News from the quantum zoo

Ever heard of Schrödinger's cat? It was invented in the 1930ies by the Austrian physicist Erwin Schrödinger. He wanted to dramatize what many conceived as the weirdness of quantum mechanics, the all-encompassing and singularly successful theory of literally every subatomic phenomenon. Schrödinger wanted to illustrate how quantum mechanics seems to imply that his cat, locked as it is in a box together with some atomic contraptions, may be in a suspended state of both live and dead. A weird situation indeed! It becomes no less weird when one adds that quantum mechanics seems to imply that a decision as to whether the cat really lives or not is taken first when you open the box to check!

Schrödinger's cat has had many lives over the years and still shows up in many popular accounts of quantum mechanics. It has now been joined in the quantum zoo by *quantum pigeons* to illustrate other seemingly nonsensical implications of quantum mechanics.

The new dwellers were introduced a few years ago in an article by that maestro and grand old man of quantum mechanics, Yakir Aharonov, and his collaborators. They started by formulating the apparently self-evident *pigeonhole principle*: "If you put three pigeons in two pigeon-holes, at least two of the pigeons end up in the same hole." Aharonov and his colleagues intend to show that this principle is not a general rule in quantum mechanics. Indeed, if you substitute atomic particles – "quantum pigeons" like electrons – for the ordinary pigeons, then, so they argued, there could be instances where the pigeonhole principle is violated: Under certain circumstances, three quantum pigeons (alias electrons) having at their disposal only two "quantum pigeonholes" seem to avoid appearing together in any of the two holes. If correct, this would be a truly weird situation! And it seems to follow from a straightforward application of quantum mechanics.

But is this really the case? I decided to take a closer look at the arguments by Aharonov and coworkers, well aware that the authority of these authors weighs heavily to their advantage. However, what I found was that the arguments they had put forward were, at least, debatable. For example, I could show that even if two of the quantum pigeons were in separate holes, one of them must be in the same hole as the third pigeon and therefor obeying the pigeonhole principle. Moreover, all three quantum pigeons may be in the same pigeonhole, a situation not contemplated by the original proponents.

My conclusion, then, is that quantum mechanics may be weird, but not so weird as to defy the pigeonhole principle: even quantum pigeons may thrive together! If they will live as long as the Schrödinger cat in illustrating possible weirdness of quantum mechanics is for the future to decide.

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