Why ¥2000 notes are unpopular

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Abstract

The Japanese government issued new ¥2000 yen notes as part of the year 2000 millennial celebrations, but contrary to expectations they are rarely seen in circulation. While there are existing mathematical theories about the best denominations to use to minimize the amount of change given in financial transactions, this problem can also be reexamined as a difference between Eastern and Western cultures and their respective predilection for even and odd numbers, which might explain why the ¥2000 bill has not taken root here.

Keywords: binary numbers, ternary numbers, ¥2000 note, £20 note, even and odd numbers, Yin-Yang, 4 aversion, 13 aversion

1. The heterogeneity of 2

The December 2007 issue of "Mathematics Seminar" featured an article by Toshio Nemoto [1] entitled "The mathematical value of the ¥2000 bill," which discussed how monetary denominations should be set to minimize the number of coins and paper notes used in financial transactions. The article came to the conclusion that a binary system should be used if change is not to be given, while denominations using a ternary numerical system are more appropriate otherwise. The Japanese introduction of ¥2000 notes does have some mathematical value, but the reality is that they are rarely seen in circulation. In this paper, I would like to examine the reason for this situation from a slightly different angle.

Monetary denominations currently in use in Japan include five types of coins (¥1, ¥5, ¥10, ¥50, ¥100, ¥500) and four types of bank notes (¥1000, ¥2000, ¥5000, ¥10,000). Already familiar with handling money in units beginning with a 1 or a 5, the ¥2000 note was Japan's first encounter with a denomination beginning with a 2. This is not to say that this was a first in the history of Japanese money. There was, for example, a ¥20 bill issued in 1917, a ¥200 bill issued in 1927, a ¥20 bill issued in 1931, and a ¥200 bill issued in 1942 [2]. It was, however, the first postwar issuance of a denomination that did not begin with a 1 or a 5.

There have been numerous suggestions why the ¥2000 bill does not see more circulation, such as the fact that they cannot be used in vending machines, or because cash registers do not have a slot for sorting them, but these are not such significant issues today. This makes me think that there must be some other reason.

2. £2 coins and £20 notes

I have written in the past about why the Japanese prefer odd numbers, and Westerners even numbers [3]. In April of 2005 I began a one-year sabbatical at Cambridge, and while I was

there I got the strong impression that British culture has a strong affinity with even numbers, particularly the number 2. Currently there are eight types of British coin, £.01, £.02, £.05, £.10, £.20, £.50, £1, and £2, and four bank notes, £5, £10, £20, and £50. The UK has 3 more types of coin than does Japan, something which confused me no end, but the number of bank notes is the same. I rarely saw £50 notes, and £5 notes were uncommon as well. When I withdrew £300 from an ATM, it gave me ten £20 notes and ten £10 notes. So to make a payment of £100 I would use five £20 notes, and to make a payment of £50 I would use two £20 notes and one £10 note. While the UK issues currencies beginning with 1, 2, and 5, those beginning with 5 were rarely used. Denominations beginning with 1 and 2 were more common, 2 in particular. The highest denomination in common use was £20 for banknotes, and £2 for coins. The fee for using a public restroom was 20 pence. Perhaps all of this was largely coincidence, but it certainly felt like the British place a high value on 2.

I frequently went to London when I had some time off. As of February 2008, a round-trip ticket from Cambridge to London was £18, and a one-way ticket was £17.90. When I first saw those prices I thought they must surely be an error—only 10 pence difference between a round-trip and a one-way ticket?—but such are the ways of British Rail. In Japan, the price of a round-trip ticket is approximately double that of a one-way ticket, with perhaps a 10% discount. The British, however, seem to assume that after going somewhere you will return the same way, making one-way fares something of a quaint notion. I noticed something similar in hotels and guest houses, which seemed to assume traveling in pairs. This meant that traveling alone would incur lodging expenses the same as when going with a friend. Not that I often saw many solo travelers, nor groups of three for that matter—I most often encountered pairs, or pairs of pairs. It is interesting that the Japanese equivalent of the English expression "two heads are better than one" is instead "three together have the wisdom of the Buddha," another example of Western and Japanese differences in the value of even versus odd numbers.

While traveling, I often stayed in furnished apartments. Cleaning up after a meal one day, I noticed that the place came with four plates, four cups, and four knives and forks. My first impression was that one set must be missing, or perhaps had been broken, since in Japan five of each item is taken for granted as a complete set. I later learned that this was normal, and that in this "even-centric" country sets of tableware, too, come in even numbers. Shopping in supermarkets, I frequently saw the phrase "buy one, get one free," which seemed like another effort to round things up to an even value. People in Japan often make offerings of fruit at shrines, normally either 1 or 3 items. I wondered if the British might not be inclined to leave 2 items instead, but a scarcity of shrines precluded observation.

