Art Therapy: Journal of the American Art Therapy Association, 21(3) pp. 125-135 © AATA, Inc. 2004

Articles

Art Therapy and the Brain: An Attempt to Understand the Underlying Processes of Art Expression in Therapy

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Abstract

The application of new techniques in brain imaging has expanded the understanding of the different functions and structures of the brain involved in information processing. This paper presents the main areas and functions activated in emotional states, the formation of memories, and the processing of motor, visual, and somatosensory information. The relationship between the processes of art expressions and brain functions is approached from the viewpoint of the different levels of the Expressive Therapies Continuum (Lusebrink, 1990, 1991) with examples from art therapy interventions. The basic level of interventions with art media is through sensory stimulation. Visual feature recognition and spatial placement are processed by the ventral and dorsal branches of the visual information processing system. Mood-state drawings echo the differences in the activation of different brain areas in emotional states. The cognitive and symbolic aspects of memories can be explored through the activation of their sensory components.

> Artists are in some sense neurologists, studying the brain with techniques that are unique to them, but studying unknowingly the brain and its organization nevertheless. (Zeki, 1999, p. 10)

Introduction

The process of expression through art media and the products created in an art therapy session engage and are perceived predominantly through the tactile-haptic and visual sensory and perceptual channels, and then are processed for their affect, associations, and meaning through cognitive and verbal channels. These activities involve different motor, somatosensory, visual, emotional, and cognitive aspects of information processing with the activation of the corresponding neurophysiological processes and brain structures. The process of art expression is considered an important part of art therapy and art therapy research (Kaplan 1998; Malchiodi, 1998; McNiff, 1998). Several art therapists (Kaplan, 2000; Malchiodi, 2003; Menzen, 2001) have pointed out the need for art therapists to become familiar with the basic brain structures and functions that support art therapy expressions and interventions. According to Malchiodi (2003), art therapy is a mind-body interaction; her brief overview of research involving brain functions in areas related to art therapy covered formation of imagery, physiology of emotion, attachment theory, and placebo effect.

The advent of neuroimaging methods, such as functional Positron Emission Tomography (fPET) and functional Magnetic Resonance Imaging (fMRI), has expanded understanding of the different structures and functions of the brain involved in information processing (Carlson, 2001; Fuster, 2003; Gazzaniga, Ivry, & Mangun, 2002; Hughdahl & Davidson, 2003). These studies can provide a starting point for making general assumptions about the connections between the visual expressions in art and art therapy and the brain structures and functions involved in these processes. Neurobiologist Zeki (1999), in his explorations of art and the brain, stated, "The brain…is…an active participant in generating the visual image, according to its own rules and programs" (p. 68).

Art therapy involves visual expression on different levels of complexity. A human being functions as a whole organism, and at any given time, many brain processes and areas are active and involved. The interaction with art media in art therapy can proceed from the peripheral stimulation of the different sensory modalities or from spontaneous expression of emotions, or both. An expression through art media can also originate from complex cognitive activity involving decisions and internal imagery, thus activating the sensory channels and motor activity (Lusebrink, 1990).

The first part of this paper presents predominant areas and functions of the brain involved in visual and somatosensory information processing, emotional states, and the formation of memories. The motor component is considered in regard to working with tactile media, use of art

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implements, and kinesthetic imagery. This part of the paper also covers a brief review of the structure and functions of the neocortex, the limbic system, and the basal ganglia involved in the different aspects of information processing of interest to art therapists. Examples of fMRI research reflect the internal processes of dealing with imagery. The second part of the paper elaborates on the processes of expression on the different levels of information processing in art therapy, followed by two illustrative case examples.

The Main Areas of the Brain Involved in Art Therapy

The main functions of the left and right hemispheres are commonly known by art therapists: The left hemisphere is involved in analytical and sequential processes whereas the right hemisphere deals predominantly with intuitive and syncretistic processes in a parallel manner. Verbal information is processed predominantly in the left hemisphere, which is also in control of serial movements. Previous work (Lusebrink, 1990) summarized the results of psychophysiological studies by different authors in regard to the functions of the right hemisphere. It processes visual-spatial information, visual imagery, and visual memory. It also discriminates between color and hue. The right hemisphere integrates information across modalities more readily than the left hemisphere. In normally functioning individuals, both hemispheres are fully active and integrated with each other in their functioning even if their contributions vary (Gazzaniga, Ivry, & Mangun, 2002). Recent literature refers to a fair number of studies exploring different aspects of the asymmetrical nature of the brain (Hughdahl & Davidson, 2003). The present paper refers to a few of these studies pertinent to visual information processing.

Structurally, the cerebral or neocortex and its four lobes—frontal, parietal, temporal, and occipital—envelop the limbic system, which includes the anterior thalamic nuclei, hippocampus, amygdala, and parts of the hypothalamus and basal ganglia. The limbic system is, from a phylogenetic perspective, the old cortex. The thalamus is a relay station with specific areas that receive information from different sensory systems, which it relays to the corresponding projection areas in the cerebral cortex. The hippocampus is instrumental in converting information into long-term memories. The amygdala is essential for the integration of emotional components. The basal ganglia receive information from the frontal, parietal, and temporal cortices and are an important part of planning and executing movements (Carlson, 2001). The current trend in cognitive neuroscience, though, is to investigate neural systems instead of neural structures (Gazzaniga et al., 2002).

