

Negotiated Rhythms of Mobile Work: Time, Place, and Work Schedules

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ABSTRACT

This study investigates the role of rhythms in the collaborative coordination of mobile work as well as in the individual actors' comprehension and command of their work. Drawing on an ethnographic study of home-care work, we examine the ways in which temporal regularities or rhythms are formed and reinforced. Further, we analyse how the major temporal rhythms are configured and furnished by individual, collective, and social rhythms, and how these rhythms contribute to the collaborative flow of activities. Finally, we discuss how the concept of rhythms adds to an understanding of alignment and coordination in mobile and distributed work settings.

Categories and Subject Descriptors

H.5.3. [Information interfaces and presentation (e.g., HCI)]: Group and Organization Interfaces – *asynchronous interaction, computer-supported cooperative work, synchronous interaction.*

General Terms

Experimentation, Human Factors, Theory.

Keywords

Rhythms, mobility, temporal coordination, distributed collaboration, home-care work, field study.

1. INTRODUCTION

The widely used classification of CSCW systems by means of a two by two matrix of time (same or different) and place (same or different) reflects both a recognition of time as a category fundamental to collaborative work and a crudely simplistic notion of time. Studies of the temporal aspects of collaborative work provide plenty of evidence that time and place are intricately interrelated [2, 3, 9, 23]. Indeed, effective collaboration among spatially distributed co-workers seems to require that considerable efforts are put into deliberating and articulating when who will be doing what. The increased mobility and connectivity of “anytime, anywhere” technologies mean that temporal coordination must increasingly be accomplished through social and organizational

arrangements such as schedules [9], conventions [21], rhythms [30], and ad hoc activities [27].

This study investigates the role of rhythms in the collaborative coordination of mobile work as well as in the individual actors' comprehension and command of their work. As the concept of rhythms in social life is not new (cf. e.g. the seminal work of Zerubavel [37]), the main contribution of this paper is an in-depth analysis of the role of rhythms in meshing time and place. We will present an ethnographic description of home-care work, a mobile work setting in which temporal and spatial alignment of distributed activities is of paramount importance. Home-care work is specified in considerable temporal detail and requires that home-care professionals are at specific, distributed places for specific, tightly spaced periods of time to perform their work. Thus, a persistent awareness and negotiation of time and place is pivotal to competent performance of home-care work. This involves that overlapping, competing, and partly conflicting time regimes are continuously meshed into a meaningful temporal structuring of work. We will specifically analyse:

- How rhythms are relied upon by the home-care professionals in *reading their work schedules and adding structure and predictability* to their own activities and those of their colleagues.
- How rhythms also facilitate *effective rearrangement and modification of work schedules* to make collaboration smoother, handle exceptions with minimal disruption to other activities, and even out differences in workload.
- How rhythms are *formed and reinforced* by temporal and spatial patterns, by artefacts, and by home-care professionals' relationships with their longstanding clients.

Mobility is still a vague category. This is mainly because it is dominated by several residual traits trailing from its definition as a conceptual contrast to stationary, office-based work (e.g., [5]). Whereas space has been at the centre of discussions of mobile work, its temporal dimension has not been addressed to a similar extent. Part of the reason for this is, we surmise, that objective clock time has rendered people's rich and diverse means of accomplishing temporal structure and alignment largely invisible (see also [19, 24]). An initial observation illustrating the richness and effectiveness of these means is that while the home-care professionals' time is specified in chunks as short as five minutes, they rarely look at their watches.

The next section outlines the background for our work in terms of previous research on temporal alignment and coordination of mobile work. Section 3 briefly introduces home-care work, and Section 4 describes the methodology of our ethnographic study.

Section 5 analyses how rhythms contribute to the accomplishment of home-care work. Finally, in Section 6, we discuss how the concept of rhythms adds to an understanding of alignment and coordination in mobile work settings.

2. BACKGROUND: TIME AND MOBILITY

Alignment and coordination are constituent elements of the ways in which collaborative work is perceived and performed. Work involving distributed locations poses distinctive challenges because it makes it necessary to also align and coordinate where people are, for example to obtain simultaneous presence at one location or a balanced spread of actors across locations. In domains such as air-traffic control [8], ambulance control [22], and line control [14] these challenges have been met by establishing centres of collocated people that control and coordinate the distributed activities. This has, to some extent, rendered alignment and coordination among the distributed – and typically mobile – actors invisible. Dedicated studies of alignment and coordination among mobile actors tend to focus on relatively autonomous actors or professionals expected to exercise discretion in how they accomplish their tasks, such as businesspeople [27], hospital staff [3], real-estate agents [32], and ecologists on field research [26]. We are, however, particularly interested in alignment and coordination among mobile actors in tightly and dynamically regulated settings. One example of such work is Juhlin and Weilenmann’s [16] study of snow-clearance crews in airports. They show how these crews, in their radio communication with the control tower, repair misunderstandings, discuss the task at hand, and negotiate next actions, but they focus on the formal and hierarchical aspects of the communication, rather than on temporal alignment and coordination.

Discussions of mobile work tend to construe mobility in spatial terms. For example, Luff and Heath [20] distinguish three types of mobility – micro, local, and remote mobility – by the amount of distance covered by the movements of artefacts and actors. Bardram and Bossen [3] introduce mobility work as a concept complementary to articulation work. They define mobility work as “the work needed to achieve the right configuration of people, resources, knowledge, and place in order to carry out tasks”. While this definition emphasizes that mobility is concerned with assembling distributed entities for combined use, temporality is only implicitly part of the definition. In contrast, Kakihara and Sørensen [17] propose that mobility involves three interrelated aspects – spatial, temporal, and contextual mobility – and argue that all three aspects are necessary to appreciate the full relationship between mobility and human action.

