The effects of extended workdays

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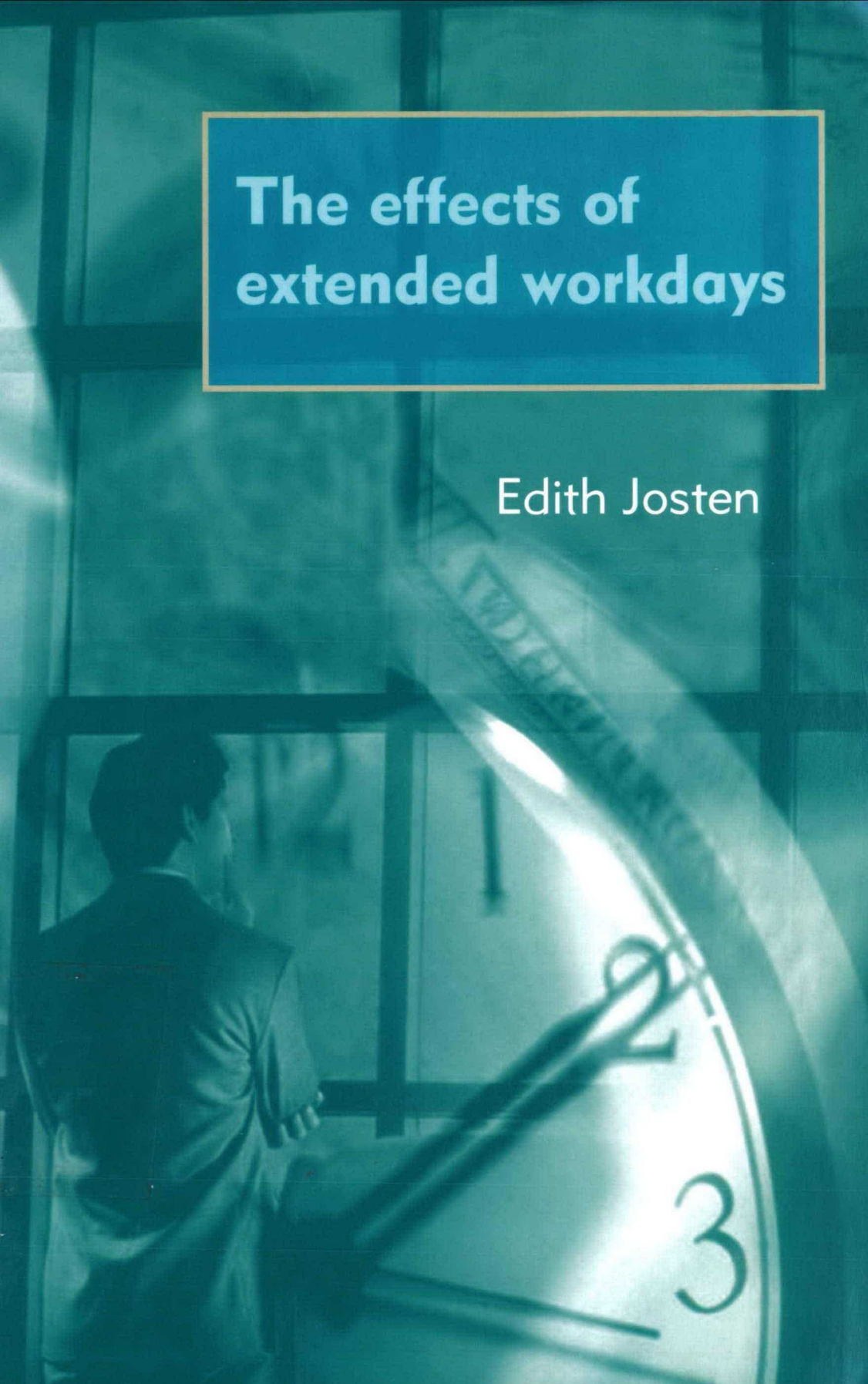

Voor mijn ouders

The effects of extended workdays

Proefschrift

ter verkrijging van de graad van doctor aan
de Katholieke Universiteit Brabant op gezag van
de rector magnificus, prof.dr. F.A. van der Duyn Schouten,
in het openbaar te verdedigen ten overstaan van een door
het college voor promoties aangewezen commissie
in de aula van de Universiteit
op vrijdag 19 april 2002 om 14.15 uur

door

Edith Jeanne Catherine Josten

geboren op 12 januari 1969 te Laren

Promotor: prof.dr. Hk. Thierry
Copromotor: dr. J.E.E. Ng-A-Tham

Contents

Voorwoord

In één van de eerste proefschriften die ik las, werd door de onderzoeker opgemerkt dat hij op een gegeven moment zelf het gedrag was gaan vertonen dat hij bestudeerde. Ook ik heb mij hieraan schuldig gemaakt, zij het slechts gedeeltelijk: de langere werkdagen kwamen wel voor, de combinatie van langere werkdagen met kortere werkweken niet.
De laatste maanden van het schrijven aan mijn proefschrift waren erg zwaar, zwaarder dan ik me had voorgesteld toen ik aan mijn promotie-onderzoek begon. Ondanks dat, en ondanks een aantal tegenslagen waarmee ik, zoals iedere AIO, te maken kreeg, kijk ik toch met plezier op de afgelopen jaren terug. Dat plezier komt ten eerste door het onderwerp van mijn onderzoek dat me nu, na al die jaren, nog steeds boeit. Het plezier heeft ook te maken met de hechte band met mijn toenmalige collega's bij de vakgroep Personeelwetenschappen. Van hen wil ik hier met name Julie, Karen B., Reiny en Renée noemen.

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Na het einde van mijn AIO-schap bleek al snel dat de combinatie van een nieuwe baan en het afronden van een proefschrift teveel was. Mijn toenmalige afdelingshoofd bij SZW, Ferdi Licher, heeft mij toen uitstekend opgevangen. Dank ook aan Gerard, op wie het werk dat ik destijds niet kon doen vervolgens neerkwam.

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over de werktijden van werknemers in Nederland. Koen Böcker, tenslotte, mocht ik lastig vallen met vragen over ANOVAs en het toetsen van interactie-effecten.

Daarnaast wil ik natuurlijk ook de organisaties bedanken die mee hebben gewerkt aan mijn onderzoek. Dank ook aan de werknemers die bereid waren om mijn wel erg omvangrijke vragenlijst in te vullen. Uiteindelijk zijn zij natuurlijk degenen die mijn promotie-onderzoek ook echt mogelijk hebben gemaakt.

Edith Josten

1 Introduction

Eight hours to work, eight hours to play
Eight hours to rest and eight bob a day

If one should ask a passer-by in the street what the regular hours of work per day are, the chances are that one would be told 8 hours. However, had the same question been asked to an industrial worker around the 1850s, the answer would more likely have been 11 or 12 hours per day. And these hours were worked not 5, but 6 days a week. Thus, the 5-day, 8 hours per day working week as we know it has not always been the norm.
Despite the 8-hour workday being the norm today, it is by no means the only workday length being used. This study focuses on workdays that are longer than 8 hours. It addresses the effects these have on employees' fatigue, health, performance, and satisfaction with working hours and free time. The study investigates the effects of one specific form of extended workday, namely that worked under compressed working weeks (CWWs). Under a compressed working week, employees work more than 8 hours per day, but less than five days per week (Tepas, 1985).
In this introductory Chapter, first, the historical developments in the length of the workday are described. The developments are detailed from the 19th century onwards, as that was when the fight for a reduction in working hours began. In the following section, the legal restrictions on the length of the workday in the Netherlands are given. Next, the prevalence of the CWW in the Netherlands is estimated. Subsequently, the reasons employers and employees have for wanting to use a compressed working week are described. The Chapter concludes with an overview of the questions addressed in this study, and a description of the design of the study and the outline of the book.

The maximum length of the workday: A brief sketch of the historical developments

During the Industrial Revolution, many workers became employed in factories and workshops. Often, their working conditions were bad. Furthermore, many of them had to work excessive hours, such as the five to six 11-hour or 12-hour workdays mentioned above.
Around the 1800s/1810s, some progressive factory owners and politicians, and the labour movement, started striving for a reduction in working hours. Often, their ideal was a workday of 8 hours, for both men and women (Karsten, 1989).
The fight for the 8-hour workday began in England. It was soon taken up in the US and Australia. In Australia, a reduction of the workday to 8 hours was achieved first: in 1856, industrial action led to an 8-hour workday for some specific groups of workers (e.g., the stonemasons in Sidney and Melbourne).

The slogan at the top of the previous page probably dates from around this period (Karsten, 1989).

In the Netherlands, the fight for a reduction in working hours began later, in the second half of the 19th century. In 1874, it led to the first act on working hours being passed. This so-called 'kinderwetje van van Houten' (children protection Act) forbade the employment of children under the age of 12, except in household services and farm work on the field. Sixteen years later, the workday of children under the age of 16 and women was restricted to 11 hours. The workday of male workers was not limited by law. That only happened in the first decade of the 1900s, when the workday of a specific group of workers (shiftworkers in mining) was restricted to 8 hours. The most important change, however, took place in the second decade: in 1919, an act was passed that restricted the working hours of both men and women in industry and workshops to 8 hours a day and 45 hours a week (Harmsen, 1991; Karsten, 1989). In 1922, the maximum number of working hours was increased to 8.5 hours a day and 48 hours a week. The reason for this was to improve the international competitive position of Dutch industry (de Lange & Vos, 1997): by having employees work longer hours, more could be produced (Ng-A-Tham, 1999). Some employees had to work even more hours than this, because their employers obtained permission for overtime (Harmsen, 1991). In 1945, the government decided that the maximum of 48 working hours per week should also be the minimum, to aid the post-war reconstruction of the Netherlands (Harmsen, 1991; Ng-A-Tham, 1999).

At the beginning of the 1960s, in many collective agreements, the working week was reduced from six to five days. As the hours per week were often only reduced from 48 to 45, this meant that the workday was lengthened (Raaijmakers, 1997; Winkler Prins, 1962). In the following years, the working hours were gradually reduced further. In the second half of the 1970s, the average workday was again 8 hours and the average working week was 40 hours (de Galan & van Miltenburg, 1991).

In the 1980s, the high unemployment rates led to an agreement between the trade unions and representatives from the employers on a further reduction in working hours (Wassenaar agreement). The 38-hour working week now became the standard. Often, this meant that the workers still worked five 8-hour days, but had an extra 11 to 13 days off (de Lange, 1989). In the 1990s, the trade unions began striving for a 36-hour working week. In 1996, about one third of the larger collective agreements laid down a working week of 36 hours or less, or had a provision that it was to be implemented within one to two years (Arbeidsinspectie, 1996).

Around 2000, in some sectors, employers wanted employees to work longer hours again, because of shortages on the labour market. The trade unions did not agree to a general lengthening of the work hours, but, in some cases, it was agreed that the working week could be lengthened if the employees had some choice in whether or not to work more hours per week (e.g., collective agreement for the police, 2001, article B6: On 1 July 2001, the normal working week is extended from 36 to 38 hours, unless the employee wants to remain on a 36-hour working week). Other organisations tried to attract more employees by offering them more choice in determining their work hours (e.g., the collective agreement for a financial services organisation (Achmea) 1999, article 12.3.1: From January 2000 on, full-timers may work 34, 35, 37, or 38 hours instead of the normal 36 hours). In the same period, on 1 July 2000, a new Act came into force that gives employees more rights to work longer or shorter hours per week.

A new act on working hours: Changes in the maximum length of the workday

Meanwhile, since the 1980s, employers had been pressing for a liberalisation of the rules on working hours, in order to improve their international competitive position (de Lange & Vos, 1997). This time, they wanted more flexibility in arranging working hours so that they could better adjust to fluctuations in the demands for products and services (Ng-A-Tham, 1999). In 1988, a licence system was introduced that allowed some deviations from the law, in anticipation of the changes that were to come. For instance, organisations could now get permission for a working week of four 9.5-hour days (de Lange & Vos, 1997).

In 1996, a new act on working hours was implemented. This act gives employers and employees more responsibility for the way in which working hours are structured. The act is rather complicated. It has two types of standards: the standards from the standard regulations and the standards from regulations to be adopted subject to consultation. The standards of the regulations to be adopted subject to consultation are somewhat more liberal than the standard regulations. The standards that apply to the length of the workday are given in Table 1. As can be seen, the maximum length of the workday was increased to nine or ten hours. This is shorter than the maximum the employers had pressed for (12 hours), but slightly longer than the maximum the trade unions had wanted (9 hours).

Table 1 Standards that apply to the length of the workday

	Standard regulations	Regulations to be adopted subject to consultation
Maximum number of hours to be worked per shift	9 hours	10 hours
Maximum number of hours to be worked per night shift	8 hours	9 hours
Maximum number of hours to be worked per shift in the case of overtime	11 hours	12 hours
	9 hours in the case of night shifts	10 hours in the case of night shifts
Breaks within shifts	30 min. if shift length > 5.5 hrs 45 min. if shift length > 8 hrs 60 min. if shift length > 10 hrs	30 min. if shift length > 5.5 hrs

Normally, the standard regulations apply. The standards of the regulations to be adopted subject to consultation may only be used in certain situations:

- if there is no collective agreement, the more liberal standards may be used if the works council has agreed to this;
- if there is a collective agreement, the more liberal standards may be used if the trade unions have agreed to this in the collective agreement;
- if there is a collective agreement and there are one or more provisions on breaks within shifts or time off between shifts in the collective agreement, the employer and the works council are entitled to reach an agreement within the more liberal standards on *both* these topics. Likewise, if there is a collective agreement and there are one or more provisions on working hours, work on Sundays, or night shifts, the employer and the works council are entitled to reach an agreement within the more liberal standards on *all three* of these topics. Naturally, if there are any restrictions regarding working hours laid down in the collective agreement, these have to be complied with.

This latter situation is needlessly complicated. Therefore, the Cabinet has put forward a proposal for changing the conditions under which the regulations to be adopted subject to consultation may be used (Kamerstukken II, 2000/2001, 27865, nr. 1).

For some specific sectors and occupations, exceptions to the Working Hours Act are listed in the Working Hours Decree. For example, dredgers and miners may work a 2-shift system consisting of 12-hour shifts, provided that each shift includes a break of at least one hour. Furthermore, non-supervisory personnel who earn more than three times the minimum wage and managers and supervisors who earn more than twice the minimum wage are exempt from the regulations in the Working Hours Act.[1]

Limitations on the length of the workday in the collective agreements

It may be expected that the liberalisation of the standards on the length of the working day should lead to more workers working extended workdays, provided, of course, that not too many collective agreements lay down further restrictions on the length of the workday. In general, however, the collective agreements do leave employers some room for lengthening the workday. A recent study on 170 sectoral collective agreements (Dijk et al., 2001) showed that only 18% restrict the maximum length of the workday to less than 9 hours (see also Table 2). The most frequently used limit is 9 hours. Thus, where the maximum length of the workday has been a subject of negotiation between employers and trade unions, the standard from the standard regulation is the most frequently occurring outcome. The agreements that have no provisions on the length of the workday all have one or more provisions on night work, working hours, and/or work on Sundays. This means that, in the sectors these agreements apply to, the workday can be extended to 10 hours, provided that the works council agrees to this.

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[1] For the first group, the regulations in the Working Hours Act do apply if they work nights or carry out work that involves an element of risk.

Table 2 Percentage of sectoral collective agreements with provisions on the maximum length of the workday

Maximum length of the workday	Percentage of sectoral collective agreements
< 9 hours	18.2%
9 hours	25.3%
> 9 hours and < 10 hours	1.8%
10 hours	7.6%
> 10 hours	1.1%
No provision	45.9%

Adapted from: Dijk et al. (2001)

A maximum workday of less than 9 hours is found, for instance, in sectors in which many employees do heavy physical and/or unhealthy work (e.g., the leather industry, the painting industry) or safety is an important issue (e.g., diving, cabin crew working at KLM). Maximum workdays of 10 hours have, for instance, been agreed to in sectors in which there has been a tradition of long hours and/or there are clear peaks and lows in the demand for products and services (e.g., the hotel and catering industry, recreation).[2]

A special form of extended workdays: The case of the compressed working week

Extended workdays may be used in arrangements such as annualised working hours (under which employees work longer hours during peak periods and shorter hours during slack periods) or the compressed working week (under which employees work more than 8 hours per day, but less than 5 days a week (Tepas, 1985)). Here, our interest lies with the latter type of arrangement. Unfortunately, there are no national statistics on the prevalence of the compressed working week (or any other form of extended workdays). Therefore, the developments in the use of the CWW cannot be traced. However, the changes in the Working Hours Act combined with the advent of the 36-hour working week (which allows a schedule of four 9-hour days) will undoubtedly have increased the use of the CWW.

To get an idea of the *present* use of the compressed working week, we look at the data from three different surveys. First, however, the CWW must be defined more exactly. How much longer than 8 hours must the workday be? And how much less than 5 days must an employee work?

Our definition is that a working week may be considered a compressed working week if:

- the average workday length is 8.5 hours or more, and;
- the number of workdays are 4.5 or less, but at least 2.

The reason for the second condition is that we feel that a CWW should provide employees with extra usable free time (in Dutch, herkenbare vrije tijd). In our

2 Data kindly provided by Robert Knegt, University of Amsterdam.

view, at least an extra half a day off per week is needed to satisfy the criterion of extra usable free time. The reason for the first condition is that we feel that a workday should only be considered extended if it is clearly longer than normal. In our view, a workday of at least 8.5 hours is clearly longer. However, we must concede that a minimum length of 9 hours would have been equally appropriate.

The prevalence of the compressed working week

The three surveys used for estimating the prevalence of the compressed working week are all administered to a sample of the Dutch labour force. Each survey comprised different questions about the hours of work of the respondents.
The first survey, the Dutch Time Use Survey, is administered every five years. The respondents are asked, amongst other things, about their contractual working hours per week. In 1995 only, a question was added concerning the number of contractual workdays worked per week. This allowed the length of the workday to be calculated.
The second survey, conducted by Centerdata, was administered with the specific purpose of measuring the prevalence of the compressed working week. The respondents to this survey were given the definition of the CWW and then asked if they did or did not work according to this type of arrangement. If they did, they were then asked exactly how many days and hours per day they worked. It was stressed that they should give their contractual hours.
The third survey, named 'Werkend Nederland', was administered to measure the working and living conditions of the Dutch labour force. The respondents were asked, amongst other things, for the contractual number of workdays they worked and the contractual number of hours they worked per day.
Although in both the first and the third survey, it is stressed that only the contractual working hours should be given, some respondents still reported their actual working hours. In the first survey, 8% of the respondents with a 5-day working week indicated that they worked 8.5 hours or more per day. In the third survey, this percentage was 3%. Except for some special groups, such as junior doctors, this is not possible.
Therefore, for these two surveys, two estimates of the prevalence of the CWW are presented: a raw, uncorrected one and one that is corrected for the overreporting of longer contractual workdays. For the 5-day workers, the percentage of overreporters can be estimated with some degree of certainty: all 5-day workers who indicated that their contractual work hours were 8.5 or more per day are considered overreporters. We then have to assume that the percentage of overreporters among the 2-day to 4.5-day workers is the same.[3] By using that percentage (see the preceding paragraph for the figures), the number of overreporters among the 2-day to 4.5-day workers can be estimated. This estimate is then subtracted from the number of respondents who said they worked extended workdays.
It should be noted that the three surveys are not completely representative of the Dutch employed labour force. In the Time Use Survey and the Working Netherlands Survey (Zijlstra & Roe, 1999), the higher educated are overrepresented. The respondents in the Centerdata Survey have a somewhat higher average income than the Dutch labour force. It is difficult to say what the effects of the overrepresentation of the higher segments of the labour market will

[3] Of course, we cannot be certain that this assumption is correct.

be. In the first years that CWWs were implemented in the Netherlands, it was mainly among low-skilled industrial workers. Since the middle of the 1990s, CWWs have also become more and more popular among higher educated workers. However, we do not know whether this means that the CWW is now equally to be found among higher and lower educated workers. Because of the overrepresentation of the higher segments of the labour market, the percentages that are calculated should only be regarded as estimates of the prevalence of the CWW.

Table 3 gives the estimates of the prevalence of the CWW in the Netherlands. As can be seen, only a few percent of the Dutch labour force work a compressed working week. In absolute terms, however, it still is quite a large group (2.7% of a labour force of about 6.9 million[4] is about 186.000).
The two surveys conducted in 1998 give a somewhat higher percentage than the survey conducted in 1995. As some large sectors (banking, local and central government) had the working week reduced to 36 hours in 1996 (thereby enabling a four-day, 9 hours per day working week), this probably represents a true increase. In all three surveys, the most frequently used form of the CWW is the four-day, 9 hours per day working week. In the two later surveys, the percentage of employees working according to this arrangement is clearly higher, which is probably also due to an increased number of employees having a 36-hour working week. In 1986, a study among personnel officers (Vermeulen et al., 1987) found that only 0.3% of the workers had a compressed working week, so its popularity has clearly increased since then.

Table 3 Estimated percentage of the Dutch labour force working a CWW[1]

Survey	year	N	% of employees working a CWW	Most frequent form of the CWW
Time Use Survey, SCP[2]	1995	1124	raw: 3.1% corrected: 1.9%	4 days, 9 hrs: 25.7%
Centerdata, Tilburg University	1998	583	2.7%	4 days, 9 hrs: 43.8%
Werkend Nederland, Tilburg University[3]	1998	975	raw: 3.6% corrected: 2.8%	4 days, 9 hrs: 54.3%

1 The self-employed are excluded. Time Use survey: prevalence is only computed for those who worked at least 12 hours per week. Centerdata: no minimum working hours used. Working Netherlands: prevalence is only computed for those who worked more than 8 hours per week.

2 Data kindly provided by Koen Breedveld, SCP.

3 Data kindly provided by Fred Zijlstra, University of Surrey.

4 This is the employed labour force in 2000. Figure from Statline, the Netherlands Central Bureau of Statistics.

Employers' reasons for implementing a compressed working week

Employees can either be required to work a CWW or be given the option to work according to this arrangement. In the first case, mostly a whole department or sometimes even the organisation works a CWW. Compulsory CWWs are found mainly in the industrial sector. In the first years that CWWs were adopted in the Netherlands, this was the most common type of CWW. Voluntary CWWs are mostly found in office work, especially in sectors that have a 34-hour or 36-hour working week (e.g., banking, central government).

Why would employers want to implement a compulsory or voluntary compressed working week? The main reasons may be that:

- it allows for an extension of the operating hours (e.g., Hedges, 1973; Loontechnische Dienst, 1992; Thierry & Jansen, 1996; Thierry & Meijman, 1994), provided that the number of days during which the organisation operates are not reduced. This advantage mostly plays a role in the introduction of compulsory CWWs;
- in the case of 24-hour operations, fewer handovers are needed if the workday is extended from 8 to 12 hours. This may reduce handover problems (e.g., de Lange, 1985). However, as 12-hour shifts are, in general, not allowed in the Netherlands, this advantage will not play much of a role here. Again, this advantage mostly plays a role in the introduction of compulsory CWWs;
- in the case of a 36-hour working week, a four-day, 9 hours per day working week may be easier to monitor for management than a working week of five 8-hour days with 26 extra days off per year in compensation for the surplus of hours worked per week. As these compensation days are a Dutch phenomenon, this advantage is unlikely to play a role in other countries;
- it may make the organisation more attractive to workers and, therefore, make it easier to recruit and retain employees (e.g., Hellriegel, 1972; Lendfers & Nijhuis, 1989; Loontechnische Dienst, 1992; Poor, 1970; Tepas, 1985) (for some employment advertisements in which the option to work a CWW was offered, see, for example, Ministry of Education, de Volkskrant, 3 September 2000; Ministry of Social Affairs, de Volkskrant, 14 November 1998). The idea behind this is that employees will like being given the opportunity to work a CWW;
- it was more or less exchanged in the bargaining process with the trade unions for an extension of the operating hours. In 1999, there was some publicity in the media about the proposals for this exchange (e.g., de Gruijter, 1999). A management representative of an organisation where such an exchange had taken place told us that they would not, of course, had agreed to this if they had not thought that the employees would like having the option to work a CWW. Therefore, in the background, the fourth reason may also play some role in this.

In the earlier literature on the CWW (e.g., Poor, 1970), increases in productivity due to an improved morale were often named as a reason for implementing a CWW. The idea was that employees would like a CWW so much that they would work harder. However, some authors (e.g., Gannon, 1974) have voiced serious doubts about this claim. Of the management representatives in the Netherlands we spoke to, none mentioned increases in productivity as a reason for implementing a CWW.

Employees' reasons for choosing to work a compressed working week

As mentioned before, it is often assumed that employees will like to work a compressed working week. Unfortunately, however, there are no statistics on the percentage of Dutch employees who would choose to work a CWW if allowed to.

For office workers, however, three studies conducted in some specific sectors may give some indications. First (and logically), it seems that the percentage of employees wanting to work a CWW depends on what other options are being offered. In a study on the 36-hour working week in the central government sector (de Lange et al., 1998), it was shown that 17% of the full-timers preferred to work four 9-hour workdays. In this sector, employees can also choose to work the popular '40 hours per week with 26 extra days off in compensation for the surplus of hours worked per week' option. 63% of the full-time employees worked this latter option.

In the banking sector, where this latter option is generally not allowed, it was found that 34% of the full-timers wanted to work four 9-hour workdays. Between banks, the preferences varied from 7% to 61% (Tijdens, 1997). The reason for the large differences between banks is unclear.

In a pension fund that also does not allow the '40 hours with 26 extra days off' option, the percentage of employees preferring a CWW approached that of the bank with the highest score. Data given to us by this organisation indicated that 52% of the full-timers worked, on average, 8.5 hours or more per day. As a survey in this organisation (Josten, 1999) had shown that 99% of the employees were allowed to work the hours per day they wanted, the actual use will be almost equal to the preferences.

Second, the preferences differ for part-timers and full-timers. In the pension fund mentioned above, of the part-timers, 23% worked, on average, 8.5 hours or more per day.

The question, then, is why employees want to work a compressed working week. In the literature, the following main reasons are given:

- less commuting to and from work. This reduces both the total commuting time and travelling costs (e.g., Colligan & Tepas, 1986; Hedges, 1971, 1973; Hellriegel, 1972; Lendfers & Nijhuis, 1989; Tepas, 1985; Thierry & Jansen, 1996);
- increase in usable leisure time because of the extra day(s) off (e.g., Colligan & Tepas, 1986; Hedges, 1971, 1973; Hellriegel, 1972; Lendfers & Nijhuis, 1989; Steele & Poor, 1970; Tepas, 1985; Thierry & Jansen, 1996; Thierry & Meijman, 1994).

The reasons Dutch employees give for choosing to work a CWW are quite similar to the ones mentioned in the literature (see Table 4). Table 4 is based on a survey we conducted among Dutch full-time employees actually working a CWW. As can be seen, the most frequently given reason was that the employee wanted more time for him/herself. A recent study on preferences regarding working hours in general also found that employees want to have more time for themselves (MuConsult, 2001).

Table 4 The five reasons for choosing to work a CWW most frequently named by Dutch office workers. Respondents were allowed to name more than one reason.
N(organisations) = 4, N(respondents) = 152.

Reason	Percentage agreeing
More time for hobbies, sport, recreation	52.6%
Long weekend	27.6%
More time for child(ren)	all respondents: 23.0% respondents with child(ren): 51.5%
Less commuting to and from work	21.7%
More time for partner	all respondents: 20.4% respondents with partner: 26.7%

Note: types of CWWs worked:
- 4 days, 9 hrs: 69.3%
- wk. 1-3: 4 days, 9 hrs,
  wk. 4: 4 days, 9 hrs + 1 day, 8 hrs: 12.4%
- wk. 1: 4 days, 9 hrs,
  wk. 2: 4 days, 9 hrs + 1 day, 8 hrs: 11.1%
- other (all with 9-hour days): 7.2%

The present study

As we have seen before, although the percentage of employees working a CWW in the Netherlands is rather small, in absolute terms, it is a rather frequently used working time arrangement. Furthermore, its prevalence may increase even more if the percentage of workers preferring it may be extrapolated from the bank and government workers to other groups of workers.
It is, therefore, important to know more about the effects of the compressed working week. Compressed working weeks may have effects at three different levels, i.e., at the individual level (e.g., on workers' levels of fatigue), at the organisational level (e.g., on organisational performance, for instance, on the number of goods produced, the services provided to clients, and contactability), and at the societal level (e.g., on traffic congestion).
Here, we are interested in the effects at the individual level. The main effects to be expected at this level are that 1. the extended workdays may increase the levels of fatigue and, consequently, affect health and performance, and 2. the extra day(s) off may have an influence on time use and satisfaction with working hours and free time.
As the effects of CWWs on Dutch employees' time use behaviour have already been extensively investigated elsewhere (Raaijmakers, 1997), we will concentrate on the effects on fatigue, health, performance, and satisfaction. The study on time use behaviour was conducted among employees working a compulsory CWW. It showed that there were hardly any differences between employees working a CWW and employees working five 8-hour days. The first only spent more time on household duties.
In the Netherlands, little research has been done on the effects of the compressed working week on fatigue, health, performance, and satisfaction (or on any other

aspect of employees' well-being). Furthermore, many of the studies that have been conducted are confidential. This makes it difficult to determine whether the liberalisation of the standards on the length of the working day was, from the viewpoint of employee health, a wise thing.
In other countries, most research has either focused on 10-hour workdays worked during daytime (the 1970s) or 12-hour shifts covering both day and night (in general, from the late 1980s on, in nursing from the 1970s on). Thus, the 9-hour workdays that are the most common form of the CWW in the Netherlands have also been very infrequently investigated in other countries. Therefore, our study will focus on CWWs with 9-hour workdays. It will mostly investigate the four-day, 9 hours per day arrangement.
Furthermore, this study also aims at filling two further gaps in our knowledge about the compressed working week. First, it may well be that the effects of a CWW depend on the situation in which it is used. For example, Thierry and Jansen (1996) expect that some jobs may be well suitable for workdays up to 11 or 12 hours, while, for others, even 8 hours may be too long. However, hardly any study has addressed the impact of type of work or other potential moderators such as age or voluntary vs. compulsory CWW.
Second, the effects of a CWW on fatigue and performance may sometimes be quite subtle, because employees can adapt to the extended workdays by changing their work strategies. For example, a study by Duchon and co-workers (1994, 1997) showed that the fatigue and performance of mineworkers was not much affected by working 12-hour shifts. However, there were some indications that the mineworkers paced their work, which may have prevented more serious effects on fatigue.
Therefore, our study will also investigate the impact of some important potential moderators and the effects on employees' work strategies. Thus, our research questions are:

- What are the effects of 9-hour workdays on employees' fatigue, health, performance, and satisfaction with working hours and free time?
- Which factors moderate the effects of 9-hour workdays?
- Do employees use other work strategies when they have 9-hour workdays?

The design of the study

Because of the potentially moderating impact of the type of work, the effects of 9-hour workdays were studied separately in three types of jobs: office jobs, nursing, and industrial jobs. In this way, we could test whether the effects indeed differed per type of work.
Originally, we had planned to conduct at least one longitudinal study (with a pre-test and post-test) among the office workers. We wanted a pre-test for the office workers because most of them could choose to work a CWW. If there is choice there may be a process of self-selection. Those who expect that the extended workdays will be too fatiguing for them will probably remain on 8-hour workdays. Furthermore, those who have decided to work extended workdays but find them too fatiguing may return to 8-hour workdays. Thus, if there is a choice, the employees working 9-hour workdays may be a select group, for instance, in terms of health. With a pre-test, we could have checked whether this is indeed the case. For the nurses and industrial workers, we considered a pre-test less essential, as they worked compulsory CWWs and so there could not be a process of self-selection in these groups.

However, when the organisation that had agreed to participate in the longitudinal study pulled out at the last moment, there was not enough time left to find a replacement and conduct both a pre-test and post-test. Therefore, a post-test with a comparison group design was used for all three types of jobs.

Table 5 Characteristics of our study per type of job

	Office work	Nursing	Industrial work
Nr. of organisations	5	3	1
Voluntary or compulsory CWW?	4 org.: voluntary 1 org.: compulsory	1 org.: compulsory 1 org.: some choice 1 org.: not applicable (only 8-hr workers)	compulsory
Type of CWW	voluntary CWW: 3 org.: 4 days, 9 hrs 1 org.: - 4 days, 9 hrs; - 4 days, 9 hrs + one 8-hr day every 4 weeks - 4 days, 9 hrs + one 8-hr day every 2 weeks compulsory CWW: 1 org.: 4 days, 9 hrs + one 4-hr day every 4 weeks	9-hr shifts, nr. of consecutive shifts may vary from 1 to 6	4 days, 9 hrs
Nightwork?	no	yes	no
type of employees	full-timers only	part-timers and full-timers	full-timers only
Comparison group from same organisation?	voluntary CWW: yes compulsory CWW: no	no	yes
Type of arrangement CWW is compared with	8-hour workdays	8-hour shifts	2-shift system (morning & afternoon shift) morning shift: 8 hrs afternoon shift: 7:45 hrs

The study was conducted in nine organisations (see Table 5). Whenever it was possible, the comparison group came from the same organisation as the 9-hour group. In general, the comparison group always did the same work as the 9-hour group. By using comparison groups that differed as little as possible from the 9-hour groups in respect of work and organisational characteristics, possible

difference in the effect variables can be attributed with more certainty to the difference in working time arrangement.
The office workers and the industrial workers in our sample did not work nights. The majority of the nurses did. It has been hypothesised (e.g., Baker et al., 1994; Wallace et al., 1990) that, in the case of nightwork, CWWs (with 12-hour shifts) may be better for employees' health, because extended shifts substantially reduce the number of nights to be worked. Therefore, circadian disruption may be less. Thus, nightwork may confound the effects of CWWs.
However, in our study, this confounding effect will be limited because 9-hour shifts only decrease the number of nights to be worked by 11.1% in the case of a 36-hour working week. With 12-hour shifts, the decrease would be 33.3%. In this case, there may even be no decrease at all, because the number of night shifts to be worked and the number of employees available for it on any given day would remain the same.[5]

Outline

The study is organised as follows. In Chapter 2, the effects of 9-hour workdays on the fatigue, health, performance, and satisfaction of office workers are described. Chapter 3 deals with the effects of 9-hour shifts in nursing. In Chapter 4, the effects on industrial workers are presented. Chapter 5 deals with the factors that may moderate the effects of 9-hour workdays on office workers and nurses. For our sample of industrial workers, the effects of the potential moderators could not be tested, because the sample size was too small. In Chapter 6, differences in work strategies between workers working 8-hour and 9-hour workdays are described. Again, this was only investigated for the office workers and the nurses. Chapter 7 comprises the conclusion and discussion.

[5] With a 12-hour shift system, the number of employees available for the night shift on any given day will nearly always increase, because there is no late shift to be staffed any more.

2 The effects of extended workdays on fatigue, health, and performance in office jobs

Abstract

Compressed working weeks (CWWs) may be expected to have few negative consequences for fatigue and performance in office jobs, as office work is not very physically demanding. However, only a small number of studies have addressed the effects of compressed working weeks in this type of work. Most of these studies investigated the effects of 9-hour or 9.5-hour days that employees had chosen to work. In general, this type of arrangement was found to have no or a few negative effects on fatigue and performance. Health was not affected. Satisfaction with working hours and free time remained the same or improved. However, the number of studies is too small to provide a reliable picture of the effects of 9-hour or 9.5-hour workdays in office work. Therefore, a study was conducted among office workers from four organisations who worked a four-day, 9 hours per day working week. In general, the effects found were identical to those demonstrated in the previous studies. Thus, the office workers' low physical workload seems to make 9-hour workdays, indeed, not too demanding. As the employees could choose the length of their workday, self-selection, however, may also have played a role. Nevertheless, a small percentage of the employees (21%) did find the 4-day, 9 hours per day working week problematic. It is unclear why the effects were different for them; they did not score differently on any of the often-mentioned risk factors (age, small children at home, work pace/workload).

Introduction

In many countries, the standard working week consists of five 8-hour days. However, there are many alternatives to this arrangement. One alternative is the compressed working week (CWW). Under the compressed working week, employees work more than 8 hours per day, but less than five days a week (Tepas, 1985).

The main advantage of the compressed working week for employees is the extra day(s) off it provides (e.g., Colligan & Tepas, 1986). In one of the first publications on this type of working time arrangement, it was, therefore, hailed as 'a revolution in work and leisure' (Poor, 1970). Its main disadvantage is the higher fatigue the longer workdays may lead to. This, in turn, may have negative consequences for health and performance (e.g., Colligan & Tepas, 1986). However, it is sometimes assumed that productivity will increase under a CWW (e.g., Steele & Poor, 1970). The idea is that the higher levels of satisfaction provided by the CWW would lead employees to work harder. In view of the weak relation between satisfaction and performance (e.g., Thierry, 1992) it is, however, questionable whether this effect will really be found. Furthermore, it

has been suggested that night work may have less adverse effects on employee health when combined with CWWs consisting of 12-hour shifts (e.g., Baker et al., 1994; Wallace et al., 1990). As 12-hour shifts substantially reduce the number of nights to be worked, circadian disruption may be less.

Research on the actual effects of the compressed working week started in the early 1970s, when there was a sudden surge of interest in this arrangement. In nursing, studies mainly addressed 12-hour day and night shifts, while, in other sectors, 9-hour or 10-hour days were mostly investigated. In the second half of the 1980s, 12-hour shifts were also more and more studied in non-nursing occupations, such as in industrial work and among police and fire officers. Most research on the CWW until now has concentrated on the effects of CWWs in industrial work and nursing.

Reviews of studies on the CWW (e.g., Baltes et al., 1999; Ronen & Primps, 1981; L. Smith et al., 1998; Thierry & Jansen, 1996; Thierry & Meijman, 1994) have shown that satisfaction with working hours and free time generally improves under a CWW. Thus, the extra day(s) off seem to be valued by employees. With regard to fatigue, health, and performance, it is concluded that the effects are mixed. Positive, negative and neutral effects have been found.

The reason for the mixed findings may be that the effects of a CWW depend on the situation in which it is used. For example, it has been suggested that a CWW may be more demanding if the physical workload is high (e.g., Knauth, 1993, 1996; Kogi, 1991; Meijman, 1992), the workpace is fast (e.g., Meijman, 1992), the employees are older (e.g., Meijman, 1992), or the employees have childcare duties (e.g., Meijman, 1992). Therefore, restricting a review to studies on CWWs in the same type of work may produce less equivocal results, as the impact of one of these potential moderators (physical workload) is then excluded.

This study, therefore, addressed the effects of the CWW in one specific group of workers, office workers. Office workers were chosen because they are nowadays one of the largest groups of workers, and so far, little attention has been given to CWWs in this group. The study focused on the effects on fatigue, health, performance, and satisfaction with working hours and free time. First, previous studies on CWWs in office work are reviewed. Then, the results of an empirical study we conducted are described. Our prior expectation was that CWWs would not have many negative effects on fatigue, health, and performance in office work, as the physical workload in this type of work is relatively low. Of course, the mental workload in office work may be higher than in other types of work, which could, in principle, have a negative impact on the effects of extended workdays. However, we suspected that the positive impact of the low physical workload would be stronger.

In discussing the effects on fatigue, health, and performance, we use the effort-recovery model as our framework (Meijman, 1989; Meijman & Mulder, 1998). This model explains how workers deal with the demands made on them by the work situation. Its basic assumption is that a worker will always actively seek a balance between work demands and his own capacity. If a worker's capacity has become too low due to fatigue, then the balance is disrupted. One of the things he can do in this case is increase his capacity by expending compensatory effort. In this way, performance can be maintained, but the expenditure of extra effort may increase fatigue levels even more. However, if the worker has some decision latitude in his work, he can also decide to use a less strenuous work strategy (e.g., work more slowly). This may prevent him from becoming more fatigued, but it may have negative effects on performance.

According to Hockey (1997), in general, employees will first try to protect their performance on their main task(s) if there is a discrepancy between work demands and capacity. Rather than let their main task(s) suffer, they will expend extra effort or perform less well on subsidiary tasks or subsidiary parts of tasks if they become more fatigued. Unfortunately, of the studies in our review, only the one by Goodale & Aagaard (1975) brought up the issue of effort. They mentioned briefly that employees reported "increased effort being required to perform their work" (p. 35).
The effort-recovery model also states that a higher level of fatigue at the end of the work period or workday can, eventually, have negative effects on health if there is insufficient time for recovery between work periods. If the employee has not fully recovered before he starts working again, he will have to expend extra effort to maintain performance, which, in turn, will lead to an even higher level of fatigue. This way, there may be an accumulation of fatigue, which may, eventually, affect an employee's health.
Tables 1 and 2 give the results of the studies in our review. Studies were included in our review if they met the following criteria:

- the data had to be reported fully and clearly;
- the studies had to have a sound design, i.e., a pre-test / post-test design, or an experimental group / comparison group design. Retrospective measurements (e.g., "Do you find the extended shift more, less, or equally fatiguing?") were also considered sound enough;
- in the case of a pre-test / post-test design and an experimental group / comparison group design, tests for significance must have been conducted.

The study reported in Latack and Foster (1985) and Foster et al. (1979), which is included in most reviews of the CWW, was not selected, because no tests for significance were performed on the only aspect (absenteeism) that was relevant for this review. The studies on CWWs with and without nights are presented separately, because the reduction in the number of nights to be worked that the first schedule leads to, may confound the effects of the longer workday.
As shown in Table 1, most studies were conducted in the Netherlands. The overrepresentation of Dutch studies does not necessarily mean that CWWs among office workers are more common in the Netherlands than in other countries. All the Dutch studies concern internal (confidential) reports. These are hard to trace by us in other countries.
In the article by Williamson et al. (1994) it is not mentioned whether the meal break is included in the shift length that is reported. Therefore, for this study, it is uncertain what the exact shift length (i.e., without meal break) is.

Table 1 The results of studies on the CWW in office work

Study	Type of CWW	Employee choice in workday length	Design & N of respondents	Time since implementation
Without nights:				
ATOS (1998)	4 days, 9 hrs	yes	pre-test & post-test with comp. group N(exp): before impl.: 131 after impl.: 101 N(com): before impl.: 41 after impl.: 27 retrosp. measurements for rating managers N(exp): 15	6 months
De Feijter & Ng-A-Tham (1992)	wk. 1: 4 days, 9 hrs wk. 2: 4 days, 9 hrs + 1 day, 8 hrs	yes	pre-test & post-test N(exp): 42	6 months
Goodale & Aagaard (1975)	4 days, 8¾ hrs	no data	retrospective measurements N(exp): 474	1 year
Jansen & van den Brink (1991)	wk. 1: 4 days, 9 hrs wk. 2: 4 days, 9 hrs + 1 day, 8 hrs	yes	post-test with comp. group, retrosp. measur. for fatigue N(exp): 267 N(com): 116	6 months
Van Limborgh (1995)	4 days, 9 hrs	yes	pre-test & post-test with comp. group N(exp): 48 N(com): 46	5 months
With nights:				
Williamson et al. (1994)	3-4 days, 12 hrs	no data, probably not	pre-test & post-test, no comp. group N(exp): 75	1 year

Legend: – = negative effects; 0 = no effects; + = positive effects

Table 1 (Continued)

Type of work	Effects on fatigue	Effects on health	Effects on performance	Effects on satisf. work. hrs & free time
employees social security agency	0	no data	production data (quantity): 0 ratings managers (quantity): – self ratings (quantity & quality): [1] 0	work. hrs: 0 free time: 0
employees large government authority	0	0	ratings managers: quantity[2] & quality: 0	comb. work & private life: 0
employees accounting division	–	no usable data	self-ratings: quantity: 0 quality: no usable data	work hrs. & free time: +
employees large government authority	– / 0	no data	self ratings: quantity[2] & quality: 0	work. hrs: [1] 0 / + free time: [1] +
employees insurance company	– / 0	no data	no data	work. hrs: + free time: 0
computer operators	+	health: + absenteeism: –	productivity data (quality) 0	no data

[1] It is not clear from the report on this study whether tests for significance were performed on this aspect. For completeness, these data are mentioned nonetheless.

[2] On average, quantity of performance was not affected. However, about 20% of the respondents thought it had improved, while another 20% thought it had deteriorated.

In general, CWWs with 9-hour days in office work were found to have no or some negative effects on fatigue. Performance was less often affected, which seems to provide some support for the notion of performance protection. If performance was affected, it was the quantity of the work that had suffered. Employees' health had not deteriorated, which may indicate that fatigue had not accumulated too much. Satisfaction with working hours and free time was not affected or positively affected. This is in line with the findings of reviews on the CWW in all types of sectors.
The overall picture (see Table 2) is, thus, fairly positive (no effects on health, no or some effects on fatigue). This may indicate that the low physical workload in office work makes this type of work indeed suitable for extending workdays (up to 9 hours). However, the fairly positive effects may also have been due to the fact that, in most studies, employees could choose the length of their workday. Furthermore, the number of studies is quite small, especially the number of studies that investigate the effects on employee health. Therefore, it is too early yet to draw a definite conclusion about the effects of 9-hour days in office work.

Employee choice may have a positive impact on the effects of extended workdays because there will probably be a process of self-selection if employees can choose the length of their workday. First, employees who expect extended workdays to be too fatiguing will probably continue to work 8-hour days. Second, employees who have chosen to work extended workdays, but find these too fatiguing, may return to 8-hour days. This will lead to an underestimation of the negative effects of extended workdays and an overestimation of their positive effects.
Atos (1998) also concluded that employee choice may lead to self-selection. Their study showed that workers who had decided to remain on 8-hour days tended to score higher on fatigue in the pre-test than did the future 9-hour workers.