Functionally, the cerebral cortex is divided into two parts: frontal cortex or executive networks, and posterior cortex or perceptual networks (Figure 1). The frontal cortex incorporates the prefrontal and motor cortices, whereas the posterior cortex consists of several areas that process sensory and perceptual information—namely, the occipital, temporal, parietal, and somatosensory cortices—which are all subdivided into smaller functional areas. According to Fuster (2003), sensory information is processed on three hierarchical levels of perceptual knowledge. These are (a) the primary sensory cortex, which analyzes and maps the elementary sensory features of perception; (b) the unimodal association cortex, which analyzes associated features of complex stimuli in the given sense modality; and (c) the transmodal or multimodal association cortex, which integrates the percepts across several sensory and nonsensory modalities. Most of the perceptual stimuli are processed in parallel and unconsciously. The conscious part of perceptual processing "is guided by selective attention, a top-down cognitive function that, like memory, determines the course of categorization" (Fuster, 2003, p. 85).

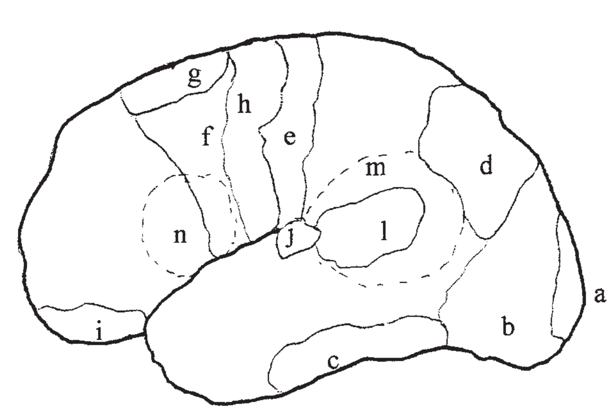

Figure 1
Areas of left hemisphere: a. striate cortex; b. extrastriate cortex; c. inferior temporal cortex; d. second level visual association cortex in parietal lobe; e. primary somatosensory cortex; f. premotor cortex; g. supplementary motor area; h. primary motor cortex; i. orbitofrontal cortex; j. primary auditory cortex; l. Wernicke's area (word recognition); m. posterior language area; n. Broca's area (speech production).

Sensory and other types of information are transferred between the two hemispheres via the corpus callosum through differentiated channels. The specific structures and pathways of the brain involved in processing visual, somatosensory, motor, emotional, and memory-related information are discussed below.

Visual Information Processing

The primary visual or striated cortex (Figure 2) is located in the occipital lobe. This area contains modules of cells that respond to direction, movement, texture, and color of visual stimuli. The striated cortex is surrounded by the extrastriated or visual association cortex, which gathers and analyzes the information received from the different modules. Subsequently, the visual information is divided into two streams of analyses. The lower or ventral stream goes to the secondary visual association cortex in the inferior temporal lobe that responds to the features of shapes and integrates form and color. Information regarding shapes is bet-

