

Numbers with Personality

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Abstract

Numbers are not simply dry and abstract symbols for arithmetic quantities. Human minds also endow them with rich and complicated personalities. Such personalities may be created and used consistently at a broad cultural level, like the Mayan portrait glyphs used for the numbers 1 through 20. Or they can be found at a highly idiosyncratic level in the form of synaesthesia known as Ordinal Linguistic Personification. Imagining personalities for numbers involves cognitive systems that are linguistic as well as mathematical. Our brains create a space where personal associations and broader social experience can mingle. The paper concludes with three of the author's poems in which numbers take on personalities that reflect contemporary urban experience.

An Aged Face

For a Mayan scribe, circa 800 CE, 'five' wore the square face of an aging man with deep lines around nose and mouth and a pod-shaped pillow like a striped hat on top of his head. 'One' however, was the face of a young woman with a fashionably sloped-back forehead, a lock of hair curled down her cheek, and an oval (or lobed object) springing from her forehead. "Nine" was a young man's profile with a patch of jaguar skin on the cheek, while ten was a skull with a bare jawbone and a fleshless, indented nose [13].

These are so-called 'head variants' devised by Maya of the Classic Period (250-900 CE) to symbolize the first 20 digits. They appear in inscriptions on carved stone panels and lintels from the historic realm of the Maya, throughout the Yucatan Peninsula and up into the highlands of Guatemala, and also in the Dresden Codex, one of the few documents that have survived from that time. The head-variant glyphs were used in very specific situations and never as stand-alone numbers; instead they served to introduce a series of glyphs that spelled out a date in the complex Mayan Long-Count calendar [4].

In many ways, the head-variant portraits were a spectacularly unnecessary tool for writing numbers. The Maya had a perfectly serviceable system of numeration, using a combination of bars (to indicate groups of five) and dots (up to four), plus a separate sign for zero. The system is relatively easy to comprehend, unlimited, useful for calculation—which the head variants don't allow—and open to highly decorative treatment.

The origin of the head-variants is unknown. They were not used nearly as frequently as bar-and-dot numerals, and seem to have been developed at a later date [16]. They may have been invented by speakers of one of the Eastern Mayan languages [13]; they may have roots in the lunar cycle [13]; and they were either associated with various gods from the beginning or became thought of as representations of gods as time went by. In the post-Classic period, after the great cities of the Classic inscriptions were abandoned, the Maya peoples continued to use their bar-and-dot system of numbers but the head variants fell into disuse.

They do have a connection, as other glyphs in the Mayan system of writing do, with the spoken sound of the numbers. The Mayan script was logosyllabic; it included a set of signs to represent syllables

in the spoken language plus many other logograms that were essentially pictures of the concept being expressed [4]. The portrait for “nine,” for instance, links the sound of the Mayan word for nine to a similar-sounding word meaning “jaguar” [13]. However, though the words are similar enough that “jaguar” could have been useful as a mnemonic, the head variant for nine is much more complex and even ambiguous than would have been needed for recording purposes, especially when a bar and four dots would have encapsulated the concept nicely.

Numbers were exceptionally significant to the Maya, especially for the recording of dates in their complex Long Count—dates that often took up more space on the stelae than the recording of events themselves. That these dates were led off by a “number god” surely indicates that the numbers themselves had a significant dimension beyond the value of the digit itself. As Stephen Chrisomalis concludes, “We had best think of [the head variant glyphs] as a complex set of metaphors by which the numerical symbolism of deities was used as a code for numerical information, not as a numerical notation system in its own right” [3].

Social Numbers

For A.P., the number five is female, a motherly figure who is “funny by accident.” “One” on the other hand is a responsible father who is nice but a bit tired [18]. A.P. is an example of someone with Ordinal Linguistic Personification (OLP), which is the automatic, involuntary tendency in certain individuals to attribute personal characteristics to units in ordinal sequences like numbers, months or the days of a week. Cases of OLP have been documented since the 1890s. For Mme. L, described by Théodore Flournoy, five was “a young man, ordinary and common in his tastes and appearance, but extravagant and self-centered” [6].

