An application of 'the timing map' for working time research: using MTUS episode data in the Netherlands and the U.S.A.

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ABSTRACT: *This paper is to examine the relationship between the length and the timing of working time by applying 'the timing map' in working time research. There is a basic analysis for the timing, which is participation rates by time of day and their graph (referred to as 'the timing graph' in this paper). Although the graph is still useful to look at when a person does a particular activity, the relationship between the length and the timing of the activity time still cannot quite be seen. As examples, additional research questions could be:*

- *When they work longer hours, to what extent do people work later in the evening or earlier in the morning?*
- *At what time do they take work breaks, meals and sleep?*

In order to answer these questions, 'the timing map' is proposed in this paper, using episode data from the Multinational Time Use Study (MTUS) provided by the Centre for Time Use Research. By comparing the timing of full-time workers between the U.S.A. and the Netherlands, we find that American workers who work excessively long hours on weekdays may have to not only work later but also get up earlier and work earlier in the morning, shorten the work break around noon, and eat later evening meals. This paper also shows that 'the timing map' has the advantage of visually representing a way one can see directly how people work and how they spend time on other activities, without losing personal episode information.

KEYWORDS: working time, timing of work, MTUS, long working hours, work episode

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1. Introduction

Working time issues have been one of the crucial topics for social researchers and policy makers and it is still important today when our ways of working and living have become so diversified. Work schedules and arrangements in most countries have been so changed in the last half century that the international community has to prepare for new standard for measuring working time. For example, the International Labour Organization (ILO) adopted a new resolution for the measurement of working time in 2008 and it defined an updated working time concept as well as describing 15 key types of working time arrangements (ILO 2009). It also held the tripartite meeting of experts on working time arrangements, and various modern working time arrangements were reviewed for future discussion in the meeting report (ILO 2011). Yet, the trend of working time diversification is rather complex and the extent of moving toward to non-standardized work schedules is uneven (in Belgian case, for example, see Glorieux et al. 2008, 2009). In addition, the diversification in part stems from the working time polarization where some work too much than they prefer and others do too less than they want or even cannot find decent jobs (Boulin et al. 2006).

Time use data already have contributed to this field by providing the data for the length and the timing of working time and for insights into relationships between working time and other activities. But it seems to be the case that the aspect of length has been paid more attention than timing; therefore, there is scope for further investigating the timing aspect. Since work schedules have been diversified, the timing aspect has become more and more important for worker, and for researchers who investigate how they work.

Several research projects on the timing of work have already been undertaken and provided valuable results. Hamermesh used the work schedule supplement data of the Current Population Survey from the 1970s to the 1990s and investigated when American people worked during a day and a week and how this timing of work has changed over the decades (Hamermesh 1996a,b). Using the German time use data, Merz et al. set two dimensions of work, i.e. the timing of work and the fragmentation of a working day, made four categories combined by the two dimensions, and examined the timing of work for each category (Metz et al. 2003, 2009). Harvey et al. (2000, 2003) used a powerful tool 'Hypercode' that is a rich typology combining start and end times of work to analyze the daily work arrangement by utilizing time use data of five industrialized countries. Lesnard introduced a sequence analysis, 'Optimal matching techniques' with French and U.K. time use data, identified some clusters of work schedules for dual-earner couples in French and for employed workers in U.K., and clarified the timing of work in each type (Lesnard 2004, 2010; Lesnard and Kan 2011). Michelson and Crouse (2004) used three dimensional graph and 'tempograms' to examine the timing of work and other activities of teleworkers by using Canadian time use data. In the field of time-geography, many

studies have been done on when, where and how people undertake different kinds of activities to visualize multi-dimensional data and the complex daily lives of people (Ellegärd and Cooper 2004). Using Japanese time use data, Kuroda et al. revealed how Japanese workers have changed the timing of work within a week and a day (Kuroda 2009; Kuroda and Yamamoto 2011, 2012). Also, Fujiwara has proposed a unique tool 'all activities rates approach' which visualized changes of the rate of all activities people undertook by the time of day between different points of time or different socio-economic attributes (Fujiwara and Hirata 2007; Fujiwara 2014).

This literature is of great use in understanding the timing of work and in providing sophisticated tools to examine it; however, what I want to consider in this paper is a rather simple issue: an attempt to improve a basic and prevalent tool for describing the timing of work.

In the field of time use research, there have been three basic descriptive indicators: (i) the average time of activities for the whole population (total mean); (ii) the average time of activities for persons who engaged in the activities (participation mean); and (iii) the proportion of the population who engaged in the activities (participation rate). The third indicator is usually divided by the time of the day and the indicator of the timing is usually visually represented by the graph, where the time of the day is placed on the horizontal axis and the proportion of people who engaged in the activity is placed on the vertical axis. It is referred to as 'the timing graph' in this paper, though it is sometimes called 'the tempogram' (Michelson and Crouse 2004; Lesnard 2010; Lesnard and Man 2011). This graph has been a prevalent timing indicator and still provides insights of when people undertake a certain activity including working time. But, one rather basic unanswered question is that a relationship still cannot quite be seen between the timing and the length of the activity time. For example, research questions could be:

- When they work longer hours, to what extent do they work later in the evening or earlier in the morning?
- At what times do they take work breaks, meals and sleep?

In order to answer these questions, 'the timing map' which takes into account both the length and the timing of working time is developed in the paper. Therefore, the purpose of the paper is to examine the relationship between the length and the timing of working time by applying 'the timing map' in working time research.

2. Data and Method

2.1 MTUS episode data

In order to examine the timing of activities, episode microdata of time use surveys are needed. The episode of time use is sequences of activities, including information about the start and end time of activities. Taking the comparative research element of this paper into account, internationally harmonized data are preferable. Such data most

comprehensively are provided by the Centre for Time Use Research (CTUR) at the University of Oxford. The CTUR has organized a unique project called Multinational Time Use Reasearch (MTUS). MTUS has collected microdata of nation-wide time use surveys mainly through the national statistical institutes, made them comparable by using distinctive harmonizing method, and provided harmonized microdata to researchers (Fisher and Gershuny 2013). In this paper the episode data in the Netherlands and the U.S.A. are used because these countries have a contrastive working time situation; that is, the Netherlands has shorter working time schedules than the U.S.A. According to the Labor Force Survey data (the Current Population Survey for the U.S.A. and the European Union Labour Force Survey for the Netherlands), weekly working time of full-time workers in 2005 was 41.5 hours for males and 38.6 hours for females in the Netherlands, but 44.2 hours for males and 41.1 hours for females in the U.S.A. Long working time can have a negative impact on health of workers themselves, their family, and in turn their society so that long working culture is a quit important social issue to be investigated (Jacobs and Gerson 2004; Burke eds. 2006; Burke and Cooper eds. 2008). Choosing such different countries would be a good example for investigating the characteristics of long working hours and the timing of work.

Table 1. Summary of the survey method

	The Netherlands	The U.S.A.
year	2005	2005
Age	12+	15+
Sample size	5950 individual participants	Approximately 26,300 diarists
Survey period	2-8 October, 9-15 October	One whole year
Number of diary days	7 consecutive days	1 day
Response rate	37%	56.6%
Type of diary	Pre-coded, look-up in dictionary	Recall from yesterday
Mode of data collection	Self-completed diary	Computer assisted telephone interview
Time interval in the diary	15-minutes	Free (nominated start/stop times)
Number of activity codes	274	564
Collector	The Netherlands Institute for Social Research	United States Bureau of Labor Statistics, Department of Labor

Source: The Centre for Time Use Research website.

MTUS provides the Harmonized Episode File (HEF) of the Netherlands and the U.S.A. in different years, but data in 2005 for both countries are used in the paper because the Netherlands' data in 2005 is the most recent data available at the present time. A summary of the survey method for both countries is shown in Table 1.

2.2 Activity codes used

MTUS has some unique harmonized activity typologies where the most detailed one is 69 categories and the simplest one is 25 categories. Even though the time use survey in different countries has a different activity code, MTUS harmonizes different codes into the MTUS' typologies and provides harmonized microdata; therefore, it is possible to make a comparison between countries with MTUS data. In the MTUS episode file, data are provided by 69 activity codes. This paper considers three activities, i.e. 'paid work', 'meals' and 'sleep', which are defined by the corresponding activities from the 69 codes (Table 2). Regarding 'paid work', there are eight related codes, but only 'paid work-main job (not at home)' and 'paid work at home (main, second or other job)' are selected in this paper because full-time workers are assumed to engage mostly in the two. Similarly, 'meals at work or school' and 'meals or snacks in other places' are referred to as 'meals', and 'sleep and naps' is referred to as 'sleep'.