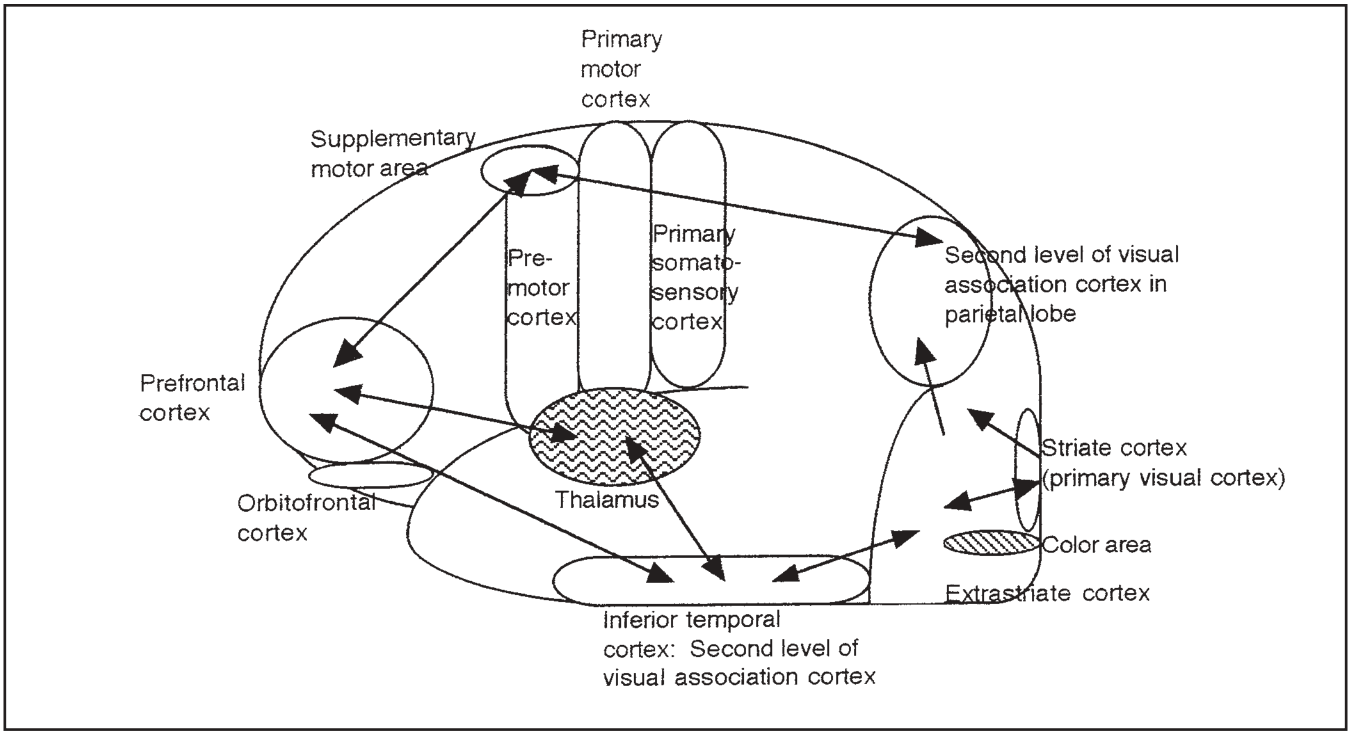

Figure 2
A schematic diagram of visual information processing (shaded areas seen through a transparent brain) (based on Carlson, 2001)

ter encoded in the right hemisphere than the left hemisphere. The upper or dorsal stream goes to the secondary visual association cortex in the parietal lobe and responds to spatial locations (Kosslyn, 1987; Kosslyn & Jacobs, 1994). Studies using fPET scans of the processing of visual stimuli have shown increased blood flow in the ventral and dorsal visual streams, respectively, corresponding to the presentation of stimuli as objects or as a spatial location. Laeng, Chabris, and Kosslyn (2003) have proposed a further division of the dorsal visual stream into coordinate and categorical subnetworks that process qualitatively different types of spatial information. According to these authors, the coordinate network encodes percepts related to distance, size, and orientation, and is processed in the right hemisphere. The categorical network deals with spatial relationships and is processed in the left hemisphere.

Color is processed in the ventral stream (Carlson, 2001), and its processing depends on the abstract or iconic nature of the stimuli. The responses to abstract color stimuli activate the color areas in the striated and extrastriated cortices, but responses to iconic or representational color stimuli involve an additional activation of the hippocampus and right inferior temporal lobe. The activity in the frontal cortex in response to representational color stimuli also differs from that created by abstract color stimuli (Zeki, 1999). As the complexity of the information increases, the cerebral activation which was constricted to one hemisphere appears to spread over both hemispheres (Saron, Foxe, Schroeder, & Vaughan, 2003).

Somatosensory Information Processing

The somatosensory information from the body travels through the dorsal column of the spine via the medulla and midbrain to a specific nucleus in the thalamus and to the primary somatosensory cortex that contains groups of neurons representing the different parts of the body. Each area of the primary somatosensory cortex responds differentially to the different submodalities of somatosensory stimulation. From here the information is transmitted to the secondary somatosensory association cortex. The multiassociation area of the parietal lobe integrates the somatosensory information with the spatial information from the visual cortex (Carlson, 2001).

For art therapists, the sensory modalities of touch and haptic sense are of special interest. Touch activates the *cutaneous* senses that respond to pressure, vibration, cooling, and heating. The haptic sense helps to perceive the shape, weight, and hardness of an object through the *kinesthetic* sensations from joints and muscles experienced in the manipulation of the object (Gibson, 1966). Textures are experienced through the movement of skin over a surface that creates a vibration of the skin. The manipulation of an object creates kinesthetic sensations from joints and muscles. Touch and haptic perceptions involve movement and also activate emotions because the amygdala receives information from the somatosensory primary cortex (Carlson, 2001). James et al. (2002) in a fMRI study found that haptic exploration of three-dimensional objects activated not only the somatosensory cortex but also the occipital cortex, thus indicating the involvement of the ventral visual pathway in the haptic perception of objects.

Motor Information Processing

Paralleling the levels of visual and somatosensory representation, the hierarchical levels of motor representation involve the primary motor cortex, premotor cortex, and prefrontal cortex (Figure 3). The basal ganglia, a group of subcortical nuclei in the forebrain, are an important part of the motor system. The primary output of the basal ganglia goes to the premotor cortex and supplementary motor area via specific nuclei in the thalamus. The basal ganglia also monitor information from the somatosensory areas. The basal ganglia and thalamus form one of the two pathways between the motor association cortex and the somatosensory association cortex. The other pathway between these two areas is a direct transcortical connection. This arrangement is similar to the visual system that also has a direct connection to the prefrontal cortex and another through the thalamus (Carlson, 2001). Knowledge of the two pathways involving the basal ganglia is important to art therapists involved in the reconstitution of lost mental facilities for stroke and Alzheimer's patients (Menzen, 2001).

