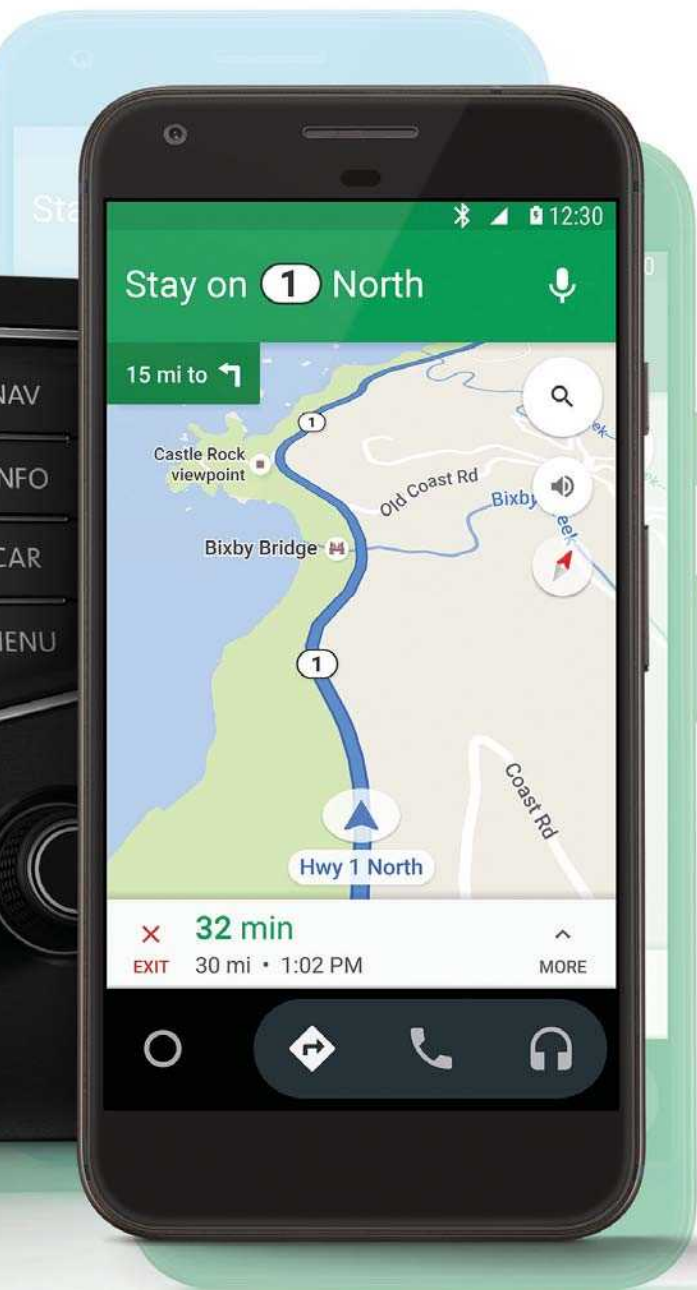


[THE ART OF THE GLANCE]



Monotype and MIT's Clear-IP research lab shows typography's true power—and how designers can more effectively wield it for the greater good.

by Jason Tselentis



Studies from Clear-IP have helped Android Auto's research team better understand a driver's use of in-vehicle displays. Image courtesy Android Auto.

Typography is the first thing we see every day. Our alarm clock, watch or smartphone sounds, and we check the time. Preparing breakfast, we see type on kitchen appliances such as microwaves, ovens and refrigerators, as well as toasters—and increasingly, those appliances have complex LED displays. Typography has also overtaken our automobiles, with many cars now including large digital displays

that can sync to our smartphones to showcase most of our device's content. The music we listen to, as well as traffic and the day's mapped destinations, all feature typography for us to read—or glance at—during our commute.

