News From the Background to the Foreground: How People Use Technology To Manage Media Transitions

A Study of Technology-mediated News Behaviors in a Hyper-connected World

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People are the designers and curators of their own news and information ecosystems, due to the disruption of the news industry and developments in media technology. To understand how people use technology to manage their news consumption, we conducted a two-week diary study with 14 participants, focusing on how people transition between news content and behaviors via different media, sources, platforms and devices. We used an inductive, qualitative analysis of the diary study data to analyze the news behaviors and their underlying motivations and found that people frequently shift their focus between ambient background news streams and active foreground news behaviors. Although people often passively consume news content as a background activity, they also actively manage background news habits to increase the chances of relevant foreground experiences. People manage news consumption by developing routines that are often supported by technology use and social interactions. We encourage product designers to treat backgrounding as an essential part of news consumption behavior and suggest new design directions that employ ubiquitous computing technologies—such as context sensing and routine modeling—to more effectively attend to background-to-foreground behaviors and transitions.

CCS Concepts: • **Human-centered computing → User studies**; **Smartphones**; **Empirical studies in ubiquitous and mobile computing**.

Additional Key Words and Phrases: news, media consumption, multitasking, cross-platform, cross-media, cross-device, diary study, transmodal, passive media, information seeking

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1 INTRODUCTION

The changing media technology landscape has thrown the news industry into upheaval. Daily U.S. newspaper circulation continues to decline year over year, as does revenue from advertising [27]. Simultaneously, the ubiquity of mobile devices, the abundance of digital news outlets, and the growing role of social media have disrupted how people find news content. As content is dispersed in new ways, traditional news media categories (such as print and broadcast media) have merged with digital experiences, blurring the boundaries between these categories [31]. Faced with media convergence and diffuse news content, people are now cast as the (sometimes accidental) designers and curators of their own personal news and information ecosystems.

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In today's media and technology landscape, how do people interact with the news? Take the hypothetical example of a person listening to public radio news in the car on her way to work. She hears a story that catches her attention about an earthquake that triggered a tsunami near her hometown. When she gets to work, she searches for eye-witness videos and photos on Twitter. She texts friends who live near the earthquake to see if they are okay. During the transitions from her commute to her office, her attention and her ability to engage with the news changes. In this single event, she experiences many different technology platforms (car radio, mobile phone, laptop, Twitter, SMS), behavioral modes (listening, reading, watching), media types (audio, video, text), news sources (NPR, eye-witness accounts, search/aggregation), and motivations (seeking out information, connecting with loved ones). As this example shows, interactions with news are complex and highly contextual, marked by transitions between diverse news behaviors. These transitions are the object of this study: By studying news behaviors in context, we attempt to understand these transitions and their motivations. This approach opens up new lines of inquiry into researching and designing for news behaviors.

Understanding news behaviors allows us to better foster civic engagement within communities. Ksiaszek, Malthouse, and Webster [16] showed a positive relationship between news consumption and formal and informal civic participation. Yet these increasingly individualized, multi-dimensional, self-curated news behaviors are difficult to study. Nine in ten U.S. adults consume news content online [33], but news behavior is far from homogeneous. People engage in, and switch between, different *behavioral modes*—reading, listening, or watching—while consuming news content, and all of these modes are possible in both digital and analog formats and on many different technology platforms. HCI has explored social interactions with news [22], but consumption research has often focused on single-platform analysis such as news on Facebook or Reddit [18, 19]. Driscoll and Thorson [8] critique these single-platform approaches to studying news behaviors because they cannot capture the richness of people's lived experiences. Instead, they advocate for a cross-platform approach. To understand how news platforms fit into the larger context of how people are engaging with news, we need to understand motivations, intents, and catalysts for news engagement.

The goal of our research is to understand the attitudes and values underlying people's news consumption preferences and behaviors across media types and technology platforms, in order to guide the development of future news media products to meet people's dynamic information needs. We set out to look at the holistic ways people interact with news in the rich contexts of their daily routines—such as when they are at home, commuting, or at work, or as when their attention is focused versus when it is divided. Specifically, we ask the following research questions:

(RQ1) *How do situational contexts drive people to seek out and transition between different news behaviors?*
(RQ2) *How do routines and social context influence people to engage with (or disengage from) news?*

To address these questions, we conducted a two-week diary study, designed upon a phenomenological approach [32], with 14 people across the U.S. who frequently consume news content. There are widely varying definitions of what makes content newsworthy [11]. We adopt Lee's [20] universal approach to news which includes both "harder" and "softer" genres. Hard news is typically related to current events, whereas soft news stories are not time-specific and more likely to be of "human interest" [36]. We allowed our participants to self-define news without imposing genre constraints, thus our study includes entertainment, sports and special interest news topics.

In initial interviews with our participants, we asked how they switch between reading, listening to, and watching the news as a way to understand news behavior transitions. However, based on their responses, it became clear that these transitions are entangled with other types of transitions—such as media, platform, device, or source. Thus in the post-diary study interviews, we adopted a more systemic lens, asking about many kinds of news behavior transitions: People can move *cross-media*, quickly switching between text-, video-, and audio-based

experiences. They can also move *cross-platform*, switching between distribution methods like news websites, podcasting apps, social media feeds, or *cross-device*, switching between smartphones, computers, TVs, radios, and smart speakers. Finally, people can move *cross-source*, encountering content created by different media outlets, via word of mouth, or aggregated by human or algorithmic curators.

This paper contributes to a deeper understanding of the way in which digital experiences mediate news consumption by exposing how people rely on both background and foreground news consumption behaviors in their routines. Background experiences are times when people do not—or cannot—devote their full attention to the news, and might skim headlines or consume ambient news media. Foreground experiences are times when people are more attentive, participating in active behaviors such as searching for more information or sharing. Background and foreground activities each have unique utility for people as they engage with, or disengage from, the news. We also introduce a *transmodal news consumption* framework, which can be used to explore how and why people transition between news behaviors. Finally, we present implications for designing platforms for people to consume news-related content—whether through social media, apps, voice interactions, or other digital platforms—that attend to news behavior transitions.

2 RELATED WORK

2.1 The State of the News Landscape

People turn to multiple sources to get news: Molyneux [26] found that 80% of US adults use three or more news platforms at least once a week. Those platforms span digital and analog technologies. Pew Research Center, which tracks trends and patterns in the media and news landscape, found that as of 2017, 50% of American adults "often" get news from TV, 43% from online sources, 25% from radio, and 18% from print newspapers [9]. Recent surveys from Pew show that 68% of Americans "at least occasionally" get news from social media; Reddit, Twitter, and Facebook are most popular. Frequency of use is not necessarily equated with trust: Pew Research Center also found that 57% of Americans distrust social media and consider it to be an inaccurate news source [24].

