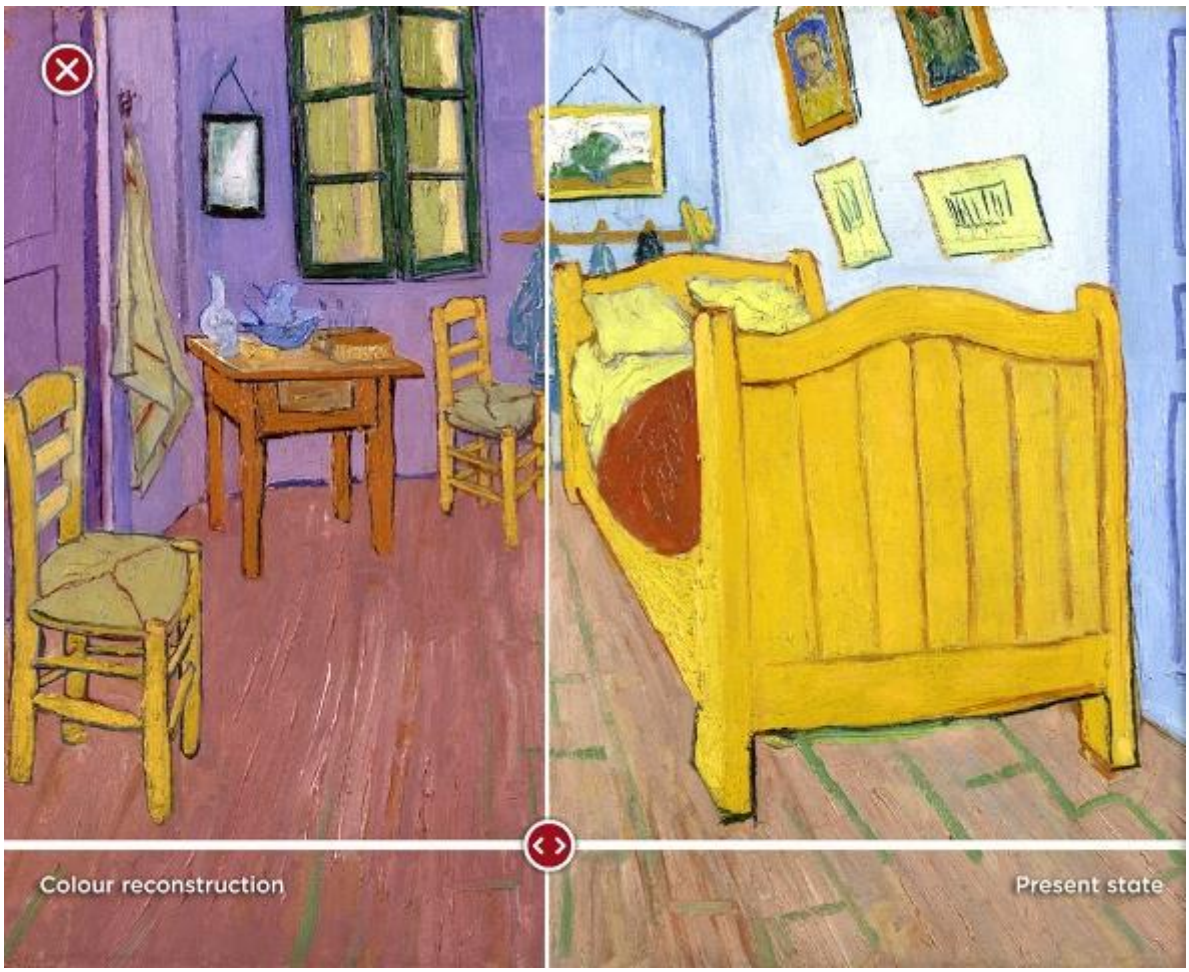
Van Gogh Museum Amsterdam

Original colours of Van Gogh's paintings
Research project REVIGO

'All the colours that Impressionism has made fashionable are unstable', Van Gogh wrote from Arles to his brother Theo, underlining the sentence to emphasize the gravity of the matter. 'All the more reason', he continued, 'boldly to use them too raw, time will only soften them too much' [letter 595]. He was right. The REVIGO (REassessing VIncent van GOgh) research project was launched four years ago to gain a clearer understanding of the extent to which his colours have diminished in intensity. Ironically, Van Gogh wrote the relevant letter in a purple ink that was just as unstable as certain of the pigments he painted with. Several drawings he made with the same ink have likewise discoloured and faded dramatically – another aspect studied by the REVIGO project.