Table 2. MTUS activity categories used in this paper

Activity related to paid work, meals and sleep in MTUS 69 codes	Value label in MTUS Episode file	Whether included in this paper	Terms used in this paper
Paid work-main job (not at home)	7	Yes	'paid work'
Paid work at home	8	Yes	
Second or other job not at home	9	No	--
Unpaid work to generate household income	10	No	--
Travel as a part of work	11	No	--
Work breaks	12	No	--
Other time at workplace	13	No	--
Look for work	14	No	--
Meals at work or school	5	Yes	'meals'
Meals or snacks in other places	6	Yes	
Restaurant, café, bar, pub	39	No	--
Sleep and naps	1	Yes	'sleep'
Imputed sleep	2	No	--

2.3 Diary period limitations

The diary period of the survey in the Netherlands is seven consecutive days, whereas in the U.S.A. it is just one day. To make a comparison between the two countries, diaries for Wednesday in both countries are selected in this analysis. The research focus in this paper would be working time on a typical working day, so any weekday from Monday through Friday could be selected. But, working time on Wednesday, the middle of the working week, would be on average closest to a typical workday. Differences of working time on Wednesday and other weekdays will be examined in Section 4.1.

In addition, the diaries from Monday to Friday could be pooled in each country and treated as 'weekday' diaries so that they could be compared. But, the diary period in the Netherlands is seven consecutive days and the same person completed the weekday diary repeatedly, while the diary period in the U.S.A. is just one day and the person completed only one weekday. Thus, the pooled diaries of weekdays would have different meanings in the two countries and this difference would make any comparison flawed.

2.4 The type of employment limited to full-time workers

The style of working in terms of the length and the timing of work is obviously much different among the types of employment, for example full-time and part-time workers. Among developed countries the type of employment has diversified and in particular the number of part-time workers has increased recently; therefore, it is important to understand working time for not only full-time workers, but also part-time workers. However, this paper narrows down the research focus to full-time workers in order to control the effect of the type of employment. It also controls it by gender because there is a large difference in working time by gender. Seeing the gender differences would help to understand gender issues related to working time.

2.5 Adjustment of the time of the day

The duration of the diary (24 hours) starts at 12 midnight and ends at 12 midnight the next day in the Netherlands, while it is from 4am to 4am the next day in the U.S.A. Since it is important and reasonable for a working time study to see how full-time workers work evenings and even past midnight, the duration of the diary in the Netherlands has been converted from 12am-12am to 4am-4am (next day). The diary period in the Netherlands is seven consecutive days, so that the conversion can be done by combining the diary from 4am to 12pm on Wednesday, and another diary from 12am to 4am on Thursday.

3. The conventional 'timing graph' by the time of the day

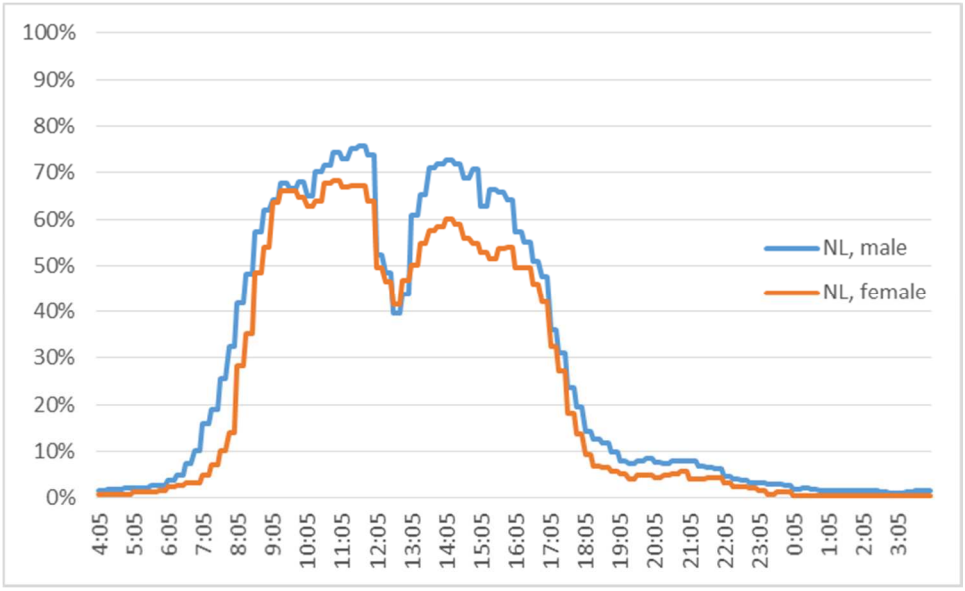
To make it clear what is different from 'the timing map', the conventional 'timing graph' is showed in this section (Figure 1). The shapes of the graphs are largely similar,

but there are differences between gender and countries. From the total mean it has been found that male full-time workers work longer hours than their female counterparts, and this reflected the fact that the male participation rates in the afternoon are higher than female ones. In other words, male workers worked later than female. Also, the total mean in the U.S.A. is larger than one in the Netherlands and it reflected the fact that the participation rates both in the morning and afternoon are higher than those in the Netherlands. It can be said that both male and female workers in the U.S.A. on average started to work earlier and finished later than workers in the Netherlands. It also can be said that American female full-time workers work more like their male counterparts than ones in the Netherlands.

4. The application of 'the timing map'

4.1 The timing of work

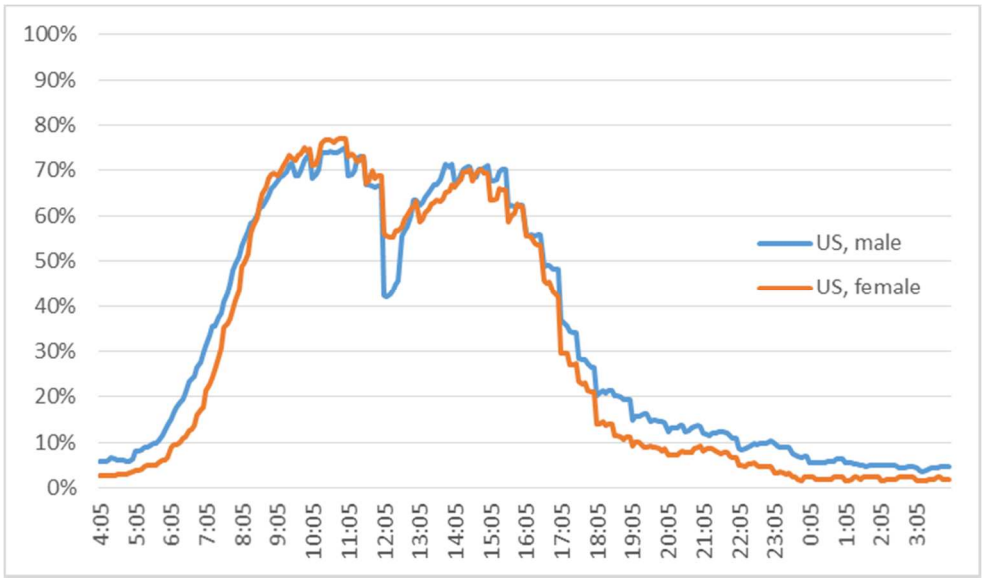
Even though the conventional 'timing graph' in Figure 1 still provides valuable aggregated information on the timing of work, there are simple questions that remain, such as: Do those who work late in the evening also work long paid work time, and to what extent do they work late in the evening or early in the morning? These questions stem from the aggregation of 'the timing graph'. Because the participation rate of 'paid work' is calculated by the time of the day (precisely, every five minutes) in 'the timing graph', it is not known exactly who engaged in 'paid work' at the particular time of the day. For example, it is not known how long those who worked late in the evening worked from the point of view of 'the timing graph'. Thus, my research focus here is to see a relationship between the timing and the length of 'paid work' time.



1(a). The Netherlands

Male→ N=537, ave=6h45m, min=0h0m, max=14h45m, sd=3h26m

Female → N=250, ave=5h36m, min=0h0m, max=13h45m, sd=3h30m



1(b). U.S.A.

N=369, ave=7h52m, min=0h0m, max=19h05m, sd=3h34m

N=304, ave=7h08m, min=0h0m, max=15h55m, sd=3h16m

Figure 1. The participation rate of 'paid work' by the time of the day, Wednesday, full-time workers, 2005

Notes: N=number of cases; ave=total mean of 'paid work'; min and max=minimum and maximum; sd=standard deviation of 'paid work'

Source: MTUS Harmonized Episode File, author's own calculation.

One way to approach this question can be achieved by simply piling each person's work episode and making a graph. The simple image of the pile of episodes is shown in Figure 2. In this example, raw information on both the timing and the length of 'paid work' is retained and visualized. In this sense, we can understand the relationship between the timing and the length of 'paid work' time.