2.2 Understanding How People Make News Choices

Today, a seemingly infinite suite of news options competes for people's attention. One concept for understanding how people integrate diverse media sources into their lives are *media repertoires*, the subset of available media options that a person regularly uses [14, 37, 41]. Yuan [43] proposed a repertoire approach to looking at news consumption across multiple media platforms and found that most Chinese news users blend multiple media types, traditional and emergent, and take both complementary (using different media for different types of information) and convergent (using multiple media types to access the same information) approaches to repertoire creation. Swart et al. [35] used a repertoire approach to develop a typology of Dutch news users based on goals and values (regionally oriented, background oriented, digital, laid back, and nationally oriented). They found that news users were often ambivalent about their own repertoire choices. Further, they noted the blurring boundaries between news and other types of media.

Within repertoire and media choice research, researchers have adopted two distinct theoretical frameworks to explain media choice. The first, *uses and gratification* theory, posits that an individual's predispositions—such as preferences, needs, or psychological states—influence a person's media consumption choices [13, 20]. The second theory is media-centric and focuses on *structural aspects* impacting the availability of news, such as Qayyum et al. [30] who found the availability of news content and device access were major determining factors for how young people in Australia engaged with the news. Webster [38] proposed a combination of individual and structural factors into a single model around the duality of media, where both individual preferences and gratifications are constrained by media availability.

2.3 News Consumption Behaviors

News consumption and media repertoires have been studied across disciplines and have focused on devices, sources, and media types, but often not in conjunction or holistically. Wolf [41] found that mobile devices afforded portability of news consumption. While people often consumed text news content from legacy media brands on mobile devices, video and audio content were consumed less frequently. Molyneux [26] also looked at mobile news consumption and found that, compared to other platforms, mobile news sessions are shorter but more frequent and "snack like." Lai found that mobile news consumption fit into otherwise unoccupied bits of time within an individual's day [17]. Dimmick et al. [7] noted that users navigate through a vast news ecosystem and often use unscheduled time for mobile news browsing. Westlund and Fardigh [40] define distinct age-based cohorts: older demographics typically used a single-media source; younger users were more likely to use cross-media news sources.

Social sharing is another way to consume news [4]. Lottridge and Bentley [22] explored behaviors and attitudes toward online news sharing, finding differences among those who share publicly, who share with small social groups, and who share via one-to-one messaging and voice. These sharing behaviors occurred across a variety of channels. Hu et al. [12] explored Twitter as a news dissemination platform for breaking news, finding that both mass media organizations and individuals play important roles in spreading information, blurring the line between social media platforms, news distribution platforms, and individual influencers.

In terms of motivations, Martin [23] explored the "ambivalence with which people approach the everyday ritual, simultaneously embracing and pulling away from the news," and described a tension between "news-as-ritual," which is passive and invisible, and "news-as-information acquisition," which is active and foregrounded. Martin theorized that news engagement might be influenced by feedback loops, where increased attention leads to greater awareness of current events, which leads to further engagement. However, Martin did not address the influences of technology in these news attending behaviors.

This related work shows initial exploration into news behaviors; however, it also identified areas that still need to be better understood. Structural factors in media studies have centered on availability, but have not explored how technology mediates social influences in people's news behaviors. We build off this past work by focusing on news behavior transitions as a way to explore how technology—across devices, platforms, sources, media types, and behavior modes—mediates news consumption behaviors.

3 DESIGNING A DIARY STUDY OF NEWS BEHAVIORS AND VALUES

Interactions with news are often fleeting and ephemeral. News content flows in and out of people's lives unnoticed, thus they may not consciously realize their choices and motivations. This makes it difficult for researchers to get accurate information about news consumption behaviors, attitudes, and values using interview and survey methods alone. For this reason, we chose a diary study as a method to get in situ information about people's news behaviors. Our diary study included a pre-interview, 11 days of microblogging on Tumblr and daily reflection voicemails, and a post-interview. To account for temporal fluctuations in news habits, each participant logged his or her own behavior for at least one full work week and one weekend.

The aim of this study was to gain a holistic understanding of people's attitudes, values, and behaviors around news across media types and technology platforms. We were more interested in what was meaningful to participants than in the participants' actions themselves; thus, we drew on the tradition of interpretative phenomenological analysis [32], which focuses on how people make sense of their own experiences. We designed an open-ended, flexible diary study, allowing participants to self-define meaningful interactions with news content.

3.1 Participants

We used a professional recruitment service to find a diverse sample of 14 people across the United States (ages 22-51; 7 men, 7 women). To qualify for the study, participants must pay attention to news several time a week, regularly use at least two distinct behavior modes (reading, listening or watching) to access news content, and own a mobile phone. All of the participants engaged in both hard and soft [20] news content during the course of the study. Participants were compensated $350 for fully completing the diary and interviews.

3.2 Pre-interviews: Background Information and Setup

We conducted one-hour, semi-structured, one-on-one pre-interviews about the participants' daily news habits. Five interviews were conducted in a lab and the remaining nine were conducted remotely via video chat. Sessions were video recorded and transcribed. First, we asked how participants read, listen to, and watch news content, which medium they prefer, and how those activities fit into their daily routines. We also asked about their sharing and social news habits.

Next, we stepped participants through the process of joining and using the private, password-protected Tumblr blogs we created for their diary and ensured that they had the Tumblr app downloaded onto their phones. Tumblr allows users to post text, images, links, or video content. This initial setup was critical to assure participants were confident in their ability to use the data collection tool [6]. Only the researchers and the participants could access the Tumblr blogs. All but one of the participants were first-time Tumblr users.

3.3 Diary Study: Snippets and Voicemails

Our diary study consisted of ad hoc snippet collection [2], via Tumblr, and daily voicemail messages [28] using Google Voice. We chose this combination of methods to allow participants (a) to document news interactions, which may otherwise go unnoticed, in the moment, and (b) to reflect on news interactions at the end of each day. During the pre-interview, we gave participants a detailed participant guide for reference (available in supplementary materials).

Here is how we explained snippets in the participant guide: "*Snippets* are little artifacts that you record *in the moment*. They are meant to help you remember what you did later on when you get a chance to sit down and reflect." We told participants that snippets should be recorded, "Every time you engage with the news in a meaningful way," and can be screenshots, videos, audio messages, links, or text notes. How often participants posted to their Tumblr blogs was completely at their discretion; compensation for the study was not based on whether or how often they posted snippets.