In those *brief-glance environments* such as in an automobile, safety matters, and the time we take our eyes off the road can make all the difference. We have to translate and interpret what we see in fractions of a second, and it's designers who are responsible for making sure everything works correctly. What typeface or typefaces will read best? How big should the text be? What about the type's contrast and color? The type designers who make typefaces and the graphic designers who use those fonts have an appreciation and understanding of how type works. But what if the guiding principles designers understand and use are wrong—or at the very least, misunderstood? What if the age we're living in, full of digital devices and quick glances at screens, necessitates new standards and guidelines for typography?

Sure, there are differences in typefaces used for a variety of applications, such as those made for distance reading versus close reading. But the decision-making process requires more than these factors—a lot more, according to Bryan Reimer, Ph.D., a research scientist in the MIT AgeLab and the associate director of The New England University Transportation Center at MIT.

"Every design is the end result of thousands of decisions, large and small," he says. "What makes a design most legible will vary depending on the situation—is it printed? Digital? Indoors? Outdoors?—and must be balanced with the intent of the design."

Reimer and his colleagues at the Clear Information Presentation research consortium (Clear-IP) are delving far beyond the surface properties of typography and exploring the way it works in glance-based environments—with the intention of discovering how, exactly, we can all make it work better.

GOING TYPE-FIRST

Monotype and MIT created the Clear-IP collaboration in 2012 to study visual design, typography and usability in highway signage and automobile interfaces, two areas where brief glances are routine. As the founder and leader of Clear-IP, Reimer and his colleagues have conducted research on text legibility, but they have also widened their investigations to other areas of design. It's a team effort between Monotype and MIT's AgeLab, along with Google, which has joined as Clear-IP's first full-fledged member. In the case of Android Auto, Clear-IP's

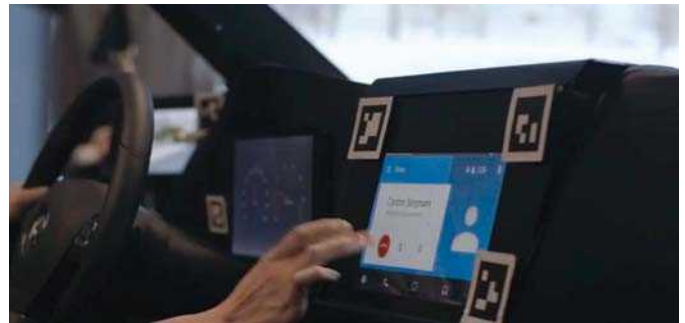
findings help inform the team’s design decisions, assisting them with understanding how typefaces and typographic layout can influence a driver’s use of in-vehicle displays.

On the whole, Clear-IP’s research, new discoveries and findings may signal fresh design paradigms in our always-on, all-digital, brief-glance day and age.

As technology has taken deep roots in our lives, so too has typography, to the point that a designer might need to now work *type-first*. In the case of brief-glance environments, typography is the primary design element, and sometimes the only design element, along with shape and color. Automobiles, mobile devices, HTML advertisements and, yes, even your refrigerator are just some of the environments where we now see typography on a routine basis, says Nadine Chahine, Ph.D., type director and legibility expert at Monotype and member of the Clear-IP board of directors. “There are many questions we want to answer, but we cannot do the research on our own,” she says. A variety of contributors to Clear-IP are conducting research that results in “empirical data to guide decisions on typography and design. What we need is a thirst for knowledge, and more support for the approach for scientific questioning.”

In addition to being Monotype’s resident Arabic expert, Chahine’s research focuses on *psycholinguistics*—how we read and how our eyes move during the act of reading. She finished her independent legibility research in 2012, the same year Clear-IP was founded. Per Chahine, Clear-IP’s goal is simple: to “quantify the effect of not choosing the right typeface.” Chahine cites one example in which a designer might use black text on a white ground because it’s *thought* to be more legible, and more so at night—but success can depend on how much light goes into the retina, and how it affects the size of your pupil. Jonathan Dobres, a research scientist at MIT AgeLab, elaborates: “We’ve found that more light generally improves legibility. The exact reason is an ongoing debate in the field, but ... under lower lighting, our pupils dilate and get larger. Because the surface of the eye is imperfect, this distorts the incoming visual information. Under brighter lighting, the pupil is tighter and there is less chance of optical aberration. So brighter lighting tends to result in clearer images from the eye, or so the theory goes.” These findings were published in “Effects of Ambient Illumination, Contrast Polarity and Letter Size on Text Legibility Under Glance-like Reading,”¹ and Dobres stresses the need for more research. “The dynamics of this pupillary response, and its implications for legibility, beg further investigation—particularly in regards to how these dynamics change when one is switching between bright and dark rapidly, as one may when using an in-vehicle device during night driving.”

