

Nomalized solving time (NST) for Rubik's cube®

Kurukurukai Yuichi Hamada

2017/08/17

This paper describes one of proposals of new measuring scheme so as to overcome so-called “beginner's discouraging valley”, which hinders many Rubik's cube® beginners' motivation and discourages their interest in Rubik's cubes®.

1. Background

I have taught how to solve Rubik's cube® for several years in a Rubik's cube club¹, and more than 350 children and adults learnt it. Each of them was able to solve Rubik's cube® at least once by referring to a manual.

However, more than half of them discontinue playing Rubik's cube®, in particular, seldom adults shows interest in speed cubing. I interviewed these people and found out the following facts:

- (1) They learnt how to solve Rubik's cube® and found that solving is not miracle or super-intelligence, but algorithm;
- (2) At first, they showed interest in speed cubing. However, by looking at videos such as Youtube and Youku, the world-class speed cuber's techniques overwhelmed their interests completely. As a result, they abandoned Rubik's cube®.

This is what I saw many times in past. This is very sad.

2. Hypothesis

Having said that, I wonder why other sports and games may attract people. For example, lots of people are fascinated in marathon and golf. For a long time, many people love chess. Why not Rubik's cube®?

I start with a hypothesis. These historically-surviving sports and games have motivating environment to avoid discouragement towards beginners. Golf has a handicap system. Most of non-professional marathon race has age-divided award system (e.g. student class, and middle age class). Chess players compete in each “grade”.

On the other hand, in speed cubing, cubers always compete by using only “time”, no matter how experience we have. This is fair, but not attractive to beginners.

Therefore, a new measuring scheme, so-called Nomalized Solving Time (NST), is

¹ This Rubik's cube club is called “Kurukurukai”, known as くるくる会 in Japanese, and 酷酷会 in Chinese. It was founded in 2008 in Tokyo, and as of today, more than 350 beginners has joined Kurukurukai.

proposed as below.

3. Nomalized Solving Time (NST)

NST is defined as below:

$$NST = [Actual\ Time] \times \frac{C1 \times ([experience] + 1)}{|[age] - C2|} + C3 \times [help]$$

In Nomalized Solving Time (NST), $[experience]$ in cubing works as an increasing factor in time, and $[age]$ works as an decreasing factor in time.

$[experience]$ can be:

- (1) Cubing experience in years or months;
- (2) Number of times of previous award winning; or
- (3) Number of times of participation in competitions or cubing clubs.

Based on the assumption that there exists a prime age in cubing (e.g. 20 years old), $[age]$ parameter is introduced. The more the difference between an actual age and the prime age is, the more handicap the cuber enjoys.

At the beginning of learning Rubik's cube®, beginners require some help, such as a glance of manual, and assistance from experts. In order to be fair, this kind of help should be reflected in NST as a negative factor.

C1, C2, and C3 are coefficients of NST, which should be optimized to maximize the motivation of beginners and fairness between them.

4. Implementation of NST

Here are some examples of NST in Rubik's cube® club.

- $[experience]$ is a number of times in which a competitor participates in Rubik's cube® club.
- Not to invade a competitor's privacy, $[age]$ of adult competitors are set equal. (35 years old fixed).
- $[help]$ is a number of oral assistance from experts. Furthermore, $[help]$ is increased by 1, if a competitor have a look at cubing manual.
- The NST coefficients are set as $C1 = 5$, $C2 = 20$, and $C3 = 30$.

No.	Competitor	Actual time	Actual time [s]	Num. of participation [times]	Glance at manual	Assistance [times]	Age	NST [s]
1	7 year's boy	5 min 32 sec	332	4	Yes	2	7	758.5
2	9 year's girl	2 min 42 sec	162	2	No	0	9	220.9
3	12 year's boy	7 min 2 sec	422	1	Yes	5	8	443.8
4	Father A	9 min 32 sec	572	1	Yes	2	35	280.7
5	Father B	3 min 31 sec	211	2	No	0	35	211.0

Table1: Example of NST

5. Observation

As mentioned above, NST coefficients should be adjusted to maximize its purpose.

- To encourage a very beginner (e.g. first participation in Rubik's cube club) or to weaken the age factor, C1 should be large.
- C2 could be flexible, in such a way that C2 could be the age of the fastest cuber in that competition.
- C3 should be small amount so as not to demotivate beginners.

6. Summary

This paper briefly describes one of proposals of new measuring scheme called NST. Due to the insufficient research regarding NST, its pros and cons have not been studied in detail yet. The research is continued in Rubik's cube® club and some optimization and/or adjustment will be proposed in the future.

Happy cubing!

Kurukurukai