For the daily voicemail messages, we asked participants to talk about how they interacted with the news that day. To scaffold the voicemails, in the participant guide we included a short list of questions to respond to about the details and significance of any snippets they posted, and whether they switched between reading, listening and watching news. To be fully compensated for the study, participants were required to leave voicemails on 10 out of 11 days. To mitigate the possibility of participants artificially increasing their news behavior because they were part of a study, we emphasized that they did not need to interact with the news every day. If they had a news-free day, we instructed participants to simply state that in their voicemails.

3.4 Post-interviews

After participants had completed the diary study, we conducted one-hour, semi-structured, one-on-one interviews. To prepare for these interviews, we conducted close readings of each participant's pre-interview transcript, Tumblr snippets, and transcribed daily voicemails. Using a thematic analysis technique [3], we created customized interview questions for each participant, which included member-check questions [21] to validate our rough themes and our understanding of the snippet and voicemail artifacts. This brought the participants into the

analysis process. Together, the researcher and the participant looked at the Tumblr blog and had an open dialog about why those news interactions were important and what they reveal about the participant's information needs. We used laddering questions [34] to dig deeper into the consequences and values underlying the participants' news behaviors. We also asked participants to reflect on the experience of the diary study: How did they find the experience, and did they learn anything surprising about their own news habits? Drawing on the hermeneutic tradition of interpretive phenomenological analysis [32], as researchers we were attempting to make sense of the participants' experiences, participants were simultaneously reflexively making sense of their own experiences.

3.5 Analysis

Our analysis approach was inductive and anchored in the participants' narratives of their own news behaviors. We first transcribed the pre- and post-study interviews and daily voicemails. We then did a close reading of these to identify rough themes, followed by a second reading to pull out direct quotes, behaviors, and researcher observations that represented distinct ideas, which we refer to as *notes*. This close reading resulted in 1100 notes, which represent our smallest unit of analysis. We then conducted an inductive analysis of those notes using an affinity diagramming technique [10], which all researchers iterated on collaboratively until we reached a consensus. Through affinity diagramming, we produced a hierarchical database: the notes were organized into 200 categories (a group of tightly-related notes); those categories were organized into 25 meta-categories (a group of tightly-related categories). A full list of notes, categories, and meta-categories is available in our supplementary materials. Figure 1 visualizes meta-categories and categories from our affinity analysis.

3.6 Limitations of the Study Design

During a diary study, participants are aware they are being observed, which can cause them to change their behavior. The length of our study and our instructions to participants mitigated this observation effect. For example, one participant noted that for the first few days she felt like she was doing homework, and was researching news items in more depth than she normally would (JW, post-interview). After a few days, she remembered that she had been instructed to be normal, and returned to her normal news behavior.

By design, our research approach lacks clear boundaries. Once we allowed people to wander beyond the bounds of a single behavioral mode, media type, or platform, we could not be sure where they would go. Our research agenda considered news content to include both hard news and soft news genres and allowed participants to determine their own boundaries based on what they considered to be news. This was discussed in the introductory interview with the participants when they were given instructions. However, as people went through the study, they sometimes grappled with defining what news meant to them as they reflected on their own news consumption behaviors. Hard news topics, such as politics, crime, or current events, were easier for participants to quickly self-define as news. However, they treated soft news categories with more ambiguity. We saw this in our diary study when participants explicitly questioned, "Is this thing news?" as they micro-blogged and left voicemails about topics such as sports, celebrity news, TV shows, and personal health topics. We tempered this ambiguity by reassuring participants that news content and platforms could be whatever fit their own personal definitions—this broad range of news content was novel and relevant to each participant.

This study is qualitative in nature, which allows us to identify dominant themes, motivations, and values in news behaviors. However, it does not allow us to draw quantitative conclusions about the prevalence or frequency of such behaviors.

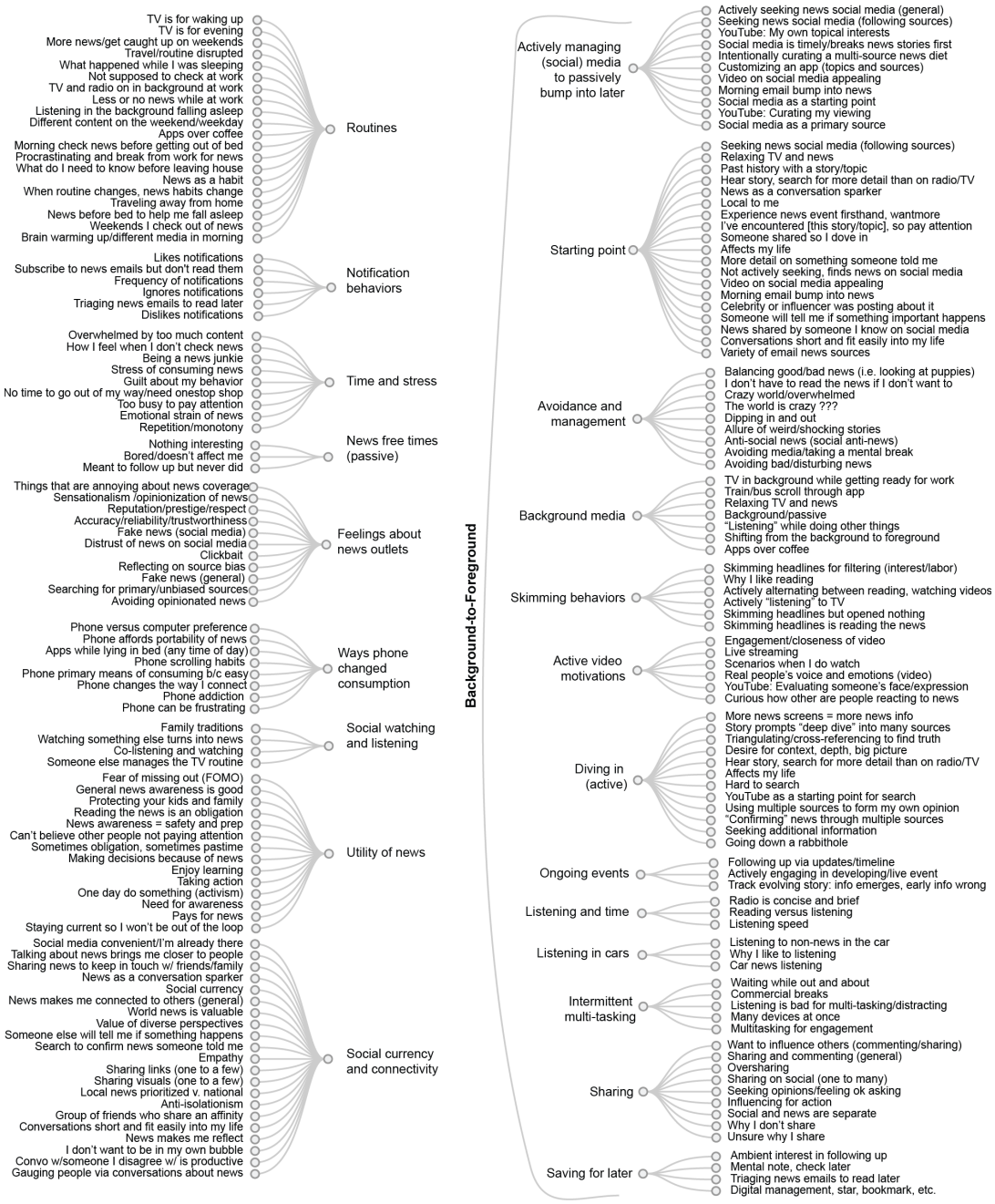

Figure 1. This visualization shows the categories and meta-categories from the affinity diagramming analysis. The categories and meta-categories on the right are most closely related to background-to-foreground transitions. Note that only 20 of 25 meta-categories are shown here. For a full database of our analysis categories, see the supplementary materials.

