



American Academy of Sleep Medicine calls for elimination of daylight saving time

DARIEN, IL – Public health and safety would benefit from eliminating daylight saving time, according to a [position statement](#) from the American Academy of Sleep Medicine.

The AASM supports a switch to [permanent standard time](#), explaining in the statement that [standard time more closely aligns with the daily rhythms of the body's internal clock](#). The position statement also cites evidence of increased risks of motor vehicle accidents, cardiovascular events, and mood disturbances following the annual “spring forward” to daylight saving time.

[“Permanent, year-round standard time is the best choice to most closely match our circadian sleep-wake cycle,”](#) said lead author [Dr. M. Adeel Rishi, a pulmonology, sleep medicine and critical care specialist at the Mayo Clinic](#) in Eau Claire, Wisconsin, and [vice chair of the AASM Public Safety Committee](#). [“Daylight saving time results in more darkness in the morning and more light in the evening, disrupting the body's natural rhythm.”](#)

The position statement, published online as an accepted paper in the Journal of Clinical Sleep Medicine, outlines the acute effects of daylight saving time, which range from increased risk of stroke and hospital admissions to sleep loss and increased production of inflammatory markers, one of the body's responses to stress. In addition, studies show that traffic fatalities have increased as much as six percent in the first few days following the change to daylight saving time, and a recently published research abstract found an [18 percent increase in adverse medical events related to human error](#) in the week after switching to daylight saving time.

“There is ample evidence of the negative, short-term consequences of the annual change to daylight saving time in the spring,” said AASM President Dr. Kannan Ramar. “Because the adoption of [permanent standard time would be beneficial for public health and safety](#), the AASM will be advocating at the federal level for this legislative change.”

In July, an AASM survey of more than 2,000 U.S. adults found that [63 percent support the elimination of seasonal time changes](#) in favor of a national, fixed, year-round time, and only 11 percent oppose it. Additionally, a 2019 survey by the AASM found that [55 percent of adults feel extremely or somewhat tired](#) after the spring change to daylight saving time.

The AASM position statement on daylight saving time has been [endorsed by the following organizations](#):

- American Academy of Cardiovascular Sleep Medicine
- American Academy of Dental Sleep Medicine
- American College of Chest Physicians (CHEST)
- American College of Occupational and Environmental Medicine
- California Sleep Society
- Dakotas Sleep Society
- Kentucky Sleep Society
- Maryland Sleep Society
- Michigan Academy of Sleep Medicine
- Missouri Sleep Society
- National PTA
- National Safety Council
- Society for Research on Biological Rhythms
- Society of Anesthesia and Sleep Medicine
- Society of Behavioral Sleep Medicine
- Southern Sleep Society
- Start School Later
- Tennessee Sleep Society
- Wisconsin Sleep Society
- World Sleep Society.

###

To request a copy of the statement, "[Daylight saving time: An American Academy of Sleep Medicine position statement](#)," or to arrange an interview with an author or an AASM spokesperson, please contact the AASM at 630-737-9700 or media@aasm.org. Accepted papers, which are published online prior to their final inclusion in an issue, are not embargoed. The position statement is scheduled to appear in the Oct. 15, 2020 issue of the journal.

The monthly, peer-reviewed [Journal of Clinical Sleep Medicine](#) is the official publication of the American Academy of Sleep Medicine, a professional membership society that advances sleep care and enhances sleep health to improve lives. The AASM encourages patients to talk to their doctor about sleep problems and visit SleepEducation.org for more information about sleep, including a searchable directory of AASM-accredited sleep centers.

August 27th, 2020 | [Featured](#), [Press Releases](#)



Turn back the clock on Daylight Savings: Why **Standard Time all year round is the healthy choice**

NICOLAS CERMAKIAN, PATRICIA LAKIN-THOMAS AND TAMI MARTINO

SPECIAL TO THE GLOBE AND MAIL

PUBLISHED NOVEMBER 2, 2019

UPDATED 4 HOURS AGO

Nicolas Cermakian is a **professor in the department of psychiatry at McGill University** and the **director of the laboratory of molecular chronobiology in the Research Centre of the Douglas Mental Health University Institute**.

Patricia Lakin-Thomas is an **associate professor in the department of biology at York University**.

Tami Martino is a **professor and the director of the Centre for Cardiovascular Investigations at the University of Guelph**.

They are **writing on behalf of the Canadian Society for Chronobiology**.

Changing our clocks twice a year has little benefit, economic or otherwise, so isn't it time to stop this antiquated practice? The good news is that some provincial legislatures agree and are currently considering bills to adopt permanent time. **As experts on biological rhythms, we support the switch to a permanent time. However, in doing so, we must adopt Standard Time (ST), not Daylight Savings Time (DST, or "summer time").**

There is general agreement that getting rid of the time switch twice a year would be a good idea. After time switches, particularly the "spring forward," there are increased rates of car accidents, heart attacks, strokes and workplace injuries. So why does it matter whether we adopt permanent DST or permanent ST?

All the processes happening in our bodies are co-ordinated by our biological clocks, located in our brains and all other organs. The argument in favour of permanent DST is that there would be more light in the evening. While this is true, we can't change the number of hours of light in the day. **More evening light means less morning light.** But importantly, **it's the light in the morning that is most important** in resetting our biological clocks. Consider this: If we all spent our time outdoors getting plenty of natural light, and could choose when to get up and go to sleep as our ancestors did, our internal clocks would be set by the sun so that we would tend to wake up at dawn, and then, depending on the time of year, stay awake for a while in the evening after dark. Our body clocks would be in sync with the sun clock. The problem is that we live in societies that force us to get up and go to work or school at times that we don't get to choose.

Chronobiologists, the name given to scientists who study biological timing, call this situation “social jet lag,” when the body clock doesn’t match the social clock. Just like the jet lag you get when you fly across time zones and find yourself out of sync with the new local time, **social jet lag can cause many problems including disrupted sleep, increased risk of accidents, lower productivity at work and in school, and increased risk of negative health impacts.** Permanent ST would move “social time” closer to our natural “body time,” while permanent DST would move social time further away.

Can just one hour make such a big difference? We already have evidence from a huge natural experiment that we are all part of: the difference between people living on the western and eastern edges of any time zone. The sun moves continuously across time zones, but we are arbitrarily divided up into one-hour blocks. **People on the western edge are forced to get up an hour earlier than people on the east,** according to sun time. **Analysis of health data from millions of people shows that people on the western edges of time zones get about 19 minutes less sleep every night than people on the east, and also have significantly higher rates of obesity, diabetes and heart attacks than people on the eastern edges.** Even scarier, **cancer rates significantly increase when the sunrise is later on the western edges.** Permanent DST would make sunrise even later for everyone, while permanent ST would make sunrise closer to body time.

Permanent DST was tried in the United States in the past century but was quickly repealed when the public found that waking up in the dark is hard, and energy savings were negligible. Let’s not repeat that failed experiment in Canada. Since Canadians live even further north, the challenge would be even more profound in our country. Recently, several provincial legislatures have considered stopping the switch, with a bill currently on the table in British Columbia, but in all cases the plan is to switch to DST, not ST.

Scientists around the world support this initiative to adopt Standard Time, and statements have been issued by the U.S.-based Society for Research on Biological Rhythms, the European Biological Rhythms Society, and the European Sleep Research Society. As Canadian biological rhythm researchers supporting evidence-based policy, we strongly recommend a switch to permanent Standard Time.

To the EU Commission on DST

Chronobiology studies the influence of day-night rhythms and seasonal changes in living organisms (and received the Nobel Prize 2017 for these discoveries). As experts in biological clocks and sleep, we have been following the initiative of the European Commission to abandon the annual clock-time changes in spring and autumn in the EU. We would like to emphasize that the scientific evidence presently available indicates that installing permanent Standard Time (ST, or 'wintertime') is the best option for public health.

With ST there will be more morning light exposure in winter and less evening light exposure in summer. This will better synchronise the biological clock and people will sleep earlier relative to their work and school times (1). The feeling of chronic jetlag (Social Jetlag) will be reduced compared to daylight savings time, the body will function better and mental performance will improve. Throughout the year, ST will be healthier than daylight savings time (DST).