The British seem to have an aversion to odd numbers in equal proportion to their proclivity for even numbers. The very word "odd" attests to that in phrases such as "odd sock" and "odd hand," the implication being that a thing without its matching pair is not normal. Other phrases such as "odd things" and "odd jobs" also seem somewhat dismissive of the word. It almost feels as if the even 2 represents completeness, and the odd 1 is somehow insufficient. This is further supported by the words used to express "even numbers" and "odd numbers" in other European languages. In Spanish, for example, we have *número par* for even numbers, and *número impal* for odd. In French, *nombre pair* and *nombre impair*. Italian uses *número pari* and

número dispari, and German *gerade Zahl* and *ungerade Zahl.* In each case, the phrase used to describe odd numbers is a negation of the even. Even in English, odd numbers were at one point referred to as "uneven" numbers. In each case, even numbers are presented as the "correct" kind of number, and odd numbers as some kind of lesser state.

3. Odd culture and even culture

In Japan, it is common to give cash gifts to a couple upon their marriage. I did a bit of research on the Internet to find out what is considered an appropriate amount. The results indicated that ¥20,000 or ¥30,000 is appropriate for friends and coworkers, ¥30,000 or ¥50,000 for bosses or other higher-ups, and ¥50,000 or ¥100,000 for relatives, depending on how close they are. The interesting fact is that amounts beginning with an even number, 4 in particular, are avoided as being inauspicious. The one exception to this rule is the ¥20,000 gift, which is perhaps allowed because it is not excessively high, as well as the "2" being conveniently representative of the bride and groom for whom the gift is intended, if one is to look for some justification. In that case, however, the recommendation is to "odd things out" by presenting one ¥10,000 bill and two ¥5000 bills.

Suggested cash offerings to the bereaved at funereal rites, too, are clustered around ¥3000, ¥5000, and ¥10,000 in the case of coworkers. ¥5000 seems to be a particularly safe bet. Gifts of ¥4000 and ¥9000 are particularly avoided, due to superstitious beliefs surrounding the numbers 4 (which can be pronounced as a homophone for the word "death") and 9 (similarly, "suffering"). Cross-cultural comparison is difficult in this case, as the British generally do not give cash gifts at such ceremonial occasions, but I cannot help but suspect that if they did even-valued amounts would be the norm.

The use of odd numbers appears in other aspects of Japanese society as well. A ¥5 coin is often used as a symbol of positive relations. Children visit shrines at ages 3, 5, and 7 to celebrate their continued growth. There are national holidays on the double-odd calendar dates January 1, March 3, May 5, July 7, and September 9. The length of lines in *haiku* poems are 5-7-5 syllables, and in *tanka* poems they are 5-7-5-7-7. The Japanese adaptation of classical Chinese poetry uses a base-5 or base-7 total meter, and even Japanese cheerleading squads chant in a 3-3-7 beat. Conversely, in part due to unfortunate associations with other Japanese
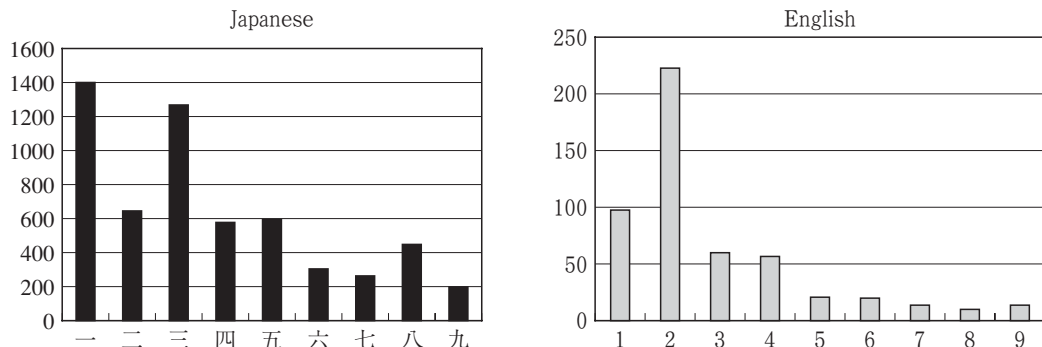

Figure 1. A comparison of word counts for words beginning with numbers 1-9.

words, 2 can signify separation, 4 death, and 6 a ne're-do-well, making these numbers to avoid. (There are exceptions to this pattern—the form of the character used for 8 gives an association with ever-increasing success, while as mentioned above, 9 has an association with suffering.)

I used the digital editions of Sanseido's *Daijirin* dictionary (2nd edition) and Kenkyusha's *New College English-Japanese Dictionary* (6th edition) to compare the number of words beginning with each number 1-9. Figure 1 shows the results. While the selection set was a good bit smaller for English words, there is a definite clustering of words beginning with 1 and 3 in Japanese, and those beginning with 2 in English.

4. Yin-Yang versus Pythagoras

So what is it about odd numbers that makes them so attractive to the Japanese? To discuss that, we have touch on the concept of Yin-Yang and the I Ching of ancient China, specifically, the Zhou Dynasty of the 12th through 3rd centuries B.C.E.

The central concept of I Ching is that of Yin and Yang. It assigns to the even and odd numbers features of fluidity versus solidity and resistance versus compliance. Yin is associated with obedience, and Yang with fortitude. Yin is stillness while Yang is motion. Everything in both the natural and human worlds can be separated into these two aspects. To Yin belongs the earth, the moon, motherhood, femininity, justice, that which is below, that which is behind, darkness, arrivals, night, vulgarity, wealth, and misfortune. To Yang belongs the heavens, the sun, fatherhood, masculinity, virtue, that which is above, that which is before, brightness, departures, noon, respect, nobility, and luck.

