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Changes in Painting Styles of Two Artists With Alzheimer's Disease

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A substantial body of literature supports the idea that systematic changes can occur in artists' painting styles after the onset of degenerating neurological illnesses like Alzheimer's disease or Fronto-temporal dementia. However, these studies have typically been descriptive and qualitative in their analyses. Our study was motivated to show that quantitative methods can be applied to the neuropsychology of art production and to determine whether there are systematic changes in the art produced by two individuals with Alzheimer's disease (AD). Using the Assessment of Art Attributes which probes 6 formal characteristics (depth, color temperature, color saturation, balance, stroke, and simplicity) and 6 conceptual characteristics (depictive accuracy, abstractness, emotion, symbolism, realism, and animacy), we found that both AD patients produced paintings with more abstraction and use of symbolism and with less depictive accuracy and realism. Their paintings did not change in the use of depth, or balance or in the quality of their stroke. When these observations are combined with those made recently in 3 artists with focal brain damage, we find that conceptual more than formal perceptual attributes are susceptible to change after neurological illness.

Keywords: neuroaesthetics, art, neuropsychology, aesthetics

Cognitive neuroscience recently joined a tradition of empirical aesthetics research that dates back to Fechner in the 19th century (Fechner, 1876). These are early days for the neuroscience of aesthetics (Chatterjee, 2011). The proper methods and even which questions might be addressed profitably are still being worked out. In this study we explore a specific domain within neuroaesthetics, which addresses the effects of neurological illness on artistic production (Bogousslavsky & Boller, 2005; Chatterjee, 2004a; Zaidel, 2005). Neuropsychology has been instrumental in contributing to our knowledge of various complex systems, such as perception, memory, and language. However, its impact on aesthetics has thus far been minimal. One reason for this lack of impact is the lack of appropriate measures that can be applied to investigations (Chatterjee, 2009).

How might we advance our understanding of the neural basis of art production from cases of artists with brain damage? Many have reported changes in art produced by people with neurologic disease (Bogousslavsky & Boller, 2005; Chatterjee, 2006; Zaidel, 2005). These reports are predicated on the idea that we might be able to infer the neural bases of artistic production from its derangement by brain damage (Chatterjee, 2006). The effect of brain damage on the capacity to produce visual art contrasts sharply with many other human capacities. Damage to the brain can impair our ability to talk, move, recognize objects, apprehend emotions, and make logical decisions. In contrast to these abilities, while diseases of the brain can certainly alter the ability to produce art, the alterations are sometimes considered improvements (Chatterjee, 2006). By examining the range of alterations in art produced by such cases, we might begin to understand the components of and neural substrates underlying artistic production.

The strategy to advance our understanding of the neural bases for art is to map locations and nature of neural damage to changes in artistic production (Bogousslavsky & Boller, 2005; Chatterjee, 2004a, 2004b; Rose, 2006; Zaidel, 2005). Despite the fact that observations guided by this strategy date back at least to the 1940s (Alajouanine, 1948), the field has not matured (Chatterjee, 2009). Artists with brain damage who continue to produce a body of work are rare. It is difficult, if not impossible, to conduct large-scale group studies of artistic production. Past reports typically describe anecdotal observations and draw inferences from a few art examples. We are left with a collection of anecdotes that are fascinating by themselves but do not contribute to a comprehensive understanding of the systems involved, or any formal tests of hypotheses. A critical obstacle to advancing this line of research is the lack of quantitative measures. How do we quantify a work of art? Doing so is critical if we are to measure change. How can we assess change if we do not know what is changing and can reliably measure this change?