Bardram [2] emphasizes that temporal coordination is itself work and that it is mediated by artefacts. The work involved in temporal coordination takes place at multiple levels of abstraction and includes continuous synchronization, planned scheduling, and allocation of temporal resources to various activities. Thus, people’s activities are intertwined with an ongoing process of temporal structuring [1]. According to Orlikowski and Yates [24] it is through this process people in organizations experience time; that is, time is experienced through organizational practice rather than as objective clock time or as a subjective phenomenon. Among the analytic concepts that have been employed in discussing the temporal structures people create and use in the course of performing their work, we want to emphasize trajectories and rhythms, two related but subtly different concepts:

Trajectories [35] structure events by providing temporal sequencing. Being on the waiting list for an operation informs medical staff that the patient has previously been diagnosed and a treatment decided upon and that the patient is now to be considered when patients are scheduled for this operation [9]. The waiting list also informs medical staff about upcoming needs for post-operation facilities and activities. Trajectories focus on one actor (or work object) and describe the sequence of events and activities this actor contributes to (or this object is subjected to) in the course of the collaborative activity. An example of the use of trajectories in healthcare settings is Strauss et al. [35].

Rhythms structure events by providing temporal cycles [37]. Nursing shifts and morning rounds are examples of large-scale rhythms central to the daily regularity of hospital work. At a finer-grained level, the time between successive refills of intravenously administered drugs is known to experienced nurses without necessarily checking the medication orders and adds temporal rhythm to their treatment of patients [30]. Rhythms punctuate the continuous flow of activities with periodically recurring events and thereby offer ways of condensing myriad individual events into patterns exhibiting at least some regularity and predictability. Rhythms have, for example, been used in predicting when people are available for interruptions [4, 15].

In complex work settings trajectories and rhythms are, to a large extent, instigated by conventions and procedures and enforced by artefacts such as coordination mechanisms [33] and classification schemes [6]. This way, appreciation of trajectories and rhythms mediates articulation work and thereby contributes to reducing the complexity of work and alleviating the need for ad hoc negotiation and planning. Reddy and Dourish [30] illustrate how rhythms often make it unnecessary for healthcare professionals to actively get hold of each other because they, for example, know they both attend bed management meetings, which take place three times during the day, and will thus meet ‘automatically’. In highly regulated or specialized settings, work may be serialized or otherwise decoupled into trajectories where actors seldom meet. Fitzpatrick et al. [11] report a case where technological artefacts rendered the collaborative aspects of work nearly invisible and made work appear to take place in isolation. The studied people had separate offices, preferred to keep their door closed, and spent a large portion of their working day “alone in front of a computer screen, typing in silence at a keyboard”. The apparent isolation masked collaborative rhythms, defined by regular patterns of daily activities, and extensive virtual communication and collaboration. A similar masking of collaboration and rhythms characterizes home-care work.

3. HOME-CARE WORK

Home-care work consists of providing care to elderly people in their homes. Although some care-related tasks may appear mundane and deprived of complexity – for example cleaning, doing the laundry, preparing food, and socializing – these home-care activities must be performed in specific time-spans, at specific places, and in accordance with the elderly persons’ preferences and special needs. This introduces two distinct, but interrelated sources of complexity.

First, since home-care professionals have a distributed, location-based work setting, they are on the move most of the day and generally spend a minimum of time in office settings with other home-care professionals. Consequently, opportunities for face-to-

face communication and informal coordination of activities are restricted to short periods of time, for example during lunch. Communication and coordination are, however, crucial to home-care work, because the elderly are often receiving treatment and care from various home-care professionals, such as occupational therapists, physical therapists, social workers, nurses, case managers, and home-care workers. The mobile and location-based nature of home-care work introduces an organizational complexity that must be dealt with in short-term treatment coordination as well as long-term treatment planning.

Second, in addition to the organizational complexity, home-care work is also complex because it is context-dependent. The exact nature of the care-giving activities varies with, and must be adapted to, the individual elderly person's home, activities, preferences, and special needs. Further, activities, preferences, and needs change dynamically as the elderly person's condition improves or deteriorates. Adapting to these changes, which may happen over night, is pivotal to competent home-care work. While the organizational complexity concerns the interdependencies and coordination among distributed home-care professionals each responsible for their specific activities, the source of the context-induced complexity is the individual elderly person's dynamically changing condition, presenting different needs for adaptation.

Studies of home-care work within CSCW have primarily examined the organizational complexity. In particular, Pinelle and Gutwin [28, 29] investigated loosely coupled home-care work in a setting characterized by worker autonomy and remote mobility. The Danish home-care setting we have investigated is, in contrast, tightly regulated and characterized by local mobility.

In Denmark 68,000 full-time equivalent (FTE) employees are working as home-care professionals, and approximately 200,000 elderly people are receiving home-care services [10]. To make the amount of resources spent on home care more transparent, a protocol-based taxonomy was introduced in 1998. In essence, the taxonomy is a conceptual tool that describes the different types of care an elderly can acquire. An elderly is scheduled for home-care by a visiting nurse who performs an assessment of the care to be administered. The outcome of such an assessment is a list of items from the taxonomy and the time allocated to each task. These items are fed into a scheduling system used by municipal authorities in producing the home-care professionals' daily work schedules, which specify the elderly to be visited, the care to be administered, and the time allocated to each task. In some home-care regions, the scheduling system has recently been extended with personal digital assistants (PDAs), through which the home-care professionals access their daily work schedules. This is for example the case in the home-care region we studied.

