Evolution of Complexes from LEGO™ Bricks in a Washing Machine

by Ingo Althöfer
Department of Mathematics and Computer Science
Friedrich-Schiller University Ernst, Jena, Germany

Disclaimers: *This work has not been supported by the LEGO Group or any other brick toy company This work has not been sponsored by the Miele domestic appliance and machine manufacturing company. This work has not been supported by the artist Piet Mondrian.*

Some people use their washing machine to clean LEGO bricks. No surprise, it works. But more than just cleaning occurs. Typically during the washing process, some of the bricks join together randomly, forming complexes.

I observed the phenomenon (see Figure 1), and became curiously obsessed. I spent the next nineteen and a half weeks conducting many brick washing sessions.

Photo 1: Ingo Althöfer, observing a washing run. (Photo courtesy: K.-H. Wüllhorst)

I learned several things about what can result from tumbling bricks in a washing machine:

(1) Some bricks randomly join together, forming complexes.

(2) Sometimes some of the randomly formed complexes are beautiful.

(3) Sometimes some of the randomly formed complexes are scientifically and technically interesting.

(4) The phenomenon is not limited to LEGO bricks.

(5) Interesting complexes can form between bricks of different companies.

And about design processes in general:

(6) In many situations adding some random elements may help.

Beautiful Random Complexes

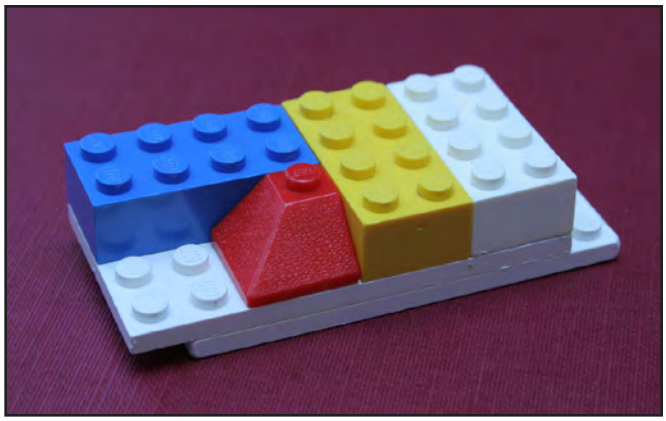

Photo 2: Our very first beautiful complex. Had Piet Mondrian inspired the washing machine? The complex became "Art Emiele No. I".

The complex in Photo 2 was in the harvest of my first controlled LEGO washing run, exactly with these colors. Seeing it through the machine's bull's eye I realized immediately: That is great art! That is Art Emiele! Explanation: my washing machine is a Miele.™. Most of the beautiful complexes are appealing because of their smooth (almost convex) shape. (This discovery has economic, not just scientific, value. I have made money by selling unique items from the Art Emiele edition.)

Technically Interesting Random Complexes

"Adult fans of LEGO" (AFoLs) use a nontrivial building technique called SNOT. "SNOT" stands for "Studs Not On Top" and means that LEGO bricks are set together in a way where not all pins are on top. The washing machine realized a basic SNOT complex: a flat 2x2-tile keeps two normal 3x2-bricks together, with pins (i.e., stumps) looking in opposite directions. For AFoL seniors this complex is well known; for me it was new.

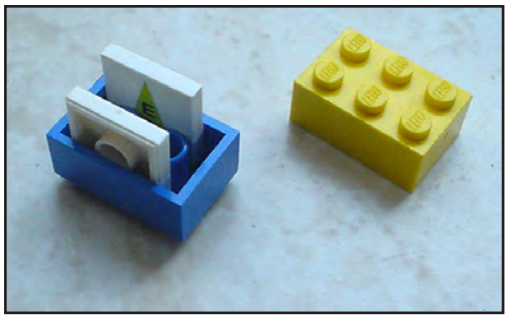

Photo 3: The machine generated a non-perfect complex with one 2x2-tile only. Seeing this it took me only a second to improve the structure: two tiles (one on each side) give a more stable SNOT. The yellow brick is cocked ***over the tiles, like a little hat.***

Stable and Unstable Random Complexes

Danish mathematicians Mikkel Abrahamsen and Soeren Eilers computed in how many ways six mono-color LEGO bricks of size 4x2 can be put together. There are exactly 915,103,765 different arrangements — almost a billion! In several washing runs with 260 4x2-bricks, not a single such "six-pack" was found. This may be partly explained by the fact that bricks not only clutch together randomly, but then also randomly disintegrate again.

