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The Interactional Uses of Evidenced Sleep: An Exploration of Online Depictions of Sleep Tracking Data

*Christine Hine, Robert Meadows & Gary Pritchard**

Abstract: »Die interaktive Handhabung evidenzbasierten Schlafs: Eine Betrachtung von Online-Darstellungen von Schlafttracking Daten«. A wide array of consumer devices that purport to measure sleep are now available, with sleep measurement often an additional feature alongside the measurement of daily activity through steps and monitoring of heart rate. These devices offer their users insight into the duration of sleep and different sleep phases and the ability to share the outcomes in the form of numbers, charts, and graphs. This paper explores the ways in which these technologies are deployed within everyday online interactions. We explore depictions of sleep self-tracking that are commonly available online and analyse how the sleep data collected are interpreted by users and deployed in differing social interactions through a comparison of traces of the Fitbit sleep self-tracker across Twitter, Instagram, and the parenting discussion forum Mumsnet. We find that sleep self-tracking is, across platforms, occasioning new practices of evidencing sleep that acquire particular meaning within existing relationships. There is also however a strong mood of rejection, mistrust, and doubt around self-tracked sleep. The new ways of evidencing sleep sit alongside and in dialogue with previous ways of knowing sleep and of deploying it within social interactions, rather than displacing them.

Keywords: Datafication, sleep, self-tracking, Fitbit, Twitter, Instagram, Mumsnet.

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1. Introduction

It has historically been notoriously challenging for us to know about our own sleep. According to Leder (1990), the sleeping body partakes of depth-disappearance and “disappears from perception and command, from Self and Other, as a result of its withdrawal from the sensorimotor circuit” (Leder 1990, 58). For Leder (1990), we cannot directly know or audit our sleep length or quality. We can only infer it or learn of it indirectly from others. According to Kroker (2007), historically what counted as knowledge of sleep came from personal experience. The practices and technologies of the sleep lab changed this: “Relying on the testimony of instruments rather than individuals, investigators interested in sleep began to create a new series of sleep phenomena that refashioned sleep as a scientific object” (Kroker 2007, 5). Through these scientific practices, a third-person perspective is introduced and knowing something about sleep meant knowing about the “sleep of others.” Knowledge of sleep as a scientific object was thus unevenly socially distributed and largely confined to acknowledged sleep experts. Despite this lack of access to our own sleep, however, there is ample evidence that sleep is social and is subject to rules and norms that vary across socio-cultural contexts. Among the Asabano, for example, sleeping is as social as waking; with houses and bedding used for both sleep and wake activities and people interacting long after dark (Lohmann 2013; Airhihenbuwa et al. 2016). Sleep is also “another place, both spatial and temporal, where gender differences are expressed and revealed” (Venn et al. 2008, 96). In heterosexual couples where the male partner is the sole earner, women often agree that it is reasonable for them to get up in the night for children. Negotiations leading to this situation are largely implicit and rarely re-negotiated when female partners return to paid employment (Venn et al. 2008). Sleep is thus a social phenomenon acquiring meaning in interaction.

Recently, Williams, Coveney, and Meadows (2015) have suggested that the advent of new technologies for monitoring sleep that are accessible to a lay audience may have opened space for new ways to know our own sleep. Following Hoeyer, Bauer, and Pickersgill (2019, 460), these technologies may also have created a need to ask “What is counted? What counts? And to whom, how and why does it count?” In this paper, we explore these questions through a focus on everyday uses of sleep monitoring technologies as manifested in online social media platforms. In addition to its relevance within the evolving histories of ways of knowing sleep, we further situate this concern within current debates about the significance of a broader cultural shift towards datafication (Mayer-Schönberger and Cukier 2013). Datafication entails an ongoing rendering of an increasing array of features of everyday life as data, in the process re-shaping our understanding of mundane activities

by making traces of these activities persistent in data form and available to be revalorised and circulated in new ways. This paper focuses on sleep as a mundane activity touched by a datafication that shifts the availability of knowledge about sleep and potentially more fundamentally shifts our understanding of what sleep is.

A further contextualisation is provided by a specific set of concerns that pervade sleep as a focus of datafication and add distinctive connotations to the possibility of evidencing and sharing sleep. Sleep is a key site of tension in contemporary society. Anxiety about how much we sleep and how to address concerns about lack of sleep is widespread, whether we be hard-pressed commuters, teenagers suffering from shifted body clocks, or parents juggling the sleep demands of children and partners. Sleep disorders have become the focus of an industry of therapists, apps, and technologies and the site of a plethora of well-meaning advice. This widespread anxiety forms a backdrop for the efforts we describe in this paper to find out more about what people are making of the datafication of sleep as a part of their everyday lives. Rather than expecting that the datafication of sleep shapes the current anxieties about sleep or vice versa, we take sleep as a social practice that is done within a specific contemporary context and remain open to finding continuities with previous practices.