4. RESEARCH SITE AND METHOD

The fieldwork reported in this paper is part of a longitudinal study of how home-care professionals use mobile technologies in their daily work. We studied one of the seven home-care regions in the greater Copenhagen area, Greenwood (a pseudonym). This home-care region employs approximately 70 home-care workers and 10 nurses who deliver home care to about 620 elderly people. On a daily basis, 675 visits are arranged and undertaken. This amount to a total of more than 230,000 home-care visits a year.

The home-care professionals in Greenwood are divided into teams of 12, and each team shoulders responsibility for delivering care

to the elderly in a sub area of Greenwood. As Greenwood is a suburban area of 3-8 storey buildings, the sub areas are of limited size and the means of transportation from visit to visit is bicycles. In the scheduling system the home-care professionals are allocated seven minutes of travel time to get from one visit to the next. A home-care professional typically has 10-13 visits a day.

The first author was engaged in fieldwork in Greenwood during October and December 2004 to investigate how work schedules were being used, managed, adapted, and configured by home-care professionals. Multiple representations of the work schedules were of interest in that they were discussed orally, inspected on the whiteboard in the main office, accessed on the PDAs, and held in the heads of individual home-care professionals. To investigate these aspects of home-care work, three different qualitative techniques were employed: participant observations, contextual interviews, and workshop seminars.

Participant observation. The first author observed five home-care professionals during entire working days – from 7:30 am, when the home-care professionals arrive at the main office, to 2:30 pm or 3:30 pm when their shift ends. Four of the home-care professionals were home-care workers and one was a nurse originally trained as a home-care worker. Two of the home-care workers were young and educated recently; the three others had been employed in home-care services for five or more years. The fieldwork was an eminently mobile affair comprised of following the home-care professionals from the main office to the homes of the elderly, entering their homes, observing home-care activities, and taking part in some casual activities, like vacuum cleaning. In sum the fieldwork amounted to 70 hours of observing – and sometimes participating in – the daily work of home-care professionals.

Contextual interviews. Since home-care professionals' time is highly regulated and their activities cannot be interrupted due to the private nature of giving care, contextual interviews were added to the participant observations. In this context, the contextual interviews consisted of biking alongside the home-care professionals, in-between visits, while interviewing them about what had happened during the visit they had just completed. As it turned out, these brief, recurrent interviews provided excellent opportunities for grounding interviews in concrete events and getting details about the background reasons and on-site reflections shaping the visits.

Workshop seminars. While the participant observation and contextual interviews took place during the fieldwork, the workshop seminars were held subsequently. The seminars consisted of presenting observations and preliminary analyses of the field data to the home-care professionals and their management, followed by discussion. This served to inform and corroborate our understanding of the alignment and coordination of home-care work, specifically the use of the work schedules and the role of rhythms. The first author conducted three workshop seminars.

The observations, most of the interviews, and the seminars were documented in field notes. The remaining interviews were audio recorded and transcribed. The major reason for using field notes as the primary means of documentation was ethical. Field notes were chosen in collaboration with home-care management in Greenwood as appropriate for use in the elderly people's homes and given the personal nature of many home-care activities. In

analysing the field notes and transcribed interviews we aimed at developing a grounded understanding of temporal coordination in home-care work, conceptualized in terms of rhythmic structures.

5. RHYTHMS AND HOME-CARE WORK

In this section we present our analysis of the fieldwork. First, we describe the major temporal rhythm that structure home-care work in Greenwood. Second, we analyse how the major temporal rhythm is configured and essentially furnished by other types of rhythms, and how the rhythms are formed and reinforced by artefacts, and by temporal and spatial patterns.

5.1 Clock-time Rhythms

In contrast to other types of mobile work (cf. Section 2), the mobility of home-care work in Greenwood is structured around a rigid specification of exactly when, where, and for how long activities take place. This clock-time specification forms the backbone of home-care work: The home-care workers arrive at the main office at 7:30 am and download their daily schedule on a PDA. At 7:45 am, the home-care workers leave the office to deliver care to typically 5-7 clients; then at 11:00 am they return to the office for lunch for approximately half an hour before returning to the care-related work and administering care to typically 4-5 clients. At approximately 2:15 pm or 3:15 pm, depending on whether they are working short or long shifts, they once again return to the main office. While engaged in work, the home-care workers use the PDA to record time; when entering a new visit, the home-care worker presses 'start' on the PDA, and when the visit is over the home-care worker presses 'stop' on the PDA. In between visits a standard bicycle time of seven minutes is allocated. Pressing stop on the PDA automatically triggers the seven-minute bicycle time. On returning to the main office, the home-care workers upload their schedule to the main server. The uploaded schedule reflects the de facto order in which visits have been carried out and the exact time spent on the different visits.

The schedules downloaded to the home-care workers' PDAs in the morning are based on a standard plan. A designated team member is responsible for the local coordination of the weekly schedules, detailing the clients to be visited and the care to be administered. While the weekly schedule is arranged so that home-care workers primarily have the same clients, there are always exceptions to the pre-planned schedule. Sometimes home-care workers call in sick; at other times clients have been hospitalized during the night. The management at Greenwood handles these day-to-day exceptions by generating an *updated* version of the schedule before home-care workers arrive at the main office in the morning. This, however, amounts to home-care workers not knowing their exact schedule before they download it. Attuning to the exceptions of the updated schedule and understanding the temporal and spatial implications, is one of the decisive activities that take place before the home-care workers leave the main office at 7:45 am