While our study size (n=14) is typical for a diary study, we had some demographic limitations. The frequency with which our participants engage with news content makes them fairly active news users as compared to the U.S. population in general [25]. Participants were self-selecting in that we pulled them from a database of people who have signed up to participate in user research. Our participants were distributed across the U.S. and their habits covered a broad spectrum of political perspectives and topics—FoxNews, the BBC, indie news organizations; entertainment, politics, gaming, finance. However, they were concentrated in urban areas (Bay Area, Houston, Chicago, New York) so this study does not describe rural news consumers.

4 FINDINGS

In this section, we explore transitions in news behavior through three major themes that emerged from our affinity analysis: (1) news management, curation and control strategies, (2) the social and intrinsic motivations behind news behaviors, and (3) news as a background-to-foreground activity, to which we devote the majority of this section. We also introduce a formal definition of *transmodal news behavior*, which can be used to understand news transitions.

Throughout this section, we refer to quotes from our participants, whom we identify with initials. We also indicate what stage the quote was from (pre-interview, voicemail, or post-interview) to illustrate how these themes emerged over the course of the diary study.

4.1 Management, Curation, and Control Strategies for Fitting News into Daily Life

Participants managed—unintentionally and intentionally—their news consumption by developing strategies to accomplish three distinct goals: (a) set themselves up to bump into personally relevant news, (b) save content for later if they cannot devote attention to the news, and (c) transition back into the news after a deliberate or accidental break. In section 4.1.1. we address RQ1 — *How do situational contexts drive people to seek out and transition between different news behaviors?* — by focusing on the types of news sources people deliberately pursue. In sections 4.1.2 and 4.1.3 we address RQ2 — *How do routines and social context influence people to engage with (or disengage from) news?* — by focusing on how people fit news into (or remove news from) their daily lives.

4.1.1 Curating Personally Relevant News Sources. Although news consumption is often passive, people actively curated their passive news streams to facilitate future active and relevant news experiences. Participants accomplished this by following news organizations or news-conscious friends on social media, communicating with social circles via group texts, installing and customizing mobile apps, managing app notification settings, and curating daily routines that facilitate background radio and TV consumption. For more examples, see meta-categories "Actively managing (social) media to passively bump into later" and "Routines" in Figure 1. Across these strategies, participants valued the ability to find stories that personally resonate and the ease of fitting news into daily life. One participant turns to a customized news app because, "I only get what I wanted to read. So, it will be fast, it will be interesting to me" (IL, post-interview). Another participant uses the LinkedIn app as her preferred background news source because:

> It's easy to scroll through quickly when you have a moment. [...] So you want people to think like you but you also want more people that maybe don't think like you to give you more insight[...] My feed has become more interesting, I think. Like I've been getting more relevant material to me, at least lately, as I've added my network. (CM, post-interview)

4.1.2 Disengaging from News. We observed varying attitudes toward news: Some participants viewed news as a chore or obligation, while others viewed it as a welcome hobby or an escape from the stresses of daily life. Regardless of their attitudes toward news, all of our participants experienced challenges fitting news consumption into their daily lives. It's quite common for people to disengage from the news: All but one of our participants had

at least one voicemail acknowledging that news had played a diminished or nonexistent role in their life that day. People disengage from news because they are busy, "Today was a super busy day, so I didn't see a lot of news" (SB, voicemail), or traveling, "I usually look at more news, but I was out for most of the day" (ML, voicemail). Sometimes, they intentionally disengage due to news fatigue, "After all the nastiness today in the news, I am just going to go and listen to my silly armchair podcast while getting ready for bed" (LV, voicemail).

Some participants welcomed news free days, "I just like not having to look at my phone all the time" (SK, post-interview). However, several participants expressed that disengaging from the news can increase their stress, "You know when...you don't have access to news and then you kind of come back and then there's all these stories and all this stuff going on and you almost feel behind" (CM, post-interview). For others, a day or two without any news is totally fine, but "when I get to a week or more without knowing anything about the news, then I start to get a little stir crazy" (JS, post-interview). One participant searches for live news TV news coverage on YouTube when, "I feel like I'm not keeping up enough, and I'm like, 'Shoot, I need to catch up'" (SB, pre-interview).

4.1.3 Time-shifting News Content. When people unintentionally disengaged from the news, for example if they were busy, they employed strategies for time-shifting content to return to it later. One such strategy is making a mental note to check on a story. For example, a participant talked about seeing news notifications on his phone while at work but not being able to attend to them, and then looking them up on his computer when he got home later (BW, post-interview). However, this strategy doesn't always work, as another participant noted, "I'll see something or hear something and it's like, 'Oh, that's interesting' and then I'll move on. And then I'll never get back to it" (JW, post-interview). Another participant says, "I got notifications throughout the day, but again, I was at work and honestly if I don't read it at the time, it's hard for me to remember to read it" (SB, voicemail).

Another strategy to time-shift news consumption was to use digital notes and reminders. For example, "You know on your Gmail you can put a star or whatever, I'll highlight the star if it's something I wanna come back to" (MR, post-interview). Another participant relies heavily on news app notifications on his phone, using un-read notifications as a type of note-keeping system to remind him to look at content later in the day (BW, post-interview).

When people were intentionally disengaging from the news, they often relied on their social groups as a distinct strategy for maintaining a connection to important events:

> If I had missed something really important, someone would have brought it to my attention. (DR, post-interview)
>
> If there was something super important to happen, I would find out about it or someone will tell me about it or I'd hear about it or see it. (SK, post-interview)
>
> Most of the news things today were conversations. (SB, voicemail)

In both news-filled and news-free times, social interactions were a critical part of participants' news ecosystems.