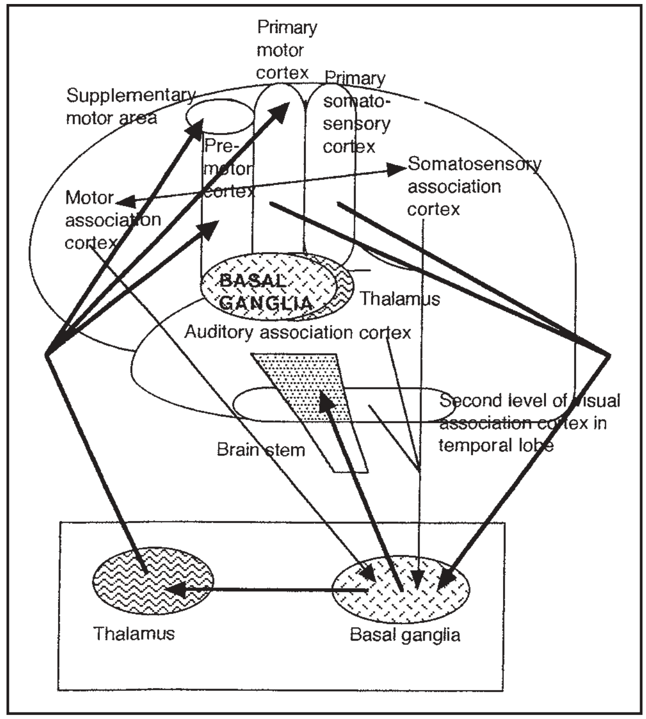

Figure 3
A schematic diagram of the basal ganglia (shaded areas seen through a transparent brain) (based on Carlson, 2001)

Brain Areas and Processes Involved in Emotions

Emotions are addressed in studies of affective neuroscience. Emotions involve patterns of autonomic activity and hormonal and cortical responses. The integration of these different inputs takes place in the amygdala. The connections of the amygdala to the neocortex are direct as well as indirect through the thalamus (Fuster, 2003). The information integrated by the amygdala goes via the thalamus to the orbitofrontal cortex (OFC) and to the prefrontal cortex (PFC). The OFC is likely involved in emotional regulation, whereas the different areas of the PFC have been conceptualized as dealing with affective working memory anticipating the consequences of positive and negative emotions (Davidson, 2000; Davidson, Putnam, & Larson, 2000). The left amygdala is preferentially involved in processing conscious emotional information whereas the right amygdala processes nonconscious information (Pizzagalli, Shackman, & Davidson, 2003). Different emotions constitute different activation patterns in the brain (Jennings, 2001). The central nucleus of the amygdala is important for expressing fear, whereas the anterior cingulate cortex of the limbic system is activated during irritation and anger (Carlson, 2001).

The right hemisphere is better than the left in the expression of emotions and in the recognition of emotions in facial expressions. Emotions are predominantly processed in the right hemisphere, especially negative emotions such as sadness and fear. The arousal of the right frontal region is associated with emotions involving reflective awareness, depression, and withdrawal. Arousal of the left frontal region is associated with alert expectations and approach (Heller, Koven, & Miller, 2003; Tucker, 1981). Depression involves decreased activity in the left frontal and in the right parietotemporal cortex (Bruder, 2003; Heller et al., 2003). Similar to the hemispheric differences in the frontal cortical areas in expressing approach and aversive reactions, the left amygdala is involved in reward processing whereas the right amygdala is associated with aversive processing (Pizzagelli et al., 2003). In a fPET study, subjects with Post-Traumatic Stress Disorder (PTSD) as compared to control subjects showed increased activity in the anterior cingulated gyrus and right amygdala while imagining combat-related pictures (Carlson, 2001).

Brain Areas and Processes Involved in Memory

Memory is an associative function and involves the formation and activation of different areas of cortical networks. Perceptual memory is based on the three hierarchical levels of perceptual knowledge gained through the senses and stored in the posterior cortex. Most of the perceptual memory is implicit or nondeclarative (Fuster, 2003). The recall of perceptual memories involves ventral and dorsal streams for the two types of visual information. Both streams have direct reciprocal connections to the prefrontal cortex; the latter is involved in short-term memory for all sense modalities (Carlson, 2001).

Executive memory is stored in the frontal cortex. The prefrontal cortex performs the integrative functions of working memory, attention, and inhibition. Motor memories of concrete and stereotypical sequences of actions are stored in the basal ganglia. Long-term or declarative memories involve two brain areas: the right hippocampus and the right prefrontal cortex. The integration of sensory information and formation of declarative memories take place in the hippocampus, which is active in the formation of long-term memories but does not store them. The hippocampus receives and processes information from the sensory association areas in the parietal lobe as well as from the amygdala, basal ganglia, and other subcortical areas. In this process the hippocampus forms associations between the representations and relays them back to the association cortex, where the memories are consolidated and modified (Carlson, 2001; Fuster, 2003). As shown in two fMRI studies of war veterans with PTSD (Carlson, 2001), traumatic combat experiences can result in hippocampal damage.

Speech production involves Broca's area in the inferior left frontal lobe whereas speech comprehension and recognition of words are located in the Wernicke's area. The posterior language area surrounding the Wernicke's area interfaces with the perceptions and memories stored in the sensory association cortex, thus contributing to the meaning of words (Carlson, 2001). An fPET study of responses to naming animals and tools showed activity in Broca's area and inferior temporal cortex, the latter indicating activation of the visual ventral stream. In addition, there were two selective activations: one in the premotor cortex for the images of tools and one in the visual association cortex for the images of animals (Martin, Wiggs, Ungerleider, & Huxby, 1996).

Mental images share the same pathways and brain areas for their formation and processing as do perceptions in the different sense modalities (Horowitz, 1970; Lusebrink, 1990; Lusebrink & McGuigan, 1989). As recorded with fMRI, mental images of the construction of three dimensional objects activated the dorsal visual stream and the frontal lobes; the concomitant activity recorded in the ventral stream of the inferior temporal cortex presumably indicated the subject's recognition of the shape created (Carlson, 2001). At times, internally formed images may interfere with the processing of external stimuli (Kosslyn & Konig, 1995; Marks, 1983; Segal, 1972).