An array of authors has argued for the need to move beyond the level of hyperbole and extrapolation when we discuss what datafication might mean for society. Kennedy (2018), for example, suggests that too little attention has hitherto been given to the everyday experiences of datafication, arguing that we need to understand how people are “living with data.” Pink et al. (2015) discuss the need for “non-digital-centric” approaches to understanding the embedding of digital technologies into everyday life, stepping away from focusing only on the technologies themselves and exploring the broader contexts in which they derive their meaning. In a similar vein, Couldry and Powell (2014) stress the need for a “bottom up” study of big data within which it is important to explore the agency and reflexivity of those affected by datafication. While we undoubtedly do need analyses exposing the concerning developments in new forms of data-enabled governance and commercialised dataveillance, it is also important not to treat ordinary people as unthinking “datafication dopes” who are passive victims of an irresistible trend. We need to explore what the appeal of these developments is for ordinary users and how they respond to and make use of the data that these devices provide in everyday lives and social interactions. The issues of interest span a practice-based dimension enquiring into who uses these technologies and how they use them and an affective dimension concerning how we feel about these devices and the depictions of sleep that they produce. Kennedy and Hill (2018), for example, highlight the need to understand the emotional response to datafication in all its nuance, rather than assuming in advance that data subjects

will find the experience harmful or oppressive. Taking these insights as inspiration, this paper seeks to explore what people are making of the datafication of sleep through a focus on the practices and emotions of sleep self-tracking.

The self-tracking trend is most usually linked with the self-identified Quantified Self movement as initially promoted by Wolf (2010), in which participants use monitoring, tracking, and analysis of various forms of data about their physiology, activities, and performance in a quest to identify lifestyle adjustments they can make to optimize health and performance. However, not all self-trackers are overtly connected with the Quantified Self movement (Neff and Nafus 2016): Lupton (2016) describes self-tracking as comprising complex and multi-faceted cultures. Even while highlighting this diversity, however, Lupton (2016) often aligns practices of self-tracking with a project of self-optimization and a reflexive self-monitoring. The prospect of other approaches to self-tracked data, to a less purposive, more chaotic and uncertain relationship with the output of such devices and the prospect of a diverse range of socially-situated and contextually meaningful appropriations of the data remain relatively unexplored. Sharon and Zandbergen (2017) point out that, even within the Quantified Self movement, data derived from self-monitoring are not always fetishized as giving access to an objective truth, but rather are frequently used within practices of mindfulness, as a means of resistance and as a component of an enriched narrative of the self that is informed by, but not reduced to, the measured data. Not all self-tracking will necessarily be part of a project of self-optimization nor will users take data always at face value and, as we explore in the next section, sleep may not be treated in the same way as other forms of self-tracking.

We use an examination of visible online discourses to explore publicly available perceptions of sleep self-tracking. The use of pre-existing online data, rather than interviews or surveys, allows us to explore a diverse array of everyday manifestations of sleep self-tracking. We include three different online platforms, to avoid limiting the analysis to the kind of interaction prevalent in any one platform. The research questions that we explore are as follows:

- How do people make use of and interpret sleep self-tracking within interactions on online platforms?
- How does the online landscape of sleep self-tracking vary across online platforms?

2. Self-Tracked Sleep in the Literature

Sleep has been subject to an array of expert interventions, most notably in the measuring of sleep within the laboratory, but it is also subject to persistent

measurement uncertainties and competing knowledge claims. The “gold-standard” means of measuring sleep is the polysomnograph, comprising a range of physiological sensors including heart monitors, movement sensors, muscle tone sensors, and oxygen saturation monitors. However, as Ravichandran et al. (2017) argue, the artificiality of the laboratory setting and the cumbersome nature of the polysomnograph technology mean that more portable self-tracking devices have a considerable appeal for sleep researchers. Self-tracked sleep does however suffer some problems of legitimacy as a measurement of sleep. While it might gain an ecological validity as compared with polysomnography, it suffers in accuracy through using a very limited set of measurements as proxies for sleep and using algorithms to determine sleep time that may be opaque to users and experts alike. Lee and Finkelstein (2015) reviewed the consumer sleep-tracking devices available at the time and found that information on mode of operation and sensor accuracy was scarce. Users were being offered little detail beyond face-value claims that these devices measured sleep. Researchers have reported disappointing and variable results rendering the output of consumer-devices unreliable in measuring sleep for research purposes (De Zambotti et al. 2016; Baroni et al. 2016; Mantua, Gravel, and Spencer 2016; Rosenberger et al. 2016; Cook, Prairie, and Plante 2017; Kolla, Mansukhani, and Mansukhani 2016). Chinoy et al. (2022) have however more recently found more promising results for commercial wearables as compared to research grade actigraphy: the technology is rapidly evolving and efforts to calibrate different forms of sleep knowledge are ongoing (Ibáñez, Silva, and Cauli 2018). Claims that self-tracking devices “measure sleep” have thus been taken with caution among sleep researchers but it remains to be seen whether lay users experience the same uncertainties and indeed whether they display any interest or concern in how the results are generated and how they compare with laboratory standards.