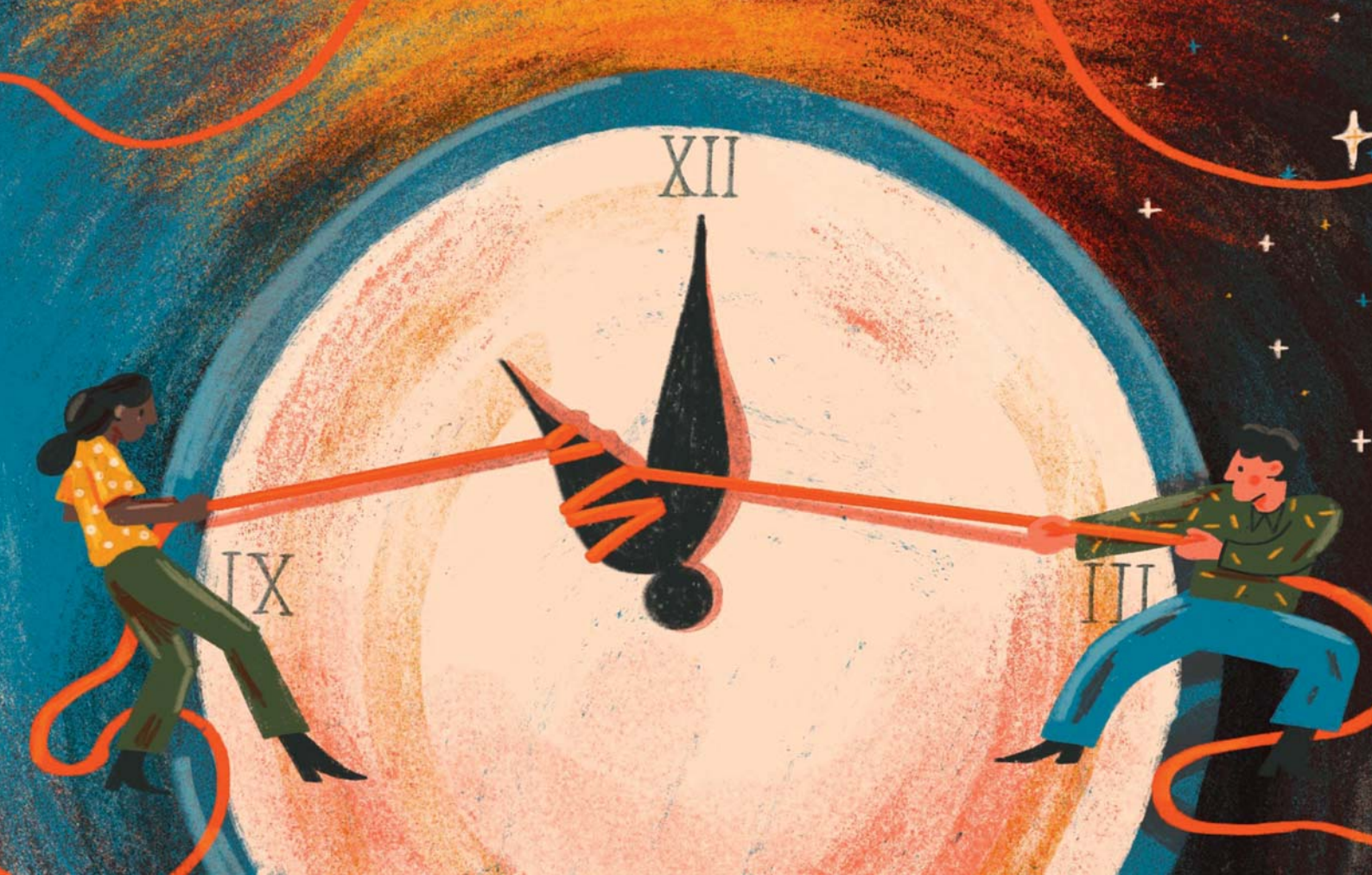
ST improves our sleep (1) and will be healthier for our heart (2) and our weight (3). The incidence of cancer will decrease (4), in addition to reduced alcohol- and tobacco consumption (5). People will be psychologically healthier (6) and performance at school and work will improve (7). Abandoning clock changes will offer the unique nation-wide opportunity to improve general health by installing Standard Time.

We would gladly explain our advice in more detail as required.

Sincerely,

European Biological Rhythms Society
European Sleep Research Society
Society for Research on Biological Rhythms
Society for Light Treatment and Biological Rhythms
Société Française de Recherche et Médecine du Sommeil
Société Francophone de Chronobiologie

-
- 1) Kantermann et al. (2007) The human circadian clock's seasonal adjustment is disrupted by daylight saving time. *Current Biology* 17:1996-2000.
 - 2) Merikanto et al. (2013) Associations of Chronotype and Sleep With Cardiovascular Diseases and Type 2 Diabetes. *Chronobiol.Int.* 30:470-477.
 - 3) Roenneberg et al. (2012) Social Jetlag and Obesity. *CURRENT BIOLOGY* 22: 939-943.
 - 4) Borisenkov (2011) Latitude of Residence and Position in Time Zone are Predictors of Cancer Incidence, Cancer Mortality, and Life Expectancy at Birth. *Chronobiol.Int.* 28: 155-162.
 - 5) Wittmann et al (2006) Social jetlag: Misalignment of biological and social time. *Chronobiol.Int.* 23:497-509.
 - 6) Borisenkov et al. (2017) Seven-year survey of sleep timing in Russian children and adolescents: chronic 1-h forward transition of social clock is associated with increased social jetlag and winter pattern of mood seasonality. *Biological Rhythm Research* 48:3-12.
 - 7) Van der Vinne (2015) Timing of Examinations Affects School Performance Differently in Early and Late Chronotypes. *Journal of Biological Rhythms* 30:53-60.



The Future of Daylight Saving Time

by Dietrich Henckel, Björn Gernig, Ulrich Mückenberger

**Deutsche
Gesellschaft für
Zeitpolitik**

DGfZP

**German
Society for
Time Policy**

Editor: Deutsche Gesellschaft für Zeitpolitik e.V. – DGfZP
Authors: Dietrich Henckel, Björn Gernig, Ulrich Mückenberger
Translation from German by Hella Beister
2021
ISBN 978-3-9823112-1-0
www.zeitpolitik.de | Twitter: @Zeitpolitik

The Future of Daylight Saving Time

by Dietrich Henckel, Björn Gernig, Ulrich Mückenberger

Summary

1. For a variety of reasons, **controversies, campaigns, or legislative initiatives to abolish the clock change are currently underway** in many countries, in particular the USA and the EU, their aim being to either return to standard time or to implement permanent ‘summer time’ (‘daylight saving time’ – DST). Basically, the issue at stake is conflicts between natural time, social time regimes, and individuals’ experience of time.
2. The ‘time change’, that is, the setting of clocks ahead by one hour to ‘summer time’ (DST) in spring and back to standard time (‘winter time’) in autumn has a varied history – it was repeatedly implemented, mostly in times of war, and often abolished again after the war. In the EU, the change is uniformly and permanently regulated by Directive 2000/84/EC 2000 from 2000. In 2020, 73 countries all over the globe (as many as 49 of them in Europe alone) practiced the clock change. 67 abolished it.
3. In 2018, the EU launched an **EU-wide online public consultation** on the biannual clock change to ‘summer time’ (DST) in spring and back to standard time (‘winter time’) in autumn. The consultation – its scientific quality not being at issue here – resulted in a **majority in favour of abolishing the clock change**, which prompted the EU Parliament to make a decision to this effect. However, since both EU and nation state legislations as well as issues of international cooperation and coordination are involved, the process turned out to be more complex than expected. The importance of ‘time’ as an instrument of coordination, disciplining, and the exercise of power became obvious, and with it the need for concrete time policy in the proper sense.
4. This decision is an important **occasion as well as an opportunity to systematically examine the different models and arguments** so as to be able to support a rational decision which evaluates the advantages and disadvantages of certain variants and makes for a workable and pragmatic solution that takes account of the currently available knowledge.
5. Any debate about the significance and the effects of the clock change makes sense **only when coupled with the problem of time zones**, notwithstanding the fact that the relationship between the clock change and the time zone regime is only inadequately considered in the public discussion.
6. The definition and distribution of the time zones of standard time (which are of course **a social construction**) is based on the principle that on every degree of longitude (meridian) the sun is at its highest at 12:00 noon and at its lowest at 24:00/0:00.
7. The springtime clock change simply consists in the clock being put ahead by one hour, which is **equivalent to an assignment to one time zone further east**: since nothing is changed except the clock time (the habitual work start and school start times, for instance, remain unchanged), we all get up one hour earlier, and the sun reaches its zenith at 13:00 rather than 12:00. This goes to show that this is not a time change but merely a clock change that decouples social rhythms from solar rhythms by one hour.
8. This **decoupling leads to substantial health problems with far-reaching short-term and long-term economic effects**, the former being most frequent right after the respective dates of the clock change, and more particularly so in spring, the latter primarily arising from the so-called social jetlag. In contrast to the jetlag resulting from long-distance travel where it takes only a short time for us to adjust to the solar cycle by ‘synchronising’ clock time and solar altitude and, thus, to settle in the new surroundings, social jetlag means that there is no such adjustment because we permanently live in another time zone, as it were.