Table 2 Overall results of studies on CWWs in office work

	Fatigue	Health	Performance	Satisfaction working hrs	Satisfaction free time
Without nights	−: 3x	0: 1x	−: 1x		
	0: 2x		0: 3x	0: 2x	0: 3x
				+: 2x	+: 2x
With nights					
			0: 1x		
	+: 1x				
		X: 1x			

Legend: − = negative effects; 0 = no effects; + = positive effects
Note: The aspect 'combination work & private life' in the study by de Feijter & Ng-A-Tham (1992) was categorised as satisfaction with free time

The only study on 12-hour days and nights found more positive effects on fatigue and health. This seems to confirm that the reduction in the number of nights to be worked is indeed beneficial to employees' health. However, again, more research is needed to provide a reliable picture of the effects.

The small number of studies and the little variation in shift length within CWWs with and without nights made it impossible to test whether different shift lengths produce different results (e.g., higher levels of fatigue when the shift length is longer). Although this would seem to be one of the main questions to be investigated in research on extended workdays, it has hardly ever been addressed. The two studies that did investigate this issue reported more complaints in employees working the longer shifts (deCarufel & Schaan, 1990 (9-hour vs.12-hour shifts in policing); Kogi et al., 1990 (12-hour vs. 16-hour night shifts in nursing)).
Due to the small number of studies, it could also not be tested whether the effects of the CWW change over time. Positive changes may be expected if employees need some time to get used to working extended workdays. Negative changes may occur if there is an accumulation of fatigue or if the novelty of the change has worn off after some time. Little research has addressed the effects of time since implementation and the results have been mixed. In a study on 10-hour workdays among industrial workers, the initial positive effects shown at 13 months had disappeared 12 months later (Ivancevich & Lyon, 1977). However, a meta-analysis of extended workdays worked during daytime found that time since implementation did not moderate the effects of extended days (Baltes et al., 1999). Still, if one wants to test the longer lasting effects of a CWW, it is probably safest to conduct the study at least one year after implementation, because the effects will probably have stabilised by then.

The present study

To recapitulate briefly, 9-hour days were found to have no or some negative effects on fatigue in office work. Performance was mostly not negatively affected. There was no deterioration in employee health. Furthermore, satisfaction with working hours and free time increased or remained the same.
However, there were too few studies to provide a reliable picture of the effects of 9-hour days in office work. Therefore, we conducted a study on this type of arrangement in office work. The respondents to this study could choose the length of their workday. This means that there may be an effect of self-selection in the study. However, as most office workers in the Netherlands who work 9-hour workdays have chosen to do so, it was practically impossible for us to exclude this effect.
On the basis of the results of previous studies, the following hypotheses were formulated:

- fatigue will be higher on 9-hour days than on 8-hour days;
- health will not be affected;
- performance will not be affected;
- satisfaction with working hours and free time will be greater on 9-hour days than on 8-hour days.

The finding in previous studies that performance was less often affected than fatigue suggests that employees try to protect performance by expending more effort. This study also aimed at finding out whether that is indeed the case.

Therefore, the following hypothesis was formulated:

- more effort will be expended by those working 9-hour days than by those working 8-hour days.

Method

The study was conducted in four organisations (a bank, a municipality, a large government authority, and a pension fund) that use 9-hour workdays (see Table 3). In all four organisations, the employees could choose whether they wanted to work 8 or 9 hours a day. The employees who had chosen to remain on 8-hour days formed the comparison group. The meal break was not included in the length of the workday.

In the bank, the large governmental authority, and the pension fund, the employees in the comparison group had the same jobs as the employees in the 9-hour group. In these organisations, the 8-hour and the 9-hour group were, therefore, matched with regard to job content. In the municipality, both the 8-hour and the 9-hour group consisted of employees with various types of jobs (e.g., clerical worker, policy adviser). Therefore, these groups were not matched with regard to job content. However, there were no large differences between the two groups in the average educational level required for the jobs.

The 9-hour workdays had been implemented 15 to 25 months before the study was held. The average experience with the 9-hour workdays was 17 months.

The data were collected by means of a questionnaire. Follow-up telephone interviews were conducted with a sub-sample of the respondents, but the results of these are not discussed in detail here.

A total of 210 employees participated in the study. The response rate differed widely between organisations (see Table 3). The low response rate in the pension fund was probably due to the fact that, in this organisation, employees had been explicitly told they could only fill in part of the questionnaire during working time.

Table 3 Organisations, type of jobs, and response rate

Organisation	Type of work	Response rate[1]	N(9-hr)	N(8-hr)
bank	- document checking - IT specialists	42.6%	43	22
municipality	- various jobs	60.3%	32	36
large government authority	- policy advisers	35.6%	18	14
pension fund	- pension administration - financial administration - IT specialists	17.2%	35	10
total		34.0%	128	82

[1] The response rate is based on all respondents who filled in the questionnaire. Some of the respondents were not included in the analyses reported here because of their deviating working time pattern. N(9-hr) and N(8-hr) refer to the number of respondents that were actually used in this study.

All the respondents worked full-time. In the bank, the municipality, and the large government authority, the full-time working week was 36 hours. The 9-hour respondents in these organisations all worked four 9-hour days (see Table 4). In the pension fund, employees could choose whether they wanted to work 36, 37, 38, 39, or 40 hours a week. The respondents who worked 39 hours or more are not included in this study, because the 9-hour workers in this group mostly had a 44-hour working week every two weeks (week 1: 4 days, 9 hrs; week 2: 4 days, 9 hrs plus 1 day, 8 hrs). This may be considered much more demanding than working four 9-hour days (36-hour working week) or working four 9-hour days plus one 8-hour day every four weeks (38-hour working week).
In the municipality and the large government authority, the employees could also choose to work five 8-hour days and have 26 extra holidays in compensation. This offered them maximum flexibility in choosing when they would have a day off. In the large government authority, two of the possible working time patterns were not used by the respondents in our sample, which is why these are put in brackets.
In the municipality, employees had to get permission from the company doctor, before they were allowed to work a compressed working week. Permission was not given if the employee had severe health problems (e.g., heart problems).
In all four organisations, the employees could choose when they were free, although they mostly had to consult with their supervisor or manager first. The most popular day off among the 9-hour respondents was Friday (44%), followed by Wednesday (24%).
With the exception of some respondents in the bank, all the respondents only worked during daytime. These respondents from the bank (IT-specialists) were at home but on call seven consecutive nights every four or six weeks.

Table 4 Working time patterns and actual workday length

	Official working time pattern		Actual hrs worked per day	
	9-hr. gr.	8-hr gr.	9-hr gr.	8-hr gr.
Bank	1	3, 4	9.0 hrs	8.1 hrs
Municipality	1	3, 4, 5	9.5 hrs	8.6 hrs
Large government authority	1	(3, 4,) 5	9.2 hrs	8.0 hrs
Pension fund	1, 2	3, 4, 6	9.1 hrs	8.0 hrs

Legend:

9 hour days:

36 hr working week:
1 = 4 days, 9 hrs

38 hr working week:
2 = wk. 1-3: 4 days, 9 hrs
wk. 4: 4 days, 9 hrs + 1 day, 8 hrs

8 hour days:

36 hr working week:
3 = wk. 1: 5 days, 8 hrs / wk. 2: 4 days, 8 hrs
4 = 4 days, 8 hrs + 1 day, 4 hrs
5 = 5 days, 8 hrs with 26 extra days off

38 hr working week:
6 = wk. 1-3: 5 days, 8 hrs / wk. 4: 4 days, 8 hrs

Actual working hours were measured to check if the 8-hour and the 9-hour group indeed differed in the number of hours worked per day. Actual working hours were measured by having employees record their time use for one week. Table 4 shows that the two groups did differ on this aspect. In all four organisations, the average actual workday equalled or exceeded the hours the employees had to work. The number of actual hours worked per day was highest in the municipality.

Table 5 gives some biographical and work-related details pertaining to the 8-hour and 9-hour group. The majority of the respondents were male. There were no significant differences between the two groups on the biographical and work-related variables.

Measures

The questionnaire comprised the following measures:

- Fatigue

Fatigue was measured using two scales. The first scale was a checklist (Meijman, 1991) which measured the level of fatigue at the beginning and the end of the workday. The checklist was filled in for each workday during a one-week period. The scale consisted of nineteen 5-point items (e.g., Mentally fresh - mentally tired). Cronbach's alpha was .95 (calculated for both the begin and the end of the first workday).

The second scale, need for recuperation, measured the extent to which the fatigue built up during the workday spilt over into the free hours and free days after work. The scale consisted of eleven 2-point items (e.g., I have difficulties concentrating in my free hours after work) (van Veldhoven, 1996). Cronbach's alpha was .84.

- Health complaints

Health complaints were measured using an eleven 2-point item scale (e.g., Is your stomach often upset?) (Dirken, 1967). Cronbach's alpha was .75.

- Performance

Performance was measured using self-ratings which were filled in for each workday during a one-week period. The performance measures were newly constructed. The respondents had to rate their performance as a percentage of the best performance they had ever produced in the same job. We asked separate ratings for quantity and quality. Quantity was operationalised as the amount of work done *per hour* to make the comparison between 8-hour and 9-hour days a fair one.

The advantage of self-ratings is that the employee himself/herself will usually be the one who is best informed about his or her performance. The disadvantage, however, is that the ratings may be too lenient (Murphy & Cleveland, 1991). If there are indications of a leniency effect, this will be mentioned.

- Effort

Effort was measured using a graphic rating scale (Zijlstra, 1993), which was filled in for each workday during a one-week period. The effort ratings were given by putting a mark on a line.

- Satisfaction with working hours

This was measured using a newly constructed three-item, 5-point Likert scale (e.g., All in all, I am satisfied with the hours that I work). Cronbach's alpha was .84.

Table 5 Biographical and work-related details pertaining to the 8-hour and 9-hour group

	9-hr gr.			8-hr gr.			9-hr gr.		8-hr gr.	
	Age						*% of females*			
	M	SD	N	M	SD	N	%	N	%	N
Bank	37.8	7.2	43	38.7	8.7	22	14.0%	43	9.1%	22
Municipality	39.9	9.2	32	41.3	10.0	36	28.1%	32	36.1%	36
Large government authority	43.3	9.6	18	41.6	6.6	14	22.2%	18	0.0%	14
Pension fund	37.0	7.8	35	37.4	8.1	10	34.3%	35	50.0%	10
Total	38.9	8.4	128	40.2	9.0	82	24.2%	128	24.4%	82
	total group: $t = 1.03$, $p = .303$						total group: $Chi^2 = 0.00$, $p = .977$			
	% with children < 12 yrs living at home									
	%		N	%		N				
Bank	34.9%		43	27.3%		22				
Municipality	25.0%		32	13.9%		36				
Large government authority	16.7%		18	21.4%		14				
Pension fund	31.4%		35	20.0%		10				
Total	28.9%		128	19.5%		82				
	total group: $Chi^2 = 2.34$, $p = .126$									
	Decision latitude (1 = low, 5 = high)						*Work pace/workload (1 = low, 4 = high)*			
	M	SD	N	M	SD	N	M	SD	N	M	SD	N
Bank	3.2	0.5	42	3.2	0.5	22	2.2	0.4	43	2.2	0.4	22
Municipality	3.8	0.5	32	3.7	0.8	36	2.5	0.4	32	2.5	0.6	36
Large government authority	3.5	0.5	18	3.5	0.4	14	2.4	0.4	18	2.5	0.4	14
Pension fund	3.6	0.6	35	3.3	0.9	10	2.6	0.4	35	2.5	0.4	10
Total	3.5	0.6	127	3.5	0.7	82	2.4	0.4	128	2.4	0.5	82
	total group: $t = 0.11$, $p = .915$						total group: $t = 0.50$, $p = .619$					

Note: Work pace/workload and decision latitude were measured by self-ratings (work pace/workload: scale by van Veldhoven (1996). 1 = low, 4 = high. α(this study): .89; decision latitude: scale by de Jonge (1995). 1 = low, 5 = high. α(this study): .89).

Satisfaction with free time
This was measured using a newly constructed two-item, 5-point Likert scale (e.g., I am satisfied with the amount of free time I have). Cronbach's alpha was .75.

Analyses

For all respondents, it was first checked if the working week during which the levels of fatigue, performance, and effort were recorded deviated greatly from a normal working week (e.g., because of a three-day conference abroad or a close family member becoming severely ill). This was done by asking the respondent at the end of the questionnaire if anything abnormal had happened during this week. If this was the case, the respondent's data were deleted from the analyses of fatigue, performance, and effort.
Three 8-hour respondents from the pension fund had previously worked 9-hour days. They had returned to 8-hour days because they found working four 9-hour days too fatiguing. These respondents were deleted from all analyses of fatigue, health, and performance. The same applied to the two respondents from the municipality who wanted to work a compressed working week, but were not allowed to because of their ill health.
The 9-hour respondents were only included in the analyses of the aspects recorded during one working week (i.e., fatigue, performance, and effort) if they were free on a Monday or a Friday. If a 9-hour worker is free on a Tuesday, Wednesday, or Thursday, this may give him time to recuperate during the working week, which may contaminate the results (see Chapter 5 for a test of the impact of the location of the free day).
The 'working week' data were analysed using repeated-measures ANOVAs. Box's ε-hat adjustment was used for all within-subjects analyses with more than two levels. The other data were mainly analysed using analyses of variance (ANOVA). In both types of analyses, post hoc analyses of significant interactions incorporated adjustments of the familywise error rate (Bonferroni adjustment). As all post hoc analyses consisted of two follow-up tests, an alpha value of .025 was adopted as the criterion for statistical significance in these analyses. All post hoc analyses consisted of additional analyses of variance or t-tests, at each level of the factor under investigation.

Results

Fatigue and health

Figure 1 shows the levels of fatigue at the beginning and end of the workday. The three-way interaction of time of day, day of week and workday length (8 hrs. vs. 9 hrs) was not significant ($F = 0.44$, $p = .711$). For the total group of respondents, there was a highly significant time of day effect ($F= 34.72$, $p = .000$), meaning that the respondents were more fatigued at the end than at the beginning of the day. Furthermore, there was a significant interaction ($F = 7.56$, $p = .007$) between workday length and time of day. For the 9-hour group, fatigue *increased* more over the day. However, a subsequent test of this interaction revealed that there were no significant differences between the 9-hour and the 8-

hour group in the mean levels of fatigue at the beginning ($F = 0.92$, $p = .340$) and the end of the day ($F = 0.84$, $p = .363$). There was no significant main effect for day ($F = 1.99$, $p = .126$). The interaction from day-effect with workday length, however, was almost significant ($F = 2.74$, $p = .053$). A subsequent test of the interaction showed that there tended to be a day-effect for the 8-hour group ($F = 3.10$, $p = .035$), but not for the 9-hour group ($F = 1.47$, $p = .231$). As can be seen in Figure 1, the 8-hour group's fatigue scores tended to fluctuate over the week, while the fatigue levels of the 9-hour group were quite stable. There was no significant main effect for workday length ($F = 0.00$, $p = .990$).

Figure 1 Levels of fatigue over the working week
0 = low, 57 = high
N(9-hr) = 64, N(8-hr) = 36

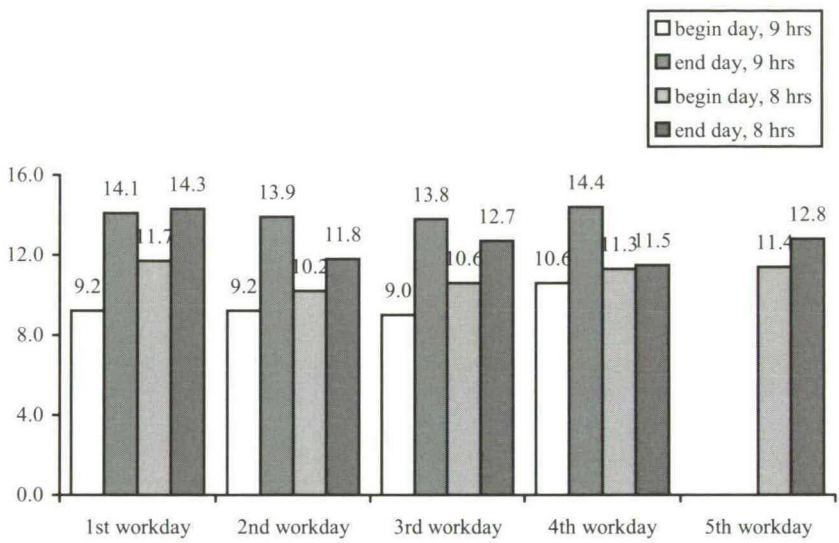


Table 6 gives the mean scores on need for recuperation and health complaints. In the analyses on both aspects, the organisation was included as a random factor. This was to test whether the effects of 9-hour workdays differed per organisation. This could not be tested for the fatigue scores because, for that variable, the number of respondents per organisation was too small.
As shown in the Table, the p-value for the interaction term between organisation and workday length was always .20 or higher. Thus, the effects of 9-hour days on need for recuperation and health complaints did not differ per organisation. It is, therefore, unlikely that they would have differed with regard to fatigue.
The Table also shows that there were no significant differences between the 8-hour and 9-hour groups with regard to need for recuperation and health complaints. Both groups were, on average, quite healthy: the mean number of health complaints was low.

Table 6 Need for recuperation and health complaints

	9-hr gr.			8-hr gr.					
	M	SD	N	M	SD	N		F	p
Need for recuperation (0 = low, 11 = high)									
Bank	2.4	2.9	43	3.0	2.5	22	8 vs. 9 hours (fixed factor)	0.43	.554
Municipality	1.8	2.8	32	1.6	1.8	34	organisation (random factor)	2.07	.283
Large government authority	2.4	2.7	18	4.3	3.6	14	organisation x 8 vs. 9 hrs (interaction)	1.51	.213
Pension fund	2.8	2.7	35	2.0	2.3	7			
Total	2.4	2.8	128	2.5	2.6	77			
Health complaints (0 = low, 11 = high)									
Bank	1.9	2.0	43	2.1	2.0	22	8 vs. 9 hours (fixed factor)	2.31	.202
Municipality	0.9	1.7	32	1.1	1.4	34	organisation (random factor)	4.32	.130
Large government authority	1.1	1.7	18	2.4	2.4	14	organisation x 8 vs. 9 hrs (interaction)	0.80	.496
Pension fund	1.9	2.1	35	2.0	2.4	7			
Total	1.6	1.9	128	1.7	1.9	77			

However, there were some 9-hour respondents for whom the CWW was problematic. When asked about the disadvantages of the CWW, 21% of the respondents indicated that they found this arrangement more fatiguing. This percentage did not differ much between organisations. Only in the bank was the percentage somewhat higher (bank: 30%; municipality: 13%; large government authority: 17%; pension fund: 20%).

A repeated-measures ANOVA with fatigue as dependent variable showed that there was a significant interaction ($F = 6.39$, $p = .014$) between time of day and fatigued vs. not more fatigued 9-hour group. Subsequent tests of the interaction revealed that the more fatigued group did not score higher on fatigue at the beginning of the workday than the other 9-hour workers (see Table 7). However, at the end of the workday they were clearly more fatigued.

The interaction of day of week with fatigued vs. not more fatigued group was also significant ($F = 4.80$, $p = .006$). Subsequent tests of the interaction showed that there was a significant day-effect for the fatigued group ($F = 4.34$, $p = .021$). On the fourth workday, the levels of fatigue (both at the beginning and the end of the day) were clearly higher than on workdays 1-3. Thus, for this group, fatigue built up over a working week of four 9-hour days. There was no significant day-effect for the not-fatigued group ($F = 0.02$, $p = .989$)

The fatigued group also scored significantly higher on need for recuperation and health complaints than the 9-hour workers who did not find the CWW more

fatiguing. It is unclear why the more fatigued 9-hour workers had more problems with working the CWW. They did not score higher on any of the often-mentioned risk factors (age, workpace/work load and childcare duties, see Table 7).

Table 7 The more fatigued 9-hour workers vs. the not more fatigued 9-hour workers

	9-hr gr.: more fatigued			9-hr gr.: not more fatigued				
	M	SD	N	M	SD	N	F	p
Fatigue: beginning of the day	10.9	7.4	16	9.1	6.8	48	0.94	.337
Fatigue: end of the day	18.5	8.7	16	12.6	7.3	48	7.28	.009
							t	p
Health complaints	2.6	2.5	27	1.3	1.7	101	2.70	.011
Need for recuperation	3.9	2.8	27	1.9	2.6	101	3.43	.001
							t	p
Age	38.4	8.6	27	39.0	8.4	101	0.32	.753
Work pace/ workload	2.4	0.4	27	2.4	0.4	101	0.39	.696
	%		N	%		N	Chi^2	p
% with children < 12 yrs living at home	22.2%		27	30.7%		101	0.74	.388

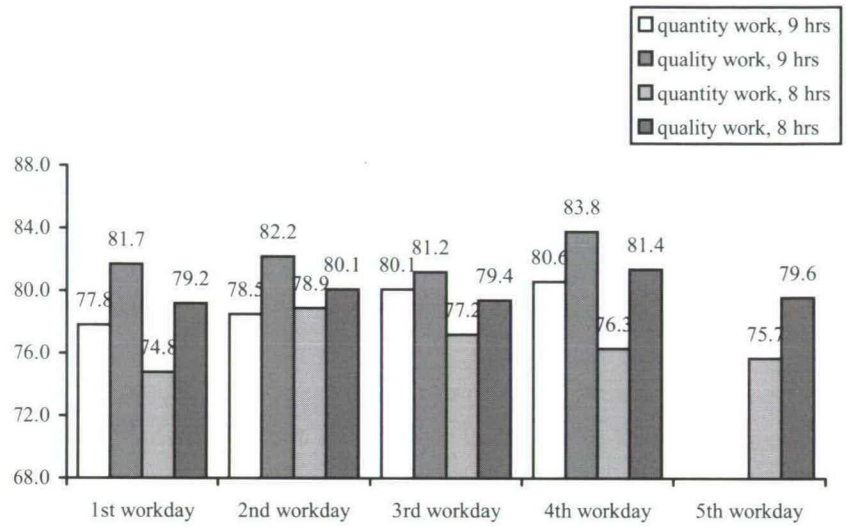
The question, then, is whether the 9-hour group's higher increase in fatigue over the workday would still be found when the more fatigued group is not included in the analyses. The answer to this question is yes. The interaction between working time arrangement and time of day was still significant ($F = 4.25$, $p = .042$) and had the same direction, although it had decreased in size.

Performance

Figure 2 shows the performance self-ratings given by the 8-hour and the 9-hour group. There were no significant differences between the two groups in the mean levels of quantity ($F = 0.89$, $p = .347$) and quality of performance ($F = 0.71$, $p = .402$). There was also no significant main effect of day for the performance variables (quantity: $F = 1.21$, $p = .305$; quality: $F = 1.83$, $p = .151$), nor a significant interaction between day effect and workday length (quantity: $F = 0.88$, $p = .434$; quality: $F = 0.05$, $p = .974$). Thus, performance did not change over the working week for either group.
We also looked at the variability in performance. Variability was measured by calculating separately for each respondent the standard deviation in quantity and quality scores over the first four days of the week. Again, a comparison of the

two groups found no significant results (quantity: M(9-hr) = 7.7, M(8-hr) = 9.1; t = 1.09, p = .277; quality: M(9-hr) = 5.3, M(8-hr) = 6.5; t = 1.12, p = .265).

Figure 2 Quantity and quality of performance over the week
0 = low, 100 = high
N(9-hr) = 65, N(8-hr) = 41



The respondents were also asked to compare their present performance with their performance before the compressed working week was introduced (retrospective measurement, see Table 8). The scores from the municipality are not included in the Table, because there was a major reorganisation there, which, for many employees, resulted in changes in job content at the time the compressed working week was introduced.

As shown in the Table, the extension of the workday to 9 hours had no negative effects on the 9-hour respondents' overall performance. The quality of their performance during the final hour of their workday was also not affected. However, the quantity of the work done during the final hour of the workday did tend to be; it had decreased almost significantly more often for the 9-hour group than for the 8-hour group.

The results of the telephone interviews confirm that the decrease in the amount of work done during the final hour of the workday was due to the longer workdays. We interviewed six 9-hour respondents who had indicated that the quantity of their work during the final hour of the workday had deteriorated. All of them said that this was because of the higher level of fatigue at the end of the day.

Table 8 Effects on performance, retrospectively measured

	9-hr gr.		8-hr gr.		9-hr gr.		8-hr gr.	
	Quantity of work, overall				*Quality of work, overall*			
	-	0 / +	-	0 / +	-	0 / +	-	0 / +
Bank	0.0% (0)	100.0% (30)	0.0% (0)	100.0% (15)	3.4% (1)	96.6% (28)	6.7% (1)	93.3% (14)
Large government authority	0.0% (0)	100.0% (11)	0.0% (0)	100.0% (9)	9.1% (1)	90.9% (10)	11.1% (1)	88.9% (8)
Pension fund	12.5% (3)	87.5% (21)	0.0% (0)	100.0% (6)	8.3% (2)	91.7% (22)	0.0% (0)	100.0% (6)
Total	4.6% (3)	95.4% (62)	0.0% (0)	100.0% (30)	6.3% (4)	93.8% (60)	6.7% (2)	93.3% (28)
	total group: Fish. exact: p = .549				total group: Fish. exact: p = 1.000			
	Quantity of work, final hour workday				*Quality of work, final hour workday*			
	-	0 / +	-	0 / +	-	0 / +	-	0 / +
Bank	33.3% (10)	66.7% (20)	6.7% (1)	93.3% (14)	26.7% (8)	73.3% (22)	0.0% (0)	100.0% (15)
Large government authority	9.1% (1)	90.9% (10)	22.2% (2)	77.8% (7)	0.0% (0)	100.0% (11)	22.2% (2)	77.8% (7)
Pension fund	37.5% (9)	62.5% (15)	16.7% (1)	83.3% (5)	16.7% (4)	83.3% (20)	16.7% (1)	83.3% (5)
Total	30.8% (20)	69.2% (45)	13.3% (4)	86.7% (26)	18.5% (12)	81.5% (53)	10.0% (3)	90.0% (27)
	total group: $Chi^2 = 3.31$, p = .069				total group: Fish. exact: p = .375			

Note: The original categories were "very much deteriorated", "much deteriorated", "a little deteriorated", "not affected", "a little improved", "much improved", and "very much improved". As the number of respondents in some categories was too low, the categories had to be pooled.

Subsequent analyses showed that it was the more fatigued group's quantity of performance that had suffered during the final hour of the workday. If this group was excluded from the analyses, no difference was found between the 8-hour and the 9-hour group on this aspect ($Chi^2 = 0.64$, p = .424). In the more fatigued group, the *quality* of the work done during the final hour of the workday had also suffered quite often (see Table 9). However, most of the respondents from this group did not think that their overall performance had deteriorated. Thus, it seems that they were of the opinion that they managed to make up for the decreased performance during the final hour of the day at other times of the day. If this was really always possible may be doubted.

Table 9 The performance of the more fatigued 9-hour workers

	9-hr gr.: more fatigued		9-hr gr.: not more fatigued			
	-	0 / +	-	0 / +		p
Quantity of work, overall	18.8% (3)	81.3% (13)	0.0% (0)	100.0% (49)	Fish. exact	.013
Quality of work, overall	13.3% (2)	86.7% (13)	4.1% (2)	95.9% (47)	Fish. exact	.232
Quantity of work, final hour workday	62.5% (10)	37.5% (6)	20.4% (10)	79.6% (39)	Fish. exact	.004
Quality of work, final hour workday	50.0% (8)	50.0% (8)	8.2% (4)	91.8% (45)	Fish. exact	.001
	yes	no	yes	no	Chi^2	p
Mean actual workday length < 8:50	52.2% (12)	47.8% (11)	22.5% (20)	77.5% (69)	7.90	.005

The data on the actual number of hours worked per day also indicated that performance had suffered somewhat for the more fatigued group (see Table 9). The proportion of respondents who worked, on average, more than 10 minutes shorter per day than they should have done, was significantly higher for the more fatigued 9-hour group than for the not more fatigued 9-hour group. It was also significantly higher than that of the 8-hour group (8-hour group: 17% worked more than 10 minutes shorter than they should have done; $Chi^2 = 10.82$, $p = .001$). It may be that the more fatigued 9-hour workers tried to prevent fatigue from increasing too much by working somewhat shorter.

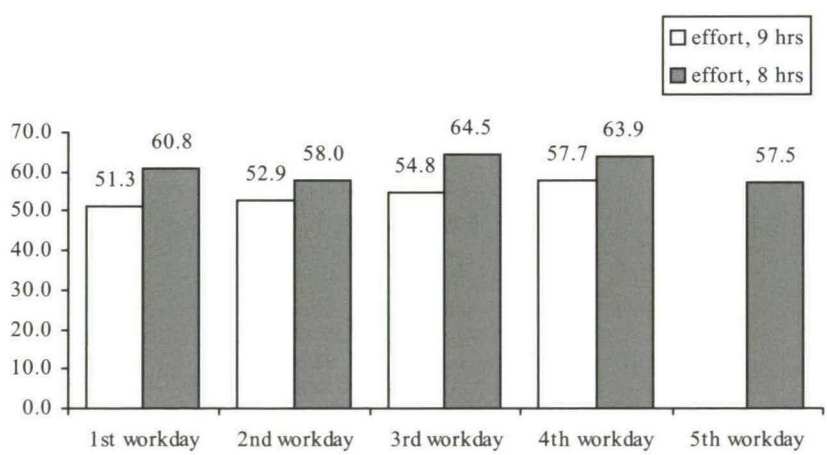
The more fatigued 9-hour group's higher levels of fatigue on the 4th workday (see previous section) did not lead to a lowered performance on that day. A comparison of the more fatigued and the not more fatigued 9-hour group showed that there was no significant interaction between group and day of week (quantity: $F = 0.19$, $p = .894$; quality: $F = 0.39$, $p = .746$). The main effect of day was not significant either (quantity: $F = 0.91$, $p = .431$; quality: $F = 1.18$, $p = .317$). Thus, for both groups, performance remained quite stable over the week.

Effort

Figure 3 shows the amount of effort expended over the week. We had expected that the 9-hour workers would try to prevent fatigue from having an effect on performance by expending more effort. Thus, we had hypothesised that their levels of effort would be higher. However, contrary to our expectations, it was the 8-hour group that tended to score higher on effort ($F = 2.89$, $p = .092$). There was a significant day-effect ($F = 3.42$, $p = .028$) for the total group of respondents, meaning that the levels of effort expended varied over the week.

The interaction between day of week and workday length was not significant (F = 0.65, p = .543).
The finding that the 9-hour group did not expend more effort may be due to the fact that most of them did not have many problems with working 9-hour days. Thus, there was no need for them to protect their performance from the influence of fatigue. However, a comparison of the more fatigued and the not more fatigued 9-hour workers showed that there were no significant differences in effort between these two groups either (F = 0.06, p = .814), although the first did have problems with working 9-hour days. This seems to contradict Hockey's notion of performance protection.
It should be noted, however, that there was an almost significant interaction between day of week and fatigued vs. not more fatigued 9-hour group (F = 2.53, p = .076). Subsequent tests of the interaction showed that there was no day-effect in the not more fatigued group (F = 0.64, p = .541). In the more fatigued group, the day-effect was not significant either (F = 3.08, p = .063), but a trend-analysis showed that there did tend to be a linear increase in the amount of effort expended over the week by this group (interaction linear trend with fatigued vs. not fatigued group: F = 3.99 p = .050; subsequent test interaction for fatigued group: F = 4.87, p = .046; for not-fatigued group: F = 1.01, p = .321). Thus, the more fatigued 9-hour workers did seem to try to protect their performance from the higher levels of fatigue at the end of the week.

Figure 3 Levels of effort expended over the week
0 = low, 150 = high
N(9-hr) = 63, N(8-hr) = 34



Satisfaction with working hours and free time

Table 10 shows how satisfied the 8-hour and 9-hour group were with their working hours and free time. Two fixed factors were included in the analyses on these aspects. The first factor represented whether or not a respondent worked four 9-hour days. The second factor represented whether the respondent worked in an organisation that also offered the option of working five 8-hour days with 26 extra days off, or not. As this option gives employees maximum flexibility in

choosing when they have a day off, we suspected that offering this option would be highly valued by employees, especially by those not wanting to work a compressed working week. Therefore, this option may be expected to increase satisfaction with working hours and free time. The two organisations that offered this option are denoted in the Table by an 'f' in brackets.

The results show that offering this option indeed increased satisfaction with working hours and free time. Furthermore, satisfaction was also higher among the respondents working four 9-hour days, as had been hypothesised earlier. With regard to satisfaction with working hours, there was a nearly significant interaction between workday length and the extra free days option. Subsequent tests of the interaction showed that in the organisations not offering the extra free days options there was a highly significant difference in satisfaction between the 8-hour and the 9-hour group ($t = 3.45$, $p = .001$). In the organisations that did offer this option, the difference in satisfaction only tended to be higher ($t = 1.82$, $p = .071$). Probably, if employees have much choice, both in the hours worked per day and in when to take their days off, most of them will be able to find an arrangement that suits them. As a consequence, differences in satisfaction between arrangements will then be minimised.

Table 10 Satisfaction with working hours and free time

	9-hr gr.			8-hr gr.					
	M	SD	N	M	SD	N		F	p
Satisfaction with working hours (1 = low, 5 = high)									
Bank	4.6	0.4	43	3.9	1.0	22	8 vs. 9 hours (fixed factor)	19.44	.000
Municipality (f)	4.7	0.6	31	4.3	0.9	36	option extra free days (fixed factor)	7.79	.006
Large government authority (f)	4.6	0.8	18	4.5	0.7	14	option x 8 vs. 9 hrs (interaction)	3.12	.079
Pension fund	4.5	0.6	35	3.8	1.1	10			
Total	4.6	0.6	127	4.2	1.0	82			
Satisfaction with free time (1 = low, 5 = high)									
Bank	3.9	1.0	43	3.4	0.9	22	8 vs. 9 hours (fixed factor)	5.78	.017
Municipality (f)	4.1	1.0	32	4.1	1.0	36	option extra free days (fixed factor)	13.94	.000
Large government authority (f)	4.4	0.7	18	3.9	0.9	14	option x 8 vs. 9 hrs (interaction)	1.33	.250
Pension fund	3.8	1.0	35	3.4	0.8	10			
Total	4.0	1.0	128	3.8	1.0	82			

Conclusion and discussion

Previous research on 9-hour workdays in office work has shown that these have, in general, no or some negative effects on fatigue. Performance and health do not decrease. Satisfaction with working hours and free time remains the same or improves.

We attributed these fairly positive effects to the fact that a. office work is not very physically demanding, and b. the respondents could mostly choose whether they worked 8 or 9 hours per day. However, the number of studies is too small to provide a reliable picture of the effects of 9-hour workdays in office work. Therefore, we decided to conduct a study on 9-hour workdays in office work. The respondents to our study could also choose the length of their workday. The study also investigated whether employees who work 9 hours per day try to protect their performance from the effects of fatigue by expending extra effort. This might explain why the higher levels of fatigue do not always lower performance.

The results of the previous studies were mostly replicated. In general, working four 9-hour days in office work was not problematic for our respondents. Although there was a significantly higher increase in fatigue over the workday, need for recuperation and health were not affected. The absolute levels of performance did not differ either. Contrary to our expectations, effort even tended to be lower. Furthermore, satisfaction with working hours and free time was greater among those who worked 9-hour days.

Due to the design of our study, it could not be tested which aspect, employee choice or the low physical workload, was responsible for the generally favourable findings. This is something which is difficult to test in the Netherlands, as most office workers who work 9-hour days have chosen to do so. However, we will make an attempt at investigating this in a later study (see Chapters 5 and 6).

The finding that the effects were, in general, positive may also be due to the fact that this specific CWW was not very demanding. Nine-hour workdays are not much longer than 8-hour workdays. Furthermore, the three days off may give employees enough time to recuperate. This latter advantage may, for instance, explain why the higher increase in fatigue over the workday did not lead to a higher need for recuperation or more health complaints.

However, the effects may also have been fairly positive because the employees seemed to deal strategically with the extended workday. For example, our analyses showed that the 9-hour group's fatigue scores at the end of the day were quite stable over the week, while the scores of the 8-hour group tended to fluctuate. It may be that the 9-hour group tried to avoid peaks in fatigue because they had to work another long day the next day. Our results on effort seemed to support this assumption. If the assumption were correct, one would expect a somewhat lower and constant level of effort for the 9-hour group. For the majority of the workers, this tended to be found. It should be noted, however, that the constant and lower level of fatigue may also be explained by the fact that the 9-hour workers were a quite fit group of workers, whose levels of fatigue may, therefore, not easily rise above a certain level.

There was a small group of 9-hour workers for whom the CWW was problematic. This group scored higher on fatigue at the end of the workday and had more health complaints. There was some evidence that the employees in this group tried to protect their performance to some degree by expending extra effort. However, their performance still seemed to have deteriorated somewhat.

The fact that about half of them worked, on average, not enough hours per day indicated that they sometimes even deliberately chose to let their performance suffer a bit. Thus, they did not always try to protect their performance.
It may be that they did so because their levels of fatigue would otherwise have become much too high. It may also be, however, that they saw no use in staying somewhat longer at their work, because they were too fatigued to achieve an acceptable level of performance.
It is unclear why a CWW with 9-hour workdays was problematic for this group of workers. They did not score higher on any of the often-mentioned risk factors (work pace/workload, age, childcare duties) than the 9-hour workers who did not find the CWW more fatiguing. An alternative explanation could be that the first were already somewhat less healthy before the CWW was implemented and that the CWW was, therefore, more demanding for them. As we did not have data on the respondents' health before the CWW was implemented, this assumption could not be tested. If the assumption is true it also means, of course, that the difference in the number of health complaints found between the fatigued and the not fatigued 9-hour group was, to some extent at least, already present before the implementation of the CWW.
Like many other studies, ours also found that satisfaction with working hours and free time was greater among those working the CWW. This did not lead to an increase in productivity, as sometimes is expected. Considering the fact that, in most research on satisfaction and productivity in other areas, only a weak relation was found between the two (e.g., Thierry, 1992), this is not very surprising. Compressed working weeks, therefore, should not be seen as a tool for improving the individual employee's productivity. However, they can, of course, be profitable to an organisation because they can be used to extend the operating hours or to reduce the number of hand-overs.

3 The effects of extended workdays on fatigue, health, and performance in nursing[6]

Abstract

It has often been claimed that 12-hour shifts in nursing are better for both employees and patient care. However, although the research has, indeed, found positive effects on satisfaction with working hours and free time, the effects on employee fatigue, health, and performance has mostly been neutral or negative. The aim of this study was to investigate whether 9-hour shifts can combine the 12-hour shift's positive impact on satisfaction with the 8-hour shift's better record on fatigue, health, and performance. To this end, two groups of nurses, one working 9-hour shifts, the other working 8-hour shifts were compared. The 9-hour nurses experienced more fatigue, had more health complaints and were less satisfied with their working hours and free time than the 8-hour nurses. Their performance was a little poorer. Thus, the 9-hour shift seemed to combine the negative aspects of the 12-hour shift with the negative aspects of the 8-hour shift. It is suggested that the 9-hour shifts had more negative effects than 12-hour shifts because of the fact that, in this study, 1. the nurses could not choose what shift length they worked, 2. many nurses worked part-time, and 3. the nurses already had many days off. It is also suggested that increases in workload since the 1970s/1980s make extended shifts in nursing nowadays more fatiguing.

Introduction

Traditionally, in nursing, three 8-hour shifts (day/morning, afternoon/late and night) are used to cover the 24 hours of the day. Split shifts and part-time shifts are sometimes used in addition to the 8-hour shifts, for example, if the workload fluctuates over the day.

Since the 1970s, several articles have described experiments with extended, mostly 12-hour shifts. Often, the tone is quite positive; favourable consequences are reported for both nurses and patient care. For nurses, lengthening shifts may be advantageous, because this gives them more days and more weekends off (e.g., Crump & Newson, 1975; Ganong et al., 1976; Hodgson, 1995; Underwood, 1975). Regarding patient care, the advantage is that the patients see fewer different faces each day. It is claimed that this will improve the continuity of care (e.g., Crump & Newson, 1975; Ganong et al., 1976; Underwood, 1975).

However, some articles have reported less favourable experiences with extended shifts in nursing. The main disadvantages that are cited are a higher level of fatigue and, as a consequence, a lower overall quality of care (e.g., Facey, 1995; Palmer, 1991; Price, 1984).

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[6] An abridged version of this chapter has been submitted for publication. Co-authors are J.E.E. Ng-A-Tham and Hk. Thierry.

Unfortunately, many studies, both ones with positive results and ones with negative results, suffer from one or more methodological flaws. Therefore, the value of these claims is often dubious (Todd et al., 1991). For example, the data are often not or unclearly reported, meaning that it is not possible to check the assertions that are made. Furthermore, sometimes the research design is inadequate (e.g., a post-test only is conducted without a comparison group or retrospective measurements) or tests for significance are lacking. Therefore, it is difficult to draw a firm conclusion about the effects of extended shifts in nursing.

In order to get a more reliable picture, we conducted a review of the more rigorous studies. Studies were classified as rigorous if they met the following criteria:

- the data had to be reported fully and clearly;
- the studies had to have a sound design, i.e., a pre-test / post-test design or an experimental group / comparison group design. Retrospective measurements (e.g., "Do you find the extended shift more, less or equally fatiguing?") were also considered adequate;
- in the case of a pre-test / post-test design and an experimental group / comparison group design, tests for significance must have been conducted.

We restricted our review to studies that focused on the effects on fatigue, health (e.g., self-perceived health), performance (e.g., quality of care), and/or satisfaction with working hours and free time. These four aspects were chosen because they represent the most important aspects on which extended shifts may have an effect. The review is followed by an empirical study on 9-hour shifts. We chose to study this shift length, as our review showed that hardly any study in nursing has focused on shifts that are extended only a little.

In discussing the effects on fatigue, health, and performance, we use the effort-recovery model as our framework (Meijman, 1989; Meijman & Mulder, 1998). This model explains how workers deal with the demands made on them by the work situation. Its basic assumption is that a worker will always actively seek a balance between work demands and his own capacity. If a worker's capacity has become too low due to fatigue, then the balance is disrupted. One of the things he can do in this case is increase his capacity by expending compensatory effort. This way, performance can be maintained, but the expenditure of extra effort may increase fatigue levels even more. However, if the worker has some decision latitude in his work, he can also decide to use a less strenuous work strategy (e.g., work more slowly). This may prevent him from becoming more fatigued, but it may have negative effects on performance.

According to Hockey (1997), in general, employees will first try to protect their performance on their main task(s) if there is a discrepancy between work demands and capacity. Rather than let their main task(s) suffer, they will expend extra effort or perform less well on subsidiary tasks or subsidiary parts of tasks if they become more fatigued. Unfortunately, none of the studies on extended workdays in nursing which we found has investigated the effects on effort.

The effort-recovery model also states that a higher level of fatigue at the end of the work period or workday can, eventually, have negative effects on health if there is insufficient time for recovery between work periods. If the employee has not fully recovered before he starts working again, he will have to expend extra effort to maintain performance, which, in turn, will lead to an even higher level of fatigue. This way, there may be an accumulation of fatigue, which may, eventually, affect an employee's health.

Tables 1 and 2 give an overview of the results of the more rigorous studies included in our review. The tables show that, in general, extended shifts in nursing increase the levels of fatigue. With regard to the health of the nurses, the results are mixed. Thus, it is not clear whether the higher levels of fatigue will, eventually, affect employees' health. The effects on performance are mostly neutral or negative. The finding that performance is less frequently affected than fatigue can be seen as evidence for performance protection. Satisfaction with working hours and free time mostly improves with extended shifts. Overall, the more rigorous studies thus seem to give a less favourable picture of the effects of extended shifts in nursing.

Unfortunately, it was not possible to test whether different shift lengths (e.g., 11 hrs, 12 hrs) produce different results. This was because many studies did not give the exact shift length; often it was not clear whether the meal break was or was not included in the shift length that was reported. As a consequence, one cannot be certain whether a shift length of, for example, 12 hours in one study is really longer than a shift length of 11 hours in another study.
Although the impact of shift length would seem to be one of the main issues to be investigated in research on extended workdays, it has hardly ever been addressed. The two studies that did investigate this issue, reported more complaints in employees working the longer shifts (deCarufel & Schaan, 1990 (9-hour vs.12-hour shifts in policing); Kogi et al., 1990 (12-hour vs. 16-hour night shifts in nursing)).
Information about how long ago the extended shifts were implemented was given more often. This information is important because the effects of extended shifts may change over time. For example, positive changes may be expected if employees need some time to get used to working extended shifts. Negative changes may occur if there is an accumulation of fatigue or the novelty of the change has worn off after some time. Little research has addressed the effects of time since implementation and the results have been mixed. In a study on 10-hour workdays among industrial workers, the initial positive effects shown at 13 months had disappeared 12 months later (Ivancevich & Lyon, 1977). However, a meta-analysis of extended workdays worked during daytime found that time since implementation did not moderate the effects of extended days (Baltes et al., 1999). Among the studies in our review, there were no clear differences between the results of studies for which the data was collected before or after 6 months had elapsed (see Table 2).

