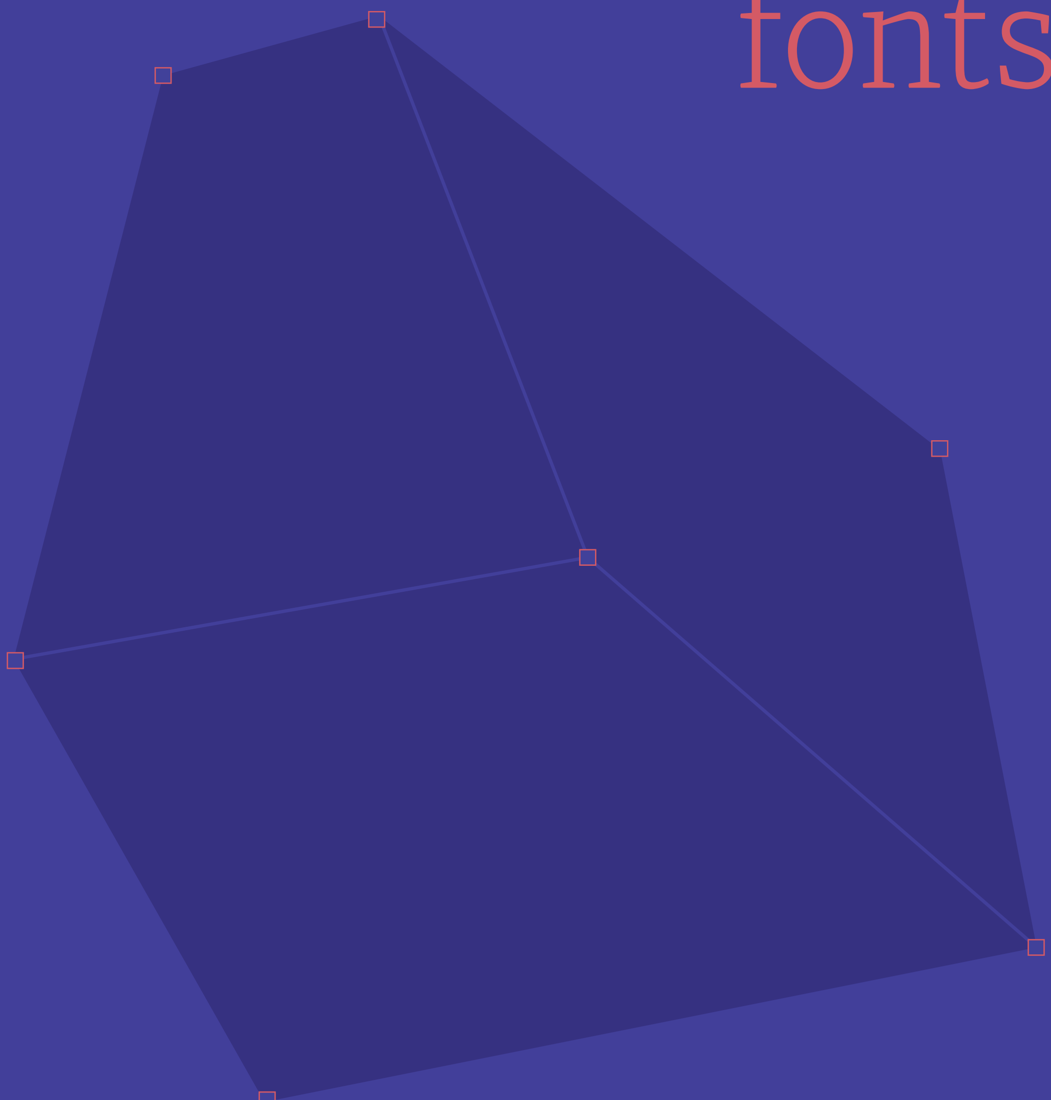
The evolution of variable fonts



A NEW PARADIGM FOR TYPE FOUNDRIES

The Evolution of Variable Fonts: A New Paradigm for Type Foundries

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The Evolution of Variable Fonts: A New Paradigm for Type Foundries

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And no one knows the where's or why's
But something stirs and something tries
And starts to climb toward the light

Pink Floyd, Echoes (1971)

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Abstract

ENGLISH

Typographic practice is shaped by a continuous dynamic of transitions, changes, advances—and, at times, also historical revisitations—that reconfigure its expression. As technological systems evolve, typography seeks to adjust to the realities of the moment, keeping pace with the demands of the different media through which it is presented. Today, in a landscape where screens are omnipresent, text has come to reflect this condition, requiring greater speed and flexibility. Variable fonts respond to this need, emerging as one of the most significant developments in the history of typography, with a direct impact on how we read, perceive, and interact with written content. They thus manifest themselves as an extension of historical continuity, where solutions long sought for centuries converge.

Within this context, the aim of this thesis is to analyse the current level of adoption and integration of variable fonts, taking into account that a decade has passed since their introduction in 2016. To address this question, the fundamental aspects of the format's evolution are examined, including its origins, the challenges it was designed to overcome, its technical characteristics, and its use in practice. The dissertation also explores the ways in which variable fonts are materialised through type foundries—the central agents throughout the entire process—by examining how they present, promote, and license the format. Type foundries therefore act as mediating entities, establishing the connection between the production of variable fonts and designers.

ITALIANO

La pratica tipografica è modellata da una dinamica continua di transizioni, cambiamenti, progressi —e, talvolta, anche di rivisitazioni storiche—che ne riconfigurano l'espressione. Con l'evoluzione dei sistemi tecnologici, la tipografia cerca di adattarsi alle realtà del momento, mantenendo il passo con le esigenze dei diversi supporti attraverso i quali viene presentata. Oggi, in un panorama in cui gli schermi sono onnipresenti, il testo ha finito per riflettere questa stessa condizione, richiedendo sempre maggiore rapidità e flessibilità. I variable fonts rispondono a questa esigenza, emergendo come uno degli sviluppi più significativi nella storia della tipografia, con un impatto diretto sul modo in cui leggiamo, comprendiamo e interagiamo con il contenuto scritto. Si manifestano così come un'estensione della continuità storica stessa, nella quale convergono soluzioni ricercate da molti secoli.

In questo contesto, l'oggetto di interesse di questa tesi consiste nell'analizzare l'attuale livello di adozione e integrazione dei variable fonts, considerando che è trascorso un decennio dalla loro introduzione nel 2016. Per affrontare questa questione, vengono esaminati gli aspetti fondamentali dell'evoluzione del formato, tra cui le sue origini, le sfide superate, le caratteristiche tecniche e il suo funzionamento pratico. Questa tesi esplora inoltre i modi in cui i variable fonts vengono materializzati nelle fonderie tipografiche—attori centrali dell'intero processo—attraverso l'analisi di come queste presentano, promuovono e concedono in licenza il formato. Le fonderie tipografiche agiscono quindi come entità mediatrici che stabiliscono il collegamento tra la produzione dei variable fonts e il designer.

Keywords

ENGLISH

variable fonts;
typography;
flexibility;
type foundries

ITALIANO

variable fonts;
tipografia;
flessibilità;
fonderie tipografiche

Introduction

Letters carry an inherent, latent plasticity. They are entities with personalities of their own, whose forms—and the ways they are manifested—continuously transform over time.

Because today's media landscape is volatile, responsive, and omnipresent, it demands a level of formal elasticity previously unseen, forcing letterforms to constantly reinvent their modes of expression.

Consequently, the rigid solidity that characterised previous centuries has given way to a living system, and this is precisely where variable fonts enter the frame. Although relatively recent, the format carries a rich historical lineage encoded into its structure, reviving concepts from the past while completely renewing modern ones. As a result, variable fonts turn typography into an even more elastic, metamorphosing system.

This study examines how variable fonts emerged, their historical precursors, and which problems they were designed to solve —from metal type to photographic processes, and subsequently to pixels and mathematical models. Beyond technical mechanics, this analysis assesses the contemporary contribution of variable fonts to digital typography, as well as the strategies employed by digital type foundries to promote the format. In order to provide a structured framework, the following research questions were established:

RQ1	How did variable fonts emerge, and which limitations of static fonts were they intended to overcome?
RQ2	What strategies are digital type foundries using to experiment with and promote variable fonts?
RQ3	How extensive is the current market implementation of variable fonts?

To address these questions, this study adopts a qualitative research approach, combining a comprehensive literature review with the analysis of technical documentation, academic sources, and case studies from digital type foundries. Although organised chronologically, the investigation followed an iterative process.

This consolidation thesis is structured into five chapters. Chapter 1 presents a historical overview of typography, identifying its initial limitations and challenges. The need to examine the past is justified by the fact that technologies do not operate in a vacuum: it is essential to map the historical friction between the form of the letter and the constraints of the machine in order to understand the roots of this parametric system. Chapter 2 explores the emergence of digital fonts, moving through the PostScript, TrueType, and OpenType formats. It also references Multiple Master, a precursor to the technology later developed for variable fonts. Chapter 3 focuses on variable fonts, analysing their technical mechanisms and characteristics, including design space and interpolation, as well as their impact on web performance. Chapter 4 demonstrates the format's potential to enhance legibility, accessibility, and interactivity, alongside its application in design systems. Chapter 5 investigates the role of digital type foundries, with particular attention to strategies for promoting variable fonts, licensing models, distribution practices, and their current market adoption. Finally, the conclusion synthesises the findings of the study. This is followed by the bibliography and the list of figures.

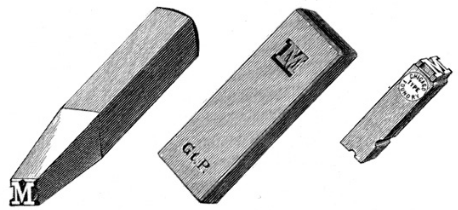
Chapter 1. Historical Framing

1.1. Gutenberg and Movable Type Printing

Ever since the concept of typography emerged, it has been inseparable from technology. If we understand typography as “the craft of endowing human language with a durable visual form” (Bringhurst, 2008, p. 11), then we can trace its origins back to the mid-fifteenth century, when the invention of movable type coined a moment that transformed language into something that could be seen, reproduced, and preserved across time.

Before this development, books were manually transcribed by scribes. This process was inherently labour-intensive, as each manuscript had to be produced individually, often over extended periods of time. As Lupton (2010, p. 89) states, “copies were copied from copies, each with its own glitches and gaps”. Inevitably, written content was not standardised in the way we understand it today: handwriting, spacing, and layout varied considerably from one manuscript to another. As a result, there was no unified process of reproduction, and textual consistency depended entirely on the individual scribe’s skill and practice.

Around 1450, Gutenberg’s printing press changed this situation by introducing a modular system based on movable type. Here, the production of type began to involve several carefully defined stages aimed at improving efficiency and enabling uniform reproduction of text. Southall (2005, pp. 3–4) explains that this procedure began with punch-cutters, who worked in minute detail to counter-punch and engrave the ends of steel bars to make reversed letterforms. The engraved steel bar, known as the punch, functioned as the master model of the character. By driving this steel bar into a softer metal, usually copper, an impression called matrix was created. The matrix was then “justified by filing its face and its edges, to ensure that it will produce type which has the correct width, alignment and height to paper, and is used with a mould to cast type” (Southall, 2005, pp. 3–4). Molten metal was therefore poured into the mould in order to produce individual pieces of type 1.1 . Once cast, the characters were manually assembled to form words, lines, and the overall layout of the page. As McNeil (2017, p. 12) observes, the composed type was then locked into a frame, inked, and pressed onto either paper or vellum to create a printed text.



1.1
Punch, matrix, and cast metal type character.

With this technology, letters became tangible units that could be reproduced consistently. From a critical perspective, this moment marked a profound shift in how textual understanding was mediated and structured. Kinross (1992, p. 9) points out that “when printing becomes typography is also when printing becomes modern. Printing becomes modern with the spreading of knowledge about itself.” As information about the craft became available, printing emerged as one of the first systems for organising letterforms at scale, thereby establishing the principles for typographic standardisation.