9. The **economic benefits** time and again put forth in favour of the clock change, in particular resource saving, **cannot be substantiated**. As a justification of the clock change, this argument is therefore invalid.
10. In contrast, at the current state of knowledge, there is enough evidence of **serious adverse effects** on human health and sleep patterns, and of the economic consequences which follow from them, to make the clock change questionable, to say the least.
11. Since the decision on the clock change is a decision on the ‘order of time’, the **decision criteria** need to be stated. These should be:
 - a high level of synchronisation between solar and social rhythms;
 - a high level of cross-territory uniformity in order to facilitate coordination and avoid a ‘temporal patchwork’;
 - the lowest possible level of adverse effects from temporal regulations;
 - the highest possible level of temporal autonomy, that is, the possibility for individuals to decide on how to use their own time, and a low level of heteronomy;
 - a pragmatic procedure based on the available knowledge and geared to reaching a workable compromise by transparent and democratic decision-making.
12. This is the background for the Deutsche Gesellschaft für Zeitpolitik (DGfZP; German Society for Time Policy) to call for
 - an abolition of the clock change and a **permanent return to standard time**, associated with
 - an **adjustment of time zones in Europe** along the lines agreed on at the International Meridian Conference which happen to fairly closely coincide with European nation state boundaries.
13. For implementing these proposals, the DGfZP calls for an EU **procedure** that observes the principles of **participative-democratic, European-minded time policies** and does not create the impression that ‘Brussels’ is remote-controlling people’s everyday life by way of bureaucracy.
 - This includes national and transnational awareness, exploration, and discussion processes with citizens as well as experts from the fields of politics, business, and science aiming to develop proposals for a reform of the current arrangement.
 - The format of the European Future Conference could also be applied to the issues of standard time reimplementation and time zone adjustment .
 - The decision to implement a new arrangement rests with the democratically legitimised EU bodies.

Content

Summary	5
Content	6
1 Relevance and topicality of the issue	8
2 A brief history of time zones	10
3 A brief history of the clock change	15
4 Current debate and arguments	17
4.1 Energy saving, resource conservation, and other ecological aspects	18
4.2 Economy	18
4.3 Human Health	19
4.4 Social and cultural dimensions	26
5 The obligation to state reasons, and some reflections on procedure	28
6 Evaluation	30
6.1 Overall context	30
6.2 Options for the future	32
6.3 Fragmentation, the right to time, and flexibility	37
7 Conclusions, and a call to action	38
8 New time zone definitions in the EU as a result of democratic time policy	39
8.1 Time policy and time zone regimes in Europe	39
8.2 Precepts of democracy in the EU and its member states	39
8.3 Ways to create a European time policy: the example of standard time and time zone ..	40
Literature	41
Charts	44
Appendix	45
German Society for Time Policy	47

1 Relevance and topicality of the issue

The biannual clock change – ‘spring forward’ by one hour at the end of March to ‘daylight saving time’ (DST; aka ‘summer time’, the term used in the EU papers as well as in Germany (‘Sommerzeit’)), ‘fall back’ by one hour at the end of October to ‘standard time’ (or, in Germany, also ‘Normalzeit’, ‘normal time’) – has had a varied history.¹ Its first more extended implementation was organised in Germany during World War I, but discontinued after the War. In 1984, as a late consequence of the 1970s oil crisis, it was made mandatory for all of the EU. It has never been uncontroversial, and there have always been initiatives to abolish it, in particular in Germany. The concept of ‘standard time’ (or ‘Normalzeit’) already indicates that this is a convention, a social construction based on the fact that noon is defined as the time when the sun is at its highest. ‘Standard time’ is more definite in this respect than ‘Normalzeit’ since ‘normal’ is more likely to suggest something natural.

In 2018, given the controversial nature of the ‘time change’ – which is actually nothing but a ‘clock change’ – and the various initiatives to abolish it, the EU Commission launched a public consultation across its member states in order to gather citizens’, stakeholders’, and member states’ views on the clock change and its potential modifications. The consultation was held online from July 4, 2018 to August 16, 2018 and resulted in around 4.6 million valid responses.² Replies came from all 28 member states, but replies from Germany alone made up 70% of them (3.1 million). 8.6% of all replies came from France (393,000 respondents), 6% from Austria (259,000). Although participation rates were uncommonly high in many countries,³ the consultation is problematic in more than one respect: its lack of representativity or, rather, verifiability, its preparatory information, its insufficient methodological clarity, and its rather suggestive way of wording the questions.

Results show that more than three quarters of EU citizens who replied to the consultation reported a negative experience with the biannual clock change, albeit with marked differences between countries.⁴ Unsurprisingly, therefore, there also was a very large majority of votes for its abolition, that is, only 16% of the respondents were in favour of maintaining the current regime. The reasons given are worth considering:

- ‘Human health’ was highlighted by around 3.2 million respondents (84% of all respondents) as the main reason for wishing to *abolish* the current arrangement.⁵ Frustrated hopes for energy saving were highlighted by around 1.5 million respondents (40%).
- The main reasons highlighted by those in favour of *maintaining* the clock change (741,191 of respondents, or 16%), are leisure activities in the evening (88%, with only 650,535 entries)

1 For a very good overview of this varied history with its multiple implementations and abolitions, differentiated arrangements even within small territorial units, and alternating pro and contra argumentations and actors – with its primary focus on the USA –, see Michael Downing (2005); for Germany, see also Mutz (2015, 2016), Kuchenbuch (2018).

2 The following is mainly a summary of the EU report featuring an analysis of the outcome of the consultation (European Commission 2018).

3 Thus, for the ARD survey ‘Sonntagsfrage’ (‘Sunday question’) where German citizens are asked which party they would vote for if federal elections were held this Sunday, the representative sample consists of only 1,000 respondents who are, however, contacted by way of a scientific random sampling procedure.

4 In the southern member states Cyprus, Malta, Greece, and Italy only half of the respondents reported any negative effects.

5 The consultation allowed for multiple answers. Therefore, percentages differ widely according to whether the percentage of replies highlighting each of these reasons is based on the total number of respondents (4,6 million) or on the total number of multiple answers (around 7,5 million). The analysis of the EU Commission reports the percentage of answers based on the total number of multiple answers (see European Commission 2018: 7f). Therefore, in the respective chart of the EU Commission’s report, the percentage of answers highlighting human health as a reason is only 43% (of the total number of answers) rather than 84% (of respondents who (also) highlighted this reason; see above).

and the prospect of energy saving (35 %, 259,908 entries). But there is also a non-negligible proportion of 30 % (225,204 entries) of answers highlighting ‘human health’ as a reason for maintaining the clock change.

While the preference for abolishing the clock change was highlighted in over four fifths of replies (84 %) and was thus quite obvious, preferences for possible alternatives were less clear. Just over half (56 %) of the respondents were in favour of permanent DST (‘summer time’), just over one third (36 %) expressed a preference for permanent standard time (‘winter time’). Based on these outcomes, leading politicians (among them the then President of the EU-Commission Jean-Claude Juncker) were quick to draw far-reaching conclusions in favour of repealing the current arrangement and switching to permanent DST.

