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ON THE LACK OF RIGOR IN RESEARCH ON SAVANT SYNDROME

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Abstract:
Research on savant syndrome is fascinating. Some otherwise retarded individuals, often autistic people, show extraordinary feats; e.g., music, calculation, and drawing. Unfortunately, many reports on savant syndrome lack rigor, and some were even questioned about their credibility. I pointed out such flaws before (Yamaguchi, 2005; 2007; 2009), thus there is no need to repeat them here.
Pointing out flaws in other researchers' reports is not pleasant at all. Unfortunately, however, without doing it, wrong facts are continuously read and cited by researchers, which is also impermissible. These criticisms should not be interpreted as personal attacks. Their errors should simply be corrected, and their lack of accurate knowledge in a certain filed does not devalue their other lines of works. However, also note that some scientists may say it is unethical to copy others' text without understanding it.

Keywords*: savant, autism.*

Research on savant syndrome is fascinating. Some otherwise retarded individuals, often autistic people, show extraordinary feats; e.g., music, calculation, and drawing. Unfortunately, many reports on savant syndrome lack rigor, and some were even questioned about their credibility. I pointed out such flaws before (Yamaguchi, 2005; 2007; 2009), thus there is no need to repeat them here.

Pointing out flaws in other researchers' reports is not pleasant at all. Unfortunately, however, without doing it, wrong facts are continuously read and cited by researchers, which is also impermissible. Here I must point out several additional things.

Late Beate Hermelin (2001), leading researcher, attempted to explain mathematical facts about prime numbers. Unfortunately, it is extremely inaccurate. According to her, Fermat discovered the "prime number theorem", which shows that every prime number is either in the form $4n+1$ or $4n-1$, and Euler later formally proved it. (The smallest prime number 2 is exception to this rule, so we must say *odd* prime numbers.) She confirmed that this rule holds for 13 and 19, and said "Simple, isn't it?" In fact, it is really far too simple. Even lay readers may feel something is strange. As $4n$ and $4n+2$ are even numbers, odd primes must of course be either $4n+1$ or $4n-1$. Such an easily seen statement cannot be called a theorem, and proving it does not need to wait for a genius like Euler. What she should have meant is *Fermat's theorem on sums of two squares*, which was indeed proved by Euler. The theorem is:

*An odd prime is expressed as the sum of two squares of integers if it is in the form $4n+1$. (And an odd prime is not expressed as such if it is $4n-1$. This fact is far easier to prove and was known from earlier days, so it is sometimes omitted from the theorem).

Her mistake was caused by inaccurate copying of the best-selling popular book, Fermat's Last Theorem by Simon Singh (1997). He stated that prime numbers are either $4n+1$ or $4n-1$, which she copied, and then soon after it (in the same paragraph) he (almost) correctly explained Fermat's theorem on sums of two squares. In sum, she copied a wrong part. Note that as Singh was trained in not mathematics but physics, his descriptions are not entirely accurate. In fact, "the prime number theorem" means a different theorem. Perhaps Singh confused this Fermat's and Dirichlet's theorem, from which it can be derived that there are infinite numbers of both $4n+1$ and $4n-1$ type primes.

Next Hermelin explains Gold Bach's conjecture inaccurately. The correct conjecture is:

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*Every even number larger than 2 can be written as the sum of 2 prime numbers.

Therefore, her stating "larger that 24" is wrong, which is perhaps easily verified; e.g., 8=3+5. The cause of this mistake is unknown. Incidentally, she treats modular arithmetic as if it is the evidence of modularity of the mind. Modular arithmetic has nothing to do with it.

Also troubling is her and her colleagues' methodology (Anderson, O'Connor & Hermelin, 1998; Hermelin & O'Connor, 1990). They compared a savant (Michael) with a single control subject. Comparison with one subject is usually not informative. The control subject seemed to have used trial division, but its details should have been clearly presented. Most people, even with substantial mathematical training, do not know that division is necessary only until $\sqrt{N}$, not $N/2$. This is because number theory is relatively isolated from other mathematical areas and those other areas are more emphasized in higher education. In addition, their presentation of data lacks rigor. Significant digits in the data were inconsistent.

Matthysse and Greenberg (1988) explained basic modular arithmetic, and discussed the Fermat test and Carmichael numbers. (For the concrete method of the Fermat test using spreadsheet, see Yamaguchi, 2009). Carmichael numbers are composite numbers that erroneously pass the Fermat test. They take up 561, the smallest Carmichael number, and state that $2^{560}\equiv1 \bmod 561$, $3^{560}\equiv1 \bmod 561$, $4^{560}\equiv1 \bmod 561$, and so on. This is wrong. Popular mathematical books may simply state that Carmichael numbers always behave as if they were prime numbers in the Fermat test. However, more rigorous mathematical textbooks never fail to mention that Carmichael numbers mimic prime numbers unless the base is not relatively prime to that number. As 561=3*11*17, it is revealed to be composite using base 3 (among many others). Indeed, $3^{560}\equiv375 \bmod 561$. As some influential researchers (e.g., Ramachandran) proposed testing the Fermat test for arithmetical savants, this proviso is not trivial but important. Researchers could have conducted a wrong experiment! Also note that speculations by Sacks (1985) concerning modular arithmetic are irrelevant (see Yamaguchi, 2009).

In retrospect, credibility of Sacks' report could have been doubted much earlier. Compare original reports of the twins (Horwitz, Kestenbaum, Person & Jarvik, 1965; Horwitz, Deming & Winter, 1969) with Sacks'. Although Horwitz et al. reported that the twins had difficulties remembering the dates of Easter; Sacks claimed that they perfectly answered such questions. This alone can be considered as evidence of exaggeration. Also, recently there was another revelation. A purported savant (D.T.), who was often featured in the media, has been researched by famous scientists (e.g., Ramachandran). However, a journalist (Foer, 2011) interviewed him and found inconsistencies in his remarks, and also found new facts, raising doubt whether he is a savant. It is interesting that such an important finding was made by a journalist, not scientists.

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