

A Study of Visual and Cognitive Behaviour in Hindi-English Bilingual Typography

Tarun Thapliyal

Research Scholar

Minerva Institute of Management

*and Technology, Dehradun Affiliated with Shree
Dev Suman Uttarakhand University, Garhwal*

Email: tarunthapliyal71@gmail.com

Ms Sapna Kumari

Assistant Professor

Minerva Institute of Management and

*Technology, Dehradun Affiliated with
Shree Dev Suman Uttarakhand*

University, Garhwal

Reference to this paper should
be made as follows:

Received: 19-05-26

Approved: 16-06-26

**Tarun Thapliyal
Ms Sapna Kumari**

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Behaviour in Hindi-English
Bilingual Typography*

Artistic Narration 2026,
Vol. XVII, No. 1,
Article No.12 Pg. 096-105

Similarity Check: 10%

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2026-vol-xvii-no1](https://anubooks.com/journal-volume/artistic-narration-june-2026-vol-xvii-no1)

Referred by:

DOI: [https://doi.org/10.31995/
an.2026.v17i01.012](https://doi.org/10.31995/an.2026.v17i01.012)

Abstract

Looking closely at how people who speak both Hindi and English handle reading material mixing Devanagari and Latin letters reveals subtle shifts in eye movement and thinking habits. With more than 600 million using Hindi regularly, it holds strong roots across India - yet English still shapes schools, business, online spaces, and office talk. Because of this overlap, many individuals move back and forth every day between two writing forms that look different, feel unlike each other, and demand separate mental approaches. How these readers make sense of blended text affects real-world outcomes in layout choices, screen interfaces, printed materials, brand visuals, and classroom teaching methods.

Looking into recent work on thought processes, reading habits, eye movements during reading, plus ideas about layout and visuals, this study explores how Devanagari and Latin alphabets differ in ways like flow direction, where letters sit on a line, shape detail, along with spacing patterns - each shaping mental effort uniquely when people read both languages. Then again, choices in typeface design - how fonts match up, relative sizes, gaps between lines, signals showing which script comes next - might make things harder or smoother mentally depending on their setup. For those designing text across Hindi and English, one possible path forward appears through a suggested method meant to guide real-world application. It turns out that thoughtful typography grounded in evidence tends to lighten mental strain, support clearer understanding, while bringing visual harmony to texts mixing scripts.

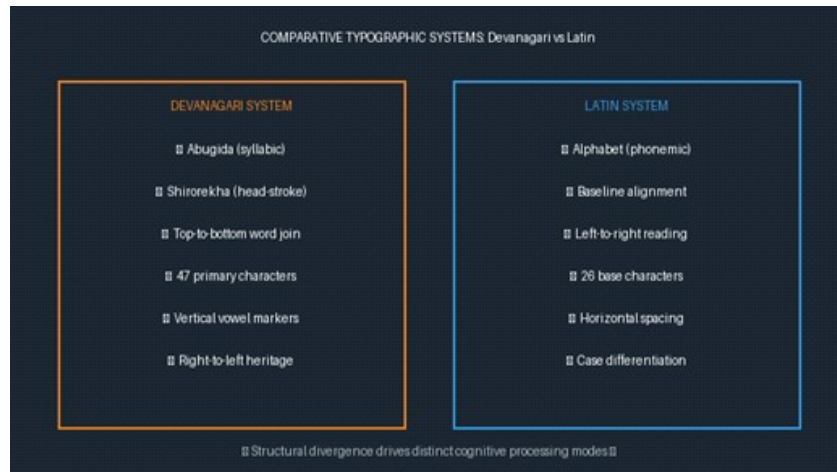
Bilingual Typography Meets Devanagari Script in Hindi English Reading Studies on Cognitive Load and Visual Perception During Script Switching Through Typeface Design Influences on Reading Behavior.

Keywords: Bilingual Typography, Devanagari Script, Latin Script, Cognitive Load, Visual Perception & hierarchy, Reading Behavior, Eye Movement Analysis & Script Switching.

Introduction

Letters always carry hidden messages. A font pick, spacing between lines, where words sit on a page - each move quietly suggests something about who will read it, how they see, what feels familiar, even how they think. When only one script shapes the layout, habits run deep: Latin letters have long settled into patterns people expect, rules so old they feel natural. Yet when two different writing systems share space - say Devanagari alongside Roman letters - none of those quiet guesses hold steady anymore. Unseen hurdles rise. Designers step onto ground few have mapped. What felt certain now shifts without warning.