But the legal and regulatory framework and the substantial evaluation of the decision on a new arrangement are more complicated than many had assumed. Conflicts primarily arise from divergent evaluations of *solar* and *social* times and rhythms and the need to coordinate them. The relation between and harmonisation of social and solar rhythms is therefore the key question also for this dossier.

The European Parliament’s decision to discontinue the EU-wide clock change from winter time to summer time and back again (Directive 2000/84/EC) and to replace it by such arrangements as the member states see fit to implement – and, hopefully, coordinate – (provisional legislative decision of the European Parliament, 26 March 2019 – P8_TA-PROV(2019)0225) affords the opportunity to once more take a closer look into the regulation of standard time and, if necessary, its biannual change in order to see which of the potential options would be optimal in light of the evidence at hand: maintaining the clock change vs. discontinuing it and switching to either permanent DST or permanent standard time.

A look at the history of DST shows the great variety of ways in which DST has been used within states and across states, as well as the arguments that have time and again been reiterated. Over time, the weighting of these arguments has shifted from production- and efficiency-oriented arguments to leisure time-oriented arguments, thus reflecting shifts in the respective power positions of the various lobby groups (Mutz 2015). Debates have always been highly emotional and have differed widely depending on whether they were conducted at a national, regional, or actor-centred level (Downing 2005, Kuchenbuch 2018, Mutz 2015). Changes in time regimes have always reflected the prevailing political power structures and claims to power. Thus, impacting as they do on the routines of everyday life, they have great symbolic significance and are highly emotionally charged. At the same time, the clock change is a prime example of time policies. Hassid/Watson (2014: 170) stress that few state actions affect citizens’ everyday experience as fundamentally as the setting of time parameters. Nevertheless, social scientists have largely ignored the implications that come with the power to regulate time (cf. also Rifkin 1988). Since in the 20th century, the deployment of DST has been a permanent field of experimentation for political and social actors rather than a purely technical issue (Mutz 2016: 1), it is not hard to see why the debate about the clock change (and the time zones) is so highly politically and emotionally charged.

So, what does the clock change mean in practice? Setting the clock ahead by one hour in spring is equivalent to moving one time zone to the east. The time in Germany, for instance, is oriented to the solar time of 15 degrees east longitude, which runs roughly parallel to the Polish-German border (see the beginning of the next chapter). With DST, German clock time is geared to the solar time of 30 degrees east longitude, the meridian which passes for instance through the Ukraine and the east of Belarus. Nevertheless, the relationship between clock change and time-zone assignment has so far been almost exclusively addressed in parts of the scientific debate.

But the clock change and its effects cannot be adequately understood unless time zones and their relevance and impact are factored in. Therefore, we will begin with a brief account of their origin and function, followed by an outline of the history of the clock change and, then, a review of the evidence currently at hand, mainly on the basis of

- a 2016 expert report of the Büro für Technikfolgenabschätzung des Deutschen Bundestages (TAB; Office of Technology Assessment at the German Bundestag);
- a range of recent publications.

We will conclude by evaluating the evidence in order to form an opinion of the Deutsche Gesellschaft für Zeitpolitik (German Society for Time Policy) concerning a future regime.

As it is, this discussion of substantive and procedural issues is of urgency primarily because

- the implementation of the clock change as well as its possible abolition (in connection with time-zone assignments) has far-reaching consequences for the societies involved, and any such ‘fussing with the clock’ is a prime example of action in terms of *time policy*;
- this is a highly charged debate, so an evidence-based survey seems indicated;
- right now, decisions risk being made that are likely to have particularly adverse effects;
- right now, a compromise that takes optimal account of the evidence currently at hand – which is all we can possibly hope for – is still within reach.

The European Parliament calls for the clock change to be abolished by 2021. This is the agreement reached by its members on 26 March 2019 at Strasbourg, with 410 votes for, 192 against, and 51 abstentions. But before the final decision can be made, the EU ministers of transport need to agree upon a common policy and pass a formal resolution. By now, 2021 seems a most unlikely deadline for a new arrangement to become effective. Also, a new arrangement would not necessarily lead to the clock change being abolished but, possibly, merely to a renationalisation of the decision (following from the repeal of Directive 2000/84/EC). The European Parliament’s legislative decision of 26 March 2019 does not lay down any binding standards for an EU-wide regime. Each member state would, thus, be free to decide for itself whether to leave everything as it is or to abolish the clock change (and, in the latter case, whether to switch to permanent standard time or permanent DST). The fact that within the current legal and regulatory EU framework, this regulation can take place at the intergovernmental or transnational rather than supranational level (that is, by ‘coordination’ among member states rather than ‘top-down’ as in the 1984 Directive) makes for a more complicated procedure but also for an interesting and relevant issue in terms of time policies.

2 A brief history of time zones

No discussion of the biannual spring and autumn clock change can dispense with looking into the structure and impact of time zones since the clock change amounts to nothing less than a ‘migration’ to one time zone to the east in spring and a ‘remigration’ back to the initial time zone in autumn. Chronobiological research, in particular, has in recent years come up with a number of new findings on the impact of different time-zone assignments (see the discussion in a later section of this paper).

The history of the division and measurement of time is a history of social construction,⁶ a history of standardisation and time policies by means of ‘the thousands of everyday acts and symbols – like control over time zones – that together naturalise and reinforce the superstruc-

6 ‘For us, sub-dividing the day into 24 hours of equal length is a given. We don’t reflect on the fact that this is an arbitrary regulatory scheme and a rather recent cultural achievement’ (Padova 2017: 38).

ture of state power over everyday life' (Hassid/Watson 2014: 169). Time measurement became relevant as social processes became more complex and required more accurate temporal as well as more long-range spatial coordination (Padova 2017). Mumford even argues that '[t]he clock, not the steam-engine, is the key-machine of the modern industrial age' (Mumford 1923: 14).

Archaic societies are essentially oriented to the course of the sun and to events rather than chronometric accuracy. The history of time measurement and the division of time which Dohrn-van Rossum, in particular, describes in 'Die Geschichte der Stunde' (1992) clearly shows that this was always about creating meaningful divisions capable of harmonising the natural day-night and light-dark rhythms with the social rhythms (working schedules, school schedules, timetables, etc.) which had traditionally been primarily structured by the position of the sun (see also Sorokin/Merton 1937). In the current organisation of time, the year (complete rotation of the earth around the sun) and the day (complete rotation of the earth around its own axis)⁷ are the only natural units in timekeeping. All the other units (months, weeks, hours, minutes, etc.) are human 'inventions.' One of these key inventions or 'constructions' is the division of the day into 24 hours of equal length (60 minutes each, that is, a total of 1.440 minutes for one rotation of the earth around its own axis), with the highest position of the sun defined as noon, the lowest position as midnight. These definitions then served as the reference point for the division into and equal distribution of hours over the day, with the result that today we call 24:00/0:00 midnight – and the beginning of the day – and 12:00 noon.

But the position of the sun varies with the geographical location, so in the early days of the chronometric division of time, each location observed its own time. It was not until the means of transportation became faster and timetable organisation more large-scale, i.e., not until there were railways (and also telegraphy), that the coordination of timetables across many local times became a problem. The result, first in the USA then in Europe, was a wide-area synchronization of local times in terms of railway time (Schivelbusch 1984; Downing 2005). Local times were synchronised with city times, usually that of a region's chief city. The larger the area thus covered, the greater the divergence of this standard time from local solar times.

The global time zone system traces back to the international agreement reached at the 1884 International Meridian Conference in Washington, D.C., where the meridian that passes through the Royal Greenwich Observatory in London was defined as the prime meridian (Greenwich Mean Time, GMT).⁸ The term meridian designates the half of a circle of longitude, its ends being the North Pole and the South Pole. It is the line that links all locations on earth where the sun reaches the zenith of its daily course at the same time, that is, where noon is at the same time. (A fact also highlighted by the etymology of the term from Latin *meridies*, 'midday', and *circulus meridianus*, 'midday circle'; see Figure 1).

