Van Gogh’s brushstrokes: marks of authenticity?

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ABSTRACT The process of attributing paintings relies partly upon recognition of an artist’s hand. Around the middle of the last century, Maurits M. van Dantzig (1903–1960) attempted to define the ‘characteristic touch’ of the painter, Vincent van Gogh (1853–1890). His broader aim was to develop a flexible yet precise method to measure the features of both spontaneity and inhibition, evident in the style of brushwork for example. The underlying idea that these qualities can be used to separate a genuine work from a second-rate copy or forgery still plays a key role in attribution studies today. A recent initiative explores the potential of advanced computer image analysis techniques to help identify and quantify these properties at the scale of brushwork. This paper describes the basic principles of the method used, involving statistical analysis of different size wavelets present in digital images of paintings by Van Gogh or other artists.

Introduction

Traditionally, connoisseurship – involving intuitive recognition of an artist’s hand – plays a significant role in the process of authenticating paintings. This is especially so when other paths of technical, art-historical and documentary investigation prove inconclusive, placing more onus on visual judgement in the attribution decision. Connoisseurship rests upon the notion that every artist has a specific character that may be identified and traced through all his changes in style. Brushstrokes, for example, are seen to convey the artist’s uniquely personal touch, since they capture movements typical of the person in action. Although the style of brushwork changes throughout the evolution of an artist’s work, like actual handwriting, it may be considered to display constant characteristics that reflect what remains uniform in the make-up of the artist’s personality throughout his career.

Pictology

This belief in consistency of an artist’s hand formed the basis of the method of pictology, developed by Maurits M. van Dantzig (1903–1960) to attribute paintings based on statistical analysis of their visual features. Van Dantzig took Van Gogh as one of the painters to elucidate his method, despite the challenge presented by the fluctuating style of his work. In his book, Vincent? A New Method of Identifying the Artist and his Work and of Unmasking the Forger and his Products (Van Dantzig 1952), he divides the painter’s output into three main periods, each with its own set of characteristics (Fig. 1). At the same time he claimed that a significant proportion of these visual qualities remained consistent throughout the painter’s lifetime (Van Dantzig 1973: 50), and that they could already be detected in one of his earliest paintings executed in August 1882, The Beach at Scheveningen (Van Dantzig 1952: 57–62). Van Dantzig identifies 93 constant features for
Van Gogh, including 25 relating to brushwork observed at different scales ranging from overall patterns, the orientation and apparent speed of brushstrokes applied, down to fine details such as the shapes of individual marks (Van Dantzig 1952: accompanying list nos. 58–83).

Although it seems fair to say that Van Dantzig’s method has not gained general acceptance among art historians, it should be credited as a first serious attempt to systematise and quantify the process of artistic evaluation for attribution purposes. He aimed to develop
a flexible but quite precise measurement of the characteristics of both spontaneity and inhibition, with the idea that a genuine work will maintain a high degree of spontaneity, while a second-rate work or forgery will be full of inhibition. As considered in this paper, this notion remains relevant to Van Gogh attribution studies up to the present day.

**Fluid impasto**

One aspect contributing to the sense of immediacy in Van Gogh’s touch is the working consistency of his paints. On the one hand, the stiffness (short consistency) of his tube colours left crisply defined marks standing as applied; tide lines accumulated along the edges of brush-strokes remained frozen, as it were, in paint. On the other hand, the fluidity of his paints allowed trailing threads to form where the brush was lifted from the canvas, sometimes drawn across from one touch to the next, enabling us to retrace his path of action (Fig. 2). Van Dantzig noted this particular combination as typical for Van Gogh, though careful scrutiny reveals comparable paint flow features in the work of his French contemporaries who similarly employed ready-manufactured tube colours (see Fig. 3).
Recently, attempts were made to replicate this characteristic look of Van Gogh’s impasto using equivalent paints made following historical procedures (Carlyle et al. 2005: ch. 3). These efforts pinpointed the particular oil binding medium used, and its way of preparation, as a critical factor. A mixture of poppy oil and water-washed linseed oil was found to provide a lead white oil paint with a character that most closely resembled that seen on Van Gogh paintings (Fig. 4). Later copyists’ and forgers’ attempts to provide a convincing imitation of Van Gogh’s impasto were often doomed by the use of more modern oil paints that behaved less responsively to the brush, sometimes resorting to the addition of a gelled medium to enhance the thixotropic (buttery) qualities of the paint.²