Levels of Expression in Art Therapy and the Implied Brain Processes

The human body processes external and internal stimulation as a complex organism with multitudes of finely tuned and interactive systems. Art therapy focuses predominantly on visual and somatosensory information; that is, how images and their expression reflect emotional experiences and how the emotional experiences affect thoughts and behavior. Formation of internal images activates sensory pathways (Lusebrink & McGuigan, 1989). Literature suggests that art therapy interventions benefit predominantly the following general areas: (a) reconstitution and rehabilitation of physical impairments (Kaplan, 2000; Menzen, 2001); (b) promotion of mental, emotional, and physical healing (Kaplan, 2000; Malchiodi, 1999a, 1999b); and (c) enhancement of cognitive and emotional growth (Kaplan, 2000; Menzen, 2001; Rosal, 1992).

The following discussion gives examples of art therapy expressions and interventions on different levels of complexity in the preceding three areas with some references to the possible brain structures and functions involved. The discussion is presented along the levels of the developmentally based model of the Expressive Therapies Continuum (ETC) (Lusebrink, 1990, 1991). This model presents interactions with media and expressions created in art therapy on three different levels of complexity: Kinesthetic/Sensory (K/S), Perceptual/Affective (P/A), and Cognitive/Symbolic (C/Sy). A fourth level, the Creative Level, is conceptualized as crossing the other levels. In a well functioning individual, all these levels are readily accessible, but individual expressive styles or an art therapist's approaches may emphasize a particular level. The conceptual model of the ETC and its three levels echo Fuster's (2003) proposed three hierarchical levels of sensory information processing.

Basic Kinesthetic and Sensory Stimulation

The K/S Level refers to basic kinesthetic-motor and sensory-tactile and interaction with the art media. All art experiences involve motor action and movement, but the motor action itself can be used as a stimulus and as a reconstitutive agent. It can be used therapeutically to express energy through the art media (Lusebrink, 1990). Further, the kinesthetic interaction with media modified through visual feedback can form lines and, therefore, can involve the activity of the directional columns of cells in the primary visual cortex. The perception of straight lines is based on alignment of the cellular columns in particular areas of the primary visual cortex (Zeki, 1999).

In the rehabilitation of stroke patients, Alzheimer's patients, and chronic schizophrenics, kinesthetic action can serve as a reconstitutive agent in that it can stimulate motor memories including those sequences of motor actions relegated to the basal ganglia. Haptic sensory stimulation can bypass impaired brain areas and help to reconstitute memories (Menzen, 2001). The formation of episodic memories involves the basal ganglia in connection with the hippocampus. As one of the two pathways between the motor association cortex and the somatosensory cortex, the basal ganglia and the associated motor movements can provide a bridge between the two association cortices in cases where the transcortical pathways may be impaired (Carlson, 2001). The actions and memories activated through motor action presumably become accessible to conscious inspection and visual processing.

The sensory modality of touch involves motor movement. Sensory stimulation, exploration, and play with art media facilitate imagery formation. For developmentally impaired children and adults, tactile interaction with art media stimulates new development. Menzen (2001) defined this level of interaction as the "basic ('basal') aesthetic stimulation" (p. 149). He pointed out that the use of different tactile materials, such as sand, water, seeds, and rocks, stimulates the sensory and motor systems of individuals who suffer from organic or traumatic brain damage. Tactile interaction with fluid media, such as fingerpaints or paste, adds additional aspects to the stimulation that include color (Kahn-Dennis, 1997). Tactile media are also likely to stimulate emotional responses. In addition to tactile stimulation, work with wood or styrofoam blocks lends itself to three-dimensional exploration of space. Work with three dimensional media, such as clay, gives the individual haptic feedback about the form and its spatial relationships. This observation is corroborated by the knowledge that Alzheimer's disease is associated with damage to the visuo-constructive skills (Wald, 1986).

Formation of Visual Gestalts

The term "perception" in cognitive neurosciences refers to all the sensory modalities on their different levels of complexity. In art therapy, the perceptual end of the P/A Level of the ETC (Lusebrink, 1990) refers to the formal elements in visual expression—such as forms, colors, and lines. This level of the ETC focuses predominantly on the activity of the visual association cortex and the subsequent two streams of visual information processing. The division of the visual information encoding in the visual association cortex is of interest in that the ventral stream recognizes *what* an object is by recognizing the patterns of its features. The dorsal stream determines *where* the object is located spatially in relation to other objects (Kosslyn & Jacobs, 1994). Interactions with art media facilitate a differential emphasis on either the formal features or spatial aspects of the expressions.

The ventral or "what" stream in the inferior temporal cortex elaborates on perceptual forms through external and internal input including color and emotional aspects. A good gestalt or configuration reflects the search for constancies through distilling all essential features of an object. The receptive fields of visual cells in the early stages of visual processing are usually square or rectangular in shape, thus supporting artists' quest for essential basic forms (Zeki, 1999). Visual expression involves the organization of forms and can help to achieve good gestalts through visual feedback. In art therapy, the exploration of external objects visually or through the modality of touch may help to define and elaborate forms.