The temporal specification of home-care work constitutes the major clock-time temporal rhythm that structures home-care work. In addition, this rhythm is inherently cyclical — the same event-types, for instance, arriving at the main office at 7:30 am, downloading the schedule to the PDA, administering care to a relatively stable group of clients, and uploading the schedule, take place over and over again. On the one hand, this major work rhythm catches many of the features related to home-care work; it

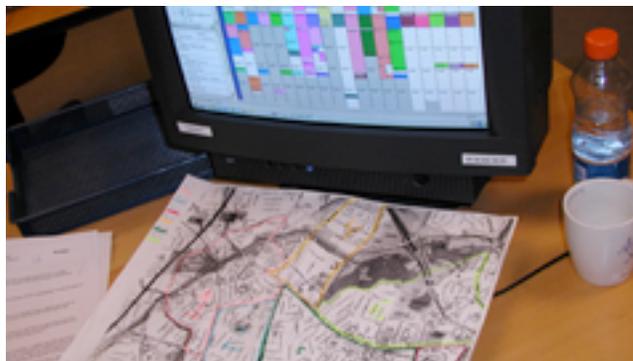


Figure 1. The standard plan (displayed on the screen). The map in front of the screen illustrates the different sub areas of the Greenwood district.

describes the stationary and the mobile aspects, and it gives an impression of why time and place is of crucial importance in home-care work in Greenwood. On the other hand, the major temporal rhythm is based on objective, quantifiable, and precise clock time [1]. The home-care workers' comprehension of time and command of their work is, however, constituted by other rhythms in addition to the clock-time rhythm.

5.2 Social Aspects of Rhythms

During our fieldwork, we increasingly noticed other types of rhythms — in particular, rhythms pertaining to home-care workers' co-presence in the main office, their presence in the homes of the clients, and the mobility of home-care work — than the ones associated with the temporal structuring of clock time. An initial observation indicating that the cyclical, clock-time rhythm did not capture all facets of home-care work was that home-care workers did not constantly check the PDA to learn whether they were on schedule. Still, they managed to keep track of time. Additionally, we observed that keeping track of time and the visits to be carried out was a collaborative effort. Being aware of the schedules of other home-care workers proved to be a major activity. A final observation suggesting the existence of other types of rhythms was the different temporal and spatial patterns associated with the different places of home-care work. In short, the observations indicated that home-care workers relied on other types of rhythms than the ones associated with clock time. These fieldwork observations, which indicate the existence of other types of rhythms, were substantiated by the contextual interviews and the workshop seminars.

In the following, we analyse how home-care workers, on the one hand, rely on the major clock-time rhythm that on first glance structure their work, and how home-care workers, on the other hand, furnish the major clock-time structuring with several other types of rhythms.

5.2.1 Structure and Predictability

Since the schedule is the focal point of home-care work in Greenwood, we continue our analysis with an excerpt describing the activities associated with downloading the schedule to the PDA¹:

¹ All names in the excerpts, which are based on the fieldwork notes and the transcribed interviews, have been disguised.

It's 7:32 am; Christine, a home-care worker in her mid-twenties, enters the main office. She notices the message on the whiteboard: "Peter, Susan – October 22, ill." The office is sizzling from the activities of her colleagues. Two of them, Kate and Simon, are engaged in conversation: One of Simon's regulars has to be picked up early this morning because he is going to the elder centre [a note in the paper-based team calendar specifies this]. Also, Simon has two of Susan's clients this morning. Kate accepts to take Simon's first visit, a visit consisting of preparing food. [7:37 am] Christine downloads her schedule to her PDA and briefly runs her eyes over it. During this, she immediately observes two of Peter's regulars on her schedule. "Look," she says [addressed to the first author], "today, we are going to Hill Street [a place on the outskirts of the Greenwood district]. Shortly after this, Christine asks one of her co-workers if she is acquainted with Peter's regulars, and if she knows how to get there from the centre of the Greenwood district. The co-worker replies, "they are fine, a bit moody, though", and explains the route she has taken on previous visits. The two new visits are due at 12:00 noon and 12:50 pm All of Christine's regulars live in the centre of Greenwood. During the day, Christine does not take the visits in the order specified. As the added visits are not health-critical [e.g., giving medicine], Christine first takes her regular visits at the centre of Greenwood, and finally Peter's regulars on Hill Street.

The home-care workers are thoroughly familiar with their regulars who constitute a recurrent structure that forms the backbone of their weekly schedules. In addition, they know their route through the district, and when and where visits are normally scheduled. Accordingly, the weekly schedule and the temporal and spatial rhythms associated with the weekly schedule serve as a *background structuring* against which changes are readily noticed. When entering the team-room, the home-care workers immediately get a sense of the challenges they must face. If the whiteboard stipulates that someone from the team has called in sick there is bound to be newly added visits to their schedules; and if the team calendar specifies that a client must visit the elder centre, the morning visits must be rearranged. Therefore, the artefacts situated in the main office make potential changes to the schedules of the home-care workers' activities during the day highly visible. As the excerpt illustrates, the home-care workers quickly spot changes to their downloaded schedule, and accordingly grasp the implications of added visits. The implications of added visits concern the mobility of the work, that is, how home-care workers travel through the district. This route is not accidental; the home-care workers have consciously configured their route to move efficiently through the district in accomplishing their weekly schedule. Often it involves taking shortcuts through back alleys or crossing playing fields wheeling their bicycles. In reading through their schedule, the experienced home-care workers rely on this route. In contrast, the inexperienced home-care workers and the home-care workers just employed at Greenwood are still struggling with the topography of Greenwood. They rely on printouts of maps and every morning they spend some time figuring out the most suitable route through the district.