Although the printing press was initially designed to produce short documents—such as indulgences, pamphlets, and administrative texts—it soon made it possible to print the first mass-produced book: the *42-line Gutenberg Bible*. Completed around 1455, this work had a profound influence on the history of written communication, as texts could thereafter be reproduced with a level of consistency and speed previously impractical to achieve through manual copying.

In terms of typographic form, Gutenberg’s design choices were closely guided by the manuscript traditions of his time. During the fifteenth century, books were designed so as to imitate the calligraphy of medieval manuscripts, as this was the most direct way of reproducing familiar forms of written language. For this reason, the typeface used in the Gutenberg Bible was modelled on Textura, a highly formalised Gothic script used in Germany for religious manuscripts (McNeil, 2017, p. 12).

Despite its technological innovation, this system remained firmly rooted in the conventions of manuscripts, both in terms of visual appearance and compositional logic. Over time, in an effort to overcome these constraints, the printing industry began to seek ways of making the practice more reproducible.

1.2. Standardisation and Cultural Adaptation

Throughout the second half of the fifteenth century, printing expanded rapidly beyond Germany, particularly to Italy, which was then one of Europe’s most dynamic intellectual and commercial hubs. The city of Venice, most prominently, became an important centre for printing activity supported by its economic networks and scholarly communities. As printers settled in Italy, they encountered a manuscript culture that was quite different from that of Northern Europe. Whereas German written traditions were dominated by dense Gothic scripts, Italian scholars and humanists commonly used a more open style of writing—derived from Carolingian minuscule—known as humanistic script (Lupton, 2010, p. 15).

The context required printers to adapt their typographic systems both visually and functionally, in order to meet local expectations. This shift became evident in the adoption of Roman letterforms, which offered greater clarity and openness compared to Gothic scripts, making them especially suitable for books intended for academic and literary purposes. Within this new paradigm, typography evolved into a language in its own right, rather than a mere copy of calligraphy. McNeil (2017, p. 11) notes that:

> *When printing reached Italy, the fulcrum of humanist thinking during the Renaissance, letterforms started to evolve into the styles with which we are familiar today. This step in the development of typography was an expression of contemporary Italian tastes and attitudes, motivated by a rediscovery of classical Greco-Roman culture.*

At the level of printing technology, the principles of the screw press remained in use, but the method was continuously being refined. The construction of presses improved, as did ink application techniques, so that ink could be distributed more uniformly across the page.

Overall, the influence of Italian printing clearly shaped the European typographic landscape. This legacy underpinned subsequent developments in France, during the sixteenth century, where typefaces began to be refined and standardised within the existing system of movable type. French punch-cutters and printers contributed to the systematisation of typographic practice, reinforcing the idea of typography as a repeatable system.

By the seventeenth and eighteenth centuries, movable type printing had become fully established across Europe. This period was characterised by the expansion of conventions and the progressive standardisation of typographic practice. However, the underlying printing technology itself remained largely unchanged, with very few technical improvements or efficiency gains. (McNeil, 2017, p. 65).

Although revolutionary, this form of printing had its limitations, as each character existed as a solid, isolated object. For instance, adjustments to spacing or size typically required recasting pieces from scratch. Furthermore, metal type wore down over time, constantly needing to be replaced as the letters lost their original shape.

1.3. Mechanisation of Typesetting

The technical limitations of early forms of printing highlighted the inherent constraints of metal type and pointed to a broader period of transformation. Within this context, the Industrial Revolution brought an unprecedented and enormous acceleration in technological development, which spread across all fields. Rappo (2019) states that "the cultural and social implications of these changes should also not be underestimated", noting that this moment was reflected in the skills of printing professionals, as well as in printing itself.

During the Industrial Revolution, rising literacy rates led to a growing demand for books, newspapers, posters, and advertising, requiring the printing industry to operate with far greater speed and efficiency (Southall, 1997, p. 42). In parallel, paper production underwent fundamental changes: instead of being manufactured manually from linen and cotton rags, it gradually became machine-made and based on wood pulp, making it considerably cheaper and available in larger quantities and formats.

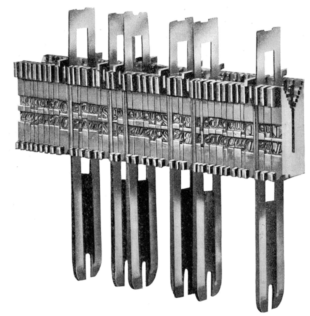
This growth in production was accompanied by major developments in printing press technology. The wooden hand press—virtually unchanged since Gutenberg—was first replaced in the early nineteenth century by iron presses. These machines were quickly adapted to steam power and later to gas and electricity, thereby significantly increasing their efficiency. At the same time, the introduction of cylinder and rotary systems finally substituted the intermittent action of the hand press with continuous mechanical movement (Hoe, 1902).

Alongside these significant gains in printing speed, the production of type needed to be rethought in order to adopt more mechanised methods, resulting in techniques such as pantographic punchcutting, patented by Benton in 1885. Southall (1997, p. 42) explains that the pantograph operated by moving the punch blank around a fixed cutter, while its movement was controlled by a mechanism that traced the outline of an enlarged character pattern. In essence, this machine could be described as “a device that reproduces the movements of a tracing point at a different scale by means of pivoted levers” (Southall, 2005, p. 20).

As an immediate consequence, the pantograph made it possible to produce multiple identical punches (Southall, 1997, p. 43), demonstrating that typographers were already, at that time, actively seeking to expand the technical possibilities of type manufacture within the limits imposed by physical constraints.

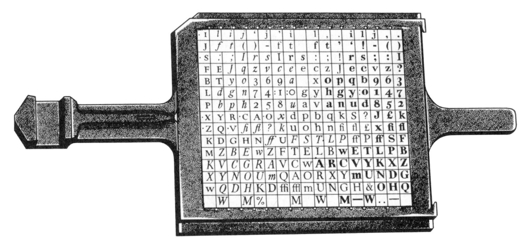
For much of the nineteenth century, both individuals and companies continued to experiment with methods of automating typesetting. Numerous patents and experimental systems were designed, but most proved to be too complex, unreliable, or commercially impractical. It was only after decades of experimentation that successful mechanical composition techniques finally culminated in the advent of hot metal typesetting machines, which marked one of the most significant transformations in typographic production since the invention of movable type. Bringhurst (2008, p. 137) points out that the first commercial solution was the Linotype machine, developed by Ottmar Mergenthaler in 1884. This technology allowed an entire line of type to be cast as a single metal slug, with the operator composing text via a keyboard; the input was then automatically converted into matrices

and cast into lines through a system of individual matrices and wedge-shaped spacebands 1.2 . The main advantage of Linotype was speed, particularly for newspaper production, where continuous text flow was essential.



1.2
Linotype matrices and spacebands.

However, its line-based structure had certain limitations in terms of editorial control and typographic precision. In response to these constraints, Monotype was announced in 1887 by Tolbert Lanston as an alternative approach to mechanical composition. While it also relied on a keyboard input process, this technology produced a perforated paper tape that controlled a separate casting machine, which made it possible to cast characters separately. Instead of assembling individual matrices, the Monotype caster used a compact, dense grid containing all characters—the matrix case 1.3 —which shifted rapidly to cast loose characters sequentially, one by one. This modular system offered greater editorial precision, as single characters could be corrected manually without recasting the entire line (Southall, 2005, pp. 35–36).



1.3
Monotype matrix case, showing the compact grid.

[1]
A glyph is a specific visual representation of a character in a typeface (e.g. a letter, number, punctuation mark, or symbol)

All this innovation in printing was also giving rise to the concept of typeface that we know today. As mechanical typesetting required characters to be precisely designed and consistently reproduced, letterforms could be understood as coherent visual systems of related glyphs [1] working together, as Southall (1997, p. 32) explains:

> *In mechanical systems for the preparation of text, called composing systems, the characters of the text have shapes which are already defined in detail before the text is composed. Sets of such visually related characters with defined shapes are called typefaces.*

Together, Linotype and Monotype established two complementary models of mechanical typesetting: one prioritising speed through line composition, and the other emphasising precision through character-based casting. The introduction of hot-metal composing techniques transformed the technical requirements of type production itself.

1.4. Phototypesetting

[2]
Letterpress printing is a relief printing method based on raised metal type, commonly used with hot-metal composition systems.

At the beginning of the twentieth century, the printing industry was therefore characterised not by a single dominant technology, but by the coexistence of multiple production systems. Letterpress printing [2] was widely used, supported by hot-metal composition machines, mainly as Linotype and Monotype (Bringhurst, 2008, pp. 138–139).

Companies were continuously seeking faster methods of production for both typesetting and printing processes. This led to experimentation with photographic processes, where light was used to expose images onto photosensitive surfaces, contributing to the emergence of offset lithography, a printing method in which the image is transferred from a plate to a rubber blanket and then to the printing surface of the page (Bringhurst, 2008, p. 139). Although emerging in the early decades of the twentieth century, offset techniques only became widely adopted from the 1950s onwards, when industrial conditions made it more viable.

By that time, the act of typesetting shifted from the physical arrangement of metal sorts to the control of exposure through photographic processes, fundamentally altering typographic production. One of the major inventions was phototypesetting, developed by Louis Moyroud and René Higonnet, which was described as “a game changer in typography” (Johnston Baril, 2025). The first commercially viable implementation of this approach was introduced in France—the Lumitype—and worked through an optical process based on light and photographic reproduction. Phototypesetting relied essentially on matrices, typically made of glass discs containing images of photographic characters 1.4 . These systems primarily operated through optical projection, as Southall (2005, p. 79-80) states:

1.4
A phototypesetting disc containing photographic character matrices.

The images on the matrix are invariably negatives: transparent images on an opaque ground. There is a light source that illuminates the image to be composed, and a selection mechanism that makes sure the illuminated image is the right one and that it is correctly positioned relative to the machine's optical axis.

Because characters existed as photographic images rather than physical blocks, they could be easily scaled, repositioned, and manipulated without the need to recast type. This enabled a new level of efficiency and control, particularly in spacing, alignment, and line composition. The expanded range of typographic possibilities offered by phototypesetting is clearly illustrated in many contemporary specimen materials. Southall (2005, p. 84) observes that the Lumitype type-specimen book 1.5 , published by Deberny & Peignot in 1961, demonstrates the extent of flexibility enabled by phototypesetting, revealing clear advantages in typographic control.

1.5

Lumitype specimen showing a 11-point type line with varying set widths (10.25–11.75).

Ceci est une ligne de corps onze sur set dix et demi
Ceci est une ligne de corps onze sur set dix trois quarts
Ceci est une ligne de corps onze sur set onze
Ceci est une ligne de corps onze sur set onze un quart
Ceci est une ligne de corps onze sur set onze et demi
Ceci est une ligne de corps onze sur set onze trois quarts

This method progressively replaced most hot-metal techniques. While still analogue, it introduced new approaches to composition, particularly in terms of spacing control, scaling, and variation in typographic setting. More importantly, it brought a conceptual shift in which typographic form became independent from its physical material support, as letterforms were no longer tied to metal but to photographic and optical processes.

However, as with most technological advances, the possibilities provided by phototypesetting also left room for misuse and inconsistent applications. Unlike metal type, which was constrained by physical matrices and mechanical precision, phototypesetting allowed for a more fluid manipulation of letterforms, which in turn often resulted in inconsistencies in alignment, spacing, and typographic coherence. In this sense, the technology introduced a paradox: while it expanded creative possibilities, it also shifted a degree of control away from the material constraints, opening the door to less predictable and sometimes less disciplined typographic outcomes.