4.2 Motivations for Paying Attention to the News

This section addresses RQ2, *How do routines and social context influence people to engage with (or disengage from) news?* Offline and online relationships play major roles in how people navigate, make sense of, and relate to the news. Our diary study revealed insights about the way technology mediates the social traditions that comprise background news and the social incentives for news engagement. For some participants, the act of noticing their own news behaviors invited critical reflection about their own motivations and actions.

4.2.1 Maintaining Relationships and Feeling Connected. Family, friends and co-workers served as de facto news streams, helping people stay in touch with current events and inspiring them to dig in deeper to relevant stories. Several participants are involved in ongoing group or one-to-one text message chains where news intermingles with other types of content. In these social contexts, news is not simply information—it is also a nudge to stay in

touch. News provides a shared vocabulary for real-time interaction, mediated by the immediacy of text messaging. The laddering questions used in the post-interviews revealed the potent social motivations underlying foreground news behaviors. News serves as a connective tissue that helps people feel close to friends and family, "I think news to me, it's almost like you can say Sunday dinner, it brings me closer to my friends" (ML, post-interview). Sharing a news story is a type of social down payment that strengthens relationships, "It's kinda cool to sometimes just be the one to almost break a story to somebody...it's kind of like a pay it forward type of thing" (BW, post-interview).

News also helps people feel less isolated. One participant added hashtags to his Tumblr diary, unprompted by the researchers, to categorize and synthesize news stories. When we asked why, he said it helped him feel more connected:

> I feel like I was doing this in isolation, but to really see like okay, well when I put these hashtags and things are popping up [...] So to see that other people are consuming the news similarly to me, or that some of these same hashtags are trending, it tells me like okay, well what I'm following other people, there's interest in that as well. (ML, post-interview)

Another participant described the news as a tool for empathy and a way to feel more connected to the broader world:

> Yeah, it's probably pretty easy to get stuck in your own space, in your own bubble. But finding out the things happening in the world, it feels less like, I'm just living in a bubble. (SK, post-interview)

Applying this to RQ2, these social motivators not only drew people to pay more attention to news that was relevant to people in their social circles, but also allowed them to disengage from the news with the confidence that their social networks would notify them if important news happened.

4.2.2 Critical Reflections on Personal News Behaviors. In addition to extrinsic social motivations, our participants also voiced intrinsic motivations for engaging with news, as evidenced through their reflections on their own behaviors evoked by participating in a news diary study:

> ...having the right information from the right source is important to me, but I realized I wasn't doing that. (DR, post-interview)

> [I thought news was] passive because I was doing it to kill time, but never until I did this realized how it was active (LV, post-interview)

In some cases, participants voiced wanting to modify their news behavior to align with their goals, either to engage with the news more—"I've learned that I skim too much through stories" (AB, post-interview)—or less—"I was quite surprised that I really do spend way too much time on my news apps. Need to put down the phone sometimes and read a book" (LV, post-interview). Tracking personal news habits helped one participant see previously invisible connections between events, "I never realized until doing this that a lot of these stories compliment each other" (ML, post-interview). Logging his news activities revealed the "tapestry" of the news.

4.3 News as a Background-to-foreground Activity

In this section we address RQ1, *How do situational contexts drive people to seek out and transition between different news behaviors?* We observed two distinct behaviors as people interacted with news content: They were either partially devoting their attention to the news as an ambient or background activity, or they were fully engaged and focused on news content. The categories and meta-categories most relevant to background news, foreground news, and the transitions between them are shown on the right side of Figure 1.

4.3.1 Background News Behaviors. Participants often described interacting with news content as a passive, background activity. For example, having the TV on in the background while getting dressed in the morning (IL, post-interview), listening to the BBC World Service while doing yoga (SK, pre-interview), or scrolling through

social media feeds while commuting (AB, pre-interview); see meta-categories "Background media" and "Skimming behaviors" in Figure 1 for more examples. One person even had background media on during the initial interview, admitting "right now while we're talking, trust me I'm paying attention to our phone call...I have the Cubs game on" (JS, pre-interview). Background news sources span media types and devices, including Twitter, radio, email newsletters, and news apps. Background news behaviors require a low level of attention and engagement:

> If I'm tending to skim only the headlines, I'm kind of in the middle of something else or kind of procrastinating. I don't have, I guess, the energy capacity, necessarily, to go and click through every article. (SK, post-interview)

The background behaviors participants described included ambient media exposure, passive scrolling, and multitasking. For example, one participant looked at news app headlines on his phone while watching "The Walking Dead" (CW, voicemail). What unifies these activities is that people are not engaging deeply with news content, but instead are only partially devoting their attention to the news.

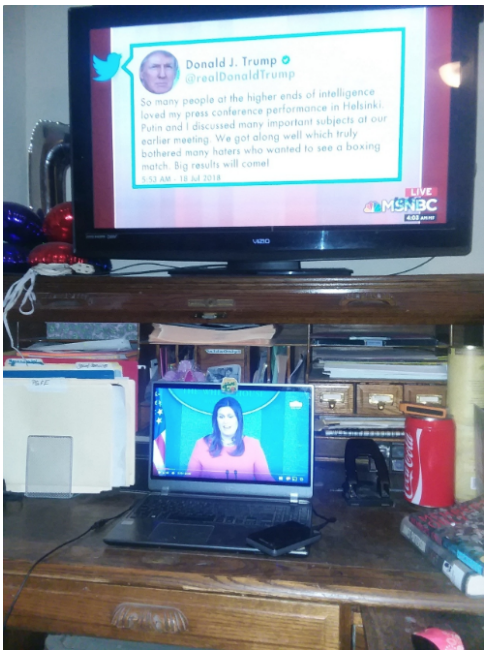

Fig. 2. This is a photo one of the participants (MR, diary snippet) took of how she uses multiple screens to engage with the news. She has MSNBC on her TV, video of a speech on her laptop, and uses her smartphone to look up additional details.

