How a Tangram Cat Happily Turns into the Pink Panther

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Do you want to create, or better generate, a new two-dimensional puzzle? Nothing could be easier! Just take one of the many well-known puzzles of this type and submit it to a geometrical transformation. The result will be a new puzzle, and — if you do it the right way — a nice one. As an example, let us take the good old Tangram and try a very simple transformation, a linear extension (Figure 1).

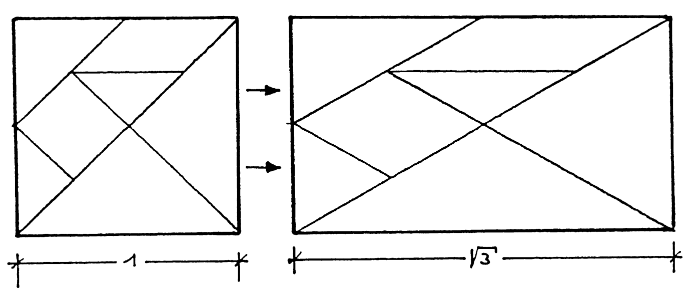

Figure 1. Tangram submitted to a linear extension. The result is a set of pieces for a new puzzle, a Tangram derivative called Trigo-Tangram.

While the tangram pieces can be arranged in an orthogonal grid, the pieces of our new puzzle, due to $\sqrt{3}$ as extension factor, fit into a grid of equilateral triangles, a trigonal grid. That's why I gave it the name Trigo-Tangram.

Puzzles generated by geometrical transformations I call *derivatives*; our new puzzle is a Tangram derivative, one of an infinite number. Depending on the complexity of the transformation, certain properties of the original puzzle are preserved in the derivative, others not. Tangram properties preserved in Trigo-Tangram are the linearity of the sides, the convexity of the pieces, and the side length and area ratios. Not preserved, for example,

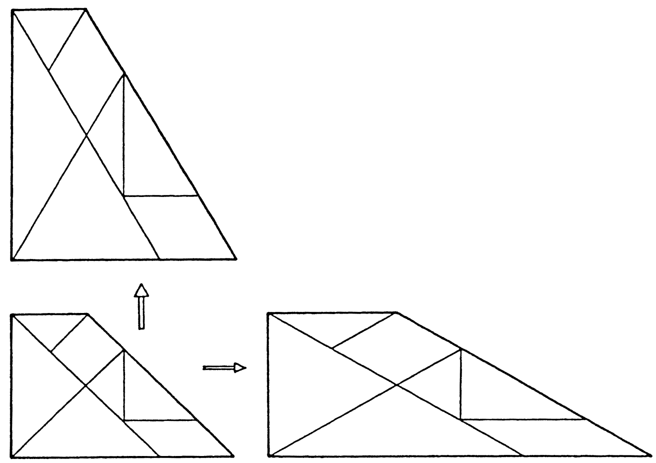

Figure 2. Suitable problems for a puzzle derivative can be found by transforming problems of the original puzzle. For Trigo-Tangram, two problems can be generated by extending this original Tangram problem in two different directions. The transformation of the solution can be a solution for the derivative (right image) or not (upper image).

are the angles and the congruence of both the two big and the two small triangles.

For our derivatives, we do not only need the pieces, we need problems as well. Problems? No problem at all! We just take some figures for the original puzzle and submit them to the same transformation as the puzzle itself. The images of the figures will be suitable problems for the derivative. In Figure 2 this is done for a Tangram problem and its solution. As you can see, the corresponding linear extension can be performed in two different directions, which gives us two different problems. And you can see another important fact: The transformation of the solution does not always render a solution for the derivative.

Figure 3 shows some problems for Trigo-Tangram. So, take a piece of cardboard, copy and cut out the pieces, and enjoy this new puzzle.

Here is another way to have fun with a puzzle and its derivative: Take the original Tangram, lay out a figure, and try to make a corresponding figure with the pieces of Trigo-Tangram. In many cases, you get funny results. Figure 4 shows how a Tangram bird stretches its neck and how a Tangram cat turns into the Pink Panther.

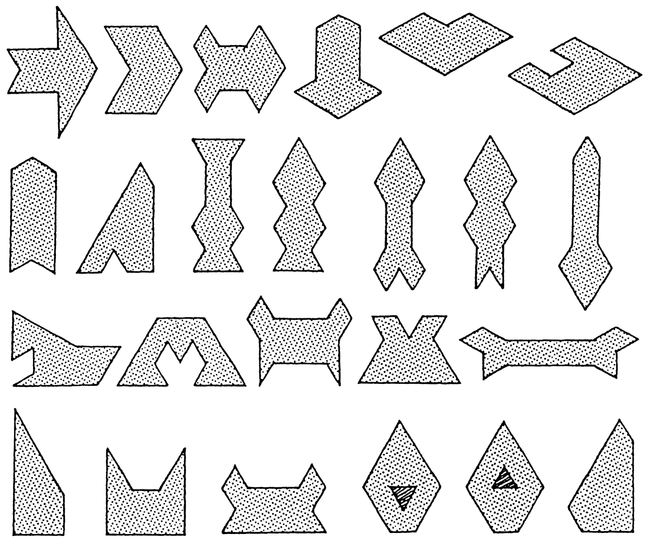

Figure 3. Some problems for the Trigo-Tangram puzzle.

Transforming two-dimensional puzzles provides endless fascination. Just look what happens if you rotate the Tangram in Figure 1 by 90° and then perform the transformation. The square and parallelogram of the original are transformed into congruent rhombi, which makes the derivative less convenient for a puzzle. You obtain better results by applying linear extensions diagonally (Figure 5). Since in this case the congruence between the two large and two small Tangram triangles is preserved, the two puzzles

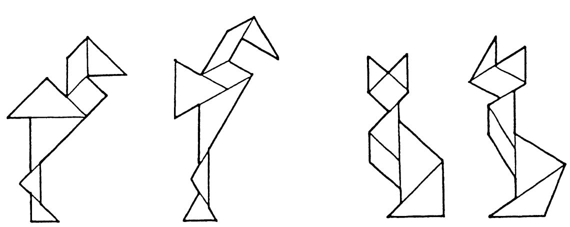

Figure 4. A Tangram bird stretches its neck, and a Tangram cat turns into the Pink Panther.

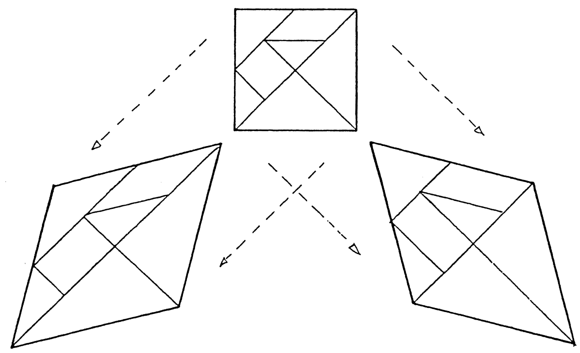

Figure 5. Transforming the Tangram by diagonal extensions leads to two derivatives which are more Tangram-like than the one shown in Figure 1.

generated are even more Tangram-like than the Trigo-Tangram. To create problems for these derivatives is left to the reader. One set of problems will serve for both of them.

I hope I have stimulated your imagination about what can be done by transforming puzzles so you may start your own work. Take your favorite puzzle, and have fun generating individual derivatives for yourself and your friends!