Phototypesetting was not a single unified technology, but rather a diverse field of competing systems developed by different manufacturers. These ranged from purely optical and mechanical processes to more advanced ones that gradually incorporated electronic control. Bringhurst (2008, p. 140) argues that "the important innovation of the period was not, after all, the convertion of fonts from metal to film, but the introduction of microcomputers to edit, compose and correct the text and to drive the last generations of photosetting machines".

From a critical standpoint, and from today's perspective, phototypesetting can be understood as a bridge—a transitional technology—that expanded the possibilities of type design while simultaneously preparing the ground for the subsequent rise of digital typography.

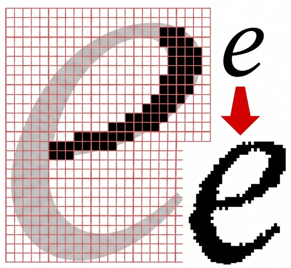
Chapter 2.
Digital Typography

2.1. Bitmap Fonts and Early Digital Systems

Computers emerged in the twentieth century, and typography kept pace with the latest developments. McNeil (2017, p. 8) explores this transition, arguing that the shift from mechanical to digital technologies during this period fundamentally reconfigured design practices. As such, typography eventually had to be rethought beyond the purely analogue space.

The first electronic computers appeared in the 1940s, but their influence on typography only became significant from the 1960s onwards, when phototypesetting was automated through electronic control via encoded tapes. During the 1960s and 1970s, CRT-based phototypesetting systems introduced a further level of automation, in which characters were generated and exposed using cathode ray tube technology (Rappo, 2019).

In the next stage of typographic development, fonts became bitmap-based, a format designed to represent letterforms electronically. Southall (2005, p. 150) describes bitmap fonts as an approach in which the "character image specifications are stored in a compressed representation of binary mode". This binary representation meant that letterforms were mapped onto a fixed grid of pixels, where each pixel was either activated or deactivated 2.1. Characters were therefore constructed as discrete units, making bitmap fonts inherently tied to a specific size and raster structure.



2.1
Pixel grid structure underlying a bitmap character.

Thus, as Mandal (2024) points out, each character was essentially "a grid of pixels, with a basic structure and limited versatility", which resulted in a clear tension between technical constraints and typographic quality. Southall (2005, p. 224) notes that one of the key challenges at the time was producing fonts that combined expressiveness and legibility at small pixel sizes. Because the grid was fixed, it imposed limitations on typographic manipulation, especially in terms of scalability: characters could not be enlarged or reduced without loss of quality, since they depended on the resolution of the output device.

Nevertheless, Mandal (2024) suggests that these rudimentary systems paved the way for subsequent advancements in digital typography. Bitmap fonts drove a significant shift in the design process, giving designers the ability to use the computer as a final proofing environment for their work. Southall (1997, p. 56) further argues that:

Digital type design systems allow designers to develop typeface designs in their final size. They use new technology to remove the obstacles to the design process that the old technology imposed, and enable the designer to work as close to the final product as the punchcutter could—although with different tools.

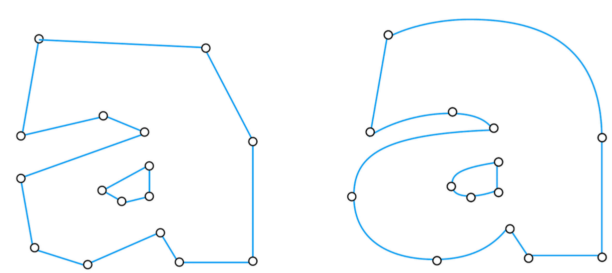
Overall, bitmap fonts marked an initial phase in digital typography. They were the first step in bringing typography into computer systems, but remained limited to resolution-dependent structures that restricted scalability and flexibility, thereby highlighting the need for more adaptable solutions.

2.2. PostScript and TrueType

The constraints of initial digital technologies eventually led to new approaches to font representation—most notably outline-based fonts—which reframed the concept of digital typography and allowed a much broader range of possibilities. Instead of being constructed from pixels, letterforms came to be described mathematically.

In the early stages of outline-based font development, typefaces were limited to straight lines, mainly due to technical constraints. As digital typography evolved, however, it became possible—and, indeed, necessary—to incorporate curved forms as well 2.2 , in order to make the glyphs more legible and consistent. This was made feasible through *Bézier* curves, which are used to define smooth transitions between control points and facilitate the precise shaping of letterforms. As Underware (2018) explains:

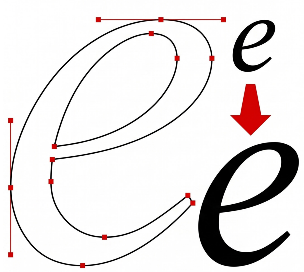
Lines are the foundation of type design. Not only of the outlines, but also of the correlation of weights within a family for example. In that sense one could say that a typeface is a collection of lines. There are two kinds of lines: straight lines and curved lines. A typeface can contain both.



2.2
Straight-line vs. Bézier curve outlines defining the same glyph structure.

Behind these curved segments lies a structure of anchor points and control handles; the anchor points form the skeletal structure of each glyph, whilst the Bézier handles determine the modulation of curvature between them. Bringhurst (2008, p. 182) notes that these resulting curves can be described as *splines*, which he compares to a material that "behaves as if it had fiber". This analogy highlights the idea of continuous tension within the curve, ensuring that letterforms are both mathematically precise and continuously adaptable.

These outline-based descriptions made it possible to scale type up or down without any loss of quality 2.3 , as the outline remains consistent regardless of size. As Barnhart (2022) explains, Bézier curves function as parametric splines defined by a set of control points: two points determine the start and end of the curve, while intermediate control points define its shape. The curve itself is generated through linear interpolation, enabling smooth and precise control over the geometry of each glyph.



2.3
Outline-based letterform defined using Bézier curves.

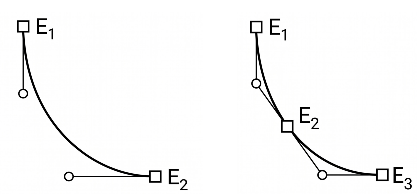
The need to extend these advances into wider typographic practice led to the introduction of PostScript Type 1 in 1982. Bringhurst (2008, p. 182) highlights that, with this new format, bitmap fonts rapidly gave way to fonts composed of scalable outlines. Developed by Adobe, PostScript had a major influence on standardising outline-based digital typography by incorporating hinting instructions [3] into typeface data to improve rendering quality at low resolutions. According to Ellen Lupton (2014), PostScript fonts introduced a system in which vector outlines could be translated dynamically into screen pixels, enabling typefaces to remain visually consistent across different display technologies. As rasterisers improved, the quality and rendering of the typefaces improved accordingly.

[3] Hinting refers to the use of mathematical instructions embedded in a font file to adjust vector outlines to align better with the pixel grid.

Outline-based fonts gained prominence and became central to the process of type design. As Lupton (2004) observes, "typography is the art of designing letterforms and arranging them in space and time". This means that, within digital media, typography ceased to be understood as a fixed and static structure, but rather as a system capable of adaptation and transformation. The transition gained particular attention throughout the eighties, with the release of the Macintosh in 1984 by Steve Jobs, which introduced digital typography into both domestic and graphic design contexts (DDC Team, 2025).

Shortly afterwards, though still based on Bézier curves, a new standard for outline-based fonts emerged: TrueType. Developed by Apple in the late 1980s and subsequently licensed to Microsoft in 1991, this format expanded on the features of PostScript by incorporating new types of hinting instructions. In parallel, on-screen rendering improved, becoming more consistent with the preview for physical printing.

The main technical distinction between PostScript and TrueType is, as Tam (2003) explains, that the first one uses cubic splines, while TrueType relies on quadratic splines 2.4 . Bringhurst (2008, p. 183) further distinguishes between the two, noting that cubic splines allow for greater flexibility in curve construc-



2.4
Comparison between a cubic spline (left) and an equivalent quadratic spline (right).

tion due to the use of additional control and inflection points, enabling more complex curvature. Quadratic splines, by contrast, are structurally simpler and operate with fewer control points, which can result in a greater number of segments being required to describe the letterforms.

Despite their different mathematical models, both PostScript and TrueType are based on the same fundamental principle: they describe the shapes of letters through points and curves rather than pixels. Together, these approaches have set the standard for scalable digital typography.

2.3. Multiple Master Technology

Alongside these inventions, Adobe introduced the Multiple Master (MM) font format as an extension of PostScript Type 1. The core idea behind MM fonts was the application of several *master designs* that could be continuously adjustable along one or more design axes, enabling the generation of intermediate instances within a single font system (Bringhurst, 2008, p. 184).

This approach represented an early attempt to move beyond static font instances, with the aim of creating more flexible typographic systems. Multiple Master fonts were able to generate glyph variations by calculating intermediate values between two or more predefined extremes. In practice, attributes such as weight, width, or optical size could be adjusted rather than selected as fixed categories. Structurally, the system remained based on Bézier outlines, but introduced an additional layer operating across corresponding points in each master design. This ensured that generated instances preserved the overall consistency of the typeface, anticipating the mechanisms later used in variable font technology.

Initially, the Multiple Master format was not widely adopted. Its implementation required complex software support, which limited its accessibility for type designers. At the same time, outside Adobe's ecosystem, implementation by third-party developers remained inconsistent. As a result, MM fonts struggled to integrate into mainstream digital typography workflows, leading to their gradual discontinuation in favour of simpler and more stable font formats (Riggs, 2014).

2.4. OpenType

Following this trajectory of experimentation with new formats, OpenType arrived in the mid-1990s as a collaboration between Adobe and Microsoft. It was primarily designed "to address the problem of cross-platform incompatibilities of the existing PostScript and TrueType formats" (King, 2001), becoming a unified and extensible font format. Unlike earlier font formats, which were limited to a single rendering model, OpenType was designed to support various outline technologies, including both TrueType and PostScript.

From a technical perspective, the format is built on a table-based architecture in which typographic information is organised into multiple interconnected tables; in this sense, an OpenType file functions as a digital container that stores different types of font data within a single structure. In practical terms, as Cheng (2020, p. 60) points out, this has enabled a significant expansion in character capacity, supporting over 65,000 glyphs, compared with the previous limit of 256. This innovation stemmed from the adoption of Unicode encoding, which replaced the previous 8-bit system—limited to 256 character slots—with a 16-bit architecture capable of supporting tens of thousands of characters and glyphs.

OpenType also introduced advanced typographic features such as tabular figures and stylistic sets. Moreover, as Lupton (2010, p. 80) explains, in TrueType and Type 1 fonts, features such as small capitals, alternate ligatures, and other special characters had to be stored in separate files, sometimes referred to as 'Expert'. In contrast, with the OpenType format, these attributes are incorporated directly into the main font file. The author further states that OpenType fonts "automatically adjust the position of hyphens, brackets, and parentheses for letters set in all-capitals".

Another advantage of OpenType is its ability to include a large number of glyphs, thereby enabling support for multiple languages. Consequently, it is common for OpenType fonts to have extended Latin characters, as well as Greek and Cyrillic alphabets. Furthermore, advanced layout tables such as GSUB (Glyph Substitution) and GPOS (Glyph Positioning) became central components of the format, allowing features such as contextual alternates and precise kerning pairs through automated substitution and positioning rules.

OpenType became widely adopted also due to its cross-platform compatibility, ensuring consistent rendering across different operating systems. The format was fully standardised in 2007, when it was approved by the ISO (International Organisation for Standardisation) (Cheng, 2020).

Chapter 3. The Structure and Mechanics of Variable Fonts

3.1. From Static to Variable Typography

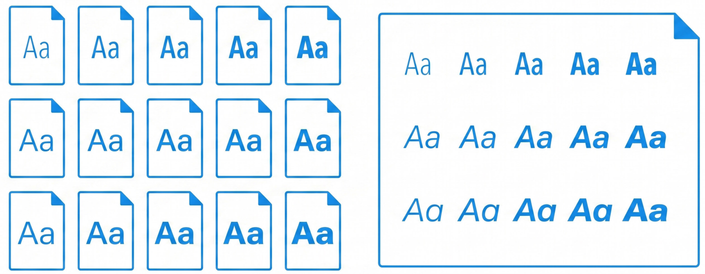
In an increasingly dynamic world shaped by digital systems, typography has gradually moved away from its static nature in search of a more fluid and adaptive logic. This shift should be understood as part of a much longer historical continuum, in which designers have, over centuries, sought ways to adapt letterforms to different contexts of use. From optical sizing in metal type to phototypesetting and later digital font technologies, each technological stage has expanded the possibilities of typographic variation.