Yin-Yang divides up the numbers, too, assigning them to the Heavens (Yang) or Earth (Yin). "To the Heavens 1, to the Earth 2. To the Heavens 3, to the Earth 4. To the Heavens 5, to the Earth 6. To the Heavens 7, to the Earth 8. To the Heavens 9, to the Earth 10. Five days to the Heavens, five days to the Earth." (It would be many years before the 0 was developed in India, so Yin-Yang does not include that number.) Yin-Yang is considered a concept of opposing forces, not one of superiority and inferiority, but it is difficult not to associate Yin with evil and the inferior and Yang with good and the superior, an association that lives on in superstitions seen even in the modern age.

The Zhou Dynasty was contemporary to ancient Greece, where the Pythagoreans first classified the numbers as even or odd in the 4th or 5th century B.C.E. Pythagoras associated all things with numbers, and tried to describe them as such. Odd numbers cannot be split into equal portions, and because that which cannot be divided is therefore complete, the odd numbers were associated with divinity, the finite, and the orderly. Since the even numbers will split into two, they were assigned opposing characteristics. Aristotle, however, had different ideas. Chapter 5 of the first volume of his Metaphysics lists 10 opposing principles: the limited and the unlimited, odd and even, one and plurality, right and left, male and female, resting and moving, straight and curved, light and darkness, good and bad, square and oblong. Here it seems that a material difference is being drawn between the good, which go into the first column, and the bad, which go into the second. Note which column the odd numbers went into.

The mathematics of ancient Greece faded into that of Arabia and India. Arabic mathematics made its way into Italy during the area of the Crusades, and spread throughout Europe to

develop into the foundations of modern mathematics. What we study today is a celebration of the rational and the scientific, as represented by Newton, so any associations of parity with good and evil no longer carry any sort of conceptual or philosophical meaning. Yet when counting, odd numbers remain somehow incomplete, and even numbers the more rational.

5. Aversion to 13 versus aversion to 4

In Japan, as in much of the rest of Asia, there is a tendency to avoid the number 4. A similar tendency exists in the West for the number 13, which is superstitiously seen as an unlucky number. Many ancient calendar systems used 60 as a base, for which 12 is a convenient factor for splitting up into hours or months or points on a dial. The prime 13 on the other hand is divisible by nothing, making it something of a troublemaker. There are furthermore Biblical considerations to contend with, in that Judas, sitting in the 13th seat at the Last Supper, was the betrayer of Christ. This has led to Friday the 13th being a particularly inauspicious day in Christendom, despite one coming at least once a year without significant ill effects.

I did some more reading about the number 13 on Wikipedia. There, I learned that many buildings do not have a 13th floor, the floor above 12 being labeled "12B," "12.5," or skipping the issue altogether by going straight to 14. Apartments and airline seats also avoid the number 13, and there are no Gate 13s in airports. While 13 is a taboo number in the West, things are quite the opposite in Asia. While Buddhist temple pagodas most commonly have 3 or 5 levels, there are also those with 13. Figure 2 shows one example, the Tanzan Shrine in Nara. Memorial services for deceased relatives are held on the 3rd, 7th, 13th, and the 17th anniversaries of their death (all odd numbers!).

Figure 3 shows the number of live births in Japan from 1947 to 2005, according to Japanese census data. It is difficult to miss the aberration that is 1966. That year showed a remarkable decline in the number of births, with a less remarkable but nonetheless significant uptick in the preceding and following years. This occurred because 1966 was an inauspicious year to be born in, of a type that comes about once every 60 years. I imagine that Westerners would find this

Figure 2. The 13-tiered
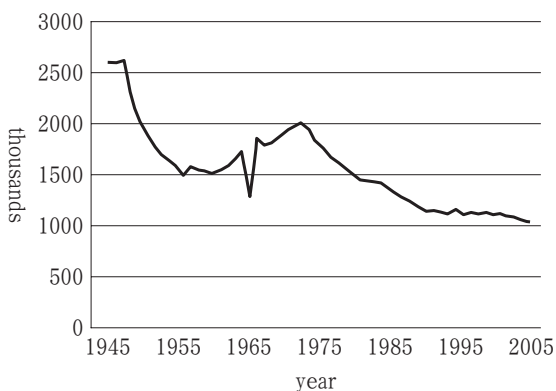pagoda of Tanzan Shrine
(photo courtesy of Wikipedia)

Figure 3. Japanese birthrate trends (1966 is an "unlucky" year).

just as incomprehensible as the Japanese find aversion to Friday the 13th. One would like to think that we live in a modern age where science has triumphed over superstition, but it looks like we are not quite there yet.

While I have strayed somewhat from my original topic, I hope that I have shown that there is indeed such thing as "even culture" and "odd culture." While the ¥2000 banknote has a definite mathematical value, it appears that it will be some time before it is fully accepted by the Japanese.

References
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