Table 1 The results of studies on extended shifts in nursing

Study	Shift length[1]	Employee choice in workday length	Design & N of respondents	Time since implementation
Bacon & Kun (1986)	9.5 hrs (m.br. unclear) day shift only	yes	retrospective measurement N(exp): 9	4-5 months
Blanchflower (1986)	11 hrs vs 8 hrs	no	retrospective measurement N(exp): 15	3 weeks
Bowers Hutto & Lindsey Davis (1989)	12 hrs vs 8 hrs (m.br. unclear)	no data	retrospective measurement N(exp): 23	no data
Colt & Corley (1974)	10 hrs vs. 8 hrs (m.br. unclear)	yes	retrospective measurement N(exp): 166	about 1.5 year
Eaton & Gottselig (1980)	12 hrs vs. 8 hrs (m.br. unclear)	yes	pre-test & post-test N(exp): 24	6 months
Havlovic et al. (1998)	11 hrs vs. 7.5 hrs	collective agreement gives nurses some say	post-test with comp. gr. N(total): 520	no data
Hibberd (1973)	12¼ hrs vs. 8¼ hrs (with m.br.)	yes	pre-test & post-test with comp. gr. N(total): 58	3 measurements at 5 weeks, 10 weeks, 15 weeks
Iskra-Golec et al. (1996)	12 hrs vs. 8 hrs (m.br. unclear)	no data	post-test with comp. gr. N(exp): 96 N(com): 30	no data

[1] Meal breaks are not included in the length of the shift, unless otherwise stated:
with m.br. = shift length with meal break, length of meal break not known
m.br. unclear = unclear whether meal break is or is not included in shift length

Table 1 (Continued)

Effects on fatigue	Effects on health	Effects on performance	Effects on satisf. work. hrs & free time
0	no data	no usable data	no data
–	no data	no usable data	no usable data
–	0 / –	quality of care (self ratings): 0	free time: +
0 / –	no data	quality of care (self ratings): 0 / +	+
no data	+	quality of care (chart audit data): 0 computer tasks: 0	work. hrs: +
no data	sleep interference: 0	no usable data	work. hrs: 0 free time: –
no data	no usable data	quality of care (observers): 0 patient satisf.: 0	no usable data
chronic fatigue: –	sleep quality: – cardiovasc. & digestive problems: 0	no data	free time: +

Legend: – = negative effects; 0 = no effects; + = positive effects

Table 1 (Continued)

Study	Shift length[1]	Employee choice in workday length	Design & N of respondents	Time since implementation
Kogi et al. (1989)	16 hr & 12 hr vs 8 hr (m.br. unclear) night shift only	no data	post-test with comp. gr. N(16 hr):28 N(12 hr): 10 N(8 hr): 40	1 month
Mills et al. (1982)	12 hrs (without m.br.) vs. 8 hrs (m.br. unclear)	no data	pre-test & post-test quality of care: N(exp): 5 satisfaction: N(exp): 30	1 year
Nelson & Blasdell (1988)	12 hrs vs. 8 hrs (m.br. unclear)	no data	post-test with comp. gr. N(exp): 10 N(com): 10	no data
Stinson & Hazlett (1975); Ryan (1975)	12 hrs vs. 8 hrs (m.br. unclear)	yes	pre-test & post-test N(exp): 23	3 months
Todd et al. (1989); Reid et al. (1993); Todd et al. (1993)	12 hrs vs. 8 hrs (with m.br.)	no	pre-test & post-test quality & quantity of care: N(exp): 10 wards fatigue & satisfaction: N(exp): no data	6 months
Vik & Mackay (1982)	12 hrs vs. 8 hrs (m.br. unclear)	yes	post-test with comp. gr. patients are unit of measurement N(exp): 30 patients N(com): 30 patients	no data
Washburn (1991)	12 hrs vs. 8 hrs (m.br. unclear)	no data	post-test with comp. gr. N(exp): 49 N(com): 68	no data

[1] Meal breaks are not included in the length of the shift, unless otherwise stated:
with m.br. = shift length with meal break, length of meal break not known
m.br. unclear = unclear whether meal break is or is not included in shift length

Table 1 (Continued)

Effects on fatigue	Effects on health	Effects on performance	Effects on satisf. work. hrs & free time
–	no data	computer tasks: –	work. hrs: –
no data	no usable data	quality of care (audit): 0	work. hrs: +
no data	no data	quality of care, final 2 hrs day shift (observers) – / 0	no data
no usable data	no usable data	quality of care (physicians' opinions): 0	+
–	no data	quality of care (observers): – quantity of care (observers): –	–
no data	no data	quality of care (observers): –	no data
0	no data	computer tasks: 0	no data

Legend: – = negative effects; 0 = no effects; + = positive effects

Table 2 Overall results of studies on extended shifts in nursing

	Fatigue	Health	Performance	Satisfaction working hrs	Satisfaction free time
Overall	−: 5x	−: 2x	−: 4x	−: 2x	−: 2x
	0: 2x	0: 1x	0: 6x	0: 1x	+: 4x
		+: 1x	+: 1x	+: 4x	
≤ 6 months	−: 2x		−: 1x	−: 1x	
	0: 1x		0: 2x		
				+: 1x	+: 1x
> 6 months	−: 2x		−: 1x	−: 3x	−: 1x
			0: 2x		
		+: 1x	+: 1x	+: 1x	+: 1x
No choice	−: 2x		−: 1x	−: 1x	−: 1x
Choice	−: 1x		−: 1x		−: 1x
	0: 1x	0: 1x	0: 3x	0: 3x	
		+: 1x	+: 1x	+: 1x	+: 2x

Another aspect that may moderate the effects of extended workdays is employee choice. Employee choice may moderate the effects of extended workdays, because 1. employees who expect extended shifts to be too fatiguing will probably continue to work 8-hour shifts, and 2. employees who have chosen to work extended shifts but find these too fatiguing may return to 8-hour shifts. In other words, if there is choice, there will be a process of self-selection. This will lead to an underestimation of the negative effects of extended shifts and an overestimation of their positive effects.
The studies in our review (see Table 2) show that employee choice probably does indeed moderate the effects of extended shifts. While the results of studies were mostly neutral or positive when the employees had some choice, they were negative when they had no choice.

The present study

Almost all of the studies in our review investigated shift lengths of 10 hours or more. To recapitulate briefly, in general, the studies found negative effects on fatigue; mixed effects on health; and no or negative effects on performance. The effects on satisfaction were mostly positive.
It may be expected that shifts that are extended only a little will have a less negative effect on fatigue, health, and performance. In order to find out if this is indeed the case, this study investigated the effects of 9-hour shifts. The study addressed the effects on fatigue, health, performance, and satisfaction with working hours and free time. In the Netherlands, full-time workers in health care have a 36-hour working week, which means that 9-hour shifts give them a four-day working week. Therefore, 9-hour shifts may still increase satisfaction with working hours and free time.

Our hypotheses were that 9-hour shifts will, compared to 8-hour shifts:

- increase fatigue only a little;
- have no effect on employees' health;
- have no effect on performance;
- increase satisfaction with working hours and free time.

The study also aimed at finding out whether the nurses indeed try to protect their performance by expending extra effort. Therefore, the following hypothesis was formulated:

- more effort will be expended by nurses working 9-hour shifts.

Method

The study was conducted in three nursing homes (A, B, and C) located in the northern part of the Netherlands. Two of these nursing homes (A and C) used 9-hour shifts.

In nursing home A, both part-time and full-time nurses and nurse's aides worked this shift length. In nursing home C, two units (C2 and C3) used 9-hour shifts, but these were only worked by full-timers during the day and afternoon shift. The part-timers in these units worked a maximum of 8 hours per shift (see Table 3).

In unit C1 of nursing home C and in nursing home B, both part-timers and full-timers worked a maximum shift length of 8 hours. Together with the part-timers from units C2 and C3, these employees formed the comparison group. In all three nursing homes, almost all the nurses worked rotating shifts. Many of the part-timers also worked shorter shift lengths (e.g., 4 or 6 hours). The meal break was not included in any of the shift lengths reported.

As we only came into contact with the nursing homes after the 9-hour shifts had been introduced, it was not possible to conduct a pre-test. Instead, a post-test only design with a comparison group was used. The information obtained through this design was complemented with a few retrospective measurements, which enabled us to make some pre-intervention and post-intervention comparisons.

In nursing home A, the study was held ten months after the 9-hour shifts had been implemented. In nursing home C, the study was held 21 months after implementation.

In both nursing homes, the 9-hour shifts were implemented when the working week in health care was reduced from 38 to 36 hours per week. The reasons for implementing 9-hour shifts were that they would be easier to schedule (both nursing homes) and were expected to increase the continuity of care (nursing home A).

In nursing home A, the nurses could not choose between 8-hour and 9-hour shifts, as the 8-hour shifts had been abolished. In units C2 and C3, the nurses could avoid the 9-hour shifts by changing to part-time work (i.e., $\leq$ 35 hours per week). In our sample, 10 of the 15 (67%) full-timers from these units decided to work part-time when or shortly after the 9-hour shifts were introduced, despite the decrease in income this entailed. Their reasons were that "the 9-hour shift lasts too long" (100%) and "the 9-hour shift is too fatiguing" (50%).

The possibility of avoiding the 9-hour shifts has thus probably led to a process of self-selection. As a consequence, the remaining five full-timers from these units will be a select group. As this can distort our results, the data from this group

will be presented separately (provided that we have data for all five of them), except when we discuss what shift lengths the nurses prefer. In the rest of this article, these five full-timers will be referred to as the "9-hr - choice group".

Table 3 Working hours and response rate in the 3 nursing homes

Organisation	Maximum shift length	Response rate[2]	N(9-hr)	N(8-hr)
Nursing home A	9 hrs for all employees	73.0%	75	-
Nursing home B	8 hrs for all employees	29.1%	-	15
Nursing home C, unit 1	8 hrs for all employees	14.6%	-	20
Nursing home C, units 2 & 3	day & a'noon: 9 hrs for full-timers, 8 hrs for part-timers night: unit C2: 8 hrs unit C3: 8:20 hrs[1]	C2: 8.1% C3: 33.5%	5	19

[1] Due to the deviating length of their night shift, the respondents from unit C3 were not included in comparisons between the 8-hour and 9-hour night shifts.

[2] The response rate is based on all respondents who filled in the questionnaire. Some respondents were not included in the analyses reported here because they did not work 8-hour or 9-hour shifts. N(9-hr) and N(8-hr) refer to the number of respondents that were actually used in this study.

The data were collected by means of a questionnaire. Follow-up telephone interviews were conducted with a sub-sample of the respondents, but the results of these are not discussed in detail here. The response rate differed widely between the organisations (see Table 3). The extremely low response rate in unit C2 was probably caused by the fact that, at the time of the study, some nurses from this unit were being transferred to unit C3 against their will. Naturally, this caused much unrest. The reason for the transfers was that the newly appointed ward manager found that the nurses were too friendly with each other.

Table 4 gives some biographical details pertaining to the 8-hour and 9-hour groups. As can be seen, almost all the respondents were female. Apart from the number of contracted hours, there were no significant differences between the two groups. To control for this difference, the number of contracted hours was included as a covariate in the analyses. As the results of the analyses with and without the covariate were highly similar, the results of the analyses without the covariate are presented here. The *percentage* of part-timers did not differ significantly between the two groups. In the 9-hour group, 79% of the nurses worked part-time (< 36 hrs) and in the 8-hour group, 82%. This high proportion of part-timers is characteristic for Dutch nursing homes.

Table 4 Biographical and work-related details pertaining to the 8-hour and 9-hour group

	9-hr gr.			8-hr gr.				
	%		N	%		N	Chi^2	p
% of females	97.3%		75	94.4%		54	Fish. exact	.649
· 9-hr – choice group	80.0%		5					
% with children < 12 yrs living at home	18.7%		75	16.7%		54	0.09	.770
· 9-hr – choice group	0.0%		5					
	M	SD	N	M	SD	N	t	p
Age	32.9	9.1	75	31.4	7.5	54	0.96	.339
· 9-hr – choice group	26.6	6.4	5					
Work pace/workload	2.5	0.4	75	2.5	0.4	54	0.24	.809
· 9-hr – choice group	2.4	0.5	5					
Number of contracted work hours	27.4	7.0	75	30.7	5.2	54	-3.16	.002
· 9-hr – choice group	36.0	0.0	5					

Note: Work pace/workload was measured using self-ratings (scale by van Veldhoven (1996), 1 = low, 4 = high).

Measures

The questionnaire comprised the following measures:

· Fatigue

Fatigue was measured using two scales. The first scale was a checklist (Meijman, 1991) which measured the level of fatigue at the beginning and the end of the workday. The checklist was filled in retrospectively for each shift type (8-or 9-hour day shift, 8-hour or 9-hour afternoon shift, 8-hour or 9-hour night shift) the respondent had worked in the four weeks preceding the study. The scale consisted of nineteen 5-point items (e.g., Mentally fresh - mentally tired). Cronbach's alpha was .97 (day shift).

The second scale, need for recuperation, measured the extent to which the fatigue built up during the workday spilt over into the free hours and free days after work. The scale consisted of eleven 2-point items (e.g., I have difficulties concentrating in my free hours after work) (van Veldhoven, 1996). Cronbach's alpha was .88.

· Health complaints

Health complaints were measured using an eleven 2-point item scale (e.g., Is your stomach often upset?) (Dirken, 1967). Cronbach's alpha was .80.

· Performance

Performance was measured using self-ratings which were filled in for each shift type the respondent had worked in the four weeks preceding the study. This measure was newly constructed. The respondents had to rate their performance as a percentage of the best performance they had ever produced in the same job. We asked separate ratings for quantity and quality. Quantity was operationalised as the amount of work done *per hour* to make the comparison between 8-hour and 9-hour shifts a fair one. It was not possible to measure performance by having observers rate the quality of care, as many studies of extended shifts in nursing have done.

The respondents were also asked to compare their present performance with their performance before the implementation of the 36-hour working week. This implementation had happened at exactly the same time as the introduction of the 9-hour shifts. By using the 36-hour working week as reference point (e.g., "Has the quality of your performance improved, deteriorated or remained the same, compared to before the implementation of the 36-hour working week?"), the retrospective performance ratings could also be filled in by the 8-hour workers.

The advantage of self-ratings is that the employee himself/herself will usually be the one who is best informed about his or her performance. The disadvantage, however, is that the ratings may be too lenient (Murphy & Cleveland, 1991). If there are indications of a leniency effect, this will be mentioned.

· Effort

Effort was measured using a graphic rating scale (Zijlstra, 1993), which was filled in for each shift type the respondent had worked in the four weeks preceding the study. The effort ratings were given by putting a mark on a line.

· Satisfaction with working hours

This was measured using a newly constructed three-item, 5-point Likert scale (e.g., All in all, I am satisfied with the hours that I work). Cronbach's alpha was .72.

· Satisfaction with free time

This was measured using a newly constructed two-item, 5-point Likert scale (e.g., I am satisfied with the amount of free time I have). Cronbach's alpha was .79.

· Satisfaction with the different types of shifts

This was measured using three 1-item measures (e.g., How satisfied are you with the 9-hour/8-hour day shift?).

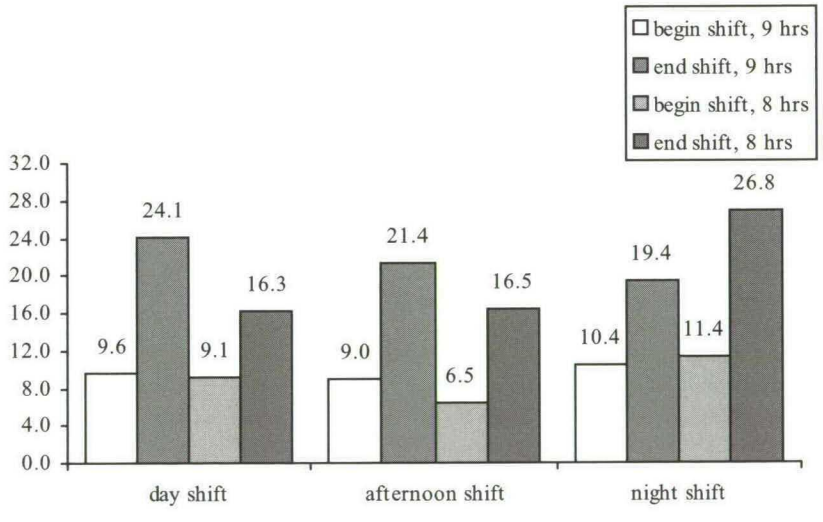
Results

Fatigue and health

Figure 1 presents the levels of fatigue at the beginning and the end of the shifts. T-tests showed that the levels of fatigue at the *beginning* of the shift did not differ significantly between the 8-hour and 9-hour group (day shift: $t = 0.24$, $p = .811$; afternoon shift: $t = 1.11$, $p = .270$; night shift: $t = 0.31$, $p = .757$). However, at the *end* of both the day shift ($t = 3.87$, $p = .000$) and the afternoon shift ($t = 2.18$, $p = .032$), the 9-hour group was significantly more fatigued. The opposite was true with regard to the night shift: the 8-hour group tended to be more fatigued at the end of this shift ($t = 1.83$, $p = .075$). However, as the 8-hour night group was very small, this latter result should be interpreted with caution.

The results of the retrospective measurements also showed that lengthening the day and the afternoon shift was more fatiguing than lengthening the night shift. 73% of the 9-hour group indicated that they found the 9-hour day shift more fatiguing and 65% reported this of the 9-hour afternoon shift. For the 9-hour night shift, this percentage was only 11%. In the telephone interviews, the respondents indicated that extending the night shift did not pose many problems, because the workload is much lower during this shift. Most patients are asleep and, apart from one or two rounds, their work during this shift mostly consists of waiting for patients' calls.
The percentage of the 9-hour nurses who found the day and/or afternoon shift more fatiguing tended to be somewhat higher in part-timers than in full-timers (part-timers: 83%, full-timers: 63%; Fisher Exact test: $p = .10$). This was despite the fact that the part-timers worked fewer 9-hour shifts in a row than the full-timers did. In a meeting during which the results of the study were discussed, the two main reasons the respondents gave for this finding were that 1. employees who decide to work part-time may do so because they feel less able to work many hours, and 2. because part-timers also work shorter shift lengths (e.g., 4 or 6 hours) it is more difficult for them to get used to working 9 hours.

Figure 1 Levels of fatigue at the beginning and end of the shifts;
0 = low, 57 = high
day shift: N(9-hr) = 61, N(8-hr) = 44; afternoon shift: N(9-hr) = 44, N(8-hr) = 39; night shift: N(9-hr) = 32, N(8-hr) = 9



The 9-hour group also scored significantly higher on need for recuperation than the 8-hour group[7] (see Table 5). This suggests that there was a spillover from the higher fatigue at the end of the 9-hour shift into the free hours and days after work. Furthermore, contrary to our hypothesis, the 9-hour group also experienced more health complaints.
For the five respondents from the 9-hr - choice group, need for recuperation and health had not been much affected. This indicates that the possibility of avoiding the 9-hour shifts had, indeed, led to a process of self-selection.

Table 5 Need for recuperation and health complaints

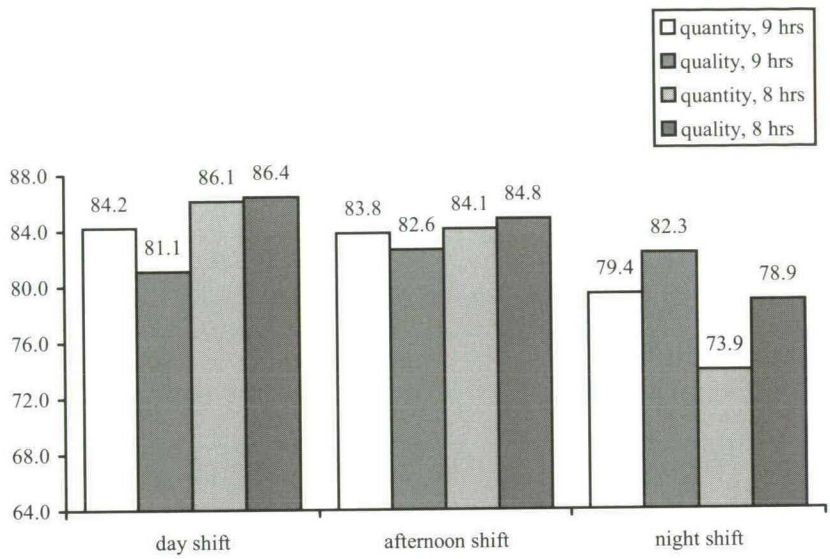
	9-hr gr.			8-hr gr.				
	M	SD	N	M	SD	N	t	p
Need for recuperation (0 = low, 11 = high)								
No choice group	6.2	3.4	72	3.3	3.1	49	4.84	.000
Choice group	3.8	3.6	5					
Health complaints (0 = low, 11 = high)								
No choice group	3.4	2.7	72	1.8	2.0	47	3.92	.000
Choice group	2.4	2.1	5					

Performance

The overall performance of the respondents was not much affected by the higher levels of fatigue during the 9-hour day and afternoon shift (see Figure 2). Only with regard to the quality of work done during the day shift did the 9-hour group tend to score less well ($t = 1.94$, $p = .055$). Thus, it seems as if the nurses tried to protect their performance from the higher levels of fatigue. Of course, their answers may also have been influenced to some extent by social desirability. With regard to the night shift, no significant differences in performance were found.

[7] The 8-hour group's score is equal to that of a national sample of health care workers. Data kindly provided by Marc van Veldhoven, Tilburg University.

Figure 2 Quantity and quality of performance
0 = low, 100 = high
day shift: N(9-hr, quantity) = 53; N(9-hr, quality) = 52; N(8-hr) = 36; afternoon shift: N(9-hr, quantity) = 40; N(9-hr, quality) =38, N(8-hr, quantity) = 35; N(8-hr, quality = 33; night shift: N(9-hr, quantity) = 27; N(9-hr, quality) = 26; N(8-hr) = 9



The retrospective measurements (see Table 6) also showed that it was the quality of the work, rather than the quantity, that had suffered somewhat since the implementation of the 9-hour shifts. 45% of the 9-hour group indicated that the quality of their work had deteriorated, while only 7% of the 8-hour group reported this. The extent of the deterioration was not large, however. 70% of the 9-hour nurses who found that the quality of their work had deteriorated, thought that it had suffered only a little.
During the final hour of the day and the afternoon shifts, both quantity and quality had deteriorated significantly more often for the 9-hour group. The percentages showed that it was again the quality of the work done during the day shift that had suffered the most.

Table 6 Effects on performance, retrospectively measured

	9-hr gr.		8-hr gr.			9-hr gr.		8-hr gr.	
	-	0 / +	-	0 / +		-	0 / +	-	0 / +
Quantity, overall	12.1% (7)	87.9% (51)	0.0% (0)	100.0 % (43)	*Quality, overall*	45.0% (27)	55.0% (33)	7.0% (3)	93.0% (40)
	Fish. exact, p = .019					Chi^2 = 17.54, p = .000			
Quantity, final hour day shift	49.1% (28)	50.9% (29)	2.8% (1)	97.2% (35)	*Quality, final hour day shift*	68.4% (39)	31.6% (18)	8.3% (3)	91.7% (33)
	Chi^2 = 22.08, p = .000					Chi^2 = 32.17, p = .000			
Quantity, final hour afternoon shift	30.2% (16)	69.8% (37)	5.7% (2)	94.3% (33)	*Quality, final hour afternoon shift*	39.6% (21)	60.4% (32)	8.6% (3)	91.4% (32)
	Chi^2 = 7.76, p = .005					Chi^2 = 10.25, p = .001			

Notes: - The respondents from the 8-hour group were asked to compare their present performance with their performance before the implementation of the 36-hour working week. This was when nursing homes A and C introduced 9-hour shifts.

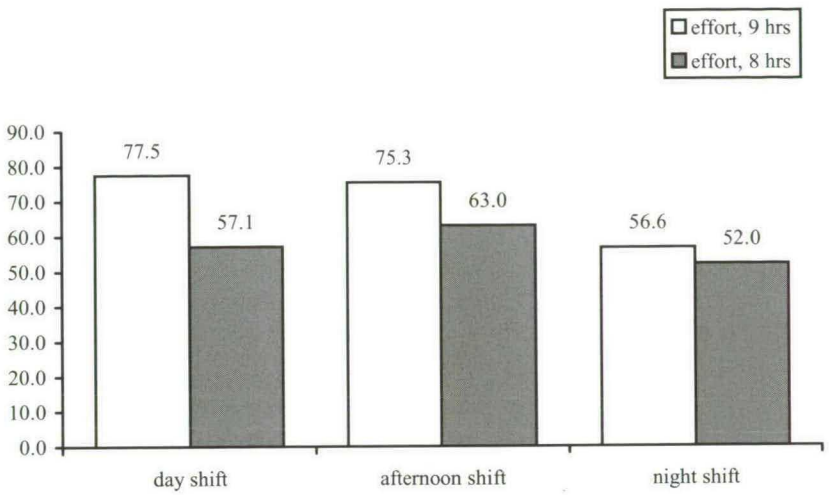
-The original categories were "very much deteriorated", "much deteriorated", "a little deteriorated", "not affected", "a little improved", "much improved", and "very much improved". As the number of respondents in some categories was too low, the categories had to be pooled.

In nursing home A, one of the reasons for implementing 9-hour shifts was to improve the continuity of care. However, only 16% of the respondents from this home were of the opinion that this objective had been achieved. As 9-hour shifts do not reduce the number of handovers (there are still three handovers needed per 24 hours of the day), it was unlikely that it would be achieved.

Effort

Our hypothesis was that the expenditure of effort would be greater on 9-hour shifts. Figure 3 shows this to be true. The 9-hour group expended significantly more effort during both the day and the afternoon shifts than the 8-hour group (day shift: t = 4.36, p = .000; afternoon shift: t = 2.32, p = .023). There were no significant differences for the night shift (t = 0.43, p = .668). This is in agreement with the finding that lengthening the night shift had no negative effects on fatigue.

Figure 3 Levels of effort expended
0 = low, 150 = high
day shift: N(9-hr) = 59, N(8-hr) = 44; afternoon shift: N(9-hr) = 44, N(8-hr) = 41; night shift: N(9-hr) = 29, N(8-hr) = 11



Satisfaction with working hours and free time

Our hypothesis was that 9-hour shifts would have a positive effect on satisfaction with working hours and free time. Table 7 shows that the hypothesis is not confirmed; on the contrary, the 8-hour group was more satisfied. Satisfaction with the different types of shift was also significantly lower for the 9-hour group. Satisfaction with the day and afternoon shift was extremely low.
The answers of the 9-hour respondents to a question on the disadvantages of the 9-hour shifts indicated that they found the 9-hour day and afternoon shift not only more fatiguing (see the section on fatigue and health) but also disadvantageous to their private lives. 83% of the 9-hour respondents complained that they were home late with a 9-hour day shift and 84% said that they had only a few hours in the morning left for non-work activities when working a 9-hour afternoon shift. The extra days off, on the other hand, were only named as an advantage by 48% (see Josten (2000) for more details on the advantages and disadvantages of the 9-hour shifts[8]).
The respondents from the 9-hr - choice group were, on average, more satisfied with the 9-hour day and afternoon shifts. The standard deviation for this group was rather large, however, which indicates that there were considerable differences in opinion within this group.
Satisfaction with the 9-hour night shift was not as low as satisfaction with the 9-hour day and afternoon shift, but still significantly lower than satisfaction with the 8-hour night shift. This was despite the fact that most 9-hour respondents did

[8] In that article, the attitudes of the teamleaders are also included in the data reported.

not consider the lengthening of the night shift more fatiguing and that most of them would like to keep this shift (see following section).

Table 7 Satisfaction with working hours and free time

	9-hr gr.			8-hr gr.				
	M	SD	N	M	SD	N	t	p
Satisfaction with working hours (1 = low, 5 = high)								
No choice group	3.4	0.8	69	4.2	0.8	51	-5.41	.000
Choice group	4.3	1.2	5					
Satisfaction with free time (1 = low, 5 = high)								
No choice group	3.5	1.1	71	4.1	1.0	53	-3.01	.003
Choice group	3.8	1.1	5					
Satisfaction with day shift (1 = low, 5 = high)								
No choice group	2.0	1.1	69	4.7	0.6	50	-16.85	.000
Choice group	3.8	1.8	5					
Satisfaction with afternoon shift (1 = low, 5 = high)								
No choice group	1.7	1.0	62	4.6	0.7	48	-17.83	.000
Choice group	3.8	1.8	5					
Satisfaction with night shift (1 = low, 5 = high)								
No choice group	3.8	1.3	55	4.9	0.3	19	-5.72	.000

The respondents were also asked what shift lengths they preferred. Not surprisingly, most respondents wanted to work a maximum of 8 hours during the day (80%) and the afternoon shift (71%). 19% even wanted to work a maximum of 7 hours or less during the afternoon shift. Mostly (79% of these respondents), this was to have more time for one's home and social life on a workday. A maximum shift length of 9 hours was only preferred by a small proportion of the respondents (day shift: 10%; afternoon shift: 8%). Most of the respondents who preferred a maximum shift length of 9 hours for the day and/or afternoon shift were full-timers (day shift: full-timers: 29%, part-timers: 3%; afternoon shift: full-timers: 25%, part-timers: 3%).

The respondents were less unanimous with regard to the night shift. 44% wanted to work a maximum of 8 hours during the night shift, while 45% preferred a maximum of 9 hours. The preferences for the night shift differed depending on the shift length that was worked. Of the 9-hour night group, 75% wanted to work a maximum of 9 hours during the night, while for the 8-hour and 8:20-hour

night group, this percentage was only 9%. Thus, for the night shift only, becoming used to extended shifts seemed to make them more acceptable.

Conclusion and discussion

Previous studies on extended, mostly 12-hour shifts in nursing have, in general, found higher levels of fatigue at the end of the workday; mixed effects on health; no or negative effects on performance; and a higher satisfaction with working hours and free time.

In order to find out whether shifts that are lengthened only a little can combine the 12-hour shift's positive impact on satisfaction with the 8-hour shift's better record on fatigue, health, and performance, we conducted a study on 9-hour shifts. Our hypotheses were that 9-hour shifts would lead to only a small increase in fatigue, and would have no negative effects on health and performance. Satisfaction with working hours and free time was expected to be greater. Furthermore, we expected that the nurses would try to prevent the increased level of fatigue from having an adverse effect on performance, by expending extra effort.

The results of our study only confirmed our hypothesis regarding effort. Contrary to our expectations, the 9-hour nurses were clearly more fatigued at the end of the day and the afternoon shifts, had more health complaints, tended to score lower on quality of performance during the day shift, and were less satisfied with their working hours and free time. Thus, 9-hour shifts had the disadvantages, but not the advantages of 12-hour shifts. Moreover, with regard to employee health, the disadvantages even seemed to be greater.

It should be noted that, in our study, the nurses could, in general, not choose between 8-hour or 9-hour shifts. As noted earlier in this Chapter, the studies in our review in which the nurses also had no choice in shift length found negative effects on all aspects that were measured as well.

In the group of nurses in our study who did have some choice, there was a process of self-selection. Those who found the extended shifts too fatiguing decided to work 8-hour shifts. As a consequence, the 9-hour shifts had a less negative effect on those who remained on this shift.

Although the more positive effects of other studies can, therefore, be at least partially attributed to self-selection, the question still remains as to why so few of the respondents in our study preferred to work extended shifts. In some of the studies in our review, a whole ward or almost a whole ward was interested in working extended shifts.

One of the reasons may be that 9-hour shifts hardly reduce the number of nights to be worked, while 12-hour shifts do reduce these substantially. It has been suggested that this aspect of 12-hour shifts may make them advantageous to employees' health (e.g., Baker et al., 1994; Wallace et al., 1990). However, most of the studies on 12-hour shifts in nursing did not find improvements in health.

Another reason for the more negative effects may be differences in workload. If the studies in our review are divided into studies in which the overall effects were positive (i.e., a + sign on at least one aspect and a 0 sign on the other aspects) and studies in which the overall effects were neutral or negative (all the other studies), one sees that the studies in the first category (Colt & Corley, 1974; Eaton & Gottselig, 1980; Mills, 1982; Stinson & Hazlett, 1975) all date from 1982 or earlier. As many nurses who have been working in nursing for a long time have told us, the work has become much more demanding since then.

They comment that the patients who are now in nursing homes are more dependent on the nurses and require much more care than in the 1980s. Furthermore, due to cuts in the budget for health care, levels of staffing are reported to be only barely adequate nowadays.

It may well be that this increased workload (which also increases the physical demands) has made nursing less suitable for lengthening shifts. Knauth (1993, 1996) has already warned that extended workdays may be too fatiguing if the workload is high. The fact that the lengthening of the night shift, during which the workload is much lower, was not problematic, confirms that a high workload makes extended shifts more fatiguing.

A second confirmation of the impact of workload can be found when the attitudes of the nurses are compared with those of the teamleaders. The work of the teamleaders is physically somewhat less demanding because they spend only the first few hours of the day shift on direct patient care; the rest of their time is spent on administrative duties. Of the seven (full-time working) teamleaders, 43% considered the 9-hour shifts to be more fatiguing. Among the full-time working nurses, this percentage was 63%.

A third reason for the more negative results may be that there were considerably more part-timers among our respondents. In the studies in our review that reported the percentage of part-timers, there were between 0% and 30% part-timers, while, in our study, the percentage of part-timers was 80%. As the part-timers in our study tended to complain more often that the 9-hour shifts were more fatiguing, this may also have contributed to the more negative effects found in our study. The reasons the part-timers gave for the fact that a higher percentage of them had problems with the 9-hour shifts were that 1. employees who decide to work part-time may do so because they feel less able to work many hours, and 2. because part-timers also worked shorter shift lengths it is more difficult for them to get used to working 9 hours. The latter reason might indicate that the nurses would have rated the 9-hour shifts more favourably if they had had more experience with this shift. However, it seems unlikely that they would have become really positive about it, as they disliked this shift length very much.

One of the most unexpected findings was that satisfaction with working hours and free time was significantly lower among nurses working 9-hour shifts. In other words, the advantage the 9-hour shift may provide (the extra days off) did not outweigh its disadvantages. Possibly, the reason for this is that the nurses already had quite a lot of days off. In the Netherlands, full-time workers in health care who work 8-hour days are entitled to 47 paid free days (public holidays excluded), and, in addition to this, they can get some compensation days for working irregular hours.

In countries in which the number of free days is much lower, the extra free days may be considered more attractive. For example, a Canadian nurse who worked half-time and voted for working 11-hour shifts, once told us that she had no paid free days. If she wanted a longer period of free time, she had to swap shifts with the person she shared her job with. In such a situation, longer shifts may seem more attractive, as the fewer workdays make it easier to arrange larger blocks of free days.

Due to the negative effects the 9-hour shifts were shown to have in our study, nursing homes A and C have both returned to 8-hour shifts. In nursing home A, the 9-hour night shift has been maintained, as this shift was liked by the nurses.

4 The effects of extended workdays on fatigue, health, and performance in industrial work

Abstract

Research on extended workdays in industrial work has mostly concentrated on either 12-hour day and night shifts or on 9-hour or 10-hour days. In general, 12-hour days and nights do not affect fatigue, are neutral or positive to employees' health, decrease performance, and improve satisfaction with working hours and free time. The effects of 9-hour or 10-hour days are the same, except that health does not improve. The 12-hour system's positive effect on health may be due to the fact that it: 1. reduces the number of nights to be worked, and 2. often also reduces the number of hours per sequence. Systems with 9-hour or 10-hour days do not offer these advantages. The finding that these systems had no effects on health seems to corroborate the above interpretation. However, the number of studies on 9-hour or 10-hour days in industrial work is very small. Therefore, more research is needed before it can be concluded that this system indeed lacks the 12-hour system's positive effects on health. To contribute to this, a small study comparing 8-hour and 9-hour days was conducted. The 9-hour workers did not differ in levels of fatigue, nor in satisfaction with working hours and free time. Their performance was somewhat poorer. Health was found not be affected, which again confirms the interpretation above. However, as there are still too few studies on this subject, more research is needed. It is also suggested that future research on 12-hour shifts should address which aspect (number of nights or hours per sequence) causes the favourable findings.

Introduction

In the industrial sector, operating hours are often extended beyond the standard Monday to Friday, 8 hours per day working week, due to continuous processes that cannot be easily interrupted, the wish to make more efficient use of expensive machinery, and an increased demand for the company's products. The extension of operating hours is often achieved by using two or more crews that both work 8-hour shifts (e.g., rotating morning and afternoon shifts). However, operating hours can also be extended by implementing a compressed working week (CWW). Under a compressed working week, employees work more than 8 hours per day (e.g., 10 or 12 hours) but less than five days per week (e.g., 4 or 3 days) (Tepas, 1985). If the number of days an organisation operates are not reduced or even extended when a CWW is implemented, then the operating hours will increase.

The main advantage of the compressed working week for employees is the extra day(s) off it provides. This may improve their satisfaction with working hours and free time. Its main disadvantage is the extended workdays. These may

increase fatigue levels, which, in turn, may negatively affect health and performance.

CWWs in industrial work mostly involve either systems with 12-hour day and night shifts or systems with 9-hour or 10-hour days. On the face of it, one would expect the first arrangement to be more detrimental to employees' fatigue, health, and performance because the workday is extended more. However, the advantage of the 12-hour system is that it reduces the number of nights to be worked. It has been suggested by some researchers that 12-hour shifts may, therefore, lead to less circadian disruption, which may make them beneficial to employee's health (e.g., Baker et al., 1994; Wallace et al., 1990).

In order to find out if CWWs with nights do indeed have more positive effects on employee health than CWWs without nights, we conducted a review of studies on these two types of arrangements in industrial work. Previous reviews of CWWs have either dealt with one type of CWW (e.g., 12-hour shifts: L. Smith et al., 1998; CWW without nights: Baltes et al., 1999) or reviewed them all together (e.g., Thierry & Jansen, 1996; Thierry & Meijman, 1994). Our review also included the effects on fatigue, performance, and satisfaction with working hours and free time, to provide a more complete picture of possible differences between the two systems. For example, it has been hypothesised that extended nights shifts will have more negative effects on fatigue and performance than extended day shifts, because the low in the circadian rhythm at night may exacerbate the effects of extended shifts (e.g. Folkard, 1996). The review is followed by an empirical study on a CWW without nights. We chose to study this type of arrangement, because our review showed that only little research has addressed the effects of CWWs without nights in industrial work.

In discussing the effects on fatigue, health, and performance, we use the effort-recovery model as our framework (Meijman, 1989; Meijman & Mulder, 1998). This model explains how workers deal with the demands made on them by the work situation. Its basic assumption is that a worker will always actively seek a balance between work demands and his own capacity. If a worker's capacity has become too low due to fatigue, then the balance is disrupted. One of the things he can do in this case is increase his capacity by expending compensatory effort. This way, performance can be maintained, but the expenditure of extra effort may increase fatigue levels even more. However, if the worker has some decision latitude in his work, he can also decide to use a less strenuous work strategy (e.g., work more slowly). This may prevent him from becoming more fatigued, but it may have negative effects on performance.

According to Hockey (1997), in general, employees will first try to protect their performance on their main task(s) if there is a discrepancy between work demands and capacity. Rather than let their main task(s) suffer, they will expend extra effort or perform less well on subsidiary tasks or subsidiary parts of tasks if they become more fatigued. Unfortunately, only one of the studies on extended workdays in industry we found, has investigated the effects on effort. In this study (Duchon et al., 1997), a lower level of effort was found in employees working 12-hour shifts. This seems to contradict Hockey's notion of performance protection.

The effort-recovery model also states that a higher level of fatigue at the end of the work period or workday can, eventually, have negative effects on health if there is insufficient time for recovery between work periods. If the employee has not fully recovered before he starts working again, he will have to expend extra effort to maintain performance, which, in turn, will lead to an even higher level

of fatigue. This way, there may be an accumulation of fatigue, which may, eventually, affect an employee's health.

Tables 1 and 2 give an overview of the results of studies on CWWs in industrial work. In order to be included in our review, studies had to meet the following criteria:

- the data had to be reported fully and clearly;
- the studies had to have a sound design, i.e., a pre-test / post-test design, or an experimental group / comparison group design. Retrospective measurements (e.g., "Do you find the extended shift more, less or equally fatiguing?") were also considered adequate;
- in the case of a pre-test / post-test design and an experimental group / comparison group design, tests for significance must have been conducted.

Studies were classified as having found mixed effects if the respondents scored significantly better on a certain aspect (e.g., alertness) during some parts of the extended shift, but significantly poorer during other parts. If several measures were used for one aspect and the respondents scored significantly poorer on some of these measures but significantly better on others, then the same classification was given. The studies by Seibt et al. (1990) and Axelsson et al. (1998) on systems with 8-hour weekdays and 12-hour weekend days were not included in our review. For our purposes, this arrangement differs too much from conventional CWWs.
Tables 1 and 2 show that many studies only addressed one or two of the aspects we were interested in. Therefore, the number of studies per aspect is sometimes quite small, especially the number of studies on CWWs without nights.
Studies on CWWs with nights mainly date from the late 1980s or later. Mostly, these studies concerned jobs with a light physical workload (e.g., operators). Studies on CWWs without nights were either conducted in the 1970s or in the 1990s (the two Dutch studies). The physical workload of the jobs in these studies was light (packaging) to medium (manufacturing).

In general, studies on CWWs with nights have found no or negative effects on fatigue. The effects on employees' health have mostly been neutral or positive (see Table 3). This may indicate that the hypothesis regarding the positive effects of having to work fewer nights is supported. It also indicates that fatigue has, in general, not accumulated too much.
It should be noted, however, that CWWs with nights often differ from traditional 8-hour systems with nights in more than only the number of nights to be worked. Another important difference is that many CWWs with nights reduce the number of working hours per sequence. As shown in Table 1, under the 8-hour system, the maximum number of hours per sequence was often 56. Under the CWW, this was often reduced to 36 or 48 hours. Evidently, this may also have contributed to the positive effects on health found in about half of the studies.

