

1 **At-a-Glance: Exploring Glanceable Interfaces**

2
3 ADAM SCHROFEL, University of Winnipeg, Canada

4
5 BRADLEY REY, University of Winnipeg, Canada

6 Glanceable visualizations, interfaces intended to be understood "at-a-glance", are increasingly appearing across Human Computer
7 Interaction (HCI) literature on a variety of devices, yet the many terms for glanceable remain loosely defined (often not at all) within
8 HCI. WE present a systematic literature review that categorizes how these terms are used, defined, and measured within HCI research.
9
10 Using the term "*glanc**"(* is a wildcard so any term beginning with "glanc") as a keyword, we retrieved 187 papers from ACM and
11 IEEE libraries, then applied an iterative open-coding process to reach a final corpus of 68 papers. Each paper was coded along
12 four dimensions: Definition, Technology, Data, Method. Our analysis reveals 71% of papers claim their interfaces/visualizations are
13 glanceable, without any definition or reasoning as to why they have this characteristic. Additionally, we found existing temporal
14 metrics for glances range anywhere from 200ms to 10s, with a 5s glance metric cited by only a small handful of studies. We outline an
15 agenda for establishing empirically grounded, domain-sensitive metrics and analyze what characteristics and features of glanceable
16 displays were frequently referenced. By mapping current practice and exposing gaps, this review lays the groundwork for more
17 comparable studies and actionable design guidelines for future glanceable interfaces.

18
19 CCS Concepts: • **Do Not Use This Code → Generate the Correct Terms for Your Paper**; *Generate the Correct Terms for Your*
20 *Paper*; Generate the Correct Terms for Your Paper; Generate the Correct Terms for Your Paper.

21
22 Additional Key Words and Phrases: Glanceable, Glanceability, Glance, Visualizations, Interfaces, Mobile Computing

23
24 **ACM Reference Format:**

25 Adam Schrofel and Bradley Rey. 2018. At-a-Glance: Exploring Glanceable Interfaces. In *Proceedings of Make sure to enter the correct*
26 *conference title from your rights confirmation email (Conference acronym 'XX)*. ACM, New York, NY, USA, 11 pages. <https://doi.org/10.1145/XXXXXX.XXXXXXX>

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29 **1 Introduction**

30 Glanceable displays, visualizations that can viewed at a glance, and the many terms that describe glanceability regarding
31 interfaces is an increasingly mentioned concept within HCI thanks to the rise of mobile and wearable devices. Defining
32 and characterizing what constitutes the quality of glanceable is a unenviable task given the complex nature of (NOT
33 SURE). Many existing definitions and metrics are used to describe and assess the glanceability of a visualization,
34 with different fields utilizing different thresholds, metrics, and definitions. This concept is increasingly important in
35 contexts where users attention is limited (e.g. Mobile/Wearable Devices). However, despite frequent usage of terms like
36 "glanceable" and "glanceability" in HCI, the literature frequently uses these terms without clearly defining or quantifying
37 how an interface has these qualities, which has led to ambiguity and inconsistency in both research and application
38 of these types of interfaces. This in turn has resulted in many studies using arbitrary temporal measurements for

39 Authors' Contact Information: Adam Schrofel, schrofel-a@webmail.uwinnipeg.ca, University of Winnipeg, MB, Winnipeg, Canada; Bradley Rey,
40 b.rey@uwinnipeg.ca, University of Winnipeg, MB, Winnipeg, Canada.