4.3.2 Foreground News Behaviors. Contrast news backgrounding with what happens when a news story grabs a participants' full attention:

> I'll passively go through the news, I'll passively listen to people have a conversation about topics that might be interesting. If something catches my ear I'll listen more actively. (JW, post-interview)

> I kind of noticed that mostly the news that interests me were the ones that kind of catch my eye. Whether it's a picture or the title or information that I think I might need. Those are the ones that I pay attention too. (IL, post-interview)

Our participants described foreground behaviors such as seeing a news article via an app and then talking about it later with a family member (AB, post-interview), searching for information on a topic by doing web searches and seeking out YouTube videos (DR, pre-interview), and watching a story on TV while also looking up additional information on a phone (MR, pre-interview). In the context of this diary study, logging news behavior via Tumblr and voicemail messages was also a foreground news activity. For more examples of foreground motivations and behaviors, see meta-category "Diving in (active)" in Figure 1. As with background news, foreground news content can span a range of devices and sources; what distinguishes foreground behaviors from background behaviors are the high level of engagement and involvement around active information seeking or sharing. This active engagement can be relatively short, like in this example:

> It was a CNN update I got on my phone, [9 am] this morning I tapped on at work, and an update popped up ... Evidence detected of lake beneath the surface of Mars. So there's liquid on Mars that's underneath the surface. The article didn't give as much detail as I wanted, so I Googled it. I came

Table 1. Examples of background-to-foreground news behaviors observed during the diary study

Background Behaviors	Inciting Factors	Foreground Behaviors
Scanning headlines while checking e-mail	Evokes personal memory	Searching for more information
Checking trending topics on Twitter	Know a friend would be interested	Seeking reactions from influencers
"Listening" to TV while cooking	Story is alarming or surprising	Sharing screen grabs in a group text
Casual chat with co-workers	Contains information for survival	Making mental notes to follow-up
Scrolling through news app	Affinity for a topic	Asking questions to a friend
Listening to radio while driving	Shared by family member	Drawing connections to past events

> across BBC.com [...] the lake is about 12 miles across. There's liquid water flowing underneath the surface, which is pretty incredible. (BW, voicemail)

Foreground engagement can also be more protracted and involved. For example, in the wake of the TV network ABC cancelling the reboot of "Roseanne" after Roseanne Barr tweeted racist comments [15], one of our participants went on a deep dive, spending hours searching for videos and articles in order to find out, "Was it something that was misconstrued? Was it something that was taken out of somewhere else because of her beliefs?" (MR, post-interview)

Foregrounding can include both a widening (greater breadth of sources) and a deepening (more time spent with each source) of news engagement. These foreground behaviors reflect the values of curiosity, a desire to connect with other people about news, and a need to ask deeper questions about the material. Foreground behaviors helped our participants access different perspectives on news topics, form opinions about the news, and gain confidence and familiarity with current events so that they could engage in peer discussions. The values and goals are particularly evident in the difference between background multitasking—"Anything that requires waiting, or I'm just bored, I pull out the phone and I look" (ML, pre-interview)—and foreground multitasking, such as when participants saw a news story on TV and did a web search on their phone to provide more depth and context. In cases like this, multitasking and multi-screening facilitates a faster switch between background and foreground. One participant who frequently searched on a phone for more context while watching TV news built this into a routine, "This is my TV, my desk, the laptop, and then usually I have two phones right here. This is just how I do the news sometimes" (MR, post-interview; Figure 2 shows how she uses multiple screens for enhanced engagement). With background multitasking, people are bored and disengaged, but with foreground multitasking, people are inquisitive and involved.

4.3.3 Inciting Factors for News Transitions. Why do people switch from the background to the foreground? We refer the motivations for doing so as *inciting factors*, and they can be either individually- or socially-driven. For example, the participant who noted the lake on Mars paid attention to this news item because his roommate is a physicist (BW, post-interview). Other inciting factors could be that a news event relates directly to one's personal surroundings, like the participant who heard helicopters and then searched for news about an escaped inmate (CW, pre-interview). Or it could be a personal affinity for a topic, like the participant who searched for more information about Roseanne Barr because she grew up watching the original TV series (MR, post-voicemail). For more examples of inciting factors, see meta-category "Starting point" in Figure 1.

This background-to-foreground news behavior is characterized by exposure to a stream of background news content, foreground engagement, and an inciting moment or factor which causes a shift from background to foreground. We use a "T-shaped" construction to help visualize this background-to-foreground pattern (illustrated in Figure 3). More examples of the background behaviors, inciting factors, and foreground behaviors we observed during the diary study are shown in Table 1.

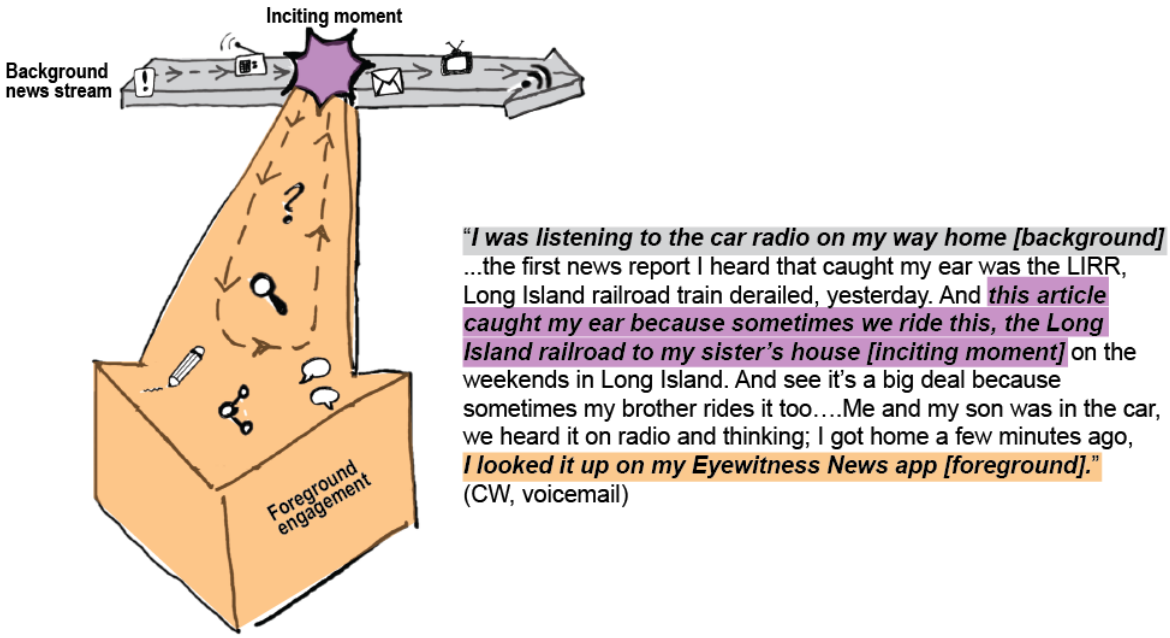

Fig. 3. This image illustrates "T-shaped" news behavior, which includes background news streams on the top of the "T" and foreground engagement activities on the stem of the "T". As a news user transitions from the background to the foreground, engagement with the news gets both wider and deeper. News users can continue in the foreground, or return to background behavior at any time. The accompanying quote is annotated to identify background news (listening to the radio while driving), an inciting moment (having a personal connection to the story), and a foreground activity (making a mental note to check up on a story and then seeking out additional information from an app).