For the experienced home-care workers, the major clock-time work rhythm and the fact that they have a stable base of regulars, provide a recurrent structure that adds predictability to their work. As the excerpt indicates, the fifteen minutes of co-presence in the main office, from 7:30 am to 7:45 am, is not only a specific time

span conceived of as clock time. It is also a recurring *event time*. Sometimes the fifteen minutes are very busy for all the home-care workers, sometimes only for a few of them. The excerpt also indicates that there are several *social aspects* to the major temporal rhythm that structure the work. Home-care workers do not just download their schedule, notice the added visits, and then leave the main office. They engage in conversation asking their colleagues about clients and locations; they notice who is talking to whom, and who is busy and who is not. Thus, the main office is both a place for the individual, sequential rhythms related to entering the office, downloading the schedule to the PDA, and leaving the office, and a place for establishing collaborative work rhythms, that is, exchanging visits, asking clarifying questions about clients and locations. In this fashion being aware of the other home-care workers' schedules and activities during the morning meeting is crucial in order to know who is available for ad hoc support during the day and who may need a hand to complete their schedule.

The social aspects also include the *mobility* of the work. When leaving the main office, home-care workers do not bicycle individually to the first scheduled visit. Instead, they bicycle in group formation the first half mile and then spilt up. Whereas the communication in the main office is mostly work-related and centred around coordinative problems, the conversations during the five minute bicycle ride to the centre of Greenwood are informal and tend to focus on either stories from the home-care workers' everyday life, or stories from recent visits. The stories of recent visits are somewhat similar to the 'war stories' of Orr's study of copy-technicians [25]. Like the copy-technicians, the home-care workers also tell each other stories about significant episodes from their work practice, and through the stories pass on knowledge about how to handle critical things (e.g., dealing with clients with dementia). Additionally, the mobility of the work also includes casual encounters where home-care workers meet on-route, in-between visits. While these encounters at the beginning of our fieldwork appeared to be very informal, mundane moments of socializing, an in-depth analysis of the fieldwork notes and contextual interviews showed that the casual encounters are not banana time [31]. The analysis revealed that the social interaction and questions asked depended on the location of the other home-care worker or nurse. If the other home-care worker or nurse was even slightly out of synch relative to where he or she would normally be at that point in time, it immediately triggered questions probing into the cause of their unusual location.

A final social aspect of the major work rhythm is that it includes *the clients*. The clients rely on the home-care workers to visit them on more or less the same time every day, and therefore structure their everyday life accordingly. Moreover, the long-standing relationship between clients and home-care workers — sometimes lasting more than a decade — changes the nature of home-care work. In short, it is not only work, but also a social and friendly meeting. Furthermore, this relationship establishes a fine-grained awareness of the elderly person's habits, preferences, and special needs. This includes such minutia as precisely how to season an oatmeal porridge with a pinch of salt. Finally, as the elderly person's preferences and needs change, for example, due to arthritis, dementia, or diabetes, the home-care workers aptly sense these changes and adjust appropriately.

The social aspects are essentially furnishing the major temporal rhythm with several other kinds of rhythms. These rhythms are

individual and collective as well as social. The *individual rhythms* concern both the home-care workers' schedule, their route through the district, and the everyday life of the clients. The *collective rhythms* are also embedded in the major structuring of work but relate to the collaborative flow of activities, that is, the meshing of both home-care workers' and clients' individual rhythms. Whereas the collective and individual rhythms concern the sequential order of work and the everyday life of clients, the *social rhythms* are of a different kind. Unlike the collective and individual rhythms, the social rhythms are not formed by the spatiotemporal regularities of the work. However, the regularities produced by the collective and individual rhythms instigate special opportunities and expectations for recurrent, collocated moments. These expectations and opportunities form several social rhythms. Examples of such social rhythms are when home-care workers bicycle together from the main office into Greenwood in the morning and the social interaction that takes place in the homes of the clients and at the main office. Therefore, the recurrent daily events — that is, the arrival at the main office, the bicycle ride through the district, and the visits to largely the same clients — are not only a structuring of work in terms of a temporal, clock-time specification. The events are also forming several types of rhythms — each of them with distinctive qualities that are related to, but neither predictable from, nor reducible to the major temporal rhythm. In this sense, these rhythms of different places are supervenient upon the major temporal structuring (see e.g., [18] for a discussion of supervenience).

While the delineation of rhythms as a supervenient property of the temporal structuring might serve as a formal definition of rhythms, it does not fully explain what the rhythms of home-care work do — besides establishing a social awareness. But as our analysis will further demonstrate, the rhythms are not only social aspects of the major temporal structuring; the relations and interdependencies between the rhythms essentially contribute to an effective delivery of home care and a collaborative flow of activities. In particular, the rhythms have a deep impact on how home-care workers handle exceptions to their daily schedule. This is especially the case when dealing with rearrangement and modification of the work schedule downloaded to the PDA.

5.2.2 *Re-arrangement and Modification*

Due to the changes performed in the morning, the home-care workers' daily schedules are sometimes overlapping, competing, and partly in conflict with the temporal and spatial rhythms of the weekly schedule. Therefore the order of the visits must be rearranged, and sometimes the schedules must be modified. Exchanging visits is a typical example of a modification to the downloaded schedule. The daily, recurring co-presence at the main office during the morning meeting, but also during lunch-breaks, provides an opportunity for rearranging the order of the visits and thereby modifying the schedule. Re-arranging the schedule and thereby configuring a suitable route through the district, however, is not only an individual endeavour. It must be orchestrated in accordance with the schedules of other home-care workers and nurses. This presents a number of coordinative complexities that home-care workers and nurses must address when rearranging the schedule.

