presenting the technique and showing what could be gleaned from the Hawaii and Louisville chains. Our original CVA image[1] was derived from all Pacific seamounts, including many that are clearly not related to hotspots. A more sophisticated analysis would involve removing such seamounts and ridges, and would perhaps attempt iterative hotspotting[3].

Hotspotting is blind to the ages of features. However, we have never argued that ages should not be used, but simply that hotspotting does not require them. Investigations of mid-plate tectonics would do well to use all available data and both methods.

Our ~3-Myr-old stage pole and consequent relocation of the Louisville hotspot are controversial but plausible. Hollister lava compositions represent mixtures of Louisville plume and depleted mid-ocean-ridge basalts[4] and do not require a separate mantle source[5]. Five long-lived Pacific hotspots (Hawaii, Louisville, Cobb, Bowie and Caroline) have produced seamounts giving rise to trails (and CVA intersections) consistent with our plate-motion model. Furthermore, the short Marquesas lineament is fitted by our model only; other short-lived age-progressive chains in French Polynesia are not. Finally, the Late Neogene evolution of circum-Pacific tectonism is consistent with our model[6].

Aslanian *et al.* are sceptical about using hotspotting to refine plate-motion models. Whether or not an inverse formulation incorporating both backtracking and hotspotting can be successfully implemented is still unresolved, but we believe it is worth investigating and that the criticism of such inversions by Aslanian *et al.* is premature.

Hotspotting is not flawed, but its success depends on assumptions that may not always hold in practice. It allows for the inclusion of much larger data sets and improves the precision of the optimal hotspot locations. Unlike 'pseudodating', it may even be applied without the *a priori* assignment of seamounts to particular chains. Like backtracking, hotspotting has both strengths and weaknesses. It is in its infancy and has been developed only as a forward method. We will no doubt learn how to use the technique more effectively as its use becomes more widespread.

Paul Wessel, Loren Kroenke
School of Ocean and Earth Science and Technology,
University of Hawaii,
1680 East-West Road, Honolulu,
Hawaii 96822, USA
e-mail: wessel@soest.hawaii.edu

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Music training improves verbal memory

Magnetic resonance imaging has shown that the left planum temporale region of the brain is larger in musicians than in non-musicians[1]. If this results from a change in cortical organization[2,3], the left temporal area in musicians might have a better developed cognitive function than the right temporal lobe. Because verbal memory is mediated mainly by the left temporal lobe, and visual memory by the right[4,5], adults with music training should have better verbal, but not visual, memory than adults without such training. Here we show that adults who received music training before the age of 12 have a better memory for spoken words than those who did not. Music training in childhood may therefore have long-term positive effects on verbal memory.

To determine the effect of neocortical development associated with music training, we studied the verbal and visual memories of a group of adults. We studied 60 female college students from the Chinese University of Hong Kong, of whom 30 had had at least six years of training with a Western musical instrument before the age of 12, and 30 had received no music training. The two groups of participants were matched ($P > 0.01$) in terms of age (music training, 19.9; no music training, 19.6; $t = 0.99$), grade point average (music training, 3.0; no music training, 3.0; $t = 0.21$) and years of education (music training, 14.7; no music training, 14.3; $t = 2.07$).

We assessed the verbal memory of each subject by the number of words she could recall in a list-learning task in which a 16-word list was presented orally three times to each subject. After each presentation, the subject was required to recall as many words as she could. We evaluated each subject's visual memory by the proportion of ten simple figures that she could draw from memory in the Benton visual-retention test[6].

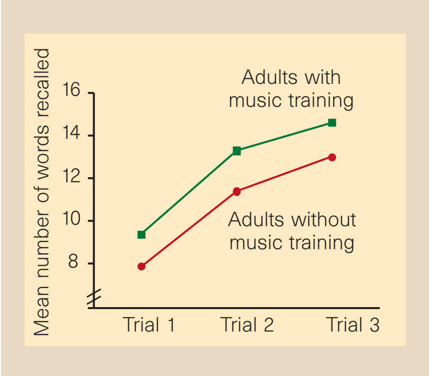

Figure 1 Mean number of words recalled by adults with and without music training. The list-learning task consisted of 16 words from four categories ('family member', 'country', 'furniture' and 'vegetable') that were presented in a fixed random order. The list was presented orally three times to each subject, who was asked to recall as many words as possible after each presentation. The subjects with music training recalled on average 16% more words than those with no music training.

We found that adults with music training learned significantly more words than those without any music training ($F(1,58) = 17.69$, $P < 0.01$); results were consistent across the three trials ($F(2,116) = 274.05$, $P < 0.01$; Fig. 1). However, the performances of adults with (score: 7.2 out of 10) and without (score: 6.9) music training were not significantly different in the visual memory task ($t(58) = 1.00$, not significant). Both results were replicated when the subjects were tested again with another list-learning task ($t(26.89) = 3.07$, $P < 0.01$) and another visual-memory task (the Rey-Osterreith[7] figure immediate recall task; $t(26.88) = 0.44$, not significant).

Because most memory-training programmes are based on mnemonic and compensatory techniques[8], the idea of using music training to improve verbal memory seems unusual. However, music training has advantages over other techniques. First, it may be easier to engage children in playing musical instruments, which is an enjoyable activity, than in mnemonic strategies. Second, musical training requires little verbal skill, so it may be more suitable as a memory-training technique for patients with language impairment.

Our results provide preliminary evidence that music training may have a long-term effect on the improvement of verbal memory. Investigation of the effects of the age at which music training begins, and of the duration of training, will provide corroboration and theoretical refinement of our results.

Agnes S. Chan, Yim-Chi Ho,
Mei-Chun Cheung
Department of Psychology,
The Chinese University of Hong Kong,
Shatin, Hong Kong, China
e-mail: aschan@psy.cuhk.edu.hk

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