Given Clear-IP’s collaborations between scientists, typeface designers and automotive experts, is it a case of art meeting science? Perhaps it’s better framed as entirely science and research, especially since purpose comes first, even with typeface design. Chahine calls type design—the practice of creating, designing, testing and producing typefaces—“practical design” intended to fulfill a purpose. It’s not only about the visual solution, the



Android Auto in action. Images courtesy Nat & Friends, via YouTube: <http://youtu.be/OFHjmDrUF9A>.

design on the surface, but also factors such as age, suboptimal viewing conditions and accessibility.

Whether it’s the type designer who creates it, the graphic designer who composes with it, or the user who reads it, everyone has one thing in common: They each utilize a translation mechanism. Chahine says the mechanism in our brain recognizes type and makes sense of it via its own code. When translation fails, we don’t recognize the letterform or letterforms, and the typography fails. Much of what we see and translate is based on what we know, and Chahine cites factors such as vision, culture, familiarity and speed, all of which play into the translation. Speed is what the eye can gather in a given amount of time, and with more people referencing screens more than ever, the bottom line is that typography *has* to work. The process of designing, testing and reviewing, and then verifying and reverifying what works, is important when it comes to how typography functions when fractions of a second matter—and matter a lot. In some cases, Clear-IP has undertaken equipment-intensive research studies, such as with “Assessing the Impact of Typeface Design in a Text-Rich

Automotive User Interface.” Dobres cites the importance of the study and such research: “Our first typographical study performed in a fully simulated driving environment showed that the choice of typeface used for an in-vehicle menu system made a measurable and significant difference in the amount of time spent glancing to the screen, number of errors made, and overall time completing tasks while driving. While it is difficult, of course, to draw a line directly from these indicators to roadway safety, it is certainly reasonable to say that they are related. We want a vehicle environment that keeps the drivers’ eyes on the road, and typography that is optimized for legibility allows the driver to complete a potentially distracting task and return his/her eyes to the roadway quickly.”

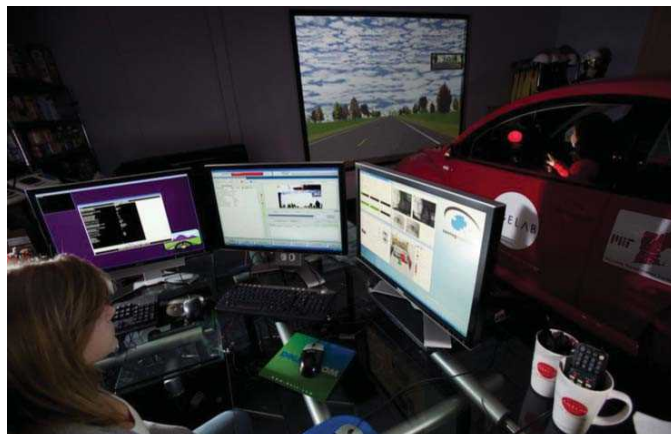
While Clear-IP has a particular focus on typography in vehicles, it’s not the only issue they seek to address. “There are many new environments that we need to design for that we know very little about, or that present design challenges that are completely new to us,” Chahine says. “This is particularly the case with augmented reality, virtual reality, as well as digital displays that require very fast reading speeds or are very small in size and need design solutions that can adapt to that. ... It really is about the testing of how well the design decision we take works, and our research has shown that some of what we assume to be better is not always the case. So we too have been surprised sometimes by the research results.”