Building on this trajectory, on 14 September 2016, a significant leap in type design was announced through a collaboration between Microsoft, Apple, Adobe, and Google: variable fonts (VFs). The format was officially presented at the ATypI 2016 conference in Warsaw, where it was positioned as the first major evolution in font technology since the introduction of OpenType (Viction:ary, 2020, p. 3).

With this new paradigm, type families such as Source Sans Variable, Amstelvar, and Decovar emerged, developed to demonstrate the potential of variable fonts. Up to that point, each style—such as different weights, widths, or italics—required a separate file, which placed constraints on both design expressiveness and technical optimisation. The primary purpose of variable fonts was, therefore, to save time in web delivery by reducing the number of font files, bringing all variations of a typeface together into one unified file 3.1 . This approach leads to the core definition of VFs, which Hudson (2016) describes as "a single font file that behaves like multiple fonts".

Beyond this definition, variable fonts also represent a broader evolution in how typography operates within web environments. As Pamental (2016) suggests, their importance lies not only in file efficiency but in their alignment with the demands of contemporary digital design, where performance, scalability, and flexibility must be prioritised.

3.1
Static font file (left) compared to a variable font file (right).



[4]
Introduced as part of the OpenType 1.8 specification in 2016, OpenType Font Variations enables multiple design variations.

In terms of format, VFs are defined through the OpenType Font Variations [4] specification, which extends the principles of OpenType and is also based on a system of tables, each responsible for a specific type of information. This table-based architecture separates the visual definition of glyph outlines from the rules that govern their behaviour, making the format more adaptable.

From a practical point of view, variable fonts introduced entirely new ways of controlling typographic form. Designers started interacting with type in real time, adjusting its parameters as if it was a living organism. This format marked the beginning of a truly adaptive system—based on and derived from centuries of refinement—capable of responding to the growing diversity of screens and reading environments. As Lupton (2004) notes, in digital media, typographic structures and the content they support have "the possibility of continuous transformation". Variable fonts evidence this condition by allowing letterforms to shift fluidly across multiple states and configurations within a single font file.

3.2. How Variable Fonts are Built

The structure of variable fonts is rooted in the fundamental principles of digital font design. At their core, they are based on vector outlines defined through points and curves, a construction inherited from outline font technologies. Yet, what distinguishes variable fonts is not the outline model itself, but the way these outlines are organised into a flexible system.

In mathematical terms, the variations in a variable font are expressed as offsets, known as *deltas* (Hudson, 2016). These deltas describe how each point in the outline shifts relative to a default shape, defining both direction and magnitude. By storing only the point-based adjustments instead of full duplicate outlines, the font file becomes significantly more efficient while still supporting a wide range of visual variations.

Due to their construction, letterforms can be adjusted with a high degree of precision, often down to very subtle variations. The 'original' state of a variable font (for example, in terms of weight, typically its lightest form) is known as a master. The same applies to its opposite extreme, such as the heaviest or boldest form. In this sense, variable fonts are constructed from a set of masters, which define the extremes of a typeface's variation, ranging from the lightest to the heaviest weights or from the narrowest to the widest widths. Thus, variable fonts are defined by the connections between the points of different outlines, meaning that points control the curves, and curves define the form of each letter (Underware, 2018).

For a variable font to function properly, these outlines must be structurally compatible throughout all instances. Each glyph therefore needs to have the same number of points, arranged in the same order, so that corresponding points align across different instances. This requirement for structural consistency has been directly reflected in contemporary type design software. Applications such as Glyphs, RoboFont, and FontLab (widely used for the development of variable fonts) provide tools that allow designers to monitor node compatibility in real time during the design process, indicating whether the corresponding points are correctly aligned. With this in mind, creating a variable font requires consistency not only in its visual appearance but also in the internal structure of the glyphs.

3.3. Variation Axes

One of the key principles of a variable font is that it is customisable through axes. These axes are adjustable parameters that allow for continuous typographic variations of the typeface throughout a defined range between masters. Variable fonts may contain a single axis—most commonly weight—or multiple ones. Additionally, these axes can be categorised into two distinct types: registered and custom, depending on whether they are defined within the OpenType specification or left open for designers to set freely.

[5] OpenType specification that uses four-letter codes in lowercase.

On the one hand, registered axes are standardised dimensions of variation, ensuring consistent behaviour on different platforms and applications. Since they follow shared convention, they are defined using official tags [5]: *wght*, *wdth*, *ital*, *slnt*, and *opsz*, corresponding respectively to weight, width, italic, slant, and optical size. This standardisation ensures that these axes can be reliably interpreted by software.

For instance, in the weight axis 3.2 , rather than selecting from predefined weights, a continuous slider enables the selection of a specific value in the range. Typically, the value corresponding to the regular style of a static font, in the case of the weight axis, is 400 (Pamental, 2019). The width axis determines how narrow or wide a typeface is, ranging from condensed to expanded forms, where a value of 100 is considered a 'normal' width.

3.2 Different instances generated across the weight axis of Solidus Open typeface, ranging from 100 to 900.

The slant and italic axes control variations in the angle of the letterforms, either through a mechanical slant or by activating a true italic design. While the slant applies only a geometric transformation, italic typically involves glyph substitution. Therefore, when the user reaches a certain threshold [6] on the italic axis, the rendering engine can switch between glyph variants, for example replacing a single-storey roman *a* with a double-storey italic form. Finally, the optical size axis adapts the typeface to different sizes of use, optimising legibility according to specific viewing conditions (Pamental, 2019).

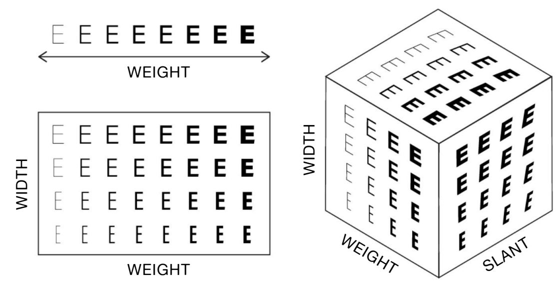
[6] In variable fonts, a threshold refers to a defined value at which the rendering behaviour may change in order to preserve legibility and typographic consistency.

On the other hand, custom axes are not defined as part of the OpenType specification. They can represent almost any aspect of a typeface design that is turned into a variable parameter, introducing specific forms of expressiveness according to the needs of a particular typeface. As Pamental (2019) notes, "there are the more 'expected' ones like serif shape or perhaps x-height (the height of the lower case letters) to much more inventive ones like 'gravity' or 'yeast'." Beyond these, custom axes can also become more experimental, such as 'grade', 'softness', or 'casualness', further expanding the potential of variable typography.

3.4. Interpolation and Design Space

[7]
A parametric system is understood as a system capable of generating forms or outcomes from adjustable parameters.

Variable fonts redefined typographic practice as a parametric system[7]. All the possible variations of a variable font exist within what is known as the design space 3.3 : a multidimensional environment defined by its axes. Each axis represents a dimension, and every point corresponds to a specific instance of the typeface. This space can be understood as a structured framework in which all potential states of a typeface are mapped according to their parametric relationships.

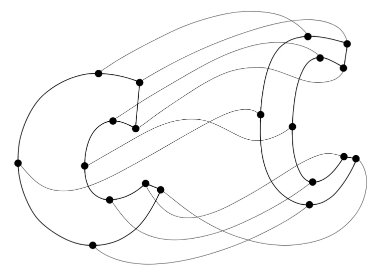


3.3
Variable font design space in one, two, and three dimensions.

From a designer's perspective, the design space can be seen as an interactive environment in which typographic variation is explored dynamically. In its simplest form, a typeface with a single axis defines a linear design space. As more axes are included, this space expands into multiple dimensions. Variations are not arbitrary but are structured and organised through OpenType tables, guaranteeing that each combination occupies a corresponding position (Hudson, 2016).

Hudson (2016) remarks that "there is no practical limit on the number of axes of variation that a variable font may include (the architectural limit, as with so much in the OpenType format, is 64k)". Even so, the addition of each new axis significantly increases the complexity of the design space, and overly complex variable fonts can become difficult to manage. Consequently, the effectiveness of VFs is determined not only by the range of potential variations but also by the clarity with which those variations can be meaningfully used.

The mechanism that generates typographic variation within the design space is called interpolation 3.4 . It is through this process that it becomes viable to calculate intermediate values between predefined masters. Masters function as reference points that define the boundaries of the design space (Hudson, 2016).



3.4
Interpolation scheme between two masters.

Interpolation underlies the functioning of variable fonts, acting as a fundamental component that operates through mathematical values and enables smooth transitions between styles. It is through interpolation that a variable font gains a sense of movement and ceases to be a fixed entity.

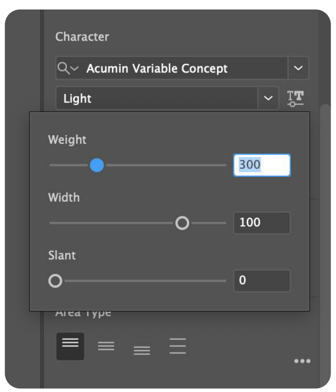
3.5. Software Support

As might be expected, for the efficiency of variable fonts to become more widely adopted, a coordinated effort was required among web browsers, operating systems, and software. The adoption has been gradual and closely tied to the pace at which major platforms have integrated full support for the technology (Janes, 2020).

In terms of design software, VFs have been incorporated into the most commonly used platforms, such as Adobe Illustrator, Adobe Photoshop, and Adobe InDesign. It was around 2020 that support within Adobe Creative Cloud became more stable, with clearer interfaces specifically designed for manipulating font axes. This integration has helped variable fonts to move beyond being seen as a purely experimental feature and has become part of the actual design practice, particularly in areas such as visual identity, product design, and editorial.

Later, in 2022, Figma also began to officially support variable fonts, creating a control area within the typography settings panel. This development facilitated the integration of variable typography in responsive interface design, making it viable for typographic properties to adapt more fluidly to different screen sizes, layouts, and interaction requirements. This has therefore empowered designers to interact with VFs in a more direct and intuitive way, instead of relying on Figma plugins.

Across virtually all platforms, the way designers select and manipulate variable fonts is usually done through sliders 3.5 , which enabled adjusting typographic properties in real time. Although sliders are the most direct way of controlling these continuous varitions, Hudson (2016) explains that most software



3.5
Adobe Illustrator interface showing a variable font with three adjustable axes (weight, width, and slant).

supporting variable fonts also provides named instances such as Ultra Light, Light, Regular, Semi Bold, or Bold. These instances do not necessarily correspond to the extremes of an axis, but can be positioned anywhere within its range. They function as predefined reference points, giving designers the ability to access commonly used typographic styles through a form of shortcut.

As design software began to adopt VFs, it also became essential for the web to support their implementation. In this sense, variable fonts are now compatible with all major browsers, including Google Chrome, Safari, Mozilla Firefox and Microsoft Edge. Browsers load variable fonts in a similar way to conventional web fonts [8], mainly via the CSS @font-face declaration. Once the fonts have been loaded, CSS properties such as *font-weight*, *font-stretch*, and *font-variation-settings* allow each browser to dynamically interpret and control the typographic axes (Janes, 2020).

[8] Fonts delivered and used in web browsers via CSS.