Table 1 The results of studies on CWWs with nights in industrial work

Study	Shift length[1]	Max. nr. of consecutive shifts	Employee say in implement. CWW	Design & N of respondents
Aguirre et al. (2000)	12 hrs vs 8 hrs (m.br. unclear)	12 hr: max 4 8 hr: max 7	no data	pre-test & post-test N(exp): before impl.: 194 after impl.: 205
Conrad-Betschart (1990)	12 hrs vs 8 hrs (with m.br.)	12 hr: max 3 8 hr: max 7	yes	retrospective measurements N(exp): 78
Cunningham (1989)	12 hrs vs 8 hrs (m.br. unclear)	12 hr: max 4 8 hr: max 5	yes	pre-test & post-test with comp. gr. fatigue: N(exp): 68 N(com): 17
Daniel & Potasová (1989); Daniel (1990a); Daniel (1990b)	12 hrs vs 8 hrs (m.br. unclear)	12 hr: max 2 8 hr: max 6	no data	post-test with comp. gr. satisf. work hrs: N(exp): 118 N(com): 125 absenteeism: N(exp): 711 N(com): 943 computer tasks: N(exp): 16 N(com): 18
Duchon et al. (1994); Keran et al. (1994); Duchon et al. (1997)	12 hrs vs 8 hrs (m.br. unclear) comp. gr.: works no nights	12 hr: 4 8 hr: exp gr.: 7; com gr.: 5	no data	pre-test & post-test with comp. gr. N(exp): 31 N(com): 10
Frese & Semmer (1986)	12 hrs vs 8 hrs (m.br. unclear)	no data	no data	post-test with comp. gr. N(exp): 1198 N(com): 1295

[1] Meal breaks are not included in the length of the shift, unless otherwise stated:
with m.br. = shift length with meal break, length of meal break not known
m.br. unclear = unclear whether meal break is or is not included in shift length

Table 1 (Continued)

Time since implementation	Type of work	Effects on fatigue	Effects on health	Effects on performance	Effects on satisf. work. hrs & free time
6 months	work in paper mill	alertness: 0	+	self-ratings (quality): 0	+
4 months	operators	no data	0 / +	no data	free time: +
no data	mining	–	no data	no data	no data
no data	operators	no data	absenteeism: 0	computer tasks (quantity): –	work. hrs: +
10 months	mining on site lodging for 12 hr group	fatigue: X	no data	computer tasks: X	work. hrs: +
no data	light industrial work	no data	0	no data	no data

Legend: – = negative effects; 0 = no effects; + = positive effects, X = mixed effects

Table 1 (Continued)

Study	Shift length[1]	Max. nr. of consecutive shifts	Employee say in implement. CWW	Design & N of respondents
Heslegrave, Rhodes & Gil (2000)	12.5 hrs vs 9 hrs (m.br. unclear)	12.5 hr: max 4 9 hr: max 7	no data	pre-test & post-test N(exp): before impl.: 86 after impl.: 81
Heslegrave et al. (2000)	10 hrs vs 8 hrs 10-hr night: 17:00-3:00 8-hr night: 0:00-8:00	10 hr: 4 8 hr: 5	no data	pre-test & post-test N(exp): before: 241 after: 120
Johnson & Sharit (2001)	12 hrs vs 8 hrs (m.br. unclear)	12 hr: no data 8 hr: 7	yes	pre-test & post-test N(exp): before impl.: 369 after impl. (11 months): 393 after impl. (9 years): 104
Loskant (1970)	11.25 hrs vs 8 hrs	11.25 hr: 3 8 hr: 7	yes	post-test with comp. gr. N(exp):100 N(com): 100
Lowden et al. (1998)	12 hrs vs 8 hrs (m.br. unclear) comp. gr.: does not work nights	12 hr: max 3 8 hr: max 6	no data	pre-test & post test with comp. gr. & retrospective measurements health & satisfaction N(exp): 34? N(com): 16? sleepiness & computer tasks N(exp): 14 N(com): 9
Mitchell & Williamson (2000)	12 hrs vs 8 hrs (m.br. unclear)	12 hr: max 5 8 hr: max 7	no data	pre-test & post-test N(exp): before impl.: 15 after impl.: 12

[1] Meal breaks are not included in the length of the shift, unless otherwise stated:
with m.br. = shift length with meal break, length of meal break not known
m.br. unclear = unclear whether meal break is or is not included in shift length

Table 1 (Continued)

Time since implementation	Type of work	Effects on fatigue	Effects on health	Effects on performance	Effects on satisf. work. hrs & free time
1 year	operators	–	no usable data	self-ratings: –	no data
1 month	mining	no data	+	self-ratings: days: – nights: +	no data
2 measurements, at 11 months and 9 years	operators and service workers	no data	+	no data	work. hrs: +
no data	operators	no data	+	no data	no data
10 months	operators	sleepiness: +	0 / +	computer tasks: 0	+
10 months	electrical power station	0	0 / +	0	free time: +

Legend: – = negative effects; 0 = no effects; + = positive effects, X = mixed effects

Table 1 (Continued)

Study	Shift length[1]	Max. nr. of consecutive shifts	Employee say in implement. CWW	Design & N of respondents
Rosa et al. (1989); Rosa (1991)	12.5 hrs vs 8.5 hrs (m.br. unclear)	12.5 hr: max 4 8.5 hr: max 7	no data	pre-test & post-test 7 months: computer tasks: N(exp): 24 fatigue: N(exp): 50 3.5 years: computer tasks: N(exp): 15 fatigue: N(exp): 20
Rosa & Bonnett (1993)	12 hrs vs 8 hrs (m.br. unclear)	12 hr: max 3 8 hr: max 7	no data	2 designs: - pre-test & post-test: N(exp): 6 - post-test with comp gr.: N(exp): 12 N(com): 9
P. Smith et al. (1998)	12 hrs vs 8 hrs (m.br. unclear)	12 hr: max 3 8 hr: max 7	yes	2 designs: - pre-test & post-test N(exp): 12 - post-test with comp. gr.: N(exp): 32 N(com): 15
Tucker et al. (1996)	12 hrs vs 8 hrs (m.br. unclear)	12 hr: max 4 8 hr: max 7	no data	post-test with comp. gr. N(exp): 92 N(com): 70
Tucker et al. (1998a); Tucker et al. (1998b)	12 hrs vs 8 hrs (m.br unclear)	12 hr: max 4 8 hr: max 7	no data	post-test with comp. gr. N(exp): 335 N(com): 171
Ward Gardner & Dagnall (1977)	12 hrs vs 8 hrs (m.br. unclear)	12 hr: max 4 8 hr: max 7	no data	pre-test & post-test N(exp): 356

[1] Meal breaks are not included in the length of the shift, unless otherwise stated:
with m.br. = shift length with meal break, length of meal break not known
m.br. unclear = unclear whether meal break is or is not included in shift length

Table 1 (Continued)

Time since implementation	Type of work	Effects on fatigue	Effects on health	Effects on performance	Effects on satisf. work. hrs & free time
2 measurements, at 7 months and 3.5 years	operators	sleepiness: – / 0	no data	computer tasks: –	no data
3 months	natural gas utility	sleepiness: day shift: 0 night shift: X	no data	computer tasks: X	no data
5-6 months	sewage treatment plants	0	design 1: 0 design 2: 0 / +	no data	design 1: 0 design 2: +
no data	chemical workers	alertness: 0	0 / +	no data	work. hrs: – free time: +
no data	manufacturing & engineering	alertness: X	X	no data	+
≥ 1 year	chemical workers	no data	absenteeism: 0	no data	no data

Legend: – = negative effects; 0 = no effects; + = positive effects, X = mixed effects

Table 2 The results of studies on CWWs without nights in industrial work

Study	Shift length[1]	Max. nr. of consecutive shifts	Employee say in implement. CWW	Design & N of respondents
Calvasina & Boxx (1975)	9.5 hrs vs 8 hrs (m.br. unclear)	9.5 hr: max 4 8 hr: max 5	no data	pre-test & post-test N(exp): 167
Frietman et al. (1991)	9.5 hrs vs 8 hrs	9.5 hr: max 4 8 hr: max 5	yes	retrospective measurements N(exp): 1074
Ivancevich (1974); Ivancevich & Lyon (1977)	10 hrs vs 8 hrs (m.br. unclear)	10 hr: 4 8 hr: 5	no data	pre-test & post-test with comp. gr. at 13 months: N(exp): 215 N(com): 200 at 25 months: N(exp): 97 N(com): 94
Jansen & Mul (1990); Atos & UvA (1988)	9 hrs vs 8 hrs	9 hr: max 4 8 hr: 5	no data	pre-test & post-test N(exp): 87
Mahoney (1978)	10 hrs vs 8 hrs (m.br. unclear)	10 hr: 4 8 hr: 5	no data	retrospective measurements N(exp): 232
Volle et al. (1979)	10 hrs vs 8 hrs (m.br. unclear)	10 hr: max 4 8 hr: max 5	no data	post-test with comp. gr. N(exp): 33 N(com): 17

[1] Meal breaks are not included in the length of the shift, unless otherwise stated:
with m.br. = shift length with meal break, length of meal break not known
m.br. unclear = unclear whether meal break is or is not included in shift length

Table 2 (Continued)

Time since implementation	Type of work	Effects on fatigue	Effects on health	Effects on performance	Eff. on satisf. work. hrs & free time
1st year following implementation	sewing	no data	no data	production data (quantity and variability in quantity): 0	no data
1.5 years	manufacturing	– / 0	no data	self-ratings: quality: –	work. hrs: + / 0 free time: no usable data
three measurements at 3 months, 13 months, 25 months	manufacturing	no data	no data	supervisor ratings: quality: 0 quantity: at 13 mnths: + at 25 mnthts: 0	no data
about 4 months	packaging of sweets	0	no data	no data	work. hrs: 0 free time: +
2 years	manufacturing	no data	no data	no data	free time: +
≥ 1 year	manufacturing	no data	0	computer tasks: –/ 0	no data

Legend: – = negative effects; 0 = no effects; + = positive effects, X = mixed effects

The effects of CWWs with nights on performance were neutral or negative, like the effects on fatigue. This may be due to the fact that most studies use a proxy for performance (i.e., computer tasks), for which the motivation to maintain performance (despite an increase in fatigue) may be lower than for real-life tasks. However, it may also indicate that it is too difficult or not considered necessary to protect performance 12 hours long.
There were no consistent differences between day and night shifts in the effects on fatigue and performance. Thus, the assumption that the effects of extended shifts will be more negative during the night shift is not confirmed.
With regard to satisfaction with working hours and free time, the effects were generally positive. In other sectors, CWWs were found to have positive effects on satisfaction as well (see, for example, Chapters 2 and 3).

Table 3 Comparison of the effects of CWWs with and without nights

	Fatigue	Health	Performance	Satisfaction working hrs	Satisfaction free time
Without nights	–: 2x	0: 1x	–: 2x		
	0: 1x		0: 2x	0: 1x	
				+: 1x	+: 2x
With nights	–: 3x		–: 4x	–: 1x	0: 1x
	0: 4x	0: 4x	0: 3x	0: 1x	+: 6x
	+: 1x	+: 8x		+: 6x	
	X: 3x	X: 1x	X: 2x		
With nights,			–: 1x		
≤ 6 months	0: 2x	0: 1x	0: 1x	0: 1x	0: 1x
		+: 3x		+: 1x	+: 2x
	X: 1x		X: 1x		
With nights,	–: 2x		–: 2x		
> 6 months	0: 1x	0: 1x	0: 2x		
	+: 1x	+: 3x		+: 3x	+: 2x
	X: 1x		X: 1x		

Legend: – = negative effects; 0 = no effects; + = positive effects, X = mixed effects

Notes: 1. If studies measured the effects at more than one point in time, the results found at the latest point in time are used.

2. Of the study by Heslegrave et al. (2000), the effects on performance during the night shift are not included because, under the new system, the night shift does not cover the 03:00-08:00 period anymore.

3. Of the study by P. Smith et al. (1998), the results of design 1 are used.

CWWs without nights mostly had the same effects, except perhaps with regard to employee health; in the one study that addressed this aspect, neutral effects were found. This may indicate that the improvements in health often observed under CWWs with nights are indeed due to the reduced number of nights. However, the other potential cause (reduced number of hours per sequence) is still equally valid because CWWs without nights in general do not reduce this. Furthermore, because only one study on CWWs without nights addressed the effects on health, one cannot be certain whether the effects are truly different. Therefore, more research on CWWs without nights is needed.

We had also wanted to find out whether different shift lengths produce different results (e.g., more fatigue if the shift length is longer). Although this would seem to be one of the main questions to be investigated in research on extended workdays, it has hardly ever been addressed. The two studies that did address this issue, reported more complaints in employees working the longer shifts (deCarufel & Schaan, 1990 (9-hour vs. 12-hour shifts in policing); Kogi et al., 1990 (12-hour vs. 16-hour night shifts in nursing)).
Unfortunately, it was not possible to test the effect of shift length. First, there was too little variation in shift length within CWWs with and without nights. Second, many studies did not report the exact shift length (i.e., without meal break).
Other information that was often missing was whether the employees had had some say in the decision to implement a CWW or not. This information should be given because, if employees expect a CWW to be too demanding, they will be more likely to vote against its implementation. Evidently, this may mean that the negative effects of extended shifts will be underestimated and the positive effects overestimated, if employees have some say.
Information on how long ago the CWW had been implemented was given more often although, again, not all studies provided information on this. The reason why this information should be given is that the effects of a CWW may change over time. For example, positive changes may be expected if the employees need some time to get used to working extended shifts. Negative changes may occur if there is an accumulation of fatigue or if the novelty of the change has worn off after some time. Little research has addressed the effects of time since implementation and the results have been mixed. In a study on 10-hour workdays among industrial workers, the initial positive effects shown at 13 months had disappeared 12 months later (Ivancevich & Lyon, 1977). However, a meta-analysis of extended workdays worked during daytime found that time since implementation did not moderate the effects of extended days (Baltes et al., 1999). Among the studies in our review (see Table 3), there were no clear differences between the results of studies that had collected the data before or after 6 months had elapsed.

The present study

To recapitulate briefly, CWWs without nights had the same effects as CWWs with nights, except perhaps with regard to employee health. However, more research on the first type of arrangement is needed to get a reliable picture of its effects.
The opportunity arose to study a CWW without nights in the production department of a medium-sized company in the metallurgical industry. In this department, a four-day, 9 hours per day working week was implemented 14 years ago. It was a management decision to implement it. The workers had had no say in it.
The arrangement was compared to a discontinuous system (morning and afternoon shifts) that was also used in the same department. This latter system was implemented some 10 years ago. Nowadays, it is being used more and more often, because management wants to extend the operating hours further.
The work done under both systems was the same. In Figure 1, the two shift systems are illustrated. Under the discontinuous system, the average workday was 7.75 hours. To simplify notation, the employees who work this system are

referred to as the 8-hour group. The employees who work the CWW are referred to as the 9-hour group.

Figure 1 The two shift systems

CWW						Discontinuous system					
Week	Mon	Tue	Wed	Thu	Fri	Week	Mon	Tue	Wed	Thu	Fri
1	–	D	D	D	D	1	M1	M2	M2	M2	M2
2	D	–	D	D	D	2	A	A	A	A	–
3	D	D	–	D	D						
4	D	D	D	–	D						
5	D	D	D	D	–						

D = 9-hr day shift; 7:00 - 17:00; meal break = 60 min.
M1 = 6.75-hr morning shift: 6:45 - 14:00, meal break = 30 min.
M2 = 8-hr morning shift: 5:30 - 14:00, meal break = 30 min.
A = 7.75-hr afternoon shift: 14:00 - 22:15, meal break = 30 min.
– = free day

The discontinuous system's morning shift starts quite early (5:30). It is well known that early starts reduce sleep length and sleep quality and, consequently, affect fatigue and performance (e.g., Knauth, 1993, 1996). As we did not have any expectations in advance about which would be more demanding - early starts or longer days - the comparison of the 9-hour shift with the morning shift is of an exploratory nature. Regarding the comparison of the 9-hour shift with the afternoon shift and the discontinuous system as a whole, the following hypotheses were formulated:

- fatigue will be higher on the 9-hour shift than on the afternoon shift;
- there will be no differences in health;
- performance will be lower on the 9-hour shift than on the afternoon shift;
- satisfaction with working hours and free time will be greater on the 9-hour shift than on the discontinuous system.

The hypothesis regarding effort was based on the effort-recovery model and Hockey's notion of performance protection. Although there was no evidence on performance protection in previous research on CWWs in industrial work, we expected that, by measuring effort directly, some evidence for performance protection might be found. Therefore, the hypothesis was that:

- more effort will be expended on the 9-hour shift than on the afternoon shift.

Method

The machine the employee worked at determined under which shift system he or she worked. All employees did the same work. The work was machine-paced; the employees had to place material into moulds that rotated from one worker to the next. There were one to six workers working at each machine. The machines differed from each other in the diameter of the material that was processed. There was much noise and dust. The rate of sickness absence was high: more than 10% at the time of the study. About 40% of all sickness days were due to neck, shoulder, or arm complaints. This high prevalence of musculoskeletal

complaints was caused by the repetitive movements the workers had to make. The work could be characterised as physically quite demanding.

The data for the study were collected by means of a questionnaire that was handed out to all 75 full-time workers in the department. 20 of them returned the questionnaire, which was a response rate of 27%. Although this was quite a low response rate, it is not unusual for a group of low-skilled workers such as these. Some workers were even practically illiterate. They were still given a questionnaire, as we considered it an invasion of privacy if management told us which workers it concerned.

Table 4 gives the biographical details pertaining to the respondents. The majority of the respondents were male. The average age of the 9-hour group was 34 years, that of the 8-hour group 44 years. As Table 4 shows, this difference was statistically significant. To control for this difference, age was included as a covariate in the analyses. Both the results of the analyses with and without the covariate are presented.

Table 4 Biographical and work-related details pertaining to the 8-hour and 9-hour group

	9-hr group			8-hr group				
	%		N	%		N		p
% of females	14.3%		7	15.4%		13	Fish. ex.	1.000
% with children < 12 yrs living at home	0.0%		7	23.1%		13	Fish. ex.	.521
	M	SD	N	M	SD	N	t	p
Age	33.9	7.8	7	43.8	7.7	13	-2.76	.013
Nr. of years on current schedule	8.3	2.4	6	8.5	5.1	11	-0.05	.958
Work pace / workload	2.2	0.3	7	2.3	0.5	13	-0.67	.512
Decision latitude	2.3	1.0	7	2.2	0.8	13	0.27	.793

Note: Work pace/workload and decision latitude were measured by self-ratings (work pace/ workload: scale by Van Veldhoven (1996), 1 = low, 4 = high; decision latitude: scale by de Jonge (1995), 1 = low, 5 = high).

Sleep length was measured to check if the respondents indeed slept shorter on the morning shift. The respondents recorded their sleep lengths for a one-week (9-hour group) or two-week period (8-hour group: one week with morning shifts and one week with afternoon shifts). The results showed that sleep length was indeed much shorter on the morning shift (day 1: 6.4 hrs, days 2-5: 5.6 hrs), than on the afternoon shift (8.2 hrs). The 9-hour respondents slept 6.8 hours on average before a workday.

Measures

The questionnaire comprised the following measures:

- Fatigue

Fatigue was measured using two scales. The first scale was a checklist (Meijman, 1991) which measured the level of fatigue at the beginning and the end of the workday. The checklist was filled in for each workday during a one-week (9-hour group) or two-week period (8-hour group: one week with morning shifts and one week with afternoon shifts). The scale consisted of nineteen 5-point items (e.g., Mentally fresh - mentally tired).

The second scale, need for recuperation, measured the extent to which the fatigue built up during the workday spilt over into the free hours and free days after work. The scale consisted of eleven 2-point items (e.g., I have difficulties concentrating in my free hours after work) (van Veldhoven, 1996).

- Health complaints

Health complaints were measured using an eleven 2-point item scale (e.g., Is your stomach often upset?) (Dirken, 1967).

- Performance

Performance was measured using self-ratings which were filled in for each workday during a one-week (9-hour group) or two-week period (8-hour group). The performance measures were newly constructed. The respondents had to rate their performance as a percentage of the best performance they had ever produced in the same job. Only ratings for quality were asked, as quantity was not under direct control of the individual worker due to the work being machine-paced. We did not use computer tasks to measure performance as we wanted to know how the respondents performed on their real tasks and not on a proxy.

The advantage of self-ratings is that the employee himself/herself will usually be the one who is best informed about his or her performance. The disadvantage, however, is that the ratings may be too lenient (Murphy & Cleveland, 1991). If there are indications of a leniency effect, this will be mentioned.

We also obtained production data for each machine in the department. The production data covered a period of 6 weeks before the study was held. We expressly selected a period before the study so that the data could not have been influenced by the workers' awareness that the data would be used.

The production data gave information on the amount of time a machine stood still per day. We were interested in the percentage of stand-still time that was due to material failure. Although the workers mostly could not influence the occurrence of a failure, they did have some influence as a group on the time it took to solve the problem. Unfortunately, only the total time that a machine stood still due to problems with the material was recorded, and not the number of failures. Therefore, we had to assume that there were no great differences between the machines in the number of failures.

In the production department, there were three sub-departments. The sub-departments differed from each other in the diameter of the material that was processed. As the production data suggested that the diameter of the material affected the number of failures, only machines from the same sub-department were compared. The data from one sub-department, in which most 9-hour machines stood, were not used because the only 8-hour machine in this sub-department differed too much from the other machines in the diameter of the material that was processed.

- Effort

Effort was measured using a graphic rating scale (Zijlstra, 1993), which was filled in for each workday during a one-week (9-hour group) or two-week period (8-hour group). The effort ratings were given by putting a mark on a line.

- Satisfaction with working hours

This was measured using a newly constructed three-item, 5-point Likert scale (e.g., All in all, I am satisfied with the hours that I work). The scale was shown to have satisfactory to good reliability in the two previous Chapters.

- Satisfaction with free time

This was measured using a newly constructed two-item, 5-point Likert scale (e.g., I am satisfied with the amount of free time I have). The scale was shown to have satisfactory to good reliability in the two previous Chapters.

Analyses

For both groups, it was first checked if the working week(s) during which the respondents recorded their levels of fatigue, performance, and effort deviated greatly from a normal working week. This was done by asking the respondent at the end of the questionnaire if anything abnormal had happened during this week. If this was the case, the respondent's data were deleted from the analyses of fatigue, performance, and effort. Unfortunately, four of the seven 9-hour respondents were found not to have worked 9-hour shifts in the second half of the week. As a consequence, there was only a complete set of data for the 9-hour group for the first two days of the week.

In the 8-hour group, there were two respondents (out of the 13) who had not worked every workday of the two-week period. Furthermore, three respondents had not filled in the questionnaire for every day or aspect of the week with afternoon shifts. Therefore, the analyses that compare the morning and afternoon shifts of the discontinuous system were only conducted on the eight (fatigue) or nine (performance and effort) respondents who filled in the full two-week period. The effects of day of week were tested separately for the morning shift and the afternoon shift, because the number of workdays per week was not the same for these shifts.

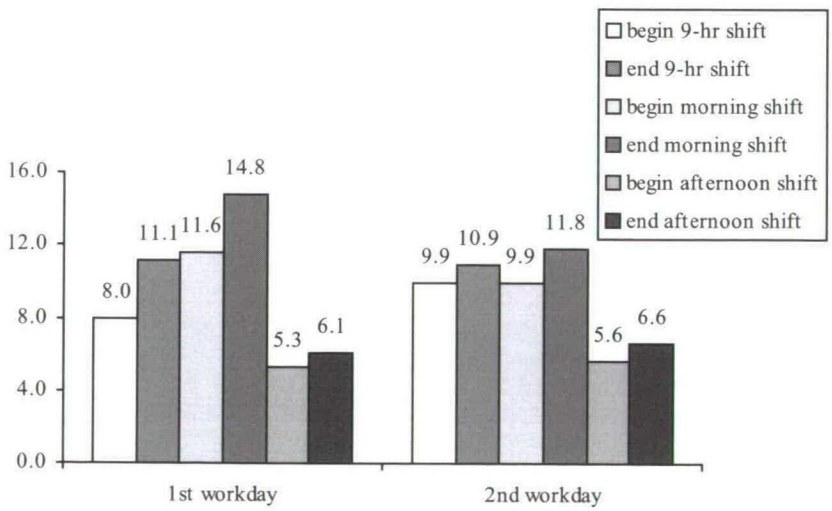
As the number of respondents was quite small, an alpha value of .10 was adopted as the criterion for statistical significance in all analyses. Fatigue, performance, and effort were analysed using repeated-measures analyses of variance. Post hoc analyses of significant interactions incorporated adjustments of the familywise error rate (Bonferroni adjustment). As all post hoc analyses consisted of two follow-up tests, an alpha value of .050 was adopted as the criterion for statistical significance in these analyses. All post hoc analyses consisted of additional analyses of variance, at each level of the factor under investigation. Need for recuperation, health complaints, and satisfaction were analysed using t-tests and analyses of covariance (Ancova).

Results

Fatigue and health

Figure 2 shows the levels of fatigue at the beginning and end of the shifts. The three-way interaction of time of day (beginning vs. end), day of week (1 vs. 2) and shift length (8 hrs. vs. 9 hrs) was not significant in the comparison of the 9-hour shift with the morning shift (crude: $F = 0.13$, $p = .721$; with covariate: $F = 0.14$, $p = .717$). In the comparison of the 9-hour shift with the afternoon shift, there was a significant three-way interaction when age was included as a covariate in the analyses (crude: $F = 1.36$, $p = .263$; with covariate: $F = 3.94$, $p = .069$). However, subsequent tests of this interaction showed that there were no significant effects. The interaction between shift length and time of day was not significant (9-hour vs. morning: crude: $F = 0.04$, $p = .852$; with covariate: $F = 0.42$, $p = .526$; 9-hour vs. afternoon: crude: $F = 0.16$, $p = .691$; with covariate: $F = 0.11$, $p = .742$). In other words, the increase in fatigue between beginning and end of the shift did not differ. The interaction between shift length and day of week was not significant either (9-hour vs. morning: crude: $F = 2.81$, $p = .112$; with covariate: $F = 1.84$, $p = .194$; 9-hour vs. afternoon: crude: $F = 0.08$, $p = .782$; with covariate: $F = 0.14$, $p = .715$), meaning that the 8-hour and 9-hour group's fatigue scores did not evolve differently over days 1 and 2. Furthermore, there was no significant main effect of shift length either (9-hour vs. morning: crude: $F = 0.22$, $p = .647$; with covariate: $F = 1.01$, $p = .329$; 9-hour vs. afternoon: crude: $F = 1.41$, $p = .255$; with covariate: $F = 0.45$, $p = .515$).

Figure 2 Levels of fatigue at the beginning and end of days 1 and 2
0 = low, 57 = high
N(9-hr group) = 7, N(8-hr group - morning) = 12, N(8-hr group - afternoon) = 9



The fatigue scores on the morning and afternoon shifts did differ from each other. There was a significant main effect of type of shift ($F = 6.91$, $p = .034$). As can be seen in Figure 2, the levels of fatigue (both at the beginning and at the end of the shift) were higher on the morning shift. Thus, the reduced sleep length on the morning shift did indeed lead to greater feelings of fatigue.
There was no significant interaction with time of day ($F = 0.51$, $p = .498$), meaning that the levels of fatigue did not *increase* more during the morning shift. With regard to the effect of day of week, the results were somewhat inconclusive. If only the eight respondents who filled in the full two-week period were included in the analyses, then no significant day-effect was found for both the morning and the afternoon shift (morning: $F = 1.70$, $p = .178$; afternoon: $F = 0.22$, $p = .885$). However, if the two respondents who did not fill in the full afternoon week were also included in the analysis on the morning shift, then a significant day-effect was found ($F = 3.32$, $p = .020$); on both the first day and the fifth day of the morning shift, fatigue was higher.
For the 9-hour group, we could not statistically test whether there was a day-effect because only three respondents had worked a full week of 9-hour shifts. If we look at their individual scores, we see that the picture is not clear (see Table 5). One respondent, on average, scored the same on workdays three and four as on days one and two. Two respondents scored higher on fatigue at the end of the workdays three and four compared to workdays one and two.

Table 5 9-hour group: fatigue at the end of the shift
The three respondents who filled in the questionnaire for the full working week

	day 1	day 2	day 3	day 4	day off
Respondent A	4.0	3.0	1.0	6.0	Wednesday
Respondent B	21.0	20.0	27.0	25.0	Monday
Respondent C	19.0	10.0	20.0	23.0	Wednesday

The respondents were also asked if they found their current working pattern as a whole fatiguing. 43% of the 9-hour group indicated that they did, while of the 8-hour group 25% reported this. This difference was statistically not significant (Fisher Exact: $p = .617$). There were no significant differences between the two groups with regard to need for recuperation and health complaints either (see Table 6). The 8-hour group's score on need for recuperation equalled that of a national sample of industrial workers.[9] Health complaints, however, were relatively high.

[9] Data kindly provided by Marc van Veldhoven, Tilburg University.

Table 6 Need for recuperation and health complaints

	9-hr gr.			8-hr gr.			crude		with covariate	
	M	SD	N	M	SD	N	t	p	F	p
Need for recuperation (0 = low, 11 = high)	1.7	2.4	7	2.4	3.0	13	-0.53	.603	1.07	.316
Health complaints (0 = low, 11 = high)	3.2	2.3	7	2.8	2.7	13	0.35	.731	0.21	.655

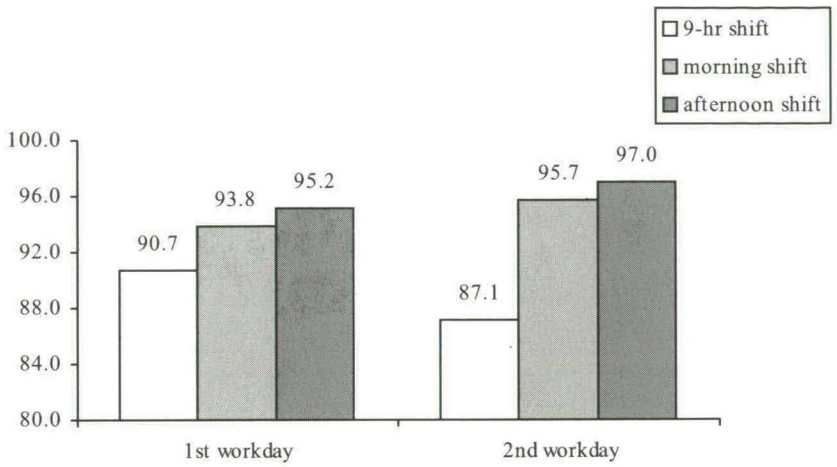
As it may be more difficult for workers to sustain attention for 9 hours, the risk of an accident may be higher on 9-hour shifts. Therefore, the absence records were checked to see whether there had been any workers absent due to work injuries during a one-year period (9 months before and 3 months after our study). Four workers had been absent due to a work-related injury: two had sustained this injury on the 9-hour shift, one on the morning shift, and one on the afternoon shift. All these injuries occurred during a period when about half the employees worked 9-hour shifts and the other half worked the discontinuous shift system. Hence, there seemed to be no differences between the two shift systems in the risk of sustaining an injury.

Performance

Figure 3 shows the performance scores of the 8-hour and 9-hour groups. The scores were quite high. Probably, the perceptual-motor skills the work requires, become highly automated over time. Furthermore, if the workers do not put the material into the moulds in time, they run the risk that their fingers will come under the press.

The 9-hour group did not differ significantly from the 8-hour group's morning shift in the quality of performance (crude: $F = 2.56$, $p = .129$; with covariate: $F = 1.00$, $p = .332$). However, the comparison with 8-hour group's afternoon shift found both a significant main effect of shift length ($F = 4.80$, $p = .045$) and a significant interaction between day and shift length ($F = 4.85$, $p = .044$). These effects remained significant after controlling for the effects of age (main effect: $F = 3.55$, $p = .081$; interaction effect: $F = 7.18$, $p = .018$). Subsequent tests of the interaction showed that the 9-hour group scored significantly lower on the quality of performance on the second workday (crude: $t = 2.32$, $p = .053$; with covariate: $F = 6.43$, $p = .024$), but not on the first (crude: $t = 1.36$, $p = .194$; with covariate: $F = 0.89$, $p = .360$).

Figure 3 Quality of performance during the first two days of the week
0 = low, 100 = high
N(9-hr group) = 7, N(8-hr group - morning) = 11, N(8-hr group - afternoon) = 10



There was no significant difference between the performance scores on the morning and the afternoon shifts ($F = 2.77$, $p = .135$). Furthermore, there was no significant day-effect for both shift types (morning shift: $F = 1.36$, $p = .269$; afternoon shift: $F = 2.02$, $p = .138$). The individual scores of the 9-hour group revealed that there seemed to be no consistent day-effect for this shift length either (see Table 7). One 9-hour respondent had the same scores across all days of the week, one respondent scored lower on workdays 1 and 2 compared to workdays 3 and 4, and the third respondent scored lower on days 3 and 4.

Table 7 9-hour group: quality of performance
The three respondents who filled in the questionnaire for the full working week

	day 1	day 2	day 3	day 4	day off
Respondent A	100	100	100	100	Wednesday
Respondent B	85	70	80	85	Monday
Respondent C	95	95	80	70	Tuesday

The production data pertaining to the stand-still time are shown in Table 8. For all three shift types, the percentage of time the machines stand still due to material failure was averaged over the first four days of the week. This was done because there is no afternoon shift on the fifth workday, Friday.
If the difference between shifts in the percentage of stand-still time was more than 1, we concluded that there was a reliable difference. For example, if the afternoon shift had a stand-still time of 3.0% and the morning shift a stand-still time of 4.1%, it was concluded that performance was poorer on the morning shift. A stand-still time of 1% represented a stand-still time of 5.4 minutes per day on the 9-hour shift and 4.6 minutes on the discontinuous system.
The average percentage of stand-still time was calculated for all 6 weeks for which we had data separately. As mentioned before, only machines within the same division were compared, as the diameter of the material that is processed differed between divisions.

Table 8 Stand-still time due to material failure averaged over the first four days of the week

	Division Y				Division Z			
	Number of machines		Stand-still time		Number of machines		Stand-still time	
Week	9-hr	disc. syste m	9-hr vs. disc. syst.	morn. vs. a'noon	9-hr	disc. syste m	9-hr vs. disc. syst.	morn. vs. a'noon
14	1	2	9 < m & a	m > a	1	5	9 > m & a	m = a
15	0	3	-	m < a	1	4	9 < m & a	m < a
17	-	-	-	-	1	4	9 < m; 9 = a	m > a
19	0	3	-	m = a	1	5	9 < m; 9 = a	m > a
20	0	3	-	m = a	1	3	9 > m & a	m = a
24	0	3	-	m > a	1	3	9 > m & a	m > a
Total			9 < m: 1x	m > a: 2x m = a: 2x m < a: 1x			9 > m: 3x 9 < m: 3x	m > a: 3x m = a: 2x m < a: 1x
			9 < a: 1x				9 > a: 3x 9 = a: 2x 9 < a: 1x	

Legend: 9 : 9-hour shift
m : morning shift
a : afternoon shift
= : difference in % of stand-still time is less than 1
> : % of stand-still time is more than 1 longer
< : % of stand-still time is more than 1 shorter

Note: The number of machines on the morning and the afternoon shift was always the same

Table 8 shows that there was no clear difference between the 9-hour group and the morning shift in the percentage of stand-still time. However, there was an indication that stand-still time was longer during the 9-hour shift and the morning shift, when compared to the afternoon shift. The difference was not very marked, though, and was only found in division Z.

Of course, it is possible that the effects of shift type were obscured by differences between crews. For the discontinuous system, it could be checked if this was the case.

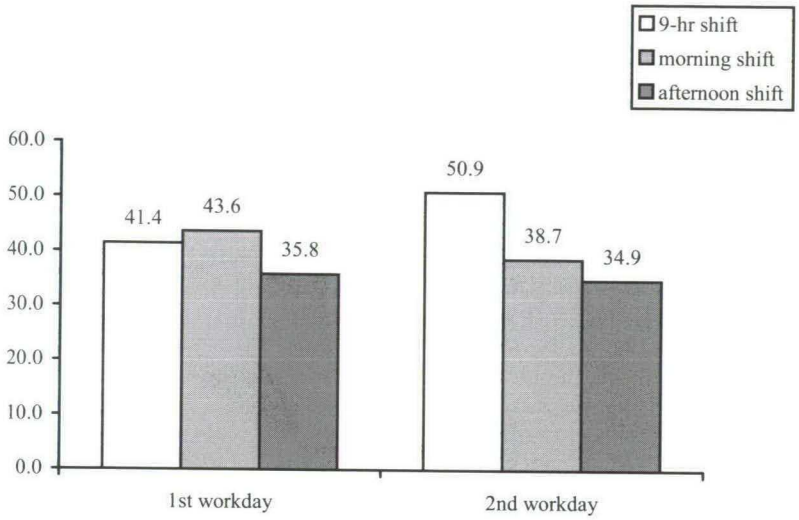
We selected those crews of which we had at least scores over both two morning and two afternoon weeks. The percentage of stand-still time was then averaged over the morning and afternoon weeks separately. There were six machines of which there were enough data on both crews that worked on the machine. On all six machines, one crew scored consistently better than the other crew. The ratio between better and poorer crew varied between 1.04 and 2.43.

If the poorer crew was on the morning shift, the ratio between better and poorer crew became larger for four of the machines. For one of the machines, the ratio remained the same, and for the sixth machine the ratio became smaller. The fact that, for the majority of the machines, differences in percentage of stand-still time increased when the poorer crew was on the morning shift again indicates that performance was negatively affected on the morning shift. Probably, this was due to the higher levels of fatigue on the morning shift. However, it should be noted that the differences between shifts were rather small compared to the differences between crews. Of course, an alternative interpretation for the poorer performance on the morning shift could be that there were difficulties in starting up the production process in the morning. Unfortunately, our data did not allow us to rule out that possibility.

Effort

Figure 4 shows the levels of effort expended by the respondents. There was no main effect of shift length (9-hr vs. morning: crude: $F = 0.17$, $p = .686$; with covariate: $F = 0.03$, $p = .859$; 9-hr vs. afternoon: crude: $F = 0.62$, $p = .446$; with covariate: $F = 0.56$, $p = .468$). Although the interaction between shift length and day of the week was significant (morning shift: crude: $F = 5.88$, $p = .026$; with covariate: $F = 3.86$, $p = .066$; afternoon shift: crude: $F = 4.89$, $p = .044$; with covariate: $F = 4.90$, $p = .045$), follow-up tests indicated that the 9-hour group did not differ from the 8-hour group on any of the workdays (morning shift: 1st day: crude: $t = 0.19$, $p = .855$; with covariate: $F = 0.10$, $p = .761$; 2nd day: crude: $t = 0.92$, $p = .368$; with covariate: $F = 0.37$, $p = .551$; afternoon shift: 1st day: crude: $t = 0.45$, $p = .661$; with covariate: $F = .017$, $p = .687$; 2nd day: crude: $t = 1.05$, $p = .311$; with covariate: $F = 1.03$, $p = .329$).

Figure 4 Levels of effort expended during the first two days of the week
0 = low, 150 = high
N(9-hr group) = 7, N(8-hr group - morning) = 13, N(8-hr group - afternoon) = 9



In the 8-hour group, the scores on the morning and afternoon shifts did not differ from each other ($F = 1.63$, $p = .237$). For the afternoon shift, there was no significant day-effect ($F = 1.68$, $p = .199$), but for the morning shift there was ($F = 3.80$, $p = .012$); on the morning shift, effort increased every two days during the week. For the 9-hour group, a look at the individual scores showed that the amount of effort also seemed to increase during the week. For all three respondents, effort was highest on workday 4 (see Table 9).

Table 9 9-hour group: levels of effort expended
The three respondents who filled in the questionnaire for the full working week

	day 1	day 2	day 3	day 4	day off
Respondent A	28	40	25	49	Wednesday
Respondent B	72	102	102	114	Monday
Respondent C	40	39	61	74	Wednesday

Satisfaction with working hours and free time

Table 10 shows how satisfied the respondents were with their working hours and free time. Satisfaction was reasonable to good. It had been hypothesised that satisfaction would be higher in the 9-hour group than in the 8-hour group. Although the differences between the two groups tended towards the expected direction, they were not significant. Thus, the hypothesis was not confirmed.

Table 10 Satisfaction with working hours and free time

	9-hr gr.			8-hr gr.			crude		with covariate	
	M	SD	N	M	SD	N	t	p	F	p
Satisfaction with working hours (1 = low, 5 = high)	4.3	0.8	7	3.7	1.0	13	1.36	.190	2.18	.158
Satisfaction with free time (1 = low, 5 = high)	4.0	1.2	7	3.4	1.3	13	0.98	.340	2.79	.113

Conclusion and discussion

Our review of CWWs with and without nights in industrial work showed that the first often had positive effects on employee health while the second had not. We attributed these positive effects to the fact that CWWs with nights reduce the number of nights to be worked and often also reduce the number of working hours per sequence. The effects on fatigue, performance, and satisfaction with working hours and free time were the same: both arrangements had no or negative effects on fatigue and performance, and led to greater satisfaction.

However, the number of studies on CWWs without nights was too small to provide a reliable picture of the effects of this arrangement. Therefore, a study on a 4-day, 9 hours per day working week without nights was conducted. It was hypothesised that the effects mentioned above would be replicated. The study also investigated whether employees do indeed first try to protect performance from the effects of fatigue, as has been suggested by Hockey (1997). If they do so, they may be expected to expend more effort when fatigued. As previous studies on CWWs in industrial work had shown that fatigue and performance decreased about as often, there seemed to be no evidence for performance protection. However, we hypothesised that, by directly measuring effort, some evidence for performance protection might be found.

Unfortunately, the number of participants in our study was very small, which limited the power of our analyses. However, a definite plus of our study was that it also comprised production data. Although it is often advised to get objective data on workers' real performance, it is only seldom achieved.

The results of our study partly confirmed our hypotheses. There were no differences in health, as we had expected. Performance (both self-report and production data) was somewhat lower for the 9-hour group, which suggests that the 9-hour workdays were indeed somewhat more demanding. However, the hypotheses regarding fatigue, effort, and satisfaction with working hours and free time were not confirmed. The 8-hour and 9-hour groups did not differ on these aspects. As the differences in satisfaction were large and in the expected direction, the absence of a significant effect may have been due to our small sample size.

The fact that negative effects on performance were found, but no increases in fatigue and effort, seems to contradict Hockey's notion of performance protection. However, the absence of evidence for performance protection was in line with the results of earlier studies on CWWs in industrial work.

In Chapter 3, which addressed extended shifts in nursing, both the review and our own study did find some evidence for performance protection. The difference in performance protection between nursing and industrial work may be due to the fact that performing less well if fatigued is considered less acceptable if one works with persons rather than objects. Furthermore, it may also be more difficult to reduce performance when dealing with persons because they may ask for attention (which objects evidently cannot do).

The finding that the workers in this study did not try to prevent the extended workdays from having an effect on performance may also be due to the fact that their work was physically quite demanding; their level of musculoskeletal complaints was already quite high. If they had let their performance come first, then the levels of complaints might have been even higher. It might also be that they did try to protect performance during the first months they worked 9-hour shifts, but that they learnt that it was better for their health if they did not do this. However, it should be noted that the effects on performance were not very marked. The lower performance was only found on the second workday but not on the first. The difference in the production data was not that large either. Furthermore, effort did increase during the week for the three respondents of whom we had a complete set of data. This suggests that, although the workers did accept some decreases in performance due to fatigue, they still tried to protect performance when it was bound to drop below a certain set point.

As health was not affected in our study, this may indicate that CWWs without nights do indeed not have the favourable consequences for employee health CWWs with nights often have. More research is, however, needed, as the number of studies on CWWs without nights is still very small. Research should also be done on the question *why* CWWs with nights often have favourable effects on health. Is it the smaller number of nights to be worked or the smaller number of consecutive shifts? Furthermore, our review of extended shifts in *nursing* showed that 12-hour shifts in general did not improve the health of this group. The reasons for this should also be investigated. For example, the higher physical and emotional workload in nursing (as compared to that of operators) may make extended shifts more demanding. This may then offset the positive effects of having to work fewer nights. It may also be that the nurses, who are mostly female, still spend some time on household duties and childcare after work hours when on a 12-hour shift and that the industrial workers, who are mostly male, do not do this. If this is the case, the nurses will have less time for recuperation. If this explanation is true, it may mean that extended shifts are less suitable for employees with many domestic obligations. A third reason for the more negative effects in nursing may be that, in this type of work, long stretches of night shifts are sometimes still scheduled, even with 12-hour shifts (see, for example, the schedules given by Eaves (1985); Hodgson (1995)). As all these suggestions, if true, may provide guidelines for the design of better work schedules, they should be investigated.

5 The impact of schedule, work, and personal characteristics on the effects of extended workdays

Abstract

Many researchers have warned that extended workdays should not be used in certain situations, for example not when the physical workload is high. They suspect that in these cases, the effects of extended workdays on fatigue and health
may be aggravated. However, only few studies have investigated which factors actually moderate the effects of extended workdays. Therefore, a study on some potentially important moderators was conducted. The study addressed the impact of five categories of moderators: employee choice, time since implementation, and schedule, work, and personal characteristics. It looked at the impact of these moderators on the effects of extended workdays on fatigue, health, performance, and satisfaction with working hours and free time. The data used in the study came from two previous studies on 9-hour workdays; one in office work and one in nursing. It was concluded that the most important factors that aggravate the effects of 9-hour workdays were: a high physical and/or emotional workload, having no choice in workday length, a poorer health status, and working more than four consecutive 9-hour workdays. There were some negative effects of taking courses in one's spare time and a longer commuting time. Time since implementation, time the workday starts, the length of the meal break, age, childcare obligations, and a high work pace/workload combined with little decision latitude did not act as moderators.

Introduction

Around the 1850s, employees often had to work very long hours, such as five or six 11-hour to 12-hour days. Under strong pressure by some progressive politicians and factory owners, and the labour movement, working hours have been reduced substantially since then (Karsten, 1989). Nowadays, the regular workday in most Western countries is 8 hours. Full-timers often work these hours five days a week (5/40).

Besides the regular 5/40 working week, there are also alternative ways of arranging working hours. One of these is the compressed working week (CWW). Under a compressed working week, employees work more than 8 hours per day (e.g., 10 or 12 hours), but less than five days a week (e.g., 4 or 3 days) (Tepas, 1985).

The main advantage of the CWW for employees is that it provides them with more days off (e.g., Colligan & Tepas, 1986). This may increase their satisfaction with working hours and free time. Some organisations implemented a CWW because they expected that this increase in satisfaction would motivate their employees to work harder and thus improve productivity (e.g., Poor, 1970).

The main disadvantage of the CWW is the higher fatigue the longer workday may lead to (e.g., Colligan & Tepas, 1986). This, in turn, may negatively affect health and performance. However, it has been suggested that in the case of nightwork, CWWs may be beneficial to employees' health. If the shift is extended from 8 to 12 hours, fewer nights have to be worked and so circadian disruption may be less (e.g., Baker et al., 1994; Wallace et al., 1990).

Reviews of studies on the actual effects of the CWW (e.g., Baltes et al., 1999; Ronen & Primps, 1981; L. Smith et al., 1998; Thierry & Jansen, 1996; Thierry & Meijman, 1994) have found that satisfaction with working hours and free time is indeed generally higher under a CWW. With regard to the effects on fatigue, health, and performance, however, the results have been mixed.

We have suggested earlier (see Chapter 2) that the reason for the mixed findings may be that the effects of a CWW depend on the situation in which it is used. Therefore, if only extended workdays used in the same type of situation are reviewed together, the results may be more consistent.

Separate reviews we conducted of the effects of extended workdays in office work, nursing, and industrial work gave some support for this assumption. Within these types of work, the results seemed to be less equivocal. The reviews also showed that the effects of extended workdays differed between these types of work. For example, 12-hour day and night shifts had more negative effects on fatigue and health in nursing than in industrial work (mostly operator work). This may be due to the fact that the first type of work is more physically demanding: a high physical workload is the most often named aspect in recommendations on when *not* to use extended workdays (see, for example, the recommendations by Burrow & Leslie, 1972; Knauth, 1993, 1996; Kogi, 1991; Meijman, 1992; Stafford et al., 1988). Also, some field studies on 11-hour or 12-hour shifts that found many negative effects have attributed this to a high physical workload (e.g., heavy industrial work: Bourdouxhe et al., 1999; nurses: Havlovic et al., 1998).[10]

However, our reviews also showed that there were no large differences between the effects of 9-hour or 10-hour workdays in office work and industrial work, although the physical workload in the latter type of work is also higher. In both types of work, 9-hour or 10-hour workdays had slightly negative effects on fatigue and performance, and no effects on health. This may indicate that a high physical workload only moderates the effects of workdays that are extended considerably. However, a study on 9-hour shifts we conducted, showed that this shift length did have many negative effects on fatigue and health in nursing (see Chapter 3). Therefore, the explanation given above is not very likely. Instead, it may be that the industrial workers had fewer problems with working under a high physical workload for a few extra hours per day because of their greater physical strength (most of them were males[11]). It may also be that the nurses did not want their patients to suffer from their higher levels of fatigue and, therefore,

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[10] However, Duchon and co-workers (1994, 1997) found that 12-hour shifts in underground mining, which is physically very demanding, did not have many negative effects on fatigue and performance. It should be noted, however, that the miners were lodged on-site, which means that non-work activities were restricted (Rosa, 1995). Also, there was some evidence of a pacing effect (Duchon et al., 1997).

[11] In a small empirical study (Josten et al., 1999), we found that female cleaners, whose physical workload is also quite high, had many problems with working 9-hour workdays as well. However, as there were no male cleaners in the organisation where the study was conducted, we do not know whether they would have had fewer problems with this shift length.

tried to protect their performance longer by expending more effort. If they did so, this would have increased their levels of fatigue even more. The industrial workers may not have expended as much effort, because they work with objects; letting these suffer from the effects of fatigue may be considered more acceptable. Thirdly, it may also be that it is the combination of a high physical *and* emotional workload that nursing is known to have (e.g., van Veldhoven et al., 1999) which makes this type of work less suitable for extended shifts.
Besides the type of work (whether or not in combination with being male or female), there may, of course, also be other factors that moderate the effects of extended workdays. However, little research has actually addressed the impact of potential moderators. The few studies that have been done on this topic mostly investigated the impact of individual characteristics, such as age.
The factors that have been named as potential moderators can be divided into:

- degree of employee choice or say in the length of the workday (Tucker et al., 2000);
- time since implementation (Baltes et al., 1999);
- characteristics of the schedule (e.g., number of consecutive workdays) (Cunningham, 1989; Rosa, 1995, 2000; Tucker et al., 2000);
- characteristics of the work situation (e.g., physical workload) (Cunningham, 1989; Ronen & Primps, 1981; Rosa, 1995, 2000; Tucker et al., 2000);
- characteristics of the individual worker (e.g., age) (Cunningham, 1989; Ronen & Primps, 1981; Rosa, 1995, 2000; Tucker et al., 2000).