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53 glances, without any verification of whether the durations truly measures the glanceability of an interface or the glance
 54 behaviour of the participants.
 55

56 Related fields, specifically the Automotive Industry and Vision Science, use more rigorous definitions and metrics
 57 for glances. The automotive industry, driven by strict safety guidelines consistently employs a 3 tiered categorization
 58 of glances(short, medium, long), ranging between 0-2s, to measure interface glanceability and driver attention [2]. In
 59 contrast, Vision Science typically focuses on shorter metrics ranging between 50 to 500ms, which highlights their
 60 focus on rapid visual perception and recognition tasks. These fields have both successfully implemented standardized
 61 definitions, enabling concurrent evaluations of interfaces and user authentication, and clear comparisons between
 62 interfaces within their respective domains.
 63

64 Looking outside these domains, the terms are still widely used but no consistency of definitions or metrics are
 65 employed. Motivated by this gap, our research aims to clarify and standardize the notion of glanceability within the
 66 HCI community. Establishing clear, consistent definitions and metrics is crucial for improving comparability among
 67 studies and developing meaningful design guidelines for glanceable interfaces/visualizations. With that in mind we
 68 also acknowledge the difficulty of defining a complex topic as many factors need to be accounted for when attempting
 69 to define such terms. We specifically investigate the following: How has glanceability/glanceable been defined across
 70 HCI literature? What measurable attributes (e.g. Temporal duration, information density, cognitive load) characterize
 71 a glanceable visualization? How consistently are these attributes measured and reported across existing research
 72 literature?
 73

74 To address this, we conducted a literature review to investigate how the HCI community has implemented and
 75 defined glanceable visualizations and the many terms in line with that concept. We collected work that uses the term
 76 *glanc** (* is a wildcard so any term beginning with "glanc" was collected), and then applied an open coding process. We
 77 discuss how literature has defined glanceable and its other terms, and then reflect on the many issues and challenges
 78 presented by these existing definitions, or lack thereof. Discussions on the technology used to display these visuals, the
 79 domain of use the data being displayed is intended for, and Our approach included categorizing definitions, identifying
 80 commonly referenced metrics, and exploring the methodologies employed. By utilizing an iterative open coding process,
 81 we were able to refine a large group of HCI literature into a relevant and mature selection of final papers.
 82

83 Our contribution a comprehensive literature review analyzing how the term glanceable and its many variations are
 84 used across HCI literature. We map out the existing definitions, highlight where inconsistencies arise in their usage,
 85 and propose considerations for future research. By clarifying the terms use across HCI literature, we aim to enable
 86 more comparable studies and better inform design guidelines for glanceable interfaces.
 87

91 2 Related Work

92 While existing HCI literature on glanceable interfaces often remains fragmented and disconnected, adjacent fields
 93 and communities, specifically the Automotive Industry and Vision Science communities, have converged on clear and
 94 agreed upon metrics for glances. Examining their approaches sheds light on why HCI definitions may differ, and why
 95 such a gap between fields exists.
 96

97 2.1 Automotive

98 The automotive industry has recognized the safety implications associated with visual attention demands imposed by
 99 in-vehicle interfaces, resulting in widely adopted metrics for glance durations. The U.S. Department of Transportation
 100 found that glances exceeding two seconds away from the road significantly increase near crash/crash risk [27]. This
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two second metric has largely been recognized and is reflected in the National Highway Traffic Safety Administration (NHTSA) Driver Distraction Guidelines for In-Vehicle Electronic Devices [1]. The guidelines advise interface designs to limit visual demands to glances under this two second threshold. Building upon these guidelines, Bach et al. established a standardized methodology that categorizes eye glances into short (below 0.5 seconds), medium (between 0.5 - 2.0 seconds) and long (above 2.0 seconds) glances[2]. These metrics have been broadly applied across automotive studies to consistently evaluate driver attention and interface safety [13, 14, 19, 25]. Specifically, the 0.5 second threshold distinguishes brief, rapid eye movements from more deliberate fixations, which are indicative of focused attention [2]. By adhering to these thresholds, researchers can reliably compare interface designs and ensure that interactions within the vehicle remain within safe glance-duration limits.

2.2 Vision Science

The vision science community provides a foundation for understanding the limits of human perception relevant to glanceable interfaces. Blascheck et al. state the visual science community categorizes glances between 50 to 500 ms [4], which is derived from Holcombe's research on human perceptual limits which analyzes temporal thresholds ranging from 20 - 500ms.[22]. This notion of a glance lasting only a few hundred milliseconds is supported by Oliva's work on human perception using the term "*glance (about 200 ms)*"[33] and other Visual Science research []. This notion of glances being fast actions only a few hundred milliseconds long reflects a focus on rapid preattentive processing. Crucially the 500 millisecond cutoff marks the transition from preattentive to attentive processing, aligning conceptually with the 0.5s "short glance" threshold seen in automotive research. Vision Science metrics thus offer a physiological basis for designing interfaces that convey simplistic information within the brains earliest perceptual window.