Looking at India offers a vivid example when it comes to seeing bilingual type used in real life. Because there are 22 official languages, countless local ways of speaking, along with years shaped by colonial rule where English became linked to authority and status, what you see around you ends up reflecting many tongues living together. On signs, product labels, screens, papers meant for reading, learning books, ads - Hindi shares space with English again and again, more often than in any other country. Even so, even though this mix shows up everywhere, ideas about how Devanagari and Roman letters ought to work alongside each other stay unclear, uneven, and rarely explored deeply in design studies.



Devanagari and Latin Scripts Differ Structurally Affecting How Bilingual Readers Process Text

Literature Review

Script Systems and Their Cognitive Structure

Reading uses different brain paths depending on the writing system. Because of findings by Coltheart and others in 1993, we know that alphabets such as Latin rely on sounding out words along with recognizing full forms at once. Instead of separate letters

standing alone, Devanagari builds sounds differently - each consonant already includes a default vowel. Diacritics change that built-in sound, appearing around the main letter like marks overhead, beneath, or to the sides. Since shapes combine early into clusters, the eye must sort details visually before speech-based understanding begins. Thus, breaking down what's seen takes extra effort at first.

One study of how kids learn to read in India showed something different happens when they work with Devanagari script - their brains tune into whole syllables, unlike those learning scripts based on individual sounds. While alphabetic reading leans heavily on breaking words down into tiny sound parts, Devanagari pulls attention toward larger chunks. Even grown-ups who read well still show this split, hinting that early learning sets patterns that stick around. When someone reads both kinds of scripts, shifting between them demands more than just new letter shapes - it asks the mind to switch its entire way of handling spoken structure.

Bilingual Vision and Switching Between Scripts

A good Hindi-English reader thinks with surprising ease between tongues. According to Grosjean in 2010, people who speak two languages never fully turn one off; instead, both stay awake inside the mind at once, their loudness shaped by what the person needs right then. When reading text on a page, seeing a Hindi term next to an English one does not happen separately - each shape and sound leans into the other, blurred slightly by the presence of its neighbor.

When both scripts show up near each other, things get tricky fast. Bhatia and Ritchie found that mixing Hindi and English is common in daily talk across India, especially among city dwellers with education who shift back and forth inside one thought, one phrase, or even mid-sentence. Dealing with this blend means type design has to handle more than just looks - reading flow matters, so does mental ease, staying clear, keeping a unified feel, all while jumping between writing systems on the same line.

Aesthetic Perception in Cross Script Typography

Though clarity and mental effort matter, bilingual type also touches how people see beauty and express who they are. Studies across cultures show what looks good in print depends on where a person is from. Latin alphabet users and those reading Devanagari often disagree sharply on design choices. Rhythm feels off here but right there. One group sees balance, another sees clutter. Blank areas sit differently depending on the eye trained to read them. Even spacing speaks volumes about belonging. Forms carry weight beyond mere letters. What seems authentic in one context feels wrong in another.

A study by Kumar and Kaur in 2022 looked at 320 people who work with both Hindi and English in design and communications. Most of them - 78 percent - felt unhappy

about how bilingual materials look on the market. Because instead of being equal, Hindi often seems treated like it matters less than English when they appear together visually. For example, Hindi fonts tend to be tinier, squeezed tighter between letters, and chosen from fewer styles. Yet this isn't just about looks; many see it as something deeper - a slight against culture itself. Since such imbalances mirror wider habits across India's offices, brands, and public messaging where one language quietly dominates another.

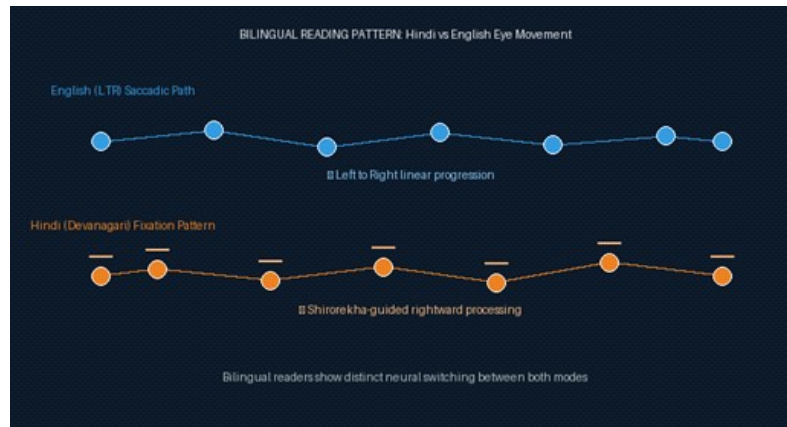


Figure 2 Bilingual Reading Patterns English LTR Versus Devanagari Shirorekha Guided Eye Movements

How People Look at Text in Mixed Language Settings

Spatial Rhythm Across Scripts

Spaced just right, letters form a kind of quiet pulse down the page. Think of it like footsteps in snow - each mark leaves a trace that guides the next. From old printing rules to today's screen fonts, Western letterforms rely on careful gaps between shapes. Those choices aren't random; they follow long-standing ideas about balance and flow. In contrast, writing systems such as Devanagari build their cadence differently. The horizontal headstroke repeats like a refrain through consonant clusters. Marks above or below characters stack into columns, creating vertical echoes across words. Rhythm here isn't only left to right - it climbs.