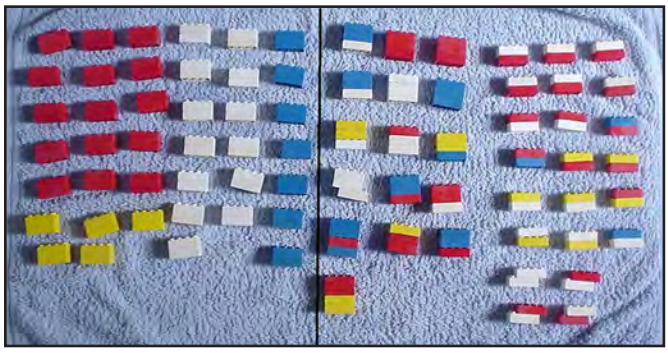

Photo 4: A harvest from washing 4x2-bricks. In this run I had started not with isolated bricks but with monocolored towers of height 2. Thus, it was guaranteed that each 2-tower with two different colors had not been there, surviving, since the very start of a washing machine tumble session.

Washing Other Types of Bricks

Also other bricks (either from the LEGO Group or other companies) form complexes in the washing machine. We collected experiences with (in alphabetic order) BestLock, Duplo, Formo, Idema, MicroBlox, Ministeck, Modulex, NanoBlock, PeBe, PeBe2000, Rasti, and Tente.

Even in "rather" different brick systems such as Dusyma and BristleBlocks, random complexes form.

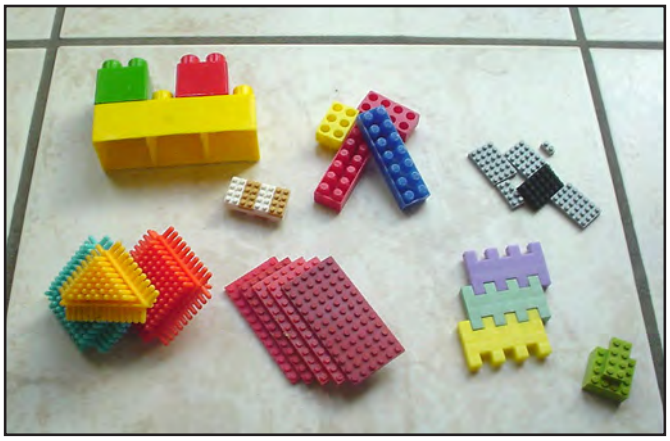

Photo 5: An ensemble with (very) different types of bricks. They all form complexes in the washing machine. They all form complexes in the washing machine. The green bricks in the lower right are MODULEX (these are LEGO bricks with 5 mm basic measure).

Some History: The Eastern and Western Blocks, Divided by an Iron Curtain

During the years of cold war, East Germany had not enough valuta (or other resources that could be converted into valuta) to order large amounts of LEGO bricks from the capitalist countries. So, they designed their own LEGO clones, which they called "PeBe". For decades the LEGO Company simply ignored the breach of patent.

But in the early 1980's, the "Billund boys" (the headquarter of the LEGO Group is in Billund, Denmark) started legal proceedings. As a result, the production of PeBe bricks was stopped. Instead, in 1985 a substitute came to the East German market: "PeBe2000" which was unlike its predecessor, PcBe, was not compatible with LEGO. People — on both sides of the iron curtain and also after German reunification — believed in a "two worlds view": LEGO in this world, PeBe2000 in that world. According to this view, there were two completely different toys, which could and would not interact.