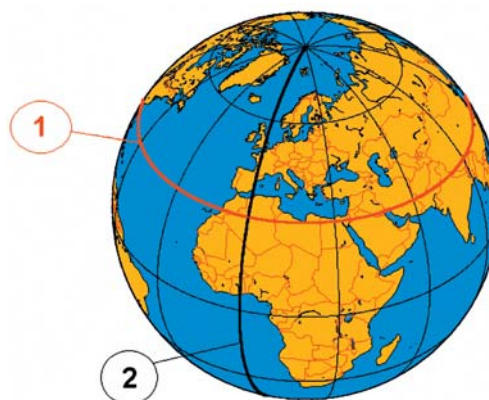


Figure 1: 1 – Circle of latitude, 2 – Meridian

7 These artificial temporal divisions are not fully congruent with the natural day: to correct the discrepancy, leap years or leap seconds need to be intercalated.

8 In Chapter 15 of her book 'Longitude', Sobel (2007) gives a convincing account of the fact that this agreement was a historical contingency rather than necessity. And Ogle (2015) shows that the definition and imposition of time zones was anything but a clear and straightforward process: 'In this perspective, the 1884 conference in Washington, D.C., in which experts were so invested, appears not as an endpoint but rather as a modest and soon completely forgotten beginning of time reform, remaining largely without influence. To the adoption of mean times, the 1884 conference was almost meaningless as the process of time unification dragged on until the 1930s and 1940s and was all but unstable, precarious, and full of malfunctions, even in Europa' (2015: 14).

Since in 24 hours the earth does a full 360° rotation around its own axis it was, on the model of the arc of a geometric circle, divided into 360 degrees of longitude. Thus, there is a 4-minute difference between degrees in the course of the sun (if the sun has reached its zenith at 1°, for example, it will reach it four minutes later at 2° and one hour later at 15°, accordingly). Thus, 24 theoretical time zones were created, each of them spanning 15 degrees longitude with a 1-hour difference between meridians, that is, between the times when the sun reaches the respective position in the middle of each time zone. Every single location on earth was assigned a time zone more or less in accordance with its solar time (cf. Roenneberg 2019a: 181f.).

In 1890, the German state railways that were organised in the Verein Deutscher Eisenbahnverwaltungen (Association of German Railway Administrations) agreed to use Central European time (CET, the mean solar time of the 15th meridian east) as their common operating time. On 1 April 1893, CET was implemented as the legal time for all of the German Reich by the ‘Zeitgesetz’ (‘Gesetz betreffend die Einführung einer einheitlichen Zeitbestimmung’, law ‘concerning the introduction of uniform time reckoning’ – ‘Time Act’). Until then, the German Länder used to observe different time regimes (Bavaria, for instance, observed Munich time and was, thus, seven minutes behind Prussia’s Berlin time).

In 1972, CET was replaced by UTC – Coordinated Universal Time. As a consequence, the Greenwich prime meridian now serves as the meridian of reference for all the world’s – theoretically – 24 time zones which were accordingly expressed in terms of their positive or negative offset from UTC (UTC+1 through UTC+12 to the east and UTC-1 through UTC-12 to the west of the prime meridian).

With the establishment of time zones, accurate solar time (i.e., the sun being at its zenith at 12:00) now solely applies to the degree of longitude in the middle of each time zone. Thus, time zones are already a compromise set to coordinate social and solar times across a given territory and, thus, imply a certain departure from ‘real’ solar time.⁹ The maximum difference between the western and the eastern borders of a standard time zone is one hour. The larger the time zone, the wider this departure – which already indicates that there may be more at work in time zone definitions than just the zoning rules proposed by the International Meridian Conference.

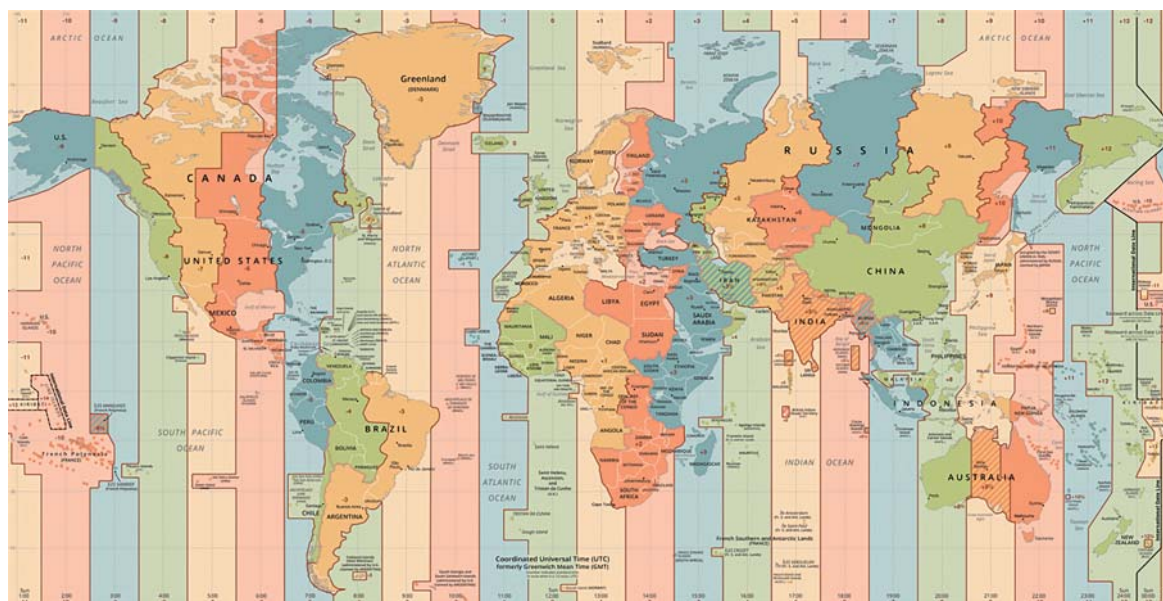


Figure 2: Global time zone map

9 ‘Mechanical clock time never really was sun time. Clock time is mean time. Thus, depending on your specific location on the earth, over the course of the year, a clock will differ substantially from a sundial, sometimes by more than fifteen minutes. Sundials show you your place in the sun. Clocks make every day an average day’ (Downing 2005: 74).

Even though the Meridian Conference had agreed to – in theory – have 24 evenly distributed time zones, the actual time zone situation is quite different: actually, there currently is a global total of 40 time zones, give or take a few depending on your reference date (cf. Gleick 2016 and Figure 2).

The map reveals the diversity of time zone arrangements. Very large countries usually span several of the time zones agreed on at the Meridian Conference (e.g., 5 in the USA, 4 in Canada, 11 in Russia, 5 in China). For various reasons, however, these countries chose to combine certain time zones, so the USA¹⁰ and Canada have only four time zones, Russia used to have nine time zones between 2011 and 2014 but has since then returned to the pre-2011 number of eleven, and China has only one time zone. These decisions indicate that there may be various reasons for states to differ from the practice agreed on at the Meridian Conference. Moreover, the definition of time zones often serves as a nation-state, political, or symbolical tool of power (Hassid/Watson 2014, Ogle 2015). Here a few prominent cases:

- Spain, which in terms of solar time is in the western European time zone (UTC+0), observes central European time (UTC+1) because after his victory in the Spanish Civil War, Spanish dictator Francisco Franco decided in 1942 that Spain should be in the same time zone as Hitler's Germany and Mussolini's Italy. In the western Spanish town of Vigo, for instance, this means that in July, 'noon' is as late as at about 14:40 because it is only then that the sun reaches its highest point in the sky.
- During the German occupation of France in World War II, Germany imposed Berlin time, which is why France is assigned to the Central European time zone (UTC+1) although it was initially in the western European time zone (UTC+0).
- China spans 5 time zones (from UTC+5 to UTC+9) but observes a single time to emphasise its unity: Beijing time, which is reasonably adequate only on the east coast of China.¹¹ In the 1910s and 1920s the Kuomintang government, having toppled China's last dynasty, established five time zones that were in accordance with the international standard. After the founding of the People's Republic in 1949, the whole country was again brought under a single time zone because Mao, who was fully aware of the symbolic power of this ruling, insisted on the need for one country to observe one time (Deuber 2018, Hassid/Watson 2014).
- In 2015, North Korea established its own time zone, setting the clocks back by 30 minutes to Pyongyang time. In the course of the country's tentative opening, this ruling has meanwhile been repealed.