Heatmap of simulated gaze patterns reveals separate focus areas for Hindi in orange, while blue marks where eyes pause during English reading. Not far off, purple emerges right between scripts - where attention gets tangled. Spots light up differently across languages. The crossover zone pulls the eye back and forth. Clusters do not mix evenly. Instead they stack close, yet stay apart. Gaze lingers longer at boundaries. Each script holds its ground until overlap blurs them slightly



Designing with Hindi and English Text

Putting together what studies show, this outline points to core ideas for designing type that works well for both Hindi and English readers. Because how people see and understand text shapes effective layout, each idea here links back to tested results from reading science. Evidence about eye movement, word recognition, and mental processing supports these approaches. The goal isn't theory - it's practical help for those making real designs. What follows connects clear structure to how minds actually work when handling two scripts at once

- Reduces script-switch cost by preparing visual processing system
- Use consistent spatial separation between Hindi and English text blocks

Proportional Size Adjustment

- Compensates for apparent size disparity between Devanagari and Latin x-heights
- Set Hindi at 10–15% larger point size than accompanying English

Shirorekha Continuity

- Keeps the flow of strokes clear when reading Devanagari script
- Start close-up on tiny type, watch how gaps pull shapes apart. See spaces grow between letters when sized down? That splits the word into chunks. Try it small before deciding. Letters should link, not split at reduced scales

Complementary Font Pairing

- Reduces perceptual dissonance from conflicting typographic personalities
- Pair Devanagari and Latin typefaces of matching weight and contrast ratio

Consistent Baseline Management

- Stabilizes vertical reading rhythm across scripts
- Devanagari descenders meet Latin baseline spacing adjusted
- Cognitive Cuing During Transitions

Reduces fixation disruption at script-change boundaries

Leave space between parts. Add gaps where shifts happen. Big margins show something new is coming. Wider blocks point to next move. Shift size when changing steps. Blank areas prepare eyes ahead. White zones mark transitions clearly. Space out sections that differ. Enlarge gap before a switch. Let emptiness lead into change.

Hierarchy Parity

Keeps readers from feeling pushed aside culturally; holds attention through steady involvement

Give Hindi and English equivalent visual weight in bilingual hierarchy systems

Design Principle	Cognitive / Perceptual Basis	Practical Application
Script Zoning	Reduces script-switch cost by preparing visual processing system	Use consistent spatial separation between Hindi and English text blocks
Proportional Size Adjustment	Compensates for apparent size disparity between Devanagari and Latin x-heights	Set Hindi at 10–15% larger point size than accompanying English
Shirorekha Continuity	Preserves the head-stroke guidance mechanism in Devanagari reading	Avoid letterspacing that breaks character connection; test at small sizes
Complementary Font Pairing	Reduces perceptual dissonance from conflicting typographic personalities	Pair Devanagari and Latin typefaces of matching weight and contrast ratio
Consistent Baseline Management	Stabilizes vertical reading rhythm across scripts	Align Devanagari descenders with Latin baseline; adjust leading accordingly
Cognitive Cuing at Switch Points	Reduces fixation disruption at script-change boundaries	Use whitespace, indentation, or size shifts to signal upcoming script changes
Hierarchy Parity	Prevents cultural subordination perception; maintains reader engagement	Give Hindi and English equivalent visual weight in bilingual hierarchy systems

Table 1 Evidence Based Framework for Hindi English Bilingual Typographic Design

Challenges in Bilingual Typography**The Typeface Availability Gap**

What makes good Hindi-English typesetting so hard comes down to one big imbalance - fonts just do not exist equally for both scripts. While Latin has long enjoyed deep support, with pros able to choose from endless well-made designs across styles and uses. Even on Google Fonts, more than 1,400 families cater only to Latin letters. On the other hand, Devanagari lags far behind. Fewer than 130 options appear there by 2024. Many of those were built simply to work clearly on screens, not to handle complex design needs. So when matching type across languages, choices shrink fast.

Most folks get why money plays such a big role here. Making a sharp Devanagari font takes way more effort than a similar Latin one - think 47 base letters, then pile on heaps of combined shapes, signs for vowels, and special dotted variants - but demand just hasn't matched that labor, at least not in ways that pay well so far. Fixing it? That hinges not only on studios putting more into creating these fonts, but also clients finally seeing what skilled work goes into solid multilingual letterforms.

