Evolution of bee dances

SIR — von Frisch[1] and his students are famous for their descriptions of the highly evolved dance 'language' in *Apis* which is used by worker bees throughout this genus to communicate the distance and direction of sources of food, water and nest sites. Because only minor variation in dance biology exists across the genus, hypotheses for the evolution of dance language are problematic. The classical theory[1] suggests that the excited movements of foraging workers became fixed as a stylized round dance. Evolutionary refinements then produced additional dance elements encoding more precise information.

A. andreniformis is an Asian species of honey bee only recently recognized as biologically distinct from its sister species, *A. florea*[2]. Like *A. florea*, *A. andreniformis* constructs a nest comprising a single wax comb suspended from a branch. The comb surrounds a section of the supporting branch and the portion of the nest above the branch is used for honey storage. Worker bees cover the comb in a protective curtain. During a study of reproductive isolation of sympatric *A. florea* and *A. andreniformis* through the temporal separation of mating flights[3], we observed the behaviour of drones before mating flights, recording several hundred flights and many tens of dances using a video camera.

Other than during or somewhat before the time of drone flight, drones of both species are hard to detect among the bees of the protective curtain. During the half hour before flight begins, drones of both species appear on the protective curtain, walk upward and eventually begin flights from the honey storage area at the crown of the nest. Before flying, some drones of *A. andreniformis* run, with wings somewhat extended to the side, in circling loops. Some runs, but not all, end with the drone taking flight. These runs are visually identical in form and tempo to the round dances of *A. mellifera* workers. The dances of drones stimulate other drones in two ways: (1) after encountering a dancing drone, other drones will often follow the dance; and (2) when a dance ends in flight, the following drones often take flight with the lead dancer. This results in groups of two to ten drones taking flight together. Dances and group flights occurred every 2–7 minutes in the three colonies we observed.

We can think of three hypotheses to explain the adaptive value of drone dancing. First, the dance may warm muscles before flight; second, it may help orientate the dancer to celestial cues; or third, it may synchronize group flight by drones. The first two hypotheses lack appeal as most drones do not dance. Mating flights by small groups of *A. andreniformis* may enhance mate location, mating or avoidance of predation. Interestingly, *A. florea* drones also fly in groups but do not dance[3].

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Of mice and men

SIR — Increasing numbers of transgenic mice are now being generated which have heterozygous or homozygous nonfunctional genes known to be important in humans. There is also a strong expectation in the current literature that mice and men should have essentially the same molecular and cellular characteristics.

An illustration of this is provided in Ed Harlow's recent *News and Views* article (*Nature* **359**, 270–271; 1992). Harlow finds it surprising that mice heterozygous for the Rb tumour-suppressor gene do not develop retinoblastomas, as humans do. Yet in the case of tumour progression, it has been known for many years that mice and men are totally different. Mouse cells can readily be transformed to a tumorigenic phenotype by carcinogens or activated oncogenes, whereas human cells are extraordinarily resistant to such transformation. Moreover, mouse cells first become immortalized (for example, to a 3T3 fibroblast cell line) and then fully transformed. Human cells can be first morphologically transformed by some viral genes, or immortalized, but only very occasionally does a fully transformed immortalized cell line emerge. Therefore, I am not surprised that tumour-suppressor genes and oncogenes behave very differently in mouse and man.

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Protein kinase C downregulation?

SIR — de Vries-Smits *et al.*[1] provide novel information on factors that regulate 'downstream' cellular kinases, such as ERK2. Whereas *ras* appears to be important, the reported findings suggest that protein kinase C (PKC) is not involved in insulin-stimulated ERK2 activation. These negative findings on PKC largely derive from an experimental paradigm, 'PKC downregulation' (depletion), provoked by prolonged treatment with certain PKC activators such as the phorbol ester 12-*O*-tetradecanoyl phorbol 13-acetate (TPA).

Unfortunately, this experimental paradigm is commonly flawed. For example, the persistence of insulin effects and the loss of acute TPA effects on ERK2 following 'PKC downregulation' could logically be interpreted to suggest that PKC is not involved during insulin action. But as we have found[2,3], TPA may be very effective in acutely translocating (activating) and chronically downregulating (depleting) PKC-α, but may have little or no effect on PKC-β in certain cell types (for example BC3H-1 myocytes). Moreover, insulin acutely translocates PKC-β in both non-downregulated and 'PKC-downregulated' myocytes, but has little or no effect on PKC-α in these cells[3]. These differential effects of insulin and TPA on PKC-α and PKC-β, both acutely and chronically, could explain a seemingly paradoxical situation in which insulin-stimulated, PKC-dependent effects persist after prolonged TPA treatment of myocytes, whereas acute TPA-stimulated, PKC-dependent effects are lost.

de Vries-Smits *et al.* used an antibody that specifically recognizes PKC-α (ref. 4) to verify 'PKC downregulation' in their studies in A14 cells, and were careful to point out that the insulin effect on ERK2 is not mediated by a TPA-sensitive PKC. Nevertheless, the unwary reader should be aware of the caveat we describe here in using the experimental paradigm of phorbol ester-stimulated 'PKC downregulation'.

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