PUTTING ON THE BEST FACE

Not that long ago, when we wanted to find an unfamiliar destination, we’d use a printed map to help guide our journey. Maybe it was drawn by hand, based on what we saw on a phone book’s map—or maybe we tore the map *out* of the phone book. But these days, we have a map on our phone and will read it and walk. This, Chahine says, is a good example of a “new reading situation” that designers must analyze, “especially if a handheld device is being read in low ambient lighting or on the move (both being suboptimal conditions for reading).”

Clear-IP’s rigorous approach requires scientific questioning to drive the quest for answers. In one study Chahine conducted, Clear-IP tested the Neue Frutiger Regular typeface at two sizes (3mm and 4mm cap height) in two line spacing values (0% and 33%). “The results were interesting, as the 4mm with 0% line spacing performed better than the 3mm with 33% line spacing. The latter looks nice, cleaner and would be what I would have chosen as a designer. The logic for that is that the extra spacing around the words would have improved reading. However, it seems that the effect of size is bigger than the effect of line spacing, so while line spacing brings a benefit to design, it cannot compensate for the hurdle of setting text in a relatively small size. This is what we are usually referring to when we say that we need to know how to balance our design decisions and to understand how each factor affects legibility.”

Dobres cites one study the group conducted, “Utilising Psychophysical Techniques to Investigate the Effects of Age, Typeface Design, Size and Display Polarity on Glance Legibility,”³ which yielded unexpected findings about typography as well as demo-



An automobile testing environment in the MIT AgeLab. Photograph by MIT AgeLab.

graphics. “This study replicated the results found in [a] driving simulator using desktop-based methods, and also expanded the investigation to the effect of font size on legibility. There were two surprises here: First, the interaction between font size and font style was more dramatic than we had thought it would be. It turns out that some fonts scale better than others, likely because of how their design characteristics interact with the pixel grid. This is a nice example of how the art of typographic design interacts with the science of rendering technologies. Secondly, we noticed that in this study, people younger than 30 weren’t really affected by the choice of typeface. Past 30, however, differences in legibility began to emerge. We had thought that these effects would start later in life, but it turns out that ‘aging’ [as it pertains to typographic perception] starts in the early 30s, not the early 50s. This has implications for accessible design.”

When it comes to analyzing specific typefaces, Dobres points out that research studies and results aren’t intended to *absolutely* identify a winner or loser. “We have indeed found that typefaces with larger x-heights and more varied letter shapes have superior legibility compared to those that do not. We’ve also found that black-on-white text is easier to read than white-on-black, though this may have less to do with typeface design and more to do with the amount of illumination emitted by the bright or dark background of the screen. We’ve compared the typefaces Eurostile and Frutiger, for example, and Frutiger is much more legible. It’s also important to keep in mind that we aren’t saying that Frutiger is absolutely always better than Eurostile, or better than any specific font in a specific situation, for that matter. Our work is about understanding the trade-offs that manifest between factors like typeface design, size, color, etc.” (Eurostile was used in the comparison because, according to Dobres, “it was—and still is—popular in in-vehicle interfaces because of its ‘high-tech’ look.” Frutiger, on the other hand, has been a go-to typeface for many designers because of its legibility, a result of its high x-height.)

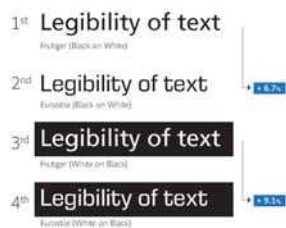
On the whole, Reimer concurs with Dobres.

“Clear-IP’s research does show that some typefaces, for example, seem intrinsically more or less legible at a glance than others.



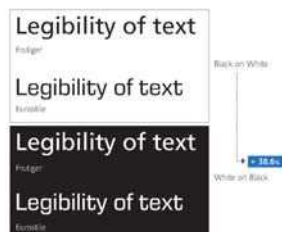
Research Results: Typeface Style

Legibility benefit of Frutiger over Eurostile evident in both color settings.