Employee choice or say may moderate the effects of extended workdays, because if employees have some choice or say, they will probably choose, or vote for, a system that suits them best. Thus, there may be less negative and more positive effects if employees have some choice or say. Time since implementation may act as a moderator, because the effects of extended workdays may change over time. For example, employees may need some time to get used to working extended workdays (i.e., a change in a positive direction), or there may be an accumulation of fatigue taking its toll after some time (i.e., a change in a negative direction).
For the factors in the other categories, it is not always made clear through what mechanism they may moderate the effects of extended workdays. However, they all represent one or more of the following situations:

- demands made on the worker in his work or personal situation that in itself may already increase the levels of fatigue (e.g., a high physical workload; being the primary caretaker at home);
- characteristics of the worker's work, his schedule, or his personal situation that may restrict his time for recuperation (e.g., a higher number of consecutive workdays; being the primary caretaker at home). As too little time for recuperation may mean that the worker is not fully rested when starting his workday, this may also increase the levels of fatigue;
- characteristics of the worker that may make him more easily fatigued (e.g., a higher age).

If a worker is fatigued while working, then he will have to expend extra effort to maintain performance. This, in turn, will increase the levels of fatigue even more (i.e., a build up of fatigue). As a result, the time needed for a full recuperation will be longer (Meijman, 1989; Meijman & Mulder, 1998). Extended workdays may be expected to amplify this process, because the expenditure of effort has to

be sustained longer and there is less time for recuperation between consecutive workdays.
However, only few studies have investigated what factors moderate the effects of extended workdays. Therefore, we decided to conduct a study on some potential moderators. The study restricted itself to the impact of the potential moderators on fatigue, health, performance, and satisfaction with working hours and free time. An aspect was included in the study if:

- previous studies had shown that that aspect may moderate the effects of extended workdays;

or,

- researchers have advised against, or expressed some concern about, the use of extended workdays when that aspect is present.

It should be noted that in the latter case it is not always clear if the researcher expects that aspect to truly *aggravate* the effects of extended workdays (multiplicative effect). It may also be that he/she feels that the load of the extended workdays *plus* the load of that aspect may be too high (additive effect). Only in the first case is the aspect truly a moderator.
As the study used an existing data set collected for two previous studies on extended workdays, this placed some further limitations on the potential moderators that could be included. Table 1 summarises which potential moderators were finally selected. In the next section, the potential moderators are described in more detail. This is followed by a discussion of the data set and its limitations. Here, it suffices to say that both previous studies had addressed the effects of 9-hour workdays. One study was conducted in office work, the other in nursing.

Table 1 The potential moderators included in this study

Employee say or choice in length of the workday
Time since implementation
Other characteristics of the schedule
· Number of consecutive workdays
· Time the workday starts
· Length of the meal break
Characteristics of the work situation
· High work pace/workload combined with little decision latitude
Characteristics of the individual worker
· Age
· Health status
· Childcare duties
· Taking courses in one's spare time
· Commuting time

The potential moderators

A. Employee say or choice in length of the workday

Employees can have an influence on their schedules in several different ways (L. Smith & Barton, 1994). First, they can be given some *say during the process* of designing the schedules. For example, they can be presented with some schedules and then be given the opportunity to vote for one of these. Second, it may be that they can *choose a schedule* for themselves, from a number of potential schedules. Third, they can be given some *influence on one or more features* of the schedule, as is, for instance, the case with flexitime (flexible start and end times). Here, we interpret this latter possibility as having choice in a feature other than the length of the workday itself.

It has been argued (e.g., Aguirre, 2000; Hatch Woodward, 2000; L. Smith et al., 1998) that employee say or choice in working extended workdays will lead to extended workdays having more positive effects. If employees have some *say* in the decision to implement extended workdays (e.g., by a vote), a schedule may be selected that best fits the personal needs of the majority of the workers. Thus, if there is say, the resulting workday length may not necessarily suit every individual.

If employees can *choose* the length of their workday, each employee can have that workday length that suits him or her best. Employees who expect that extended workdays will be too fatiguing may remain on 8-hour workdays. Employees who have changed to extended workdays but find these too fatiguing, may return to 8-hour workdays. Thus, if there is choice, there will probably be a process of self-selection, which may result in each employee having that workday length that suits him best.

Influence on a feature of the schedule (other than the length of the workday itself) has, to our knowledge, not been named as an aspect that may moderate the effects of extended workdays. However, it can be hypothesised that an influence on some specific features of the schedule (e.g., on the number of consecutive workdays worked) may make the schedule better suited to the individual and, therefore, may restrict possible negative effects. Influence on a feature of the schedule will probably have a less strong impact than employee say or choice, because the central aspect itself, the length of the workday, cannot be adjusted.

A study by Latack et al. (1983) on 12.5-hour days in computer operators offered some support for the impact of employee *say*: employees who had had no say in the schedule, were found to be less satisfied with the 12.5-hour days. In a review of extended workdays in nursing (see Chapter 3), some evidence for the impact of employee *choice* was found. In the two studies in which the employees had had no choice in the length of the workday (1. Blanchflower, 1986; 2. Todd et al., 1989, 1993, Reid et al., 1993) more negative effects on fatigue, health, performance, and satisfaction were found. A study by Frietman et al. (1991) also offered some support for the impact of employee choice. In this study, workers who had joined the company after the implementation of a schedule of four 9-hour days were more positive about the schedule than workers who had already been working with the company before the implementation. As the first group of workers knew that they would have to work extended days, only workers who were positive about it may have applied.

All in all, the research done so far does indeed indicate that employee say and choice have a positive impact on the effects of extended workdays. This study could only test the impact of employee choice. Our hypothesis was that:

Hypothesis 1: *Employee choice will have a positive impact on the effects of extended workdays on fatigue, health, performance, and satisfaction with working hours and free time.*

This study also included an exploratory analysis of whether employees with different reasons for choosing to work extended workdays experience different effects.

To our knowledge, the impact of *influence* on some features of a schedule with extended workdays has not been addressed so far. Therefore, our analysis of this aspect was of an exploratory nature.

B. Time since implementation

Regarding the impact of time since implementation, three different hypotheses have been put forward. The first is that the effects of extended workdays will become more positive over time, because employees will need some time to get used to working this arrangement. According to the second hypothesis the reverse trend may be expected; the effects of extended workdays will gradually become less positive, because the novelty of the change will wear off after some time (Baltes et al., 1999; Gannon, 1974). The third hypothesis also states that a negative trend may be expected, but then because of a build up of fatigue over time. In practice, the effects described by the second and the third hypothesis may be difficult to distinguish.

So far, no overwhelming proof for any of the hypotheses has been found. Some studies (Breaugh, 1983; Foster et al., 1979/Latack & Foster, 1985) showed that employees who were already working extended workdays were more positive about this arrangement than employees without that experience. This seems to support the first hypothesis. However, a study by Ivancevich & Lyon (1977) on 10-hour days found a negative trend: the initial positive effects on performance found 13 months after implementation, had disappeared 12 months later. Ivancevich and Lyon attributed this to a wearing off of the novelty of the change. However, as they did not measure the effects on employees' fatigue it cannot be ruled out that the disappearance of the positive effects may have been caused by a build up of fatigue. In a meta-analysis of CWWs without nights (Baltes et al., 1999), it was concluded that time since implementation did *not* moderate the effects on performance. Also, Maklan (1977) found that the time employees had been working extended workdays was not related to the degree of satisfaction with the schedule. In our reviews of the effects of extended workdays in nursing and in industry (see Chapters 3 and 4), no effects of time since implementation were observed either. Thus, most evidence indicates that time since implementation does not moderate the effects of extended workdays. Here, only the impact of time since implementation on the effects of extended workdays on fatigue was tested. Our hypothesis was that:

Hypothesis 2: *Time since implementation will have no impact on the effects of extended workdays on fatigue.*

C. Other characteristics of the schedule

1. Number of consecutive workdays

The more consecutive workdays an employee has to work, the longer he has to wait before he has some days off to recuperate. Therefore, having to work more workdays in a row may lead to a higher build up of fatigue. Consequently, health and performance may also be more negatively affected. With regard to satisfaction with working hours and free time, the impact of a higher number of consecutive workdays will depend on what employees value more: larger blocks of free time, or health benefits (and/or frequent but shorter blocks of free time).

The impact of the number of consecutive extended workdays on health and satisfaction has, to our knowledge, not been investigated so far. The impact on fatigue and performance has, mostly in connection with 12-hour shifts. With regard to this shift length, several authors (e.g., L. Smith et al., 1998; Wallace & Greenwood, 1995) have advised against the use of more than 3 or 4 consecutive shifts.

Some studies in industry have shown that fatigue (Lowden et al., 1998, Rosa et al., 1989; Rosa, 1991) and performance (Lowden et al., 1998; Rosa et al., 1989; Rosa, 1991; Rosa & Bonnett, 1993) indeed did not evolve differently across sequences of two to four 12-hour shifts, compared to sequences of five to seven 8-hour shifts. However, one of these studies (Rosa & Bonnett, 1993) found that positive mood did decrease across a sequence of three 12-hour shifts, whereas it did not across a sequence of seven 8-hour shifts. A study by Tucker et al. (1999), which was also conducted among industrial workers, indicated that working two 12-hour shifts in a row was only slightly less fatiguing than working four 12-hour shifts in a row.

However, in some cases working four consecutive 12-hour shifts may already be too much. For example, some articles on 12-hour shifts in nursing (Crump & Newson, 1975; Niemeier & Healy, 1984; Wootten, 2000) reported that the nurses did not like working more than three shifts in a row. The nurses said that if they had to work more shifts in a row than that, this led to excessive fatigue.

In a study on 9.5-hour workdays (with a rotating free day) in industry (Frietman et al., 1991), it was demonstrated that most workers (82%) did not consider these days in themselves to be more fatiguing than 8-hour days. However, working four 9.5 days *in a row* was considered problematic by more than half (63%) of the workers.

In this study, both the impact of working two or three versus four extended workdays in a row and working four versus five extended workdays in a row was addressed. This allows us to establish where the turning point is. Our hypothesis was based on the results of the only study on 9.5-hour days, as 9.5-hour days resemble the workday length investigated in this study (9-hour workdays) best. It was assumed that the impact on performance and health would be the same as that on fatigue. Thus, our hypothesis was that:

Hypothesis 3: *The higher the number of consecutive workdays is, the more negative (or less positive) the effects of extended workdays on fatigue, health, and performance will be.*

The analysis of the impact on satisfaction with working hours and free time was of an exploratory nature.

2. Time the workday starts

Several studies on 8-hour shifts have shown that workdays with early starts (before 7:00 a.m.) lead to more fatigue, a lowered performance, and sometimes also to more health complaints. This is due to the fact that sleep length before the morning shift is in general much shorter (and sleep quality much poorer) with early starts (e.g., Tucker et al., 1998). Some researchers (e.g., Knauth, 1993; Meijman, 1992), therefore, advise against a combination of early starts with extended workdays, because early starts might compound the effects of extended workdays on fatigue, performance, and health. The impact on satisfaction will probably depend on what employees value more: social advantages (i.e., more free time during the afternoon and evening of a workday) or less fatigue and/or a better health.

To our knowledge, no study has so far addressed the impact of early starts on the effects of extended workdays on performance. The impact on fatigue, health, and satisfaction was investigated in two studies. Both concerned 12-hour shifts in industrial work. In one study, a start-time of 6:00 vs. 7:00 was compared (Tucker et al., 1998). The other study compared a start time of 6:00 vs. 7:15 (L. Smith, Hammond, Macdonald & Folkard, 1998). The first study found that early starts did not aggravate the effects of extended shifts on health. There was also no difference between the systems in the effects on satisfaction with working hours. The second study, however, found that alertness, mental well-being, and satisfaction with working hours were better on the 12-hour shift with the later start.

However, in the latter study, the two systems differed not only in start time. The system with the later start time also offered employees the opportunity to change duty times, within certain constraints, while the other system did not. The authors attributed the differences in effects mainly to this difference in flexibility. Therefore, there is no convincing evidence for the impact of start time.

Taken together, the recommendations and the results of the empirical studies do not clearly refute nor support a relation between start time and the effects of extended workdays. Therefore, no hypothesis was formulated. The analysis was of an exploratory nature.

3. Length of the (meal) break

A longer meal break may give employees more time to recuperate during the extended workday. Therefore, a longer meal break may be expected to have a positive impact on the effects of extended workdays on fatigue, health, and performance. With regard to satisfaction with working hours and free time, the effects may depend on what employees value more: being home earlier (thus a shorter meal break) or their fatigue and health.

Both Meijman (1992) and Rosa (1995) recommend that the length of the (meal) break should be liberal on extended workdays. We only found one study that briefly addressed the issue of length of the meal break in relation to extended workdays. In this study (Wootten, 2000), which was conducted among nurses, it was reported that the employees wanted a one-hour uninterrupted meal break when working 12-hour shifts.

On the basis of this study and the recommendations made by Meijman and Rosa, our hypothesis was that:

Hypothesis 4: *The shorter the meal break is, the more negative (or less positive) the effects of extended workdays on fatigue, health, and performance will be.*

The analysis of the impact on satisfaction with working hours and free time was of an exploratory nature.

D. Characteristics of the work situation

1. Work pace/workload and decision latitude

Karasek's (1979) well-known demand-control model postulates that high work demands (or work pace/workload) combined with little decision latitude will negatively affect employees' health. Furthermore, it has also been derived from the model that a high decision latitude will buffer the potentially negative effects of high work demands, although there is some controversy about whether the model does indeed predict this (van der Doef & Maes, 1999). If decision latitude buffers the negative effects of high work demands, empirical studies should find a statistically significant interaction between work demands and decision latitude. However, in general, this interaction has not been found (see, for instance, the review by de Lange et al., 2001).

The research has demonstrated that work demands and decision latitude do have separate effects. This means that a combination of a high work pace/workload with little decision latitude is still the most harmful because of these added-up effects. However, as de Lange et al. (2001) showed, within the same study often only one of these factors had a significant effect.

Meijman (1992) advises against the use of extended workdays in work characterised by the combination of a high work pace/workload with little decision latitude, because he expects that this combination will be too demanding. Rosa (1995) pointed out that little decision latitude in itself may already exacerbate the effects of extended workdays, as it may restrict the opportunity for informal breaks during the workday. By taking one or more informal breaks, employees can reduce fatigue.

If high work demands combined with little decision latitude do indeed compound the effects of extended workdays on fatigue and health (and consequently performance), then satisfaction may also be expected to suffer. To our knowledge, no study has investigated whether this combination does indeed aggravate the effects of extended workdays.

However, there is some anecdotal evidence for the negative impact of one of the factors in this combination, a high work pace/workload. Palmer (1991) reported that nurses who had changed from an Intensive Care Unit to a medical unit sometimes requested to be transferred from 12-hour to 8-hour shifts. In her view, the reason for this was that the medical units were busier; in these units, a nurse has to take care of more patients. In a study by Hodgson (1995), one nurse (out of the fifteen) remarked that "12-hour shifts can be long hours when the hospice is busy". Also, Wynn (in Duchon & Smith, 1993), reported the remark by some employees that "on particularly stressful days, 12-hour shifts are more fatiguing".

As both high work demands and little decision latitude[12] were related positively and significantly to a measure for fatigue, viz. need for recuperation, in the samples used in this study,[13] this study will focus on the impact of the combination of the two. On the basis of the results mentioned above, we expected that:

Hypothesis 5: *A high work pace/workload combined with little decision latitude will have a negative impact on the effects of extended workdays on fatigue, health, performance, and satisfaction with working hours and free time.*

E. Characteristics of the individual worker

1. Age

It is sometimes remarked that older workers may have poorer health and/or need more time to recuperate. Therefore, extended workdays are sometimes expected to be more demanding for them. If this is true, this can make them, as a consequence, less enthusiastic about extended workdays (e.g., Ronen & Primps, 1981; L. Smith et al., 1998).

However, although the majority of the studies on this topic did show that older workers were less positive about both actual (Atos, 1998; Goodale & Aagaard, 1975; Jansen & van den Brink, 1991; Kundi et al., 1995; Maklan, 1977; Todd et al., 1991) and proposed CWWs (Dunham & Hawk, 1977; Kenny, 1974; Mahoney et al., 1975), mostly no relation between age and the effects on fatigue and performance were found. For example, Atos (1998), Keran et al. (1994), Todd et al. (1991), and Tellier (1974) found no relation between age and fatigue. Calvasina & Boxx (1975) and Keran et al. (1994) concluded that there was no relation with performance. And in the study by Colt & Corley (1974), it was the nurses between 25 and 44 years of age who were the least positive about the effects of 12-hour shifts on performance. Nurses under 25 years of age or over 40 were more positive. Only two of the studies we found, reported that older workers were more fatigued (deCarufel & Schaan, 1990; Frietman et al., 1991) and/or performed poorer (deCarufel & Schaan, 1990) when on extended workdays. Why older workers are still less positive about extended workdays, if it mostly does not affect their levels of fatigue, is not clear.

Whether the effects on extended workdays on health are different in different age groups has, to our knowledge, not been studied. However, it is unlikely that health will be affected if fatigue is not. Thus, our hypotheses were that:

Hypothesis 6: *A higher age will have no impact on the effects of extended workdays on fatigue, health, and performance.*

Hypothesis 7: *The older an employee is, the less positive (or more negative) the effects of extended workdays on satisfaction with working hours and free time will be.*

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12 Karasek defines decision latitude as a combination of decision authority and skill variety. The measure we used for decision latitude only comprised aspects of job autonomy (or decision authority).

13 Regression analysis office workers: work pace/workload: beta = 0.28, p = .000; decision latitude: beta = -0.27, p = .000; N = 259. Regression analysis nurses: work pace/workload: beta weight = 0.35, p = .000; decision latitude: beta weight = -0.21, p = .014; N = 121.

2. Health status

Instead of using age as an indirect measure of health status, it may be better to look at health status itself and its impact on the effects of extended workdays. It may be expected that extended workdays will be more demanding for employees who are in poorer health. This, in turn, may also have a negative impact on their satisfaction with working hours and free time.

However, hardly any study has addressed this aspect. Only Hodgson (1995), in a study on 12-hour shifts in nursing, indirectly touched on this subject. In an open-ended question about the disadvantages of the extended shifts, one of her 15 respondents remarked that "shifts are very long if you are not feeling 100%".

A good test of the impact of health status requires a pre-test and post-test design. Then, the number of health complaints found at the pre-test can be related to the effects of extended workdays shown in the post-test. As our study did not encompass a pre-test, only an indirect test of the effects of health status was possible. This test only allowed us to address the effects on fatigue. Our hypothesis was that:

Hypothesis 8: *Having a poorer health status will aggravate the effects of extended workdays on fatigue.*

3. Childcare duties

Like age, the impact of sex of the worker on the effects of extended workdays has quite often been investigated. The idea is that women will be less positive about extended workdays, because these leave them less time for childcare duties and housekeeping on a workday. Also, having childcare duties may restrict the time for recuperation, which could make extended workdays more demanding (Meijman, 1992; Rosa, 1995). On the other hand, the extra day(s) off may give more time for those activities that can be postponed for some days. However, childcare duties and some of the housekeeping duties often cannot be postponed.

To our knowledge, no study so far has addressed the impact of sex of the worker on the effects on fatigue, health, and performance. With regard to the relation with attitudes towards proposed or actual CWWs, the results have been mixed; about half of the studies found a more positive attitude in males (Dickinson & Wijting, 1975; Fottler, 1977: Kenny, 1974; Steele & Poor, 1970), while the other half found no differences between males and females (Atos, 1998; Dunham & Hawk, 1977; Hodge & Tellier, 1975; Nord & Costigan, 1973).

Studies that compared workers with and without children living at home have shown a much more consistent picture. However, contrary to the expectations, in general no relation between having children living at home and attitudes towards a CWW was found (Atos, 1998; Fottler, 1977; Hodge & Tellier, 1975; Kenny, 1974; Mahoney et al., 1975; Nord & Costigan, 1973). There was also no relation with the effects on fatigue (Frietman et al., 1991; Kundi et al., 1995).

The reason for the absence of effects may be that being female or having children living at home does not necessarily equate to being the primary caretaker. If the impact of this characteristic had been investigated, more consistent results might have been found. Therefore, this study will try to measure childcare duties more directly. Our hypothesis was that:

Hypothesis 9: *Having childcare duties will have a negative impact on the effects of extended workdays on fatigue, health, performance, and satisfaction with working hours and free time.*

4. Taking courses in one's spare time

Besides childcare duties, employees may also have other obligations outside their work. Examples of these are taking courses in one's spare time or holding a second job. It may be expected that such obligations will restrict the time an employee has for recuperation. This may have a negative impact on the effects of extended workdays on fatigue, health, and performance. With regard to the impact on satisfaction with working hours and free time, it is not clear what kind of effects to expect beforehand. Satisfaction may be negatively influenced if the combination of extended workdays with obligations outside the work leads to more fatigue. However, it may also be positively influenced because a CWW gives employees an extra day off to spend on these obligations.

To our knowledge, no study has so far investigated the impact of these factors. In our sample, there were too few respondents with a second job to test its impact (office workers: 8%, nurses: 2%). Therefore, this study only addressed the impact of taking courses. Our hypothesis was that:

Hypothesis 10: *Taking courses in one's spare time will have a negative impact on the effects of extended workdays on fatigue, health, and performance.*

The analysis of the impact on satisfaction with working hours and free time was of an exploratory nature.

5. Commuting time

Having a longer commuting time may restrict the time an employee has for recuperation. Also, longer commuting in itself can be quite demanding. Thus, employees with a longer commuting time may already be more fatigued when they arrive at work. Both Meijman (1992) and Rosa (1995) have warned that extended workdays may be more fatiguing the in case of a longer commuting time. On the other hand, an employee on extended workdays has to travel to work less often, and, therefore, has more days off to recuperate from the long commute.

With regard to satisfaction with working hours and free time, two opposing mechanisms may play a role as well. First, because the extra day off means less travel to and from work, employees with a long commuting time could be more positive about a CWW. However, if a longer commuting time does indeed make extended workdays more fatiguing, satisfaction may be negatively influenced.

To our knowledge, no study so far has addressed the impact of a longer commuting time. On the basis of the recommendations by Meijman and Rosa, our hypothesis was that:

Hypothesis 11: *A longer commuting time will have a negative impact on the effects of extended workdays on fatigue, health, and performance.*

The analysis of the impact on satisfaction with working hours and free time was of an exploratory nature.

In Table 2, the hypotheses are summarised.

Table 2 Moderators and hypothesised effects

	Fatigue	Performance	Health	Satisfaction
Employee choice	+	+	+	+
Longer time since implementation	0	0	0	0
Characteristics of the schedule				
· Higher number of consecutive workdays	–	–	–	?
· Earlier start to the workday	?	?	?	?
· Shorter meal break	–	–	–	?
Characteristics of the work situation				
· High work pace/workload combined with little decision latitude	–	–	–	–
Characteristics of the individual worker				
· Higher age	0	0	0	–
· Poorer health status	–			
· Childcare duties	–	–	–	–
· Taking courses in one's spare time	–	–	–	?
· Longer commuting time	–	–	–	?

Method

The data set

As mentioned before, the data set used in this study was collected for two previous studies on 9-hour workdays. One study was conducted in office work, the other in nursing. Both studies had a post-test only design with a comparison group.

The data for the study were gathered by means of a questionnaire. A total of 266 office workers and 134 nurses answered the questionnaire. Follow-up telephone interviews were conducted with a sub-sample of the respondents to obtain some more in-depth information. When relevant, the results of the telephone interviews are reported.

The study among office workers was conducted in four organisations: a bank, a municipality, a large government authority, and a pension fund. In all organisations, the employees could choose whether they wanted to work 8 or 9 hours per day. The employees who chose to remain on 8-hour days constituted the comparison group. All the respondents worked full-time (i.e., 36, 37, or 38 hours per week). The 9-hour workers worked four 9-hour days most of their weeks. The effects 9-hour workdays had in this group are reported in Chapter 2.

For the analyses in this Chapter, three groups of office workers were added. One group consisted of employees from an insurance company who had a 37-hour

working week. They worked a compulsory CWW, which most weeks comprised four 9-hour days. The fact that they had a compulsory CWW allowed us to test the impact of having no choice in the length of the workday. The other two groups came from the pension fund. The employees in both groups had voluntarily opted for a 39-hour or 40-hour working week. The employees in the first of these groups had chosen to work 9-hour days. They worked an extra long working week every two weeks (week 1: 4 days, 9 hrs, week 2: 4 days, 9 hrs + 1 day, 8 hrs). The employees in the other group had chosen to remain on 8-hour days. These two groups allowed us to test the impact of working more than four 9-hour days in a row. In all five groups, the employees normally did not work during the night or the weekend.

The nurses consisted of three groups. The nurses in two of these groups had had no choice in the shift length they worked. One group worked 9-hour shifts, the other group worked 8-hour shifts. Both groups comprised both part-timers and full-timers. The third group consisted of 9-hour workers who had had some sort of choice in this shift length. All employees in this group were full-timers. At the units where they worked, part-timers only worked a maximum of 8 hours per shift. Therefore, full-timers could avoid the 9-hour shifts by changing to part-time work. Of the 12 respondents in our sample who worked full-time before the 9-hour shifts were implemented, seven had changed to part-time work because of the 9-hour shifts. The remaining five full-timers allowed us to test the impact of employee choice.

In all nursing homes, most nurses also had to work nights. The effects 9-hour shifts had in this group are reported in Chapter 3. In Table 3 an overview is given of the different groups of respondents and the number of respondents in each group.

Table 3 The different groups of respondents

	Choice in workday length	No choice in workday length
Office work		
· 36-hour, 37-hour, or 38-hour working week		
9-hour	128	14
8-hour	82	-
· 39-hour or 40 hour working week		
9-hour	25	-
8-hour	17	-
Nursing		
· Part-time and full-time		
9-hour	5	75
8-hour	-	54

In Chapter 2, it was shown that 9-hour workdays had only a few negative effects on fatigue and performance in our sample of office workers. Health was not affected. Satisfaction was greater among the office workers working 9-hour

workdays. In nursing (see Chapter 3), however, the effects were rather negative. Fatigue and health complaints were substantially higher in nurses working 9-hour shifts. Performance was a little affected. Satisfaction with working hours and free time was lower on 9-hour shifts. We attribute these different effects to the fact that the physical and emotional workload is much higher in nursing, and to the fact that the nurses could not choose the length of their workday, while the office workers could.

Because of the different effects, the impact of the potential moderators was tested separately for both types of work. In the group of the nurses, the impact of starting time and length of the meal break could not be tested, because all 9-hour nurses started their shifts at the same time and had the same meal break length. The impact of time since implementation could also not be tested for the nurses, as almost all 9-hour nurses had started working this shift length at the same time. The office workers who had no choice in the length of their workday and the nurses who did have some choice were only used in the analyses of the impact of employee choice. Similarly, the office workers who worked a 39-hour or 40-hour working week were only used in the analyses of the impact of the number of consecutive workdays. This way, the aspects 'employee choice' and 'number of consecutive workdays' were kept constant in the analyses of the other potential moderators.

Table 4 gives some biographical and work-related details pertaining to the different groups of respondents. The majority of the office workers were male. Almost all the nurses were female. The nurses had less decision latitude in their work than the office workers ($t = 16.91$, $p = .000$). Their work pace/workload was somewhat higher ($t = 2.08$, $p = .038$). The number of contracted hours was lower for the nurses ($t = 13.90$, $p = .000$). As part-time employees were not included in our sample of office workers, this difference was to be expected.

In the group of office workers, the 8-hour and the 9-hour choice group with working hours ≤ 38 differed significantly on the number of contracted hours ($t = 2.08$, $p = .039$). However, in absolute terms the difference was rather small. Furthermore, the 9-hour no choice group differed significantly from the combined 8-hour and 9-hour choice group (with working hrs ≤ 38) on almost all background variables. Due to the small size of this group, it was not possible to statistically control for all the differences. It is difficult to say what the effects of these differences will be, as the no-choice group had more favourable scores on some potential moderators (e.g., commuting time), but less favourable scores on others (e.g., decision latitude). There were no significant differences between the office workers with choice who worked ≤ 38 hours per week and the office workers with choice who worked ≥ 39 hours per week, except, of course, in the number of contracted hours.

In the group of nurses, there was a significant difference between the 8-hour and the 9-hour groups in the number of contracted hours ($t = 3.16$, $p = .002$) and the level of decision latitude ($t = 2.48$, $p = .015$). However, this had no influence on the differences in fatigue, health, performance, and satisfaction between the 8-hour and the 9-hour groups that were found. It could not be tested statistically if the group of 9-hour nurses with choice differed from the 8-hour and the 9-hour no-choice groups, because of the small sample size of the first group.

Table 4 Biographical and work-related details pertaining to the 8-hour and 9-hour group

	Office workers: choice, 36-hr to 38-hr working week						Office workers: no choice, 37-hr working week			Office workers: choice, 39-hr or 40-hr working week		
	9-hr gr.[a]			8-hr gr.			9-hr gr.[b]			9-hr gr.[c]		
	M	SD	N	M	SD	N	M	SD	N	M	SD	N
Age	38.9	8.4	128	40.2	9.0	82	**34.4**	7.2	14	39.0	8.1	25
Work pace/ workload (1 = low, 4 = high)	2.4	0.4	128	2.4	0.5	82	**2.1**	0.3	14	2.3	0.5	25
Decision latitude (1 = low, 5 = high)	3.5	0.6	127	3.5	0.7	82	**3.2**	0.4	14	3.6	0.7	25
Number of contracted hours	36.3	0.8	128	36.2	0.5	82	**37.0**	0.0	14	**39.9**	0.3	25
Commuting time (in min.)	41.6	23.9	119	37.1	22.8	77	**27.0**	16.0	14	41.9	24.7	21
	%		N	%		N	%		N	%		N
% of females	24.2%		128	24.4%		82	**64.3%**		14	8.0 %		25
% with children < 12 yrs living at home	28.9%		128	19.5%		82	28.6 %		14	32.0 %		25

Note: Work pace/workload and decision latitude were measured using self-ratings (work pace/workload: scale by van Veldhoven (1996), 1 = low, 4 = high; decision latitude: scale by de Jonge (1995).,1 = low, 5 = high).

Table 4 (Continued)

	Office workers: choice, 39-hr or 40-hr working week			Nurses: no choice, 12-hr to 36-hr working week						Nurses: choice, 36-hr working week		
	8-hr gr. [c]			9-hr gr. [d]			8-hr gr.			9-hr gr.		
	M	SD	N	M	SD	N	M	SD	N	M	SD	N
Age	35.3	8.1	17	32.9	9.1	75	31.4	7.5	54	26.6	6.4	5
Work pace/ workload (1 = low, 4 = high)	2.5	0.4	17	2.5	0.4	75	2.5	0.4	54	2.4	0.5	5
Decision latitude (1 = low, 5 = high)	3.8	0.6	17	**2.3**	0.6	74	**2.6**	0.6	53	2.3	0.9	5
Number of contracted hours	**40.0**	0.0	17	**27.4**	7.0	75	30.7	5.2	54	36.0	0.0	5
Commuting time (in min.)	29.2	17.4	14	13.1	6.3	75	14.2	10.5	54	22.6	9.6	5
	%		N	%		N	%		N	%		N
% of females	17.6 %		17	97.3 %		75	94.4 %		54	80.0 %		5
% with children < 12 yrs living at home	23.5 %		17	18.7%		75	16.7%		54	0.0 %		5

Note: Boldfaced printings indicate that the group differed significantly from the group they were compared with.

[a] compared with the 8-hour office workers from the choice group, working hours 36-38

[b] compared with the combined 8-hour + 9-hour office workers from the choice group, working hours 36-38

[c] these two groups were compared with the 8-hour + 9-hour office workers from the choice group, working hours 36-38

[d] compared with the 8-hour nurses from the no choice group

Measures

The questionnaire comprised the following measures:

Effect variables:

- Fatigue

Fatigue was measured using two scales. The first scale was a checklist (Meijman, 1991) which measured the level of fatigue at the beginning and the end of the workday. The scale consisted of nineteen 5-point items (e.g., Mentally fresh - mentally tired). The office workers filled in the checklist for each workday during a one-week period. The nurses filled in the checklist retrospectively for each shift type (8-hour or 9-hour day shift, 8-hour or 9-hour afternoon shift, 8-hour or 9-hour night shift) they had worked in the four weeks preceding the study. For them, a different way of measuring fatigue was used, because their schedule was very irregular. The second scale, need for recuperation, measured the extent to which the fatigue built up during the workday spilt over into the free hours and free days after work. The scale consisted of eleven 2-point items (e.g., I have difficulties concentrating in my free hours after work) (van Veldhoven, 1996).

- Health complaints

Health complaints were measured using an eleven 2-point item scale (e.g., Is your stomach often upset?) (Dirken, 1967).

- Performance

Performance was measured using self-ratings. The performance measures were newly constructed. The respondents had to rate their performance as a percentage of the best performance they had ever produced in the same job. We asked separate ratings for quality and quantity. Quantity was operationalised as the amount of work done *per hour* to make the comparison between 8-hour and 9-hour workdays a fair one. The advantage of self-ratings is that the employee himself/herself will usually be the one who is best informed about his or her performance. The disadvantage, however, is that the ratings may be too lenient (Murphy & Cleveland, 1991). If there are indications of a leniency effect, this will be mentioned.

The office workers rated their performance for each workday during a one-week period. The nurses rated their performance retrospectively for each shift type (8- or 9-hour day shift, 8-hour or 9-hour afternoon shift, 8-hour or 9-hour night shift) he/she had worked in the four weeks preceding the study.

- Satisfaction with working hours

This was measured using a newly constructed three-item, 5-point Likert scale (e.g., All in all, I am satisfied with the hours that I work).

- Satisfaction with free time

This was measured using a newly constructed two-item, 5-point Likert scale (e.g., I am satisfied with the amount of free time I have).

Moderator variables:

- Employee choice

The impact of this potential moderator was tested for both office workers and nurses. For the nurses, it was also tested whether having an influence on another feature of the schedule moderated the effects of the 9-hour workdays.

- Time since implementation

As mentioned already, the impact of this potential moderator could only be tested for the office workers. For the 9-hour office workers, time since implementation ranged from 2 weeks to 7.4 years.

- Number of consecutive workdays

For the office workers, the impact of the number of consecutive workdays was investigated in two ways. First, it was tested whether working a maximum of two or three workdays in a row versus working four workdays in a row had a differential impact on the effects of 9-hour workdays. Second, the impact of working four versus five 9-hour workdays in a row was investigated. For the nurses, the influence of the number of consecutive workdays was investigated in a different way as their schedule was very irregular. They were asked to rate their fatigue and performance for the final workday of the longest sequence they had worked in the four weeks preceding the study. The longest sequence varied from four to five (9-hour group) or six (8-hour group) workdays. Of course, this question asked quite a lot from the respondents in terms of memory. Thus, the accuracy of this measure may be somewhat lower.

- Time the workday starts

As mentioned already, the impact of this potential moderator could only be tested for the office workers. As all of them had flexitime, start time was measured by having them record their start times for a one-week period. We then computed the average start time. If the start time was missing on one workday, the average was still computed. Start time ranged from 6:34 to 9:28.

- Length of the meal break

As mentioned already, the impact of this potential moderator could only be tested for the office workers. As all of them had flexitime, the length of the meal break was measured by having them record their meal breaks for a one-week period. We then computed the average meal break. If there were no data on the length of the meal break on one workday, the average was still computed. The average meal break ranged from 0 minutes to 1 hour.

- High work pace/workload and little decision latitude

Work pace/workload was measured using an eleven 4-point item scale (e.g., Do you have to work very fast?) (van Veldhoven, 1996). Decision latitude was measured using a ten 5-point item scale (e.g., Can you determine your work goals yourself?) (de Jonge, 1995). These scales were then split at the median for the office workers and nurses separately. If a respondent scored high on work pace/workload *and* low on decision latitude, he/she received the score of one. Otherwise, a score of zero was given. 24% of the office workers and 30% of the nurses received a score of one.

- Age

This ranged from 19 to 60 years for the office workers and 18 to 56 years for the nurses.

- Childcare duties

Originally, we wanted to measure this by having the respondents record the time spent on household and childcare duties for a one-week period. However, there were too many respondents with missing data on this variable. Therefore, a dichotomy had to be used instead. A score of one stands for having at least one child under the age of 12 and a partner who is also employed, or having at least one child under the age of 12 and being a single parent. If an employee did not belong to this category, he/she was scored zero. 17% of the office workers and 16% of nurses received a score of one.

- Taking courses in one's spare time

Originally, we wanted to measure this by having the respondents record the time spent on education/courses for a one-week period. However, there were too many respondents with missing data on this variable over the week. Therefore, this variable was dichotomised into 'taking a course vs. not taking a course'. 29% of the office workers and 14% of the nurses were taking courses.

- Commuting time (home-work)

This ranged from 5 minutes to 1:53 hours for the office workers and 2 minutes to 48 minutes for the nurses.

Analyses

The data were mostly analysed using ANOVAs or regression analyses. Post hoc analyses of significant interactions found using an ANOVA incorporated adjustments of the familywise error rate (Bonferroni adjustment). As all post hoc analyses consisted of two follow-up tests, an alpha value of .025 was adopted as the criterion for statistical significance in these analyses. All post hoc analyses consisted of additional analyses of variance or t-tests, at each level of the factor under investigation.

Results

Employee choice

Our hypothesis was that employee choice would have a positive impact on the effects of extended workdays on fatigue, health, performance, and satisfaction with working hours and free time. For the office workers, however, employee choice seemed not to moderate the effects of extended workdays (see Table 5). There were no significant differences between the choice and no choice groups in need for recuperation, health complaints, and satisfaction. There were no significant differences in levels of fatigue and performance either (not in the Table). On all aspects, the scores were highly similar.

For the nurses, employee choice did seem to moderate the effects of the CWW. Unfortunately, no statistical analyses could be conducted, because of the small number of respondents in the 9-hour choice group. However, a look at the table shows that the 9-hour choice group scored substantially better than the 9-hour no choice group, especially with regard to need for recuperation and satisfaction with working hours. Still, the 9-hour choice group had a higher need for recuperation and experienced more health complaints than the 8-hour group. Because some respondents of the 9-hour choice groups had missing scores on fatigue and performance, these aspects were not compared; the number of respondents would have been much too small.

Table 5 Office workers and nurses: the impact of employee choice

	Need for recuperation			Health complaints			Satisfaction working hours			Satisfaction free time		
	M	SD	N	M	SD	N	M	SD	N	M	SD	N
Office jobs												
8-hr group	2.5	2.6	77	1.7	1.9	77	4.2	1.0	82	3.8	1.0	82
9-hr group – choice	2.4	2.8	128	1.6	1.9	128	4.6	0.6	127	4.0	1.0	128
9-hr group – no choice	2.5	3.0	13	1.6	1.6	13	4.4	0.6	14	4.1	0.9	14
	t = 0.14, p = .886			t = 0.11, p = .912			t = 1.32, p = .189			t = 0.41, p = .679		
Nursing												
8-hr group	3.3	3.1	49	1.8	2.0	47	4.2	0.8	51	4.1	1.0	53
9-hr group – choice	3.8	3.6	5	2.4	2.1	5	4.3	1.2	5	3.8	1.1	5
9-hr group – no choice	6.2	3.4	72	3.4	2.7	72	3.4	0.8	69	3.5	1.1	71

Note: The t-tests compared the 9-hr, no choice group with the 9-hr choice group. The scores of the 8-hr group are included for illustrative purposes.
No statistical tests were conducted on the nurses, because the number of nurses in the 9-hr choice group was too small.

The nurses were also asked if their schedule maker (mostly their teamleader) took their wishes into account when making the schedules. If he or she did, this gave the nurses the opportunity to indirectly influence some other features of their working hours. Here, we were interested in whether their wishes with regard to the number of consecutive shifts were taken into account, because working fewer days in a row may restrict the build up of fatigue. Therefore, the following question was asked: If your teamleader makes the schedule, does he/she take your wishes regarding the number of consecutive shifts you want to work into account? (answers on a 5-point scale ranging from never to always).
It was first checked whether nurses with the same teamleader agreed to some extent about the behaviour of the teamleader. We did not expect a high level of agreement, because one nurse will press the teamleader more than the other to get his/her wishes fulfilled. Also, the extent to which the teamleader meets the wishes of the nurse may depend on the nurse's personal situation (e.g., whether he/she has small children or not). Nevertheless, we did expect that there will be consistent differences between teamleaders with regard to their willingness to meet the wishes of their workers.

To determine the level of agreement, the intraclass correlation coefficient (formula given by Snijders & Bosker, 1999) was computed using all teamleaders (15) on whom we had the scores of at least five respondents. The ICC was 0.21, which was considered adequate.
On average, the teamleaders sometimes took the wishes of the nurses with regard to the number of consecutive workdays into account (a score of 3.0 on the 5-point scale). Regression analyses with workday length, the extent to which the wishes were taken into account and the interaction term of the two, showed that this indirect form of influence did not moderate the effects of 9-hour shifts on need for recuperation (interaction term: $p = .260$) and quality (interaction term: $p = .299$) or quantity of performance (interaction term: $p = .886$). However, it did moderate the effects on health complaints (interaction term: $p = .035$, R^2 (interaction term) = .04); 9-hour shifts had a less negative effect on health among the respondents whose wishes were more often taken into account. Thus, an indirect form of influence on the number of consecutive workdays did indeed restrict the negative effects on employee health.

Reasons for choosing to work a CWW
An exploratory analysis was conducted on whether different reasons for choosing to work 9-hour workdays lead to different effects. This analysis was only performed for the office workers.
The 9-hour respondents were asked what reasons they had had for choosing to work 9-hour days. They were given several pre-coded reasons which they could mark. To categorise these reasons further, a classification for part-time work devised by Trommel (1987) was used. Trommel distinguishes three reasons why workers may decide to work part-time: a. they may be more or less *forced* (e.g., no full-time job available), b. it may be a *solution* to some problems (e.g., it is easier to combine with childcare duties) and c. they may do so out of free *choice* (e.g., to have more time for hobbies or personal development). Here, only the categories 'solution' and 'choice' were used. The impact of 'forced' was already tested in the analysis of employee choice. The category 'solution' was further divided into 'solution to obligations outside work' and 'solution to some tiring aspects of work'.
Respondents who indicated that they had chosen to work 9-hour workdays because it gave them a long weekend or more time for hobbies, sport, etc. were categorised as 'choice'. Respondents who indicated that they had chosen this working time arrangement in order to have more time for household duties, for their children, and/or for their education/courses were categorised as 'solution to obligations outside work'. Respondents who indicated that they had chosen to work 9-hour workdays so that they needed to get up early less often and/or needed to travel to work less often were categorised as 'solution to some tiring aspects of work'. If a respondent gave both choice and solution answers, he was categorised as solution, because giving solution answers in our view implied that there had been no entirely free choice. One respondent gave both 'solution to obligations outside work' and 'solution to some tiring aspects of work' answers. He was categorised as 'solution to some tiring aspects of work'.
Table 6 shows the percentage of the respondents in each category who, when asked about the disadvantages of the CWW, had (amongst other things) indicated that the CWW was more fatiguing. As can be seen in the Table, there was an almost significant difference between the three categories in the percentage of respondents who found the CWW more fatiguing. In the category 'choice' and the category 'solution to obligations outside work' the percentage

was about the same. In the category 'solution to some tiring aspects of work', however, it tended to be higher. Thus, deciding to work four 9-hour workdays as a solution to some tiring aspects of work may not be wise.

Table 6 Office workers: reasons for working a CWW and fatigue

	% who had indicated that they found the CWW more fatiguing	Chi^2	p
Choice	16.2 % (6 out of 37)	5.32	.070
Solution to obligations outside work	13.6 % (6 out of 44)		
Solution to some tiring aspects of work	33.3 % (12 out of 36)		

Time since implementation

Our hypothesis was that the effects of 9-hour workdays on fatigue would not change over time. The hypothesis could only be investigated for the office workers, as almost all 9-hour nurses had started working 9-hour shifts at the same time. The hypothesis was tested by splitting the 9-hour workers into two groups: one group that, when asked about the disadvantages of the CWW, had (amongst other things) named fatigue and another group that had not. Subsequently, the time these groups had been working 9-hour workdays was compared. A t-test showed that there was no significant difference between the two groups (fatigue group: M = 16.0 months, SD = 8.2 months, N = 27; no fatigue group: M = 17.6 months, SD = 12.8 months, N = 101; t = 0.62, p = .535). Thus, the hypothesis was confirmed.
In the telephone interviews, three of the fifty 9-hour workers who were interviewed said that when they first started working the CWW, they found the extended workdays fatiguing. However, after two to three months they had become used to the extended workdays and did not find these fatiguing anymore. This may indicate that for some employees, the effects of extended workdays do become more positive over time, but that effects are already stabilised after only some months. Unfortunately, there were too few respondents in our sample with less than four months' experience of 9-hour workdays to test whether they did indeed more often complain of fatigue.