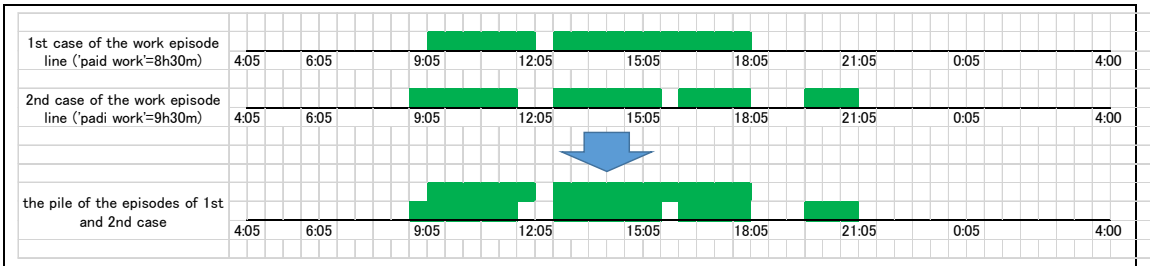


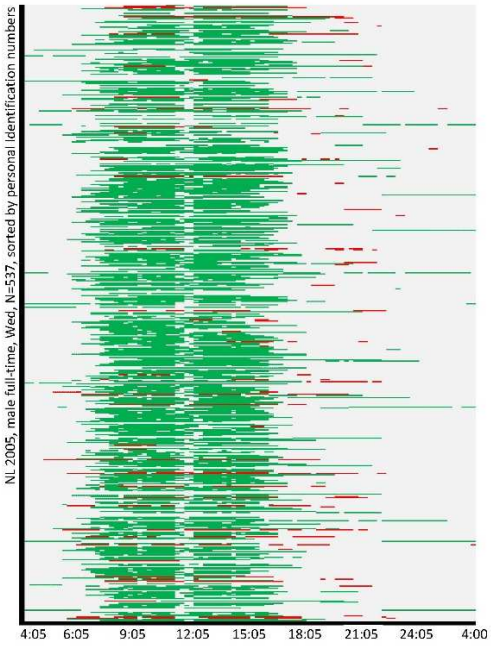
Figure 2 A hypothetical example of piled work episodes

Note: green indicates 'paid work'.

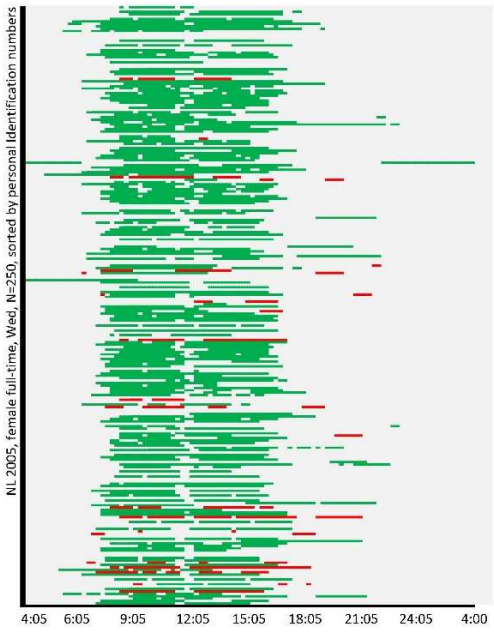
Figure 3 is constructed by piling all relevant cases for the two countries. This type of graph is called 'the timing map' in the paper, as a matter of convenience and differentiation from conventional 'timing graphs.' Here, each person's work episode is piled and sorted by personal identification numbers in the survey. Since the personal identification numbers do not have any meanings, there are no meanings on the vertical axis in this graph.

Even though there are no meanings on the vertical axis and the fact that most episodes are concentrated in the 9am-5pm period seems to be similar to 'the timing graph', each actual person's work episodes can be looked at because this is not an aggregated statistical graph. When each line of episode is looked at, there is a sense of the relationship between the timing and the length of 'paid work' time.

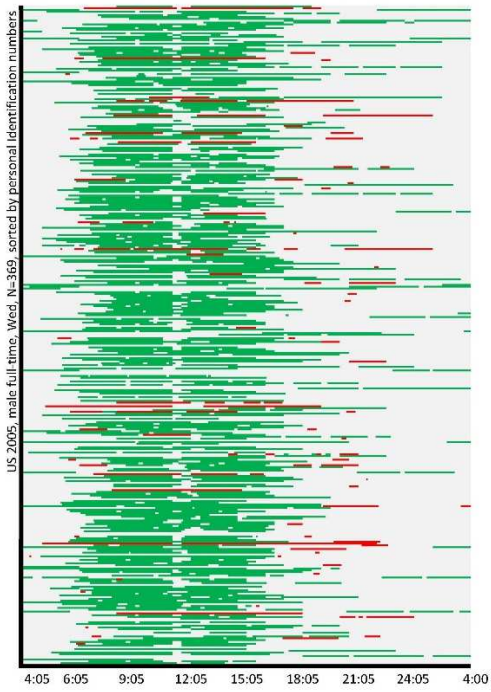
To make this clearer, each work episode on the vertical axis is sorted by the length of 'paid work' time in Figure 4. This means those who did more 'paid work' are located at the bottom of the figures. In addition, three lines are drawn at the quartile points of the length of 'paid work' time to help read the length of 'paid work' time of each episode. The idea of 'the timing map' is not actually new. This kind of visualization was pioneered in the field of time-geography by Ellegärd and Cooper (2004), who showed the very same graph in terms of activities related to meals. In addition, the same kind of graphs have been proposed within the field of sequence analysis in a more sophisticated way, called 'sequence plots' (Piccarreta and Lior 2010). Moreover, Lesnard (2011) presented the very same graphs on working time. In this respect this paper is inspired by their studies and one can say that this is a simple application of their working time research methodology.



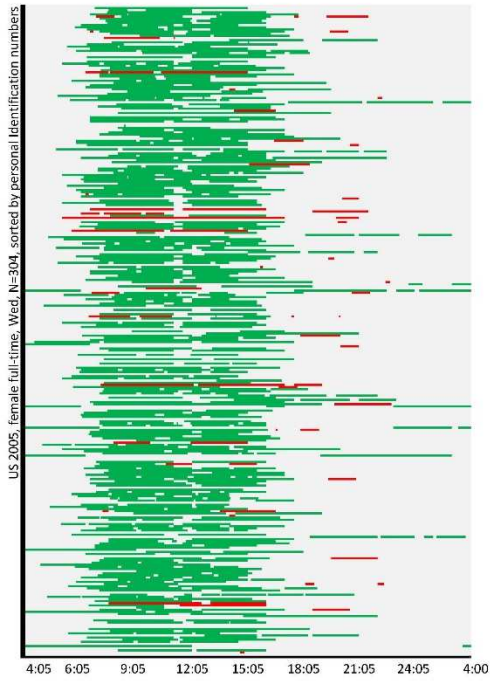
3(a). Male, the Netherlands (N=537)



3(b). Female, the Netherlands (N=250)



3(c). Male, U.S.A. (N=369)

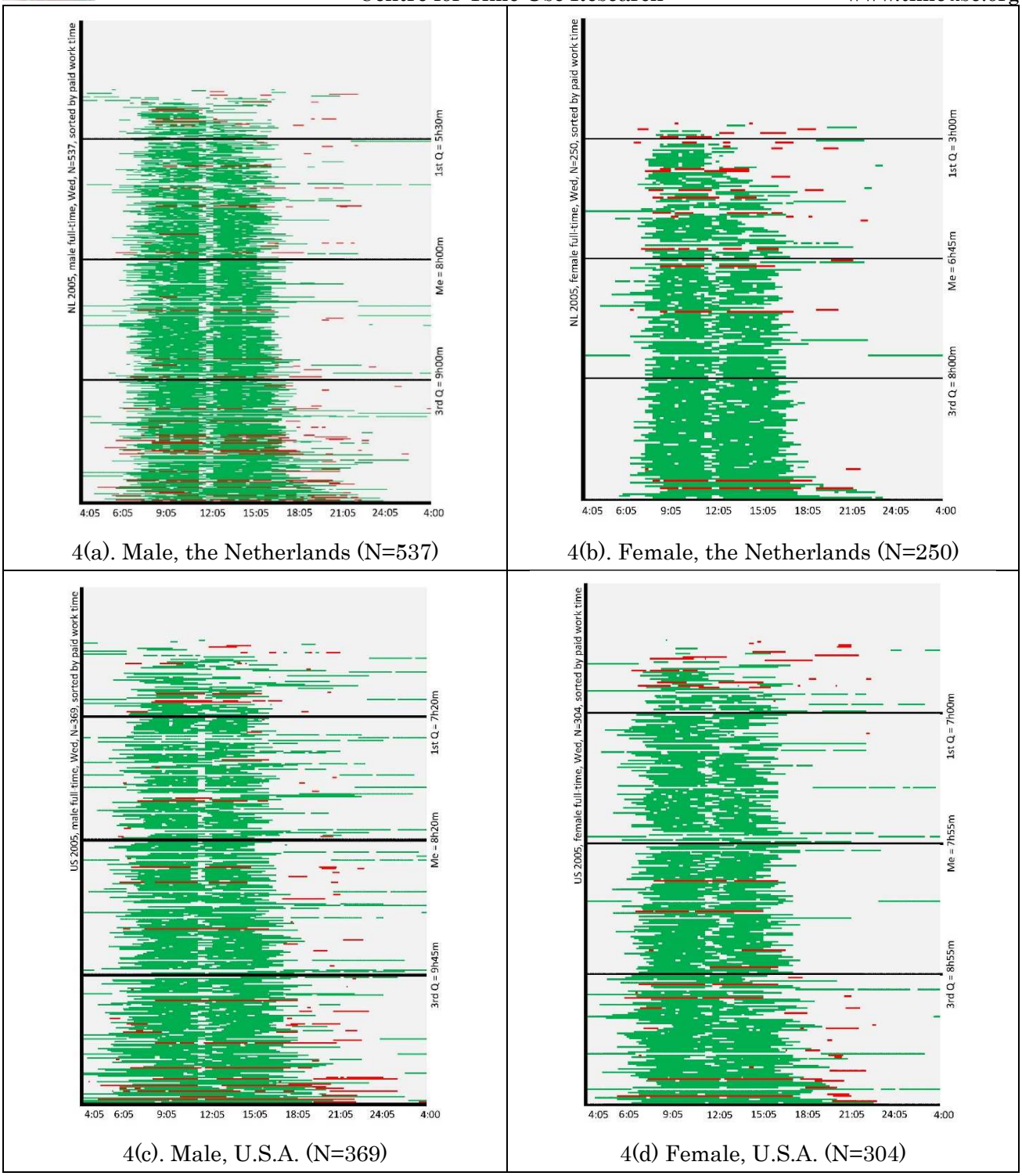


3(d) Female, U.S.A. (N=304)

Figure 3. The timing map of 'paid work' by the time of the day, Wednesday, full-time workers, 2005, sorted by the personal identification numbers on the vertical axis.