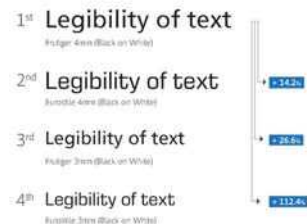
Research Results: Color Settings

Color settings have a big impact on legibility.



Research Results: Style and Size Effects

Frutiger is more legible than Eurostil in both sizes and the 4mm size is more legible than the 3mm size.



But it's not about saying, 'X is always better than Y.' Clear-IP's work is more attuned to the relationships between these factors, trying to understand the web of connections that govern legibility. For example, if a designer wishes to use a somewhat less-glance-legible typeface for stylistic purposes, she may be able to balance that loss of legibility by making the typeface slightly larger."

... What if Clear-IP's research findings suggest we've been going about things incorrectly—or at least a bit differently than we should? Who would need to be alerted? Would it start at the academic level, with university coursework being adjusted? Would practicing designers need to change the way they go about their jobs? Chahine says everyone would need to know. "We would have to open the eyes of the design community," she says. She suggests that publishing results, writing articles, giving talks and taking part in interviews are just some of the ways to get the word out about Clear-IP's findings and to raise awareness.

BALANCING FORM AND FUNCTION

All of this talk about typography, and testing and verifying what works or doesn't, can cause a designer to question their role, or even second-guess their work. But similar to choosing between two typefaces, it's not necessarily about right versus wrong, Reimer says. It's about improvement. "Our hope is that Clear-IP's research allows designers to make better-informed decisions. ... We are building a body of research that will help designers understand the 'shape of the landscape' as they balance the many trade-offs that go into any design."

Part of that overall improvement extends to the larger team-based environments where, say, automobiles are created. It's not only designers who play a role in choosing and using typefaces, but also engineers, as Reimer details in the MIT short film *Impact of Typeface on Driver Demand*.⁴ He cites a "tug of war" between designers and engineers. "In many contexts where efficient glance-based reading has safety relevance, such as the automobile and smartphone, branding and design language have clouded the need for reduced reading demands." Designers obviously have different considerations than engineers, and it's the engineers who may be more attuned to "practical limitations" or applications. A typeface or layout may not be possible based on what the engineers have to work with. If branding considerations come first, and those considerations are applied to the in-vehicle displays but the typefaces are

"Our work is about understanding the trade-offs that manifest between factors like typeface design, size, color, etc."

JONATHAN DOBRES

not ideal for in-vehicle use, then branding has gotten in the way of functional design.

Contrasting the automobile simulation research referenced earlier in this article, these days Clear-IP's studies have become less equipment-intensive. They've begun applying techniques from vision science—Dobres' specialization—to develop “desktop-based methods of assessment” that he dubs “more resource-efficient.”

Chahine compares the two.

“Our first study used simulated driving, and the subjects were sitting in a specially fitted car, and their eye movements were being tracked while they drove the simulator and completed the on-screen tasks. Afterwards, we switched to a new method based on word recognition. It is a pure test of legibility and requires only a computer screen and a regular computer. It can be conducted in a variety of environments and the data collection is very straightforward.”

Dobres elaborates. “The type of data we collect now might result from briefly showing someone a word under a specific typographic configuration or visual scenario (lighting, background textures, etc.). We can collect things like response accuracy and reaction time to gauge how well a person is processing the information, which allows us to infer things about how different reading scenarios are perceived.”