Discoloured pigments

It is a sobering experiment to search Van Gogh's correspondence for the keywords *violet*, *lilac*, *purple* and *pink* and then to view the paintings in which he says he used the colours in question. The first three tones have given way in many cases to blue, while the pink has become off-white. This is because Van Gogh mixed unstable red pigments – red lakes – with blue and white to obtain the composite colours purple and pink. Over the years, the red has faded or disappeared, causing the other colour in the mixture to dominate. A digital reconstruction that the museum made a few years ago of the purple and red tones in *The Bedroom* starkly illustrates the consequences of this discoloration: the painting's strikingly blue walls and doors were originally purple, and the floor a harder red. This might sound innocuous on paper, but the digital reconstruction was hard for many to swallow – 'too raw', to use Van Gogh's own words.



Colour reconstruction of 'The Bedroom' from the 'Touch Van Gogh' app.

In addition to the red lakes, discoloured chrome yellow interferes significantly with the appearance of his work. Van Gogh used three different types, one of which has a tendency to darken.

Making paint

Because of its relatively straightforward structure with expanses of colour, *The Bedroom* lent itself well to a reconstruction of this type. It was ultimately decided to focus on a different and, as it turned out, somewhat more challenging work in the REVIGO project, namely *Field with Irises near Arles*. The paints used were identified via XRF (X-Ray Fluorescence) and analysis of minuscule samples. The surface of the painting was also photographed using a hyperspectral camera. Every pixel of the digital image taken with this device provided information about the colour structure of that single tiny point. In an inspiring piece of lab work, pigments that were detected in the painting and which have contributed substantially to its discoloration were then recreated based on old recipes. These home-made pigments were used

alongside historical examples from the collection kept by the Cultural Heritage Agency of the Netherlands, some of which are no longer available on the market because of their toxicity. Kremer brand pigments were also used. All the pigments were prepared using oil as a binding agent.

Preparing the paint

The linseed oil used for the project was pressed specifically for this purpose in an oil mill. The newly made paints were then brushed onto opacity cards to mimic and to measure how well or poorly Gogh's paint covered the surface and to determine its original colour characteristics.

The recreated paints brushed onto opacity cards. Photograph: Art Ness Proaño Gaibor, Cultural Heritage Agency of the Netherlands

Digital reconstruction

By first reconstructing the paints, it was possible to recreate the whole of Van Gogh's palette. The data from the hyperspectral camera were processed using software written specially for this painting, which calculated the concentrations of blended colours. This allowed paint to be mixed virtually and the colour of any given concentration ratio to be predicted. It was a colossal task, given that the calculation had to be performed individually for each of the million and a half tiny points. Fortunately, we were able to use the same ingenious software algorithms that allow you to mix any colour of paint at a hardware store.

Once we had determined the colour mix ratios for each pixel, we substituted the existing, aged colour mixes with their original shades, as previously established in the laboratory. Although the computer calculations went smoothly and precisely, we noticed that a few adjustments were still needed. Van Gogh used different techniques when painting the irises, later adding an extra thin layer of red lake, for instance, to various flowers. We also discovered that the collection of white dots at the bottom of the painting had been pink. In this case, the red pigment is only visible under the microscope deeper in the painted layer.

Once the calculations were complete and the final adjustments made, a digital image was generated to give an idea of how the painting must have looked shortly after Van Gogh finished it. In one of his letters, the painter described the motif as a 'sea of yellow flowers with a line of purple irises' [letter 612]. This effect is barely visible any more in the painting, but the digital reconstruction shows a variety of purple irises rather than the blue flowers we see now, against a more intensely yellow-coloured field beyond. The reconstructed colours form a better match with Van Gogh's own description of the work. The reconstruction also gives a more accurate idea of the depth effects, while showing greater variation in colour between the different irises. In this way, it provides a good impression of the colour contrasts that were so important to Van Gogh in his work.

Digital reconstruction of '*Field with Irises near Arles*'

Conclusion

REVIGO initially set out to develop innovative tools that would allow data for any work by Van Gogh to be fed into a computer program so that a correctly coloured reconstruction could then simply be printed off, as it were, in order to provide the best possible approximation of how Van Gogh might originally have painted or drawn it. As the project progressed, it swiftly became apparent that tools of this kind are highly dependent on which painting is to be reconstructed and which precise measurement data are available for it. We developed several different analysis tools specially for the painting *Field with Irises near Arles*. This enabled us to work out a digital reconstruction of the artwork, which clearly shows how certain of its colours have changed or lost intensity over time.

We acquired an immense amount of knowledge during the project about the discoloration of pigments and how the colour balance in Van Gogh's French work has been distorted or damaged. However, by no means all the questions have been

answered. It was not clear, for example, whether the touches of white paint in the field in the background were uniformly pink, or whether Van Gogh varied them a little, as seems more likely. No samples were taken from the sky, meanwhile, so we hope to discover in the future what pigment he used in this area and how it influenced its colour. Research into discoloration will therefore continue after REVIGO, in order to place Van Gogh's bold use of colour in better context. It is an odd thought, after all, that paintings that are still among the most colourful in the history of art, were once even bolder.

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