Number of consecutive workdays

The impact of the number of consecutive workdays was tested in two ways. First, working four 9-hour workdays in a row was compared with working a maximum of two to three 9-hour workdays in a row. This analysis was only performed on the office workers. Second, the impact of working four consecutive 9-hour workdays vs. more than four consecutive 9-hour workdays was explored. This analysis was conducted on both the office workers and the nurses. Our hypothesis was that the higher the number of consecutive workdays

is, the more negative the effects of 9-hour workdays on fatigue, health, and performance will be.
The 9-hour office workers worked four 9-hour days in a row if they were off on a Monday or a Friday. They worked a maximum of two or three days in a row if they were off on a Tuesday, Wednesday or Thursday (see Table 7). A comparison of the two groups showed that there were no differences in health complaints ($t = 0.67$, $p = .507$), need for recuperation ($t = 0.32$, $p = .749$), performance (quality: $t = 0.60$, $p = .550$; quantity: $t = 0.85$, $p = .400$), or in satisfaction with working hours ($t = 0.80$, $p = .423$) and free time ($t = 0.35$, $p = .724$).

Table 7 Possible schedules of the 9-hour workers

	Mon	Tue	Wed	Thu	Fri
Monday	–	9	9	9	9
Tuesday	9	–	9	9	9
Wednesday	9	9	–	9	9
Thursday	9	9	9	–	9
Friday	9	9	9	9	–

However, with regard to the *increase* in fatigue over the workday, a significant interaction between the number of consecutive workdays and taking courses in one's spare time was found (see Table 8; the scores of the 8-hour workers are included for illustrative purposes). Subsequent tests of the interaction showed that, for those taking a course in their spare time, working four 9-hour workdays in a row led to a higher *increase* in fatigue over the workday than working two or three 9-hour workdays in a row ($t = 3.49$, $p = .002$). For those who did not take a course in their spare time, no difference between working four versus two or three consecutive workdays was found ($t = 0.03$, $p = .976$).
There was no significant interaction between the number of consecutive workdays and having childcare duties ($F = 0.63$, $p = .430$). Thus, having a higher total load because of childcare duties did not make working four consecutive 9-hour workdays more fatiguing than working two or three consecutive 9-hour workdays. This may be due to the fact that most of the 9-hour respondents with childcare duties were male and that males, even if their partner also has a paid job, do, in general, still not take an equal share of childcare duties.
All in all, in general, a higher number of consecutive workdays seems not to aggravate the effects of 9-hour workdays, at least, as long as no more than four extended workdays are worked. Only for those employees whose total load is high because they are also taking a course in their spare time do four consecutive workdays make 9-hour workdays more fatiguing.

Table 8 Office workers: number of consecutive workdays and fatigue

	9-hr group: 4 consecutive days			9-hr group: 2-3 consecutive days			8-hr group					
	M	SD	N	M	SD	N	M	SD	N		F	p
Increase in fatigue over the workday										schedule	6.28	.014
No education/ courses	3.5	5.4	41	3.5	4.9	22	2.6	3.5	23	education/ courses	0.07	.781
Education/ Courses	6.3	6.4	19	0.1	3.3	11	0.0	2.1	12	interac-tion	6.45	.013

Note: For the 8-hour group, the increase in fatigue is computed over the first 4 days of the week. The scores of the 8-hour group are included for illustrative purposes.

For the office workers, the impact of working more than four 9-hour workdays in a row was tested by looking at the 9-hour workers who had a working week of 39 or 40 hours. They worked 4 days, 9 hours one week, and 4 days, 9 hours + 1 day, 8 hours the other week. Analyses of variance showed that there was a significant interaction between hours per week (≤ 38 hrs vs. ≥ 39 hrs) and workday length with regard to need for recuperation and health complaints (see Table 10). Subsequent tests of the interaction showed that in the '≥ 39 hrs' group, the 9-hour workers scored significantly higher on need for recuperation ($t = 2.55$, $p = .015$) and health complaints ($t = 2.28$, $p = .029$) than the 8-hour workers. Thus, working more than four 9-hour workdays had some negative effects for the total group of 9-hour workers and not only a subgroup of them. In the '≤ 38 hrs' group, there was no significant difference between the 8-hour and 9-hour workers (need for recuperation: $t = 0.33$, $p = .740$; health complaints: $t = 0.49$, $p = .627$). Interestingly, the 8-hour workers in the '≥ 39' group had the lowest average score on health complaints and need for recuperation. It may be that only employees who were quite fit decided to work this arrangement. However, it may also be that *all* employees (both 8-hour and 9-hour workers) who decided to work 39 or 40 hours per week were quite fit when they started working their respective arrangements, but that the 9-hour workers' fitness had decreased due to their demanding working hours. As there had been no pre-test, this could not be investigated.

Regarding satisfaction with free time, no significant interaction was found ($F = 1.23$, $p = .270$). With respect to satisfaction with working hours, however, there was an almost significant interaction (see Table 9). Subsequent tests of this interaction showed that in the '≤ 38 hrs' group, the 8-hour workers were significantly less satisfied than the 9-hour workers ($t = 3.45$, $p = .001$). In the '≥ 39 hrs' group, there were no significant differences between the 8-hour and 9-hour workers ($t = 0.75$, $p = .460$). The reason for this finding is probably that the 9-hour workers from the '≤ 38 hrs' and the '≥ 39 hrs' groups and the 8-hour workers from the '≥ 39 hrs' group all had gained something (extra free days and/or extra income) compared to the situation before the extended workdays

were implemented. In the old situation, each employee worked 8-hour workdays and had a 38-hour working week. Thus, for the 8-hour workers from the '≤ 38 hrs' group not much had changed.[14]

Table 9 Office workers: number of consecutive workdays and impact on need for recuperation, health complaints, and satisfaction

	9-hr group			8-hr group					
	M	SD	N	M	SD	N		F	p
Need for recuperation							workday length	3.98	.047
Working hrs ≤ 38	2.4	2.8	128	2.5	2.6	77	working hrs	0.42	.520
Working hrs ≥ 39	3.2	3.6	25	1.1	1.4	17	interaction	5.14	.024
Health complaints							workday length	3.71	.055
Working hrs ≤ 38	1.6	1.9	128	1.7	1.9	77	working hrs	0.00	.998
Working hrs ≥ 39	2.4	2.8	25	0.9	1.3	17	interaction	5.38	.021
Satisfaction working hours							workday length	9.65	.002
Working hrs ≤ 38	4.6	0.5	78	3.9	1.0	32	working hrs	1.72	.192
Working hrs ≥ 39	4.5	0.6	25	4.3	0.8	17	interaction	3.50	.063

Note: for the analyses of satisfaction with working hours, only the respondents from the bank and the pension fund were used. This was done because the municipality and the large government authority also offered employees the option to work five 8-hour days with 26 extra days off, while the bank and the pension fund did not. Previous analyses showed that this tended to make the difference in satisfaction between the 8-hour and 9-hour group smaller (see Chapter 2).

To analyse the impact on fatigue and performance, we first averaged the respondents' fatigue and performance scores across the first four days of the week. Using MANOVAs, these scores were then compared to the scores on the fifth workday. Working time arrangement ('8 hr, ≤ 38 hrs', '8 hr ≥ 39 hrs' , '9 hr ≥ 39 hrs') was used as a between-subjects factor in the analyses. The 9-hour workers from the '≤ 38 hrs' group were not included, as they only worked four days a week.

[14] Naturally, the 8-hour workers from the '≤ 38 hrs' group who worked 36 or 37 hours per week were some more days off than before. The extra days off a full-time working week of less than 40 hours gives are called compensation days in the Netherlands. In the bank and the pension fund, these so-called compensation days now had to be scheduled in advance. Before the implementation of the CWW, most compensation days could be taken when the employee wanted. Thus, some of the 8-hr workers from the '≤ 38 hrs' group may even have felt that their working hours were now less favourable.

With regard to the quality of performance, there were no significant main effects for either part of the week (day 1-4 vs. day 5: $F = 1.57$, $p = .214$) or working time arrangement ($F = 1.13$, $p = .329$). There was no significant interaction between the two either ($F = 0.55$, $p = .579$). Thus, for all three groups the quality of performance remained quite stable over the two parts of the week. With regard to the quantity of performance, there was a main effect of part of the week ($F = 4.01$, $p = .049$): all three groups scored lower on the fifth day compared to the average score over the first four days of the week. Furthermore, there was also a significant effect of working time arrangement ($F = 3.46$, $p = .037$). The 8-hour workers from the '≥ 39' group scored higher on quantity of performance during both parts of the week. The interaction between part of the week and working time arrangement was not significant ($F = 0.70$, $p = .501$), indicating that the extent of the change in quantity of performance over the week did not differ for the three groups.

With regard to the increase in fatigue over the workday, the picture was a bit more complex. The MANOVA showed that there was an almost significant interaction between part of the week and working time arrangement ($F = 2.72$, $p = .074$). Subsequent tests of the interaction revealed that the 9-hour workers from the '≥ 39' group scored higher on increase in fatigue, when averaged across the first four days, compared to the 8-hour workers from the '≤ 38' group ($M(9\text{-hr}, \geq 39) = 4.89$, $M(8\text{-hr}, \leq 38) = 1.66$, $M(8\text{-hr}, \geq 39) = 2.06$, oneway ANOVA: $F = 5.15$, $p = .009$, post-hoc Bonferroni comparison '9-hr, ≥ 39' vs. '8-hr, ≤ 38': $p = .007$; '9-hr, ≥ 39' vs. '8-hr, ≥ 39': $p = .089$). Earlier analyses (see Chapter 2) had shown that the 9-hour workers from the '≤ 38 hrs' group also scored higher on increase in fatigue, when compared to this group. On the fifth workday, the 9-hour workers from the '≥ 39' group still scored higher on increase in fatigue, when compared to the 8-hour workers from the '≤ 38' group. Both group's fatigue scores had not changed much. However, the 8-hour workers from the '≥ 39' group now also scored higher on increase in fatigue than the 8-hour workers from the '≤ 38' group ($M(9\text{-hr}, \geq 39) = 5.31$, $M(8\text{-hr}, \leq 38) = 1.39$, $M(8\text{-hr}, \geq 39) = 5.46$, oneway ANOVA: $F = 5.13$, $p = .009$, post-hoc Bonferroni comparison '9-hr, ≥ 39' vs. '8-hr, ≤ 38': $p = .034$; '8-hr, ≥ 39' vs. '8-hr, ≤ 38': $p = .043$). The reason for this is unclear.

For the nurses, only the impact of working four versus more than four 9-hour shifts was investigated. This was tested as follows: the nurses were asked to rate their fatigue and performance on the final shift of the longest sequence they had worked in the four weeks preceding the study. The ratings only had to be given if the final workday was a day shift or an afternoon shift and the sequence was at least four workdays long. The final shift should not be a night shift, to exclude interference from the disruption of the circadian rhythm. As the number of nurses who answered these questions was quite small (see Table 10), no statistical tests were performed.

Table 10 shows that after working six consecutive shifts, the 8-hour group reached levels of fatigue comparable to those of the 9-hour group after working only four shifts in a row. That is, after a sequence that totalled 48 hours the 8-hour group was as fatigued as the 9-hour group already was after 36 hours of work. In the 9-hour group, those who had worked four shifts in a row had about the same levels of fatigue as those who had worked five shifts in a row. Therefore, there seemed to be no extra build up of fatigue from four to five 9-hour shifts. This was also the case for the 9-hour office workers. However, two of the eleven 9-hour nurses in our telephone interviews said that working four

consecutive shifts was enough, and that five was too much. They also said that they had told their teamleader this and that he/she mostly took that into account when making the schedule. If this was also the case for other 9-hour nurses who found working five consecutive 9-hour shifts too fatiguing, the impact of working this number of 9-hour shifts will be underestimated.

Table 10 Nurses: number of consecutive workdays and impact on fatigue and performance

	9-hr group			8-hr group		
	M	SD	N	M	SD	N
Fatigue at the end of the shift						
4 days in a row	22.9	11.2	7	15.0	7.1	9
5 days in a row	21.0	12.5	5	16.4	9.4	13
6 days in a row	only data from 1 respondent			22.2	16.2	5
Quality of performance						
4 days in a row	82.0	8.4	5	88.0	13.0	5
5 days in a row	78.8	2.5	4	86.9	7.5	13
6 days in a row	only data from 1 respondent			83.0	14.0	5
Quantity of performance						
4 days in a row	81.0	10.2	5	84.0	13.9	5
5 days in a row	81.0	18.2	5	85.4	12.7	13
6 days in a row	only data from 1 respondent			84.0	11.4	5

The quality of performance did seem to be affected a little by working five consecutive 9-hour shifts. In the 8-hour group, it was a little poorer on the sixth workday. The quantity of performance, however, was not affected by working more shifts in a row.

Start time, length of the meal break, work characteristics, personal characteristics

The impact of the potential moderators 'start time', 'length of the meal break', 'high work pace/workload combined with little decision latitude', 'age', 'childcare duties, 'taking courses in one's spare time', and 'commuting time' were jointly tested in several regression analyses. In the first step of theses analyses, all potential moderators and a dummy for workday length were entered.

In the second step, the interaction terms of the potential moderators with workday length were added. It is the interaction term that reveals if a factor does indeed moderate the effects of workday length. The hypotheses were that a shorter meal break, a high work pace/workload combined with little decision latitude, childcare duties, taking courses in one's spare time, and a longer

commuting time would aggravate the effects of extended workdays on fatigue, health, and performance. A high work pace/workload combined with little decision latitude, a higher age and childcare duties were expected to negatively influence the effects on satisfaction.
For the office workers, the ratio of independent variables to respondents was considered high enough for the dependent variables 'health complaints', 'need for recuperation', 'satisfaction with working hours' and 'satisfaction with free time' (1: ≥ 15 for the analyses without interaction terms, 1: ≥ 10 for the analyses with interaction terms). For the dependent variables 'quality of performance', 'quantity of performance', 'fatigue at the beginning of the workday', and 'fatigue of the end of the workday', the ratio was not high enough. For the variables 'quantity of performance' and 'quality of performance', the ratio of independent variables to respondents was increased by omitting the independent variables 'start time' and 'length of the meal break'. We chose to omit these variables, because they were not included in the analyses on the nurses either. For the dependent variables 'fatigue at the beginning of the workday' and 'fatigue at the end of the workday' omitting these variables would still not have made the ratio high enough. Therefore, no regression analyses were performed on these variables. For the nurses, the ratio of respondents to independent variables was high enough for all the dependent variables we wished to analyse.
Prior to conducting the regression analyses, the independent variables were centered in order to get reliable estimates for the beta-coefficients of the interaction variables (Cohen & Cohen, 1983). In the analyses on the office workers, the residuals of the dependent variables 'need for recuperation' and 'health complaints' were found not to be normally distributed: they were positively skewed. However, a log transformation of these dependent variables did not produce a much more normal distribution of the residuals. Therefore, the untransformed scores are used. It must be kept in mind that the least squares estimators will be less efficient in this case (Fox, 1997). Thus, the power of the analysis was reduced for these variables.

Table 11 summarises the results of the analyses for the office workers. In the group of office workers, hardly any characteristic moderated the effects of 9-hour workdays. Only commuting time acted as a moderator in the analysis of quality of performance. While quality of performance was in general not affected on 9-hour shifts, it did become poorer when commuting time was longer (e.g., commuting time home-work ≥ 46 min.: quality of performance: 8-hour group: M = 82.0, SD = 10.0, N = 16; 9-hour group: M = 78.7, SD = 12.7, N = 36).
In the telephone interviews, two of the fifty 9-hour respondents interviewed said that they found the 9-hour workday more fatiguing when their workload was higher. However, in the regression analyses, no significant interaction between workday length and the factor 'high work pace/workload combined with little decision latitude' was found. Including only the factor 'high work pace/workload' produced no significant effect on, for example, need for recuperation either (p(interaction term)= .780).

Table 11 Office workers: regression analyses. The beta coefficients

	Need for recuperation		Health complaints		Quantity of performance	
	step 1	step 2	step 1	step 2	step 1	step 2
9 vs. 8 hrs (1 = 9 hrs, 0 = 8 hrs)	-.04		-.05		.06	
Other schedule characteristics						
Start time	.08	-.08	.09	-.10	not included	
Length of the meal break	.10	-.07	.14#	-.02	not included	
Characteristics of the work						
High work pace/workload & little decision latitude (1 = yes, 0 = no)	.25**	.11	.24**	.00	.22**	.03
Characteristics of the worker						
Age	-.02	-.01	-.06	-.00	.32**	-.00
Childcare duties (1 = yes, 0 = no)	-.01	-.07	.02	-.10	.04	.00
Education/courses (1 = yes, 0 = no)	.03	-.00	.02	.08	.20*	.03
Commuting time	.13	.06	.12	.08	-.05	-.08
Organisation (reference category: municipality)						
Bank	.11		.15		-.16#	
Large government authority	.10		-.01		-.21*	
Pension fund	.13		.16#		.08	
step 1: R^2 / step 2 : ΔR^2	.14**	.02	.15**	.03	.26**	.01
N	181		181		140	

Legend: #: $p \leq 0.10$; *: $p \leq 0.05$; **: $p \leq 0.01$

ΔR^2: the extra % of variance explained by adding the interaction terms

As can be seen in the Table, a high work pace/workload combined with little decision latitude did have a direct influence on some of the outcome variables. It led to a higher need for recuperation, more health complaints, and a lower satisfaction with working hours, regardless of length of the workday. Logically, it also increased the quantity of performance, as a high work pace/workload means that employees have to produce more. Of the other factors, education/courses and age also had a direct effect on some outcome variables. Employees who were taking a course in their spare time and older employees scored higher on both quantity and quality of performance. The first may indicate that the courses were mostly work-related and achieved their objective, improving performance.

Table 11 (Continued)

	Quality of performance		Satisfaction working hours		Satisfaction free time	
	step 1	step 2	step 1	step 2	step 1	step 2
9 vs. 8 hrs (1 = 9 hrs, 0 = 8 hrs)	.09		.31**		.16*	
Other schedule characteristics						
Start time	not included		-.08	-.03	-.03	-.01
Length of the meal break	not included		-.04	-.01	.01	.06
Characteristics of the work						
High work pace/workload & little decision latitude (1 = yes, 0 = no)	.11	-.04	-.14#	.05	-.09	-.04
Characteristics of the worker						
Age	.28**	-.07	.08	-.02	.14#	-.06
Childcare duties (1 = yes, 0 = no)	.06	.02	.01	.01	-.06	.08
Education/courses (1 = yes, 0 = no)	.21*	-.05	.06	-.03	-.02	-.03
Commuting time	-.06	-.17*	.05	-.06	-.05	.02
Organisation (reference category: municipality)						
Bank	-.00		-.18#		-.19#	
Large government authority	-.23*		.07		.05	
Pension fund	.04		-.20*		-.16#	
step 1: R^2 / step 2 : ΔR^2	.19**	.03	.16**	.01	.11*	.02
N	140		185		186	

However, an alternative interpretation may be that employees who are taking courses in their spare time are more ambitious and therefore do their best more at their work. The positive relation of age with performance may be due to older employees having more experience of the job.

Table 12 Nurses: regression analyses. The beta coefficients

	Fatigue at begin of shift (day shift)		Fatigue at end of shift (day shift)		Need for recuperation		Health complaints	
	step 1	step 2	step 1	step 2	step 1	step 2	step 1	step 2
9 vs. 8 hrs (1 = 9 hrs, 0 = 8 hrs)	-.02		.33**		.37**		.31**	
Characteristics of the work								
High work pace/workload & little decision latitude (1 = yes, 0 = no)	.07	.06	.31**	.11	.40**	.10	.30**	.07
Characteristics of the worker								
Age	.16	-.10	.09	-.16	-.07	-.20*	-.08	-.09
Childcare duties (1 = yes, 0 = no)	-.12	.12	-.17#	.15	-.16*	.02	-.14#	.06
Education/courses (1 = yes, 0 = no)	-.16	.00	.04	.12	.08	.16#	-.12	-.04
Commuting time	-.17#	-.11	.04	-.00	.04	-.06	.06	.03
step 1: R^2 / step 2 : ΔR^2	.08	.03	.25**	.03	.33**	.03	.22**	.02
N	104		104		120		118	

Legend: #: $p \leq 0.10$, *: $p \leq 0.05$, **: $p \leq 0.01$

ΔR^2: the extra % of variance explained by adding the interaction terms

Among the nurses, a few more factors moderated the effects of 9-hour workdays (see Table 12). Firstly, and unexpectedly, the difference between the 8-hour workers and the 9-hour workers in need for recuperation was smaller among the older workers. However, the difference did not disappear completely: in the older age brackets, the 9-hour workers still scored somewhat higher on need for recuperation (e.g., workers ≥ 40: 9-hour group: M = 7.0, SD = 3.3, N = 18; 8-hour group: M = 5.5, SD = 4.1, N = 7). The reason for the smaller difference is unclear. Maybe it was a ceiling effect; the older nurses already scored quite high on need for recuperation.

Secondly, there were three interaction terms that approached significance. The first was that among employees taking a course in their spare time, the difference in need for recuperation between the 8-hour and the 9-hour groups tended to be larger. Furthermore, although the quantity of performance in general was not affected on 9-hour shifts, for the 9-hour workers taking a course in their spare time it did tend to be. The same applied to the 9-hour workers whose commuting time was longer. Thus, having an extra load outside work seemed to aggravate the effects of 9-hour shifts.

Table 12 (Continued)

	Quantity of performance (day shift)		Quality of performance (day shift)		Satisfaction working hours		Satisfaction free time	
	step 1	step 2	step 1	step 2	step 1	step 2	step 1	step 2
9 vs. 8 hrs (1 = 9 hrs, 0 = 8 hrs)	-.10		-.21#		-.44**		-.25**	
Characteristics of the work								
High work pace/workload & little decision latitude (1 = yes, 0 = no)	-.03	.18	-.17	.01	-.23**	.03	-.27**	.11
Characteristics of the worker								
Age	-.02	.17	-.01	.07	.23**	.04	.14	.01
Childcare duties (1 = yes, 0 = no)	-.00	-.09	.08	-.21	.08	-.06	.02	-.10
Education/courses (1 = yes, 0 = no)	.01	-.26#	.03	-.15	-.01	.04	.17#	.06
Commuting time	-.19#	-.22#	-.03	.06	.02	.00	.00	-.13
step 1: R^2 / step 2 : ΔR^2	.04	.13*	.07	.04	.27**	.01	.17**	.04
N	89		88		118		122	

As was the case for the office workers, a high work pace/workload combined with little decision latitude had a direct effect on several of the outcome variables. It led to a higher need for recuperation, more health complaints, a higher fatigue at the end of the day shift, and a lower satisfaction with working hours and free time.

Need for recuperation was also higher in employees without childcare duties. This is contrary to what one would expect, and may be due to the fact that the respondents with childcare duties less often worked nights and more often worked part-time. It may also be, however, that only employees (here: women) who are quite fit try to combine work and being the primary caretaker.

Furthermore, older workers were more satisfied with their working hours, regardless of shift length. A nation-wide study among workers in all sorts of occupations also showed that older workers were more satisfied with several aspects of their work (van Veldhoven et al., 1999).

Health status

Our hypothesis was that employees who are in poorer health will have more problems working 9-hour workdays. However, as this study did not encompass a pre-test, the impact of health status could only be indirectly tested. In the telephone interviews, six of the fifty 9-hour office workers we interviewed said that they normally had no problems working 9-hour workdays. However, they added that the 9-hour workdays were more fatiguing than the 8-hour workdays when they were not feeling well or when they had not slept enough and, therefore, were not well rested.
To test the impact of health status further, the office workers were divided into two groups. One group consisted of respondents who had a score of one or less on health complaints. The other group consisted of respondents who had a score of more than one.[15] In these groups, the impact of length of the workday on increase in fatigue over the workday was then explored (see Table 13).

Table 13 Office workers: health status and increase in fatigue

	9-hr group			8-hr group					
	M	SD	N	M	SD	N		F	p
Health status							workday length	10.54	.002
Good	3.2	4.5	40	3.1	3.4	25	health status	4.36	.040
Poorer	8.4	6.6	20	2.1	1.8	13	interaction	9.54	.003

As Table 13 shows, there was a highly significant interaction between length of the workday and health status. Subsequent tests of the interaction showed that in the poorer health group, the 9-hour group scored significantly higher on increase in fatigue over the workday than the 8-hour group ($t = 4.04$, $p = .001$). In the good health group, there was no significant difference between the 8-hour and the 9-hour groups ($t = 0.15$, $p = .881$).
Of course, it cannot be ruled out that the poorer-health 9-hour group consisted of respondents whose health had deteriorated because of a high build up of fatigue over the extended workday. The poorer-health 8-hour group may have consisted of respondents who already had a poorer health before the CWW was implemented and, therefore, chose to remain on 8-hour workdays. If this were true, saying that a poorer health leads to a higher increase in fatigue when on 9-hour workdays would be confusing cause and effect.
However, previous analyses had shown that 9-hour workdays in general did not affect the health of the office workers. Therefore, we do not think that the extended workdays were the (main) cause of the higher number of health complaints in the poorer-health 9-hour group. For the nurses, on whose health 9-hour shifts did have detrimental effects, this analysis, however, was therefore not performed.

[15] The scale health complaints ranged from 0 (no complaints) to 11 (many complaints).

Conclusion and discussion

The effects of extended workdays appear not to be the same in every situation. For example, two earlier studies (see Chapters 2 and 3) showed that the effects of 9-hour shifts were negative in nursing but mainly neutral (fatigue, performance, and health) to positive (satisfaction) in office work. We attributed these differences to the fact that the physical and emotional workload in nursing is substantially higher (see, for example van Veldhoven et al., 1999) and that the nurses mostly could not choose the length of their workday.

Using the data from the same studies, it was investigated whether there are more factors that moderate the effects of extended workdays. The potential moderators included in the study were: employee choice in workday length, time since implementation, the number of consecutive workdays, start time, length of the meal break, a high work pace/workload combined with little decision latitude, age, health status, childcare duties, taking course in one's spare time, and commuting time.

The study showed that the most important moderators (in terms of number and strength of impact) were: employee choice, the number of consecutive workdays, and health status. Employee choice was found to reduce the negative effects of 9-hour workdays on fatigue, health, and satisfaction among nurses. Even an indirect form of influence (through the schedule maker) resulted in 9-hour shifts having a less negative effect on health in this group. Among the office workers, employee choice seemed to have no influence. However, the *reasons* an employee had for choosing to work a CWW did moderate the effects of 9-hour workdays among office workers. Those who had chosen to work 9-hour workdays as a solution to some tiring aspects of work more often considered the 9-hour workdays to be more fatiguing than 8-hour workdays.

Working five 9-hour workdays in a row increased need for recuperation and health complaints (office workers) and reduced the quality of performance (nurses). For the office workers, the impact of working a maximum of two or three consecutive 9-hour workdays vs. four consecutive 9-hour workdays was also tested. It was found that working four consecutive 9-hour days only led to a higher increase in fatigue over the workday for a specific group of workers: those whose total load was high because they were also taking a course in their spare time. Thus, the advice often given for 12-hour shifts, i.e., that no more than four consecutive workdays should be worked, seems to apply to 9-hour workdays as well.

The effects of health status could only be indirectly tested because the study did not encompass a pre-test. It was found that office workers whose health was poorer became much more fatigued over the workday if they were on 9-hour workdays than if they were on 8-hour workdays. If their health was good, 9-hour workdays did not lead to a higher increase in fatigue. Unfortunately, the impact of health status could not be tested for the group of nurses. However, we see no reason why health status would not have an effect in this group.

The impact of physical and emotional workload could not be tested within the groups of office workers and nurses. However, the large differences in the effects of 9-hour workdays between office work and nursing indicate that it is probably very important as well.

Of the other potential moderators, commuting time and taking a course in one's spare time also had some impact, but less strongly. When the commuting time was longer, performance (office workers: quality, nurses: quantity) was negatively affected on 9-hour workdays, while it was not with a shorter

commuting time. Taking courses had a negative impact on fatigue (nurses and office workers, for the latter only in combination with working four consecutive 9-hour workdays) and quantity of performance (nurses). Age also acted as a moderator in one instance, but its impact was contrary to what was expected. Among the older nurses, the difference in need for recuperation between the 8-hour and the 9-hour groups was smaller. The factors time since implementation, start time, length of the meal break, a high work pace/workload combined with little decision latitude, and childcare duties did not moderate the effects of 9-hour workdays.

All in all, the study thus did not find many moderators. In the group of office workers, this may have been due to the fact that the respondents could choose the length of their workday. If employees have a choice, it may be expected that only those who think that extended workdays will not be too fatiguing for them will opt for working these workdays. Therefore, characteristics of employees or their work that can, in principle, make extended workdays more fatiguing may not have many effects if employees have room for choice. For example, if a CWW is in general more fatiguing for older workers, but only those older workers who are quite fit decide to work it, no impact of age will be found.

Perhaps, the impact of potential moderators should, therefore, be investigated in a different way in the case of employee choice. It may be more fruitful to look at employees who have dropped out of extended workdays because they find these too fatiguing and see whether they have any special characteristics. Of course, that can only be done for those characteristics that do not change under the influence of working extended workdays (thus, the impact of, for instance, employee health is better not tested this way). In this study, this way of testing the impact of some potential moderators was not possible, because only three respondents had returned to 8-hour workdays because of fatigue. All three were taking courses in their spare time and had a commuting time that was much longer than average (all needed more than 45 minutes to commute from home to work). However, it could not be tested whether this was a coincidence or not, as the number of respondents was much too small.

Another reason why there were not many moderators may be that the effects of 9-hour workdays were so strong (nurses) or so weak (office workers) that the moderators could not substantially aggravate or reduce the effects. Furthermore, the relatively small number of respondents (266 office workers and 134 nurses) may also have made it difficult to find moderators.

The hypotheses that were formulated were relatively coarse, in that it was only indicated if a moderator was expected to improve or aggravate the effects of extended workdays. It may be that the impact of the potential moderators is not linear or that only a configuration of several factors will have an impact. For example, the impact of time since implementation may not be linear. It may be that there is first a period during which employees need to get used to working extended workdays (i.e., a change in a positive direction), followed by a stable period, and then a period during which the higher increase in fatigue over the extended workdays begins to take its toll (accumulation period, i.e., a change in a negative direction). However, there were mostly no theoretical considerations or previous research on which to base a search for non-linear relations. And where there may have been (like with time since implementation), there were not enough respondents to test it.

The results regarding the three drop-outs and the impact of taking courses in one's spare time in combination with working four consecutive 9-hour workdays may indicate that only a configuration of several demanding factors will

moderate the effects of 9-hour workdays. However, again, there were no theoretical considerations (except with regard to a high work pace/workload combined with little decision latitude) or previous studies on the basis of which some factors could be combined in advance. For an exploratory analysis, which would look at the impact of a certain factor within levels of another factor, there were not enough respondents.[16]

To conclude, on the basis of the results of our study, we would advise against the use of 9-hour workdays if a. there is no room for employee choice or say, b. the physical and/or emotional workload is high, c. the employee has a poorer health status, and/or d. more than four consecutive 9-hour workdays have to be worked. Furthermore, there may also be situations that do not *aggravate* the effects of extended workdays, but in which the *sum* of the load from that situation and the load from the extended workdays may be too high. A likely candidate for this is a combination of a high work pace/workload with little decision latitude, as it was found that this combination greatly increased fatigue and health complaints in both office workers and nurses.

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16 Nevertheless, we still tried to conduct an exploratory analysis of the impact of taking courses in one's spare time in combination with a long commuting time in the group of office workers. It seemed that for the 9-hour workers, this combination did indeed lead to a higher need for recuperation, while it did not among the 8-hour workers. However, sample sizes were too small for statistical analyses.

6 The effects of extended workdays on changes in work strategies because of fatigue

Abstract

The effects of extended workdays on fatigue have quite often been investigated. In about half (studies in office work and industrial work) to three-quarters of the studies (studies in nursing) the levels of fatigue were found to be higher on extended workdays. However, hardly any study has addressed how employees deal with these higher levels of fatigue in their work. Therefore, this study investigated whether employees changed their work strategies because of fatigue more often during 9-hour workdays. Changes in work strategies were measured using self-reports. It was found that office workers who had voluntarily chosen to work 9-hour days, and who found these, in general, not more fatiguing, did not change their work strategies more often than 8-hour workers. However, office workers who worked compulsory 9-hour days did use the strategies 'take a short break' and 'work at a slower pace' more often. As previous analyses had shown that this group did not differ in overall levels of fatigue and performance, these results showed the value an investigation into work strategies can have to detect subtle effects. In a group of 9-hour nurses who worked compulsory 9-hour shifts and found these more fatiguing, there was also some evidence of a pacing effect. It is concluded that asking workers themselves about changes in work strategies because of fatigue can be a good method for detecting such changes. However, this method can only be used for changes employees quite consciously decide to use and that are not too abstract.

Introduction

Although a working week of five 8-hour days is still considered the regular working week in many countries, alternative ways of arranging working hours are more and more being implemented. One such alternative is the compressed working week (CWW). Under a compressed working week, employees work more than 8 hours per day (e.g., 10 or 12 hours) but less than five days a week (e.g., 4 or 3 days) (Tepas, 1985).

Many studies of the CWW have investigated the effects on employees' levels of fatigue. In the three reviews of the CWW we conducted (see Chapters 2, 3, and 4), we found that fatigue was reported to be higher in about half (studies in office work and industrial work) to three-quarters of the studies (studies in nursing). However, hardly any study has addressed how employees deal with these higher levels of fatigue during the extended workday (for an exception, see, for example, Duchon et al., 1997). Changes in work strategies because of fatigue in general have also seldom been investigated.

The way in which employees deal with fatigue in their work can be explained by a model for workload: the effort-recovery model (Meijman, 1989; Meijman &

Mulder, 1998). Its basic assumption is that a worker will always actively seek a balance between work demands and his own capacity. The work demands can exceed the capacity of the worker if his capacity has decreased due to fatigue or the work demands have become too high (e.g., by an increase in workload). Here, as mentioned before, we are interested in how a worker deals with fatigue. If a worker's capacity has become too low due to fatigue, one of the things he can do is increase his capacity by expending compensatory effort. In this way, performance can be maintained, but the expenditure of extra effort may increase fatigue levels even more. However, if the worker has some decision latitude in his work, he can also decide to use a less strenuous work strategy such as working more slowly or spending less time on controlling his work output. This may prevent him from becoming more fatigued, but it may have negative effects on performance.
Hockey (1997) and Schönpflug (1983) also view fatigue (and stress) as states in which work demands outbalance the worker's capacity. Like Meijman and Mulder, they assume that the balance can be restored by either decreasing the demands or increasing the worker's capacity. Hockey (1997) adds that, in general, employees will first try to protect their performance on their main task if there is a discrepancy between work demands and capacity. Thus, rather than let their main task(s) suffer, they will expend extra effort or perform less well on subsidiary tasks or subsidiary parts of tasks if they are fatigued.

The present study

In order to gain a better insight into changes in work strategies because of fatigue on extended workdays, we conducted a study among office workers and nurses working 8-hour or 9-hour workdays. The question addressed in the study was whether changes in work strategies because of fatigue occur more often during 9-hour than 8-hour workdays.
As little is known about possible changes, we first had to explore what types of changes can be distinguished. To this end, we conducted a literature search and a pilot study (pilot study 1). The pilot study was added because only few studies have investigated changes in work strategy because of fatigue. On the basis of the results of both the literature search and the pilot study, several types of work strategies were distinguished. The next section first describes the pilot study in more detail. Then, the different types of work strategies are discussed.
To measure the use of the strategies, they were translated into a questionnaire, which has to be filled in by the workers themselves. The questionnaire was first tested in a small pilot study (pilot study 2). Subsequently, a second test was conducted among a sub-sample of the 8-hour and 9-hour office workers and nurses mentioned above. Then, using the total sample, the strategy use of 8-hour and 9-hour workers was compared. It should be noted that the research reported here is only a first, provisional step towards more in-depth knowledge about changes in work strategy because of fatigue.

Pilot study 1

The pilot study that was used to distinguish several types of work strategies consisted of semi-structured interviews with employees who regularly worked extended workdays. They worked these days either because they had a compressed working week or frequently had to work overtime. A total of 23 employees (15 males, 8 females) from six organisations participated in the interviews. All the interviewees had office jobs. Office workers were chosen because the larger sample used for comparing the strategy use of 8-hour and 9-hour workers was mainly to consist of office workers. Also, little is known about changes in work strategies because of fatigue in office work; most of the studies found in the literature search concerned industrial work.
The interviewees were selected by a contact person from the organisation where they worked. This contact person had been given some information about the purpose of the study. He was asked to select three to four employees who worked extended days and had different types of jobs. Before the interview, the respondents were informed about the purpose of the interview (i.e., to gain more knowledge about what employees do when they are fatigued). The interviewer did not name any specific strategy in her explanation, to avoid influencing the respondents' answers.
The interviewees were then asked several questions about the way in which they carried out their work, for example: How do you normally do your work? Are there any changes in the way you carry out your work if you become fatigued? Is the way you work at the end of the workday different from the way you work at the beginning of the workday? Is the way you work during an extended workday different from the way you work(ed) during a regular workday?

An employee may not always make a conscious decision to change his work strategies because of fatigue. For example, an industrial worker once told us that when he felt fit, he carried out some operations simultaneously (e.g., he put the material into a mould with his left hand while at the same time putting a metal part on it with his right hand). When he was tired, he carried out these operations one after another. He added that he did not decide to change his work strategy very consciously; it more or less just seemed to happen.
Because changes in work strategies may become more or less automated, we do not require that a change has been very consciously decided upon (in German: *Bewusstseinspflichtig* (Hacker, 1986)) for it to qualify as a change in work strategy. However, it must be a change an employee can be *aware* of (in German: *Bewusstseinsfähig* (Hacker, 1986)). Also, it must be a change that could, in principle, have been consciously decided. The effects an automation of changes in work strategies can have for the reliability of self-reports are discussed when the questionnaire is described.

The different types of work strategies

Table 1 shows the different types of work strategies we distinguished on the basis of the results from both the pilot study and the literature search. Each type of strategy is briefly illustrated below by some results of the pilot study and the literature search.

Table 1 The different types of strategies

A.	Expend more effort
B.	Reduce the time that is worked
	B1. Reduce the number of work hours
	B2. Take one or more short breaks
C.	Carry out less work
	C1. Do not carry out a task
	C2. Do not carry out certain parts of a task
D.	Change aspiration level
	D1. Work at a slower pace
	D2. Be less accurate
E.	Carry out the work in a different, less demanding way
	E1. Carry out a task at a lower level of processing
	E2. Carry out actions one after another instead of simultaneously
F.	Switch to another task

A. Expend more effort

According to Hacker and Richter (1984), expending more effort will be an employee's first response to fatigue. By expending more effort, an employee can increase his capacity and thus maintain performance (Gaillard, 1993, 1996; Hacker & Richter, 1984; Hockey, 1997; Meijman, 1989; Meijman & Mulder, 1998; Meijman & Schaufeli, 1997; Schönpflug, 1983; Zijlstra, 1993). Sometimes, such compensatory effort may at first even improve performance a little (Hacker & Richter, 1984). However, a continued expenditure of extra effort will eventually increase fatigue only more (Hacker & Richter, 1984; Meijman, 1989; Meijman & Mulder, 1998). The extent to which an employee continues expending more effort may be dependent on the employee's motivation to perform a task (Fröberg, 1985; Gaillard, 1993, 1996; Hacker & Richter, 1984; Hockey, 1997; Zijlstra, 1996). Out of the 23 interviewees in our pilot study, seven mentioned expending more effort as a strategy for dealing with fatigue.

B. Reduce the time that is worked

B1. Reduce the number of work hours

Reducing the number of hours that are worked not only decreases the work demands, but also gives the employee time to recover from fatigue and thereby the opportunity to increase his capacity. Work hours can be reduced by beginning later, leaving earlier, taking a longer meal break, or working less overtime. Out of the 23 respondents in our pilot study, a total of five said they sometimes used one of these options when they were fatigued. If an employee adopts this strategy, it will probably not involve very large blocks of time, as this would not be much appreciated by the organisation where he works. In a more extreme form, working hours can also be reduced by taking a day off or reporting ill for one or more days. These latter two options were mentioned by none of our respondents.

B2. Take one or more short breaks

Taking one or more short (often informal) breaks during work time can also reduce the work demands (at least during the break) and at the same time improve the employee's capacity. An employee who is fatigued may therefore make more use of this strategy. Research has shown that this is indeed the case. In two studies, the percentage of time spent on informal breaks was found to increase towards the end of the workday (Hacker & Richter, 1984; Plath, 1973). Furthermore, a study among nurses showed that the percentage of time spent on unofficial breaks increased when the shift length was extended from eight to twelve hours (Reid et al., 1993). Out of our 23 respondents, three said they took more breaks when they felt fatigued. Research on the effects of *imposed* breaks has shown that taking a break helps: overall performance improves when employees regularly have to take a short break during their workday (Gaillard, 1996; Hacker & Richer, 1984).

C. Carry out less work

C1. Do not carry out a task

Not carrying out a task can also reduce work demands. Therefore, this is a strategy a worker may adopt if he is fatigued. In its most extreme form, it can mean abandoning a task altogether. However, in a work situation, this is not a likely response (Hockey, 1997); a worker may rather decide to postpone the execution of a task. Instead of postponing or abandoning a task, an employee may also ask a colleague to carry out a task for him. An example of this was given in an article in Nursing Times (Facey, 1995). A nurse who had been working 12-hour shifts reported that, at the end of the shift, she sometimes asked a colleague who had just started her shift to check the prescriptions for her, because she felt too tired to do this herself. Out of the 23 respondents in our pilot study, one mentioned postponing a task as a method for dealing with fatigue. Abandoning a task or asking a colleague to carry out a task were not mentioned.

C2. Do not carry out certain parts of a task

An employee may also reduce work demands by not carrying out some *parts* of a task.[17] In accordance with the idea of performance protection, the parts he skips may be expected to be the less important parts of a task. For example, he may carry out a certain task, but not check the results (Gaillard, 1996; Hacker & Richter, 1984). We found two studies that showed that workers do indeed skip parts of a task more often when they are fatigued. A study among textile workers (Plath, 1973) showed that the percentage of time spent on control operations decreased during the shift. A study on crane drivers (Wendrich, 1973) found that they quite often skipped a step in the execution of their task at the end of the shift. At the beginning of the shift, they did not do this. Out of the 23 employees we interviewed, none said they used this strategy when they felt fatigued. Some of them did indicate, however, that they used this strategy when they were under time pressure. In some laboratory experiments (e.g., Krediet, 1999; Schulz & Schönpflug, 1982), it has also been shown that actual or perceived time pressure can lead to skipping parts of a task.

D. Change aspiration level: work at a slower pace or be less accurate

Changes in aspiration level are quite often named as a method for dealing with fatigue: work demands may be reduced by working at a slower pace or being

[17] Of course, the distinction between task and part of a task is gradual rather than clear-cut.

less accurate (Gaillard, 1993, 1996; Hacker & Richter, 1984; Hockey, 1997; Meijman & Mulder, 1998; Meijman & Schaufeli, 1997; Schönpflug, 1983; Zijlstra, 1993). In general, there seems to be a trade-off between speed and accuracy. If speed is maintained, then accuracy suffers and the other way round. Therefore, if the work is machine-paced or time pressure is high, accuracy is more likely to be affected when an employee becomes fatigued. However, a study among assembly line workers showed that, even with machine-paced work, speed may decrease towards the end of the workday (Teiger, 1978). Evidence for changes in aspiration level was also found in a study on extended workdays (Duchon et al., 1997). Here, a pacing effect was found among miners when their workday was extended from eight to twelve hours. Out of our 23 respondents, seven said they worked more slowly when they were fatigued. The same number of respondents said that they worked less accurately then.

E. .Carry out the work in a different, less demanding way

E1. Carry out a task at a lower level of processing

It has been suggested by some authors that work demands may also be reduced by changing to a lower level of processing (Hockey, 1997; Meijman & Mulder, 1998). Therefore, instead of working at a knowledge-based level (i.e., formulating and developing a plan to handle a specific situation), an employee may switch to a rule-based level (i.e., using stored rules and procedures to handle a situation) if he is fatigued (taxonomy by Hacker, 1986; Rasmussen, 1986). In an unfamiliar situation, an employee may switch to a feedback strategy (i.e., trying out a certain action and correcting it if it does not work properly). However, one of the symptoms of fatigue is that actions are carried out less automatically and less smoothly (e.g., Hacker & Richter, 1984). Therefore, actions may have to be carried out under cognitive control to ensure adequate performance when fatigued. This may make it more difficult to switch to a lower level, at least if the worker wants to maintain performance. Unfortunately, no study known to us has investigated whether switches in processing level do occur under the influence of fatigue. It has been shown, however, that a change to a lower level may be observed if the workload increases (e.g., Coeterier (1971), Sperandio (1978)). Out of our 23 respondents, none mentioned this strategy as a method for dealing with fatigue. Perhaps, this is because it is quite an abstract strategy.

E2. Carry out actions one after another instead of simultaneously

Carrying out actions one after another instead of simultaneously may also reduce work demands. Therefore, an employee who is fatigued may change from the latter to the former method of carrying out his work. This strategy may be subdivided into carrying out different *parts* of a task one after another and carrying out different *tasks* one after another. Out of the 23 respondents in our pilot study, one mentioned this latter strategy. She told us that if she was fatigued and the telephone rang while she was writing a short note, then she would first finish the note before she picked up the receiver. Normally, she would have answered the telephone immediately, while still writing.

F. Switch to another task

If an employee becomes fatigued, he may also decide to switch to another task. For example, he may decide to work on an easier task as this will lower work demands. Another strategy may be to switch to a more interesting task. As a

1960s study by Wilkinson (in Fröberg, 1985) showed, performance declines less under the influence of fatigue if a task is experienced as interesting or challenging. An employee may also decide to work on just any other task. This may work if the assumption that a change is as good as a rest is true. Among the 23 participants in our pilot study, switching to a different task was the most frequently mentioned strategy. Thirteen mentioned working on an easier task (e.g., doing the layout of a report instead of writing on it), two mentioned working on a more interesting task, and two mentioned working on any other task.