Note: green=paid work-main job (not at home); red=paid work at home. Each line represents each person's 'paid work' episode.

Source: MTUS Harmonized Episode File, author's own calculation.



4(a). Male, the Netherlands (N=537)

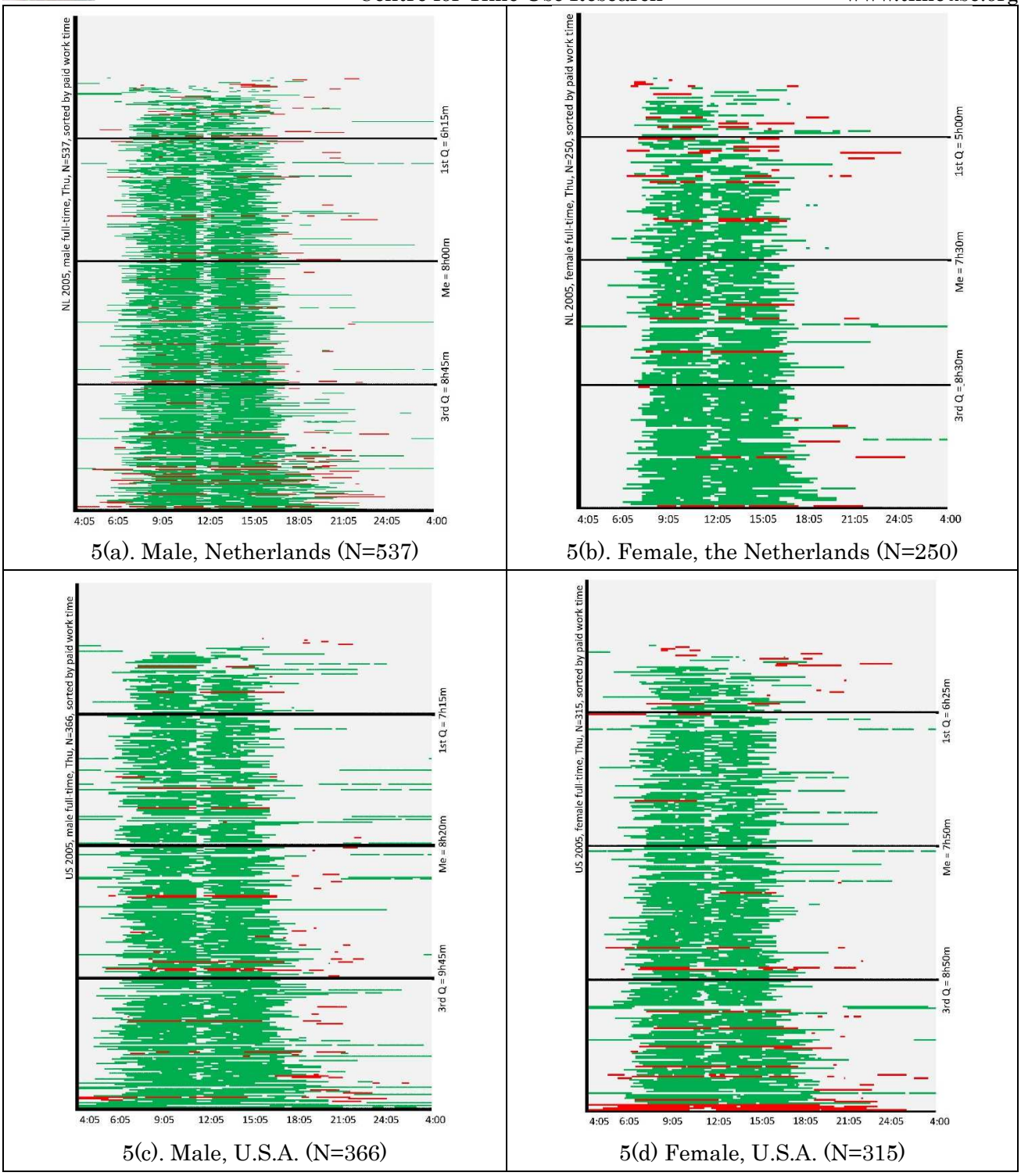
4(b). Female, the Netherlands (N=250)

4(c). Male, U.S.A. (N=369)

4(d) Female, U.S.A. (N=304)

Figure 4. The timing map of 'paid work' by the time of the day, Wednesday, full-time workers, 2005, sorted by the length of 'paid work' on the vertical axis.

Notes: green=paid work-main job (not at home); red=paid work at home. Each person's episode of 'paid work' is piled and sorted by the length of 'paid work'. The three black lines represent the quartile points of the length of 'paid work'. Source: MTUS Harmonized Episode File, author's own calculation.



5(a). Male, Netherlands (N=537)

5(b). Female, the Netherlands (N=250)

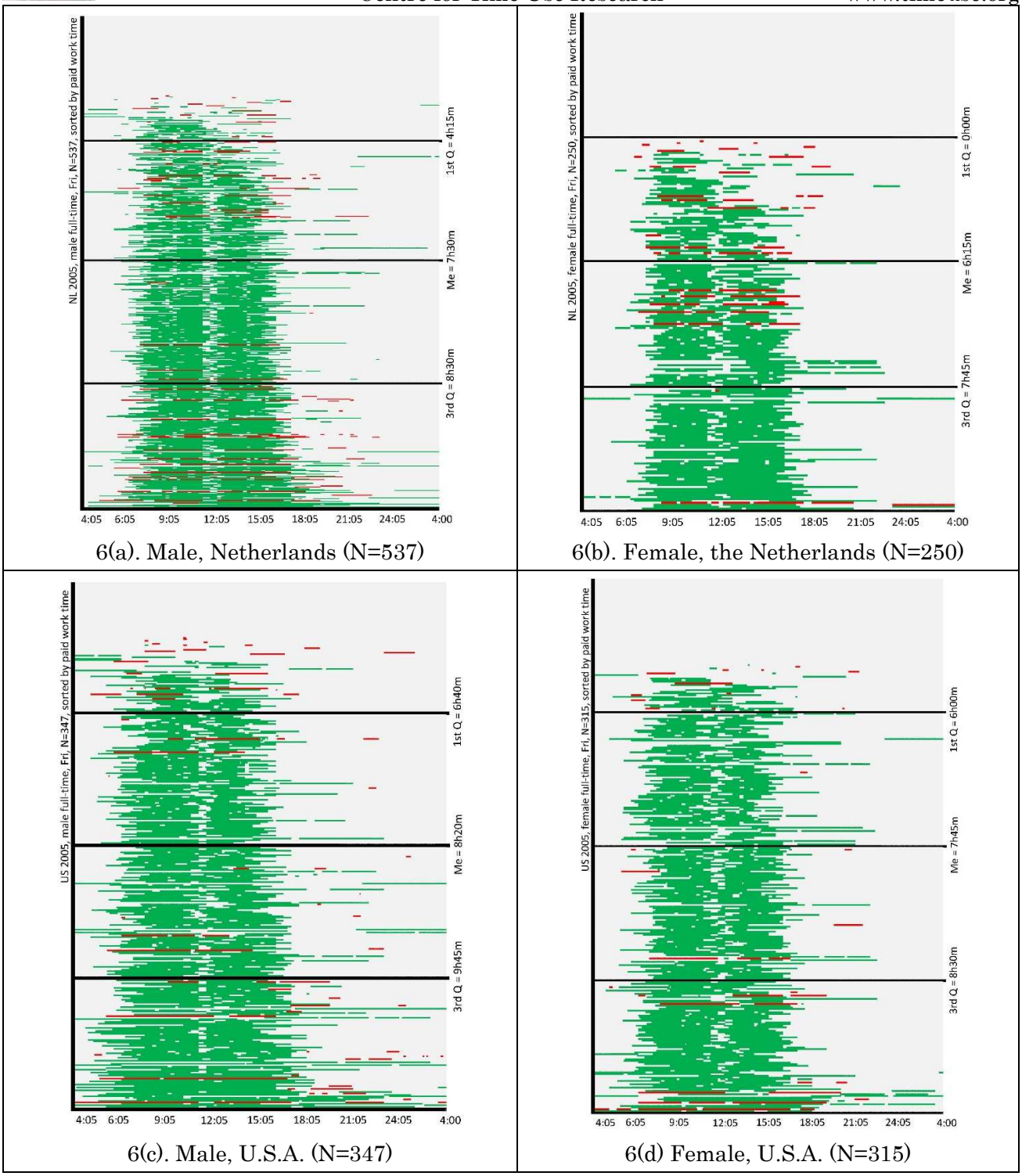
5(c). Male, U.S.A. (N=366)

5(d) Female, U.S.A. (N=315)

Figure 5. The timing map of 'paid work' by the time of the day, Thursday, full-time workers, 2005, sorted by the length of 'paid work' in the vertical axis.