To address this need for a quantitative instrument in assessing changes in art, we recently developed the Assessment of Art Attributes (AAA) (Chatterjee, Widick, Sternschein, Smith II, & Bromberger, 2010). We have argued elsewhere (Chatterjee, 2009)

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that such an instrument should be componential and it should be quantitative so that hypotheses can be tested formally. The design of the AAA is based on the widely held view that artworks have formal–perceptual qualities and content–conceptual qualities (Russell & George, 1990; Woods, 1991). We selected six formal–perceptual attributes and six content–conceptual attributes based on a review of the literature with special consideration of attributes proposed to change in individuals with brain damage. The formal–perceptual attributes correspond to early and intermediate visual processing; they are as follows: Color temperature (warm–cold), Color saturation (calm–vibrant), Stroke style (controlled–loose), Depth (flat–deep), Balance (low–high), and Complexity (simple–complex). The content–conceptual attributes correspond to higher/late visual processing and its contact with other domains, like semantics and emotional systems; they are as follows: Representational accuracy (less–more), Abstractness (less–more), Realism (less–more), Animacy (less–more), Symbolism (less–more), and Emotionality (less–more). We familiarize participants with each attribute. Their assessments are made using a Likert scale, giving quantitative form to these descriptive attributes. The 24 paintings in the AAA were selected from the Western canon, covering different time periods. A well-known artist created each painting to ensure aesthetic quality in our stimuli. However, the selected paintings were not the artists' most popular works (e.g., Hopper's *Nighthawks*) that might be familiar to even artistically naïve participants.

Participants initially rate each painting on each of the 12 attributes. As detailed elsewhere (Chatterjee et al., 2010), participants agree highly on their ratings of these paintings based on Spearman's Rho correlation coefficients for each of the attributes in the AAA. In the instrument's development, artistically naïve participants correlation coefficients ranged from a high of 0.807 for Abstractness to a low of 0.486 for Balance. Reliability of all the scales determined by comparing the first 30 naïve participants' ratings and the second 30 naïve participants' ratings using Cronbach's alpha test of reliability was high at $\alpha = .961$.

Our procedures familiarize participants with the specific attributes of interest using the 24 AAA paintings. Then they see the patients' work and make the same ratings. These works are presented in random order and the participants are blind to which paintings were created before and which after their neurological injury, or in diseases with gradual progression they are kept blind to when in the natural history of the disease the paintings were created.

We recently used the AAA to examine changes in the artwork of three people before and after their strokes. Katherine Sherwood and Zlatio Boiyadjiev had large left hemisphere strokes and Lovis Corinth had a large right hemisphere stroke. In each case, their art was judged as more abstract, distorted, and less realistic after their cerebrovascular accident. They also painted with looser strokes, less depth, and more vibrant colors. No unique pattern was observed after right brain damage. However, art produced after left brain damage also became more symbolic (Chatterjee, Bromberger, & Smith, 2011). Thus, the AAA can successfully assess changes in art produced by patients with neurological illness.

In this study we investigated the effects of Alzheimer's disease (AD) on artists' painting styles. AD provides an important contrast to patients with focal brain damage. AD, the most common cause of dementia, is a gradually progressive degenerative disease of the brain. It is characterized by degeneration of the medial temporal lobes and parts of the cerebral cortex. Pathology of the temporal-parietal junction can lead to problems integrating visuospatial and semantic representations of the world. Primary sensory and motor cortices are relatively spared in the disease. Short of pathological analysis at autopsy, the diagnosis of AD is made clinically, based on the patient's history, cognitive exam, and after other causes of dementia have been excluded.

Investigating artists with AD allows us to look for systematic trends in art production changes rather than sudden changes brought about by a stroke. Anecdotally, artists with AD who continue to paint tend toward depicting increased abstraction as the disease progresses (Chatterjee, 2004a; S. Crutch, Isaacs, & Rossor, 2001; Cummings & Zarit, 1987; Rankin, 2007). This tendency toward abstraction may be related to the deterioration of visuospatial organization or semantic knowledge of objects as the disease progresses (Maurer & Prvulovic, 2004). Using the AAA we wished to find out whether these impressions of the change in art produced by people with AD could be confirmed and extended using rigorous methods. Furthermore, we wished to find out how changes in artwork by people with AD compare with the changes we observed in the artists with stroke.