As a result, browsers can now generate intermediate values in real time, according to specific needs, enabling typography to exhibit flexible behaviour and adapt to different digital environments. Janes (2020) further highlights that, since these parameters can be manipulated through JavaScript, variable fonts also open up new possibilities for interaction, animation, and responsive typography.

3.6. Web Infrastructure and Performance

One of the main advantages of variable fonts, as previously mentioned, is their ability to reduce file sizes. This technically happens because they store only the essential outlines and data needed to describe the variations between instances. The process can be understood as a transformation of discrete units into a unified system—which becomes more compact—while simultaneously increasing versatility in terms of performance and optimisation, especially in digital environments. As Hudson (2016) notes:

> *There are numerous benefits to this technology. A variable font is a single binary with greatly-reduced comparable file size and, hence, smaller disc footprint and webfont bandwidth. This means more efficient packaging of embedded fonts, and faster delivery and loading of webfonts.*

However, this is not always a linear case. Although variable fonts do indeed have the ability to reduce the total file size by replacing several related styles, if we consider a particularly complex variable font—containing multiple axes (such as *wght*, *wdth*, and *ital*) as well as extended language support (including Cyrillic, Greek, and Latin)—the file size can easily exceed 1MB. In this scenario, the theoretical effectiveness of the format becomes dependent on its actual implementation. For instance, if a web project only uses a limited set of styles, such as Regular and Bold, loading the entire variable font may result in unnecessary bandwidth usage when compared to two optimised static files. This highlights a key tension within variable font technology: its efficiency is contingent on whether the design practices take advantage of its variability.

When discussing performance on the web, it is not only determined by the internal structure of a font, but also by the way it is compressed and rendered. In this context, the compression format has a direct impact on overall file size and loading efficiency. WOFF2 (Web Open Font Format) [9] is particularly important here, as it is capable of further improving the performance of a typeface by optimising the way font data is stored and delivered. In other words, it encapsulates OpenType data in a highly compressed format, enabling faster transmission and consequently reducing

[9] WOFF2 is a compressed font format designed specifically for use on the web, introduced in 2014 and standardized by the W3C in 2018.

the file size. Some variable font families are also available in other formats, such as TrueType Font (TTF), and can similarly be used on the web. However, the compression and compatibility offered by WOFF2 generally make it the preferred choice in most digital environments. As argued by Pamental (2019), “TTF works as well, but the file size compression and compatibility gains with WOFF2 are so great that there’s no reason not to use it.”

It is worth noting that all of this has implications for web page load time, which is one of the main factors influencing whether users remain on a website or leave it. Research has shown that a significant proportion of users expect a page to load within approximately two seconds or less, and that delays beyond three seconds can lead to abandonment. Therefore, variable fonts stand out as a technology with considerable potential, while also contributing to increased user retention (Pamental, 2019).

This efficiency is also due to the fact that VFs require fewer HTTP requests [10], which directly improves the loading speed and overall performance of the website. Fewer requests also mean lower bandwidth consumption, and thus, the amount of data that needs to be transferred between the server and the user is reduced, resulting in faster rendering times (Monotype, 2024).

[10] Requests made by a web browser to a server in order to load resources such as fonts, images, CSS, or JavaScript files.

Large-scale font distribution platforms, particularly Google Fonts, have had a profound impact on the performance optimisation of variable fonts. Rather than requiring developers to host and manage font files on their own servers, these platforms distribute fonts through global Content Delivery Networks (CDNs). By serving files from servers located closer to the user’s geographic location, CDNs reduce latency, improve loading times, and enable fonts to be delivered more efficiently.

Chapter 4. Legibility, Accessibility, and Responsive Design

4.1. Legibility

For a text to fulfil its purpose—which is usually to convey a message, establish an emotional connection, and highlight key elements—it must be easy to read. Legibility is influenced by a number of factors, one of the most significant being typography, as it directly affects the speed and accuracy with which readers perceive and understand content.

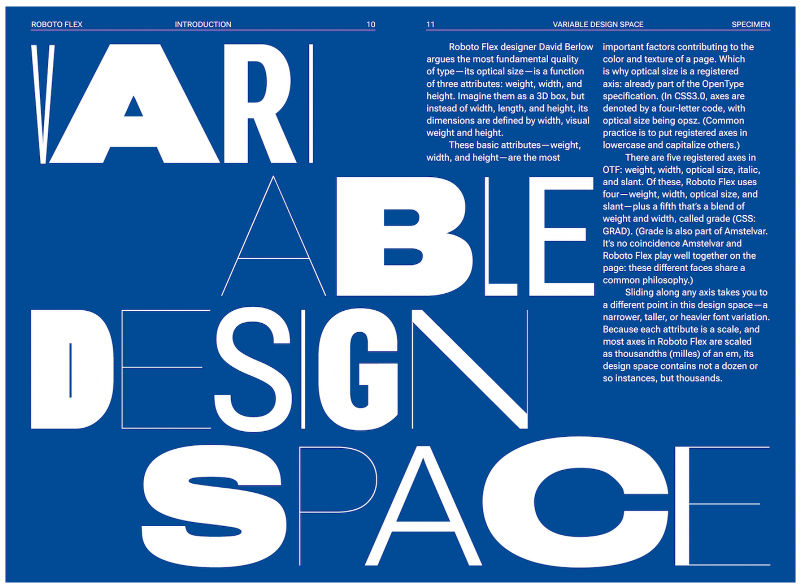
The idea of legibility can be defined in multiple ways, one of which is "by the smallest amount of correlation in the surface of the characters" (Beier, 2011, p. 35). In other words, the more distinguishable letterforms are from one another, the more legible they become. Beier (2011, p. 7) further notes that:

> *For instance, typefaces presented under difficult reading conditions, such as small point sizes in low-quality newspaper print or street and building signs viewed from afar, need to be created in specific ways to function at their very best.*

Given that using a typeface today involves taking into account a much broader range of formats than in Gutenberg's time—when text was limited to print—it is essential to consider the various complexities involved. Added to this is the constant evolution of screen resolutions, which offer more and more rendering capabilities, meaning that typography must adapt—just as it has done throughout history—to the demands of the contemporary context.

Accordingly, variable fonts have also emerged in response to the sheer volume of text that is now read on a wide variety of screens, which have become ubiquitous in everyday life. When only static fonts were available, “the typical scenario would be to constrain any given design to 3–5 different fonts to represent every aspect of a site’s design language and voice” (Pamental, 2018). In contrast, variable fonts allow the use of different weights within page hierarchies, improving legibility while maintaining visual consistency across devices.

Overall, VFs provide the necessary flexibility to adjust text in order to maximise legibility with minimal effort. They enable finer control over the density and rhythm of text blocks. The width axis, for instance, can be used to shift between condensed and expanded forms 4.1 , adapting the texture of the paragraph to different reading conditions. This flexibility helps regulate typographic continuity, creating a smoother and more continuous reading flow.



4.1
Roboto Flex type specimen showing the typeface’s width and weight responsive behaviour.

When discussing legibility, it is also important to consider other factors that influence how text is read, including screen modes. In this sense, the growing use of dark mode interfaces highlights the need for typography to be flexible not only in terms of size and structure but also in relation to different backgrounds and themes. In cases where the device is in dark mode, text is typically displayed as light on dark, and variable fonts offer a way to address this challenge by having context-sensitive adjustments. In such cases, the font weight can be slightly reduced compared to light mode 4.2 , compensating for the increased perceived thickness of light text and helping to maintain consistent visual comfort.

4.2
Variation of typographic weight in a variable font between dark and light conditions.

These adjustments are minimal and often imperceptible to the user, but they play an important role in providing a balanced experience between light and dark interfaces. This is further supported by the CSS media query *prefers-colour-scheme*, which allows styles to adapt automatically according to the user’s system mode settings (Janes, 2020). Hence, typography becomes more adaptive, as it is able to respond to interface conditions and user preferences (New Target, 2025).

This concern with adaptability at the level of text composition is also linked to a longer typographic tradition; indeed, as Pamental (2018) notes, a feature that was common in metal type but lost in the transition to phototypesetting and early digital systems was optical sizing. This practice dates back several centuries, when typefaces had to be designed specifically for each physical size. Historically, smaller text sizes were cut with heavier strokes, more open counters, and wider apertures to preserve legibility. With the shift to phototypesetting, and, later, to digital typography, this practice became far less common and almost disappeared. Variable fonts, however, have revived optical sizing as a dynamic feature, once again permitting typefaces to adapt to different scales. Through the optical size axis, typographic characteristics such as stroke weight, contrast, and spacing can be subtly adjusted.

In this sense, it can be argued that part of the distinctiveness of variable fonts lies in their ability to connect different moments in the history of typography, drawing on principles established across several eras. This reflects a broader pattern in typographic development, whereby technological progress does not simply follow a linear path, but frequently returns and reinterprets earlier practices.

4.2. Accessibility

The reading experience is not universally the same, since even on the same device and under identical settings, readability is perceived and shaped by the user's preferences and individual perceptual conditions. This is where the issue of accessibility becomes crucial, because, as Lupton (2010, p. 136) points out, "the web was invented in order to provide universal access to information, regardless of a person's physical abilities or access to specialised hardware or software", meaning that reading is a highly individual experience.

Unlike printed text, where design choices are fixed and unchangeable, written content on the web can be continuously adjusted and modified, as well as mediated through assistive technologies (W3C, 2024). With this in mind, the use of variable

fonts provides flexibility as a backbone, enabling a single typeface to respond to different reading requirements.

There are many situations in which adaptability becomes essential, particularly in cases of low vision and light sensitivity. Variable fonts brought the possibility to enhance stroke weight and adjust spacing, which helps to maintain clarity. When users activate high-contrast settings, websites can respond by using variable font axes to increase weight or adjust letterform openness, specifically to improve readability in those conditions (New Target, 2025).

A concrete exploration of typographic accessibility can be found in hyperlegible typefaces. One example is Atkinson Hyperlegible, which was originally developed as a static font in 2019 and later relaunched in 2025 with the release of Atkinson Hyperlegible Next 4.3 as a variable font. According to the Braille Institute (n.d.), this typeface was designed to reduce ambiguity in reading, supporting readers with dyslexia and low vision. From a technical perspective, it works by emphasising distinctions between letterforms, adjusting spacing, and enhancing contrast.

4.3 Specimen of Atkinson Hyperlegible Next.

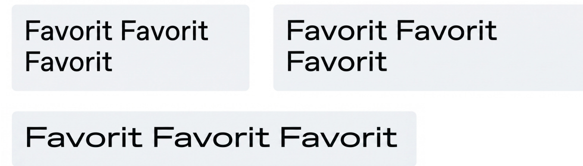
All of these layers of fine-tuning allow accessibility in variable fonts to be inherent to the fonts themselves, rather than an external requirement applied after design decisions have been made. This perspective aligns with principles of user-centred design where systems are designed around users' needs, abilities, and limitations (Norman, 2013).

4.3. Responsive Design

The smartphone era has introduced new challenges—alongside new opportunities—for design. As the rapid proliferation of new devices has become evident, this meant that designers and developers have had to start creating solutions capable of adapting to different screen sizes and orientations (Mandal, 2024). Thus, responsiveness became a fundamental aspect of design, an aspect that is reflected, for example, in Google's penalisation of non-responsive websites. Since 2015, digital platforms that fail to adopt responsive practices and result in illegible content tend to be assigned lower rankings in Google Search. Consequently, this reinforced a mobile-first design methodology, where interfaces should be initially thought for mobile devices and then adapted to larger screens. In 2018, Google further announced that mobile-friendly websites would be indexed before desktop-oriented versions (Viction:ary, 2020, p. 4).

This led to the rise of responsive design as a concept—a flexible approach to digital interface layout, image scaling, and coherent content flow—where typography plays a crucial role. Responsiveness is strongly supported by VFs, which enable typography to adapt in a much more granular and precise way than static fonts previously did (New Target, 2025). With variable fonts, typefaces are treated as dynamic compositions, capable of reacting to different devices, screen orientations, and even reading distances (Hudson, 2016).