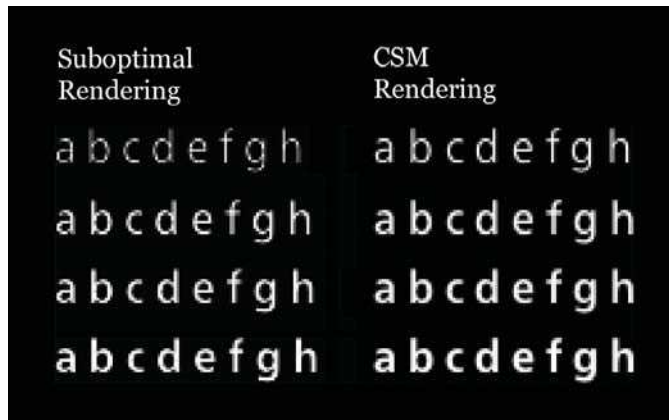
The benefits are big. “The desktop-based methods can be used with standard computer equipment and grant us more experimental control, since generally the ‘experimental situation’ is simpler and more targeted to some issue of interest.”

DRIVING THE FUTURE FORWARD

So how does Google fit into all of this? Greg Neiswander, UX research manager for Android Auto, says his team contributes to Clear-IP by providing insights for the consortium's activities and direction. As stakeholders, Android Auto receives Clear-IP's subsequent findings. “Ultimately, we want to better understand the efficiencies of driver interactions to inform design decisions, and it has certainly been a rewarding experience for us to engage with the consortium's experts to explore legibility for glanceable environments,” Neiswander says. “As is often with research, I think we collectively find that the more we start to investigate and dig into one area, the more new questions arise and the more we all want to further explore. So there's been no shortage of topics. ... From a grander perspective, the research topics being explored within Clear-IP are certainly bigger than just our own individual product or the automotive space.”



Testing four weights of Neue Frutiger. According to Jonathan Dobres, the rendering comparisons “highlight a disconnect that can exist between what the designers are working with (often, high-quality samples on nice, bright monitors), and what can happen in the actual interface (suboptimal rendering).”



To that end, if conducting research with typography and in-vehicle displays and other digital devices seems high-tech, there's another domain that's even more next-gen, and it's an area of research that Clear-IP is excited about: augmented reality, or AR. It's at the “top of their list,” Chahine says, because AR “presents text on a completely unpredictable background.” AR is the kind of environment that's ripe with possibilities for the designer—and ripe with possibilities for miserable, unusable typography.

Reimer stresses the complications involved with AR, as well as virtual reality—especially when it comes to legibility. “VR and AR increase the level of complexity in information display. For example, designers are often placing text upon partially opaque layers that impact reading in ways we don't yet understand. Blending of motion into interfaces further complicates the factors. AR/VR is also currently affected by the close distance of the display to the eye, as well as the achievable texture resolution, both of which can degrade legibility. I suspect that the user's ability to clearly extract information will be reduced if we don't begin to invest in developing an understanding of the key design principles in this space.”

In-vehicle displays, smartphones, AR and VR are just some of the areas Clear-IP has dug into with their research. It's all for the greater good and, according to Chahine, intended to further scientific research for better design guidelines and principles.

Chahine is excited about every study, no matter what it involves or where it takes her and, on the whole, Clear-IP is up for anything: “As long as it's typography,” says Chahine, “we don't have any topics off limits.”

Type-first, for certain. ■

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1. Dobres, J., Chahine, N., and Reimer, B. (2017). “Effects of Ambient Illumination, Contrast Polarity, and Letter Size on Text Legibility Under Glance-like Reading.” *Applied Ergonomics* 60(C) 68–73.
2. Reimer, B., Mehler, B., Dobres, J., Coughlin, J. F., Matteson, S., Gould, D., Chahine, N., and Levantovsky, V. (2014). “Assessing the Impact of Typeface Design in a Text-Rich Automotive User Interface.” *Ergonomics*, 57(11), 1643–1658.
3. Dobres, J., Chahine, N., Reimer, B., Gould, D., Mehler, B., and Coughlin, J. F. (2016). “Utilising Psychophysical Techniques to Investigate the Effects of Age, Typeface Design, Size and Display Polarity on Glance Legibility.” *Ergonomics*, 59(10), 1377–1391.
4. <http://lip.mit.edu/video/detail.jsp?id=755>