Taken together, the automotive and vision science communities demonstrate how domain specific safety and perceptual requirements can drive consensus on glance durations. HCI's lack of a similarly unified metric or definitions creates challenges for comparing study results and guiding designs, we now look to show where these gaps emerge and how a standardized classification might bridge them.

3 Study

This section outlines our approach to investigate the usage of the many terminologies of glanceable visualizations within HCI literature. We conducted a qualitative analysis based on an open coding process, where a consensus based refinement process resulted in validating our code-book. Our goal was to establish a reproducible process, aligning with methods demonstrated in previous studies on visualizations[7].

Keyword Search: To build our corpus of papers, we performed a keyword search in the ACM Digital Library and IEEE Xplore for any paper published through January 2025 whose title, abstract, or author keywords contained the term "*glanc**" (* being a wildcard, resulting in any term beginning with "glanc" being collected). Within ACM we restricted sponsors to SIGCHI, SIGMM, and SIGMOBILE; in IEEE we restricted venues to TVCG, CGA, PacificVis, VRW, and VIS. This broad search yielded 187 initial papers, capturing a wide range of work that self identifies with glance-related technology.

3.1 Removals

The broad collection of initial papers led to us refine our code-book iteratively to select our final corpus of 68 papers. **Publication Type:** First we excluded posters, short papers, workshops, videos, and proceedings to focus on mature, full-length studies. **Duplicates:** We then removed 19 duplicate papers gathered during initial paper collection. Looking to

¹⁵⁷ determine relevancy we then moved towards removing papers that exclusively matched any of the following iteratively
¹⁵⁸ refined criteria:

- ¹⁶⁰ • **Non-visualization:** We removed papers that only used the term "glanc**" in a non-visualization context(e.g.
¹⁶¹ Person A glances at person B).
- ¹⁶² • **Author/Reader Action:** The author uses "glanc**" only to refer to their own action/process, or to direct the
¹⁶³ readers attention to a graphic or visual(e.g. "We direct the reader to glance at figure 4").
- ¹⁶⁵ • **Name:** The term "glanc**" is only used as part of a name (e.g. Glancemug).
- ¹⁶⁶ • **Third party:** Glanc* is being used only to describe something external to the paper itself.
- ¹⁶⁷ • **Glance/Gaze Tracking:** Eye tracking being used to control an interface, or eye tracking being monitored but
¹⁶⁸ outside of the context of measuring glanceable/glanceability.

¹⁷⁰ Through both rounds of removals we used the following procedure: We first discussed the possible exclusion criteria
¹⁷¹ to develop initial codes. Then a subsection of papers was collected at random and each author separately coded the
¹⁷² subsection. The assigned codes were then compared to determine if an 80% agreement was reached. Until that was
¹⁷³ met, we discussed refinement of codes and/or additional codes to be added to the code-book, then coded another
¹⁷⁴ subset of papers and compared again. When the threshold was met, the entire collection was independently coded, and
¹⁷⁵ any remaining disagreements were discussed and resolved. The final code-book was then created, comprising four
¹⁷⁶ dimensions—Definition, Data, Technology, and Method—providing a structured framework for our subsequent analysis.