Rather than being unknowledgeable about sleep, it may be more apt to think of lay people as having different forms of sleep knowledge to those of sleep experts. Sociological attention to sleep has demonstrated that rather than being simply a biological fact, sleep is inherently social (Meadows et al. 2018) and subject to multiple different understandings (Meadows et al. 2021). Sleep is a practice that is “done,” and negotiated with others, rather than solely a property of the individual body. Recent work in sociology of sleep (Williams, Coveney, and Meadows 2015) has considered the turn to monitoring our own sleep as having the potential to impact everyday experiences of sleep. Williams et al. (2015) argue that sleep monitoring technologies act as sociotechnical assemblages and thus do not have a deterministic impact on our understandings of sleep. The status of these sleep measuring devices is the upshot of “mutual shaping by developers and users in a wider context of [...] shifting information scapes” (Williams, Coveney, and Meadows 2015, 1041). Similarly, Nagele, Hough, and Dinnen (2022) suggest that sleep

trackers need to be considered as social agents in their own right, with the capacity to reconfigure the ways in which people relate to their sleeping selves but stress that users orient to this agency in diverse ways. It is therefore important to ask how sleep self-tracking is appropriated and interpreted by users without expecting singular deterministic effects.

Taking into account that not all self-tracking may be part of a self-optimization project, it is also important to consider that sleep may not be like other forms of self-tracking, even if the user wanted to self-optimize. Whitson (2014) draws on a Foucauldian perspective to suggest that the self-tracking device Fitbit enrolls “our desires for self-mastery and improvement into a new care of the self, a care of the self that is also predicated on governance” (Whitson 2014, 340). Such devices employ gamification through the setting of targets and rewards for reaching goals and thus, it is argued, encourage a playful form of self-surveillance. It is, however, doubtful whether this regime of care of the self should be taken to apply to all users of the Fitbit and particularly whether this framing applies where the bodily activity being measured is sleep. For example, Liang and Ploderer (2016) carried out interviews with 12 users of Fitbit devices to track sleep and found that being aware of sleep in this way did not translate into an improvement in sleep due to not having a reference point for what normal sleep would be, perceived lack of accuracy in the data, not understanding what might be causing poor sleep and not knowing how to act to improve sleep. The sleep data recorded by Fitbit provided scope for reflection on sleep but no clear pointers to help users to act on those reflections. More recently in a longitudinal study, Wang, Lizardo, and Hachen (2022) found that college students had high levels of trust in the measurements of self-tracking devices including tracked sleep, but that there was little evidence that this led to changes in their levels of activity or sleep. Alqahtani, Jay, and Vigo (2020) found however that self-trackers reported that uncertainty about the measurements could in fact enhance their experience of reflection, suggesting that measurements do not need to be seen as accurate in order to be found useful. Again, it is important not to assume that the device itself determines the outcomes: Jarrahi, Gafinowitz, and Shin (2018) studied the informational and motivational use of Fitbits over time in a study not specifically focused on sleep and found that people take up diverse positions, responding to the affordances of the device from their own situated positions.

Liu, Ploderer, and Hoang (2015) studied online forums focused on measuring of sleep, including BulletProof Sleep, Lifehacker, Connectedly, Gizmodo, and Quantified Self Sleep. These forums tend to attract a community of users committed to self-measurement often with an active focus on self-optimization and thus would be expected to be distinctive in their orientation towards measured sleep as compared to a general population. A key set of concerns raised in the forums focused on challenges of attaining continuity of tracking

due to factors such as discomfort of wearing the device, battery life, and lack of fit with lifestyle. Other challenges focused on lack of trust in accuracy, difficulties in downloading and combining datasets, and problems of interpretation. Even if users of sleep self-trackers do want to improve their sleep, then, doing so is not straightforward. Ravichandran et al. (2017) combined interviews with users of sleep self-tracking and experts with an analysis of online reviews of commercially available devices. The analysis notes a problematic fit between the tendency of devices to report on the amount of time spent in various forms of sleep (REM sleep, deep sleep, light sleep), users' understandings of what good sleep might be, and their ability to take any meaningful actions based on reported amounts of different forms of sleep. "Deep sleep" was often taken by users to denote "good sleep," but they were unable to identify ways to influence the amount of time that they slept in this way.

