rats exposed to the Mozart sonata *in utero* and for 60 days post-partum during their waking cycles learned a spatial maze faster and with fewer errors over days than did controls[11]. It is unlikely that learning improved in these animals as a result of pleasure they derived from the treatment. Second, students who listened to Mozart, Mendelssohn, relaxation instructions or silence demonstrated a Mozart effect despite ratings of the Mendelssohn work as being maximally arousing[4]. Third, students who listened to the Mozart sonata scored higher on a spatial–temporal task than after they listened to other stimuli, regardless of their preference (F.H.R. *et al.*, manuscript in preparation). Finally, investigation of the Mozart effect on epileptiform activity showed that the sonata produced a reversal of the epileptic state in comatose patients[12]. No effects were found after exposure to control music. According to these authors, this finding strongly suggests that the effect is not caused by emotional state or arousal.

Steele *et al.* find no Mozart effect in three differently designed studies. Not one design replicated the original reports[1–3], and they introduced several methodological concerns. For example, spatial–temporal task performance varies widely between individuals, making randomization an inefficient way to ensure uniform before-treatment task proficiency[2]. What measures were taken by the two studies using between-subjects designs to tackle this? Was testing done blind, as in other replications (refs 1,3,4 and F.H.R. *et al.*, manuscript in preparation)?

Chabris' analysis is incomplete and includes studies not relevant to the effect he was exploring. Although the Mozart effect cannot be found under all laboratory conditions, as discussed by Steele *et al.*, several studies have successfully replicated it (refs 1–8,11,13,14 and F.H.R. *et al.*, manuscripts in preparation). Because some people cannot get bread to rise does not negate the existence of a 'yeast effect'.

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Ubiquitous dispersal of microbial species

The biosphere supports astronomical numbers of free-living microorganisms that belong to an indeterminate number of species. One view[1–3] is that the abundance of microorganisms drives their dispersal, making them ubiquitous and resulting in a moderate global richness of species. But ubiquity is hard to demonstrate, not only because active species have a rapid turnover, but also because most species in a habitat at any moment in time are relatively rare or in some cryptic state[4]. Here we use microbes that leave traces of their recent population growth in the form of siliceous scale structures to show that all species in the chrysomonad flagellate genus *Paraphysomonas* are probably ubiquitous.

Paraphysomonas consists of 50 species, which can be distinguished by the morphology of their surface scales[5], although oligonucleotide sequence (small-subunit ribosomal RNA) data indicate that the morphospecies are also genetically distinct[6]. The scales remain recognizable for several months after cell death, so looking at their remains in the sediment of a pond provides evidence of the preceding species succession. We used transmission electron microscopy to examine the superficial ~2 mm of sediment collected from a one-hectare freshwater pond (Priest Pot, Cumbria, UK[7]). ^{210}Pb dating indicated that this sediment layer had been deposited within the previous three months. We identified and quantified all the scales and cell remains of *Paraphysomonas* species present, and used this information to reconstruct whole cells. Our examination of 25.2 μl of sediment yielded data on the relative abundance of 32 species.

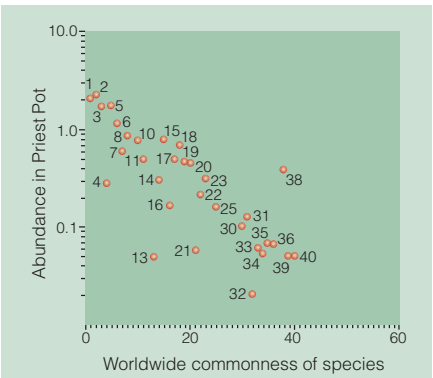

Figure 1 The abundance of each *Paraphysomonas* species in 25.2 μl (equivalent to ~0.1 cm^2) of superficial Priest Pot sediment, plotted against its worldwide commonness. Commonness data are ranked in order, decreasing from left to right. Species 1 and 2 are *P. vestita* and *P. imperforata*, respectively. Further details are available from the authors.

We compared our data with information in 73 published surveys of *Paraphysomonas* species from biogeographic regions across the world. These surveys recorded a total of 41 species, 78% of which were detected in our small volume of pond sediment. The pattern of relative abundance of species in Priest Pot is similar to the global one (Fig. 1). Species that are frequently recorded globally are also abundant in sediment from Priest Pot, and species that are rarely found globally are not abundant in Priest Pot.

We think that globally abundant species will, through neutral migration, 'seed' the pond more frequently than rare species. They are probably capable of population growth in a broad range of conditions, so they will more frequently find suitable conditions. Finally, termination of population growth is accompanied by the production of resting cysts. As the size of the 'cyst bank' for each species is likely to be proportional to its global abundance, repeated cyst production will effectively strengthen the pattern of relative abundance of species that results from neutral migration.

It is widely believed that most microbial species have yet to be discovered, which follows from the general rule that, for each tenfold reduction in body length, the global number of taxa increases roughly 100-fold[8]. But this relation breaks down for organisms smaller than about 1 mm (refs 1,8,9), probably because the enormous number of microorganisms (the water column of Priest Pot typically supports ~4×10^{14} living *Paraphysomonas*) drives large-scale dispersal across the physical and geographical barriers that halt the migrations of larger animals and plants. As ubiquity will limit rates of local speciation and extinction[1], the global number of species less than 1 mm long will be relatively small.

Free-living bacteria sustain all the important ecosystem functions. They are about three orders of magnitude more numerous than heterotrophic flagellates, so it is even more likely that they too are ubiquitous, and that the global richness of free-living microbial species is moderate.

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