¹⁷⁹ 4 Results

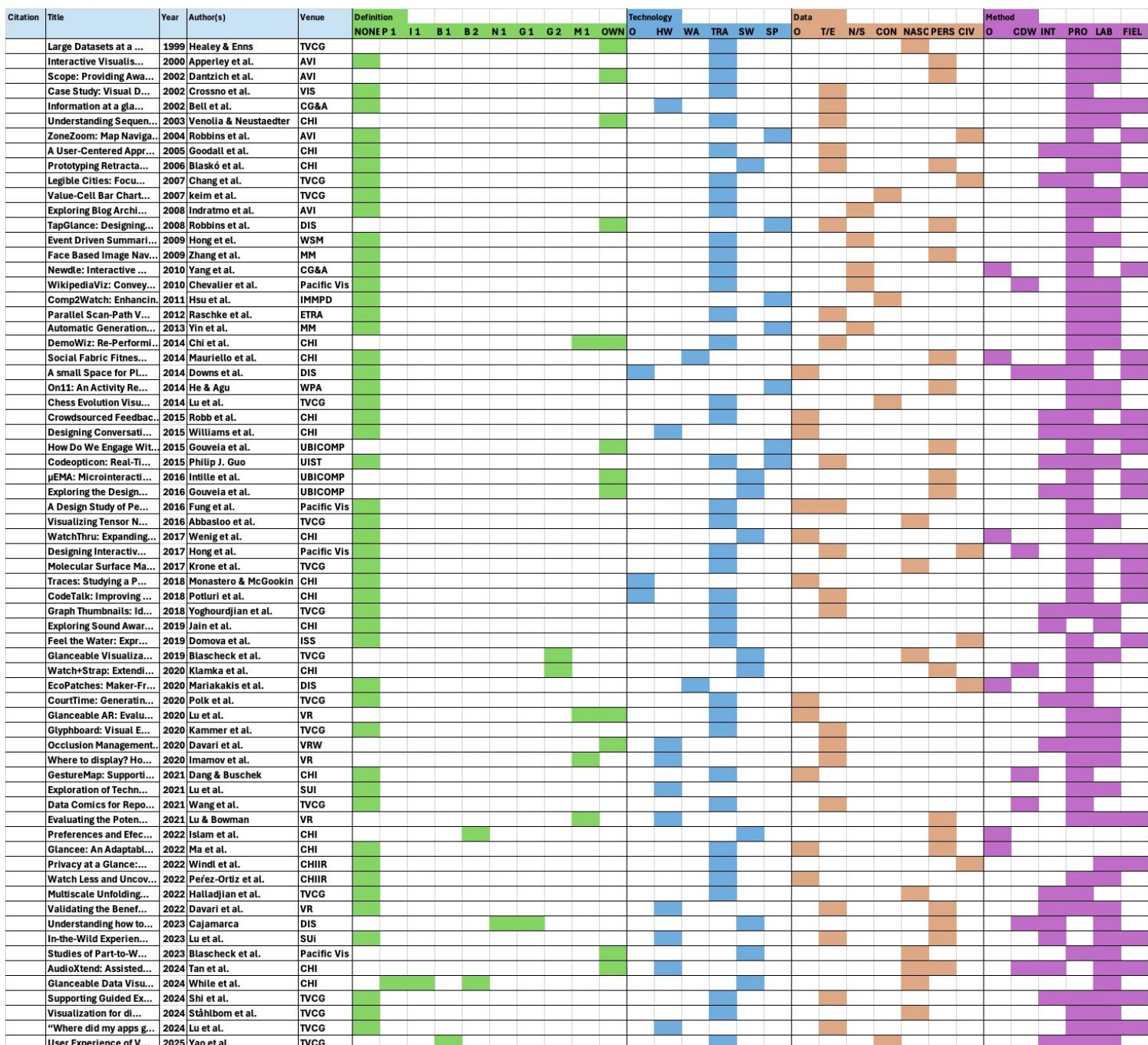


Fig. 1. Final corpus of papers with codes: Definition, Data, Technology, Method

Abbrev.	Code
250 251 252 253 254 255 256 257 258 259 260 261 262 263 264 265 266 267 268 269 270 271 272 273 274 275 276 277 278 279 280 281 282 283 284 285 286 287 288 289 290 291 292 293 294 295 296 297 298 299 300 301	NONE No Definition P 1 Pizza et al. I 1 Isenberg B 1 Blashchek et al. "Studies" B 2 Blaschek et al. "Characterizing" N 1 Neshati et al. G 1 Gouveia et al. "Exploring" G 2 Gouveia et al. "Habito" M 1 Matthews et al. OWN Own Definition O Other HW Head-Worn Display WA Wearable Display (non-smartwatch) TRAD Traditional Display SW SmartWatch SP Smartphone O Other T/E Technology/Engineering N/S News/Social Media CON Consumer/Business NASC Natural Sciences PERS Personal CIV Civic O Other CDW Co-Design / Design Probe / Workshop / Focus Group INT One-on-One Interviews PRO Artifact/System Contribution/Prototype LAB Lab Study FIEL Field Study

Table 1. Abbreviations Used in Figure 1.

Our final code book categorizes 68 papers across the four previously mentioned dimensions (see Figure 1). These include *definition of glanc**, *technology*, *type of data*, and *method*, and spans publications from 2000-2025 across 18 venues: CHI, AVI, DIS, WSM, MM, IMMPD, ETRA, WPA, UBICOMP, ISS, UIST, SUI, CHIIR, PACIFIC VIS, TVCG, VR, VRW, CG&A. To analyze the trends across the literature, we outline key findings for each dimension.

4.1 Definitions of glanc*

The papers within the corpus can be categorized as papers that either define the concept of a "glanceable visual/interface", cite prior papers that defined a glanceable visualization, or do not contain a definition. A total of 48/68 papers do not contain any definition for glanc* or what constitutes a glanceable display or interface. The terms usage has notably seen a rise in recent years, with the exception of 2025, each year since 2014 contained 3 or more papers using the term. Prior to 2014, only a single year since 2000 contained 3 papers using the term (2003).

302 4.1.1 *No Definition.* The literature in this category often claims prototypes/visuals to be "glanceable" or carry glanceable
303 characteristics. These works tend to treat glanceability as a self-evident property of their prototype or visualization,