Europe currently spans four time zones – from Iceland and UTC+0 to European Russia and UTC+3. All EU countries set the clock forward to 'summer time' in spring and back to standard time in autumn. Most European non-EU states also adhere to this arrangement, except for Russia and Belarus where standard time ('winter time') is observed all year round. Iceland, which also does not adhere to the EU summer time arrangement, observes UTC+0 all year round although its actual time zone is UTC-1; which means that Iceland actually observes permanent DST (see Figure 3 and Figure 11).

Thus, the legal responsibility for defining the 'lived' time zone lies with the respective states, allowing them to lay down their time regimes by law. In Germany, the time regime was, in a first step, codified by the 'Gesetz betreffend die Einführung einer einheitlichen Zeitbestimmung', or 'Zeitgesetz' (law concerning the introduction of uniform time reckoning, or Time Act). After its

¹⁰ These four time zones apply to the main, i.e., continental part of the country. There are two additional time zones for Alaska and Hawaii and five additional time zones for insular areas, both inhabited and uninhabited.

¹¹ The effects for China's westernmost region, the province of Xinjiang, and the political dimension of different times are comprehensively described in a YouTube video: Zapatka (2020).

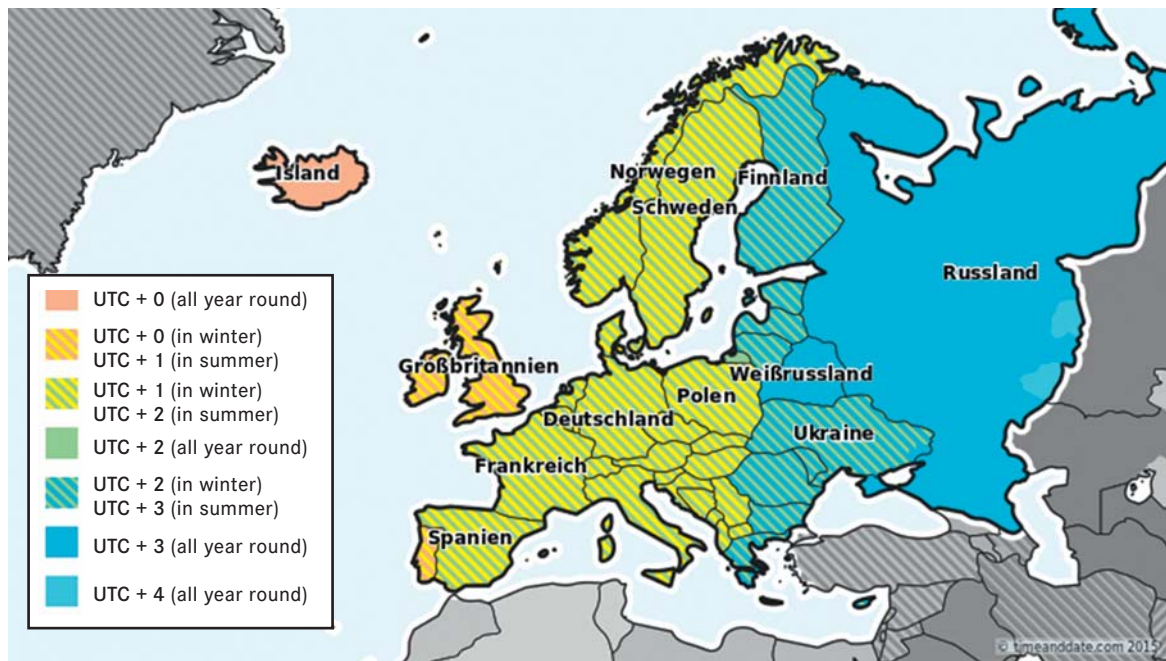


Figure 3: Map of time zones and clock change arrangements in Europe

termination on July 12, 2008, the provisions of the former Time Act were integrated into the Gesetz über die Einheiten im Messwesen, or Einheiten- und Zeitgesetz (EinhZeitG; law relating to units of measurement). The latter provides that the legal definition of the units of measurement falls within the competence of the respective Ministry – at the time, the Bundesministerium für Wirtschaft und Technologie (Federal Ministry of Economics and Technology); today, the Bundesministerium für Wirtschaft und Energy (Federal Ministry of Economics and Energy). For the EU, a common regime for all member states was implemented by Directive 2000/84/EC 2000. Braml and Felbermayer (2019) argue that ‘clock time is a nominal construct’ (258) and that, therefore, there is more than one way of ‘counting the hours without leaving the 24-hour system: in the Babylonian way of counting, the first hour of the day begins at sunrise’ (259). Time zone conversion can be seen in analogy to currency conversion – clock times are made commensurable by factoring out the real (time-zone dependent) position of the sun. The most consistent option is global universal time which corresponds to UTC+0 (with the prime meridian that passes through Greenwich as its point of reference) and is observed in fields – e.g., air and sea navigation, telecommunications, meteorology, etc. – where a single time leads to simplifications in terms of practicability.

In view of the fact that universal time plays an increasingly important role in the ongoing organisation of global connectivity, there have been calls for quite some time to implement universal time on a general basis. This is a very far-reaching option which takes the ‘nominal nature of clock time’ to its extreme and goes far beyond the current debate about DST (‘summer time’) and its effects, especially since no consideration is given to issues of practicability.

Time zones relate to degrees of longitude. However, due to the tilt of the earth’s axis, the degrees of latitude also play an essential role in determining the length of the periods of light and darkness on any given day. In the summer, days in the north are significantly longer – on the Arctic circle on June 21 the sun virtually doesn’t set while on December 21, it virtually doesn’t rise, and vice versa in the southern hemisphere. Along a degree of longitude within a time zone, however, the rule still holds that the sun is at its highest at 12:00 and at its lowest at 24:00/0:00. The clock change does not lead to gains in natural light, the only change to be had is in the distribution of daylight hours within the nominal range of clock time.

3 A brief history of the clock change

What is commonly called a ‘time change’ and is since 2000 subject to EU-wide uniform regulation is actually nothing but a clock change where clocks are turned forward by one hour in spring (one ‘loses’ one hour) and back by one hour in autumn (one ‘regains’ one hour). De facto, it is a change in time zone assignment: a move one time zone to the east in spring (in Germany, from UTC+1 to UTC+2) and a move back in winter.

The history of the clock change is significantly shorter than the history of time zone establishment. The clock change was implemented in Germany during World War I on the assumption and with the aim to make better use of daylight, reduce energy use and, thus, increase the productivity of the war economy. After the War, the clock change was quickly repealed, only to be reimplemented, with the same arguments, during World War II. After World War II, it was again abolished in 1950 and not reimplemented until 1984 as a late consequence of the 1973 oil crisis and part of the efforts to advance the unification of Europe and promote the internal market (cf. Deutscher Bundestag 2016).¹²

Thus, the reasons given for the clock change (aka the change in time zone assignment) have always been of a more or less economic or political nature such as, for instance, optimising daylight use to (hopefully) enhance efficiency and resource conservation, provide more leisure activities in the evening, strengthen the ‘temporal’ unity of the respective country – the relationship between solar and social rhythms was not an issue: ‘[T]he adoption of summer or daylight saving time was debated as an instrument to change people’s behavior’ (Ogle 2015: 15).

From a language point of view, even the terms used to designate the ‘times’ that result from this change are rather suggestive insofar as they already imply – in various ways depending on the language examined and/or the terms relied on – a certain perspective, or framing:¹³

- In German, the distinction is between ‘Normalzeit’, or frequently also ‘Winterzeit’ (a common if non-official term), on the one hand, and ‘Sommerzeit’ on the other.
- In English, there is ‘standard time’ and ‘daylight saving time (DST)’, or ‘winter time’ and ‘summer time’.
- In French, the terms are ‘l’heure d’hiver’ or ‘l’heure normale’, which in France is also ‘l’heure légale’, and ‘l’heure d’été’.
- In Italian, the terms are ‘ora solare’ or ‘ora civile convenzionale’ for standard or ‘winter’ time, and ‘ora legale’ for ‘summer time’.

