala without further information. The CSSM contributes to the automation and standardization of the structured mandala as an art therapy assessment with high reliability, validity, and usefulness. The system can be used as an assessment for other art therapy dealing with various psychological disorders.

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Introduction

The mandalas can be used in art therapy assessment in two ways: drawing free figures in a circle (unstructured mandala) and coloring a given pattern in a circle (structured mandala). This study focuses on structured mandalas colored by four different groups: non-patients, anxious patients, depressed patients, and schizophrenic patients. As referred to Kim, Kang, and Kim (2009)'s previous research, the main reason for using structured mandala in this paper is that only color-related elements can be analyzed and rated by the current computer technology. The detection of the forms, symbols, lines, and movements in unstructured mandalas or 'free' drawings is beyond the capacity of computer technology.

The structured mandala can be viewed as prestructured art in the sense that one simply colors on given pattern and it can be utilized in the short-term art therapy environment (Vick, 1999). Curry and Kasser (2005) reported that coloring a structured mandala and coloring a plaid design were equally effective for anxiety reduction. Vennet and Serice (2012) concluded that coloring a structured mandala reduced anxiety to a significantly greater degree than coloring a plaid design or coloring on blank paper. Kim, Kim, and Kim

(2008) developed an expert system that interprets the colors of a structured mandala in relation to the drawer's family relationships. Kim, Kang, et al. (2009) developed a computer system that evaluates the elements of completeness, accuracy, and concentration in a structured mandala. Kim, Betts, Kim, and Kang (2009) analyzed the correlation among the elements of a structured mandala and the scores of the Mini Mental State Examination (MMSE) (Folstein, Folstein, & McHugh, 1975). They observed that the selection of brown, light green, and green as main colors, the number of clusters, and the degree of accuracy accurately explained the scores of the MMSE.

One of the purposes of art therapy assessments is to gather information on a person's clinical state and to provide a psychiatric diagnosis. The Diagnostic Drawing Series (DDS) (Cohen, 1986/1994) was designed to gather clinical information on a client in a single session. The Formal Elements Art Therapy Scale (FEATS) (Gantt & Tabone, 1998) provided a method to understand and examine the non-symbolic aspects of art and to demonstrate how the structural characteristics of a drawing furnish information about a person's clinical state and his or her psychiatric diagnosis. This study develops information that can be derived from a structured mandala (simply *mandala* hereafter) on the three aforementioned psychological disorders of anxiety, depression, and schizophrenia. We developed the Computer System for the Structured Mandala (CSSM), which evaluates the elements of the

mandala, differentiates the above four groups, and identifies the group that drew a given mandala.

The CSSM evaluates 32 elements of a structured mandala via the Computer Color-Related Elements of Art Therapy Evaluation System (C-CREATES) (Kim, Bae, & Lee, 2007; Kim, 2010). When contrasted with the elements of an unstructured mandala, the elements of a structured mandala, in which geometric lines are given, can be automatically evaluated by the C-CREATES. Applying the techniques of digital image processing, the C-CREATES can automatically and quantitatively analyze the 32 elements of the structured mandala, including the number and types of colors used, the area used for each color, the number of clusters, the length of the edges, the main color, completeness, accuracy, etc., all of which are explicitly or implicitly related to color.

Most art therapists would likely be at a loss if they were presented with only one structured mandala and asked to guess which group drew it. Therapists must consider all possible supplementary information, such as the drawer's family or personal relationships; the cultural environments of values, languages, and traditions; and the behavioral patterns of the society in which the individual was raised or currently resides rather than relying exclusively on the singular characteristics of a single drawing. Thus, most art-based assessments have been limited to finding statistically significant elements that differentiate the groups. The validity of the DDS and the FEATS has been tested on groups of patients with various psychiatric symptoms. For example, the elements of light pressure, unusual placement, water images, etc., in the DDS differentiated the groups of non-patients, dysthymia patients, depressed patients, and schizophrenic patients (Cohen, Hammer, & Singer, 1988). Three elements of color prominence, details of objects and environment, and line quality in the FEATS differentiated between children with Attention Deficit and Hyperactivity Disorders (ADHD) and children with no learning or behavioral problems (Munley, 2002).