304 using the term descriptively but offering no operational criteria.
305

306 4.1.2 *Cited Definitions.* The only definitions of glanceable visualizations that are cited multiple times in the corpus
307 are Matthews' definition [31], Gouveia et al.'s definition [16, 17], and Blascheck et al.'s definition [5, 6]. A total of 9/64
308 papers cite one of the three. Matthews work is not included in the final corpus as their thesis did not meet our selection
309 criteria. Matthews defines glanceability as "*a visual quality that enables users to understand information quickly and*
310 *with low cognitive effort.*" [31]. Gouveia et al.'s definition provides a metric for glances as "*brief, 5-second sessions where*
311 *individuals check ongoing activity levels with no further interaction.*" [16, 17]. This 5 second metric is derived from the
312 work of Banovic et al. where they define *glance sessions*, "*where the user only looks at the information on the locked screen*
313 *or home screen of the phone*", where the median time spent with the lock screen open was 5 seconds [3]. The Gouveia et
314 al. definition supports the notion of user attention and passive interactions, where a user is not interacting with the
315 device housing the visualization and devoting minimal amounts of attention, similar to Matthews' definition. This 5
316 second threshold that Gouveia et al. defined is also referenced by Blascheck et al.'s definitions[5, 6].
317
318

319 4.1.3 *Own Definitions.* Other definitions include those that state the short temporal characteristic of a glanceable
320 interface such as "*displays that can be apprehended with a minimum of attention*" [35] and "*easy to read and understand in*
321 *a minimal amount of time*" [36]. Only one other paper that mentions a temporal metric as Healey et al. states "*Preattentive*
322 *tasks can be performed in a single glance, which corresponds to 200 milliseconds (ms) or less.*" [21].
323
324

325 Other definitions include those that view glances as actions that do not require the users full attention [10], does
326 not significantly disrupt ongoing activity [23], or without interaction [37]. This notion of attention, interaction, and
327 ongoing primary tasks characterizing if displays were glanceable or visual attention was considered a glance is one we
328 found relevant for further discussion.
329
330