Of all these, the Italian terminology seems most to the point since it quite clearly indicates that standard time/winter time is the one that is oriented to the solar cycle (at 12 noon, the sun is at its zenith) whereas ‘summer time’ is a legal standardisation whose aim is most clearly expressed by the English term of ‘daylight saving time’ (DST). Since ‘winter’ and ‘summer’ are differently connoted, it can be reasonably supposed that these negative or positive connotations – as well as arguably the date when a survey is taken – play a role in how the ‘times’ get rated. Referring to ‘standard time’ or ‘normal time’ rather than ‘winter time’ underlines the fact that this is the time where the sun is at its zenith at 12:00 and is nothing to do with winter, cold, darkness, while ‘summer time’ means nothing but a resetting of the clock – forward by one hour –, thus creating the clock-induced illusion of longer evening daylight hours (because one gets up one hour earlier as compared to standard time).

¹² In his essay, Mutz gives a detailed account of the history of the clock change in Germany and of the European harmonisation process, highlighting the fact that in spite of initial statements to this effect, it has ‘not become a defining building block of European identity’ (2016: 1).

¹³ This is particularly evident in the name given to a national bill introduced to make DST the standard time year-round in the USA. The bill goes by the name of ‘The Sunshine Protection Act’ (Chuck 2019).

Far from being a European specialty, the clock change is found all over the world (see Figure 4). Daylight Saving Time statistics show that the clock change was at some time or other (if not more than once) implemented in a total of 142 countries. Their number is declining, however: in 2020, there were 73 states that fussed with the clock. Also, their number is highest in Europe and lowest near the equator (due to the significantly lower day length variation¹⁴). Almost annually, there are new countries implementing or abolishing DST. Thus, as even these meagre statistical data show, the clock change is an issue that keeps cropping up on national agendas:

Continent	Clock change in 2020	Clock change abolished	No clock change, ever
Africa	2 countries	16 countries	38 countries
Asia	7 countries	25 countries	19 countries
Australia & Pacific	5 countries	3 countries	11 countries
Europe	49 countries	5 countries	1 country
North America	8 countries	11 countries	20 countries
South America	2 countries	7 countries	5 countries
Total	73	67	94

The total number of countries listed exceeds the number of the world's UN countries because autonomous parts of a country are counted as independent countries if they belong to different time zones or observe their own DST regimes. Also, there is double listing for countries spanning two continents.

Figure 4: Current global clock change practices

As an illustration, let's take a closer look at three cases:

- Between 1968 and 1971, the United Kingdom made a first attempt to introduce permanent DST. But residents, especially in Scotland, were unwilling to put up with the prolonged morning darkness, so permanent DST was repealed (Fietze/Kantermann/Zulley 2019).
- In parts of the USA, a debate similar to the one in Europe is going on right now: in California, Washington State, and Florida, to name only these three, bills proposing the implementation of permanent DST are about to pass, or have already passed (in Florida, the bill in question goes by the name of 'Sunshine Protection Act'); six New England states want to join the Atlantic time zone, which is actually equivalent to switching to permanent DST and was couched in terms of time zone change only to comply with formal rules (cf. Chuck 2019; Herf 2019; Watson 2019). In the USA, the two camps are also locked in a heated discussion. Since concerns differ between states, if not between counties within states, regulations may lead to differences of up to two hours: 'Even so, the changes may sandwich some states between time zone boundaries and state clusters that are defying the biannual clock shift. And for some parts of the year, adjacent time zones could even be two hours apart, rather than the regular one hour difference' (Wei-Haas 2019).
- In 2011 Russia, taking its cue from the USA and China, i.e., large countries with few time zones (USA) or even a single time zone (China), switched to permanent DST and reduced the number of time zones from 11 to 9. In 2014, this arrangement was repealed: permanent standard time was made mandatory, and the number of time zones was changed back to 11. This marked the end of a three-year experiment which had led to many grievances (cf. Wagner

¹⁴ This indicates that latitude also plays role because due to the tilt of the earth's axis to their dependence on the distance to the equator, daylight hours vary considerably with the seasons. For a very impressive visualisation, see: https://www.reddit.com/r/dataisbeautiful/comments/duax05/oc_hours_of_daylight_as_a_function_of_day_of_the/ (accessed on January 31, 2020).

2018; Roenneberger 2018). However, several regions have implemented arrangements of their own: ‘Meanwhile, seven provinces have already taken measures of their own. Acting on their own authority, they changed their time-zone assignment in an effort to avoid early evening darkness. Many other provinces consider following their example’ (Donath 2018), which indicates that the discussion in Russia is far from being finished although for the foreseeable future, yet another nation-wide regulation seems unlikely.

4 The current debate and the arguments involved

The current debate is defined by a multiplicity of studies, essays, media reports, and opinions covering a wide range of aspects. Every year, media attention refocuses on the issue around the dates of the spring and autumn clock change – most intensely so in 2018 and 2019 in the wake of the EU public consultation which resulted in a significant majority in favour of abolishing the seasonal clock change (84 % of responses) (EU Commission 2018: 6). Of those who voted in favour of discontinuing the seasonal clock change, a majority (56 %) expressed a preference for permanent ‘summer time’. 36 % were in favour of permanent standard time (ibid.: 8). It is true that the clock change is often considered a ‘soft’ issue. But a historical analysis of the development of time zones and the time (clock) change shows the intense emotional charge and, thus, the symbolic significance of the political and social debate, on the one hand, while an analysis of the effects arising from this fussing with the clock attests to its practical significance, on the other. In 2016, a report of the Büro für Technikfolgenabschätzung des Deutschen Bundestages (TAB; Office of Technology Assessment at the German Bundestag) entitled ‘Bilanz der Sommerzeit’ (Comprehensive evaluation of summer time) was submitted to the relevant Bundestag Committee and published as a Bundestagsdrucksache (Bundestag document; Deutscher Bundestag 2016). By its own standards, this is the most comprehensive stock-taking effort in Germany in recent times. But in spite of the fact – described above – that the clock change is equivalent to a change in time zone assignment, this aspect is not addressed in the report. The report builds on a synopsis of the existing literature, model calculations, expert discussions, etc. and covers the following domains:

- Energy use
- Economy – impact on various sectors
- Human health – physiological and psychological impact
- Legal framework for change at the time the report was being prepared.

The report concludes with the following summary: ‘All in all, it can be said that with respect to the relevant studies and experiences, the available body of knowledge about the potential effects of summer time on energy use, the economy, or human health is limited, incomplete, and partly contradictory. However, the findings available to date do not provide any positive evidence that the observance of summer time entails serious energetic, economic, or health effects, be they positive or negative. Thus, the question of whether the current summer time arrangement should be maintained, modified, or abolished will for the foreseeable future remain a subject of political and public debates that can only to a limited extent rely on scientific facts’ (Deutscher Bundestag 2016: 15).

Roughly following the structure of the report, we will in the next sections critically examine its key statements, enhance them by a number of new findings, and supplement them in a number of points. In recent years, a range of relevant studies have been published, in particular on aspects of human health.

4.1 Energy saving, resource conservation, and other ecological aspects

The report comes to the conclusion that almost all findings suggest that the initial objectives of the clock change – energy saving and resource conservation – have not been achieved or, at best, only to a very limited degree. This seems to be the case in spite of partly contradictory findings in some studies and is also confirmed by other comparative surveys. Thus, an early study using the data of a majority of households in Indiana, USA, analysed DST-based changes in residential electricity consumption. Contrary to expectations, DST appears to increase rather than reduce consumption. Notwithstanding the limited spatial (only Indiana) and material reach of the analysis (only residential electricity consumption), the authors come to the conclusion that energy saving as a rationale for implementing DST is indeed questionable (Kotchen/Grant 2008: 23). An additional factor for stepping up energy consumption seems to be the increase in gasoline consumption that results from a more frequent use of cars for evening activities (Downing 2018).

A comparative meta-analysis of 162 estimates of energy saving effects based on 44 studies (Havranek/Herman/Irsova 2016) comes to the conclusion that results vary depending on latitude: the closer to the equator, the smaller the savings, but ‘[i]n any case, the effects of daylight saving time on energy consumption are too small to justify the biannual time-shifting’ (24).