Different lesions, depending on their location in the cortex, produce impairments in the processing and expression of visual information. Menzen (2001) discusses the effect of left- and right-hemisphere brain injuries on an individual's ability to construct shapes. The drawings of individuals with left-hemisphere injury are schematic and repetitive, whereas those of individuals with right-hemisphere injuries reflect their inability to perceive and draw complete gestalts. Wais's approach (cited in Menzen, 2001) to art therapy with the brain injured focused on the formation of new neural pathways and functional reorganization through creating arrangements and three-dimensional structures of foam and wood blocks. His work with individuals suffering from left-hemisphere injuries incorporated attention to details and sequences. On the other hand, his work with those suffering from right-hemisphere injuries emphasized spatial perception and reconstruction through emphasis on the aesthetic and pleasurable aspects of the experiences.

Emergence and Function of Emotions

The affective component of the ETC deals with the expression and channeling of emotions through art media and the effect of emotions on information processing (Lusebrink, 1990). Emotions influence many cognitive aspects—such as attention, memory, perception, and information processing (Heller et al., 2003). The presence of emotion modifies the visual expression including imagery and its formal elements. Visual responses to the names of mood states—such as sad, mad, glad, and scared—display differences in the type and placement of lines, colors, and forms for the different states. Each mood state, though, has commonalities in the expression across many subjects (Rhyne, 1979, 1983). The elaboration of a single word defining a mood state in art therapy gives visual expression of this state, thus making it accessible for conscious observation. The differences in the expressions of the mood states echo the fact that there are differences in brain areas activated when experiencing these emotions (Jennings, 2001).

The inhibition of emotion manifested in visual expression through the decrease in color usage, size of forms, and spatial arrangements seen in depression (Wadeson, 1980) may be related to the decrease of activity in the left prefrontal and right parietotemporal region as discussed before (Heller et al., 2003). The influence of emotions, or lack thereof, on cognitive functions can be seen in memory formation and recall. Emotions are important in forming memories, and emotional memories are easier to recall than nonemotional ones (Fuster, 2003). A fPET study of women with posttraumatic stress disorder (PTSD) showed that emotional memories of sexual abuse in childhood activated the orbitofrontal cortex and anterior temporal lobes (Carlson, 2001). The activity in the orbitofrontal cortex points to the influence of the emotional content of the memories. A possible resolution of traumatic memories could be directed through a paced approach with art media without emotionally overwhelming the individual. The inability to express emotions is manifested in alexithymia, under the influence of which an individual's drawings show an inability to thematically integrate forms indicating disturbances in spatial integration and the symbolic function (Demers-Desrosiers, 1982).

Cognitive and Symbolic Processes

The C/Sy Level of the ETC involves activities of the frontal cortex and encompasses memories, problem solving, and anticipatory operations with images, concepts, and the corresponding verbalizations. The cognitive component focuses on analytical and sequential operations, logical thought, and abstraction. Symbols refer to intuitive, multidimensional concept formation, part of which may be unknown or not available for conscious processing (Lusebrink, 1990). Both cognitive and symbolic aspects are necessary for memory work, and both aspects rely on the information stored in the multimodal area in the parietal cortex (Fuster, 2003).

On the cognitive end of the C/Sy Level, art therapy experiences and interaction with art media facilitate the elaboration of conceptual and abstract thought and of problem solving. The spatial and temporal relationships between objects, people, or specific occurrences can be concretely represented through the realistic or abstract images created in the art media. Rhyne's (1979) problem-solving collage used colored abstract cut-out shapes to represent the different aspects of a problem. The spatial arrangement of the shapes portrays the relationships among the different parts of the problem, which then can be observed, changed, and reintegrated on a cognitive level. The media can be helpful to elaborate the emotional or value judgments of the topics being explored. This is an example in art therapy of the use of top down differentiation followed by integration on a higher level of brain functioning as discussed by Fuster (2003). An important part of the actions on the cognitive end of the C/Sy Level is verbalization and naming of the images created.

In art therapy, the symbolic component of the ETC deals with the different aspects of formation and affective resolution of symbols (Lusebrink, 1990). Fuster (2003) defined symbols as "derivative gestalts" in that they are formed in the perceptual cortex "by repeated experience with variants of the gestalt they represent or with other symbols (e. g., words)" (p. 94). It is interesting to note that C. G. Jung conceptualized archetypal symbols as based on the structural determinants of the psyche (Jacobi, 1959), presumably meaning the underlying structure of the brain.

The process of symbolic exploration may activate the lower levels in the hierarchy of perceptual processing (Lusebrink, 1990), including the primary sensory cortices in different modalities because "symbols are solidly based in perception by virtue of their perceptual origin and their nature of perceptual retrieval" (Barcalou cited in Fuster, 2003. p. 95). The activation of the unimodal primary sensory cortices seems to be especially important in the exploration of symbolic aspects of memories as well as emotional elements that may have been repressed or dissociated. Expressions through art media may help to recover the components of symbols and related emotions on the lower levels of the perceptual hierarchy and to contribute to the exploration of the meaning of symbolic images (Lusebrink, 1990). The exploration of symbols and their sensory aspects in all modalities can contribute to an individual's growth and further the development and understanding of self and others.

Creative exploration can occur on any level of the ETC and involves the interaction of both hemispheres. An important part of creative activity is the excitement and pleasure of involvement, which in itself can be healing (Lusebrink, 1990). The brain functions involved in creativity, though, have not been addressed in the present paper.