Rubin (1986) reported that it was not possible to distinguish the schizophrenic subjects from the normal subjects using only a drawing. Only three of 40 judges could distinguish beyond chance the artwork of normal children from the artwork of schizophrenic children. Veltman and Browne (2001) reported that two developmental psychologists failed to distinguish abused children from non-abused children using the Favorite Kind of Day (FKD) (Manning, 1987) and the Kinetic Family Drawings (KFD) (Burns & Kaufman, 1972). From the samples of 23 non-abused children and five abused children, which is a relatively small sample size, for the FKD (KFD), the type I error (error identifying non-abused children as abused children) was 1/23 (4/23) and the type II error (error identifying abused children as non-abused children) was 4/5 (3/5). Numerous studies have warned against using only projective methods to identify abused, neglected, or indifferently treated children (Veltman & Browne, 2000a, 2000b). Nevertheless, the CSSM in this paper attempts not only to find the elements that differentiate among the groups but also to identify the group that drew a mandala on the basis of only one given structured mandala.

First, the CSSM uses factor analysis to find statistically significant elements of a structured mandala differentiating among two groups of four cases: (1) non-patient and patient, (2) non-patient and anxious patient, (3) non-patient and depressed patient, and (4) non-patient and schizophrenic patient. Here, the patients consist of three groups: anxiety, depression, and schizophrenia. Next, by regression analysis, the CSSM estimates the probability that a certain group of the two groups drew the mandala, and based on this probability, identifies which group drew the mandala. The CSSM provides art therapists with quantitative results of elements evaluation, group differentiation, and group identification, which are useful in their objective decision-making. The automatic and spontaneous procedure of the CSSM can save art therapists time and effort.

The following section describes the methods of sampling, measurements, data analysis, and system validation. The subsequent section determines the statistically significant elements that differentiate among the groups via factor analysis and identifies the group that drew the mandala via regression analysis. The final section is a discussion of the power of the CSSM and the usefulness of the structured mandala as an art therapy assessment.

Methods

Sampling

The samples of structured mandalas shown in Fig. 1 are obtained from 201 people without specific symptoms of psychological disorders and from 100 anxious patients, 94 depressed patients, and 100 schizophrenic patients. As the structured mandala pattern used in this paper has moderate complexity which is neither too simple for non-patients nor too complex for patients, it is expected to reflect differences among the four groups. Each patient in the sample was diagnosed by the psychiatrist based on DSM-IV-TR (American Psychiatric Association, 2000) criteria. Non-patients were employees of the hospital with no current or past mental illness as determined by the psychiatrist based on Symptom Checklist-90-Revision (Derogatis, 1992). In accordance with the regulations of Korean Art Therapy Association (2013), we obtained informed consent from the participants after explaining purposes of the study, procedures and expected effects in a plain layman's language. The study was approved by the Institutional Review Board (IRB) of the hospital.

One of the authors, an art therapist, conducted a number of single sessions to collect the structured mandala drawings over a two-year period. Drawers are provided with a box of crayons manufactured by Titi Co. Ltd. containing 12 colors: red, orange, yellow, light green, green, azure, blue, purple, brown, reddish brown, white, and black. In the rare cases in which white is used, it is considered as if no color were used for the sake of computer analysis. A session begins with the instructions of 'Please express your emotional state into colors. Please do not chat or discuss with other people,' and all the participants were given 30 min of time.
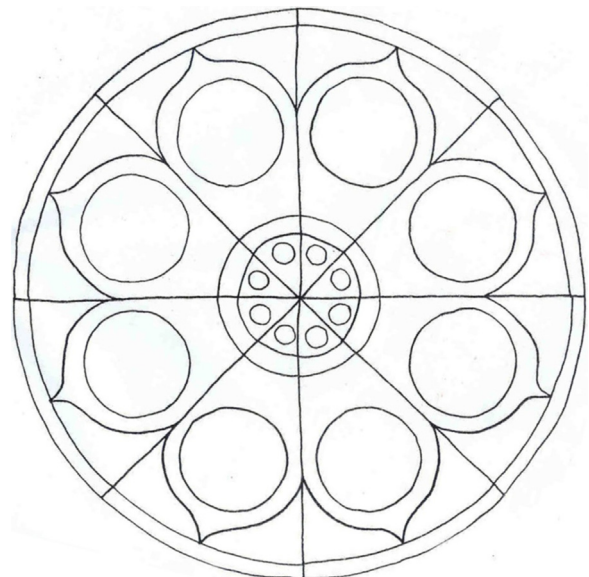

Fig. 1. Pattern of structured mandala.