Jahnke *et al.* and Mucke *et al.* use different but equally sophisticated experimental approaches to unambiguously identify and characterize the occurrence of ICD of inner-valence-ionized water dimers and clusters, respectively. Mucke *et al.* detect and analyse the water-cluster photoelectron in coincidence with the ICD electron using a so-called magnetic-bottle time-of-flight electron spectrometer. This enabled them to identify the initially excited inner-valence state, giving evidence for the production of two final outer-valence vacancies and the determination of the ICD electron energy distribution (see Fig. 1) peaking towards zero energy as predicted in calculations. Jahnke *et al.* measure the mass, charge, direction and energy of both ions and both electrons from a water dimer using a so-called cold-target recoil-ion-momentum spectroscopy analyser consisting of two multichannel plates with delay-line position readout. As well as obtaining similar information as in the experiment of Mucke *et al.*, Jahnke and colleagues are able to determine the kinetic energy release (see Fig. 1c) of the two receding water ions, allowing them to determine the distance of the two molecules at the point of break-up. Furthermore, Jahnke *et al.* provide evidence that, contrary to outer-valence-ionized clusters, inner-valence-ionized water dimers do not relax by means of migration of the proton to the neighbouring water forming H_3O^+ and OH.

Beyond the present definitive demonstration of the occurrence of ICD in loosely bound matter and thus the formation of low-energy electrons in the wake of inner-shell ionization of water, it will be interesting to explore its implications for biological systems. In particular it will be exciting to see whether similar behaviour arises in systems consisting of DNA nucleotide bases as studied in previous single-collision electron-attachment studies[3,4]. ❐

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ART ANALYSIS

The Bruegel code

When the brain processes visual input, information is mapped into patterns of neural activation, with some form of code defining which neural-activity pattern corresponds to a certain piece of information in the input image. Although many aspects of this coding process are yet to be understood, there exists a body of theoretical, computational and experimental evidence suggesting that the 'neural code' is sparse. This means that if a set of basis functions is found that can be used to reconstruct all images, then any given image is represented in terms of a linear superposition of only a small number of these functions.

James Hughes and colleagues have now taken the idea of sparse coding into a very different context — showing its usefulness for quantifying artistic style (*Proc. Natl Acad. Sci. USA* doi:10.1073/pnas.0910530107; 2010). In particular, they have looked at drawings by the Netherlandish Renaissance artist Pieter Bruegel the Elder (believed to be seen as 'the painter' in his drawing, *The Painter and The Connoisseur*), and have set up a sparse-coding model which, after suitable training, can discriminate successfully between authentic Bruegel drawings and imitations.

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Several ways of using mathematical and statistical methods for analysing visual art have been investigated over the past decade or so, not least with a view to helping art historians authenticate works. Such 'stylometric' approaches include fractal analysis (famously applied to Jackson Pollock's drip paintings), wavelet-based techniques and so-called multiresolution hidden Markov methods. But Hughes *et al.* expect that the sparse-coding approach should, given its success in analysing natural images, offer a straightforward and germane route to modelling drawings and other two-dimensional media, and one that provides, unlike other approaches, a simple quantitative metric.

In their study of Bruegel drawings, Hughes *et al.* used a set of works securely attributable to Bruegel to train their sparse-coding model, and then showed that the resulting basis functions can be combined to sparsely rebuild established Bruegel drawings; this sparseness, however, is lost when reconstructing known Bruegel imitations. Their approach compares favourably with an earlier wavelet-based analysis of the same Bruegel drawings, but a number of caveats still remain: specifically, sparsecoding requires a sufficient number of known examples to build the basis set; also, the style of an artist must not vary significantly across the works considered. Nonetheless, the results are encouraging and indicate that statistics could usefully complement the traditional tools of art analysis.

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