Method

Artists

The stimuli used in this experiment consisted of paintings by two artists diagnosed with AD. The first, William Utermohlen, was diagnosed with AD at the age of 61 after a long, successful painting career (S. Crutch et al., 2001). He was born in Philadelphia and studied at the Pennsylvania Academy of Fine Arts from 1951 to 1957. He moved to England in 1957 where he enrolled at the Ruskin School of Art in Oxford before settling in London. His early work was characterized by linear expressionism, with frequent inclusion of Pop imagery and styles, including a use of strong colors. William Utermohlen was referred to a neurologist with suspected depression and cognitive impairment, and a diagnosis of probable AD was made. The earliest symptoms of the Condition 4 years before diagnosis involved difficulties with tying a necktie, calculating household finances, and memory for day-to-day events. Formal neuropsychological examination revealed a moderate degree of global cognitive deterioration, while MRI indicated generalized cerebral atrophy. After the initial diagnosis at the age of 61, regular clinical assessments documented the expected gradual decline in cognitive function (S. J. Crutch & Rossor, 2006). We used five self-portraits executed by William Utermohlen in the 4-year period after his diagnosis. See Figure 1 for examples of his work.

The second artist, Lester Potts, was diagnosed with Alzheimer's disease around age 70. He had worked in a rural Alabama sawmill through the Great Depression. He served in the Korean War. After returning home he became a civic leader. His initial symptoms were of short-term memory (STM) loss and uncharacteristic emotional reactions to events such as the cutting down of a tree at his church. He then developed expressive language and visuospatial dysfunction. His diagnosis of AD was based on clinical and imaging criteria. He had not painted before enrolling at an adult day care center shortly after being diagnosed with AD. At the

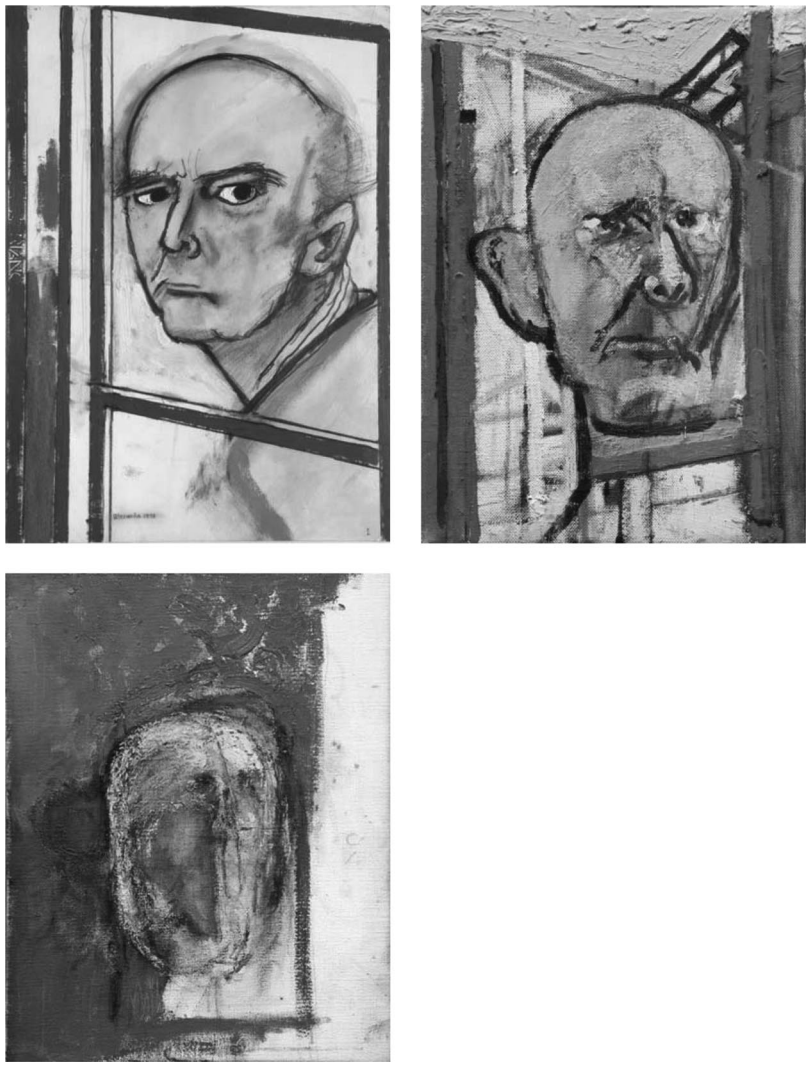

Figure 1. Examples of self-portraits done by William Utermohlen. Copyright permission obtained from Galerie Beckel Odille Boïcos.