Case Examples

The following examples from two case studies in art therapy illustrate the processes involved in art expression and reflect, by implication, the activation of different brain areas and functions. The first example deals with the subject's sensory, perceptual, and cognitive involvement on these consecutive levels of information processing through his interaction with three-dimensional art media.

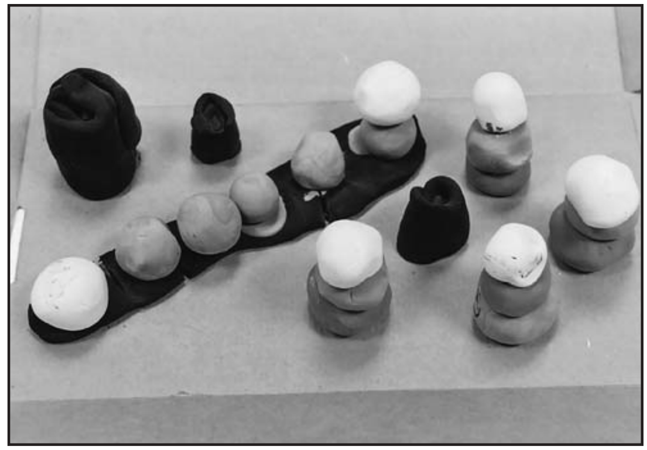

Figure 4
R.'s sequence of tactile/haptic/visual expression in colored modeling clay (courtesy of Janet K. Long)

R., a 50-year-old who was clinically depressed and suffered from chronic schizophrenia, was asked in his third art therapy session to explore the medium of modeling clay (Figure 4). He made several flat oblong pieces. In response to the art therapist asking what it was, he said it was "a sock" and rolled up the flat pieces. Following the therapist's example, he then made a number of yellow, red, and blue clay balls. When the therapist asked whether he would like to arrange them in a row or on top of each other, he made four "snowmen." Then he added, "Now they belong there" and put the rest of the balls on black pieces of clay. (Interestingly, his family consists of four people: self, mother, stepfather, and estranged father, who abandoned him as a teenager after he had been first diagnosed). R. said that he was very satisfied with his creation of clay forms. (J. K. Long, personal communication, April 20, 2003).

In the absence of concurrent brain activity measures, one only can venture to make the following assumptions about the sequence of the corresponding activation of different brain functions: (a) initial stimulation of sensory-motor activity; (b) visual inspection with activation of the ventral stream of visual processing, followed by creation of defined forms; (c) spatial orientation of forms with corresponding activation of the categorical branch of the dorsal visual stream; (d) spontaneous arrangement of balls in a row with concurrent activation of the coordinate branch of the dorsal visual stream; and (e) definition of forms as "snowmen," pointing to the activation of the cognitive processes involved in symbol making. This sequence suggests progression from a simple tactile-sensory experience to the more complex processes of definition and symbolization of visual forms. It also parallels Fuster's (2003) proposed ascending hierarchical levels of perceptual knowledge processing from unimodal to multimodal association.

Excerpts from the second case (Lusebrink, 1974) illustrate the stylistic changes in visual expression from a com-