**Contested works**

Over the past decade, several technical studies have been conducted on paintings questioned as being by Van Gogh’s hand. A striking feature of these contested works is that, often, they lack the fluency and speed of brushwork that we regard as a typical hallmark of his style. Yet, with increasingly detailed study of his established oeuvre, it emerges that there are many exceptions to this rule. More often than not, these can readily be explained as an outcome of the particular painting materials and techniques employed. To give a well-known example: critics of the Tokyo version of the *Sunflowers* (1888) have regarded as suspicious the frayed ends to trailing brushstrokes and the uneven and irregular character...
of the brushstrokes. Yet they failed to take into account the fact that the work is painted on the thinly primed and coarsely woven jute fabric that Van Gogh is known to have employed in the period, impeding fluent brushwork to a large extent (Lister et al. 2001; Van Tilborgh and Hendriks 2001: 33–4, 36). Some have also doubted the authenticity of *The Garden of the Asylum in Saint-Rémy* (1889) on the grounds of its unusually thick paint application, as well as the ‘hesitant’ style of brushwork that lacked Van Gogh’s usual vigour and intensity. But, it can be argued, this atypical look results from a repeated layering of brushstrokes applied in the course of the artist’s struggle to improve the landscape in several sittings, working onto an increasingly rough surface (Hendriks and Van Tilborgh 2001: 147, 156). These two examples serve to point out that, besides indicating quality of execution, ‘hesitant’ features of brushwork may be a direct consequence of the materials and technique employed; a fact to be taken into account when deciding the artist’s hand.

**New developments**

With the benefit of knowledge gained through material studies of the painter’s works, and the advent of advanced computer imaging tools, the time seems ripe to revisit some of the issues of style and fluency of brushwork in Van Gogh paintings addressed by Van Dantzig. One of the main criticisms of Van Dantzig’s method has been its ‘pseudo-objective’ approach. Although the method involves judging a painting by set criteria, ultimately the verdict reached rests upon the individual perception of the viewer. This objection may be laid aside by the use of computers as an unbiased means for image analysis. Also, computers provide a more highly sophisticated tool for multiscale analysis of brushwork features than the simple hand-held magnifier (8×) that Van Dantzig suggested to examine details in photographs of the paintings under consideration (Van Dantzig 1952: explanation preceding the plates). Given these and other advantages, the use of computer-aided methods for attribution may be considered a logical next step to further extend the array of analytical tools already available to assist judgement by the art historian. This move also coincides with the general switch from analogue to digital methods of recording art objects, generating the necessary images for research. It is worth stressing that the outcome of this new approach is seen as complementary to that of the established paths of documentary, visual and technical investigation followed to reach an attribution decision and is not intended to provide answers on its own.

**Digital image analysis**

An obvious difference from the viewing of paintings is that computerised image analysis systems do not see brush marks as three-dimensional physical objects, but rather as fluctuations in colour and/or luminance values across the digitised images from which they work. A single brush mark on the canvas may produce many such colour/luminance transitions of varying strength. For example, strong contrasts may be produced on both edges of the stroke against the colour of the paint beneath, while smaller, weaker fluctuations in colour will be produced within the stroke itself. Such colour transitions also have a notion of physical scale; a border between two large regions in a painting is visible from several metres away and has a physical scale of a few decimetres, whereas an equally strong colour change, produced by a tiny streak within a single brushstroke, may not be observable except under magnification and has a physical scale of fractions of millimetres. As observed below, these different physical scales of detail may provide different types of information about the artist. Computerised image analysis treats the painting’s image as the aggregate of all such colour or luminance changes within it, much as a drawing could be viewed as a collection of lines.
To date, most researchers in computer-aided analysis of art have employed a common image processing technique called wavelets\(^1\) to sort these colour transitions, often termed 'details', by both their physical scale and primary orientation, and to characterise their strength (here we illustrate this principle using a modern copy of a painting by Van Gogh as an example, see Figs 5 and 6). A variety of statistics, such as the quantity or average strength of detail at a particular physical scale, can then be measured. In order to determine which, if any, of these myriad statistics are actually meaningful, computerised methods then seek out those statistics that reliably distinguish paintings of a particular desired type (e.g. those by a particular artist or from a particular period) from other paintings available for analysis.