As mentioned before, the aim of this study was to find out if changes in work strategies because of fatigue occur more often among employees working 9-hour workdays than among employees working 8-hour workdays. To answer this question, the 8-hour and the 9-hour workers in our sample were compared with regard to the use of the different types of strategies described above. No hypotheses were formulated in advance, as there are hardly any previous studies on which such hypotheses can be based. Therefore, this part of the analyses was of an exploratory nature.
Furthermore, the study also tested whether some of the notions that have been put forward about changes in work strategies because of fatigue in general, are true. More specifically, we investigated the hypotheses that:

- employees will first try to protect performance from the effects of fatigue by expending more effort;
- employees who are highly motivated will try to maintain their performance longer, and thus expend effort longer.

It may also be expected that use of the different types of strategies will depend on the decision latitude an employee has in his work. Expending more effort and accepting a lower quality of work can also be used when the level of decision latitude is low. For the other strategies, however, some degree of decision latitude is needed.[18] Therefore, we expected that the first two strategies will be used more when the decision latitude is smaller and the other strategies more when the decision latitude is larger.
Furthermore, it may also be expected that the degree of time pressure will influence which strategies are adopted. Working at a slower pace, taking a short break, reducing the number of hours worked, and carrying out tasks one after another may be used less frequently if time pressure is high, since using these strategies means that it will take longer to finish the work. Therefore, it was also tested whether this expectation is true.

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[18] Changing the level of processing may, of course, not be used in jobs with little decision latitude because often only rule-based processing is required in these jobs.

Method

The questionnaire

The studies done on changes in work strategies so far, mostly used observations. However, observations are very time-consuming. Also, some types of jobs are better suited to observations than others. Therefore, it is probably no coincidence that previous studies on work strategies either concerned jobs that mainly required physical actions (e.g., crane drivers) or jobs in which the results of the actions taken by the employee were immediately visible (e.g., air traffic controllers). Furthermore, some types of strategies that were discussed may be hard to observe (e.g., expending more effort). Nevertheless, we do like to stress that observations can be of great value in studies on work strategies.

Because of the above-mentioned limitations of observations, we decided to construct a questionnaire that asks employees themselves about changes in work strategy because of fatigue. A difficult point in using self-ratings, is that changes in work strategies may become more or less automated (see also the example given in the previous section). If an employee has not consciously decided upon a certain change, the risk is that it may escape his attention. Therefore, asking employees themselves about changes in work strategies requires quite a lot from them in terms of awareness and memory. To improve the respondents' awareness, the cover letter with the questionnaire explicitly asked the respondents to pay attention to changes in work strategies because of fatigue in the following week (or one of the following weeks) and then fill in the questionnaire at the end of that week. Still, more subtle changes that, for instance, seem to happen more or less naturally towards the end of the workday may have escaped the respondents' notice.

The questionnaire covered all the types of strategies described in the previous section. Each of the strategies we distinguished was measured by one or more items. The employees had to indicate on a 5-point scale how often they had changed their work strategies because they felt fatigued or felt they were beginning to get fatigued during the past working week. With regard to the strategies 'take one or more short breaks', 'do not carry out a task' and 'switch to another task', some questions were first asked about specific instances of such behaviour (e.g., breaks: walk around). These questions were followed by a question in which the respondent was asked to give an estimate of the total frequency with which he had used that strategy (e.g., breaks: "All in all, how often did you take a short break during the past working week because of fatigue?"). For the different aspects of the strategy 'reduce the number of work hours', single-item measures were used (see Table 2 for some examples and the general format of the questionnaire). With regard to the strategy 'do not carry out certain parts of tasks', a distinction was made between preparatory, execution, and control/monitor activities. The full questionnaire is given in the Appendix.

The questionnaire was pilot-tested on six employees from a provincial authority and one employee from an insurance company. The pilot revealed that towards the end of the questionnaire, the respondents tended to forget that they should only mark a change in work strategy if they felt it was due to fatigue. They sometimes also marked a change if it was due to time pressure or if they generally worked that way (e.g., carrying out a task step by step). Therefore, it was decided to repeat the phrase 'because of fatigue' every two to six questions

instead of printing it only at the top of the page, as had been the case with the pilot study. It was also decided to conduct some follow-up interviews in the larger study that was to follow pilot study 1, in order to check whether the change in the layout of the questionnaire had had the desired effect.

Table 2 General format of the questionnaire

During the last working week, I ..... because of fatigue:	never	seldom	some-times	often	very often
- took a longer meal break	O	O	O	O	O
- worked less overtime	O	O	O	O	O

The larger study

The data used in the larger study came from two previous studies on the effects of 9-hour workdays. One study was conducted among office workers, the other among nurses. The office workers came from five organisations, the nurses from three. From this sample, only those respondents who had filled all questions on changes in work strategies were used. This meant that a few respondents from each group (office workers, nurses) were excluded.

The group of office workers consisted of five subgroups (see Table 3). One group worked 9 hours per day in combination with a 36-hour to 38-hour working week. The employees in this group had chosen to work 9 hours instead of 8 hours per day. Most weeks, they had a four-day working week. They were instructed to answer the questionnaire about such a week. There were a total of 106 respondents in this group. The group is referred to as the '9-hr, ≤ 38' group.

The second group also had a 36-hour to 38-hour working week but worked 8 hours per day. The respondents in this group had chosen to remain on 8-hour days. They were instructed to answer the questionnaire about a 5-day, 8 hours per day working week. They came from the same organisations as the respondents in the first group. There were 59 respondents in this group. The group is referred to as the '8-hr, ≤ 38' group.

These first two groups were the main subgroups of office workers. Most tests on the effects of 9-hour workdays on the work strategies of office workers were done on these groups. Earlier comparisons (see Chapter 2) had shown that 9-hour workdays had no serious negative effects on fatigue and health in this sample. Although there was a slightly higher *increase* in fatigue over the workday among the 9-hour workers, there were no significant differences in need for recuperation and health complaints, or in the *absolute* level of fatigue at the end of the workday. We attributed this to self-selection (only those employees who think they can cope with 9-hour workdays will choose this arrangement), the low physical workload in office work, and the fact that the three days off per week may give employees enough time to recuperate from the higher increase in fatigue.

A fourth reason we put forward for the absence of serious negative effects was that the 9-hour workers may strategically deal with the extended workdays. By using certain work strategies they may prevent fatigue from accumulating too much. The analyses on these two groups, therefore, were aimed to find out whether they did, indeed, use some work strategies more often.

The other three groups of office workers were used for some additional analyses. Group three came from an organisation where all employees *had to* work 9-hour days. The respondents in this group had a 37-hour working week. Most weeks they worked four 9-hour days. They were instructed to answer the questionnaire about such a week. There were 13 respondents in this group. The group is referred to as the '9-hr, no choice' group.
We had expected that, in this group, 9-hour workdays would have more negative effects on fatigue and health because there was no opportunity for self-selection; employees who found the 9-hour workdays too fatiguing could not return to 8-hour days. However, previous analyses (see Chapter 5) showed that this group did not differ from the 9-hour group with choice with regard to need for recuperation and health complaints. Therefore, for this group we also wanted to find out whether they compensated for the extended workday by using certain work strategies.

Table 3 The groups of respondents and the effects of 9-hour workdays

			Effects of 9-hour workdays on:		
	N(9hr)	N(8hr)	Fatigue	Health	Overall performance
Office workers:					
Choice in workday length + 36-hour to 38-hour working week	106	59	–/0	0	0
No choice in workday length + 37-hour working week	13		–/0	0	0
Choice in workday length + 39-hour or 40-hour working week	16	12	–	–	0
Nurses:					
No choice in workday length + 12-hour to 36-hour working week	23	19	—	—	–/0

The fourth and the fifth group both had a 39-hour or 40-hour working week. They had chosen to work more than 38 hours per week. The respondents in the fourth group had chosen to work 9 hours per day. One week, they worked four 9-hour days; the other week, they worked four 9-hour days plus one 8-hour day. They answered the questionnaire about the latter week. There were 16 respondents in this group. The group is referred to as the '9-hr, ≥ 39 hrs' group.
Group five consisted of employees who had chosen to remain on 8-hour days. They worked in the same organisation as the respondents from the fourth group. There were 12 respondents in this group. The group is referred to as the '8-hr, ≥ 39 hrs' group.
The five-day working week of the '9-hr, ≥ 39 hrs' group made their working hours more demanding. Compared to group five, the '9-hr, ≥ 39 hrs' group

scored significantly higher on need for recuperation and health complaints (see Chapter 5). Here, groups four and five are compared to find out if the '9-hr, ≥ 39 hrs' group had tried to adjust to the extended workdays by the more frequent use of certain work strategies.

The group of nurses consisted of two subgroups (see Table 3). One group worked 9-hour shifts, the other worked 8-hour shifts. The first group consisted of 23 respondents, the second group of 19. In both groups, the employees could not choose the length of their shifts. The nurses were not asked to look back at the past working week in filling in the questionnaire but at the last *sequence* of 9-hour or 8-hour shifts they had worked. This sequence had to consist of at least three workdays and should not include a night shift.[19]
Earlier analyses (see Chapter 3) showed that, in the group of nurses, 9-hour shifts did have serious negative effects on both fatigue and health. However, there were not many negative effects on performance. Here, it is investigated, therefore, whether the 9-hour group had tried to adjust to the extended workdays by the more frequent use of certain work strategies.

All respondents were also asked about the decision latitude they had in their work (eleven 5-point items scale by de Jonge, 1995) and their work pace/workload (ten 4-point items scale by van Veldhoven, 1996). Their motivation was measured by a scale for achievement motivation (Hermans, 1967)

The respondents

The majority of the office workers (74%) were male. Almost all the nurses were female (91%). The nurses had lower autonomy in their work than the office workers ($t = 12.64$, $p = .000$). Their work pace/workload was slightly but not significantly higher ($t = 1.40$, $p = .163$). There were no differences in achievement motivation ($t = 0.54$, $p = .590$).

Results

The measurement of the strategies

Follow-up telephone interviews were conducted to check whether the respondents had understood the questions and had indeed only marked a change in work strategy if the change was due to fatigue. A total of 65 respondents participated in the follow-up interviews on a voluntary basis. Naturally, the number of interviewees per strategy was lower, as the respondents had not marked every strategy.
The results of the interviews showed that the strategies 'expend more effort', 'reduce the number of hours worked', 'take one or more short breaks', 'work at a slower pace', 'be less accurate' and 'switch to another task' had always or

[19] This different period of time was chosen because of the irregular schedule of the nurses. The night shift was excluded to prevent interference from the disruption of the circadian rhythm.

nearly always (> 90% of the cases) been correctly marked (that is, they were marked only if they had been used because of fatigue).[20] Of the strategy 'reduce the number of work hours', the subcategories 'take a day off' and 'report a day ill' were used so little (≤ 0.4%), that these were not included in our analyses.
However, the other strategies were measured less well (see Table 4 for an overview). About half of the respondents who had marked the items belonging to the strategy 'carry out a task at a lower level of processing' meant they had switched to an easier task (they had marked that strategy as well). Because of this overlap, the strategy 'carry out a task at a lower level of processing' was not included in our analyses. Furthermore, in the strategy 'do not carry out a task', the items referring to the postponement of a task were found to overlap with switching to an easier task in about half the cases. The interviewees meant they had put aside the difficult task they were working on and had started working on an easier task. Therefore, the items referring to the postponement of a task were also deleted from our analyses. The (single) items referring to 'do not carry out a task at all' and 'ask a colleague to do a task' were reliably measured (i.e., > 90% had marked these strategies only when used because of fatigue). Therefore, we decided to use these two items as two separate categories of strategies.
About half of the respondents who had marked the strategy 'do not carry out certain parts of a task' had adopted this strategy because time pressure was high and not because of fatigue. Therefore, this strategy was deleted from our analyses as well. Out of the respondents who had marked the strategy 'carry out several tasks one after another, instead of simultaneously', about half had done so because they always worked that way. Hence, this strategy was also deleted.
The scores on the items that had been reliably measured, were subsequently dichotomised. A score of 0 meant that an employee had seldom or never used a specific strategy. A score of 1 meant that an employee had sometimes or often/very often[21] used that strategy. This was done because we felt that the *percentage* of respondents who used a strategy sometimes or more was more informative than an *average* score. Also, if one of the strategies that were maintained had not been answered correctly, it generally concerned a respondent who had given the score 'seldom'. A third reason was that the distribution of the original scores deviated quite strongly from normal.
Three of the remaining strategies consisted of two items. For these strategies, Cronbach's alpha was computed. As Table 4 shows, the reliabilities were satisfactory to good. The total score on these scales (each consisting of two items) was calculated by giving the respondent a score of one, if one or both of the component items had a score of one. Otherwise, a score of zero was given.
Of the strategies 'take one or more short breaks' and 'switch to another task', only the item referring to the total use of that strategy was used in our analyses. Some of the respondents scored 'sometimes' or higher on one or more of the specific instances of these strategies but filled in a score of 'never' on the item measuring total use (breaks: 9% of the respondents; switch task: 3% of the respondents). The total score of these respondents was still used.

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20 The scores of the respondents who had not correctly marked these strategies were still included in the analyses.

21 This latter score was hardly ever given.

Table 4 The original and the final types of strategies

Original strategy	Final strategy	Cronbach's alpha
A. Expend more effort	*A. Expend more effort*	office workers: .78 nurses: .76
B. Reduce the time that is worked		not applicable
B1. Reduce the number of work hours	Included: *B1.1 Start workday later* *B1.2 End workday earlier* *B1.3 Take a longer meal break* *B1.4 Work less overtime* Not included: B1.5 Take a day off B1.6 Report a day ill	
B2. Take one or more short breaks	*B2. Take one or more short breaks*	not applicable
C. Carry out less work		not applicable
C1. Do not carry out a task	Split into: *C1.1 Do not carry out a task at all* *C1.2 Ask a colleague to carry out a task* Not included: C1.3 Postpone finishing a task C1.4 Postpone carrying out a task	
C2. Do not carry out certain parts of a task	–	–
D. Change aspiration level	D. Change aspiration level	Work at a slower pace:
D1. Work at a slower pace D2. Be less accurate	*D1. Work at a slower pace* *D2. Be less accurate*	office workers: .80 nurses: .98 Be less accurate: office workers: .79 nurses: .86
E. Carry out the work in a different, less demanding way	–	–
E1. Carry out a task at a lower level of processing E2. Carry out actions one after another instead of simultaneously		
F. Switch to another task	*F. Switch to another task*	not applicable

Use of the different strategies: performance protection

In the introduction it was mentioned that an employee's first reaction to fatigue will probably be the expenditure of extra effort. As we did not have any data on how use of the different strategies evolved over the workday, it was not possible to test this hypothesis directly. However, we could conduct an indirect test by comparing the frequency with which the strategy 'expend more effort' on the one hand and the strategies 'work at a slower pace' and 'be less accurate' on the other hand were used (see Table 5).

Table 5 Performance protection

		Be less accurate		Work at a slower pace	
		never/seldom	sometimes or more	never/seldom	sometimes or more
Expend more effort	never/seldom	118 (47.6%)	7 (2.8%)	110 (44.4%)	15 (6.0%)
	sometimes or more	98 (39.5%)	25 (10.1%)	74 (29.8%)	49 (19.8%)

		Be less accurate	
		never/seldom	sometimes or more
Work at a slower pace	never/seldom	175 (70.6%)	9 (3.6%)
	sometimes or more	41 (16.5%)	23 (9.3%)

As the top section of Table 5 shows, expending more effort and maintaining performance was the most likely reaction to fatigue. The next most likely reaction was a combination of extra effort with being less accurate or working at a slower pace. This seems to indicate that employees do indeed first respond to fatigue by expending more effort. Letting performance suffer seems only to be done as a second response. If the respondents let their performance suffer (see bottom section of Table 5), they were more likely to cut back on the speed with which they carried out their work than on the quality of their performance. Separate analyses showed that the results above applied to the office workers and nurses alike.

Use of the different strategies: the effects of achievement motivation, decision latitude, and time pressure

In the introduction, it was hypothesised that the type of strategy an employee adopts may depend on his motivation, the decision latitude he has in his work, and the time pressure he is under. More specifically, we expected that:

- a higher motivation (as measured by achievement motivation) will lead to a higher use of the strategy 'expend more effort' and a lower use of the strategy 'be less accurate' and 'work at a slower pace';
- a higher decision latitude will lead to a lower use of the strategies 'expend more effort' and 'be less accurate' and a higher use of the other strategies;
- a higher work pace/workload will lead to a higher use of the strategies 'expend more effort', 'be less accurate', 'do not carry out a task', and 'ask a colleague to do a task'. It will lead to a lower use of the other strategies.

These hypotheses were tested by several logistic regression analyses on all respondents, with the different strategies as dependent variable and achievement motivation, decision latitude, and work pace/workload as independent variables. Furthermore, we controlled for the effects of health status (self-ratings, scale by Dirken, 1967) in the analyses because a poorer health status may increase the use of all strategies, and we wanted to know what the effects of the independent variables were with health status kept constant.

The analyses showed that achievement motivation had no significant effects on the use of any strategy. However, work pace/workload and decision latitude did have some effects. A higher work pace/workload increased the likelihood of using the strategies 'be less accurate' (odds = 4.39, p = .004) and 'ask a colleague to do a task' (odds = 4.39, p = .022). It decreased the likelihood of using the strategy 'end the workday earlier' (odds = 0.21, p = .048). A higher decision latitude was found to decrease the likelihood of 'work at a slower pace' (odds = 0.52, p = .006) and 'be less accurate' (odds = 0.35, p = .000). It tended to increase the likelihood of 'switch to another task' (odds = 1.64, p = .095), 'end the workday earlier' (odds = 2.73, p = .072), and 'take a longer meal break' (odds = 2.03, p = .075).

The relation of decision latitude with 'work at a slower pace' was contrary to what was expected. However, in view of the positive relationship of decision latitude with 'switch to another task', 'end the workday earlier', and 'take a longer meal break', it did not seem all that strange. Apparently, employees with a higher degree of decision latitude in their work prefer to stop working or do something else, to persisting with the same task and let performance suffer.

Use of the different strategies: the effects of workday length

In Table 6, the 8-hour and 9-hour workers are compared with regard to the frequency with which they used the different strategies. We made separate comparisons for the nurses and the office workers. With regard to the office workers, we first only look at the '9-hr, ≤ 38 hrs' and the '8-hr, ≤ 38 hrs' groups. To recapitulate briefly, for the nurses, 9-hour workdays had serious negative effects on fatigue and health. For this group, we wanted to find out whether they had tried to adjust their work strategies to the extended workdays. For the '9-hr, ≤ 38 hrs' group of office workers, 9-hour workdays did not have serious negative effects. For this group, we wanted to investigate whether they

compensated for the extended workdays by changes in work strategy. Perhaps they thus prevented fatigue from accumulating too much.

Table 6 Use of the different strategies: office workers and nurses

	Office workers				Nurses			
	9-hr group	8-hr group	Chi^2	p	9-hr group	8-hr group	Chi^2	p
Expend more effort	47.2%	47.5%	0.00	.972	73.9%	57.9%	1.20	.273
Start workday later	7.5%	8.5%	Fish. Exact	1.000	0.0%	0.0%	-	-
End workday earlier	5.7%	6.8%	Fish. Exact	.746	0.0%	0.0%	-	-
Take a longer meal break	10.4%	13.6%	0.38	.539	4.3%	0.0%	Fish. Exact	1.000
Work less overtime	8.5%	8.5%	0.00	.997	0.0%	0.0%	-	-
Take one or more short breaks	20.8%	22.0%	0.04	.847	47.8%	21.1%	3.25	.071
Do not carry out a task at all	2.8%	8.5%	Fish. Exact	.136	13.0%	5.3%	Fish. Exact	.613
Ask a colleague to do a task	4.7%	5.1%	Fish. Exact	1.000	21.7%	26.3%	Fish. Exact	1.000
Work at a slower pace	19.8%	23.7%	0.35	.555	65.2%	15.8%	10.38	.001
Be less accurate	7.5%	13.6%	1.56	.211	30.4%	26.3%	0.09	.769
Switch to another task	16.0%	13.6%	0.18	.670	17.4%	5.3%	Fish. Exact	.356

Table 6 shows that expending more effort was the most frequent response to fatigue in all four groups. Therefore, there was again some indirect evidence for performance protection. The strategies than can be considered the most 'radical' (i.e., 'start workday later', 'end workday earlier', 'work less overtime', and 'do not carry out a task at all') were used the least. The nurses did not use the first three strategies at all, which is probably due to the fact that they had fixed starting and end times (all the office workers above were on flexitime). The office workers also hardly used the strategy 'ask a colleague to do a task'. Among the nurses, however, this strategy was used quite frequently. This difference may be due to the fact that the nurses worked in teams, while most of the office workers did not. It should be noted that some nurses remarked that, in their team, nurses who were not feeling well would normally report this to the others at the beginning of the shifts.
Table 6 also shows that the 8-hour and 9-hour office workers did not differ from each other in their use of the strategies. Therefore, it seems that the '9-hr, ≤ 38

hrs' workers did not have to compensate for the extended workdays by changes in work strategy. For them, 9-hour workdays really seemed not to cause any problems.
The 9-hour nurses, however, did seem to have adjusted their work strategies to the extended shifts. Compared to the 8-hour nurses, they used the strategy 'work at a slower pace' significantly more often. They also tended to take a short break during their shift more often. In Chapter 3, it was shown that the 9-hour nurses did *not* rate their quantity of performance lower than the 8-hour nurses did. This does not seem to agree with their answers to the questions on work strategies. Perhaps, they managed to catch up with the lost time during a later part of their shift. However, in the telephone interviews, those who used these strategies said they did so towards the end of the shifts. Therefore, it seems unlikely that the quantity of their work had not suffered.
In a study on the quality of patient care in a nursing home (Josten et al., 1999), it was shown that the nurses rated the *quality* of their work as good if they not only managed to do all the direct patient care that is required (e.g., washing, feeding), but also managed to pay sufficient attention to their patients. Normally, the first part of a day shift is mainly spent on direct patient care. In the second part, there should be some time for paying attention to patients. If nurses take a short break because they are fatigued by that time instead of spending some time with their patients, therefore, this may signify lower quality rather than quantity of performance to them. The quality of performance was found to be affected somewhat on the 9-hour day shift.
The use of the strategy 'expend more effort' did not differ significantly between the two groups of nurses. Again, this seemed not to be in line with the results of earlier analyses. These had shown that the 9-hour group scored significantly higher on the absolute levels of effort expended during the shift. This difference in results may be due to the smaller number of respondents who answered the questions on work strategies. The question on the absolute level of effort was filled in by 2.5 times as many respondents, which substantially increases the power of the analyses.

Earlier analyses (see Chapter 2) had shown that there were some office workers for whom the extended workdays were more problematic. In a question on the disadvantages of the CWW, 21% of the 9-hour workers had indicated that they found this working time arrangement more fatiguing. Table 7 shows that the 9-hour workdays did appear to have led to changes in work strategies for this subgroup. Compared to other 9-hour workers, the workers in this group made significantly or almost significantly more use of every strategy, except being less accurate and asking a colleague to carry out a task.
The higher use of strategies that may shorten the length of the workday (start later, end earlier, less overtime) was confirmed by data on actual workday length as recorded by the workers themselves. Earlier analyses (see Chapter 2) had shown that 52% of the more fatigued group worked, on average, more than 10 minutes per day too short. In the group that did not find the CWW more fatiguing, this percentage was 23%, which was significantly lower.
The higher use of the strategy 'slower pace' was also in line with other data provided by the respondents. The more fatigued group reported significantly more often that the quantity of their performance had decreased under the CWW. The quality of their work had not decreased significantly more often, which agrees with the fact that they did not make higher use of the strategy 'be less accurate'.

Table 7 Use of the different strategies: office workers who found the CWW more fatiguing. N(fatigued): 20; N(not fatigued): 86

	9-hr gr.: more fatigued	9-hr gr.: not more fatigued	Chi^2	p
expend more effort	65.0%	43.0%	3.14	.076
start workday later	25.0%	3.5%	Fish. Exact	.006
end workday earlier	15.0%	3.5%	Fish. Exact	.080
take a longer meal break	25.0%	7.0%	Fish. Exact	.032
work less overtime	25.0%	4.7%	Fish. Exact	.011
take one or more short breaks	40.0%	16.3%	Fish. Exact	.030
do not carry out a task	15.0%	-	Fish. Exact	.006
ask a colleague to do a task	10.0%	3.5%	Fish. Exact	.237
work at a slower pace	40.0%	15.1%	Fish. Exact	.025
be less accurate	10.0%	7.0%	Fish. Exact	.644
start working at another task	30.0%	12.8%	Fish. Exact	.087

Some additional analyses were done on three other groups of office workers. To recapitulate briefly: one group had to work a CWW of four 9-hour days; they could not choose the length of their workday ('9-hr, no choice' group). In this group, the 9-hour workdays were found to have no serious negative effects on fatigue and health. We therefore wanted to find out whether the '9-hr, no choice' group compensated for the extended workdays by changes in work strategy.
The employees in the second and the third groups all worked 39 or 40 hours per week. Those in the second group had chosen to work 9 hours per day ('9-hr, ≥ 39 hrs' group), while those in the third group had chosen to remain on 8-hour days ('8-hr, ≥ 39 hrs' group). The '9-hr, ≥ 39 hrs' group worked four 9-hour days and one 8-hour day every two weeks, which can be considered quite demanding. Earlier comparisons showed that this group scored significantly higher on health complaints and need for recuperation than the '8-hr, ≥ 39 hrs' group. Here, we wanted to find out whether the '9-hr, ≥ 39 hrs' group had tried to adjust to the extended workdays by changes in work strategy.
The analyses showed that the '9-hr, no choice' group tended to make more use of strategies 'take one or more short breaks' (no choice group: 46.2%, $p = .076$) and 'work at a slower pace' (no choice group: 46.2%, $p = .071$) than the '9-hr, ≤ 38 hr' group, which had had a choice. Thus, it seemed that the '9-hr, no choice' group compensated for the extended workdays by pacing their work. The respondents in this group did not score lower on self-rated quantity of performance, which one might have expected in view of the pacing effect (see Chapter 5 for more information). Of course, they may have managed to catch up with the lost time during other parts of the day or week. Or perhaps the breaks

gave them fresh energy, enabling them afterwards to work harder than they could have done had they not taken a break. However, in our opinion, a more likely explanation is that admitting to taking a short break or working more slowly because of fatigue may be considered more acceptable to employees than admitting to a reduced overall level of performance. Hence, social desirability may have played a role in their answers on their overall levels of performance. There were no significant differences between the two groups regarding use of the strategy 'expend more effort', which agrees with the fact that the absolute levels of effort did not differ either (absolute levels of effort measured using graphic rating scale (Zijlstra, 1993). 9-hr choice: $M = 54.2$, $SD = 20.7$, $N = 63$; 9-hr no choice: $M = 48.4$, $SD = 16.7$, $N = 12$; $t = 0.91$, $p = .364$).
The '9-hr, ≥ 39 hrs' group and the '8-hr, ≥ 39 hrs' group did not differ significantly from each other in use of the strategies. The higher number of complaints in the first group, therefore, appeared not to have led to changes in work strategies. For these groups, the absence of a significant difference in use of the strategy 'expend more effort' was also in accordance with data on the absolute levels of effort: the two groups did not differ on this aspect either ('9-hr, ≥ 39 hrs': $M = 53.7$, $SD = 26.7$, $N = 15$; '8-hr, ≥ 39 hrs': $M = 52.4$, $SD = 26.5$. $N = 13$; $t = 0.14$, $p = .892$).

Conclusion and discussion

Research on the compressed working week has shown that CWWs quite often increases employees' levels of fatigue. However, hardly any study has addressed how employees deal with these higher levels of fatigue during the extended workday. Therefore, we investigated whether changes in work strategies because of fatigue occur more often during 9-hour workdays than during 8-hour workdays. The study was conducted among office workers and nurses.
The few studies that did investigate changes in work strategy because of fatigue mostly used observations. As these are rather time-consuming, it was decided to construct a questionnaire on work strategies that has to be filled in by the employees themselves. Out of the changes in work strategy listed in the questionnaire, the following were measured reliably: expend more effort, start workday later, end workday earlier, take a longer meal break, work less overtime, take one or more short breaks, ask a colleague to carry out a task, do not carry out a task at all, work slower, be less accurate, and switch to another task. The strategies that were not reliably measured were: carry out a task at a lower level of processing, carry out actions one after another instead of simultaneously, do not carry out certain parts of a tasks, and postpone the execution of a task.
The strategies that had to be deleted, are the more abstract ones (e.g., change level of processing) or the ones that are often not chosen at a very conscious level (e.g., carry out actions one after another). Asking employees themselves about strategy changes may, therefore, work best with more concrete strategies that an employee quite consciously decides to use. More subtle changes that, for instance, occur more or less naturally towards the end of the workday may not be measured well by a questionnaire either. Thus, differences in the use of these between 8-hour and 9-hour workers may also have escaped our attention.
Nevertheless, there were quite a few respondents who did answer the more abstract, less conscious strategies reliably. Therefore, employees seem to differ from each other in the degree to which they are aware of such changes, and

maybe also in the extent to which they apply such strategies deliberately. Our impression was that awareness was higher among the respondents who experienced higher levels of fatigue. This would seem logical, as they need to deal with fatigue more often.

The question, then, is how the more abstract, less conscious changes can be measured reliably. This is a difficult question to which we have no direct answer at hand. One solution may be to increase employees' awareness of such changes by giving them some general information on this topic in advance and subsequently urging them personally (thus not by letter, like in this study) to pay close attention to these changes shortly before the week on which they are to answer the questionnaire. However, a disadvantage of this method is that the increased awareness may influence how employees deal with fatigue.

Observing employees' behaviour could also give us some information about the more abstract, less conscious strategies. However, as mentioned before, observations are rather time-consuming. Furthermore, some strategy changes are difficult to observe, because there are no clear changes in the behaviour of the employees (e.g., carry out a task at a lower processing level). Those strategies that can be observed often require that the job to be observed consists of only a few activities or tasks that are repeated during the workday, to ascertain whether a certain task is carried out in a *different* way due to fatigue or not. Therefore, it is probably no coincidence that almost all studies on strategy changes that used observations concerned jobs that consist of few activities repeated over the workday.

Laboratory experiments may also provide information on strategy changes. They may also make it easier to manipulate fatigue. However, a difficult point here may be that such an experiment should preferably use workers who are experienced with the tasks that are to be carried out, and not students, as is often the case, since inexperienced workers may not know all strategy changes that are possible in those tasks. Furthermore, as in real-life observations, some strategies may be difficult to observe. All in all, it seems that certain methods are better suited to particular strategies. There probably is no method that is superior in all respects.

With regard to the strategies the questionnaire did measure reliably, two questions should be addressed in future research. The first is why some respondents said they used a specific instance of a certain strategy (e.g., they switched to a more interesting task) but still answered 'never' to the question measuring the total use of this strategy (in this example, they said they had 'never' switched to another task). The second question is that of the validity of the questionnaire. Are the answers the employees give supported by other data, preferably not from the same source? In this study, we found that some but not all differences in strategies between groups were consistent with differences in other self-report measures taken from the same respondents. Where the different self-report measures did not agree, this may have been due to a small sample size, different meanings of the term quality, or social desirability in answering the other measures.

The aim of this study was to find out whether changes in work strategies because of fatigue occur more often during 9-hour workdays than during regular 8-hour workdays. In a sample of office workers working four 9-hour days per week on a voluntary basis did not lead to a higher use of the work strategies. In an earlier Chapter, it was shown that the 9-hour workers did not score higher on need for recuperation and health complaints either. Thus, the respondents probably did

not need to adjust their work strategies; in general, working four 9-hour days on a voluntary basis did not cause any problems for office workers.
However, office workers who *had to* work four 9-hour days per week did score higher on the strategies 'work at a slower pace' and 'take a short break'. This suggests a pacing effect. The workers in this group did not score higher on need for recuperation and health complaints or lower on self-rated performance. This may indicate that the use of these strategies was quite effective. However (and perhaps more likely), the absence of any effects on self-rated performance may also be due to social desirability.
The results regarding the office workers who had no choice showed the value an investigation into work strategies can have. If we had not conducted this investigation, we would have concluded that working four 9-hour days had no negative effects on office workers, regardless of whether employees had any choice or not.[22] Now, it seems that employee choice is also important in office work, after all.
Office workers who had choice but who worked four 9-hour days plus one 8-hour day every two weeks did not differ in work strategies but did score higher on need for recuperation and health complaints. Why they did not change their work strategies is unclear. It seemed as if they simply accepted that this arrangement led to more health complaints. The reason for this may be the choice they had. Because they had chosen this arrangement, they may have felt that there should not be any negative effects on performance, even if this went at the expense of their own fatigue and health. Of course, it may also be that the managers in the organisation where these respondents worked supervised the work behaviour of their employees more closely. It should be noted, however that the number of respondents in the two last groups of office workers (the no choice group and the '4 days, 9 hrs + 1 day, 8 hrs' group) was rather small. Therefore, a replication with a larger number of respondents is needed in order to be more certain of these results.
In the sample of nurses, 9-hour workdays led to a higher use of the strategies 'take one or more short breaks' and 'work at a slower pace'. Again, this suggests a pacing effect. However, this was not entirely effective in that it could not prevent the extended workdays from having an adverse effect on the fatigue and health of the nurses.
The study also showed that employees in general first respond to fatigue by expending more effort. Working more slowly is resorted to sooner than being less accurate. More radical changes such as 'start workday later', 'end workday earlier', or 'do not carry out a task at all' are used very infrequently[23]. However, in terms of fatigue and health (but probably not in terms of short-term performance), it may be better if employees change immediately to the more radical strategies.

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22 The 9-hour office workers who had no choice did not have flexitime either. An alternative explanation may therefore be that they used the strategies 'breaks' and 'work more slowly' more often because they could not use the strategies 'start later', 'end earlier', and 'take a longer meal break'.

23 Of course, the finding that these strategies were marked infrequently may also be due to social desirability in answering the questionnaire. However, as the use of these strategies will not be much appreciated by their organisation, employees will probably really not use these strategies much.

7 Conclusion and discussion

This study addressed the effects of extended workdays on workers' fatigue, health, performance, and satisfaction with working hours and free time. It covered extended workdays worked under so-called compressed working weeks. Compressed working weeks (CWWs) compress the working week into fewer than five days by extending the workday to more than 8 hours (Tepas, 1985). Examples of the compressed working week are a schedule of four 10-hour days and a schedule of three 12-hour shifts.
The study restricted itself to extended workdays worked in office work, nursing, and industrial work. In our review of previous studies, extended workdays of any length were discussed. The empirical part of the study focused on the effects of 9-hour workdays. Nine-hour workdays were investigated, because, in the Netherlands, the most common form of the compressed working week consists of a schedule of four 9-hour workdays. The questions addressed in the empirical part of the study were:

- What are the effects of 9-hour workdays on employees' fatigue, health, performance, and satisfaction with working hours and free time?
- What factors moderate the effects of 9-hour workdays?
- Do employees use other work procedures or work strategies when working 9-hour workdays?

In this Chapter, first, the results of previous studies on extended workdays are summarised briefly. Then, the results of the empirical part of our study are described. This description follows the order of the questions above. Subsequently, the limitations of our study are discussed. This is followed by the implications of the results of our study for future research. Next, the implications for legislation on working hours are presented. The Chapter concludes with the implications for organisations.

The results of previous studies

Previous studies on extended workdays (see Table 1) have shown that the effects on fatigue and health differ per type of work. In nursing, the effects were more negative: 12-hour shifts in nursing generally much increased fatigue and had mixed effects on health. In office work and industrial work, the effects were less negative. Nine-hour or 10-hour days in office work and (heavy) industrial work increased fatigue only a little. The same applied to 12-hour days and nights in industrial work (this mostly concerned operator work). Also, 9-hour or 10-hour days had no effects on health. The effects of 12-hour days and nights on health were even neutral to positive.
The finding that 12-hour days and nights sometimes improved health may be due, in our view, to the fact that:

- 12-hour shifts substantially reduce the number of nights to be worked, which may decrease circadian disruption (Baker et al., 1994; Wallace et al., 1990);
- 12-hour systems often also substantially reduce the number of work hours per sequence of shifts (e.g., from 56 hours to 36 or 48 hours), whereas 9-hour or 10-hour days do not or only a little.

Table 1 The results of previous studies on extended workdays

	Office workers		Nurses		Industrial workers	
	9-hour or 10-hour days	12-hour days and nights	9-hour or 10-hour days	12-hour days and nights[1]	9-hour or 10-hour days	12-hour days and nights
Fatigue	–/0	only 1 study	only 1 study	–	–/0	–/0
Health complaints	0			X	0	0/+
Performance	–/0			–/0	–/0	–/0
Satisfaction with working hours	0/+			–/+	0/+	0/+
Satisfaction with free time	0/+			–/+	+	+

[1] One out of the 14 studies did not cover 12-hour days and nights, but 10-hour days.

Legend: – = negative effects; 0 = no effects; + = positive effects; X = mixed results (both negative, neutral, and positive effects)

In all three types of work, performance was generally a little affected when employees worked extended workdays. Thus, the higher increase in fatigue found in nursing did not lead to a proportionally higher decrease in performance. Satisfaction with working hours and free time was found to be higher in the majority of studies conducted in the three types of work. Therefore, the extra day(s) off which the extended workdays provide, appear to be generally valued by employees. Only in nursing were there some studies showing that employees were less satisfied when working extended shifts.

It was not possible to test whether different workday lengths produce different results (e.g., more health complaints when the workday is longer). The reason for this was that many studies did not report the exact workday length investigated (i.e., without the meal break) and that there was too little variety in workday length within CWWs with and without nights.

The results of this study

The effects of 9-hour workdays on employees' fatigue, health, performance, and satisfaction with working hours and free time

The empirical part of our study addressed the effects of 9-hour workdays. The effects were investigated separately for respondents who had had a choice in the length of their workday and for those who had not had this. The reason for this was that the effects may be expected to be more positive if employees have a choice. For example, employees who choose to work 9-hour workdays may be a select group that is in better health and, therefore, recuperates fast. If this is true, working 9-hour workdays will probably not have many negative effects if employees have a choice.

The results of our study (see Table 2) showed that, in nursing, working compulsory 9-hour workdays seriously affected fatigue and health. The performance of nurses working such shifts had deteriorated slightly. In nurses who had had some choice in working 9-hour shifts, fatigue and health complaints were a little higher. Nine-hour workdays had the least negative effects on office workers and industrial workers working voluntary or compulsory CWWs. In these types of work, there were generally no effects on health and only slightly negative effects on fatigue (office workers) or performance (industrial workers). In office workers working compulsory 9-hour workdays, there was also some evidence of a pacing effect. The finding that the self-rated quantity of performance was not lower in the last group in spite of the pacing effect may be due to the effects of social desirability in answering the questionnaire. It may also be that this group managed to make up for their lowered performance during other times of the day or week.

In our study, the increases in satisfaction with working hours and free time that are usually found on extended workdays appeared only in the sample of office workers. In the sample of industrial workers, the differences in satisfaction were in the expected direction but were not significant. This may have been due to the small number of respondents in this group. In the group of nurses, satisfaction was negatively influenced by working 9-hour shifts. In view of the negative consequences that 9-hour workdays had for the levels of fatigue and health of the nurses, this lower satisfaction cannot, however, be considered unexpected.

The finding in previous studies that extended workdays have more negative effects in nursing was, therefore, also replicated in our study. This was despite the fact that, in our study, the workdays were only extended to 9 hours.

The question, then, is why the effects are more negative in nursing. One of the reasons may be that the high physical workload in nursing makes extended workdays more demanding. Recent figures from the Netherlands Central Bureau of Statistics (CBS, 2000) showed that 44% of all employees in nursing homes regularly have to use physical power in their work. In sectors with many office workers, this varies from 7% (financial service organisations) to 12% (local and central government and social security agencies). However, the industrial workers in our sample also had a high physical workload, but working 9-hour workdays only had slightly negative effects on them. Of course, the small number of respondents in this sample (seven 9-hour workers and thirteen 8-hour workers) may have made it more difficult to detect significant differences.

Table 2 The effects of 9-hour workdays

	Office workers		Nurses		Industrial workers	
	Choice[1]	No choice	Choice	No choice	Choice	No choice
Schedule 9-hour workers	four 9-hour days most weeks	four 9-hour days most weeks	irregular schedule	irregular schedule		four 9-hour days
Fatigue	–/0	–/0	no data	–		0
Need for recuperation	0	0	–/0	–		0
Health complaints	0	0	–/0	–		0
Overall levels of performance[2]	0	0	no data	–/0		–/0
Satisfaction with working hours	+	+	0	–	not investi-gated in this study	0
Satisfaction with free time	+	+	–/0	–		0
Effort	0	0	no data	↑		0/↑
Changes in work strategy	no	yes, pacing effect	no data	yes, pacing effect		no data

[1] The data of the 9-hour office workers who worked four 9-hour days plus one 8-hour day every two weeks are not included in this Table.

[2] Performance was always self-rated. In the case of the industrial workers there were also some production data.

However, other studies on 9-hour or 10-hour workdays among industrial workers doing physically demanding work did not find many negative effects either. Therefore, the high physical workload in nursing is probably not the only reason for the more negative effects. The more negative effects in this type of work may also be due to the fact that the majority of the nurses were female, while the majority of the industrial workers were male. It may well be that males have fewer problems with working longer hours under a high physical workload because of their greater physical strength.

The fact that the industrial workers worked with objects and the nurses with human beings may also have played a role in the different effects on fatigue and health. Workers who work with human beings may try longer to maintain performance because letting human beings suffer from the effects of fatigue may be considered less acceptable than letting objects suffer. As a result of this performance protection, fatigue levels may increase even more. The finding that performance was less affected than fatigue in the group of 9-hour nurses, but more affected than fatigue in the group of 9-hour industrial workers seems to confirm that the first tried to protect performance longer. Finally, it may also be the combination of a high physical *and* emotional workload that nursing is

known to have (e.g., van Veldhoven et al., 1999) which makes this type of work less suitable for extended workdays.

The results of our study also showed that employee choice did indeed have a positive impact on the effects of 9-hour workdays. The impact of employee choice was stronger in nurses than in office workers. This is probably so because working compulsory 9-hour workdays only had a few negative effects in office workers. Therefore, there was less to improve upon.
Despite the fact that working four 9-hour workdays on a voluntary basis generally had no or only a few negative effects on fatigue in office workers, there were still some respondents in our sample of office workers (21%) who did find this CWW more fatiguing. Subsequent analyses showed that in the 'more fatigued' group, performance had suffered somewhat from working 9-hour workdays. For example, the respondents in this group did less work during the final hour of the workday and more often worked too few hours per week. The 'more fatigued' 9-hour workers also scored higher on the number of health complaints than the 9-hour workers who were not more fatigued. However, as the study did not encompass a pre-test, we do not know whether the health of the 'more fatigued' 9-hour workers was affected by working 9-hour workdays or whether they already had a poorer health before the 9-hour workdays were implemented and, therefore, had more problems with working these days.

Factors that moderate the effects of 9-hour workdays

The study also tested which factors moderate the effects of 9-hour workdays. The following factors were included in our investigation: employee choice, time since implementation, characteristics of the schedule (number of consecutive workdays, time the workday starts, length of the meal break), characteristics of the work situation (high work pace/workload combined with little decision latitude), and characteristics of the individual worker (age, childcare duties, taking courses in one's spare time, commuting time, health status). The impact of the potential moderators could not be tested for the industrial workers, as this sample was too small. The sample of nurses did not allow a test of the impact of four of the potential moderators: health status, time since implementation, time the workday starts, and length of the meal break. In the group of office workers, the impact of working more than four consecutive 9-hour workdays was tested by using the data of an additional group of 9-hour workers, who worked four 9-hour days plus one 8-hour every two weeks. Their average working hours per week were 39 or 40 because they worked four 9-hour days every other week. They were compared with a group of 8-hour workers who also had a 39-hour to 40-hour working week.
As the preceding section already showed, not having a choice in the length of the workday had a negative impact on the effects of 9-hour workdays for both office workers and nurses. Other important moderators were working more than four consecutive 9-hour workdays and being in poorer health. Working more than four consecutive 9-hour workdays led to a greater need for recuperation and more health complaints in office workers. It decreased the quality of performance in nurses. Among office workers who were in poorer health, fatigue increased more than proportionally if they worked 9-hour workdays. The preceding section also indicated that a high physical (and perhaps emotional)

workload may be an important moderator. However, its effect could not be tested in our samples of office workers and nurses.
Of the other potential moderators, commuting time and taking courses in one's spare time also had some impact, but less strongly. When commuting time was longer, performance (office workers: quality, nurses: quantity) was negatively affected on 9-hour workdays, while it was not with a shorter commuting time. Taking courses in one's spare time had a negative impact on the levels of fatigue (nurses and office workers, in the latter group only in combination with working four consecutive 9-hour workdays) or the quantity of performance (nurses) of the 9-hour workers. A higher age and having childcare duties, which are often named as potential moderators, did not have any impact.
All in all, the study did not find many moderators. This was suggested to be due to:

- the relatively small number of respondents in our sample (266 office workers and 134 nurses);
- the fact that the effects of 9-hour workdays were so weak (office workers) or so strong (nurses) that the moderators could not aggravate or reduce the effects much;
- the fact that the office workers could choose the length of their workday (employees for whom 9-hour workdays would be too fatiguing then have the opportunity to remain on 8-hour workdays).

It was also suggested that a combination of several potentially demanding factors (e.g., a long commuting time with taking courses in one's spare time) might aggravate the effects of 9-hour workdays.