From a practical point of view, VFs responsiveness relies mainly on width and weight axes, which make them optimisable for different viewports, for instance, when they need to fill the available screen space 4.4 . Small interfaces often require typography to be more compact, hence allowing text to be adapted in order to maintain spatial balance. In contrast, on larger screens, text can accommodate greater sizes and increased hierarchy.



4.4 Typographic transformation through the width axis, enabling adaptation to different viewports.

This can be achieved using CSS properties such as *font-variation-settings*, *font-weight*, and *font-stretch*, which allow browsers to interpret and adjust the axes of variable fonts dynamically. CSS also supports smooth transitions and custom properties, which means that rules such as gradually reducing font weight as the viewport becomes smaller can be implemented, a concept known as *fluid typography* (New Target, 2025). Additionally, font size also becomes a key responsive parameter, as variable fonts work in combination with fluid scaling systems in order to maintain readability across different screen sizes 4.5 .

Combined with media queries and viewport-based units, typography functions as a dynamic component, varying in the most diverse ways. As Viction:ary (2020, p. 5) remarks in the discussion about typographic dynamism:

> *In variable typography, we are typically able to see a sequence of events—a before and an after. For example, visiting a responsive website on a mobile device and then a desktop makes the rules of variability become clear through comparison.*

4.5
Comparison of type behaviour at different sizes.

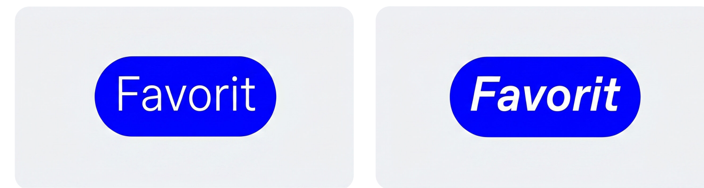
Building on the principles of responsive and variable typography, motion can also be introduced to type, adding a temporal dimension. This idea is further extended through the use of animations and *kinetic* typography, where type variability becomes perceptible over time. When characters are animated through smooth transitions, the user is forced to follow them frame by frame, making the dynamics of the typeface implicit (Viction:ary, 2020, p. 5).

In this sense, responsiveness goes beyond a matter of technical adaptation, becoming a question of perceptual continuity. Variable fonts help to create a stronger sense of consistency across devices through subtle adjustments, thereby permitting typography to transcend its mere existence as form and become defined by an inherent behaviour.

4.4. Interactivity

Interactivity in variable fonts refers to their ability to translate user input into typographic actions. These actions can take various forms, such as hovering the cursor, scrolling the screen, clicking or controlling using gestures. Thus, when the user performs an action, it activates a trigger that directly influences the typographic behaviour in real time, making the reading experience more intuitive and engaging.

Hover interactions, for example, trigger immediate typographic change, such as shifts in weight, width, or slant when the cursor hovers over a defined element 4.6 . These transitions appear smooth because they operate within the continuous range of the font's axes. Similarly, scroll-based interactions enable text to transform gradually across a page, where typography can transition from thin to bold dynamically in response to navigation.



4.6
Variable font hover interaction: inactive state (left) and active state on cursor hover (right).

This type of interaction is achieved through the use of web technologies with real-time control of variable font parameters, with JavaScript playing a key role, as it can be used to manipulate font variation settings; CSS supports transitions, custom properties, and pseudo-classes, such as :hover, to trigger typographic states. In addition, it is possible to create scroll-driven animations using libraries such as ScrollTrigger, which allows the text to respond continuously to the user's scrolling.

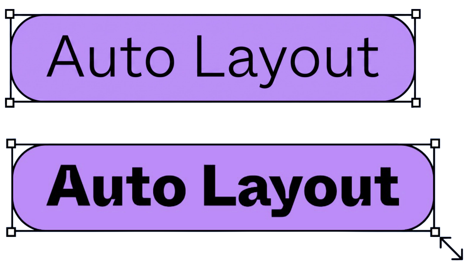
Interactivity drives variable typefaces as a system of continuous interaction between the user and the device, creating a responsive mechanism that reacts to movement, navigation and different choices in real time. This reinforces the idea of typography as an active interface, capable of establishing a direct perceptual connection.

4.5. Design Systems

As digital platforms have become more complex over time, they have created the need to develop structured frameworks—composed of rules, reusable components, and design principles—to ensure a consistent visual language. This necessity has led to the emergence of design systems, which are widely adopted in large-scale websites and mobile applications. They function as scalable mechanisms defining both the visual and functional behaviour of an interface, guiding the product's visual identity and maintaining coherence across teams, platforms, and product ecosystems.

In interface design tools such as Figma, this approach is materialised through design *tokens* and reusable *variables*. Design tokens act as the atomic building blocks of a design system, storing visual attributes such as colour, spacing, and typographic properties in a centralised and structured manner. When integrating VFs into this workflow, tokens can be directly linked to the font's variable axes, such as weight or width. In this way, designers can define precise numeric values that control how the type behaves in order to respond consistently across all parts of the interface.

Taking a button component as an example, if its text is composed with a variable font, tokens can be used to control various typographic parameters, such as weight or grade, within the component 4.7 . In this case, a heavier weight can reinforce hierarchy and visual emphasis in a call-to-action (CTA), while lighter values produce a more subtle appearance.



4.7
Button component showing variable weight parameter used to adjust emphasis and layout scaling.

As dynamic components frequently switch between states such as inactive, focused, hovered, or disabled, VFs allow these transitions to be handled smoothly. Moreover, as noted by Vic-

tion:ary (2020, p. 20), they have the ability to animate different weights and make possible the creation of gradients and patterns, expanding the potential of design systems, and finally meaning that typography can gradually shift across text or repeat in structured variations.

In terms of optimising space in elements containing large amounts of information, such as cards, the width axis of a variable font can be adjusted so that the text better adapts to layout constraints. This lets typography expand or contract horizontally depending on screen size, and results in greater legibility, preventing issues such as text overflow or clipping on constrained screens.

Ultimately, leading design ecosystems such as Google's Material Design [11] and Apple's Human Interface Guidelines (HIG) already reflect this systematic integration of typography. For instance, Google's Material Design 3 supports variable fonts to enable a dynamic type configuration, automatically adjusting attributes such as optical size and weight based on screen scale and accessibility preferences. This modular approach, which can be multiplied, fits seamlessly with the logic of design systems, enabling variable fonts to open the door for new programmatic, creative, and functional possibilities in digital product design.

[11] Google's design system that defines guidelines for building adaptive, accessible, and consistent user interfaces across platforms.

Chapter 5. Type Foundries

5.1. Defining a Type Foundry

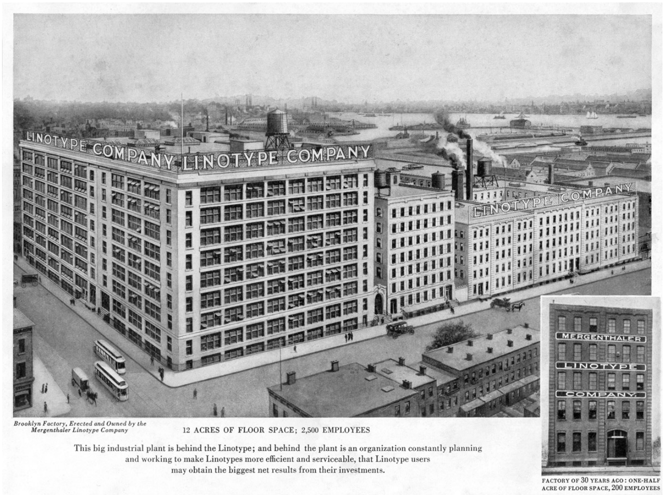
The term *foundry*—or type foundry—refers to a company that designs, produces, and distributes typefaces. As Duru (2013) points out, this terminology is a direct inheritance from the hot-metal era, which has been carried into contemporary practice. Early foundries were physical workshops where artisans produced metal type, which was then distributed to international markets within an industry dominated by a relatively small number of producers (Snaith, 2019).

Over time, this industrial model led to the emergence of large organisations that absorbed smaller foundries in order to increase production capacity and market reach. Baron (2021) provides a clear example with the American Type Founders (ATF), a company founded in 1892 through the merger of 23 small foundries, with the aim of competing with mechanised typesetting technologies. A similar pattern can be observed in European foundries such as the Bauer Type Foundry, established in 1837 and responsible for typefaces like Futura and Venus. In both cases, smaller production units were gradually transformed into larger entities, resulting in a more centralised and industrially structured market.

In parallel with this, during the late nineteenth and early twentieth centuries, the working environments of type foundries changed significantly. Companies like Linotype 5.1 transformed their industrial structure, moving from small workshops to large-scale manufacturing systems equipped with machinery and assembly lines. This consolidation influenced not only production methods; it also redefined the role of type foundries themselves.

Building on these industrial transformations, throughout the twentieth century, Linotype and Monotype reinforced this shift by moving from hardware production to the control and licensing of extensive type libraries. This repositioned foundries as corporate entities responsible for managing intellectual property (Baron, 2021).

5.1
Linotype factory (1919).



With the rise of digital distribution, physical production was gradually replaced by software, and the circulation of typefaces became global and instantaneous. As Duru (2013) observes, this technological transition also disrupted the historical geographical concentration of the industry, which had long been centred in regions such as Western Europe and the United States, particularly cities like New York, London, Berlin, and Amsterdam. While this centralisation is still partially visible today, it is progressively weakened by the accessibility of web-based distribution systems and global digital networks.

Thus, in the contemporary landscape, foundries operate almost entirely digitally, a fact reflected in their current designation as digital type foundries. The very notion of a type foundry has also become significantly more fluid: rather than being industrial manufacturers, foundries now exist in multiple forms, ranging from independent digital studios and agencies that develop and sell typefaces alongside broader design work, to companies specialising in custom typography that release their fonts commercially. This evolution has created a polarisation dividing the marketplace into corporate platforms and independent foundries (Duru, 2013).

Duru (2013) further explains that, on one hand, the corporate platforms refer to large-scale entities and digital aggregators that operate as infrastructural systems for type distribution. This sector is dominated by companies such as Monotype—which consolidated significant portions of the market through the acquisition of historical libraries and retail channels such as MyFonts—as well as platforms such as Google Fonts and Adobe Fonts. These entities manage extensive type libraries and primarily operate through licensing and subscription models.

On the other hand, the accessibility of digital networks has driven the rise of independent foundries. These structures are typically smaller in scale and founded by individual designers or specialised collectives (Duru, 2013). A pioneering historical example is Emigre, while more contemporary studios include Dinamo and Underware. Rather than focusing on mass distribution, they tend to prioritise authorship, experimentation, and conceptual approaches to type design.

At its core, regardless of their operational scale or market positioning, the structural reality of the type foundry has been fundamentally transformed. In the era of variable typography, where typefaces are no longer delivered as static vector files but as dynamic, interactive, and responsive parametric systems, the contemporary type foundry operates—and must be understood—not merely as an artisanal workshop, but as a specialised, software-driven entity.

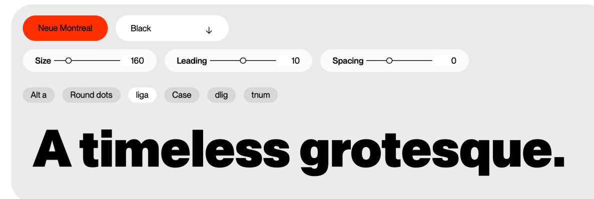
5.2. From Specimens to Interactive Testing

As type foundries migrated into digital environments, the transition from physical production not only transformed their internal structure, but also redefined the ways in which typefaces are showcased, tested, and evaluated. Historically, the primary medium used by foundries to present typefaces was the printed specimen 5.2 . This took the form of a catalogue that allowed designers to analyse the behaviour of a typeface across different contexts and typographic applications, serving simultaneously as a tool for selection, comparison, and decision-making. Beyond their functional purpose, specimens were also carefully designed editorial objects, often viewed as expressive artefacts.