center, as part of a community outreach program, he was taught to use watercolors by a retired artist. By the time of his death at age 78 Lester Potts had painted more than 100 original watercolors. We selected 25 paintings produced over this period of time. See Figure 2 for examples of his work.

Participants

We recruited a group of 43 undergraduates for our study of Utermohlen's artwork and a second group of 38 undergraduates for our study of Potts' artwork. All participants completed a screening questionnaire to determine their level of artistic experience. As described in detail elsewhere (Chatterjee et al., 2010), we used this screen to ensure that our participants were artistically naïve. Four participants from the Utermohlen group were artistically knowledgeable, and the remaining 39 were classified as artistically naïve. Eight participants from the Potts' group were artistically knowledgeable, and the remaining 30 were classified as artistically naïve. All participants gave informed consent in accordance with approval of the Institutional Review Board.

Behavioral Task Design

The experiment comprised two separate sections, each of which involved rating a set of images on 14 different scales. The first section was images from the AAA that were rated on formal and conceptual characteristics, followed by two evaluative scales of preference and interestingness. This section of the testing was used to familiarize and calibrate the participants' approach to each of the attributes of the scale.

After this training, the participants rated paintings created by Utermohlen and Potts. Art by Utermohlen and Potts were presented separately. Participants rated each painting on six formal scales (color temperature, color saturation, stroke, depth, balance, and complexity) and six content scales (depictive accuracy, ab-

Figure 2. Examples of paintings done by Lester Potts. They are titled *The Broken Jar* (painted about 2003), *The Blue Collage* (2004), and *The Last Birdhouse* (2005). Copyright permission obtained from Daniel Potts.

stractness, fantasy, animacy, symbolism, and emotion). After the formal and content scales, participants rated their interest in and preference for each painting. The experiment was composed of 14 blocks, one for each of the 12 descriptive scales and two for the evaluative scales. Images were presented in a randomized order within each block, and participants' ratings were on a Likert scale from 1 to 5 (Chatterjee et al., 2010). Participants rated the paintings of each artist one attribute at a time, and the order in which the artist's paintings appeared was randomized. The participants always completed the AAA battery first, but the order in which they rated the works of these individual artists was random. All stimuli were presented using E-Prime Software.

Before beginning each task, participants scrolled through a PowerPoint slide show of the images that they would be rating. We allowed them to familiarize themselves with the images. Participants were told when they were looking at a set of paintings by many artists (as in the AAA) and when they were looking at a set that been executed by only one (as in the sets of works made by Utermohlen and Potts). Participants were blind to the diagnoses of the individual artists, and they were given as much time as they liked to complete the experiment. All participants were compensated monetarily for their time.

Results

We first eliminated any participants who were statistical outliers in their judgments of any individual descriptive attribute of the AAA. For example, the judgments on the color attributes made by someone who is color-blind might not be informative, but their judgment on whether something is symbolic might still be valid. To remove outliers we used Spearman's correlation to compare each subject's rank order for the 24 paintings on any given attribute with the previously normed group mean rank order. If a participant's correlation fell two standard deviations outside of this standardized mean, his or her ratings for that specific attribute were not considered in our analysis of the paintings of the artists with dementia. Across all the attributes 4.9% ratings for Utermohlen and 8.1% ratings for Potts were removed from subsequent analysis.