Changes in work strategies when working 9-hour workdays

Perhaps employees adjust to extended workdays by changing their work strategies. Therefore, all 8-hour and 9-hour office workers and nurses were asked how often they changed some aspects in their work strategies (e.g., take a short break, switch to another task) because they were fatigued or were getting fatigued. Subsequently, the answers of the 8-hour and 9-hour workers were compared. For this part of the study, a newly constructed questionnaire was used.
Changes in work strategies were not investigated for our sample of industrial workers because it was too small. However, as the work of the industrial workers was machine-paced, they probably did not have many opportunities for changing their work strategies.
As mentioned before, the office workers who worked compulsory 9-hour workdays seemed, indeed, to have changed their work strategies because of the extended workdays. They took short breaks and worked more slowly due to fatigue more often, which suggests a pacing effect. The 9-hour workers who worked a voluntary CWW seemed not to have changed their work strategies. Probably they did not need to, as, in general, the 9-hour workdays were not more fatiguing for them.
Those who did find the 9-hour workdays more fatiguing, did appear to have changed their work strategies. In comparison to 9-hour workers who were not more fatigued, they expended more effort, started their workday later, ended their workday earlier, took a longer meal break, worked less overtime, took a short break, did not carry out a task, worked at a slower pace, and switched to another task due to fatigue more often. However, all these strategies could not

prevent their levels of fatigue from increasing over the working week. The office workers who worked four 9-hour days and one 8-hour day every two weeks seemed not to have changed their work strategies, despite the fact that 9-hour workdays had a negative effect on their fatigue and health. Why they did not change their work strategies is unclear. Perhaps they felt that the 9-hour workdays should not have any negative effects on performance, even if this was at the expense of their own fatigue and health, because they had chosen to work this arrangement. Of course, it may also be that the managers in the organisation where these respondents worked supervised the work behaviour of their employees more closely.
The 9-hour nurses did seem to have changed their work strategies. They took a short break due to fatigue and worked more slowly due to fatigue more often than their counterparts from the 8-hour group. However, this could not prevent the extended workdays from having negative effects on their fatigue and health. Furthermore, the absolute levels of effort expended were higher for the 9-hour nurses than for the 8-hour nurses. This suggests that the 9-hour nurses tried to protect their performance from their higher levels of fatigue.

Summary

To summarise the results of our study:

- 9-hour workdays are in general not too demanding for office workers who have chosen to work 9-hour days. On average, these days increase satisfaction, have no effects on health and overall performance, and only a few negative effects on fatigue. However, some office workers do have problems with working 9-hour days;
- 9-hour workdays may not be too problematic for industrial workers either. In this study, these days decreased performance a little, but did not affect fatigue and health. Satisfaction with working hours and free time was the same. However, the number of industrial workers in our sample was too small to draw any definite conclusions;
- 9-hour workdays are too demanding in nursing. They increase fatigue, lead to more health complaints and a lower satisfaction with working hours and free time. Performance is affected slightly;
- if employees cannot choose the length of their workday, are in poorer health, or (have to) work more than four consecutive 9-hour workdays, the effects of 9-hour workdays are substantially more negative;
- hence, it is not possible to say what the effects of 9-hour workdays are in general. The effects differ per situation.

Limitations of the study

One of the limitations of the study was that some analyses were performed on only a small number of respondents. This was particularly the case in the analyses on:

- the office workers who worked a compulsory CWW (fourteen respondents);
- the office workers who worked four 9-hour days and one 8-hour day every two weeks (twenty-five 9-hour respondents vs. seventeen 8-hour respondents);
- the nurses who had had some sort of choice in workday length (five respondents);
- the industrial workers (seven 9-hour respondents vs. thirteen 8-hour respondents);
- the impact of the moderators.

Therefore, these parts of the study should be replicated before more definite conclusions can be drawn.

The question may be asked if we could not have increased the number of respondents. The number of respondents would have been higher if more organisations had been included in the study. However, first, some types of arrangement (e.g., compulsory CWWs in office work) are used very infrequently and, therefore, difficult to find. Second, with nine organisations that all wanted a separate report and two wanting an additional study in return for participation, we were at the limits of what is possible within a four-year Ph.D. programme.

A higher response rate would also have increased the number of respondents (but not in all cases: in the group of office workers working a compulsory CWW, the response rate was 93%). A frequently heard complaint from our respondents was that the questionnaire took too much time to fill in. The respondents especially disliked the fatigue checklist (19 items) by Meijman (1991), which had to be filled in for a one-week period. As the checklist did provide valuable data on how fatigue evolves over the workday and working week, omitting it from the questionnaire would have been a severe loss. For future studies on extended workdays, limiting the checklist to six to eight items might be a good alternative, as this may improve the response rate and at the same time still provide valuable information on how fatigue evolves over the day and week.

A second limitation of the study was the absence of a pre-test. First, this prevented us from doing a direct test of the moderating impact of the factor health status. More importantly, however, it also prevented us from checking whether the office workers who had chosen to work 9-hour workdays were a select group in terms of health. If they were, the post-test comparison with the workers who remained on 8-hour days may have underestimated the effects of 9-hour workdays on fatigue and health. For example, if the levels of fatigue of the 9-hour workers had increased a little such that they now equalled those of the (less healthy) 8-hour workers, our current design would have led us to conclude that 9-hour workdays had no effects on fatigue, while in fact they had. For the industrial workers and the majority of the nurses, the absence of a pre-test mattered less because they could not choose the length of their workday.

Therefore, self-selection can hardly have played a role among them.[24] At the outset of the study, therefore, we had planned to conduct one longitudinal study among the office workers. However, when the organisation that had agreed to participate in this longitudinal study pulled out at the last moment, there was not enough time left to find a replacement and conduct both a pre-test and post-test.
The fact that the study almost exclusively relied on self-report measures can be considered a third limitation of the study. Self-report measures may be vulnerable to distortion by the respondents. For example, a respondent who is very satisfied with working 9-hour days because it gives him or her more days off may say that the extended days have no effects on performance when, in fact, they do, if he or she is afraid that management will withdraw the arrangement if the real effects are known. If there is some distortion by the respondents, it will probably involve the effects on fatigue, health, and performance, as the respondents have not much to gain by misrepresenting the effects on satisfaction. In our sample of 9-hour nurses and industrial workers, distortion was not very likely to have taken place to a large extent. The nurses knew that management would base its decision to keep or abolish the 9-hour shifts on the results of the questionnaire. This meant that it was equally important for both proponents and opponents to fill in the questionnaire. Furthermore, the nuances in the answers of the 9-hour nurses (e.g., 9-hour day shifts being more fatiguing, but 9-hour night shifts not) indicate that they have not given a very one-sided representation of the effects to strengthen their position. Therefore, there probably has not been much distortion among the nurses. With regard to the industrial workers, distortion was unlikely because their organisation was in a transition from the CWW to a 2-shift system to extend the operating hours further. The workers knew that the results of the questionnaire would not change this process.
Among the office workers who had chosen to work 9-hour days, however, some may have been afraid that they would not be allowed to work this arrangement anymore if they were completely honest about its effects. Hence, some office workers who, in reality, found the 9-hour workdays more fatiguing may have flattered the questionnaire somewhat or may simply not have filled it in. In view of the length of the questionnaire, the latter reaction (not filling in the questionnaire) would probably be the most likely. However, although we cannot rule out that this happened a few times, we do not think it occurred on any large scale. First, it would seem natural that the extent to which employees are afraid of management withdrawing the option will differ per organisation. If this is the case, we would expect the response rate to be lower in organisations in which the employees are more afraid because a larger percentage of those whose performance has decreased due to the extended workdays will expressly not have filled in the questionnaire. As a consequence, the percentage of employees who indicated that they did find the CWW more fatiguing should also be lower in these organisations. However, the latter percentage was not lower in the organisations with the lower response rates. Second, we were sometimes surprised by the respondents' frankness. Those who took part in the telephone interviews were given the choice of being called at work or at home (in the evening or on a day off). Respondents who were called at work were sometimes frankly talking about the fact that their performance had decreased due to the 9-

[24] Of course, there can be some self-selection if employees cannot choose the length of their workday because they can decide to leave the organisation and join another one where they can work 8-hour workdays.

hour workdays, while we knew there were one or more colleagues around working in the same room.
Objective performance data could have shown whether the respondents were indeed honest about their performance. However, apart from the industrial workers, there were no existing performance data or data at the right level of aggregation[25] that could be used. Developing a performance measurement system especially for this study would have been too time-consuming and in some cases (e.g., the municipality with its various types of jobs) even impossible.
Asking the respondents' supervisors about the performance of the respondents could also have given some information on the validity of the performance self-ratings. However, supervisors generally do not have the time to observe the day-to-day performance of their workers (Murphy & Cleveland, 1991). Therefore, questions about, for instance, the respondents' performance during the final hours of the workday could probably not be answered reliably by them. Also, their answers could have been biased by their personal opinion about the CWW. For example, the respondents in the pension fund were also asked about the consequences of the 9-hour workdays for the effectiveness of their department (e.g., the opportunities for scheduling meetings, the exchange of information in the department, etc.). Analyses showed that supervisors who worked 9-hour workdays themselves were more positive about the consequences for the effectiveness of their department. Because of these two limitations of supervisor ratings and the demands the study already made on the participating organisations, we decided not to use supervisor ratings.

Implications for future research

What are the implications of this study for future research? Our review of previous studies showed that when the first schedules of four 9-hour or 10-hour days were implemented in the early 1970s, research immediately focused on this type of arrangement. When 12-hour day and nights shifts came into fashion (for nurses in the 1970s and for industrial workers in the late 1980s), attention largely shifted towards this type of CWW. Although it is understandable (and often right) that researchers investigate what is in vogue at a certain moment,[26] it is time now to look at the gaps in our knowledge of the effects of extended workdays and conduct some studies to fill these gaps. In our view, the topics that certainly require further study are:

- how do extended workdays of different lengths (e.g., 10 hours, 12 hours) compare with regard to their effects on workers' fatigue, health, performance, and satisfaction?;
- what causes the positive effects of the 12-hour system on health? Is it the smaller number of nights to be worked or the smaller number of hours per sequence of shifts?;
- what factors moderate the effects of extended workdays?

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25 In one department in the bank, there were production data on each team. However, all teams included both 8-hour and 9-hour workers.

26 We do not want to pretend that we did not do so. The 9-hour workdays we investigated in this study have been fashionable in the Netherlands since about 1996.

In our view, two potential moderators should certainly be investigated in greater detail. These are characteristics of the worker's job and employee choice in length of the workday. Our study showed that type of work strongly moderated the effects of 9-hour workdays. However, although we could make a substantiated guess, we do not know for certain which characteristics of a worker's job make extended workdays more demanding.

Therefore, some systematic research should be done on which work characteristics moderate the effect of extended workdays. The characteristics whose influence should certainly be investigated are: physical workload, emotional workload, mental workload, and the degree of monotony or variety in a job. Such an investigation could be conducted by comparing the effects of extended workdays in jobs that are similar on all but one of these characteristics. Preferably, this should produce some sort of taxonomy that describes which characteristics or combination of characteristics make extended workdays too demanding. This type of taxonomy could help organisations to determine whether extended workdays are wise in a specific job. Ideally, such a taxonomy should not only describe whether extended workdays are too demanding but also what maximum workday length is preferable for each combination of characteristics. For some combinations of characteristics, this may even lead to the conclusion that an 8-hour workday is already too long. Furthermore, such a taxonomy should ideally also describe whether the impact of the characteristics differs for certain sub-populations of workers. For example, as we noted before, the impact of a high physical workload may differ for males and females.

The impact of employee choice should also be investigated further. Our study showed that letting employees choose the length of their workday had a positive impact on the effects of extended workdays. However, the study demonstrated that not all respondents made a wise decision. For some employees the 9-hour workdays were clearly disadvantageous to their levels of fatigue, but they still continued to work these days probably because this benefitted their private lives. We feel that future research should investigate in what circumstances which types of employees do not make a wise choice in terms of fatigue and health. In which cases does it not work to give employees some choice in workday length? A related question would be: what can be done to help employees make better decisions? For example, does it help if employees are given information on when extended workdays may be too demanding and what alternatives are available in such situations?

One way to gain more knowledge of these topics and the topics in the list on the previous page is to conduct some new empirical studies specifically for these purposes. More knowledge could also be obtained by conducting a meta-analysis of previous studies. For example, such a meta-analysis could address the effects of different workday lengths or the impact of some important background characteristics. However, there are too few articles on the effects of extended workdays that provide enough background information for a detailed meta-analysis. To facilitate comparisons between different studies, we feel that future studies on extended workdays should at least report the exact length of the workday (i.e., without the meal break), whether employees had some choice or say in the length of the workday and whether the work of the respondents was physically and emotionally demanding. Preferably, information should also be given on time since implementation.

The number of studies per effect variable in a meta-analysis would increase if more studies addressed more than one or two of the effect variables (fatigue, health, performance, and satisfaction with working hours and free time)

investigated here. Although it is understandable that studies cannot investigate all the effects possibly associated with extended workdays, we did wonder why something so simple to measure and so important as satisfaction with working hours and free time was frequently not addressed. For example, out of the 17 studies on CWWs with nights in industry, only seven investigated the effects on these aspects. Perhaps the researchers already knew that the workers were satisfied, for example, because the workers had voted for working extended workdays. If this is the case, the reader should be informed.
Our study and that of Duchon et al. (1997) showed that the effects of extended workdays may take rather subtle forms, such as changes in work strategy. Although these are quite difficult and time-consuming to investigate, it is worth the effort. Therefore, ideally, more research should address such changes. The theoretical models we used (Hockey, 1997; Meijman, 1989; Meijman & Mulder, 1998; Schönpflug, 1983) helped us considerably in deciding where to look for possible effects. How changes in work strategies can be best investigated, will depend on the situation, for example, on whether the work behaviour is well observable or not. The questionnaire we constructed can be considered as one of the possible options for measuring such changes. We recommend that future research first addresses which method for measuring work strategies is the best in which situation and what alternative methods can be developed.

Implications for legislation on working hours

In the introduction, we mentioned that the legal standards on workday length were liberalised quite recently (1996). What can be concluded from the results of our study about the appropriateness of the standards? Table 3 summarises the standards that apply to the length of the workday. The standards on overtime are not discussed here, as our study focused on regular working hours only.

Table 3 Standards that apply to the length of the workday

	Standard regulations	Regulations to be adopted subject to consultation
Maximum number of hours to be worked per shift	9 hours	10 hours
Maximum number of hours to be worked per *night* shift	8 hours	9 hours
Maximum number of hours to be worked per shift in the case of overtime	11 hours	12 hours
	9 hours in the case of night shifts	10 hours in the case of night shifts
Breaks within shifts	30 min. if shift length > 5.5 hrs 45 min. if shift length > 8 hrs 60 min. if shift length > 10 hrs	30 min. if shift length > 5.5 hrs

1. Number of hours per shift

A. The standards from the standard regulations restrict the maximum shift length to 9 hours. The standards from the regulations to be adopted subject to consultation are more liberal; they allow a maximum of 10 hours per shift.

In work with light to moderate physical and emotional demands, 9-hour workdays do not seem to be problematic for the majority of workers. Hence, the 9-hour limit in the standard regulations is, generally speaking, appropriate. What about the 10-hour limit in the regulations to be adopted subject to consultation, however? The office workers from one organisation in our sample (the pension fund) were asked if they wanted to have the opportunity to work 10-hour days. Only 5% of them said they did (Josten, 1999). Hence, even in a sample of workers who hardly had any problems with working 9-hour days, 10-hour days were considered too long. Meijman (1992) already concluded that working four 9.5-hour days was the limit of what is acceptable in terms of performance. This is not to say that there are no jobs in which 10-hour workdays are suitable. For example, they may be acceptable in a job with a light to medium physical and emotional workload, a not too high workpace, naturally occurring breaks, and sufficient variety in tasks. However, we do feel that 10-hour workdays should only be implemented with caution.

B. However, in the case of work involving heavy physical and emotional demands (e.g., nursing) even 9-hour workdays may already be too long. The question, then, is whether the legislator should draw up separate standards for working hours for physically and emotionally demanding work or whether it should be left to unions and employers, or work councils and employers, to reach an agreement on stricter standards for such types of work.

The idea behind the Working Hours Act is that agreements about such specific situations should, in principle, be left to employers and employees because they know these situations best. Of course, this principle of self-regulation is only a good idea as long as it works. Self-regulation can be improved by the government issuing guidelines on what is advisable in which situation.

Whether self-regulation works with regard to working hours in physically and emotionally demanding work in general, we do not know. In nursing homes, it mostly does seem to work: in a small telephone survey among 24 nursing homes, we found that none used 9-hour morning or afternoon shifts for nurses.[27]

If self-regulation does not work generally, separate standards are, in our view, needed. The problem, then, is how to decide which jobs do and which jobs do not constitute physically and emotionally demanding work as there are at present no legal standards for determining the physical and emotional demands of a job.

C. The literature review showed that in the case of nightwork, CWWs with 12-hour shifts may be beneficial to employees' health. This may be due to the fact that 12-hour shifts substantially reduce the number of nights to be worked and, therefore, may lead to less circadian disruption. In view of the growing evidence that night shifts may increase the risk of cardiovascular

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[27] Some nursing homes did use 9-hour night shifts for nurses. As our study showed, these are mostly not considered more fatiguing by the nurses.

problems (e.g., van Amelsvoort, 2000; Bøggild, 2000), this is an important advantage. Would we, therefore, advise to allow 12-hour shifts also in the Netherlands?

In our view, 12-hour shifts should not be allowed generally. However, we would advise allowing experiments with 12-hour shifts in some specific situations, viz. when the workers themselves want to try these shifts, the work is physically and/or emotionally not too demanding, the workpace is low to medium, and there are enough breaks during the shift. Furthermore, performance should not be too critical since it is likely to decrease somewhat on 12-hour shifts. It should be noted that, in the studies described in the literature, workers often had to work seven consecutive night shifts on the 8-hour shift system. In the Netherlands, three to four consecutive nights (5-crew system) or five consecutive nights (3-crew system) often have to be worked. Hence, in the Netherlands, the reduction in the number of nights to be worked would be smaller on 12-hour systems and so the health improvements might be not as large.

2. Number of hours per night shift

   Because of the negative impact night shifts may have on employees' health, the Working Hours Act has stricter limits on the night shift length. However, our review of the literature showed that, in some cases, longer but less frequent night shifts may be preferable (see also the preceding paragraph). Nevertheless, at present we would not advise a general liberalisation of the standards on the night shift length because the positive impact of 12-hour shifts on employees' health should first be demonstrated in the Netherlands. Also, this shift length is probably only applicable to certain specific types of jobs (e.g., work that is physically and emotionally not too demanding, etc. (see also the preceding paragraph)).

   The empirical part of our study only addressed the effects of 9-hour night shifts in nursing. The nurses did not consider the 9-hour night shift more fatiguing than the 8-hour night shift. In this type of work, however, the workload during the night shift is quite low; apart from one or two rounds, most of the nurses' work during the night shift consists of waiting for patients' calls. Therefore, these results cannot be generalised to other types of work involving night shifts.

3. Breaks during the shift

   The standard regulations prescribes a longer meal break if the workday is longer than 8 hours to give employees more time for recuperation *within* the extended workday.

   Our study showed that a shorter meal break did not aggravate the effects of 9-hour workdays in office workers. However, the workers involved in the analyses had a choice in both the length of their workday and the length of their meal break. As some workers did extend their meal break as a way of dealing with fatigue (see Chapter 6), a shorter meal break may have a negative impact if the shorter meal break is made compulsory and/or the extended workdays are compulsory. Therefore, we would not advise a general liberalisation of the norm on breaks during extended workdays in the standard regulations. However, we see no problem with unions and employers agreeing to a minimum meal break of 30 minutes during extended workdays, if employees can choose the length of their workdays and their meal breaks. A minimum meal break of 30 minutes on 9-hour workdays, for example, has been agreed upon in the collective agreement for an organisation that provides financial services (Collective Agreement

Achmea, 1999, article 4.5.5). The shorter minimum length of the meal break was requested by the unions (Dijk et al., 2001).

Implications for organisations

Our study showed that the effects of 9-hour workdays depend on the situation in which they are implemented. Organisations that are considering the implementation of 9-hour workdays, we would advise the following:

- let employees choose whether or not to work 9-hour workdays;
- this also means that employees who are taking courses for their work should not be pressed to work 9-hour days. Some organisations do this so as not to have to give their employees time off for study;
- make sure that other available options are also attractive to employees. Otherwise, employees may feel more or less forced to work 9-hour workdays. For instance, they may feel more or less forced if all compensation days have to be scheduled in advance per period of two to four weeks. Employees may feel that they have not enough opportunities for taking their holidays then, if they continue to work 8-hour days. Some say that advance scheduling is necessary to achieve more even staffing levels. However, compromises are often possible, such as scheduling some compensation days in advance and giving employees a choice in taking the rest of the compensation days off.
- if it is not possible to give every employee a choice because the whole department must have the same working hours, then offer employees some form of say in designing the schedule (for example, by a vote). Perhaps, it may also help to give them some choice in another important aspect of their schedule (for example, in the number of consecutive workdays);
- if employees cannot be given the opportunity to choose the length of their workday, separate arrangements should be made for employees for whom extended workdays are too much of a problem, for example, because they are too fatiguing for them or conflict with domestic obligations (e.g., the opening hours of childcare facilities);
- do not use 9-hour workdays in work that is physically and/or emotionally demanding;
- do not implement schedules with more than four consecutive 9-hour workdays.

Our study also showed that not all employees make a wise choice. For example, there was some indirect evidence that employees who were in poor health had more problems working extended workdays. Probably, these employees should have chosen to remain on 8-hour workdays. Also, we know from the personnel officer in one organisation and from a few conversations we had or overheard at occasions, that employees with health problems (e.g., heart complaints) sometimes want to work four 9-hour or 10-hour workdays. The reason they have for wanting this arrangement is that it gives them an extra day off to recuperate from their work and does not lower their pension, as working four 8-hour days would. It is doubtful whether working 9-hour or 10-hour days is good for their health. We do feel that organisations may prohibit employees from working extended workdays if they have severe health problems. The decision to prevent employees from working extended workdays on health grounds is probably best

taken by the company doctor. Of course, it is advisable to seek another solution for these workers.

Appendix The questionnaire on work strategies

Instructions:

Most people feel fatigued at work now and again. However, little is known about the consequences fatigue may have for the way in which employees carry out their work. This part of the questionnaire therefore asks whether you change your work procedure if you are fatigued or when you know it is going to be a fatiguing day. Below, several possible changes in work procedure are listed. We want to ask you to look back at the past working week and indicate how often these changes took place. You should only mark a change if it occurred because *you were fatigued or were getting fatigued, or because you knew it was going to be a fatiguing day*. In the questionnaire, the term 'because of fatigue' is used for these situations. If a certain change is not possible in your work, you should mark the answer category 'not applicable'.

	never	seldom	some-times	often	very often	not appli-cable
During the last working week, I ..... <u>because of fatigue</u>:						
1. had to expend more effort to carry out a task well	O	O	O	O	O	O
2. had to try harder to concentrate on a task	O	O	O	O	O	O
During the last working week, I ..... <u>because of fatigue</u>:						
3. took a day off	..... days					
4. reported a day ill	..... days					
5. ended my workday earlier than I otherwise would have	O	O	O	O	O	O
6. started my workday later than I otherwise would have	O	O	O	O	O	O
7. took a longer meal break or took a meal break while I otherwise would not have taken one	O	O	O	O	O	O

	never	seldom	some-times	often	very often	not appli-cable
8. worked less overtime or did not work overtime while I otherwise would have	O	O	O	O	O	O
During the last working week, I ..... <u>because of fatigue</u>:						
9. drank something (coffee, tea, a soft drink, etc.)	O	O	O	O	O	O
10. ate something	O	O	O	O	O	O
11. smoked a bit	O	O	O	O	O	O
12. started chatting with a colleague	O	O	O	O	O	O
13. walked around a bit	O	O	O	O	O	O
14. 'played' with the computer a little (e.g., a computer game, the Internet)	O	O	O	O	O	O
15. just did nothing for awhile	O	O	O	O	O	O
16. interrupted my work in another way	O	O	O	O	O	O
17. *All in all, how often did you, because of fatigue, take a short break during the last working week?*	O	O	O	O	O	O
During the last working week, I ..... <u>because of fatigue</u>:						
18. postponed carrying out a task to another day	O	O	O	O	O	O
19. postponed finishing a task to another day	O	O	O	O	O	O
20. did not carry out a task at all	O	O	O	O	O	O
21. asked a colleague to do a task for me	O	O	O	O	O	O
22. *All in all, how often did you, because of fatigue do less work on a day, during the last working week?*	O	O	O	O	O	O
During the last working week, I ..... <u>because of fatigue</u>:						
23. did not check well <u>what</u> had to be done before I started carrying out a task	O	O	O	O	O	O
24. did not check well <u>how</u> a task could best be carried out, before I started working on that task	O	O	O	O	O	O

	never	seldom	some-times	often	very often	not appli-cable
25. forgot to prepare something or get something ready before carrying out a task	O	O	O	O	O	O
26. skipped some parts or steps in carrying out a task	O	O	O	O	O	O
27. forgot to do some things in carrying out a task	O	O	O	O	O	O
28. did not check the result or did not check it well after carrying out a task	O	O	O	O	O	O
29. did not check for myself what I could have done better after carrying out a task	O	O	O	O	O	O
30. *All in all, how often did you, because of fatigue, omit doing some things in carrying out a task, during the last working week?*	O	O	O	O	O	O
During the last working week, I ..... <u>because of fatigue</u>:						
31. took longer to carry out a task	O	O	O	O	O	O
32. worked at a slower pace in carrying out a task	O	O	O	O	O	O
33. was less accurate in carrying out a task	O	O	O	O	O	O
34. produced lower quality work on a task	O	O	O	O	O	O
During the last working week, I ..... <u>because of fatigue</u>:						
35. switched to working on an easier task	O	O	O	O	O	O
36. switched to working on a more interesting task	O	O	O	O	O	O
37. switched to working on another task, for a change	O	O	O	O	O	O
38. *All in all, how often did you, because of fatigue, switch to another task, during the last working week?*	O	O	O	O	O	O

	never	seldom	some-times	often	very often	not appli-cable
During the last working week, I ..... <u>because of fatigue</u>:						
39. just tried something if I did not know well how to handle it	O	O	O	O	O	O
40. just did something if I was faced with an unknown problem or failure	O	O	O	O	O	O
41. carried out a task on automatic pilot	O	O	O	O	O	O
42. carried out a task as much as possible in a way I know well and that requires little thinking	O	O	O	O	O	O
43. carried out a task step by step	O	O	O	O	O	O
44. carried out tasks that I would normally do simultaneously, after another	O	O	O	O	O	O
45. changed something else in the way I carried out my work, viz.	O	O	O	O	O	O

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Samenvatting

In veel landen, waaronder ook Nederland, wordt een werkdag van 8 uur als de norm beschouwd. Full-timers werken deze uren vaak vijf dagen per week. Naast de 5-daagse werkweek van 8 uur per dag komen echter ook nog andere arbeidstijdregelingen voor.
Eén van deze andere arbeidstijdregelingen is de gecomprimeerde werkweek. Bij een gecomprimeerde werkweek worden minder dagen per week gewerkt, maar meer uren per dag. Zo kan een full-timer bij een gecomprimeerde werkweek bijvoorbeeld vier dagen van 10 uur werken, of vier dagen van 9 uur. In sommige andere landen (bijvoorbeeld Australië, Verenigde Staten, Zweden) komen ook wel gecomprimeerde werkweken met 12-uurs werkdagen voor. In Nederland zijn werkdagen van 12 uur echter, enkele uitzonderingen daargelaten, niet toegestaan. De maximaal toegestane lengte van de werkdag is in Nederland normaliter negen uur. Indien de vakbonden of de OR ermee instemmen mag er tien uur per dag worden gewerkt.
Naar schatting 2,7% tot 2,8% van de werknemers in Nederland heeft een gecomprimeerde werkweek.[28] In percentages bezien gaat het dus om een relatief kleine groep. In absolute aantallen zijn het echter toch relatief veel werknemers; 2,7% van een werkende beroepsbevolking van 6,9 miljoen is immers ongeveer 186.000 personen. De vaakst voorkomende vorm van de gecomprimeerde werkweek in Nederland is een werkweek van vier dagen van 9 uur.

In het hier beschreven onderzoek stond de vraag centraal wat de gevolgen zijn van de gecomprimeerde werkweek. De gecomprimeerde werkweek kan gevolgen hebben op drie verschillende niveaus, namelijk op het niveau van de individuele werknemer (bijvoorbeeld voor vermoeidheid), het niveau van de organisatie (bijvoorbeeld voor de bereikbaarheid) en het niveau van de maatschappij (bijvoorbeeld voor de files en de verkeersdrukte). Dit onderzoek richtte zich op de gevolgen voor de werknemer. Het onderzoek beperkte zich tot gecomprimeerde werkweken bij kantoorwerk, werk in de verpleging en verzorging, en industriële arbeid.
Het onderzoek bestond uit een literatuurstudie en een empirisch gedeelte. In de literatuurstudie werden eerdere studies naar gecomprimeerde werkweek besproken. De lengte van de werkdag in deze studies bedroeg in het algemeen 9 of 10 uur indien het om arbeidstijdregelingen zonder nachtwerk ging, of 12 uur indien het om arbeidstijdregelingen met nachtwerk ging. Het empirische gedeelte van het onderzoek beperkte zich tot gecomprimeerde werkweken met 9-urige werkdagen. Voor 9-urige werkdagen werd gekozen omdat de vaakst voorkomende vorm van de gecomprimeerde werkweek in Nederland 9-urige werkdagen heeft.

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[28] Deze schatting is gebaseerd op gegevens uit 1998.

In het empirische gedeelte van het onderzoek werden de volgende vragen gesteld:

- Wat zijn de gevolgen van 9-urige werkdagen voor de vermoeidheid, gezondheid en prestaties van werknemers en voor hun tevredenheid met de werktijden en de vrije tijd?
- Welke factoren beïnvloeden wat de gevolgen van 9-urige werkdagen zijn?
- Gebruiken werknemers andere werkstrategieën indien ze 9-urige werkdagen hebben?

Het theoretisch kader bij het onderzoek werd gevormd door het belasting-herstel model. Dit model veronderstelt dat werknemers een balans zoeken tussen de eisen die het werk stelt en hun eigen verwerkingsvermogen. Als het verwerkingsvermogen te laag wordt als gevolg van vermoeidheid, dan raakt de balans verstoord. Een werknemer kan de balans herstellen door extra inspanning te leveren. Op deze manier kan hij ervoor zorgen dat de prestaties op peil blijven. Het leveren van extra inspanning heeft echter als nadeel dat de vermoeidheid er nog meer door kan toenemen. Als de werknemer enige regelmogelijkheden in zijn werk heeft, kan hij er daarom ook voor kiezen een minder vermoeiende werkstrategie te gebruiken, bijvoorbeeld om langzamer te gaan werken. Dit kan ervoor zorgen dat de vermoeidheid niet verder toeneemt. Het nadeel van een dergelijke strategie is echter dat de prestaties erdoor kunnen verminderen.
Er wordt wel verondersteld dat werknemers er in het algemeen eerst voor zullen kiezen om hun prestaties op hun hoofdtaken op peil te houden indien de werkeisen te hoog zijn voor hun verwerkingsvermogen. Dit betekent dus dat ze eerst extra inspanning zullen leveren of minder goed zullen presteren op een minder belangrijke taak als ze vermoeid zijn.
Het belasting-herstel model verwacht verder dat een hoger niveau van vermoeidheid op het einde van de werkdag negatieve gevolgen kan hebben voor de gezondheid, indien er onvoldoende tijd is voor herstel tussen twee opeenvolgende werkperiodes. Als de werknemer nog niet voldoende hersteld is voor hij weer gaat werken, zal hij extra inspanning moeten leveren om zijn prestatieniveau te kunnen handhaven. Dit zal ertoe leiden dat zijn vermoeidheid nog meer toeneemt. Op den duur kan het vermoeidheidsniveau hierdoor zodanig hoog worden dat de gezondheid negatief wordt beïnvloed.

De literatuurstudie wees uit dat de gevolgen van de gecomprimeerde werkweek voor vermoeidheid en gezondheid verschillen naar gelang het soort werk dat wordt gedaan. Bij verplegenden en verzorgenden kwamen vooral 12-uursdiensten met nachtwerk voor. Deze diensten leidden in deze groep tot een flinke toename van de vermoeidheid. De gevolgen voor gezondheid waren gemengd. Bij industriële arbeid echter (hierbij ging het meestal om operators) zorgden 12-uursdiensten slechts voor een geringe toename van de vermoeidheid. De gevolgen voor gezondheid waren zelfs neutraal of positief. De positieve gevolgen voor gezondheid zijn volgens ons vermoedelijk te danken aan het feit dat:

- bij 12-uursdiensten veel minder vaak een nachtdienst hoeft te worden gedraaid. Dit kan de verstoring van het dag-nacht ritme verminderen;
- in het geval van 12-uursdiensten meestal minder uren per reeks van aaneengesloten diensten hoeven te worden gewerkt.

Bij kantoorarbeid kwamen vooral 9- of 10-uursdiensten zonder nachtwerk voor. Deze diensten leidden in het algemeen tot een kleine toename van de vermoeidheid en hadden geen gevolgen voor de gezondheid. Hetzelfde gold voor 9- of 10-

uurs diensten bij industriële arbeid (meestal ging het hierbij om lichamelijk zware arbeid).
Bij alledrie de typen werk verminderde de prestaties van werknemers in het algemeen iets wanneer ze langere dagen werkten. De grotere toename van de vermoeidheid bij de verplegenden en verzorgenden leidde niet tot een evenredig grotere afname van de prestaties. Dit lijkt erop te wijzen dat de verplegen en verzorgenden probeerden hun prestaties te beschermen. Verder waren bij alledrie de typen werk de werknemers in het algemeen tevredener met de werktijden en de vrije tijd indien ze een gecomprimeerde werkweek hadden. De extra vrije dag(en) die de gecomprimeerde werkweek oplevert, lijken dus gewaardeerd te worden. Alleen bij de verplegenden en verzorgden kwam het ook wel eens voor dat de tevredenheid verminderde als men een gecomprimeerde werkweek kreeg.

Het empirische gedeelte van het onderzoek werd uitgevoerd bij negen organisaties. Bij vijf organisaties deden de werknemers kantoorwerk, bij één organisatie was er sprake van (lichamelijk zware) industriële arbeid, en bij drie organisaties (verpleeghuizen) ging het om verplegenden en verzorgenden. Zoals eerder aangegeven beperkte het empirische gedeelte van het onderzoek zich tot 9-uurs werkdagen. Het onderzoek werd uitgevoerd door werknemers met 8-urige en werknemers met 9-urige werkdagen met elkaar te vergelijken. De kantoorwerkers hadden in het algemeen zelf kunnen kiezen of ze 8 of 9 uur per dag wilden werken. De industriële werkers en de verplegenden en verzorgenden hadden in het algemeen geen keuze in de lengte van hun werkdag gehad. De kantoorwerkers en de industriële werkers werkten allen full-time. De 9-uurswerkers in deze twee groepen werkten meestal vier dagen van 9 uur per week. De groep van verplegenden en verzorgenden bestond zowel uit part-timers als uit full-timers. Zij hadden allen een onregelmatig rooster.
Uit het empirische gedeelte van het onderzoek bleek eveneens dat de gevolgen van de gecomprimeerde werkweek verschillen naar gelang het soort werk dat wordt gedaan. Uit eerdere onderzoeken was, zoals hiervoor aangegeven, reeds gebleken dat 12-uursdiensten negatievere gevolgen hebben voor verplegenden en verzorgenden dan voor andere werknemers. Uit dit onderzoek bleek dat dit ook 9-uursdiensten geldt.
Verplegenden en verzorgenden die verplicht waren 9-uursdiensten te draaien, waren duidelijk vermoeider en hadden duidelijk meer gezondheidsklachten dan hun collega's die 8-uursdiensten draaiden. Hun prestaties waren iets minder. Tevens werkten zij vaker langzamer vanwege vermoeidheid en lasten ze vaker een korte pauze in omdat ze moe waren. Verplegenden en verzorgenden die enige keuze hadden gehad in het draaien van 9-uursdiensten, waren een beetje vermoeider en hadden iets meer gezondheidsklachten. Kantoorwerkers en industriele werkers daarentegen, die verplicht of vrijwillig 9-uurs dagen werkten, ervoeren niet meer gezondheidsklachten. Wel was er een lichte toename van de vermoeidheid (kantoorwerkers) of een lichte afname van de prestaties (industriële werkers).
De grotere tevredenheid met de werktijden en de vrije tijd waar de gecomprimeerde werkweek volgens eerder onderzoek meestal toe leidt, werd in ons onderzoek alleen gevonden bij de kantoorwerkers. Dat bij de industriële werkers geen verschillen werden gevonden, kan te maken hebben met de kleine omvang van de groep industriële werkers in dit onderzoek. De verschillen tussen de werknemers met 8-urige en de werknemers met 9-urige werkdagen tendeerden wel in de verwachte richting. De verplegenden en verzorgenden die 9-uursdiensten draaiden, waren duidelijk minder tevreden dan hun collega's met 8-

uursdiensten. In het licht van de negatieve gevolgen die de 9-uursdiensten hadden voor hun vermoeidheid en gezondheid kan dit niet verrassend worden genoemd.
Ondanks het feit dat 9-uurs werkdagen in het algemeen niet veel negatieve gevolgen hadden voor kantoorwerkers, was er toch een groep van kantoorwerkers (21% van de werknemers in dit onderzoek) die deze werkdagen wel duidelijk vermoeiender vond. Deze groep had ook vaker zijn werkstrategieën aangepast als gevolg van vermoeidheid. Zo begonnen zij bijvoorbeeld vaker wat later met werken als gevolg van vermoeidheid en hielden zij vaker wat eerder met werken op. Daarnaast was er bij deze groep sprake van een geringe achteruitgang in prestaties. Ook hadden de werknemers in deze groep meer gezondheidsklachten. Waarom de betreffende werknemers wel moeite hadden met 9-uursdagen en andere werknemers niet is niet duidelijk. Mogelijk hadden de werknemers in de eerste groep al een slechtere gezondheid voor zij 9-uursdagen gingen werkten, en zijn in dat geval langere werkdagen vermoeiender.

De vraag is dan waarom langere werkdagen negatievere gevolgen hebben voor verplegenden en verzorgenden dan voor andere werknemers. Eén van de mogelijke redenen zou kunnen zijn dat de hoge fysieke belasting in de verpleging en verzorging langere werkdagen vermoeiender maakt. Echter, de industriële werkers in ons onderzoek en in andere onderzoeken naar 9- of 10-uursdagen deden eveneens fysiek zwaar werk. Dus, een hoge fysieke belasting kan niet de enige reden zijn. Mogelijk speelt het feit dat verplegenden en verzorgenden meestal vrouw zijn en industriële werkers meestal man ook een rol. Wellicht is het voor vrouwen zwaarder om meer uren fysiek zwaar werk te doen vanwege hun geringere fysieke kracht. Wat ook mee zou kunnen spelen is dat het object van het werk verschilt; verplegenden en verzorgenden werken met mensen terwijl industriële werkers met voorwerpen werken. Het zou kunnen dat werknemers die met mensen werken langer proberen hun prestaties op peil te houden wanneer ze vermoeid zijn, omdat het leveren van een slechtere prestatie minder acceptabel wordt geacht als men met mensen werkt. Als een gevolg van dit beschermen van de prestaties zou de vermoeidheid van verplegenden en verzorgenden extra kunnen toenemen. Tenslotte zou het ook kunnen zijn dat de combinatie van fysiek èn emotioneel zwaar werk in de verpleging en verzorging, dit werk minder geschikt maakt voor langere werkdagen.

Naast het soort werk bleek ook het wel of niet kunnen kiezen van de lengte van de werkdag de gevolgen van 9-uurs werkdagen te beïnvloeden. Zoals hiervoor reeds aangegeven, waren bij de verplegenden en verzorgenden de gevolgen van 9-uursdiensten wat minder negatief als er enige keuzemogelijkheid in de dienstlengte was geweest. Bij de kantoorwerkers verschilden de werknemers die verplicht en de werknemers die vrijwillig 9 uur per dag werkten alleen op de gebruikte werkstrategieën van elkaar; de werknemers uit de eerste groep werkten vaker langzamer vanwege vermoeidheid en namen vaker een korte pauze om die reden, dan degenen die zelf voor 9-uursdagen hadden gekozen. De eerste groep leek het dus af en toe wat rustiger aan te doen. Desondanks was de hoeveelheid werk die zij verrichten, volgens henzelf althans, niet lager. Dit kan betekenen dat zij erin slaagden op andere tijden te compenseren voor het feit dat ze het soms wat rustiger aan doen. Dat hun prestaties volgens henzelf niet lager waren kan echter ook wijzen op de invloed van sociale wenselijkheid bij het beantwoorden van de vraag naar de totale prestaties. Voor de industriële werkers was de in-

vloed van het wel of niet hebben van een keuzemogelijkheid niet na te gaan, omdat alle werknemers in deze groep verplicht 8, dan wel 9 uur werkten.
Voor de kantoorwerkers en de verplegenden en verzorgenden kon ook de invloed van een aantal andere factoren worden onderzocht. Bij de kantoorwerkers bleek dat 9-urige werkdagen tot een sterkere toename van de vermoeidheid leidden als de werknemer een slechtere gezondheid had. Voor de verplegenden en verzorgenden kon dit niet worden onderzocht. Verder bleek bij beide groepen dat 9-uurs werkdagen negatievere gevolgen hebben als er meer dan vier dagen van 9 uur achter elkaar moet worden gewerkt. Daarnaast had het hebben van een lange reistijd en het volgen van een cursus of opleiding in de vrije tijd ook een negatieve invloed op de gevolgen van 9-urige werkdagen, zij het in minder sterke mate. Voor ouderen en werknemers met zorgtaken bleken 9-urige werkdagen niet zwaarder te zijn.
Al met al lijken 9-urige werkdagen in het algemeen niet een te groot probleem te zijn voor kantoorwerkers. Voor industriële werkers geldt vermoedelijk hetzelfde; het aantal industriële werkers in dit onderzoek was echter te klein om hier zeker van te zijn. De grens van 9 uur die de wetgever in Nederland aan de werkdag stelt, lijkt in het algemeen dus te voldoen. Wel kunnen werkgevers en werknemers bij sommige soorten werk, zoals de verpleging en verzorging, beter een lager maximum aanhouden. Nagegaan zou moeten worden welke kenmerken van het werk er precies voor zorgen dat een langere werkdag te vermoeiend is. Indien dit bekend is, kan ook voor andere soorten werk dan die in dit onderzoek worden aangegeven welke lengte van de werkdag het verstandigst is.

Stellingen behorend bij het proefschrift
The effects of extended workdays
van Edith Josten

1. De vraag naar de gevolgen van een verlenging van de werkdag kan niet beantwoord worden zonder kennis van het type werkzaamheden dat tijdens zo'n verlengde werkdag wordt verricht.

2. Werknemers lijken sterk op elkaar wat betreft de wijzigingen in hun manier van werken bij vermoeidheid.

3. De ruime aandacht die zondagsarbeid krijgt in de Tweede Kamer en het gebrek aan aandacht voor nachtarbeid duidt erop dat onze volksvertegenwoordigers het sociale leven van werknemers belangrijker vinden dan hun gezondheid.

4. De mededeling bij inkrimpingen dat "Tijdelijke contracten niet zullen worden verlengd. Er zullen echter geen gedwongen ontslagen vallen" getuigt van minachting voor de gevoelens van tijdelijk contractanten. Of zou men nou echt denken dat deze het niet verlengen van hun contract als een vrijwillig vertrek ervaren?

5. Organisaties die een flexibel arbeidsvoorwaardensysteem invoeren zonder eerst het personeelsbeheer (werving en selectie, salariëring) op orde te hebben zijn als modderschuiten die zich willen tooien met een vlag.

6. Het baseren van een ranglijst van goede werkgevers op makkelijk meetbare aspecten zoals het percentage vrouwelijke leidinggevenden gaat voorbij aan datgene waar het bij goed werkgeverschap werkelijk om gaat: dat er op een fatsoenlijke wijze met de werknemers wordt omgegaan.

7. Het personeelsbeleid op universiteiten blijft niet alleen achter vanwege een gebrek aan geld, maar ook vanwege het feit dat men het werken op een universiteit als een gunst beschouwt.

8. De snelheid waarmee organisaties erin slagen informatie aan te leveren die nodig is voor het uitvoeren van een onderzoek is een goede indicator voor de kwaliteit van de interne organisatie.

9. Het toenemend aantal woonhuizen met rolluiken bevordert het gevoel van veiligheid binnenshuis, maar vermindert het gevoel van veiligheid bij de voorbijgangers op straat.

10. De berichten die de NS in de trein omroept vormen een goede vervanging voor een gehoortest bij de oorarts.

11. Het schrijven van een proefschrift is niet goed voor de gezondheid.

The effects of extended workdays

Organisations that have implemented a 36-hour working week are often asked by their employees if they may work four 9-hour workdays. For employees, the advantage of this arrangement is that it provides them with three days off per week. Management, however, often has some doubts about 9-hour workdays because they fear that these will increase employees' fatigue levels and, consequently, affect performance. As only few studies have been conducted on 9-hour workdays, the effects of this workday length are not well known.

In this book, the results of a large study on the effects of 9-hour workdays are described. The book centres on the effects of 9-hour workdays on fatigue, health, performance, and satisfaction. The book details the effects for three types of work: office work, nursing, and industrial work. Also, advice is given on the situations in which 9-hour workdays may or may not be advisable.

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