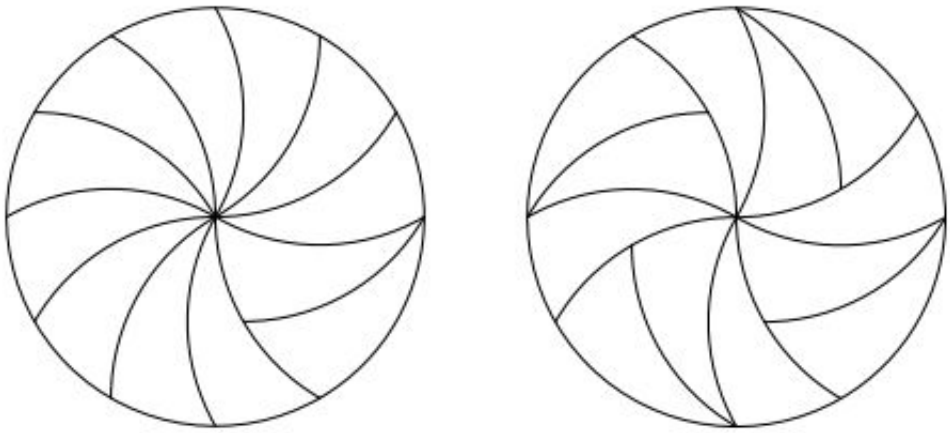
Researchers try mathematical recipe for slicing pizza

January 9 2016, by Nancy Owano



Tilings belonging to the set T^2_{12}. Credit: arXiv:1512.03794 [math.MG]

(Phys.org)—If you are rather fussy about making sure the pizza you order and share is conventionally (properly) cut into triangles, you may want to avoid having pizza-theory mathematicians presiding over the knife-cutting. They may be much more eager to explore possibilities and variations than give you the usual sized slice.

To appreciate their enthusiasm if not usefulness of results, one can have a look at a paper on arXiv by two researchers Joel Haddley and Stephen Worsley from the Department of Mathematical Sciences, University of Liverpool.

The paper is titled "Infinite families of monohedral disk tilings" and they have explored this with reference to pizza cutting.

To understand how pizza plays a role in their paper, one can turn to the definition of a monohedral tiling as one in which all the tiles are the same shape, in that each tile in the tiling is congruent to a fixed subset of the plane. The set is the prototile of the tiling, and the prototile admits the tiling.

The authors wrote in their paper: "A tiling of a planar shape is called monohedral if all tiles are congruent to each other. We will investigate the possibility of producing monohedral tilings of the disk. Such tilings are produced on a daily basis by pizza chefs by taking radial cuts distributed evenly around the center of the pizza. After constructing this tiling, a neighborhood of the origin has non-trivial intersection with each tile."

They again mentioned the main question of their article: Can we construct monohedral tilings of the disk such that a neighborhood of the origin has trivial intersection with at least one tile?

Reporting this paper, *New Scientist* had a story Friday headlined "Mathematicians invent new way to slice pizza into exotic shapes." Jacob Aron said, "Most of us divide a pizza using straight cuts that all meet in the middle. But what if the center of the pizza has a topping that some people would rather avoid, while others desperately want crust for dipping?"

Mathematicians had previously come up with a slicing recipe known as a monohedral disc tiling, said Aron, resulting in 12 identically shaped pieces, six of which form a star extending out from the center, and the other six divide up the crusty remainder. "You start by cutting curved three-sided slices across the pizza, then dividing these slices in two to get

the inside and outside groups," said Aron.

"I've no idea whether there are any applications at all to our work outside of pizza-cutting," said Haddley in *New Scientist*. He has tried slicing a pizza in this way for real. But the results are "interesting mathematically, and you can produce some nice pictures."

The pictures are not only nice but as figures they illustrate shapes and cuts achieved in their explorations of slicing possibilities and, as *Popular Science* said, "They discovered a way to slice curvy pieces with nearly an infinite number of sides (as long as it's an odd number of sides) and then further divide those slices in half." The two authors even dove into more complex shapes; they made wedges in the sides said Lindsey Kratochwill in *Popular Science*, "still producing monohedral tilings that fit together into a circle."

Actually, involving the exercise of slicing pizza in mathematical discussions is nothing new. As *Gizmodo* reminded us on Friday, "The slicing of pizza is an oddly well-researched area of mathematics, principally because it has less to do with pizza and more to do with circular geometry."

Jamie Condliffe said, "The work builds on previous research that showed that it was possible to cut a pizza into six curved slices (or 'shields'), each of which could then be sliced in half to produce 12 identical slices."

More information: Infinite families of monohedral disk tilings, arXiv:1512.03794 [math.MG] arxiv.org/abs/1512.03794

Abstract
This paper gives new solutions to the problem: 'Can we construct monohedral tilings of the disk such that a neighbourhood of the origin

has trivial intersection with at least one tile?'