4.4 From Cross-media and Cross-platform to Transmodal News Behaviors

We began this study looking for differences in news consumption based on reading, listening, and watching behaviors. However, as our findings about background-to-foreground news shifting emerged, we found that our participants' descriptions of these media boundary crossings were entangled with other boundary crossings. As our participants navigated an ever-present, technology-mediated news ecosystem, not only did they experience different media types—text, audio, video—they also accessed them on different platforms and devices—TVs, car radios, mobile news apps, Twitter. These platforms and devices do not exist in isolation, and people do not magically appear on them; rather, they travel there through social and technological scaffolding.

To describe these cross-media, cross-platform, and cross-device type traversals, we use a frame that is more encompassing and specifically attends to transitions: ***transmodal***. Our approach to studying transmodal news behavior considers **how and why users switch between behavior modes, media types, platforms, devices, sources, and contexts, especially when transitioning between background and foreground attention levels** (Table 2). The term transmodal has connotations in supply-chain logistics, where it refers to goods that are shipped using multiple modes of transportation, and in psychology, where it refers to multiple sensory and cognitive processes. The concept of transmodality has also been used by Wyatt et al. to understand education in online contexts to describe students' ability to both consume and create digital content across media and platforms, "where value is given to students' demonstrated capabilities to work within and across modes, weaving

Table 2. Elements of transmodal news behavior

Element	Key questions	Examples
Activity Mode	What is the user doing?	Reading, listening, watching
Media Type	What is the user consuming?	Text, audio, video
Platform/Device	How is it being distributed?	News app, Facebook, car radio, TV
Source	Where does it come from?	*NY Times*, primary source, co-worker
Context/Situation	What is the user's surrounding context?	While commuting, at work
Attention Mode	How is the user engaging?	Backgrounding, foregrounding
Transmodal News Behavior/ Transitions	**How/why is the user engaging? Why is the user switching experiences?**	**Searching on phone for context about a TV news story**

together or combining different meaning systems and channels of communication for effect." [42] While a multimodal perspective acknowledges that people access information via multiple modalities, a transmodal perspective specifically focuses on the transitions between those multiple modalities. In the context of news, we use transmodality to help illuminate the transitions between backgrounding and foregrounding content, especially as it relates to inciting moments that drive people to traverse between accessing news via various sources, formats, devices, platforms, or behavioral modes.

This definition of transmodal behavior can be applied directly to analyzing news transition events. Here is an example of a background-to-foreground news transition described by one of our participants:

> So, the first time I saw it I think it was on AOL. That's usually where I first see if any news is unless I really search for news. And I saw [Demi Lovato] was hospitalized for overdose and I know about her history of being addicted to drugs, that she was trying to come out clean. And she recently had a single out, a song out that she's sober, so seeing that she's still battling with a drug and everything I wanted to know like...what was pulling her back. After seeing that it was [inaudible] kinda be a big fan of hers so I kept that in the back of my mind and on Instagram...the next day you know the Jonas brothers are very close to her and they're like next to her so they're very close to her like a best friend...that was me seeing what they had to say anything about it. I went to their page, I scrolled on Nick Jonas' page and Demi Lovato's page to see any updates. I didn't see any. (DR, post-interview)

We can use transmodality to parse the elements of this transition. Her transition from generally browsing the news to having a deeper interest in a specific news story is accompanied by shifts in the elements of transmodality we identify in Table 2. Initially, our participant is reading (behavioral mode) a text story (media type) on her computer (platform/device) from AOL (source) as part of her routine background scan for interesting stories (attention mode). Then, the inciting factor her a personal affinity for the subject of the news story, Demi Lovato. Once she shifts her attention and it becomes a foreground event (attention mode), she seeks out videos, images and text (media types) from celebrities who are close to Lovato (sources) , which she reads and watches (activity mode) on the Instagram app (platform).

5 DISCUSSION

In this section we discuss how a transmodal approach is useful within HCI for understanding news and other behaviors. Then, we present design implications for news products that draw on our diary study findings and support news behavior transitions.

5.1 Analyzing Transitions in News Behavior

How does a transmodal approach help us understand news experiences? Focusing on the transitions between media types, sources, devices, and behavior modes highlights the underlying values driving news behavior. A transmodal approach encourages us to ask, *What values motivated someone to switch between news experiences?* Perhaps the transition was motivated by an inability to devote full attention to the news story due to contextual circumstances, or a desire to find additional information, or an urge to share news with a friend. These transitions, and their motivators, open up new lines of inquiry.

Drawing on the theory of uses and gratification [13], people manage their foreground and background news activities based on a range of contexts and goals. But these structural approaches do not account for the limitations and affordances of the media cycle and the availability of media in different contexts. In any given moment, a person's news consumption behaviors are mediated by goals (being bored and needing to pass the time, experiencing the fear of missing out, encountering a story that evokes a strong sense of nostalgia) and by situational context (cooking dinner, out and about shopping, at home lounging in bed). These, in turn, influence the type of media they will seek out (podcast, easily digestible headlines, in-depth long-form story) and the device they will consume it on (smart speaker, mobile phone, laptop). Further, personal preferences and social motivating factors influence how a person seeks information (going to a habitual news source, texting a friend, searching for complementary perspectives) and the platforms they use. Using transmodality, we can bridge social nature of uses and gratification and the technologically deterministic nature of single-platform approaches to come up with a more useful socio-technical stance for understanding news media behavior. A transmodal approach leverages many different behavioral, material, and contextual elements and focuses on the individual, societal, and technological influences on users' behavior as a framework for evaluating news consumption experiences in HCI. The lens of transmodality opens up new research questions and future areas of study, such as how and why someone returns to the background after a period of foreground news engagement. Using transmodality, we can perceive news users through the social and technological scaffolds that brought them to a given platform or media type to more deeply understand their information needs.

5.2 Design Implications: Attending to News Behavior Transitions

Our study revealed that people rely on both background and foreground news consumption behaviors in their routines—each has a unique utility for the news user. News and media outlets should recognize that background consumption behaviors are a way for users to build routines and to sift for potential foreground engagement opportunities. Background consumption habits such as skimming and multi-screening are often seen as peripheral to news engagement. However, our study revealed that background consumption is a critical part of a healthy news diet—it is the fiber that keeps the system running smoothly. News product design should facilitate, rather than resist, background behaviors by treating them as mandatory steps in the ladder of news engagement. Thus content providers should make sure that small bits of overview content have essential information and provide users with glimpses of deeper content and avenues for diving in when they do wish to transition to foreground engagement. Indeed, many news organizations and news apps are already doing this, which we observe in the rising popularity of digests and newsletters.

