

## How a Shapeways 3D-print puzzle got knocked off in China

By Oskar van Deventer, 24-10-2015

This article presents a forensic investigation that describes how a puzzle of mine, the Geared 5x5x5, got knocked-off in China. Although Chinese knock-offs happen all the time unfortunately, this case may be special. All the available evidence suggests that the knock-off was made from a 3D-printed sample from Shapeways. So this may be the first documented case where the knock-off was not from a mass-produced puzzle, but from a 3D-printed one.

The story begins October 2010, when I designed the Geared 5x5x5. I 3D-printed the puzzle with Shapeways [1] and I published the prototype on YouTube [2], the Shapeways Forum [3] and the Twisty Puzzles Forum [4] on 25 December 2010, see Figure 1. As the name of the puzzle already suggests, it is a 5x5x5 Rubik's-style cube with gears.

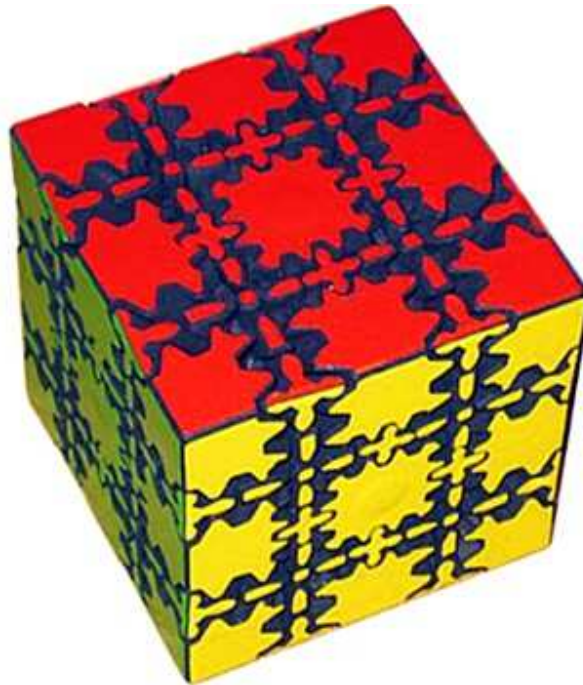


Figure 1: The original 3D-printed Geared 5x5x5.

Fast forward to July 2015, when a Chinese friend notified me of a knock-off version named 5x5x5 Gear Cube that he found at a Chinese website. I contacted some other Chinese friends through the Twisty Puzzles Forum. We obtained a sample of the KO puzzle and we started investigating. There were a lot of questions. How did the puzzle get made in China? Who performed the knock-off? And what to do about those knock-offs?



Figure 2: The Chinese knock-off 5x5x5 Gear Cube.

The first question to answer was how the puzzle got made in China.

1. Was it a parallel invention?
2. Was it reverse engineered from my photos and videos?
3. Was it copied from my own CAD design?
4. Was it copied from a Shapeways 3D-print?

The first option can be easily ruled out. The puzzles look virtually identical. There are so many design choices that the outcomes would not be identical. Also, the number of people knowing how to design geared twisty puzzles is extremely limited.

The second option can be ruled out with the same arguments. The inner details are also identical, which one could not deduce from the photos or video. Moreover, such reverse engineering would require skills that a knock-off company would not have, otherwise they'd better produce their original legitimate products instead.

I am ruling out the third option as well. I am guarding my CAD designs. I never shared the Geared 5x5x5 design with anyone for the simple reasons that nobody asked and I did not consider the design worth mass production. I just uploaded the design to Shapeways, got my 3D-print and that was it. For sure, I am ruling out Shapeways, as it is in their primary interest to guard the intellectual property of their Shapeways Shop owners.

That leaves the fourth option, did a Shapeways 3D-print get copied? In order to investigate that option, I studied a knock-off sample together with my original version, see Figure 3. As it turns out, the pieces are identical to the extent that one can swap out pieces between the original and the knock off, and the puzzles remain fully functional. I have looked at some design details. One design detail is a little bump on

all of the corner pieces, as a result of an idiosyncrasy of my CAD design. The same non-functional bump is visible in the knock-off pieces, albeit with a slightly different shape. I could also find other design details back in the knock-off, again slightly deformed. My initial hypothesis was that the 3D-print got scanned by a 3D-scanner, and that the limited accuracy of the 3D-scanner caused the subtle sub-millimeter differences. People responded that silicone cast-off may be a more plausible low-tech explanation.