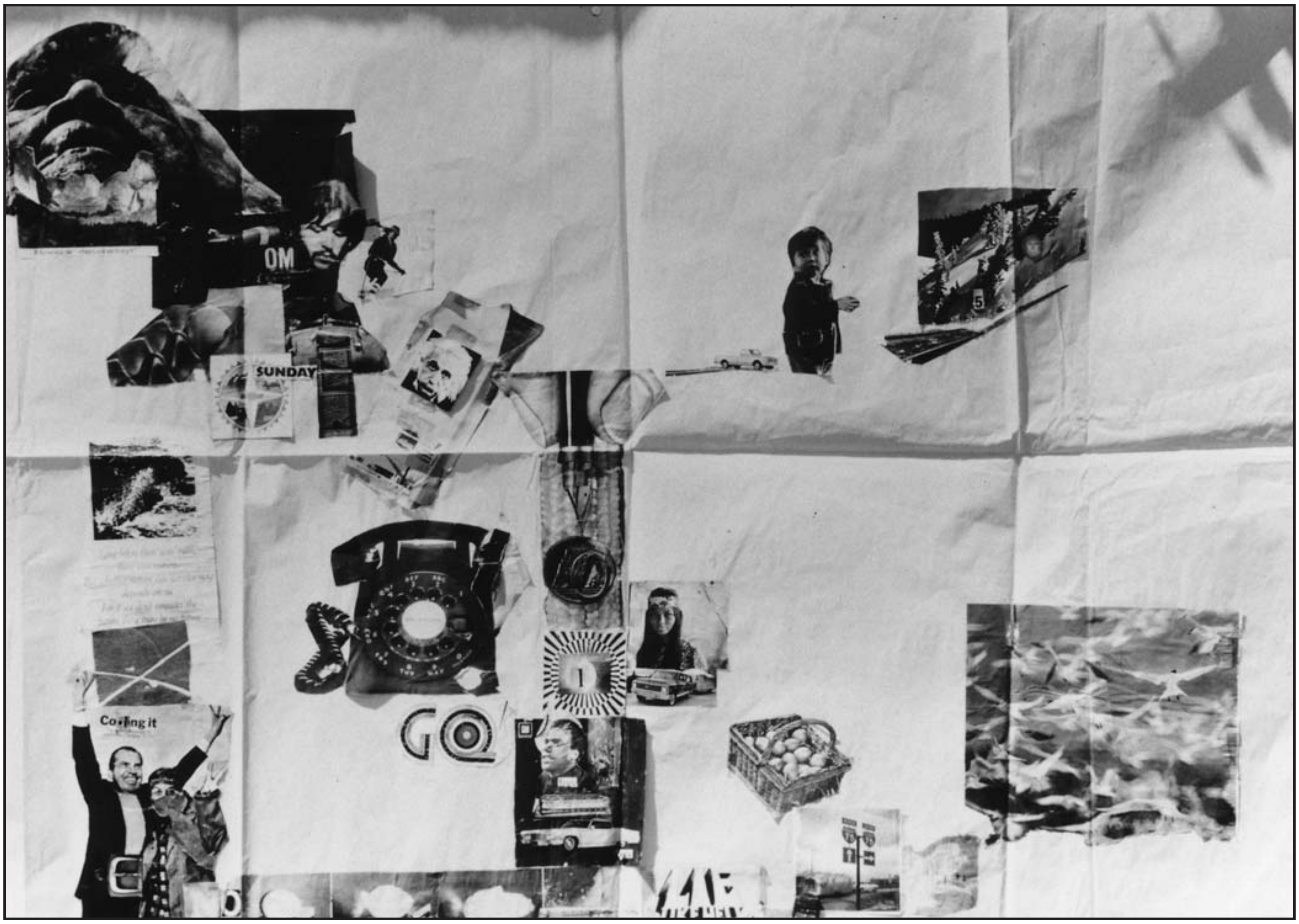

Figure 5 D.'s wall collage

plex, spatially oriented arrangement of forms to an emotionally charged representation of large, primitive forms. D., a 22-year-old diagnosed with acute schizophrenia, created a free collage on the walls of his room in a locked inpatient setting. (The collage was subsequently transferred to a large sheet of paper by the therapist; see Figure 5). The structure of the collage is mandala-like, with a definite center and four corner areas. The center refers to communications (phone) and wisdom (Einstein); it also displays the face of an Indian girl and a circle with number 1 on it. The upper left stands for "does America have to die?" and the lower left represents lies (Nixon) and an egg heading towards explosion. The lower right pictured a flight (birds) and the upper right a boy pointing towards "a skier going out of control and jumping tracks." About a week later, D. produced a free painting representing his persecutory hallucinations (Figure 6). When asked about the most important part of the painting, D. pointed to the visually undifferentiated lower right portion. In a following exploration of that area, D. painted densely condensed images of a "bunny/bowling pin," an angel, and a half moon (Figure 7).

The two last paintings are remarkably different from the collage in their style, size of images, and affective involvement. Whereas the collage has its focus on a definite spatial arrangement, the two paintings have minimal spatial differentiation. The hallucinatory image represented in Figure 6 is portrayed as a big face in a style which Simon (1991, 1997) defines as "archaic." Figure 7 displays a figure-ground reversal. The spatial structure of the collage reflects Simon's "traditional style" and the possible involvement of ventral *and* dorsal visual streams of brain

Figure 6 D.'s painting of his hallucination

Figure 7 D.'s elaboration of the lower right corner of the hallucination painting

activity. The collage seems to involve memories and symbolic associations, as contrasted to the immediacy and presumed predominance of ventral stream processing reflected in the last two paintings.

The understanding of the brain functions underlying the different processes of art expressions in art therapy can help the therapist to become aware of different aspects of these processes and their implications. Both case examples deal with severe psychopathology, but an increase in complexity of expression or changes in expressive styles can be incorporated into the therapeutic design in dealing with cases involving less or minimal psychopathology.

Conclusions and Recommendations

This paper has presented some of the basic structures and functions of the brain that could be of interest to art therapists. The examples of art experiences and levels of expression illustrate possible applications of this information to the processes in art therapy. Four main areas stand out when considering art therapy in regard to basic brain functions and structures:

1. Brain functions and areas are specialized for distinctive tasks at different levels of complexity. Most of the perceptual stimuli are processed in parallel and unconsciously; part of the processing is guided by cognition through selective attention in a top down manner (Fuster, 2003).
2. Brain structures provide alternate paths for accessing and processing visual and motor information and memories. Art therapy is uniquely equipped to take advantage of these alternate paths and activate them through the use of various art media in therapy.
3. Art therapy offers the possibility to emphasize selectively different aspects of visual information processing.
4. Art therapy offers the possibility to deal with basic sensory building blocks in the processing of information and emotions. The most elementary expressive forms may reflect the underlying brain structures.

Further explorations of the relationship between the processes of art expression and the functions of the brain could benefit from the area of art assessments based on the formal elements of visual expression, such as the Diagnostic Drawing Series (DDS) (Cohen, Mills, & Kijak, 1994; Mills, 2003) and the Formal Elements of Art

Therapy Scale (FEATS) (Gantt, 2001, Gantt & Tabone, 2003). These assessments are backed by extensive research involving different populations, thus providing a solid base for the exploration of the relationship between brain processes and the processes involved in art expression. Another area for exploration concerns the relationship between brain functions involved in emotions and their visual expression based on Rhyne's (1983) research.

The artistic background and understanding of visual language in health and psychopathology provide art therapists with an intuitive appreciation for the structural, functional, and emotional qualities of art expression. The understanding of these qualities in relation to brain structures and functions could provide a starting point for elaborating on the unique role and importance of art therapy in the arenas of therapy, healing, and growth.

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