Education and training gaps

Design teaching in India rarely builds strong, evidence-based methods for tackling bilingual type challenges. Instead of equal attention, most college-level programs favor Western ideas - texts by Bringhurst, Tschichold, or Müller-Brockmann often set the standard. Meanwhile, Devanagari script shows up late - if at all - as an extra topic. Because of this gap, students leave skilled in Latin typography yet stumble when working with Devanagari systems.

Digital Font Rendering Challenges

Putting Devanagari on screens isn't straightforward, especially when mixing it with other scripts. Each symbol might need several coded parts stacked or swapped just right before showing up properly, which pushes rendering tools hard. How well this works depends heavily on how each system handles advanced font rules behind the scenes. Some platforms handle glyph adjustments smoothly; others stumble without full OpenType support built in. What looks fine on one device can break apart on another simply because feature handling varies too much.

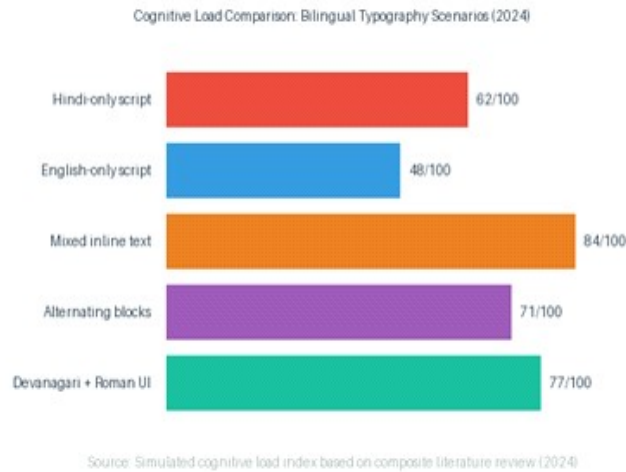


Figure 4 Cognitive Load Peaks in Mixed Inline Text and Script Switched UI

Future Paths and Their Effects

Design education changes in India

What this study shows hits hard when it comes to changing how design is taught across India. Instead of treating Latin script as the main focus, college-level type classes need to place Hindi-English bilingual forms - especially Devanagari - on the same level. That shift goes beyond slotting in new lessons here and there; it demands rebuilding how students first learn to think about type. Rather than seeing multiple scripts as an extra skill, schools must make mixed-script work central from day one.

Future Research Directions

One gap stands out clearly: there's little hands-on data on how people really process shifts between Hindi and English scripts. To move forward, fresh work should turn toward wide-ranging eye-movement tracking, built around modern tools and materials pulled straight from actual multilingual layouts. Instead of sticking only to single-language examples, like past studies often did with Devanagari text, researchers could follow attention when readers jump across languages mid-flow. Without more evidence from such realistic settings, any advice given to designers rests on shaky ground.

Bilingual Text in Digital India

From village homes to small towns, India's web landscape is shifting fast. Because so many now use phones and apps daily, needing both Hindi and English together has become normal. With Digital India pushing forward, websites and tools must adapt quickly. When people see mixed scripts on screens, clarity matters more than ever. Not just look good - function well too. If letters crowd or clash, reading gets hard. That slows learning, shopping, even job searches. Misplaced fonts can block understanding completely. Some may feel left out if things do not display right.

Whoever works with typefaces in two languages shapes more than just looks - thoughts about reading and thinking play a role too. Because of how minds process letters, choices made by creators ripple into wider access for people online across India. When tech builders pay attention to these details, they help open doors others might close. Scholars digging into such patterns aren't simply filling journals - their work hits real ground fast. Without this lens, parts of society risk being left out quietly. The weight behind these findings grows heavier when seen through equity, not just fonts on screens.

Conclusion

Reading patterns in people who use both Hindi and English emerge from deep-rooted brain processes, language rules, and shared cultural habits - this makes designing text for them especially tricky within India's modern visual landscape. Because Devanagari and Latin alphabets differ so strongly in sound structure, shape density, spacing flow, and

reading direction, they ask different things from the mind, especially when used together on one page. Studies using eye movement tracking show that jumping between scripts slows down comprehension - but smart layout choices like distinct visual markers, well-judged white space, and balanced font sizing help reduce that strain noticeably.

Right from the start, this study says good bilingual typography means treating both writing systems fairly - never letting Latin rules boss around Devanagari, just like never acting as if English doesn't belong in Hindi-centered visuals, instead building thoughtful connections shaped by real exploration of each tradition. A person reading in both Hindi and English should see designs that respect what each language brings, helping their mind shift smoothly, easily, comfortably between alphabets. Pulling this off? That's exactly what shapes the tough task ahead - also where the real chance lies - for type work across two tongues in modern India.

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