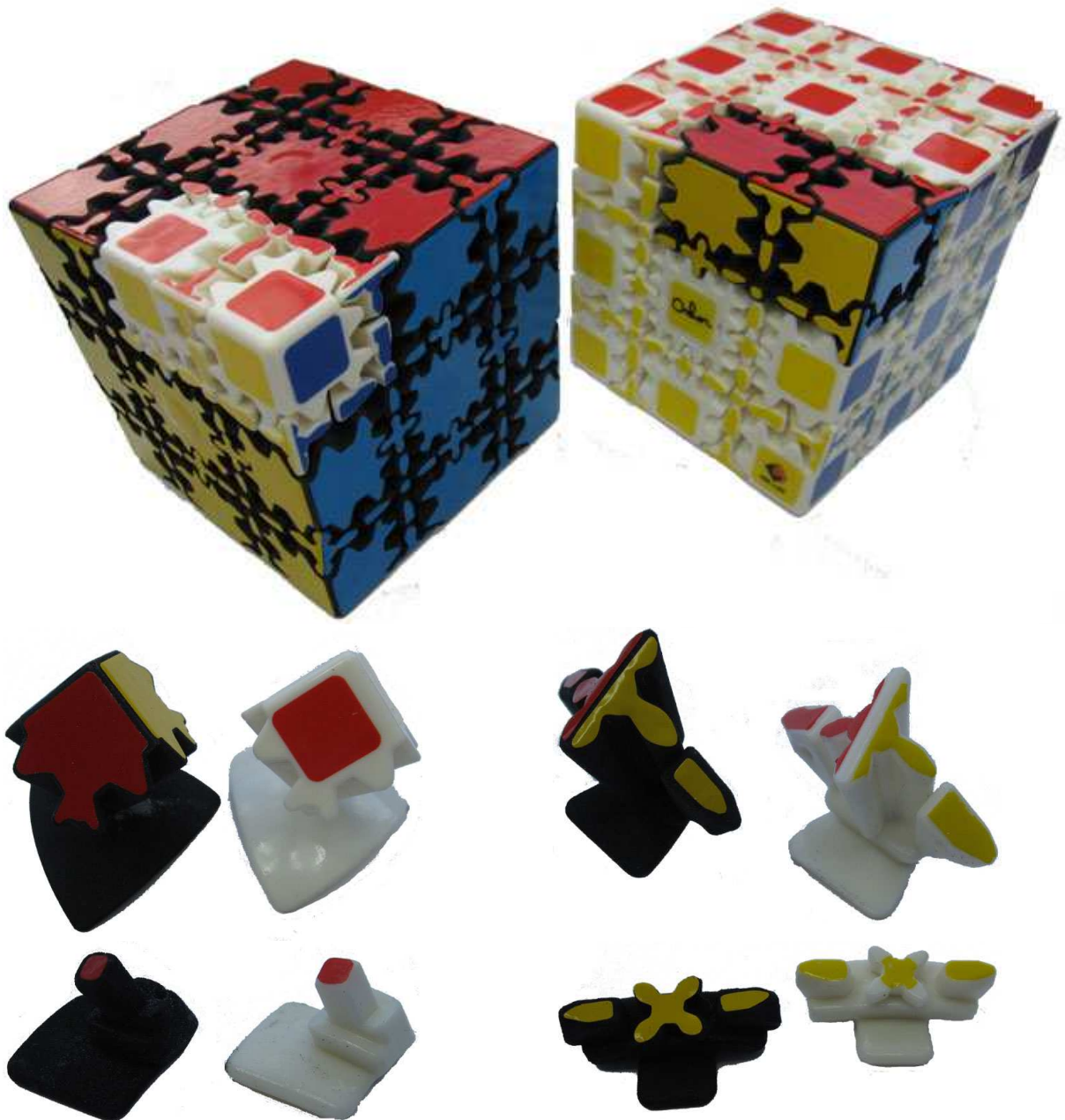


Figure 3: Comparing the original 3D-print and mass-produced version.  
(black/left = Shapeways, white/right = mass-produced)

So which Shapeways 3D-print got knocked off? That question was easy to answer, as only two 3D-prints have ever been made, namely my original prototype and one sample sold by Shapeways. Surprisingly, I

do even know the customer, whom I shall call Customer X for privacy reasons. Customer X and I had a brief communication in June 2012, as she had some difficulty in ordering the Geared 5x5x5 from Shapeways. As the puzzle has too many parts to fit within a single Shapeways model, this required some sorting out. I do not know much about Customer X. As I understand, she has a Chinese first name and an American family name, but she is addressed by her American nick name. She lives in the greater Los Angeles area. At that time, she was running a website and forum in Chinese with items titled "US purchasing advisory services" and "Ocean transport from the purchase area". According to the WayBack machine, that website was still running in December 2014, but it now provides "Discuz! Database Error".

After learning about the knock-off, I tried to contact Customer X about the Geared 5x5x5 at both her email addresses. However, she did not respond. I asked Shapeways for help. Shapeways sent her another email, to which she did not respond either. I asked Shapeways whether they could provide me with further information. They confirmed that the Geared 5x5x5 was the only purchase by customer X. As for further contact attempts, Shapeways responded "If you have already reached out to the customer and they have been unresponsive that may pretty much close that option. I do not want to send multiple emails to the customer asking to share their information. At that point we're pretty much stuck until Oskar gets a court order". That response seems fair to me, as privacy of customer is an important good that is justifiably protected by law.