Notes: green=paid work-main job (not at home); red=paid work at home. Each person's episode of 'paid work' is piled and sorted by the length of 'paid work'. Three black lines represent the quartile points of the length of 'paid work'.

Source: MTUS Harmonized Episode File, author's own calculation.



6(a). Male, Netherlands (N=537)

6(b). Female, the Netherlands (N=250)

6(c). Male, U.S.A. (N=347)

6(d) Female, U.S.A. (N=315)

Figure 6. The timing map of 'paid work' by the time of the day, Friday, full-time workers, 2005, sorted by the length of 'paid work' in the vertical axis.

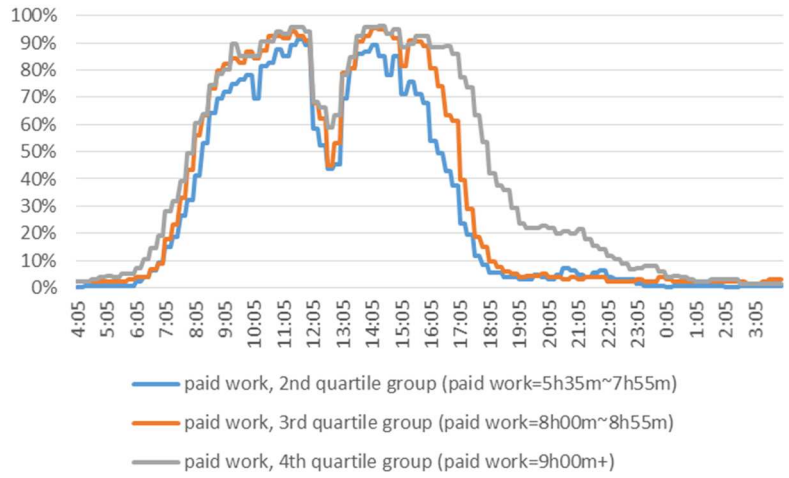
Notes: green=paid work-main job (not at home); red=paid work at home. Each person's episode of 'paid work' is piled and sorted by the length of 'paid work'. Three black lines represent the quartile points of the length of 'paid work'.

Source: MTUS Harmonized Episode File, author's own calculation.

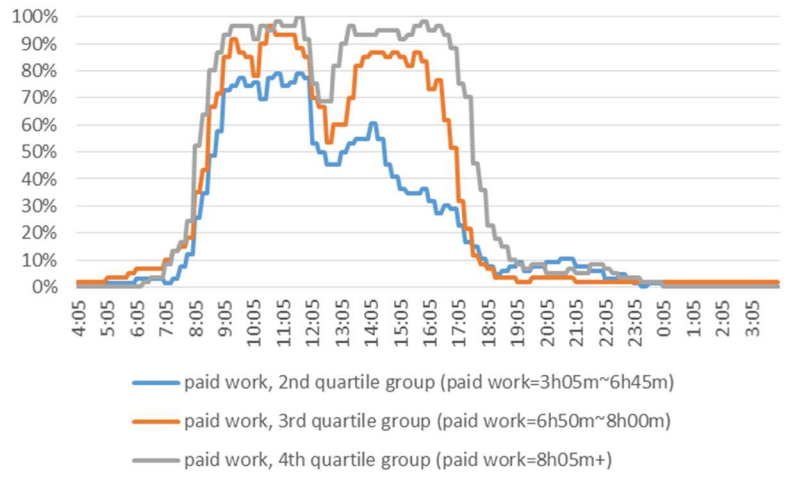
Thursday's and Friday's data on a parallel with Figure 4 are showed in Figure 5 and 6 to see differences of working time pattern on Wednesday from other weekdays. In comparison between Wednesday and Thursday, the variation is relatively small in each country. But it gets larger between Wednesday/Thursday and Friday. In both countries, the length of working time in the groups of shorter working time (i.e. 1st and 2nd quartile groups) tends to be shorter on Friday than on Wednesday/Thursday. This trend is stronger in the Netherlands, especially in Dutch female full-time workers, than in U.S.A. It could be because working arrangement is more flexible in the Netherlands than in U.S.A (Boulin et al. 2006). Therefore, Friday is likely to have the different working time pattern from other weekdays. In the following discussion, data on Wednesday are used as a typical weekday to avoid any complexity of comparing between weekdays; however, the analysis in this paper may not apply to the pattern on Friday.

Some findings can identified in Figure 4, which cannot be read in 'the timing graph'. First, there are blank spaces in the very top of the figures. This shows some full-time workers did not undertake 'paid work' at all on Wednesday (more females than males). Second, 'paid work' episodes outside of the typical work period, i.e. 9am-5pm, can be found more in the U.S.A. than the Netherlands, especially among American male workers regardless of their length of 'paid work' time. Third, knowing the fact that American male workers on average work longer than Dutch workers, it is expected that American workers who work longer tend to work later in the evening than Dutch workers, but it is striking that these American workers also tend to start working earlier in the morning than Dutch workers. Fourth, the start and end times of 'paid work' in the U.S.A. are more varied than in the Netherlands. Fifth, we can see small blank spaces around noon, which are assumed to be lunch breaks, but when the length of 'paid work' time gets longer, appearances of blank spaces become fewer. This would mean that those workers take a shorter lunch break or skip it altogether to undertake longer 'paid work' time.

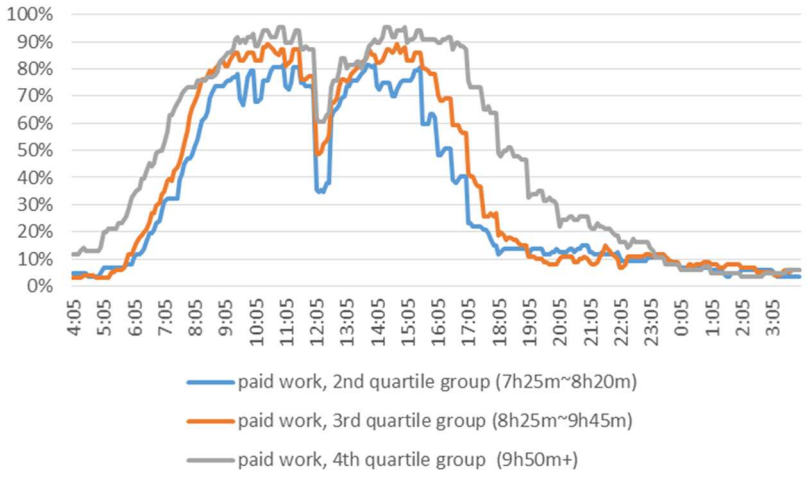
To confirm the third finding above, full-time workers were divided by quartile groups of the length of 'paid work' time, and the participation rate of 'paid work' is divided by the quartile groups and by the time of the day, as depicted in Figure 7. It can be seen that the participation rate of 'paid work' increases over the time of the day, especially in the evening as the quartile group becomes higher-ranked. This reflects the fact that those who work longer hours work later in the evening. However, the fourth quartile group of American workers, especially male workers, has a higher participation rate both in the evening and in the early morning. It is obvious that full-time workers who work ten hours a day or more have to not only work late in the evening, but also start working early in the morning.



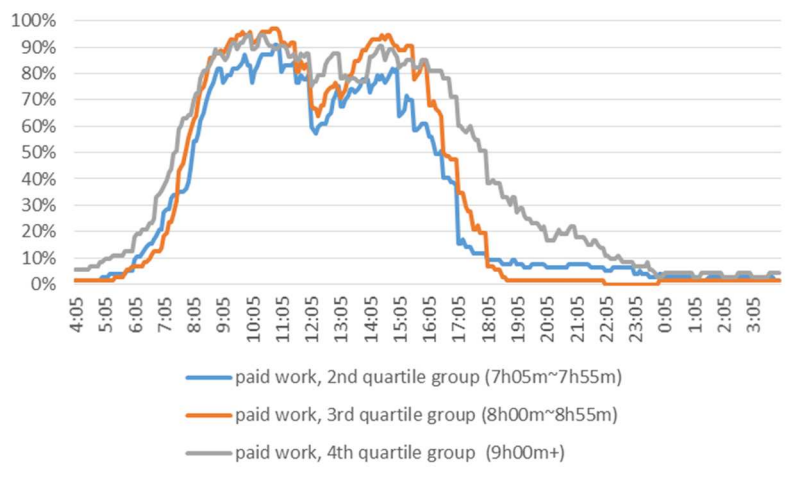
7(a). Male, the Netherlands (N=537)



7(b). Female, the Netherlands (N=250)



7(c). Male, U.S.A. (N=369)



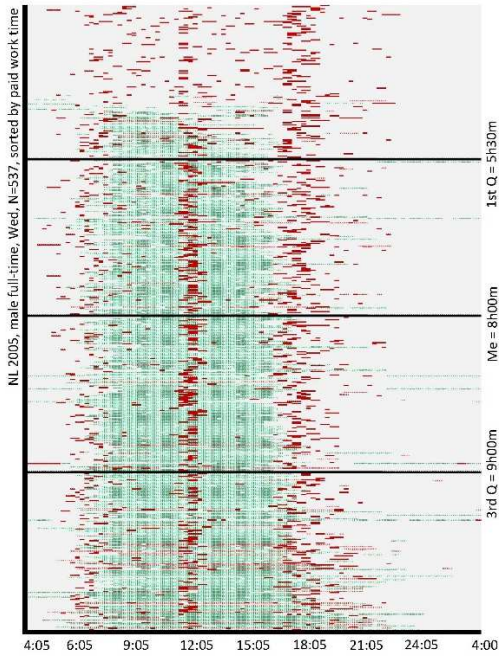
7(d). Female, U.S.A. (N=304)

Figure 7. The participation rate of paid work by time of the day and quartile groups, Wednesday, full-time workers, 2005 Source: MTUS, author's own calculation.