Sleep self-tracking thus may not be comfortably included within the frame of self-optimization and responsabilization for the self often attributed to self-tracking. Problems with the technology, doubts about the validity of the measurements, and lack of obvious ways to improve on measurements pervade the field. Many of these concerns are observed through research focused on the individual sleeper and hence neglect to take into account the sociality of sleep and sleep self-tracking. In the current study, we move away from the focus on the individual sleeper and ask, instead, what do people do with measured sleep in social situations? Little is known about how and where people share their self-tracked sleep, outside of the online communities specifically focused on sleep optimization or self-tracking. Shirazi et al. (2013) describe tests of an app-based "social alarm clock" that was able to track a user's sleep and use the data to post automated updates to the user's Facebook accounts. The privacy settings for this sharing could be personalized, and in practice testers tended to choose only to share sleep data with people that they knew well such as close friends, family, or colleagues. Shirazi et al. (2013) found signs from analysis of Facebook posts that repeatedly posting an update on one's sleep could be seen as irritating or inappropriate. This experimental study is provocative in the suggestion that it may not always be deemed socially appropriate to share one's tracked sleep data. Similar conclusions may be drawn from a study by Dong, Chen, and Wang (2019) of the extent to which users of the Mi band (similar to Fitbit and more widely used in China) shared their self-tracked information on the social media platform Weibo. Sleep data was found to be less shared than other forms of activity such as steps. Users tended to say that sleep was shared for purposes of recording their own life in a form of public diary rather than the purpose of "motivating self" more prominent for activity – and when sleep data were shared the users tended not to be expecting a response from others. Lyall (2021) found in interviews with self-trackers that sleep was often considered

an intimate form of data only to be shared with a selected few, but that it could also be the occasion for everyday repartee with friends.

3. Methods

In the current study, we observe the practices of sharing sleep data and talking about sleep data and analyse the variations we find across different online platforms. This research focuses on visible online discourses relating to sleep self-tracking, aiming to avoid an overly platform-specific viewpoint by including three different platforms (Twitter, Instagram, and Mumsnet). Many of the available software tools for exploring the online manifestations of a topic are focused on data from a single platform, such as World Wide Web or Twitter (Pearce et al. 2018). Less structured approaches are also possible – Beer and Penfold-Mounce (2009) suggest tracking circulations of online discourses using ready-to-hand search tools, to reproduce the lay experience of navigating online landscapes. Hine (2011) similarly proposes a quasi-ethnographic approach to exploration of online landscapes, focusing on the emergence of situated discourses. For our purposes, an approach inspired by these unstructured exploratory methods is deployed to build an oversight of the emerging landscape. We develop platform-specific approaches using available tools to identify emergent themes on each platform in turn, building towards a cross-platform comparison of themes. We aimed for an overview that would allow us to look across platforms to identify variations both in the practices of sharing self-tracked sleep and in the discursive treatment of the data from sleep measuring devices embedded within these practices. For this reason, we focused on approaches that lend themselves to thematic analysis rather than analysis of the networked structures of communication in any single platform.

While the full array of online manifestations of sleep self-monitoring are potentially of interest, for practical purposes it was necessary to limit our attention to a data set that could be produced without generating a large quantity of false positives. We focused, therefore, on the search terms “Fitbit” and “sleep” in an appropriate form for each platform, to generate data that would be, in almost all instances, relevant to our interest in how self-tracked sleep is shared and interpreted. It is important therefore not to claim that this dataset encompasses all forms of online manifestation of sleep self-monitoring as many of these may concern other brands and other devices or indeed make no reference at all to brands or devices. We are also only focused on publicly available data, and hence cannot address the sharing of sleep data and conversation about sleep data that goes on between individuals through private messaging or in closed groups, nor the flows of data from devices that bypass public forums. Data collection was focused on the platforms Twitter,

Instagram, and Mumsnet. In each case we focused on publicly available data¹ relating to Fitbit and sleep, using an appropriate search strategy and analytic approach for the platform, as outlined below.

4. Online Traces of Sleep Self-Tracking

4.1 Twitter

Twitter was included in the analysis of the online landscape of sleep self-tracking as a widely used platform with a demographic skewed towards younger relatively affluent adults (Blank and Lutz 2017) potentially overlapping significantly with a demographic more likely to use Fitbits (Chandrasekaran, Katthula, and Moustakas 2020). Here, we might expect to see traces of the “social feed” capabilities of the devices given that from early 2017 users were able to link their Fitbit to their Twitter account and produce automated announcements when they reached goals and achieved awards or give regular summaries of their Fitbit-measured statistics (Pressman 2017). Analysis of Twitter traffic relating to sleep self-tracking offers an indication of the extent to which people found it meaningful to select this option and share their sleep data as a matter of public interest. Twitter is also a useful site for exploring questions surrounding the comparison between self-tracking of sleep and self-tracking of other forms of activity. As highlighted above, issues of gamification and self-optimisation have been particularly noted in relation to self-tracking of activity levels, but it is not clear that this framing will apply to sleep. The availability of tools to collect and analyse large numbers of tweets allows us to explore whether on this platform there is indeed a difference in this regard between sleep and exercise (where exercise is most notably measured and reported by self-tracking devices as number of steps).