Unlike the consistent representations on Mayan head-variant glyphs, the personalities ascribed to numbers by people with OLP are wildly idiosyncratic, though they do reflect the culture in which people live. (Older studies, for instance, mention roles like “society girl” which would not show up in contemporary ones [19].) However, for individuals who experience genuine OLP, the associations they make with numbers have been part of their thought processes for as long as they remember. The connections are consistent over years. They are also so automatic that they affect cognitive processing – for example, an individual for whom “five” has a feminine gender will be slower at certain tasks where that number is paired with a masculine name [10].

Brain scans indicate that OLP has a neurological basis; individuals have extra connections with the brain areas implicated in social relationships. Another area involved is the angular gyrus (lying close to the border between the temporal and parietal lobes), which is at least partly responsible for understanding metaphors, and also involved in processing ordinal sequences [20].

OLP is a subset of the overall condition called synaesthesia, in which individuals make deeply automatic, stable connections between different kinds of mental experience. Many different synesthetic pairings have been documented—sound with colour, taste with shape, touch with smell, and so on. One of the most common forms is colour-grapheme synaesthesia, in which people experience a number or letter as having a specific colour. (Physicist Richard Feynman saw equations with the letters in colour. He described “light tan *js*, slightly violet-bluish *ns*, and dark brown *x*’s flying around,” adding, “And I wonder what the hell it must look like to the students” [5].)

While an individual’s experience of synaesthesia is idiosyncratic and personal, the associations are not random; they seem to follow unconscious rules that reflect underlying principles of cortical organization, and—in particular—the cognitive processes that aid in human language comprehension and production [19]. Often, such rules have to be deduced from statistical analysis of the pairings made by

many different synesthetes. For instance, the brain is highly sensitive to the frequency with which a stimulus occurs; we have a remarkably fine-tuned but generally unconscious sense of the statistics of our native language, specifically the frequency with which sounds and words occur. This appears to affect typical colour choice among synesthetes. Letters that occur more commonly, (such as “a”) tend to be paired with more vivid or commonly used colours (such as red). Less-frequently encountered letters (“v”) tend to be paired with less frequent or less definite colours like brown or purple [15].

Synesthesia has been studied since the 1890s, but has been of ever-greater interest in the past two decades as it becomes apparent that synesthetic research can inform questions about how the brain combines information from different sensory modalities.

General Number Associations

While synesthesia affects only about 4 per cent of the population, and OLP is a very small subset of that number (approximately one in 73 people)[21], less vivid cross-modal linkages are a surprisingly common occurrence in “ordinary” human experience—and numerals feature often in such connections.

For instance, people in the general population readily associate numbers with qualities and emotions. In one informal on-line survey, respondents were asked for their favourite number, and to explain their choices. More than 30,000 responses came in, and the descriptive words that clustered around individual digits read almost like the description by an OLP synesthete. “Eight”, for instance attracted words like “soft, feminine, kind, sensible, fat, solid, sensual, huggable, capable.” “Nine” was described with a list of words including “quiet, unobtrusive, deadly, genderless, professional” [2].

In other, more rigorous, studies, participants were asked to rate numbers on three scales: good/bad, heavy/light and excitable/calm. Once again, responses were remarkably coherent and show pronounced patterns. Odd numbers tend to be considered ‘excitable’ while even ones are calm. Numbers ending in 3, 7 and 9 tended to be considered ‘least good.’ In general, the odd/even dichotomy seems to be particularly broad-based, and prime numbers seem to be particularly marked with emotional significance: when prime numbers are identified on a chart of numbers from 1-100, it’s clear that they are broadly considered “less likeable” and “less good” and “more excitable” than other digits [2].

Personal interpretations made by individual brains are enmeshed with broader cultural patterns. Virtually every culture assigns significance to digits, and the significance often lies in associations with fortune (good or bad) or—as with the Mayan head-variant glyphs—with sacred/religious concepts. Numbers considered lucky/unlucky or sacred are widespread. As only a few examples:

- “Thirteen” is so widely considered unlucky in North America that office towers frequently leave out the 13th floor.
- “Four” is considered equally unlucky in China and Korea.
- “Eight” is associated with good fortune in China, to the extent that mobile phone customers will pay large sums for a phone number that includes several 8s [12].
- In Jewish tradition, donations are often made in multiples of 18. (An ancient notational system used letters of the Hebrew alphabet as numerals, and the letters for 18 spell “life.”)