It took 28 (twenty-eight) years— until, in October 2013, we (the Miele washing machine and I) jumped over the invisible fence, washing LEGO and PeBe2000 bricks together. Surprise: my brave Miele (Beate contradicts from time to time: "Our Miele - not only yours") generated random mixed LEGOPeBe2000 complexes! No human had dared to try the impossible. It took a stubborn washing machine with an open minded operator to connect the unconnectables.

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Evolution of Complexes from LEGO™ Bricks in a Washing Machine [continued]

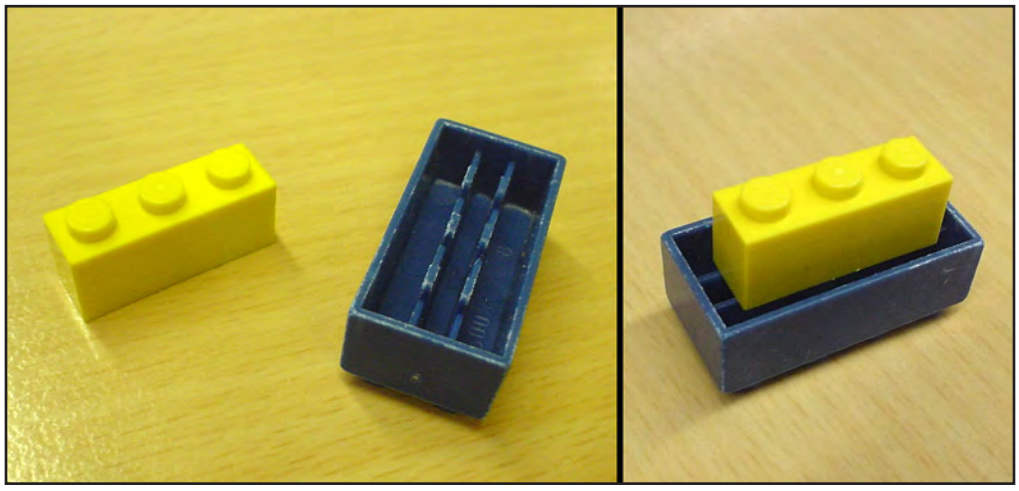

Photo 6: A stable LEGO-PeBe2000 complex found by the washing machine. The 3x1-piece is LEGO.

Also interesting in this context: There was another East German company that made toy bricks: "Formo." Agent "Emiele" found out, within a few hours of beginning an experiment, that LEGO and Formo bricks do form mixed random complexes. Trying PeBe2000 and Formo together, I found that no mixed complexes arose from that mixture, either.

A Washing Machine Can Be a Monte Carlo Sampler Device

Monte Carlo experiments are a broad class of algorithms that obtain results by repeated random sampling. Often, the phrase "Monte Carlo" is applied only with respect to operations in a digital computer. However, a washing machine can be viewed as a successful analog Monte Carlo sampler. It makes the bricks self-assemble in interesting random ways .

Concerning design and research in general, I claim: some amount of randomness helps to achieve more interesting results. Many designers and artists will subscribe to this, but also many people from all the natural and technical sciences. There is an impressive example from the world of board game programming. "Go" is a very old and famous 2-player game. Some people call it the Asian counterpart of western chess, but in my eyes (I am an advanced chess amateur, with "Elo" rating around 1,900) Go is much deeper than chess.

In 1997, the chess computer Deep Blue beat (the human) world champion, Garry Kasparov. At the same time, even the best Go computers lost badly against every normal human who was in the game for only a few months. A breakthrough came in 2006, when the idea to include randomness in Go bots was realized seriously and properly: In the Monte-Carlo approach, a Go position is evaluated by playing many "random games" from that position to the very end, to find the average result of those "games." Remi Coulom from France was the first to win a Gold medal with this approach in a Computer Olympiad (2006 in Turino). In the meantime Go bots are stronger than 99.9 % of all human players.

Photo 7: One of the leading Go bots is Pachi, developed by Petr Baudis and Jean-Loup Gailly. The right side shows the official Pachi logo, designed by Chidouri.

Reference

An annotated list of references appears at *http://www.althofer.de/brick-washing-links.html*.