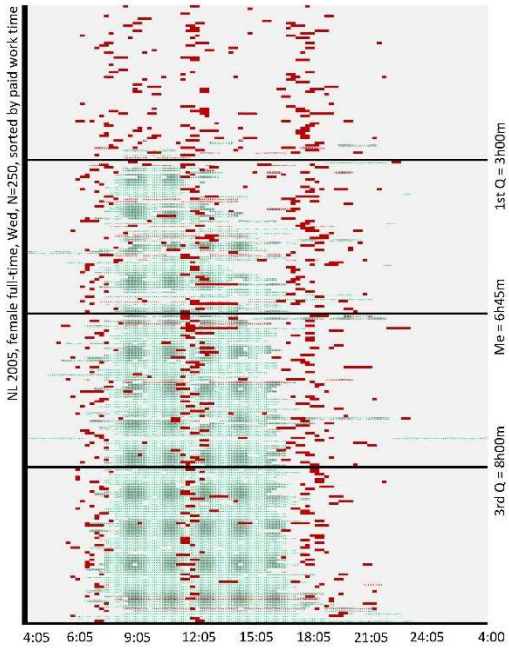
4.2 Relationship to the timing of other activities: 'meals' and 'sleep'

As 'paid work' is the main weekday activity for full-time workers, inevitably the length and the timing of 'paid work' time affects other daily activities. In this sense, it is important for working time research to convey an understanding of not only how they work but also how the way they work affects their other daily activities. Since the timing and the length of 'paid work' have been examined so far, it would be a good starting point to investigate this issue by looking at the timing and the length of other activities and trying to consider the relationship between 'paid work' and other activities. While other activities are varied and each activity has its own significance, only 'meals' and 'sleep', which are defined in Section 2, are taken up in this paper. One reason is that these two activities are physiologically the most essential ones so that from the point of view of workers' health it is worth examining how 'paid work' affects these activities. Another reason, which is rather practical one, is that activities are needed that are constantly undertaken on a daily basis because the only one weekday, Wednesday, is covered in this paper. These two activities are almost always and constantly undertaken on a daily basis. It is of course very interesting to look at activities such as unpaid work or leisure activities, but these are likely to vary on a day-to-day basis, and it would be inappropriate to look at these activities on only one weekday.

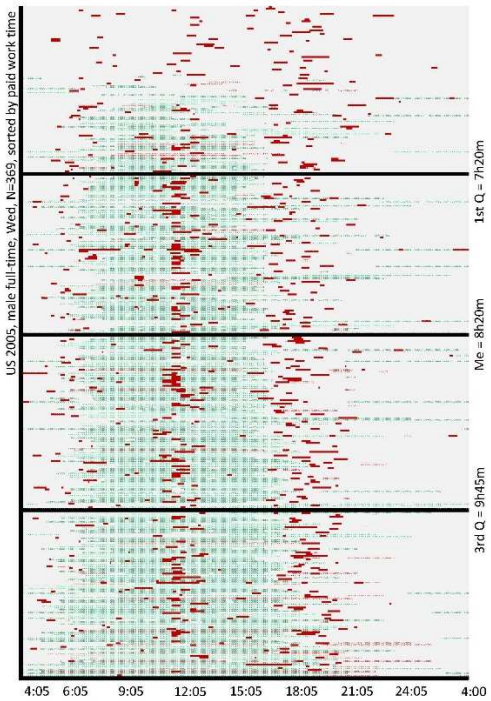
Figure 8 shows 'the timing map' of 'meals' by using the same map for 'paid work' but making the color for 'paid work' light and marking 'meals' as dark red. In this Figure it can be seen when and how much time workers spent both on 'paid work' and 'meals' at the same time, so that the relationship between the two may be visually examined without losing personal episode information. In terms of the length of 'meals' and 'paid work' time, there seems to be a negative relationship between the two. Table 3 appears to confirm this relationship. It is noteworthy that the length of 'meals' time for male workers in both countries is longer than females. Similarly, mealtime length in the Netherlands for both genders is longer than for the U.S.A. Both males and females who do not have 'meals' in the morning at all in the U.S.A seem to be greater in number than in the Netherlands. These phenomena would be an interesting subject to investigate further, but is beyond the scope of this paper. The negative relationship would be regarded as common knowledge and in fact has already been revealed by conventional time use studies concentrating on the length of time; nonetheless, the relationship of the timing between 'meals' and 'paid work' would be interesting to examine.



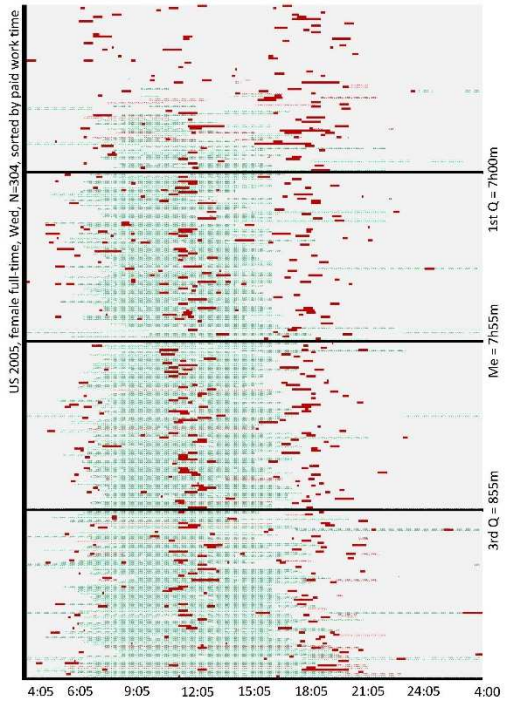
8(a). Male, the Netherlands (N=537)



8(b). Female, the Netherlands (N=250)



8(c). Male, U.S.A. (N=369)



8(d) Female, U.S.A. (N=304)

Figure 8. The timing map of 'meals' by the time of the day, Wednesday, full-time workers, 2005, sorted by the length of 'paid work' on the vertical axis.

Notes: light green=paid work-main job (not at home); light red=paid work at home. Dark red='meals' (definition given in Section 2). Each person's episode of 'paid work' is piled and sorted by the length of 'paid work'. The three black lines represent the quartile points of the length of 'paid work'.

Source: MTUS Harmonized Episode File, author's own calculation.

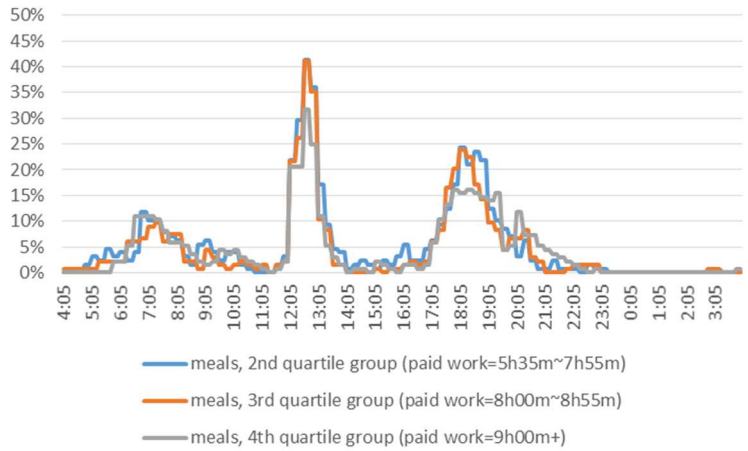
Table 3. The average time of 'meals' and 'sleep' by 'paid work' quartile group, Wednesday, full-time workers, 2005

(unit: minutes)