A search was conducted using the software COSMOS (<http://socialdata-lab.net/COSMOS/> [Accessed 26 July 2017]) available at the time of data collection, allowing real-time collection of data from Twitter and an array of facilities for visualization and exploration of the data. Search terms relating to sleep and steps in association with Fitbit were entered² and the search allowed to run for a three-day period (from Friday to Sunday night in July 2017). This method can only access public tweets that are available on the feed that Twitter makes available to researchers, leaving out tweets to private accounts. Using this approach, we therefore cannot know if people were using

¹ Given that informed consent was not acquired for each element of the dataset, we adopt a cautious approach to reporting in what follows in order to avoid drawing attention to any individual users.

² Sleep fitbit, steps fitbit, fitbitsleep, sleepfitbit, fitbitsteps, stepsfitbit, #fitbitsleep, #sleepfitbit, #stepsfitbit, #fitbitsteps.

the social feed capability to share sleep data with known friends rather than an unrestricted twitter public and have to base our analysis on the sample of public tweets that Twitter chooses to make available. The retrieved tweets were exported and coded using the following frame: (i) STEPS: AUTOMATED (for tweets which appeared to be automated messages once step goals were achieved)³; (ii) STEPS: OTHER (for tweets that users appeared to have created about steps themselves; (iii) SLEEP: AUTOMATED (for tweets which appeared to be automated messages regarding sleep; (iv) SLEEP: OTHER (where users had created their own messages about sleep); (v) SALES⁴ (for tweets selling or reselling fitbits); (vi) OTHER (for tweets which just contained links and/or what appeared to be automated accounts/porn).

As visible in Table 1, most harvested tweets related to steps and were automated messages. By contrast, very few automated tweets relating to sleep were observed. This may imply a smaller number of users choosing to use Fitbits to monitor sleep as compared to monitoring steps. It may also point to active choices made at the point of setting up the social feed on the Fitbit app. This would suggest that it was more often deemed meaningful to share one's steps in this fashion than one's sleep. This tendency is potentially compatible with a view that sleep is more resistant to the user's interventions and thus less open to gamification than activity levels. While steps might be shared in the interests of fostering competition and of receiving motivational congratulations, this framing may not work for sleep. The data offer little direct insight into the meaning of these displays of sleep: automated tweets tend not to garner replies and are shared with an indeterminate public of followers, suggesting that we may be observing a phenomenon similar to the sharing of sleep data as a form of public personal diary as noted by Dong et al. (2019). As regards the meaning attributed to shared sleep, there are signs of sleep data being presented as an explanation for the user's behaviours as many of the automated tweets took the form "Be warned - I'm running on Xh Xm of sleep last night as tracked via @Fitbit." This gives some social meaning to the sharing albeit automatically attributed by the Fitbit rather than a matter of individual choice.

³ Also included tweets where the API was simply RT.

⁴ This also include direct tweets/responses to technical support.

Table 1 Twitter Sample Coded According to Content of Tweets

		EXEMPLAR (fabricated examples to preserve confidentiality)	NUMBER OF TWEETS
SALES			76
STEPS	AUTOMATED	My fitbit #Fitstats_en_US for 7/28/2017: 8,278 steps and 3.6 miles traveled.	5583
	OTHER	Shamed by my fitbit cos I only took 250 steps today!	178
SLEEP	AUTOMATED	Be warned — I only got 5h 29m of sleep last night as tracked via @Fitbit	34
	OTHER	Not wearing my fitbit at night because I can't bear to see how little I sleep!	46
OTHER			59
TOTAL			5976

The tweets coded SLEEP: OTHER were apparently constructed directly by users, rather than produced automatically by apps. Again, there was a considerably smaller number of non-automated tweets relating to sleep than steps, suggesting either fewer users tracking sleep or a higher threshold for considering measured sleep to be meaningful to mention in a tweet. Fifteen of the SLEEP: OTHER tweets offered advice on sleep or promoted a new sleep tracking feature rather than featuring viewpoints of actual users. The remainder of the SLEEP: OTHER tweets were from individual users, and these tweets included both those unproblematically accepting the ability of the Fitbit to measure sleep and those in some way questioning the nature of measured sleep. In the former category, users described themselves as interested to see how they slept and finding the information useful. Most focused on how the user understood themselves in a new light, but a small number hinted at additional social dimensions including proving how badly one slept to one's doctor or excusing one's behaviour to friends on account of bad sleep. Across this category, users exhibited a trust in the accuracy of the measurement of sleep, but some positioned this as useful to know while others deemed it not a good idea to look, for example suggesting that they "dread reading" their sleep report. In the category of tweets that questioned the nature of measured sleep, some positioned the Fitbit data as not useful given than one already knew how one felt while others questioned the accuracy of the measurements.