Such assignment of character and significance—and even social relations slightly reminiscent of OLP—to numbers is a very old tradition, going back at least to the days of Pythagoras. For Pythagoras and his followers, every number carried a symbolic identity; two and three stood for the male and female characters, respectively, and five for their union [14].

The Linguistic Loop

Why might numbers be particularly suited to elaborations such as the Mayan head-variants and OLP that go far beyond their mathematical function? Perhaps the main reason is that numbers are not just symbols of quantity; they are words, and *as* words they are massively connected in our brains to systems of perception and emotion, judgment and social relations. Language is inherently cross-modal.

Early systems for counting/recording did not need to use words. They could be primarily visual. Notching objects as a way of keeping track has been used by humans from Paleolithic times and even into the nineteenth century, and many cultures that have survived into modern times (from the Solomon Islands to the Zuni of the south-western U.S) have used a system of counting finger joints or body points and numbers are named for those parts [11].

However, in most modern societies, the words for numerals constitute a separate class of linguistic items. While notches on a stick are almost purely *visual* representations of a quantity, number words are immediately available to us as *sounds*. The cross-modal links between vision and hearing enable a more complex response to the concepts they represent. As noted above, the Mayan head-variant glyphs are graphic representation of sounds as well as pictures; they do not function as phonetic glyphs in the way that letters of the alphabet do, but “as visual metaphors for the sounds of the numbers” [13].

In China, the good luck/bad luck associations with numbers are also linked to their sounds. Chinese number words tend to be homophones of other words and the associated emotions are carried over. In Cantonese, for instance, “eight” sounds like the word for “fortune”; “six” sounds like the word for “flow” and connotes “everything flows smoothly.” In the Korean and Chinese languages, the unlucky quality of “four” is connected to the fact that it sounds like the word for “death” [12].

Language is not the exclusive province of certain structures in the left hemisphere, as had been thought in the earlier days of brain research. Words are widely connected throughout the cortex and bring with them other far-reaching conceptual resonances, thereby becoming the basis for metaphor. This capacity for symbolic linkage has been evident from the early days of mathematics. As far back as the 3rd century CE, the poetic mnemonic system of *bhuta-samkhya* helped people remember numbers by giving them metaphorical names. Zero was called by names like *shunya* (void, emptiness) or *ambara akasa* (heavenly space or sky). “One” became *candra* (moon), *bhumi* (earth) or other one-of-a-kind things. “Two” became paired things like *netra* (eyes) or *paksa* (wings of a bird) [11].

Why, however, should numerals be particularly suitable for the kind of elaborate personification found in the Mayan number glyphs, OLP or more common forms of cross-modal connection? I suggest a couple of possibilities: that as words, numbers constitute a particular grammatical category; and as words that activate specific, relatively localized areas of the cortex, they also make long-range linkages in the brain.

The study of how number words are formed and used in different languages is an extensive field of linguistics. In most, if not all, of the world’s languages, the words and expressions used to represent number concepts form their own grammatical class, a class with unique distributional properties [8]. We begin to acquire those words and learn how to use them at around the same time we are learning to use determiners (such as “my,” “this,” “which”) and pronouns.

In ordinary English usage, a number word like “five” floats between noun and adjective. (“I got a five on the test” vs. “He is five years old.”) It can also float between the categories of common noun and proper noun/name: “Five is my favourite number” has the same structure as “Bob is my favourite friend.”

We wouldn't say, "Fives are my favourite number," or "A five is my favourite number." This capacity for acting as a name would likely make a process like personification more natural.

Mathematics encompasses multiple cognitive domains and only some of them depend on language [1]. Structures that underlie our abilities for mathematical reasoning and calculation are located in very specific areas of the brain, particularly in the intraparietal and prefrontal areas [7], though specific faculties are scattered throughout the cortex. For example we recognize the shape of numerals using a small area—the visual number form area—found on both hemispheres on the underside of the temporal lobe [17].

However, it seems that we start learning mathematical skill using a more general semantic scaffolding, along with certain non-linguistic abilities to assess small numbers and compare overall numerosity between larger collections that we share broadly with other animals. These abilities seem to link with general capacities for understanding spatial relationships or collections of items. Only as we become more expert in mathematical activities, do we shift away from using language areas in the frontal cortex to the parietal areas [17].