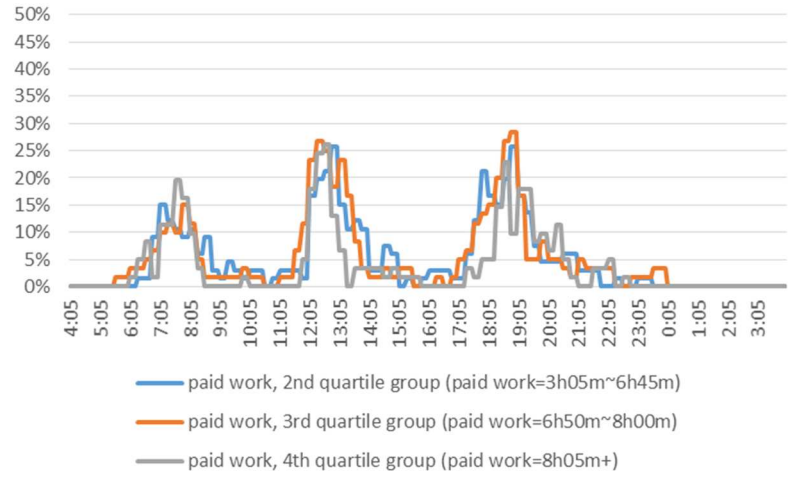
		'meals'	'sleep'
The Netherland			
male (N=537)			
1st Q group	(0~5h30m)	71	516
2nd Q group	(5h35m~7h55m)	76	449
3rd Q group	(8h00m~8h55m)	66	452
4th Q group	(9h00m+)	65	439
female (N=250)			
1st Q group	(0~3h00m)	66	566
2nd Q group	(3h05m~6h45m)	72	488
3rd Q group	(6h50m~8h00m)	74	465
4th Q group	(8h05m+)	54	445
U.S.A.			
male (N=369)			
1st Q group	(0~7h20m)	45	519
2nd Q group	(7h25m~8h20m)	62	490
3rd Q group	(8h25m~9h45m)	60	456
4th Q group	(9h50m+)	53	417
female (N=304)			
1st Q group	(0~7h00m)	45	511
2nd Q group	(7h05m~7h55m)	51	460
3rd Q group	(8h00m~8h55m)	50	467
4th Q group	(9h00m+)	44	430

Source: MTUS episode file (HEF), author's own calculation.

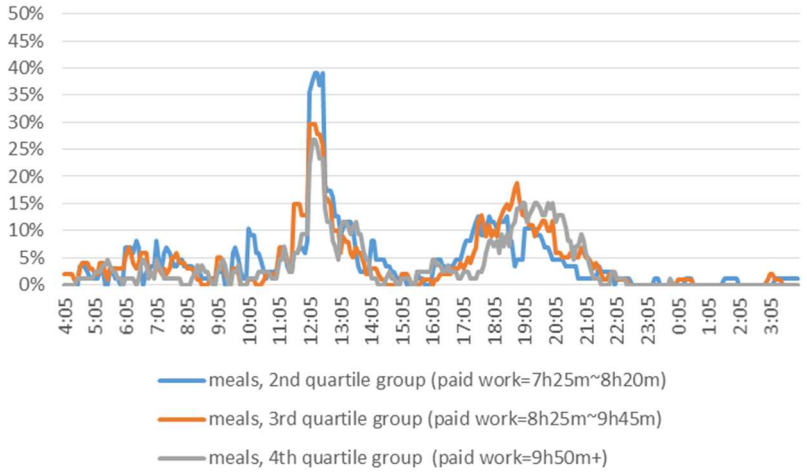
Some interesting findings between the two countries have been identified from Figure 6. First, the timing of 'meals' in the U.S.A. for both genders seems to be more varied than in the Netherlands. Similarly, the timing for the females in both countries seems to be more varied than for the males. Second, the timing of 'meals' in the morning in both countries and genders is varied regardless of the length of 'paid work' time, but the position of the timing of 'meals' in the afternoon seems to be later for those who engaged in longer 'paid work'. To further examine these findings, Figure 9 should be referred to, where the participation rate of 'meals' by the time of the day is showed by the 'paid work' quartile groups. Regarding the first finding above, the peaks for the U.S.A. are lower than for the Netherlands, meaning more varied timing of 'meals' in the U.S.A. The same aspect is applied to the gender difference: the timing of 'meals' is more varied for the female workers than for the male workers. As to the second point, looking at the line of the 4th quartile group of 'meals' for both gender and countries, it can be said that the longer the length of 'paid work' time, the later the workers have meals in the evening.



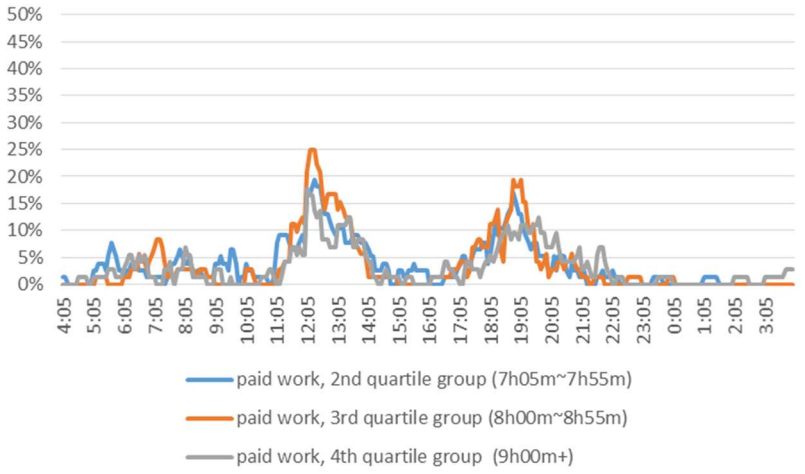
9(a). Male, the Netherlands (N=537)



9(b). Female, the Netherlands (N=250)

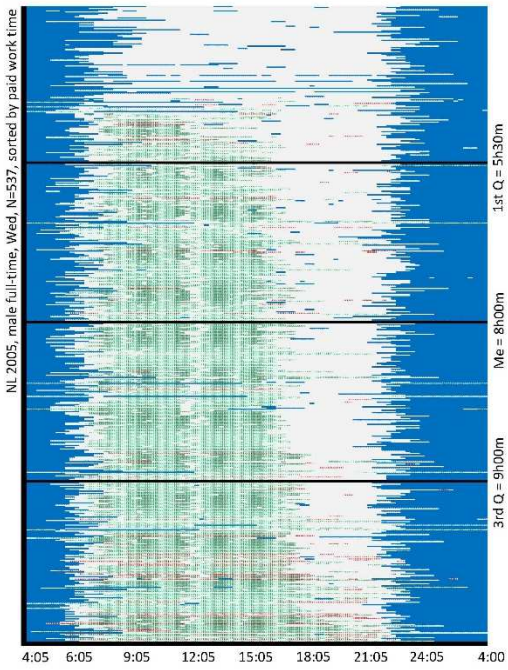


9(c). Male, U.S.A. (N=369)

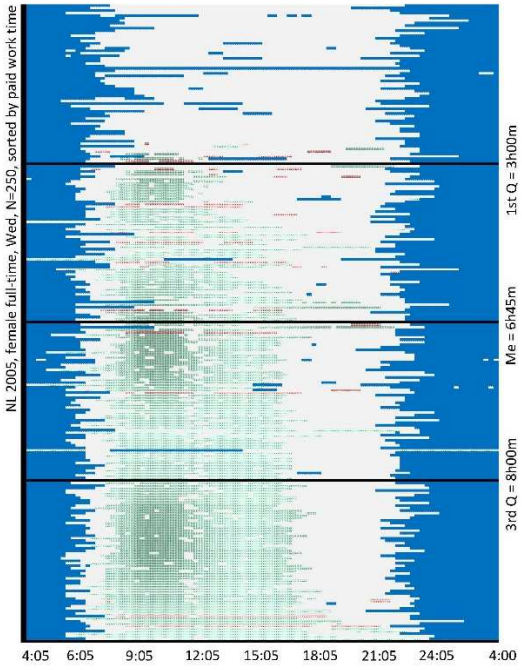


9(d). Female, U.S.A. (N=304)

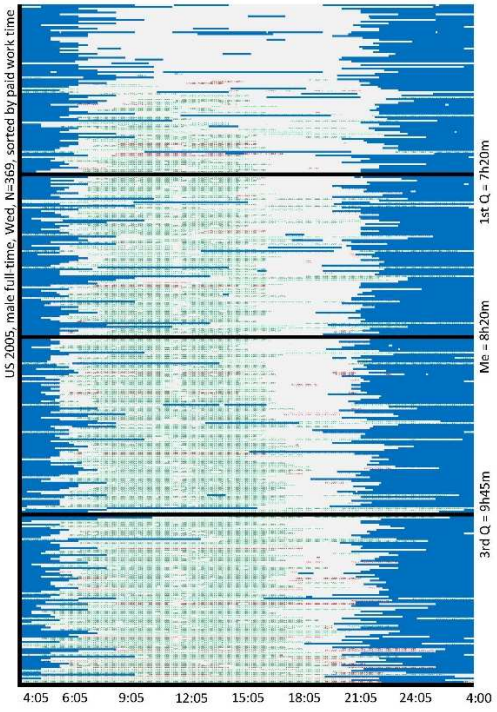
Figure 9. Participation rates of 'meals' by time of the day and quartile groups, Wednesday, full-time workers, 2005 Source: MTUS, author's own calculation.