Across the Twitter data, then, we find that sharing of sleep data is less prevalent than steps, but that some people do find it meaningful to offer a public account of how they slept even though this may not be acknowledged by others. The Fitbit evidences their sleep in a readily shared form often rendered

down into a simple measure of hours and minutes. This evidenced sleep is often simply placed in the public domain without commentary, but in other instances value judgments are attached suggesting that evidence of bad sleep may be used as an excuse for bad behaviour, or to warrant some form of special treatment. Users discuss self-tracked sleep as a form of self-knowledge but also hint at a wider social consequence of being able to evidence one's sleep in relational contexts. There are traces of some scepticism regarding accuracy of self-tracked sleep data where users draw on their own feelings as an alternative way to know how they slept.

4.2 Instagram

For further insights into practices of sharing evidence of one's sleep we turned to Instagram, a platform with a broad demographic utilizing a functionality that is strongly biased towards visual material (Blank and Lutz 2017). The turn to a form of sharing that focuses on pictures rather than words offers a perspective that is particularly relevant in the case of sleep self-tracking since the app offers users graphs showing visualizations of their nightly, weekly, or monthly sleep (see <https://www.fitbit.com/global/us/technology/sleep/> [Accessed 27 July 2017] for examples). The extent to which users choose to share such visualization and the kinds of social interaction that this sharing might prompt was of particular interest. To generate a dataset to interrogate these issues, we searched Instagram posts with a hashtag (#fitbitsleep) for 27 July 2017, saving the first 50 publicly available posts using that hashtag plus the associated likes and comments.

The results of this analysis are summarised in Table 2. The majority of the posts included a visualization of one night's sleep. This was often accompanied by a comment exclaiming about how particularly good or exceptionally bad the user's sleep had been. This suggests that sleep needed to be deemed in some way distinct from the norm in order to be shared. While most of these users attended only to total amount of sleep, some highlighted different sleep phases and disturbances apparent from the graph and accounted for them according to the presence or absence of disturbances from family members or pets. Here the self-tracked data occasioned practices of theorizing sleep as the user offered reasons for the patterns observed. Sharing of weekly sleep, or sleep data, alongside other self-tracked measures was often accompanied by commentary on lifestyle issues or the need for positive changes. A small number of Instagram accounts offered generalized sleep advice under the hashtag #fitbitsleep, suggesting the presence of a significant but not particularly dominant self-help and optimization culture.

Table 2 Posted Images #fitbitsleep

Posted Image	Number	Likes	Mean likes per post	Comments	Mean comments per post
Sleep data (night)	27	427	15.8	72	2.7
Sleep data (week)	10	280	28	10	1
Sleep data (w. other self-tracking measures)	6	137	22.8	3	0.5
Sleep insight/advice	6	19	3.2	0	0
Other	1	25	25	5	0.2

In contrast to Twitter, shared sleep on Instagram did prompt responses in the form of likes and comments. The presence of likes and comments in response to users' posts of sleep data suggests that these forms of sharing are indeed deemed socially meaningful. It is difficult to be sure what a "like" of a shared sleep graph might denote (Jang, Han, and Lee 2015), but at the very least it is an acknowledgement or recognition of an appropriate post, interpretable as a form of social interaction. Beyond likes that simply acknowledge, comments give us some richer clues as to the social meaning of shared sleep data. In comments people shared their own problems with sleep and their own intentions to make lifestyle changes, creating a common ground in sleep as a "problem." They also shared commentaries on how to maximise use of the device and some made arrangements to become Fitbit friends. Here, therefore, we see a stronger sense of social meaning emerging around sharing of sleep. People are evidencing their sleep to one another in a social interaction that acknowledges anxiety around sleep and often leads to expressions of sympathy and a shared recognition of the challenges of life. Here the data connect strongly with a sense of the contemporary age as characterised by anxiety about sleep. Trust in the data was high on this platform, and little scepticism about the accuracy of measured sleep was expressed.

4.3 Mumsnet

Many Internet users have favourite social spaces, rather than coming to online activities via the more impersonal offerings of a Google search or the complex and often fragmented world of Twitter and Instagram. Talk boards and discussion forums often have a core of regular, committed users and develop their own local social practices and norms: one such forum is Mumsnet, with a predominantly female demographic skewed towards older (31-40) and more highly educated users (Pedersen and Smithson 2013). The conventions of the site encourage discussion between users and here we might therefore find more insights on the socially meaningful nature of sleep self-tracking, but this time in a relatively anonymous online community setting, rather than the network of existing social contacts that many Instagram

users are communicating with.⁵ The Mumsnet “advanced search” facility was used to generate a dataset of threads in which both Fitbit and sleep were mentioned, from 2015 to 2017.⁶ Results were examined to exclude any false positives where the term “sleep” was not being used in the context of Fitbit and vice versa. The resulting dataset comprised 81 threads of messages making meaningful mention of sleep together with Fitbit. Following a review of the themes reflected at the level of the thread, individual statements relating to Fitbit and sleep were then isolated from these threads, resulting in a set of 139 statements that were in turn subjected to a thematic analysis.