5.2
Printed specimens (1993–2000).

However, throughout the digital era, these physical documents evolved into screen-based formats, disrupting their static nature. In particular, the emergence of variable fonts introduced the need for new ways of demonstrating typographic behaviour dynamically, in order to accurately communicate their elasticity. Leonidas (2020) notes that, as the typeface market evolves, specimens mutate to reinforce the notion that typefaces are cultural objects. Consequently, they have been transformed into interactive testing playgrounds integrated directly into foundries' websites.

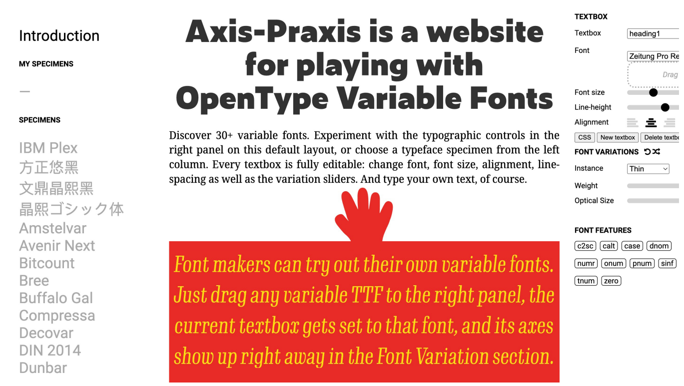
These web-based demonstration platforms typically feature interface elements designed for real-time experimentation, such as variable font sliders. A clear example of this approach can be observed in foundries such as Pangram Pangram, whose website provides users with the ability to manipulate multiple registered and custom axes simultaneously, so that they can observe how letterforms transform fluidly 5.3 .



5.3
Interactive sliders for typographic testing on Pangram Pangram's website.

Beyond observing a typeface's behaviour through pre-defined placeholder text, some interfaces function as browser-based previews that enable designers to type their own words, sentences, or paragraphs. Through these text input fields, it becomes possible to immediately test the spacing, kerning, and overall typographic texture of a typeface under specific layout conditions. In the early stages of variable font adoption, this form of testing was often dependent on external aggregator platforms such as Axis Praxis [12] 5.4 , which operate as an open environment for uploading and

(12)
Online tool for testing variable fonts in the browser, used in the early development phase of variable typography before similar functionality was integrated into type foundry websites.

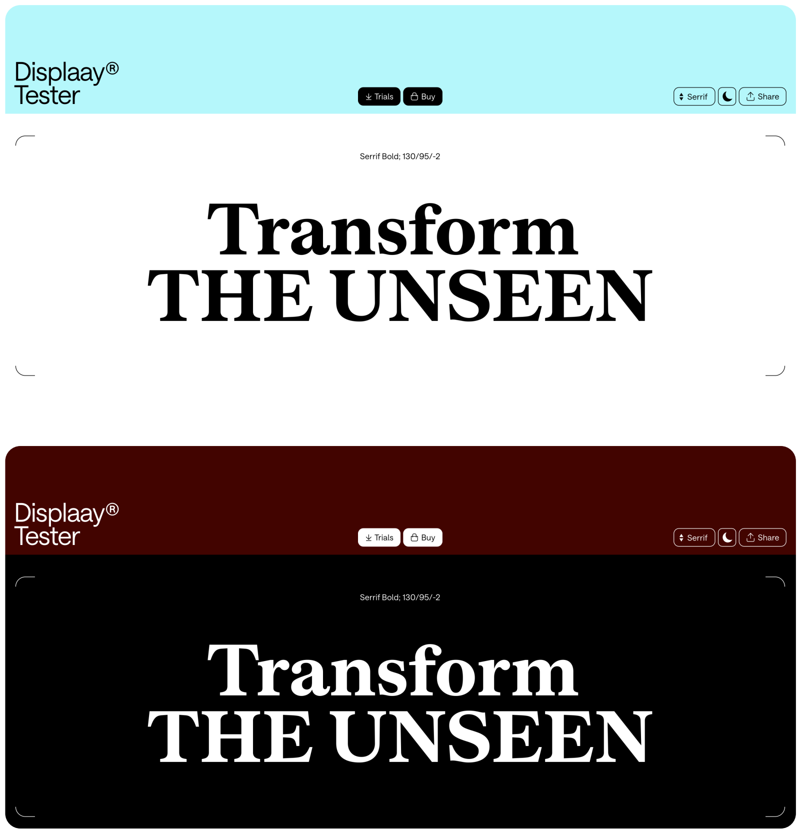


5.4
Custom text input and editing interface on the Axis Praxis platform.

previewing variable font files in the browser. Today, however, many type foundries integrate these advanced testing tools directly into their own websites.

Another common interface feature is the inclusion of mode toggles, which allow typefaces to be evaluated under different environmental conditions. For instance, the foundry Displaay uses these controls to demonstrate their typefaces in both light and dark modes, resulting in a functionality that is particularly relevant in contemporary digital workflows, as it enables designers to observe how optical density and weight respond when inverted against different backgrounds 5.5 .

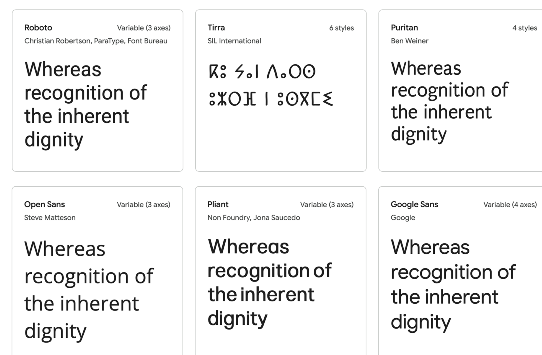
5.5
Light and dark mode toggles on Displaay's website.



In terms of navigating the complexity of these digital libraries, foundries have developed advanced search parameters and typographic filters 5.6 . In most contemporary interfaces, users can filter the catalogue to isolate and display only variable fonts, clearly distinguishing them from traditional static families. This filtering allows designers to quickly find typefaces that meet specific technical requirements.

5.6
Typographic filters and search parameters on the Dinamo website.

The overall structure of online type libraries is closely tied to each foundry's business model. Most independent foundries maintain a curated, smaller catalogue of typefaces designed in-house or in collaboration with a limited number of external contributors. In contrast, global distribution platforms operate on a much larger scale. A clear example of this high-volume model is Google Fonts 5.7 , which hosts an extensive collection of typefaces sourced from designers and type foundries worldwide, including widely used families such as Lato, Roboto, Montserrat, and Raleway (Baron, 2021).



5.7
Typeface catalogue overview on the Google Fonts platform.

Whether through a vast catalogue or a more curated selection, the presentation of contemporary typefaces is becoming less and less static. By combining real-time text customisation with dynamic, continuous controls, type foundries provide an environment where users can test a typeface in a transparent manner before licensing or purchasing it.

5.3. Promotion Strategies for Variable Fonts

Today, the contemporary type design market is highly competitive, as the industry now consists of hundreds of foundries operating across digital platforms and distribution channels. As a result, promotional strategies have become essential for maintaining market presence and establishing distinction.

Sowersby (2011) argues that producing high-quality typefaces alone is no longer sufficient for commercial success. More than ever, contemporary type foundries operate with a dual function: making fonts and selling fonts. In this context, for a typeface to reach its audience and achieve visibility, it must also be supported by effective marketing strategies capable of communicating its design intent, technical capabilities, and unique qualities to potential users.

Because variable fonts are inherently dynamic software products, promoting them requires a shift toward more active forms of storytelling, often centred around the idea of 'one font, multiple possibilities.' To communicate this flexibility, foundries frequently rely on showcasing their typefaces in real-world applications through "Fonts in Use" sections on their websites 5.8 , as well as detailed case studies. Simonson (as cited in Duru, 2013) states that "the best kind of visibility for a typeface is having designers seeing other designers using it in their work." From there, designers are

able to evaluate typefaces within practical contexts, which helps to contextualise their visual behaviour, adaptability, and potential applications.

5.8
"Fonts in Use" section showcasing real-world applications on Pangram Pangram's website.

The interactive catalogues discussed previously also function as important marketing tools. Beyond simply presenting a typeface, these environments actively demonstrate its technical possibilities through interaction, allowing users to experiment directly with variable axes and broader typographic transformations. In the realm of variable fonts, this form of engagement becomes particularly effective, as the flexibility of the typeface can only be fully understood through dynamic manipulation.

Currently, most foundries also promote their typefaces through mainstream social media platforms such as Instagram, TikTok, and X (Snaith, 2019). These channels help foundries to rapidly disseminate new releases, animated specimens, motion-based demonstrations, and visual experiments to large audiences. Animated and video-based content aligns especially well with VFs, since they make it possible to demonstrate continuous typographic transformation in ways that static images cannot.

Naturally, larger type foundries possess greater financial and infrastructural resources to invest in marketing strategies. One example is Typofonderie, which frequently accompanies new typeface releases with detailed documentation explaining the design process and the technical development behind them. By doing so, they construct a narrative around the font that not only promotes its functionality but also reinforces its cultural and conceptual value (Duru, 2013).

5.4. Licensing and Distribution

From a commercial standpoint, type foundries adopt different licensing models that define the conditions under which a typeface may be accessed and used. When users purchase a typeface, they are not buying the font as a product, but rather acquiring the right to use it. These agreements protect both the user's interests and the foundry's intellectual property (TypeType, 2024).

The End User License Agreement (EULA) is the standard legal instrument in commercial font licensing, defining the rights and restrictions associated with its deployment. Most EULAs prohibit modifying, manipulating, or altering the font, meaning that designers are not permitted to directly adjust glyph structures within the file. As Bringhurst (2008, p. 199) suggests, digital fonts are technically highly modifiable systems, although they are not intended to be altered in practice; when extensive modifications

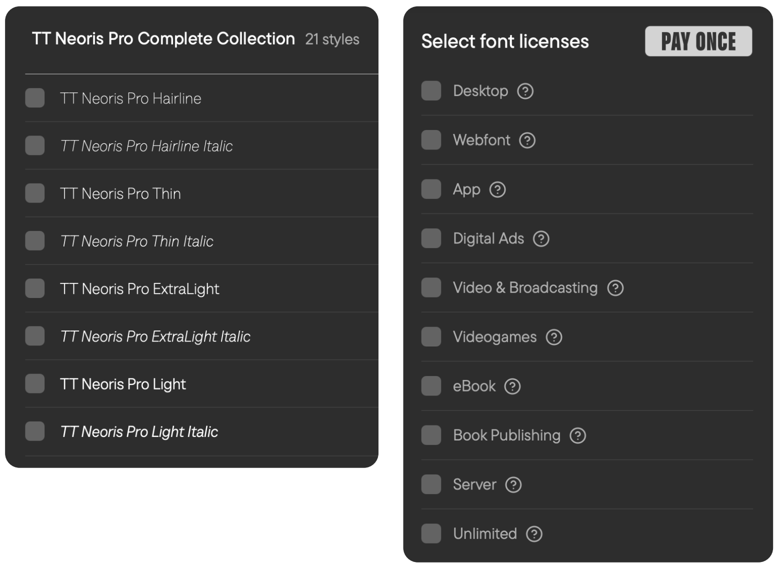
are required, it is generally more appropriate to choose a different typeface or develop a custom one from scratch. The author notes:

> *Any part of the font can be tuned—lettershapes, character set, character encoding, fitting and sidebearings, kerning table, hinting, and, in an OpenType font, the rules governing character substitution. What doesn't need tuning or fixing shouldn't be touched.*

There are several different licensing models available. The most traditional one is the perpetual license, in which users pay a one-time fee to obtain long-term usage rights for a typeface. This approach is commonly used by independent foundries and smaller digital studios. In contrast, subscription-based licensing has become increasingly widespread, functioning as an option where users do not buy individual font files, but instead pay a recurring fee to access a continuously updated, cloud-based library of typefaces. This second system is strongly associated with platforms such as Adobe Fonts (Monotype, n.d.).