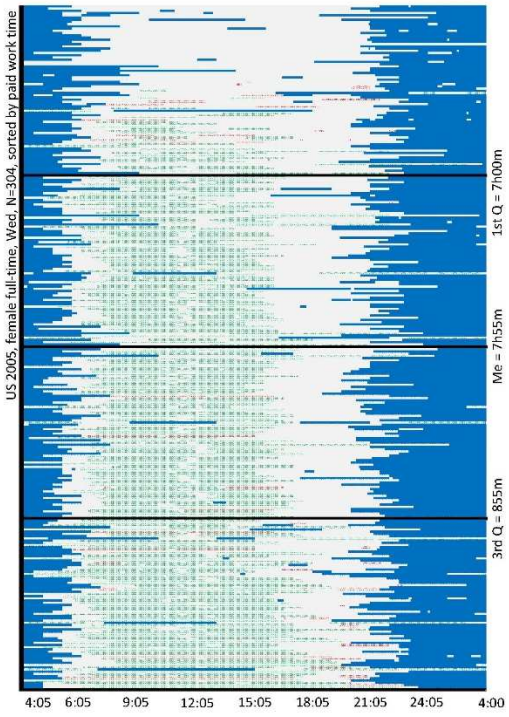
10(a). Male, the Netherlands (N=537)



10(b). Female, the Netherlands (N=250)

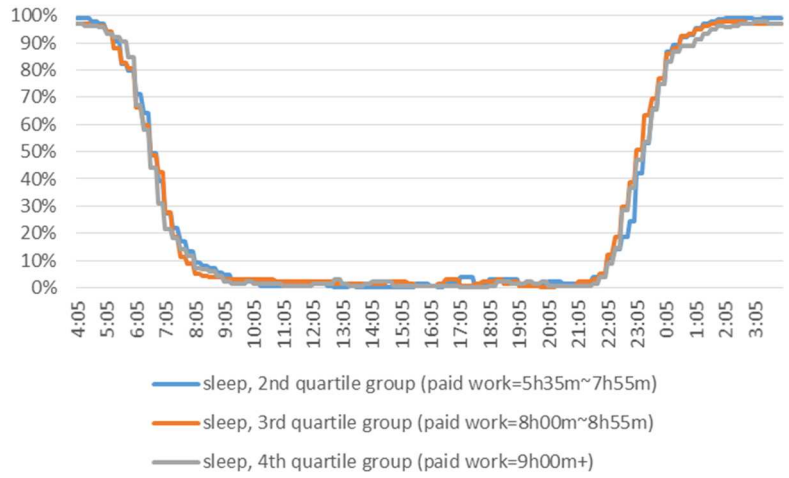


10(c). Male, U.S.A. (N=369)

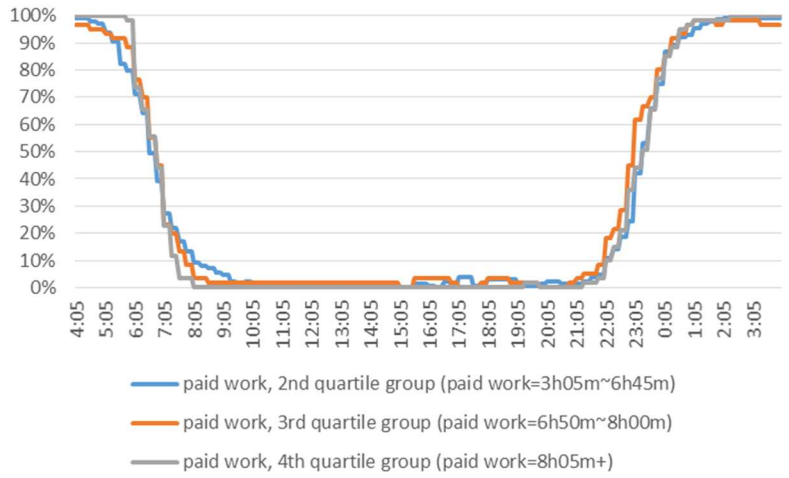


10(d) Female, U.S.A. (N=304)

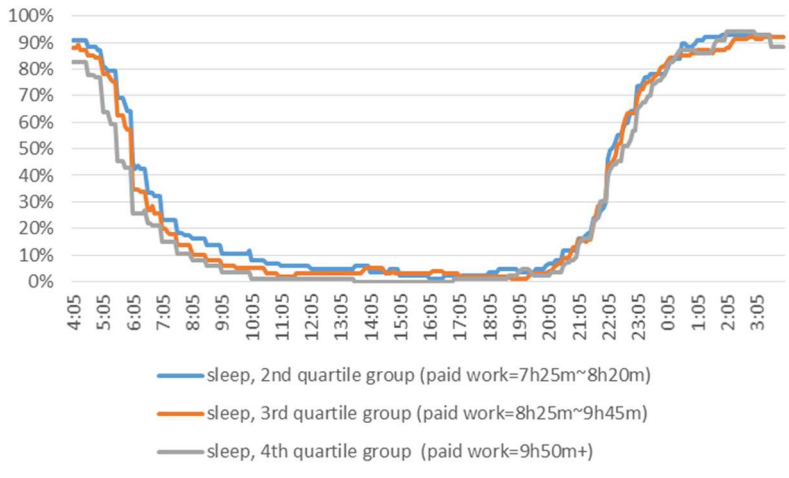
Figure 10. Timing map of sleep by time of day, Wednesdays, full-time workers, 2005, by length of paid work on vertical axis. Light green=paid work-main job (not at home); light red=paid work at home; blue=sleep (definition Section 2). Each person's episodes are piled and sorted by duration of paid work. The three black lines represent the paid work quartile points. Source: MTUS, author's calculations.



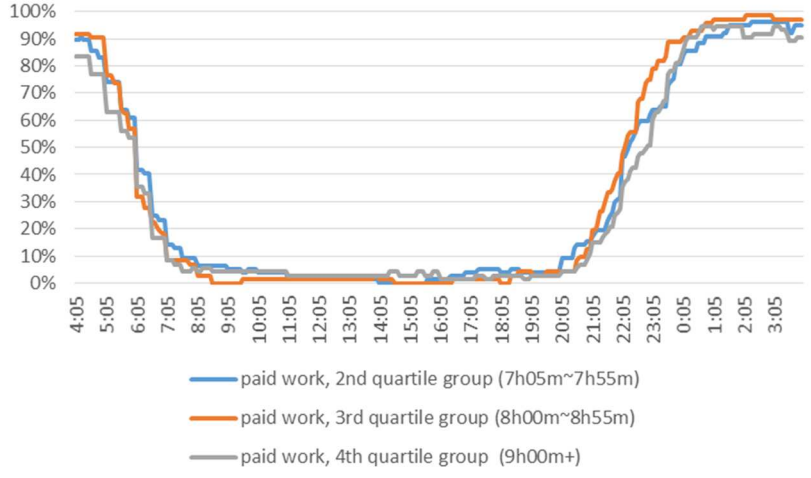
11(a). Male, the Netherlands (N=537)



11(b). Female, the Netherlands (N=250)



11(c). Male, U.S.A. (N=369)



11(d). Female, U.S.A. (N=304)

Figure 11. The participation rate of 'sleep' by time of day, and quartile groups, Wednesday, full-time workers, 2005. Source: MTUS, author's own calculation.

Turning now to the timing of 'sleep', Figure 10 is 'the timing map' for 'sleep' on a parallel with Figure 8. There does not seem to be much difference in the timing of 'sleep' by 'paid work' quartile groups; however, the negative relationship between the length of 'sleep' and 'paid work' on average can be observed in Table 3. Figure 11 shows the participation rate of 'sleep' on a parallel with Figure 9. The participation lines are not markedly different, except the 4th quartile group of the morning period in the U.S.A. This may reflect the fact that this group of workers tends to start 'paid work' earlier in the morning, which is consistent with findings from Figures 4 and 7.

5. Conclusions

This paper has proposed 'the timing map' for working time research, an alternative way of visualizing the timing of work in order to improve the conventional 'timing graph'. In comparing the timing of full-time workers between the Netherlands and the U.S.A., some characteristics of American workers, who on average work longer than Dutch workers, can be found. First, if people work long hours they have to work late as one expects, and this is confirmed in both countries. But when they work excessively long working hours, such as in the American 4th quartile group, they may also have to start work earlier in the morning. This trend is stronger for the male workers than for the female workers. Second, work breaks around noon tend to be shortened or skipped altogether when a person works longer hours. These tendencies stand out especially for American female workers who work excessive hours. Third, regardless of the length of working time, both male and female American workers work unsocial hours more than Dutch workers do. Fourth, the longer they work, the later they eat the evening meal. This is observed in the 4th quartile group in the U.S.A. Fifth, the longer they work, the earlier they have to get up in the morning. This is especially true for American male workers. All the above findings can be confirmed by taking into account not only the length of working time but also the relationship between the length and timing of working time.

From the point of view of the methodology of this paper, the advantage of 'the timing map' would be a visualization where one can see directly how people work and how they spend time on other activities, without losing personal episode information. Of course, 'the timing map' by itself can only tell the overview of how they work; thus, it would be greatly beneficial if it could be used with the conventional 'timing graph' in the same way that this paper showed both graphs.

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