One key context of discussion was the initial purchasing decision to buy a self-tracking device: 26 of the 81 threads in the dataset began with an enquiry about choosing a device. Within these threads, participants positioned sleep tracking as either relevant or not relevant to their purchasing choice: some said they actively wanted a device that could track sleep effectively while others explicitly rejected this as a feature that interested them. Sleep tracking was not framed as the primary reason for choosing to buy a device. Whilst most positioned sleep tracking as a normal thing that such devices do, some potential purchasers expressed themselves as surprised when this feature was described by existing users. A smaller number of discussion threads (12 of 81) focused on queries arising once the device had been purchased, discussing the usability of the device.

Beyond discussion of purchasing decisions and queries about use, the dataset contained many discussion threads (43 of 81) where sleep self-tracking data arose in the context of another discussion. Very rarely were users on Mumsnet actually sharing sleep graphs, with only two examples in the dataset (although it is important to remember that the data were derived from a textual search on Fitbit and sleep, so a graph shared without being labelled as such would not crop up in the dataset). Much more often than sharing of graphs, a textual remark was made about amount of sleep a user had experienced, positioned as “Fitbit says” or “my Fitbit tells me,” without any direct evidencing via the graph. This evidencing of sleep by referencing of Fitbit data took two distinct forms: personal use of sleep data; and relational use of sleep data.

⁵ Mumsnet users are identified by usernames that conceal their real-life identity. Discussions are organized into a hierarchy of topics, with separate conversations presented as individual threads within those topics.

⁶ This approach to searching for relevant data makes some significant compromises beyond the initial decision to focus our interest on Fitbit alone. The dataset will exclude misspellings of Fitbit. It will also exclude any instances where sleep data is shared by posting an image of a graph without labelling the image as stemming from Fitbit. While the dataset was generated by searching for Fitbit in practice some of the results relate to other, similar self-tracking devices. Particularly when purchasing decisions are discussed, participants compare features of other devices and it is not always apparent whether an individual statement refers to Fitbit.

Personal use of sleep data tended to position it as “interesting” to know about one’s sleep, framing it as part of a development in self-knowledge rather than being an agent of self-transformation. Sometimes sleep data was used as a measure of the extent of a participant’s insomnia or described as useful for trouble-shooting sleep problems but equally sometimes sleep data was positioned as promoting unhelpful awareness and best not known or dwelt upon. In contrast to this internal focus, some participants positioned the use of sleep data in a relational context. This relational use of sleep data took various forms: in relation to medical professionals; in relationships between children and parents; and in interactions between partners. In relation to medical professionals, some users advocated showing sleep data to doctors to evidence the extent of one’s problem. Unsurprisingly, given the nature of the forum, sleep data was depicted as useful in a parenting context in various ways, including monitoring the child’s sleep (sometimes in the context of a perceived problem) and developing an enhanced awareness of the extent to which the child disturbs the parent’s sleep (although not necessarily with any specific goal in sight of changing the situation). Sleep data became part of interactions between partners, for example showing one’s partner how much they sleep in comparison to their claims or comparing sleep with one’s partner. This suggests that evidenced sleep is participating in the gendered negotiations around parenting within couples previously observed by Venn et al. (2008). As with Instagram, the Mumsnet data offered instances of users using the prompt of self-tracked sleep to theorize both about the cause of the patterns observed and the consequences for how they felt.

When used in evidencing sleep, either for personal reflection or in a relational context, data provided by the Fitbit about one’s sleep was largely treated in a matter-of-fact sense as giving access to how one slept. However, in other threads of messages a set of discourses about the accuracy of sleep data was apparent. Here participants made statements about whether sleep tracking was accurate or not, often calibrated against what they knew about sleep and activity from their own experience. Users’ theorizing about their sleep drew on an array of resources. A small number of statements in the dataset involved speculations about how sleep tracking works, based on either technical assertions about what it measures or theories of what it must be doing based on behaviour. Across the dataset as a whole there were significant pockets of scepticism and uncertainty about the performance of sleep self-tracking but this co-exists with a widespread use of data from sleep self-tracker as self-evidently a measure of how one slept.

5. Conclusion

Across Twitter, Instagram, and Mumsnet we find a set of social practices that we characterise as “evidencing sleep.” The Fitbit device offers up representations of sleep that are readily shareable and transportable, both through the facility to feed data directly to a social media platform and as representations in numbers, charts, and graphs that travel readily and carry an air of objective factuality. The Fitbit thus offers a set of communicative affordances that are appropriated by users to enable them to evidence their sleep (Lomborg and Frandsen 2016). This evidencing of sleep encompasses a diverse set of practices including the automated Tweets warning followers of the potential consequences of a night with little sleep, a self-congratulatory Instagram post about a satisfactory lifestyle change, and Mumsnet users drawing on Fitbit data to negotiate with their partners who should get up to the crying child. The social context and the meaning of the data is different in each case, but the practices are united by the reliance on sleep as something that can now be abstracted and circulated beyond the individual sleeper to portray something about the sleeper to significant others. This evidencing of sleep has an affective dimension, in that it often connotes a coming together in shared concern over lack of sleep and occasions the expression of emotions of sympathy, anxiety, and experiences of struggling to cope. In other circumstances evidencing one’s sleep is experienced as empowering, making a case for special consideration to friends, a medical professional, or a partner. In these instances, sharing sleep data tends to be viewed as intimate and relevant only to select individuals. As public manifestations of shared sleep data, the data exemplify a contemporary concern about sleep but as a social phenomenon to be unpacked in interaction with those known to us as much as a matter of individual concern to be worked on in isolation. Self-tracked sleep enables users to insert evidence of their sleep (just as we might other aspects of our health) into social interactions as a matter of potential concern.