To assess changes in artistic styles, mean ratings for each painting on each scale were established. We numbered each artist's paintings based on the chronological order in which they had been painted. Then we tested to see whether there were any significant correlations with shifts in an attribute over time. Significant Spearman's correlations were established at the 0.05 level. We found that Utermohlen and Potts's paintings both shifted toward becoming more abstract and symbolic and less accurately depicted and realistic. Potts' paintings were also more color saturated, warmer, and less complex, animate, and emotional. Utermohlen's paintings had a trend to becoming less animate. Neither artist had a change in their use of balance or the quality of their stroke or the use of depth. As might be expected with a progressive disease, over time, the art of both individuals was regarded as less interesting and liked less.

Discussion

Our study was motivated by two reasons. First, we wished to show that quantitative methods could be applied to the analysis of artwork as it changes in the setting of progressive neurological disease. Quantitative methods permit formal tests of hypotheses

Table 1
Results of the Correlations of Art Attribute Changes Over Time in the Work of Utermohlen and Potts

	WU		LP	
Attribute	Spearman's Rho	Significance	Spearman's Rho	Significance
Formal				
Balance	0.200	0.747	0.298	0.148
Color saturation	−0.700	0.188	0.522	0.007*
Color temperature	0.500	0.391	−0.612	0.001*
Complexity	−0.700	0.188	−0.542	0.005*
Depth	−0.700	0.188	−0.497	0.011*
Stroke	0.400	0.505	−0.220	0.291
Content				
Abstractness	0.900	0.037*	−0.623	0.001*
Animacy	−0.872	0.054	−0.563	0.003*
Depictive accuracy	−0.900	0.037*	−0.514	0.009*
Emotion	−0.800	0.104	−0.563	0.003*
Realism	−0.900	0.037*	−0.567	0.003*
Symbolism	0.900	0.037*	0.450	0.024*
Evaluative				
Interest	−0.700	0.188	−0.525	0.007*
Preference	−0.700	0.188	−0.546	0.005*

and move us beyond descriptive anecdotes. That is not to say that qualitative and theoretical analyses are not useful or informative in aesthetics. However, if the neuropsychology of art is to advance as a science, then at a minimum it needs to incorporate quantitative measures. Second, we wished to see whether changes in art production of these two patients with AD are systematic. Furthermore, we wished to compare these changes to the changes we have reported in artists with focal brain damage (Chatterjee et al., 2010).

Our analyses showed that similar changes occurred in the work of Utermohlen and Potts as their disease progressed. Both artists' paintings were judged to become more abstract and more symbolic. They were also less depictively accurate and less realistic. We note that we had more examples of Potts' work than that of Utermohlen. In that regard, the trend toward less animacy in Utermohlen's art, which was seen robustly in Potts, might be regarded as a consistent change. Also, our assay for detecting changes in Utermohlens art is likely to be less sensitive than it was for Potts' paintings. Potts' paintings also showed more color saturation, warmer hues, less complexity, and less emotion as his disease progressed. Notably, changes were not seen with balance, depth, or stroke quality in either person's art.

These observations are in general accord with previous observations of the relationship between AD and artistic production but offer greater detail in the changes observed. For example, Fornazzari (2005) describes changes in the portraiture of a woman who suffered from AD. These changes include trends toward "unusual *figure fond*, loss of proportion in the facial features, and loss of proportionality." The changes that they mention might parallel those observed in Utermohlen and Potts. "Unusual figure fond" (figure-ground) and "loss of proportionality" might correspond to a decline in depictive accuracy. However, it is not clear whether loss of proportionality could refer to loss of balance, which we did not see in either person. This uncertainty highlights one of our points, which is that that clear operational definitions of art attributes are needed if we are to compare results across studies.