First, health and home-care issues must be taken into account. Taking care of diabetics — a common disease for the elderly people of Greenwood — is a typical example of a health-care critical visit. In order to keep the blood sugar level under control,

preparing food and administering insulin are tightly coupled activities. The nurse must visit the diabetic and administer an insulin injection before the home-care worker arrives and prepares breakfast or lunch. A related type of collaboration is when a client needs to be lifted out of bed. This takes two home-care workers, and therefore the home-care workers must collaborate on being in the same place at the same time. Another example is that many clients are suffering from bad blood circulation. Therefore they wear elastic stockings to keep their legs from swelling. Since it takes athletic effort to put on these stockings, the elderly people cannot do this themselves. More substantially, the stockings must be put on as soon as the elderly person gets up. The longer time the elderly person has been up, the harder it is for the home-care worker to get the elderly person into the stockings, and the less good the stockings do.

Second, establishing a collaborative flow of activities also includes the everyday rhythms of the clients. Some elderly people like to get up very early in the morning; others still maintain an outgoing social life paying regular visits to the elder centre. This affects the temporal flow of activities.

Third, the private nature of home-care work must also be taken into account. Bathing an elderly, administering an insulin injection, socializing, or even cleaning, are inherently private activities, and consequently afford the presence of only a single home-care professional at a time. Therefore, the home-care workers and nurses put considerable effort into ensuring that they will *not* be co-present during these activities.

While the weekly schedule accommodates both the tightly coupled activities such as providing care for diabetics and the private nature of home-care work, the day-to-day exceptions produce irregularities that home-care workers and nurses must integrate into the orderly, collaborative flow of activities. As described above, the co-presence in the main office during the morning meeting or for lunch provides a good opportunity for handling exceptions to the schedule and negotiating a collaborative flow of activities. Nevertheless, the *mobility* of home-care work affects the collaborative flow of activities. A punctured bicycle or a windy winter day where home-care workers are getting in and out of heavy winter clothing have an impact on the temporal flow of collaborative activities. Furthermore, as seen in the following excerpt, the *context-dependent* nature of home-care work and home-care workers' mere presence in the clients' homes produce in itself contingencies that home-care workers must manage on the fly:

Amanda, a home-care worker, visits one of her regulars, Colina, a blind woman suffering from diabetes. Amanda has just prepared lunch. While Amanda and Colina are chatting about the Christmas holidays, Amanda finds Colina's monthly, 'meals on wheels' dinner plan [the dinner meals are not prepared by the home-care workers, but delivered by a public-sector, catering company]. Amanda notices that Colina was served fish yesterday, and asks: "I see, you had fish yesterday; was it good?" Colina answers, "Well... I did not get fish." ... Amanda borrows Colina's phone and calls the company that delivers the meals and asks why Colina did not get the meal she had been signed up for. Amanda finds out that Colina could not get the meal ordered because Colina is a diabetic [the company takes the health-record of the clients into account when preparing meals]. Amanda goes through all the instances where Colina will get another meal than the meal she has ordered. Five minutes late and on her way to the

next visit, Amanda uses her own private mobile phone and calls the nurse in charge of administering insulin to Colina; Amanda asks the nurse to keep an eye on Colina's diet and blood sugar levels.

As the excerpt shows, the rearrangement and modification of the schedule is not restricted to the home-care workers' presence in the main office; it is an on-going undertaking also taking place while home-care workers are engaged in care activities. Additionally, the five aspects affecting collaborative activities — health, the everyday life of clients, the private nature of work, mobility, and context-dependency — call for much finer-grained coordination than is afforded by the temporal specification of the schedule downloaded to the PDA. Nevertheless, the different rhythms, that is, the individual, the collective, and the social, provide a means of establishing distributed, ad hoc collaboration and coordination at the different places of home-care work.

In the home of the clients, the rhythms make collaboration smoother. This is, for example, the case when giving care to diabetics. If the client is up and dressed (individual rhythm), the home-care worker assumes the nurse has already been visiting (individual and collective rhythms), and if the home-care worker is in doubt, she simply asks the client (social rhythm). In other cases, the rhythms contribute to noticing exceptions. This is the case in the excerpt above. The social rhythm (the conversation with the client) makes the home-care worker aware of a breakdown in a collective rhythm (the client has not been served the food she expected). Repairing this breakdown affects the individual rhythm (the temporal structure of the scheduled activities). More substantially, the breakdown opens up an opportunity for re-aligning the collective rhythm (the call to the nurse and the firm), and thereby reinforcing the social rhythm (strengthen the relationship with the client and the co-worker).

At the main office the rhythms present an effective remedy to the coordinative problem stemming from the day-to-day exceptions to the weekly schedule. Especially, the way home-care workers handle the PDA implicitly signify whether home-care workers are facing complexities that need to be handled or not. Some home-care workers put the PDA down on the table indicating availability for conversation; others are busy scrolling up and down the schedule. Therefore the visibility of individual rhythms creates an opportunity for establishing a collaborative flow of activities. Sometimes establishing a collaborative flow of activities creates social and additional collective rhythms. When a home-care worker takes on a visit from another home-care worker, this is usually accompanied by the other home-care worker calling during the day to check whether there is something she can do in return. The home-care workers are not required to do so but do it for social reasons and to even out differences in workload.

On the bicycle, the individual rhythms contribute to an efficient travel through the district. As the experienced home-care workers are comfortably familiar with Greenwood's topography, they usually know where added visits are situated, and if they are not familiar with the location of an added visit, the group's bicycle ride provides an occasion for clarifying such matters. This stabilizes the individual rhythm. In addition, the individual rhythms, materialized in a home-care worker's bicycle ride, add visibility to the schedule. This is in particular the case when co-workers meet in-between visits. Such a meeting is initially a social

encounter; still it provides a way of sensing the collective rhythm of home-care work.