331 4.2 Type of Technology

332 We coded the corpus based on the technology used within the paper that pertained to displaying glanceable visualizations.
333 While traditional displays (38/68)—computers, monitors, televisions, and projectors—were still the dominant technology
334 for visualizations, other technologies were still well represented (30/68), and Figure 1 reveals an increase in non-
335 traditional technologies increasing usage within recent literature. Trends of note include the shift away from mobile
336 devices to smartwatch visualizations (10/68), as well as the increase in head-worn displays(10/68)(e.g. AR) in recent
337 literature. Notably, papers working with smartwatch visualizations acknowledged the challenges of creating glanceable
338 visuals for the smaller smartwatch displays [23][17][38][26]. One group designed wearable displays(non-smartwatch)
339 such as screens on the backs of runners shirts to visualize real-time run tracking information in a group setting [32],
340 and printable chemical patches that mediate the users relationship with their surrounding environment(e.g. Current
341 UV exposure)[30].
342
343

344 4.3 Type of Data

345 The data being displayed within the papers of the corpus were quite varied and spanned across multiple domains. The
346 most frequent data group belonged to *Technology/Engineering* (21/68) which included included Network Traffic [15],
347 and Graph comparisons [40]. Another group frequently displayed was *Personal Data* (18/68) including Personal Health
348 data[32][20][16][17][24] . We categorized *Civic data* as any public data in a group setting, this included city mapping
349
350

[9], and city district water heating data[12]. Another group included *Natural Sciences*, containing a variety of data such as maps for molecular surfaces [28], and hierarchically scaled visualizations of DNA [18]. *Other*(11/68) included a variety of data such as classroom data [29], and tennis match data [34].

358 359 4.4 Type of Method

360 The vast majority of papers involved a *Artifact/System Contribution/Prototype* (60/68). Unsurprisingly the use of Lab
 361 studies (42/68) and/or Field Studies (22/68) were widely utilized throughout as well. Other groups included *One-on-One*
 362 *Interviews* (18/68), *Co-Design / Design Probe / Workshop / Focus Group* (8/68), and *Other* (6/68), which included online
 363 questionnaires [30][29].
 364

365 366 5 Discussion

367 Although glanceability and its many terms has become a commonplace concept within HCI literature, our review
 368 reveals a lack of any agreed upon definition or metric. 71% of papers provide definition, with no regard for whether
 369 the interface of visualization has any characteristic that would entail that interface or visualization actually having a
 370 "glanceable" quality. Of the papers that do offer their own or cited definition, there is little consensous to be had, besides
 371 the use of the 5 second metric within a small circle of work[5, 6, 8, 16, 17, 26]. The usage of this metric is a step towards
 372 consistency across the field, the metric itself is slightly problematic in that it is derived from a study not necessarily
 373 concerned with the notion of glanceability, rather interaction times with devices, with no regard for whether a user is
 374 intentionally glancing at the device and inferring information of some kind [3]. Overall, this lack of consensus reflects
 375 glanceability's inherently complex nature, which spans multiple disciplines, interaction contexts, and users.
 376

377 Beyond this, the literature that does provide definitions for glanceable can be pooled into two broad, slightly overlapping
 378 schools of thought. One views glanceable displays as peripheral reference points, secondary and supplementary
 379 information that does not interrupt a primary task (e.g. [11, 23]). The other treats it more as a direct visual attention but
 380 for a limited period, where users briefly focus their full attention on the display. These two trains of thought converge
 381 in that these glanceable displays are brief, simple to view, and put minimal strain on the users cognitive functioning.
 382 With that in mind, we further refine existing literature of glanceable displays into these following key characteristics.
 383 **Cognitive Load:** Glances should impose minimal effort, as not to disrupt ongoing primary tasks or exceed users
 384 attention limits. **Temporal Window:** Glances must have some sort of temporal metric associated with them. Current
 385 literature ranging from 200 milliseconds to 10 seconds is far too broad and needs refinement. **Information Density:**
 386 Visualizations must be abstracted or simplified to be understood with a glance.