Others have noted a tendency toward abstraction and increased symbolism among artists with AD (Crutch et al., 2001; Cummings & Zarit, 1987; Rankin et al., 2007; Chatterjee, 2004a; e.g., art historians describe a heightened trend toward abstraction in paintings executed by Willem de Kooning during the progression of his AD; Garrels, 1995). Maurer & Prvulovic (Maurer & Prvulovic, 2004) thought that in the later works of the painter Carolus Horn, "ornamental symbols and mythical creatures appeared, which were derived from a conjunction of different species." Cummings and Zarit (Cummings & Zarit, 1987) reported that an artist with AD over a period of 2½ years moved toward simplicity and distortion. Miller and Hou (Miller & Hou, 2004) observed AD artists to produce works with less precision and attention to spatial relationships.

The results of this study can be understood as a consequence of the distribution of neuropathology in Alzheimer's disease. The disruption of visuospatial and semantic systems from temporal-parietal junction and dorsolateral prefrontal pathology might account for the trends toward distortion and abstraction seen in artists with AD (Maurer & Prvulovic, 2004; Miller & Hou, 2004). Cummings and Zarit (Cummings & Zarit, 1987) also speculate that impairment of "motivational, organizational, and executive" ability may contribute to the distortions seen in these artworks. The increased symbolism and decreased realism might also reflect a diminished tethering to the external concrete world. Their increased use of symbols might reflect a response to their internal mental and emotional states. If this conjecture is true, art offers a way for AD patients to communicate despite profound impairments of language.

How does the pattern of impairment compare with that of the three artists with focal brain damage that we studied (Chatterjee et al., 2011)? Katherine Sherwood and Zlatio Boiyadjiev had large left middle cerebral artery strokes, and Lovis Corinth had a large right hemisphere stroke. All three artists' art were judged as having looser strokes, less depth, and more vibrant colors. They were also judged to be more abstract, more distorted, and less realistic. The

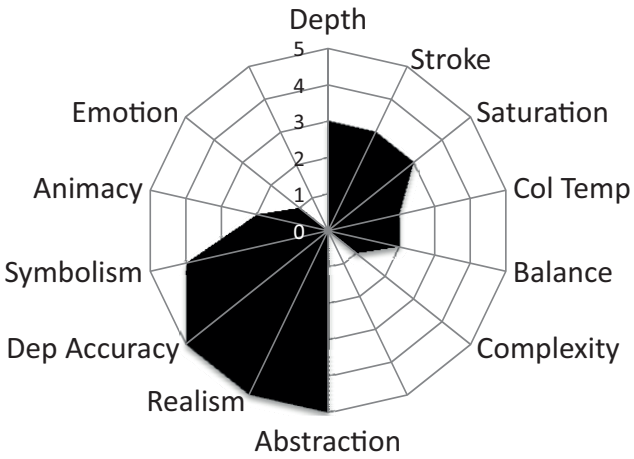

Figure 3. Radial plot showing the number of patients (five maximum, two with Alzheimer's disease, and three with middle cerebral artery strokes) with changes in different art attributes.

two artists with left brain damage became more symbolic in their paintings as well. When combined with the AD individuals here, we see that all five artists produced work judged as more abstract, less realistic, and more distorted. These three attributes might be most susceptible to change after any kind of neurological disease. Also of note, the stroke style was altered in all three artists with stroke but not in the AD artists, and balance was altered after left hemisphere damage but not right hemisphere damage or with AD. Another way to look at the data is shown in the radar plot in Figure 3. From this plot, we see that no attribute is protected from alteration by brain damage. Furthermore, it appears that content/conceptual attributes are more susceptible to change by neurological illness than are formal/perceptual attributes.

We can make one final point about the use of the AAA. We were motivated to develop the AAA to give qualitative form to changes in artistic production after brain damage, changes that had previously only been described qualitatively. However, the AAA has many more possible applications. We recently used the AAA to investigate the affects of right hemisphere brain damage on the perception of art (Bromberger, Sternschein, Widick, Smith, & Chatterjee, 2011). The AAA need not be confined to neurosychological studies. It could be used to assess changes in artistic styles and content over time or in the career of an individual artist or in comparing different artists. It could be used to assess differences in art perception based on levels of expertise or cultural backgrounds. In short, any empirical investigation that would benefit from a componential and quantitative analysis of paintings could use the AAA.

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