In sum, the different rhythms provide important contributions to the fine-grained coordination of home-care work.

5.2.3 *Forming and Reinforcing Rhythms*

The remaining question is how rhythms are formed and reinforced. On the one hand, the broad, recurrent *temporal* pattern of home-care work provides a major structuring of the work. The weekly schedules form a trajectory stabilizing the individual work rhythm of the home-care workers. Furthermore, the co-presence in the main office provides an opportunity for negotiating and exchanging visits in order to establish an orderly flow of collaborative activities, thereby strengthening the collective rhythms. In addition, the artefacts in the main office, mainly the whiteboard and the team calendar, contribute to noticing changes to the trajectory of the weekly schedule but also for noticing challenges to the collective rhythms. On the other hand, the different *places* of home-care work play a mediating role in forming and reinforcing the individual, collective, and social rhythms. Essentially the different places — the main office, the homes of the clients, or places of casual encounters in-between visits — blur the boundaries between the different types of rhythms. At some places, for example the homes of the clients, social rhythms inform individual and collective rhythms; at other places, for example the main office, individual rhythms (e.g. scrolling down the daily schedule on the PDA) corroborate social and collective rhythms.

The rhythms are also part of the home-care workers' *experience* of the collaborative fabric that ties together home-care work. As described by a nurse, originally trained as a home-care worker, the home-care workers have internalized the temporal structuring of the weekly schedule:

"Well the thing is... with this system [the scheduling system and the PDA front-end] we don't know our plan [the schedule] before we arrive for work. That's why it is important that your schedule is filled out with regular clients. In that way, you almost know what to expect. But... after a while, you easily remember it [the schedule]. It gets inside your head."

This internalization has several important affordances. Instead of constantly checking the PDA, the home-care workers notice what is going on at the main office, and are mindful of other activities while carrying out home care in the homes of the clients. Multiple observations provide evidence that home-care workers rely on rhythms in structuring their work. First, home-care workers use the expression 'regulars' when talking about their longstanding clients. This is indicative of how home-care workers themselves grasp the recurrent structure of home-care work. Second, home-care workers make an effort of being present at lunch, although it is not required that they return to the main office at precisely 11:00 am. They sometimes adapt their individual rhythm, for example, bicycling somewhat faster, in order to be at the main office at 11:00 am. Third, home-care workers have a subtle understanding of the rhythms of their co-workers.

After analysing the rhythms of home-care work, we will now discuss how the concept of rhythms adds to an understanding of alignment and coordination in mobile and distributed work settings.

6. MOBILE WORK AND RHYTHMS

While rhythms have traditionally been associated with the temporal alignment of music, some researchers have suggested the use of rhythms as a analytic device for understanding the complexities and orderliness of cooperative work [4, 12, 15, 30]. The interest in rhythms reflects that time and place are increasingly understood as interrelated. This interrelation cannot be analytically captured by the widely used two times two matrix of time and place because the foundation of the matrix is how *technologies* mediate space and time, not how time and space are experienced by means of regularities that form a background structuring of work. Since mobile work is about being at specific, distributed places at different (sometimes specific) point in time, a more elaborate understanding of the relation between time and place is called for. In particular, researchers need to look into the non-spatial aspects of mobile work. This is an analytic challenge, which Churchill and Wakeford describe like this:

Although mobility is usually associated with movement between geographically situated spaces, and hence is linked to travel, it must also be thought of in terms of time and not simply as expedient goal achievement. Mobile workers do not just need to connect while travelling (in airports, on trains, in cars, at remote locations). Their fundamental experience of mobility is embedded in an experience of temporality, which includes mutually negotiated rhythms of contact, availability and accessibility ([7], p. 173).

By using the concept of rhythms, we aim at capturing how time, place, and mobility structure work activities and, at the same time, how mobile workers experience these structures. The concept of rhythms and the relations between different types of rhythms can additionally describe the types of *negotiations* that take place while workers are engaged in work activities as well as in-between work activities. We have employed the concept of rhythms to portray and reveal these types of negotiations in terms of the interrelationships between individual, collective, and social rhythms. As our analysis has demonstrated, these rhythms indicate when home-care workers are available for contact, inform home-care workers about exceptions to their daily schedule, and make it possible to even out workloads. It should, however, be noted that rhythms are not an all-encompassing construct that can capture and encapsulate all the facets pertaining to the complexities of mobile collaborative work.

Still, we argue that unpacking the complexities of mobile work in terms of rhythmic structures presents a number of analytic advantages. *First*, it takes into account that mobile work is not solely associated with movement between distributed places; time also plays an integral role in mobile work. *Second*, it underlines that the different temporalities, some based on clock time, others on event time, and still others founded on, for instance, individual, collective and social rhythms, must also be examined. *Third*, rhythms serve to describe how workers experience time and space in combination. Instead of mapping mobile work and technologies according to the two by two matrix of time and space, the concept of rhythms is insisting on an actor-oriented approach. *Fourth*, rhythms install a particularistic way of looking at and understanding mobile work. On first sight, the orderliness of mobile work can be hard to grasp because mobile workers are constantly on the move in-between different work places. Further, the same work task is sometimes performed differently at different locations. Rhythms can contribute to understanding these