One preliminary finding of such efforts (Johnson et al. 2008) has been that certain statistics measuring the quantity of colour/luminance transition details present at the physical scale of brushstrokes, as compared with the quantity of details present at larger physical scales, seemed to somewhat reliably distinguish works by Van Gogh from those

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**Figure 5** Example of the separation of fine scale details (middle) from coarse scale details (right) achieved via wavelet analysis in a copy (left) of Van Gogh’s *The Reaper* (1889), painted by Charlotte Caspers in May 2007 for this project.

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**Figure 6** Illustration of the separation of details by orientation achieved via wavelet analysis in the copy of Van Gogh’s *The Reaper*. Above, the original fine scale details from Figure 5 (far left) are separated into those having each of three primary orientations (horizontal (middle left), vertical (middle right), and diagonal (far right)). Below, the result of adding only the fine scale details of a particular orientation (horizontal (left), vertical (middle), diagonal (right)) to the coarse scale detail image shown in Figure 5. Adding the details of all three types (orientations) would reproduce the original image.
of other artists (see Fig. 7). In fact, some statistics achieved a correct attribution of more than 85% of the studied works. Moreover, most Van Gogh paintings that were misidentified by these statistics were atypical for Van Gogh, either in style or in the technique used. Conversely, those paintings by other artists that were misattributed tended to be in Van Gogh’s style, as in the case of *The Sea at Saintes Maries* (1927–28), a Wacker forgery. These statistics, although found automatically by computer, can be roughly interpreted as a measure of the overall busyness or vigour of the artist’s brushwork, thereby offering a possible explanation for their success in characterising Van Gogh’s style.

An even more intriguing preliminary finding (Johnson *et al*. 2008) was that some copies and forgeries studied (in particular, *The Sea at Saintes Maries*), the aforementioned Wacker
forgery, and *The Sheep Shearers* (1889), a copy by Van Gogh after a Millet) show a marked increase, as compared to original works, in the quantity of details that they contain at very fine physical scales (on the order of fractions of millimetres) (see Fig. 8). Of the more than 60 original works studied, only *Pine Trees at Sunset* (1889) and *The Garden of Saint Paul’s Hospital* (1889), in which Van Gogh had carefully traced over some of his own brushstrokes after the paint had dried, showed a similar increase. It is speculated that this abundance of fine scale details is the mark of the artist’s inhibition, as small wobbles or fluctuations in speed while drawing the brush across the canvas, or, more dramatically, multiple touches in place of a single one, would be expected to produce excess fine scale details in the final image.

**Conclusion**

These preliminary results from computer-aided analysis of brushwork in Van Gogh’s paintings demonstrate the potential usefulness of new image processing tools developed in close collaboration with art specialists. Working together with a number of university-based digital imaging teams, the Van Gogh Museum aims to expand these efforts to address other issues of relevance to questions of art analysis and attribution. Working together with a number of university-based digital imaging teams, the Van Gogh Museum aims to expand these efforts to address other issues of relevance to questions of art analysis and attribution. Automated study and comparison of characteristic weave patterns in the canvases used by Van Gogh, overlay of multispectral digital images to extract information on painting technique and subsequent restorations, and virtual colour reconstructions that compensate for the alteration of Van Gogh’s poor quality paints, are just some of the topics to be addressed. Together these cumulative types of information can provide a more complete understanding of Van Gogh’s characteristic output at different moments in time, helping to distinguish ‘atypical’ features in works that are not by his hand.

**Notes**

2. One early example is the discovery by the Dutch restorer, A.M. de Wild, that considerable quantities of resin had been added to adjust the handling properties of the oil paints used to imitate Van Gogh’s impasto in the famous Wacker series of forgeries. See Feilchenfeldt 2006: 90. Artists’ handbooks described the use of various gelled mediums consisting of different mixtures of varnish, oil and drier, to improve the brushing qualities of paint. See Carlyle 2001: 101.
3. Hubbard (1998) attempts to provide an overview of both the history and the mathematical workings of wavelets in language accessible to non-scientists.
4. One additional painting, *A Clump of Trees in the Garden of Saint Paul’s Hospital* (1889), would also have been included with these, but was discounted due to a strong canvas weave artefact (which would be expected to produce excess fine scale detail) present in the painting’s digital image.
5. For an account of the international workshops on these topics held so far, see the website posting of Professor Rick Johnson (Cornell University): http://people.ece.cornell.edu/johnson/tcap.pdf.

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