We observe users appropriating the communicative properties of the self-tracking device to evidence their sleep either directly to an audience via the social media platform or in other situations that they then describe on the social media platform. Our data only comprise interactions that are public on the platform. It should be noted that sharing of self-tracked sleep may also be happening in private interactions between users, but this is not accessible via our methods of data collection focused only on the public social media platforms. As Lomborg and Frandsen (2016) describe in the context of exercise self-tracking, decisions about what to share and with whom may be carefully nuanced judgments about what is thought appropriate for a particular network of connections and may often not involve public broadcasting of self-tracked data. Our findings are in concordance with Lyall’s (2021, 147)

interview-based observations of sleep self-tracking as a “variable and ambivalent” practice open to being creatively appropriated by users. Such practices of evidencing sleep depend on taking the output of the device for granted as an unproblematic portrayal of one’s sleep. However, this straightforward acceptance of the factuality of self-tracked sleep is accompanied by another set of discursive framings that question the reliability of the devices and highlight deviations from the user’s own perceptions of how they slept. Across the various platforms we find that self-tracked sleep has a fluctuating factuality, sometimes taken self-evidently as representing sleep and in other cases subjected to a close scrutiny that aims to unpick how judgments are made and how they can be so wrong. The dataset therefore shows ample evidence that people are concerned about their sleep, but in forms that do not fit comfortably into a frame of self-optimization nor into a naïve acceptance of datafication. People make self-tracked sleep their own and they use it as meaningful to them within their social interactions. Self-tracked sleep coexists with other ways of knowing and theorizing sleep based on the users’ reflections on their experiences and feelings.

It is here that we see continuities with established ways of “doing” sleep. Writing 15 years ago, Williams (2007) suggests that *claims* to sleep can serve as a valuable social resource in interactional contexts. We may “legitimately or otherwise” seek to excuse ourselves for “some dereliction of interactional duty, propriety or performance” because we are tired or have had little sleep (Williams 2007, 318). This resonates with tweets warning others of a lack of sleep or excusing one’s behaviours to friends on account of bad sleep. Similarly, the relational use of sleep data in medical and partner contexts sit alongside previous ways of knowing sleep and deploying it within social interactions. Zahrin (2015, 726), for example, illustrates how receiving a diagnosis of obstructive sleep apnea “emerges as an equivocal, interpretive, and active process in which patients draw on previous medical and non-medical knowledge.” Zahrin (2020) also notes how two types of (sleeping) agency co-exist and co-constitute one another. *Material agency* conceptualises agents as entities which alter affairs by making a difference in another agent’s actions. This type of agency can exist in periods of sleep; for example, as snorer’s bodies interact and engender significant change in a bedfellow’s body. A second form of agency involves much more waking intentionality. In Zahrin’s (2020) study, partners tried to persuade snorers of the truthfulness of their accounts through video or audio recording. Related accountability sanctions, moral discourse, and emotions such as love and anger, can all “serve as triggers for the production or restoration of *reflexive agency*” (Zahrin 2020, 1011) and the emergence of “responsible agents.” Further work to explore the connotations of self-tracked sleep data in and as agency in these forms could be useful.

The data that we have explored are wholly derived from publicly available online interactions. We have exploited these platforms to give us a searchable

window on the embedding of sleep self-tracking into everyday life, but inevitably this limited perspective leaves many questions unanswered. To pursue further the questions of how sleep self-tracking becomes socially meaningful, we need to explore how these practices of evidencing sleep play out in diverse everyday face-to-face settings and to analyse more systematically how people share their sleep and with whom, what demographic patterns can be identified, and what existing practices these new practices of evidencing displace and occur alongside. An exploration in face-to-face settings could also be accompanied by a more systematic and wider ranging exploration of online spaces, identifying networks of influence, and mapping issues across networks. Online discourses of sleep self-tracking may vary across discussion forums, and in that regard, it would be useful to compare Fitbit's own forums with such diverse spaces as Facebook groups, Mumsnet (and other parenting forums), and reddit to explore whether there are hotspots of scepticism and spaces where evidencing practices are more routinely accepted.

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Contributions

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