Nevertheless, the semantic linkages of number words persist throughout life. This can be seen by exploring the interactive brain atlas published online by the Gallant Lab at UC Berkeley, based on neuroimaging studies of subjects listening to narratives [9]. Number is one of the significant semantic categories evaluated in the study. Words like "ten" stimulate activity in a specific area in the right hemisphere's pre-central sulcus. However, they also stimulate activity in other regions elsewhere in the brain – for instance, in an area that is activated by words related to clothing and size ("shirts," "stockings," "stout") and in another area that is activated by time-related words like "year," "weekend," "rent." Moving around the interactive site is like watching metaphor in action.

Creative Conclusions

As synaesthesia research indicates, numbers can be "wired" cross-modally at the most basic levels of perception, as in the grapheme-colour form in which 5 is seen as literally blue. In this case, the synaesthesia maps from one visual element—shape—to a second one, colour [22]. Ordinal Linguistic Personification demonstrates that numbers can also be wired at higher levels of cognition, involving social relationships, narrative, cultural memory. Numbers are specific, local and (for a mathematician) used in clearly defined ways. However, they also possess potential huge and diffuse connections. They can ramify into metaphor, characters, story—in other words, they acquire personalities.

I suggest this occurs because numbers inhabit a creatively stimulating space between simplicity and complexity, between language and mathematics. Creativity is the ability to make remote connections in the brain—in effect, the ability to make cross-modal connections that can resonate with other people. And this cross-modality is at the base of much of the art brought to the annual Bridges conferences. True, some of the artworks hanging in the exhibits are focused almost entirely on the great pleasure of working out visual patterns inherent in mathematical structures. But a glance at the exhibit catalogue for any year demonstrates broad connections with symbols, cultural associations, auditory and textual patterns, and to other disciplines such as biology.

Certainly my own art form, poetry, is cross-modal. A poem calls on visual perception: the look of the poem on the page, the way that line breaks work to shape meaning. But more of the connections involve sound, concepts, memory. It is a great pleasure to me that numbers can stimulate so much. I conclude this paper with three poems from my series of modern "number gods", inspired by the Maya concept, but as we might personify numbers according to our experience of them in modern city life.

Four

Four is the god of corners, stocky and oblong
as a bible. He is worshipped at the intersection
of streets, where his acolytes square off
against the devil. "Repent," a man shouts

in a hoarse voice to the pedestrians, and
"Four beasts guard the throne." Beside him,
a girl bundled in a thick skirt, hair bound
in a black kerchief, stares down, transfixed

by invisible commandments chiseled
on the sidewalk slab, nailed there by the cross
words he flings at passers-by. He wears
a coat like a gruff grey box and a dark fedora.

They wear the same clothes any time of year,
as though seasons in this frigid city were identical
corners on a carton, as though the year jolted round
like frozen tires, with no easy transitions.

Seven

Statues of the beast-faced god
of smoke breaks stand in alleys
where delivery vans exhaust their fumes
below office towers, puffing out stars
of frozen breath. Life-size figures
carved in stiff grey wood hold bowls
for offerings of ash. His devotees

serve their penitential sacrament
seven times each working day.
First thing every morning, lunch,
coffee breaks, quick dashes out between
meetings, last thing in the day, when sky
is already darkening like a lung
and the seven-starred Great Bear

is scooping up white smoke from frigid air.
His cult is most devoted here,
in these septentrional domains,
where it is hardest to observe his ritual.
Though he is idolized no longer
by the ruling classes, his cult remains
a place of respite for their working help.

“Septentrional” means “of the north,” and derives from the Latin “septem triōnēs,” referring to the seven stars of the Great Bear.

Eight

Eight is the goddess of stop signs.
Her red, stern, octagonal face
is mounted on pillars, prevalent
especially in school zones where
her white teeth snarl caution. Parents
and guidance counsellors appeal
to her commands, train children
to respect her, hand out placards

in her image to favoured youth
who carry them, triumphal palms,
along the sidewalk and make those
less privileged wait to cross the street.
The goddess Eight approves the chaste,
the drug-free, safe and virginal –
those who know where her heavy lines
are painted. But the young grow fast

and careless of her strictures. Her voice
is drowned in the high-octane rev
of their own motors and the wheeled
screech of freedom, to which they yield
their fierce allegiance. Confronted
by Eight's glare, they skid to a scant
acknowledgment of her, then put
the pedal to the floor and peel away.

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