Autistic Savants and large number primality detection.

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Abstract

In a sequel to the paper on small number primality detection by mental arithmetic.

In this paper, we consider primality detection of four digit prime numbers, leading next to larger six digit and eight digit numbers, optionally scaled to arbitrary sized numbers. Several mental arithmetic techniques as mental arithmetic exercises from literature are cited, towards effective primality detection, by mental arithmetic only.

The “large primes” mental arithmetic skill is developed both as a web based UI and as a UI based on slack, using the Wolfram Alpha nd Wolfram API , for primality testing and for Easter Eggs on prime numbers.

Keywords: ASD, prime number determination, autistic savants, mathematical testing, Alexa Skills, learning and Cognition, Rabin-Miller test, Lucas test, fermat primes.

Autistic Savants and prime number identification

[\(Treffert, 2009\)](#) describe five prominent savant capabilities in music, arts including sculpture and drawing, calendar calculations, mathematical capabilities, in number theory and prime number determination and extraordinary spatial and mechanical skills, including Lego and brick based building.

Autistic savants have displayed a spectrum of other skills such as precise timing of the passage of time, without clocks, precise measurements of distances, and excel in domains like neurophysiology, statistics, navigation and cartography. Extrasensory perception, with keen smell, taste or sight are other abilities. Hyperlexia, with a hyper-preceptory to symbols, scripts and patterns is predominant in autistic children.

(Savant Syndrome and Prime Number, n.d.) Yamaguchi, however, disproves mathematical capabilities in autistic savants.

(Welling, 1994)describes several case studies of autistic gifted individuals with extremely gifted mathematical capabilities, in primality detection. Several published case studies are mentioned, Dase who generated tables of factors and prime numbers for the 7th and nearly the whole 8th million. Parks, whose daughter could mentally detect primality between 1 and 1000, the autistic twins who mentally determined primality in 12 digit numbers and even 20 digit ones.

The only experimental study to date is by O' Connor in 1990 and later by Anderson in 1992 , a 20 year old autistic savant, not named, could mentally determine primality in 5 digit and larger numbers.

The non calculative primality detection hypothesis of deep memory, gestalt and other preceptory mechanism is propounded.

In ([No Title], n.d.-a, Website, n.d.-a), lists many mental arithmetic methods for factoring large numbers, used by speed arithmeticians, which is termed lightening calculations. The various methods described are summarized as identifying divisibility by the last digit, and discovering fermat's primes, and Klein and Aitken, Zerah Colburn, are described by Smith to use the $(4n + 1)$ and $(4n - 1)$ forms for primes, using the difference of squares. Fast methods of division and multiplication are also described.

(Caldwell, n.d.) describes prime number theory in detail, as a single resource for primality detection.

The Rubin-Miller test uses a witness based primality system, which is $O(\log n)^4$ in time complexity,

We can create an exercise in Rubin-Miller primality detection(Weisstein, n.d.-b) in an iteration using a random input from the user and a mental arithmetic as a probabilistic determination of primality. We propose to implement this with slack integrated with the Wolfram API.

The lucas primality test adds to the Rubin-Miller, in Wolframs PrimeQ function, we add a mental exercise to the gym with an UI developed with the Wolfram API.(Weisstein, n.d.-a)

Mindful Moment.

Mindful Moment meditation or the 'Mindful Minute' meditation is the notion of a one point concentration, in time at a moment, invented by [Marchand, William R.](#),(Marchand, 2015) applied as the similar 'one moment meditation' on a central mathematical truth, as invented by the author, one attains clarity, mental arithmetic capabilities and a coherence in thought and

being on a mathematical task or truth, and the light of the mathematical truth. This is essentially a practice of mathematics therapy applied to primality, primality mental algorithmics, to be practiced in the proposed experimental clinical study on control of normal students and autistic savants.

Method

Participants

The author embarks on creating a directory of autistic savants with extraordinary mathematical abilities, verified with quantitative measures similar to IQ tests, but with recreational mental mathematics, in special slack apps created for a quantification of mental mathematical capabilities.

Assessments and Measures

A slack based channel with wolfram api for the following gym exercises.

1. Fermat primes.
2. Rubin-Miller primality iteration.
3. Lucas Primality Iteration.

The mental exercise consists of mental computations of algorithmic steps indicated as a slack application, to match the wolframs primality functionality as a mental gymnastic exercise. With an optional mindful moment meditation, to aid concentration and build the mathematical coherence needed. We explore the spiritual 'to be - think -innovate' marketing of

Grundfos,(*Website*, n.d.-b) and maybe discover the savant approximation in ourselves. Is it a true savant?

Assessments include reaction time statistics and data on correctness, with individual variables on accuracy of each mental calculation and overall primality correctness figures.

Design Of Proposed Experiment (D.O.E),

Variables: response time for correct responses, response time for incorrect responses, number of correct responses, number of incorrect responses in iteration and primality detection.

Number of patients and control group.

The control group consists of 100 participants, using this skill as recreational mathematics and as a learning and cognition tool. The tool is also used to detect 'savant' characteristics based on response times and number of correct and incorrect responses.

Instrument Reliability

1. Inter-rater reliability
2. Test-retest reliability

Validity

1. Face validity
2. Construct validity

Use of R and the Laavan software, for the assessment of reliability and validity measures.([*No Title*], n.d.-b). We use the Laavan software to determine inter-rater and test -retest reliability and variance based validity measures, of both face and construct validity measures, published when the clinical trials are committed.

Model for the evaluation of primality detection score and reaction times.

("The Development of Mental Arithmetic: A Chronometric Approach," 1982) is epistemological on models of mental arithmetics with a progression from procedural to network models.

Reaction times are proven irrelevant to the quantification of mental arithmetic to indicate 'savantness', however reaction times and statistics are part of the data set collected, for future research in data mined correlations in reaction times. In this publication we use a fuzzy mapping to the primality detection numbers, to measure 'savantness'.

A control score as a comparison on a test of primality detection for random, 4 digit, 6 digit and 8 digit and optionally arbitrary size, is computed from published literature and the use of this test on normal subjects, for a large sample size of at least 100 subjects, for a confidence interval of 95.

Discussion and Future Work.

We have described the use of the slack channel with skills for learning and cognitive quantification with respect to mental arithmetic capabilities and valuable mental exercises in the mathematics and coding gym, which duals as recreational mathematics. We describe one skill called large primes, for mental arithmetic to determine primality of random numbers of arbitrary size. Based on response times and number of correct and incorrect answers, both in the iteration and the primality detection, we quantify a metric for savantness.

We test the Be-Think-Innovate marketing and reflect on whether it is representational of one kind of different ability? Is it also savantness?

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