particularistic aspects of mobile work, for example, in analysing how individual and social rhythms are sometimes meshed together. *Fifth*, an analysis of rhythms fleshes out the non-material facets of collaborative work. The complexity of collaborative work is not always revealed in how artefacts are handled or how technologies are used. *Sixth*, rhythms add to an understanding of the boundaries between visible and invisible work [34]. As our study have showed, the social rhythms of home-care work played an integral role in framing and forming collaboration among home-care workers as well as between home-care workers and their clients. *Seventh*, sometimes collocated moments of collaboration are needed and at other times collaboration is best served when workers avoid collocation. Understanding the individual and collective rhythms of mobile work adds to an understanding of when mobile workers are available for contact and when characteristics of the work imply that people should keep apart [13]. *Eighth*, analysing the rhythms of mobile work also expounds the trajectories of work. Trajectory is a concept related to rhythms. Trajectories has been used to describe the treatment of patients in hospital settings [30, 35]. Nonetheless, trajectories also have rhythms, just as rhythms sometimes have trajectories. An example of the relation of the two concepts from our ethnographic study is the work schedule. We have described this schedule as forming an individual rhythm. This individual rhythm is, however, formed by a trajectory specifying when and where visits are scheduled. This rhythm is related to the route the home-care workers have configured through the district and the order of the visits specified on the schedule. Therefore, the schedule is both specifying a trajectory of the daily activities, but at the same time perceived and managed as a rhythm. *Ninth*, rhythms facilitate an in-depth look at how time and space are negotiated and perceived in organisations. Typically, rhythms are locally created and mediated. In many ways, our study of home-care work resonates with Green's remark:

[...] the relationship between mobile space and time in contemporary life is not constant, but rather locally mediated on a number of levels, from the personal, to the institutional and collective. While some social times are being newly reconstructed as mobile through rhythms of use in everyday life, these new mobile rhythms are equally embedded in very familiar, but locally defined temporal practices ([12], p. 282).

The different places of home-care work — the office, the bicycle ride, and the homes of the clients — played a pivotal role in reinforcing rhythms and provide indicative examples of local mediation of rhythms. Additionally these rhythms tied together collaborative and coordinative activities and contributed to handling exceptions and even out workload.

These nine analytic aspects of rhythms provide novel elements for understanding mobile work and add to an understanding of alignment and coordination in mobile and distributed work settings. Besides the analytic power of rhythms, there are also practical reasons for using the concept of rhythms. "Anytime, anywhere" technologies sometimes facilitate a reorganization of collaborative work, including eradication of the places where workers meet and share experiences and align activities. Similarly, the introduction of PDAs in home-care work in Greenwood as well as in the other home-care districts of Copenhagen, Denmark, has made it possible to rethink the organizational ordering of work, for example, by doing away with the morning meeting. In accordance with other studies of mobile workers [25, 36], this study has showed that collocated moments

are vital to collaboration. As one of the mobile service technicians of Wiberg's study puts it after the organisation has closed down 'the Station', a frequent meeting place for the technicians:

So what now... do they want us to be just on our own[s]... and only let us talk to each other over the phones? What about [a] thing that is not that important so that you make a phone call? I mean... a lot of things evolve just in informal settings, you know when you bump into someone and you have a nice little chitchat about just anything.... but in the long run can be very good... You see, the atmosphere is hard to establish just over a phone line ([36] p. 105).

7. CONCLUSION

Our study relates to a number of studies of mobility, time, and rhythms, but also differs from previous research in several respects. Like Pinelle and Gutwin [28, 29], we have investigated home-care work. But whereas Pinelle and Gutwin analysed collaborative complexities due to worker autonomy and remote mobility, we have analysed the collaborative rhythms of a tightly regulated work setting characterized by local mobility.

Similar to Reddy and Dourish [30], we have emphasized that rhythms structure and add predictability to collaborative activities. But in contrast to Reddy and Dourish's [30] study of hospital work, the work setting we have studied is highly mobile. Additionally, whereas Reddy and Dourish primarily focus on rhythms as providers of information, we have stressed that rhythms can also be employed as an analytic device for understanding collaborative work activities as well as work trajectories.

Akin to Green's [12] work on mobile technologies of everyday life, in particular the mobile phone, we have analysed how rhythms are embedded in temporal structures and, at the same time, are locally mediated. In contrast to Green, we have particularly examined the ways in which different rhythms, from individual through social to collective, interrelate and sometimes mesh together forming a smooth flow of collaborative activities.

In our study of home-care work in Greenwood, a tightly regulated and mobile work setting, we found that home-care workers relied on rhythms in reading their work schedules. Further, individual, collective, and social rhythms facilitated effective rearrangement and modification of work schedules. This made collaboration smoother, increased the home-care workers abilities to cope with exceptions, and evened out workloads. Additionally, we have demonstrated that rhythms were not only formed by a temporal structuring of time. The different places and artefacts as well as the relationships between home-care professionals and their longstanding clients also formed several rhythms that contributed to collaborative, mobile work.

Rhythms present a novel way of looking at and analysing mobile work by depicting and fleshing out work activities in terms of regularities and recurrent structures. Rhythms exist at multiple levels of abstraction, and rhythms at higher level of abstraction are often supplemented and strengthened by finer-grained rhythms of interaction and collaboration such as social, collective, and individual rhythms.

While the concept of mobility and mobile work is still vague and somewhat elusive, we believe that rhythms provide a valuable way of gaining insights into how time and space are interrelated in

mobile work settings, and how a variety of rhythms are formed, reinforced, and replaced to enable effective collaboration.

Whereas this study has developed a grounded understanding of the role of rhythms in mobile home-care work, our future work will also focus on supporting collaborative activities by visualizing rhythmic structures. We envisage that scheduling and awareness technologies for mobile work can exploit as well as support that people perceive their activities in term of rhythmic structures.

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