387 To offer a concrete definition would be foolish given the complex nature of glanceability, with so many factors
 388 to consider, including: user characteristics and experience with said interfaces, domain of usage, and field of study.
 389 For example, Age is a consideration that 2 papers within the corpus take into account and attempt to address the
 390 challenges of designing glanceable displays for older users (citing the cognitive challenges older users face compared
 391 to younger, and the limited amount of information able to be ingested within the same time frame.)[39][8]. Again,
 392 this is in part due to the challenging nature of defining what such a term could mean, as discussed extensively by
 393 Blascheck et al. in their textbook chapter on Glanceability[4]. They breaks down the metrics and characteristics of
 394 glanceable displays into three distinct fields with their own metrics, Vision Science(0 - 500 ms), Visualization (0.5s - 2s)
 395 and Ubiquitous computing(2s-10+s). As well, Blascheck et al. synthesize prior definitions from across domains (Vision
 396 Science, Visualization, and Ubiquitous Computing) to propose characteristics of glanceable displays[4]. They are *present*
 397 & *accessible*, Designed with *simplicity & understanding* in mind, and the importance of reflecting on the *suitability &*
 398 *Manuscript submitted to ACM*

purpose of a glanceable visualization for a given goal of the user. However, Matthews offers the following: "Glanceability is not an evaluation criteria, but it is a design mechanism through which designers can improve a display's learnability, improve user awareness, minimize distraction caused by time taken to interpret a display, and increase appeal." [31]. Having a definition that sufficiently encapsulates this, and many other considerations for glanceable displays is unlikely, and likely a reason why there is such a lack of an agreed upon definition within HCI. Given the rapid increase in mobile in-situ displays and overall mobile device usage, we argue that an agreed-upon temporal metric is both necessary and achievable. Safety considerations need to be taken into account, and like the automotive industry, there must be some temporal metric that can be agreed upon and broadly used throughout future HCI research. The 5 second metric is a step in the right direction, but studies pertaining directly to user glances with regards to safe mobile device usage is needed. Future glanceability research could also adopt baseline thresholds, like the 5 second metric, and refine them according to user characteristics, context of use, and other factors. Overall an agreed upon temporal metric would provide a shared operational criteria that is desperately needed to compare and synthesize glanceable interface studies, while considerations for glanceable characteristics would still accommodate the term's inherent complexity.

6 Conclusion

Our literature review makes clear that, despite the consistent usage of glanceable and its may terms, HCI lacks a shared consistent usage of definitions and temporal metrics. Nearly three-quarters of the 68 papers in our final corpus describe interfaces as glanceable while offering criteria that the interfaces meet for that claim to have validity. Those that do define the concept disagree in key areas at times, most visibly regarding temporal metrics that stretch from sub-second perceptual thresholds to interaction windows upwards of 10 seconds. We also observed a shift toward non-traditional displays (e.g. smartwatches and head-worn displays) and a growing diversity of data domains. Drawing on patterns across the corpus, we argue that future work should make considerations to the following :

- **Temporal metric:** An evidence-based metric for safe, task-compatible glances. We argue that further research is required to establish an agreed upon metric, rather than inferring one from studies unrelated to the context of glanceability. Until that point, using the 5s metric and refining it based on context, users, and other considerations.
- **Design Considerations:** Considerations towards existing characteristics present within HCI literature such as **Cognitive Load** (Minimal attention cost relative to the users primary activity), **Information Density** (an abstraction level that affords quick and simple comprehension), and other proposed characteristics such as those presented by Blascheck et al. [4] will enable future work to maintain a close alignment with existing sentiment towards features of glanceable displays.

This paper aspires to shift discourse from implied understanding and acceptance, back to working towards standardizing and accepting metrics for glanceable displays. This will ultimately support safer, more effective interfaces for the rapidly expanding ecosystem of on-the-go technologies.

Acknowledgments

I would like to thank my parents for supporting me throughout my educational journey. Without them and their unwavering support through many struggles I would not have been able to reach this point. I would also like to thank Dr. Rey for motivating and supporting me throughout this process. His constant encouragement through a difficult period in my life and his constant passion for his work provided the motivation I needed to complete this.

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