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THE VISUAL REPRESENTATION OF TIME

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In the development and shape of time representations, it is not meaning or form which are dominant, but these things under the direction of pragmatics, usage and exercise of power.

Systems and technologies

Several important systems have repeatedly helped to shape the process of time representation, including celestial mechanics, mathematical systems, the growth of technical and mechanical competence and literacy, and above all the order imposed on our conceptions of time by linguistic systems.

Technologies that require little or no human intervention and that run continuously are preferred for representing continuous time. In the early stages of timekeeping, circular sundials required the least intervention and ran more continuously than any other device. The invention of the mechanical clock directly led to the discovery of the average length of a solar day, which allowed us to standardize upon equal hours. This created a simplified time interface and allowed for the standardization of time around the world.

The development of Hindu-Arabic numbers, the place value system, zero, and the decimal point led scientists to the discovery of the true length of a solar year, which meant that some calendars around the world (e.g. the Gregorian calendar) could stay aligned with the seasons, and we could design calendars that could be used in any year without planning their readjustment. It was not until after the invention of the printing press that easy to read and use calendars were mass-produced each year. Now, recent developments in digital technology have meant that we can design and view calendars in any form that we like, cut and paste information between days, and quickly and conveniently share our personal calendars with people around the world.

Advancements in timekeeping technology have led to advancements in science and have contributed to the representation of units of time from the smallest (Planck time) to the very large. Improvements in telescopes allow us to witness astronomical events that occurred light-years in the past, and improvements in high-speed cameras allow us to capture molecular changes as they are happening.

One of the ways in which designers choose to make aesthetically pleasing visual representations of time is through the use of symmetry. Circular representations are inherently symmetrical but other representations are made symmetrical through the sizing and placement of objects (e.g. letters, pictures) in equal amounts of space. They are also made symmetrical by turning objects in particular directions (e.g. one glyph on the Aztec calendar stone is turned to face inwards towards the centre glyph; prior to the standardization of clocks the hours of daylight and darkness were sometimes placed symmetrically around the dial rather than in one particular format).

Another tool for creating aesthetically pleasing (and for some people, more readable) visual representations of time is redundancy. Although words or numbers should, in many cases, be enough to convey the required information, graphic elements often provide a redundancy in design. As examples, the arrangement of stages in a process in a circle instantly conveys the notion that the process is recurring; changes in the thickness in a timeline across a map instantly indicates that whatever is moving across the map is also changing in some other dimension.

Representations and devices

Representations of time sometimes reflect time itself in a primary way, directly, as in a clock face, a timer, or a calendar; while in other cases the iconography of time is

secondary to other variables such as in an industrial process, a genealogical tree, or an evolutionary history.

To be truly useful, the model of time has been developed to contain specific pointers and to describe the many different ways in which people perceive time to happen: linear, cyclical, spiralling, branching, and so on. These pointers in time are analogous to pointers in space such as the closest hill or the nearest town, and developed according to the cognitive and social factors of people living within specific natural environments.

For devices that measured time directly, the pointers appeared first in calendars and were based upon natural events, such as a full moon or regular social events, such as markets. Unique pointers for each day developed within cognitively-manageable bounds so that people needed only to memorise small sequences such as 7-day weeks or 12-"moon" years. The development of clock time was also based upon helpful visible phenomena (the alternation of darkness and sunlight) and the limits of human memory. From these factors, our time-keeping system of two sets of 12 hours developed.

With the development of writing came its application to calendars and timekeeping and the beginnings of visual representations of time. Among other things, writing provided a tool for easing memory, communicating information, and planning. Its application to calendars meant that people no longer had to look to natural and social phenomena for time-related information but to a tool, which made timekeeping easier and more accessible to individuals.

Writing eventually allowed all of the days to have their own visual labels, to be grouped visually according to the same structure in which they were grouped linguistically, to be visually presented in order of occurrence, to visually show how days recurred, and to visually show which days acted as key reference points throughout the calendar. Writing also brought about the development of written numbers, which made it much easier to label the days and sum them up. The direction of a culture's writing system has an impact on the visual design of all matrix or linear style calendars.

With writing, it also became possible to make longer counts of years. The reference points for these counts were based on socially-agreed upon dates of important events and in some cultures were restarted regularly (e.g. with the establishment of a new leader) and in others established retrospectively.

Of all visual representations of time, the most standardised design is the face of the analogue clock, which arose and became a standard because it provided an easy to remember solution that was analogous to our cognitive model of time and, at the time of its design, our physical view of time (the sun moving through the heavens). Perhaps its greatest strength is the continuity it provides across its zero point.

Although the divisions of time in the Gregorian calendar are standard around the world, the visual representation of the calendar is not standard. There are various representations designed for different planning purposes and preferences among individuals, different representations for business users (e.g. these calendars often show the week beginning on Monday), different representations depending upon the needs for portability or private or public usage, and different representations for particular cultures.

The shapes of various visual representations of time are determined by how well the shape matches our mental model of the type of time we wish to represent, the technology used to measure and represent the time, and the practicalities of fitting the information onto a particular surface:

- a circular design emphasizes continuity;
- linear representations are best for representing linear (uni-directional) time, and for representations that contain many events that require descriptions;
- tree-like diagrams including family and evolutionary trees are particular types of linear representations, based upon generations showing multiple paths of time from earlier to later;
- spirals are used most often for long periods of time (e.g. geological time, evolutionary time;
- the matrix is typically used for calendars and timetables;
- layers are often seen in maps and process diagrams; and
- storyboards are now commonly used to represent how things work in time.

The events, needs, constraints and affordances that lie behind all the various devices and displays developed for the representation of time have a rich and varied texture. There is no one simple monolithic structure or conception to be discovered like the periodic table or Ohm's law, rather a range of complexities which designers can make use of in an equally rich array of presentations.