A third model is open-source licensing, in which platforms such as Google Fonts offer free access to vast font libraries under frameworks like the Open Font License. As Middendorp (2019) points out, whilst this allows unrestricted use in most contexts, it also raises broader debates around the economic sustainability of type design. The extreme accessibility of Google Fonts has changed the way typefaces are perceived in terms of value, particularly by establishing free access as a standard expectation for many designers and clients. At the same time, it is worth noting that these open-source repositories have played a key role in accelerating the adoption of variable fonts, as they have enabled a wide range of companies to experiment with and adopt them.

For all these models, licensing is structured according to different usage environments. Desktop licences remain the most common for local installation and are typically used for print design, branding, and static visual production. Web licenses regulate the embedding of fonts into websites, and are generally priced based on the number of page views or monthly traffic. Other types include app and embedding licenses 5.9, which are required when typefaces are integrated directly into digital products such as mobile applications, video games, or interactive software systems. In this sense, licensing has become increasingly complex, as typefaces now operate across multiple platforms simultaneously (TypeType, 2024).



5.9
Font license selection interface on the TypeType website.

More recently, VFs have introduced an additional layer of complexity into licensing structures. As they are provided as single files containing multiple axes of variation, questions arise as to how their use should be defined in different contexts. In response, some type foundries have adapted their licensing strategies to reflect this technical flexibility, either by licensing the full variable font as a single asset or including it in complete typeface families, adjusting prices to reflect the added versatility of the format.

Beyond licensing itself, another important aspect that foundries must address is the way typefaces are distributed; this refers to the systems and channels through which fonts are made available to users. In the digital context, distribution no longer depends on physical circulation, but on networked platforms that enable access, download, and implementation of typefaces.

Middendorp (2019) notes that the emergence of MyFonts in the early 2000s marked a crucial turning point in this field. Founded by Bitstream in 1999 and later acquired by Monotype, MyFonts became one of the first large-scale online marketplaces for font licensing and distribution. Its aim was to centralise a wide variety of fonts in a single place, thereby introducing an innovative form of democratisation and making it possible for independent foundries to reach a vast number of new users of digital typography.

In addition to these systems, many foundries choose to distribute their fonts directly through their websites. In this case, the foundry acts as both producer and distributor, hosting its own catalogue and managing access to its typefaces. This approach affords greater control over pricing and presentation, whilst also allowing foundries to shape the way their work is perceived. As a result, foundry websites function as hybrid spaces that combine commercial distribution with editorial and interactive content.

There is also another option, where typefaces are distributed through third-party distributors and aggregators that act as intermediaries between type foundries and users. Examples of this include platforms such as Adobe Fonts, Fontspring, and Type Network, which distribute fonts on behalf of various foundries. Although this model enhances visibility and simplifies access for users, it also introduces a layer of mediation that reduces direct control over the user experience (Snaith, 2019).

Variable fonts can make this ecosystem more complex, as their distribution is increasingly linked to interactive and browser-based environments. Rather than being viewed as static font families, they should be accessed through live previews, sliders, and real-time manipulation tools. This reinforces the role of foundry websites not only as commercial platforms, but also as technical and experiential infrastructures. Similarly, curated directories such as v-fonts function as important discovery tools. These systems not only distribute typefaces, but also shape how they are encountered, filtered, and compared.

5.5. Industry Adoption of Variable Fonts

Considering that variable fonts were introduced around a decade ago, a growing number of studies have sought to assess their actual uptake, particularly with regard to both practical web implementation and licensing acquisition rates among designers and companies.

In terms of web usage, available data indicate that the adoption of variable fonts has been gradual but steady. According to Berret (2026), approximately 33% of desktop websites and 34% of mobile websites used at least one variable font family in 2024. By the following year, these numbers had risen to 39.4% and 41.3%, respectively, demonstrating a pattern of continuous adoption. The study further suggests that “mobile has consistently led desktop by a small margin in variable font adoption”, attributing this trend, in part, to the greater performance benefits achieved on mobile devices, where reducing the number of font file requests has a more significant impact. At the same time, the growing prevalence of mobile-first design approaches has encouraged the integration of variable fonts, as their flexibility is particularly well suited to responsive digital environments (Berret, 2026).

In this sense, Berret (2026) argues that, based on these statistics, variable fonts “have moved from experimental to fairly mainstream in the past few years”. However, their success appears to be driven by a small number of dominant typeface families, as “just a few font families account for a very large share” of their overall use. The most widely used variable font on the web is Noto Sans JP—a Japanese sans-serif typeface from Google’s Noto family—which in 2024 was found on approximately 27% of all websites using VFs. By 2025, this proportion had stabilised at around 25–26% of pages featuring them, indicating a relatively consistent level of adoption. It is followed by three other widely used variable font families: Roboto, Open Sans, and Montserrat (Berret, 2026).

The study goes further by examining how variable fonts are actually used in practice, revealing that their application remains mostly limited to conventional typographic adjustments (Berret, 2026):

> *The common axes that are set in CSS on variable fonts provide insight: the weight axis (wght) is the most used by far—weight is explicitly adjusted on about 57-61% of pages using variable fonts. This indicates that most people use variable fonts basically to have multiple weights in one file.*

The fact that the weight axis clearly dominates the use of variable fonts indicates that, in practice, designers particularly value the ability to make text bolder or lighter, this being the most immediate and frequently used application.

Regarding VFs animation through CSS transitions or keyframes, Berret (2026) describes it as an extremely niche practice. This is supported by the finding that only 0.3% of all websites in

2025 “include an animation or transition involving variable font axes (either via *font-variation-settings*, *font-weight* or other shorthands on a variable font)” (Berret, 2026).

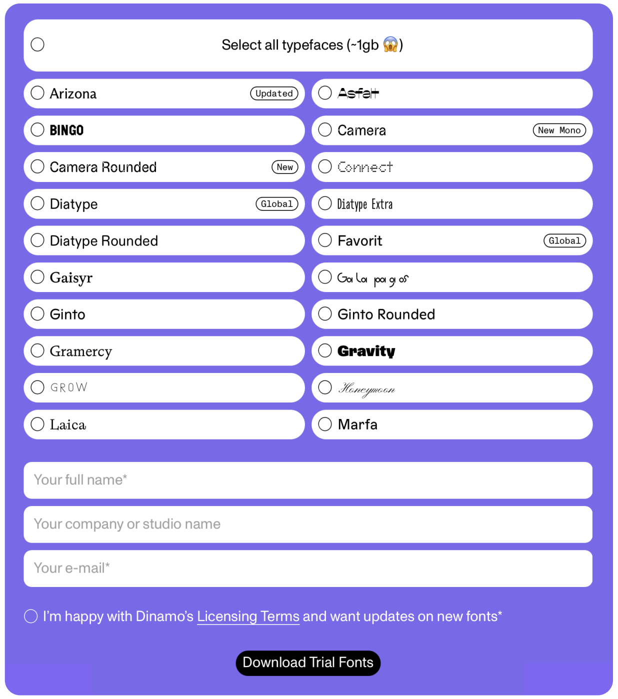
Looking at adoption within professional and commercial contexts beyond the web, Beckwith et al. (2025) report that, up to 2025, 55.5% of designers had already licensed a variable font from a foundry at least once, alongside 24.1% of enterprises that claim to have done the same.

These statistics suggest that VFs have not yet become a dominant standard; however, they do indicate a growing recognition among designers of their functional advantages, reflected in increasing levels of experimentation and practical adoption.

5.6. Trials and Anti-Piracy Measures

One important mechanism widely used in the contemporary type industry is the distribution of trial fonts 5.10 . As TypeType (2024) explains, they allow users to test a typeface by downloading fully functional or partially restricted versions before committing to a licence. As such, trial fonts function both as a marketing strategy and as an evaluation tool, enabling designers to test the typographic performance and technical capabilities directly within their projects. In this sense, the act of evaluation becomes an integral part of the decision-making process prior to licensing.

Trials are particularly important in the context of VFs. Unlike static typefaces, variable fonts cannot be properly evaluated through static previews, since their main feature is the continuous interaction between axes. Designers therefore need to test them in real environments to understand how smoothly these variations behave and whether the typeface meets their needs.



5.10 Trial font download interface on the Dinamo website.

However, these trial systems introduce a structural tension between accessibility and protection; indeed, by distributing usable font files, even in restricted form, foundries inevitably expose their intellectual property to potential misuse. As Wong (2026) notes, “the type industry has operated for decades on a workaround: registering fonts as software programs rather than as typefaces”, meaning that typefaces are legally classified as software, and unauthorised use or redistribution is therefore treated as piracy under international copyright frameworks.

The risks associated with digital font deployment are not new. As Lupton (2014, p. 12) discusses, early web technologies in the late 1990s, such as CSS2’s @font-face rule, enabled font embedding but included no piracy protection, which allowed fonts to be freely downloaded and reused across different websites. It was only in the mid-2000s that web typography regained its momentum, with the development of new web standards, alternative font technologies, and more structured licensing models.

Despite growing concerns surrounding copyright, particularly as web fonts become more widespread, piracy remains one of the most persistent challenges facing contemporary type foundries. Snaith (2019) points out that licensing agreements are often misunderstood: in many cases, unauthorised use does not result from a deliberate infringement, but rather from uncertainty regarding the terms of use of the typeface or the technical implementation.

Whereas the unauthorised use of a static font traditionally involved a single style, a variable font file typically contains a complete typographic system, including multiple axes of variation. As a result, a single unlicensed file can contain a substantially greater amount of intellectual property, thereby increasing both the commercial value and the vulnerability of the font software.

In response, many type foundries invest time and resources in monitoring and enforcing licensing compliance. This often involves identifying unauthorised distributions through online searches and professional networks, followed by legal notices. Given the small and interconnected nature of the type industry, enforcement also relies heavily on informal communication between designers (Snaith, 2019).

Conclusion

As technological advances unfold, the practice of typography is continually redefined in response to the realities of the moment.

Its evolution is visible from the organic freedom of early manuscripts, before standardisation took hold, through mechanisation, when type acquired a new life as a reproducible object, and into the digital era, where it exists within the pixels of the screen. In this way, typography has consistently overcome successive limitations, adapting to the possibilities and demands of emerging technologies. The essence of variable fonts is firmly rooted in this historical pursuit of typographic adaptability.

Throughout the time, type foundries were also required to keep pace with technological change and enter an entirely new paradigm. Rather than simply producing typefaces, they had to reinvent the ways in which these products are presented and experienced, creating interactive specimens with dynamic tools. This new landscape introduces a twofold challenge for contemporary foundries: on the one hand, they are expected to deliver open, interactive environments that allow designers to test variables in real time; on the other, they need to control how fonts are distributed, reinventing methods to protect their intellectual property and prevent piracy.

Overall, it can be argued that the promise made by variable fonts upon their introduction in 2016 is, to a large extent, being fulfilled both technically and practically. The format has achieved its main technical objectives by improving digital performance and providing greater flexibility. As a result, it is now fully integrated into leading design software ecosystems such as Adobe Creative Cloud and Figma, making it an essential component of contemporary design practice.

However, the variable font format is not yet dominant on the web, and only a relatively small selection of typefaces accounts for most of this adoption and has achieved widespread recognition among designers. This suggests that, while variable fonts have become fairly common, they are still not used as tools for fully dynamic typographic expression.

The imbalance between technical adoption and creative exploration suggests that their current role is in transition. As such, the potential of variable fonts should not be understood merely as another font format, but as the latest chapter in a long typographic history. They certainly do not mark the end of this evolution; rather, they embody its continuity, proving that typography is constantly evolving in response to new technological realities. As digital environments continue to transform, so too will the forms through which letters express themselves.

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