So even though I was unable to get any further response from Customer X, all the evidence points at the 3D-printed sample that she bought from Shapeways. A Chinese friend commented: "The business customer X was doing is quite usual here in China. As you may know, Chinese people are not very easy to go overseas but they do like foreign products. So lots of Chinese in different countries are doing same kind of 'business'. They help people in China to buy something which are only available in certain countries, or may be just easier to get in certain countries. They rent a warehouse to store what they buy, and then send back to China and earning extra money by this. So customer X may not know about twisty puzzles. She might be just a person doing business".

The next question is the culprit, who knocked off the Geared 5x5x5? One of my Chinese friends performed a search, and dug up a Chinese patent titled "a kind of Rubik's Cube" (一种魔方) [5]. The name of the inventor and assignee is Duwei Qian (杜卫谦). Since this patent is public information, I do not believe that I am violating anyone's privacy by publishing information from it. The filing date of the patent is 10 November 2012, about five months after Customer X's purchase. Figure 4 are two figures from the patent description. A Chinese friend of mine checked with his friends and he got the response "wow, it's him again!". It seems that this "inventor" has done similar things before. My friends suspect that he might be the boss of some plastic molding factory.

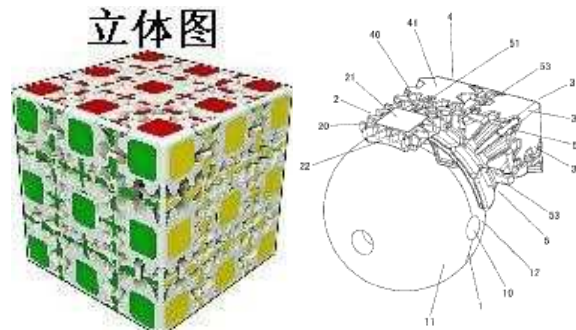


Figure 4: Drawings from the Chinese patent on the 5x5x5 Gear Cube.

The knock-off puzzle is produced by the brand Illusion Cube (梦幻魔方), and it was offered at several Chinese online marketplaces. The puzzle is made of cheap white plastic and it has rather tacky printed stickers. One person reported that the core (a big sphere) broke. Also sometimes a gear skips a tooth. Other than that, the quality of the mass-produced puzzle is reasonable, and it performs quite well when handled gently. For sure, it is more rugged than my original 3D-printed version.

With all this information in hand, what to do next? I decided to contact Illusion Cube. One of my friends helped me to establish contact through a friend of his, who knew a person that could speak on behalf of Illusion Cube. The friends helped me with translation and interpretation of the communications in Chinese, for which I am grateful. We could agree on the usual terms (royalty percentage, samples, acknowledgment). However, we could not come to a signed license agreement, for reasons that I can only speculate about (confirming identity on paper?). I also made an offer that they send me a large number of additional samples, and that I would forego the royalties and acknowledgment. That offer was rejected. Apparently, the production had been a limited run (a few thousand) that still needed to be earned back.

The next option to explore was legitimization. Legitimization is an awkward practice in the twisty-puzzles community in case of knock-off productions. A selected legitimate company buys a stock of the knock-off puzzle, pays the true inventor royalties, gets him samples and credits him as the true inventor on the product and advertising. The practice is awkward, as it does not impede knock-off productions and it may even stimulate knock-off sales. Still, several people confirmed that the mass-produced puzzle was of sufficient quality to associate my name with it. Via a Chinese friend, I found the company Cubetwist. Cubetwist is known for its original productions of bandaged Rubik's Cubes. The company has a good reputation and it was interested. So we achieved a legitimization agreement. Already a few days later, I received my batch of samples. The puzzle is now legitimately available under the Cubetwist brand, and it can be purchased among others at HKnowStore [6] and PuzzleMaster [7] for a very reasonable price, given the complexity of the puzzle. People who prefer real stickers can buy a set at Oliver's Stickers [8].

In conclusion, I am a happy man. I am happy that a puzzle of mine got available to fans worldwide, despite me discarding its viability as a mass-produced puzzle. I am grateful to all my friends, who helped me with this case in many ways, as described in this article. I am grateful to my fans, who accept the extra expense to buy a legitimized sample over a knock-off. Friends asked me why I wouldn't get the illegal patent nullified with the Chinese patent office, or sue Illusion Cube, knowing that "something I have created has been ruthlessly ripped off". The answer is that both approaches are likely ineffective money pits, whereas I'd rather approach things positively.

One thing still bothers me. Why would a person make the investment and effort via the illegal route of knock-off patents and knock-off products, while the legitimate route is so easy? They could have contacted me directly. I would have agreed to the mass production of the Geared 5x5x5. Also the royalty fees are hardly prohibitive, typically 5% from the business-to-business cost. I can only assume that the answer is stupidity and ignorance.

### More to read and watch

Watch the original 3D-printed sample and the knock-off side by side on my YouTube channel [9].

Read the discussion at the Shapeways Forum [10].

Read the discussion at the Twisty Puzzles Forum [11].

Read the discussion at Reddit [12]. Note that some of the comments are hilarious, especially the downvoted ones.

### References

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