But news designers can take this further: The transitions between these experiences are a rich and under-explored design space for news content providers. We encourage news designers to recognize that news consumption is not homogeneous. As news users transition between background and foreground attention modes, they traverse different activities, media types, platforms and devices, and news sources. We identify three main ways that product designers might apply ubiquitous computing principles to news applications that attend to transitions: (1) transitions can be used to sense when news users are engaged and to build more robust models of what content is personally relevant; (2) context sensing and routine modeling can be used to identify moments

when news users may be experiencing an inciting factor, yet be unable to devote foreground attention; and (3) self-tracking and quantified self practices, common in heath and wellness, could be applied to news domains to help users become more deliberate curators of their own news consumption.

5.2.1 Using Transitions to Sense when Users are Foregrounding News Content. The transitions people make between activities, media types, platforms and devices, and sources are clues that point to the moments when people switch between background and foreground news consumption. When someone turns up the volume on her car radio, opens up YouTube, and begins searching for video reactions, or texts her brother to ask if he has heard about a story, these are all contextual traces of foreground consumption and personal relevance. These traces—which exist across the varied environmental contexts, sources and devices in each user's personal news ecosystem—could be used to construct a situated model of what news content is most relevant to her. Of course, these traces alone are not sufficient to tell whether she is foregrounding news content: Instead of turning up the volume because she was interested, she might have driven past a loud construction zone. To address this issue, we draw on Paruthi et al.'s [29] notion of *sweet spots*, which incorporates phenomenological experiences into context-aware systems to support the successful execution of planned exercise activities. A system that is aware of a news user's routines [1] (when she is commuting to work, what media she typically consumes on that commute), as well as her situated actions (turning up the volume, texting a friend), could more accurately flag actions that deviate from her typical news behaviors, which are likely to be inciting factors.

5.2.2 Using Routine Modeling and Context Sensing to Time-shift Inciting Moments. We see similarities between planned physical exercise that is not carried out and missed inciting moments, where a person is unable to devote her full attention to relevant news content and perhaps intends to return to it later, but never does. Paruthi et al. [29] propose a context-aware system that, when a person misses a planned opportunity to exercise, could identify future opportunities and suggest repaired plans. This concept could be adapted to news behaviors. A context-aware system, supported by routine modeling, could identify moments when a news user is, by necessity, only able to devote background attention to the news. In those moments, the system could, either actively or passively, track potential inciting moments, and then re-deliver relevant news content to the user when she is in a situation where she can devote foreground attention to the news.

For example, a news user is listening to news on the radio while driving to work. She is able to devote only background attention as she drives, and wants to follow up on some of the news stories she heard. She makes mental notes of the stories she wants to research more and send to family members, but those mental notes get lost in the shuffle when she arrives at work. A passive context-aware system might automatically text a list of stories she heard on the radio to her phone so that she can review them when she is no longer driving. Then, she can either engage with them using her foreground attention or dismiss them. Alternatively, with an active context-aware system, she might tell her voice assistant, "Bookmark this story and remind me of it later," as she is driving, so that she can foreground it at a later time.

5.2.3 Applying Self-tracking Techniques. Our participants noted how the diary study allowed them to be more self-aware their own news habits. This self-tracking, also a form of foreground news behavior, motivated some of our participants to be more deliberate about their news consumption. In HCI, we typically associate self-tracking with physical fitness, wellness and mental health; however, our study demonstrated that self-tracking of news behaviors has the potential to inspire deeper engagement and to help maintain healthy news and information habits. News product designers could leverage the appeal of self-tracking by showing news users personal metrics such as the topics they most frequently foreground, the types of devices, sources, and media types they spend most time with, and how much of their news attention is allocated between background behaviors (like skimming headlines) and foreground behaviors (like searching for contextual information to supplement a news story). People already sense that their digital news habits are implicitly reflected in customization algorithms, but we

observed that people also have a desire to see their habits explicitly documented so that they can modify them. This could open up opportunities for news users to set goals about their news consumption habits and to be more deliberate about the type of news ecosystem they are curating for themselves.

Framing news as a background-to-foreground activity and attending to news behavior transitions also makes us question the prevailing metrics news organizations use to evaluate engagement—can we imagine new metrics beyond page views, shares and likes? We encourage news product teams to look for metrics that can more accurately capture news engagement, like the ratio of background time to foreground time, or the number and diversity of sources and activities a user engages with during foreground events.

5.2.4 A Seamful or Seamless Approach to Designing Transitions? Our diary study asked people to focus attention on the moments they moved from background to foreground news experiences—transitions that often go unnoticed by news users. In this type of foregrounding, we find threads of Chalmers and Galami's idea of seamful design, which encourages "selectively and carefully revealing differences and limitations of systems" [5]. We are curious to see what could happen if news product designers expose the seams in news behavior transitions. By calling attention to, rather than hiding, transitions—like changing media types, technology platforms, or news sources—product designers might inspire users to be more intentional and reflective about their news consumption.

Alternatively, we observed that people often quickly and non-consciously bring background news content into the foreground when it is relevant and needed. This evokes Weiser's speculative future [39] where people can move quickly and easily between *pads*, *tabs*, and *boards*. Weiser argued that computers should fade from people's awareness and blend seamlessly into their lives. Product designers might consider taking this seamless approach when presenting news content to reduce the friction inherent in background to foreground news transitions.

5.3 Future Work

We encourage news product designers to be aware of whether their designs take a Chalmers and Galami-inspired *seamful* or a Weiser-inspired *seamless* approach to news transitions. However, the answer to the question, "In what contexts is a seamful or a seamless approach to news behavior transitions most appropriate?" is one we cannot yet answer. This is one example of future research that a transmodal framing exposes. As news consumption is increasingly mediated by ubiquitous technologies, we encourage researchers, journalists, and designers to focus on the questions provoked by transitions and transmodality: Are specific elements of transmodality associated with certain types of transitions? How might a focus on transitions be used to study more targeted news domains, such as politics or local news? What can transitions tell us about the role of technology in trust in news and information? How can ubiquitous computing technology best support these transitions?

6 CONCLUSION

News users access and process information in complex social and technological contexts. To understand the contextual environments in which people engage with news across multiple behavioral modes, media types, technology platforms, devices, and sources, we conducted a two-week diary study with 14 participants. Our study revealed that news is a background-to-foreground behavior, where inciting factors such as a personal history with a news topic can inspire people to switch from passive to active news behaviors. We also observed the importance of background news in managing the social and emotional labor of keeping up with the news, the role of news in maintaining social relationships, and the potential to tap into self-tracking behavior as a way to encourage healthy news consumption. These contributions can help designers to create news platforms that empower news users take control of their own news habits and navigate the overwhelming news and information ecosystem. Further, a transmodal approach, which attends specifically to the transitions between news experiences, can be applied to understand motivations and behaviors.

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