4.2 Economy

The economic aspects discussed in the report do not allow for an unequivocal conclusion as to whether the clock change makes sense or should be repealed: ‘Thus, on the whole, it would seem that by now all sectors of the economy have come to terms with observing summer time. While in some sectors, the clock change in spring and autumn, i.e., the use of summer time, may be felt to be a nuisance, it is on the contrary favourably received in others –however, no vehement and publicised rejection of or support for current summer time arrangements, corroborated by position papers or specific analyses, can currently be ascertained from any of the economic sectors considered’ (Deutscher Bundestag 2016: 66).

In his comprehensive study on DST, Downing (2005) shows that the campaign for DST was mainly driven by the retail sector, the leisure industry (golf), and the mineral oil industry. His conclusion: ‘Despite its name, daylight saving has never saved anyone anything’ (Downing 2018).

Data on the (organisational) cost of the biannual change are rare (cf. Deutscher Bundestag 2016: 60, 64). All we have is the occasional and, in most cases, more or less unsubstantiated reference – e.g., to a study by the American Air Transport Association arguing that the costs of switching to DST alone were around 147 million dollar per year (Deuber 2018).

Another issue left unconsidered in the TAB report is the connection between the clock change and time zone definitions or, rather, the way time zones are defined to suit the requirements of industry. There are two types of effects which are likely to result from it: *synchronisation effects* due to shared time zones and *continuity effects* due to different time zones across linked economic areas. Based on their survey of various studies, Braml/Felbermayr (2019: 258) summarize these effects as follows:

- ‘Synchronisation effects’ (‘harmonization dividend’ (Hanke/Henry 2012)), i.e., the positive effects of being in the same time zone, may arise because it avoids having to cope with a patchwork of time zones and, thus, facilitates trade;

- ‘Continuity effects’ due to different time zones facilitate or enable the division of labour (on the Internet) – its extreme form being shift work across time zones around the globe, around the clock.

Braml/Felbermayr come to the conclusion that for the time being, the prevailing view would seem to be ‘that, on balance, differences between time zones do more harm than good because for the time being, international trade in goods largely outweighs trade in services’ (Braml/Felbermayr 2019: 258). However, as far as economic reasons are concerned, there is no conclusive evidence in favour of either harm or good.

An open and – as far as we are aware – as yet undiscussed issue is the role that the clock change, or sub-optimal time zone definitions, may generally play for the extension of economic activities into evening and night-time hours. This could arguably happen in two ways:

- On the one hand, DST could allow for activities to be ‘extended’ into the evening hours. Many arguments put forward in favour of DST as a way to promote the leisure industry follow this line (cf., for example, European Commission 2018) – certain forms of retail trade, in particular, are strong supporters of DST (Downing 2005).
- On the other hand, the continuity effects of cooperation across multiple time zones could lead to temporal colonialism, that is, require certain partners to extend operating hours because due to a reliance on person-to-person coordination they need to adapt to the schedules of the more powerful partner – for instance in supplier relationships or with shift work across multiple time zones.

This raises the general question of whether and to what extent it would seem acceptable to further facilitate and promote the trend toward a 24-hour society (24/7). As it is, the effects of 24/7 are contradictory in more than one respect: it enables economic growth and an increase in efficiency, on the one hand, but leads to more night-time work along with the concomitant health hazards, to less sleep, more accidents, more strain on the environment, and more light pollution, on the other (see, e.g., Adam et al. 1998; Crary 2013; Melbin 1987; Posch et al. 2013; Zulle/Knab 2001).

4.3 Human health

The report of the Office of Technology Assessment provides a comprehensive survey of the studies on health effects as published until 2015, as well as a differentiated description of the findings but nevertheless comes to the conclusion: ‘All in all, or by way of summary, we can therefore say with respect to potential impairments of well-being (sic!), or health effects, that although the relevant body of knowledge has been substantially enhanced and differentiated since 2007, it is still very incomplete and, in particular, lacking in sound scientific evidence’ (Deutscher Bundestag 2016: 99).

Especially in recent years, however, there have been quite a number of new findings from chronobiology concerning the clock change, the effect of time zones, and the relationship between solar, social, and the body’s own time (the ‘body clock’, or ‘circadian clock’) (Giuntella/Mazzoni 2019; Roenneberg 2019a, Roenneberg/Winnebeck/Klerman 2019, and the literature cited in each case) as well as statements and recommendations that draw on these findings (e.g. Chuck 2019; Roenneberg/ Wirz-Justice et al. 2019; Watson 2019), all of which either report their own empirical studies or give a comprehensive overview of the current state of knowledge.

The *short-time* health effects of the spring clock change are problems with sleep onset and wake-up times, reduced sleep duration right after the change, lower performance levels, higher risks from health conditions (e.g., more heart attacks), and higher risk of accidents (due to

insufficient sleep) (Roenneberg/Wirz-Justice et al. 2019: 229, and the literature cited by them; Fritz et al. 2020). Effects vary greatly between individuals because habitual early risers, for instance, find it easier to adapt. With the change back in autumn, in contrast, there are on the whole far fewer health effects because it is a 'return' to the initial situation. Findings show that the return to standard time in autumn significantly reduces the number of hospital admissions as well as the incidence of sleep deprivation (Jin/Ziebarth 2020). These acute effects alone are reason enough for chronobiologists to raise a call for abolishing DST.

What is much more relevant, though, are the *long-term* health effects of the clock change. Chronobiologic findings suggest that the spring transition which makes us rise one hour earlier in terms of solar time while all the usual social time schedules remain the same (e.g., working schedules, school start times) exacerbates the *social jetlag* – the misalignment between the individual body clock and the social rhythms. 'Measurement of SJL (social jetlag) quite simply uses the difference between mid-sleep on working days and mid-sleep on free days. The reason is that on free days, the impact of the body clock on sleep times is more obvious than on working days when sleep times are more strongly controlled by the social clock. Thus, SJL tells us how much we differ from our biological clock on working days when we need to adjust to the social time regime' (Roenneberg 2019a: 176f.).

Humans are diurnal beings with the concomitant chronobiological functions of sleep, body temperature, blood pressure, and metabolism. Almost all living beings such as plants, bacteria, animals, and humans have a *circadian system*, an internal clock, which synchronises biochemical, physiological, and behavioural processes with the environment in a cycle of roughly 24 hours (Grubisic et al. 2019). The most important so-called 'zeitgeber' (time cue) is the light-dark rhythm, i.e., daylight. Principally, the blue wavelengths of the daylight spectrum are absorbed by the light-sensitive ganglion cells of the retina of the human eye, which transmit information about the level of light intensity to the region of the brain that acts as the circadian pacemaker by producing or suppressing melatonin, the 'hormone of darkness' that regulates sleep (Münch et al. 2017). Many proteins that are produced by the human body are involved in these body processes, so the circadian clock reflects the usual genetic variances. This means that circadian clocks differ in the time – earlier or later – of their synchronising with the light-dark rhythm (Roenneberg 2019d) and that, as a result, there are different *chronotypes* – early risers ('larks') and late risers ('owls'). In pre-industrial times, chronotypes were clearly oriented to sunrise and sunset times. 'With the invention of artificial light, humans drastically interfered with their most important zeitgeber, light and darkness, because we are indoors for most of the day and use artificial light after sunset. Actually, it is only in our sleep that darkness surrounds us' (Roenneberg 2019d: 247). As a result, the range of chronotypes has widened ('more') and extended to later hours ('later'). The temporal organisation of the day is no longer determined by daylight alone but by the social rhythm of days and weeks (marked by more or less standardised working schedules, school start times, opening hours, TV program structures, etc.) which structures most people's lives. In other words: it's the alarm clock that tells us when to rise (see Figure 5). And it is this fact – the discrepancy between biological, internal time, on the one hand, which is geared to the daylight-based light-dark rhythm, and the rigid social time schedule, on the other – that creates the social jetlag.

Almost 71 % of the work force with regular, normal working schedules sleep around seven hours on average on workday nights, but as the social jetlag increases, average night-time sleep duration on workdays drops to less than seven hours (Roenneberg 2019a: 209).

A number of estimates based on data of the representative survey on time use in Germany conducted by the Statistisches Bundesamt (Federal Office of Statistics; analysis of 32,105 time logs

kept by 12,254 individuals in 2012/13) reveal the weekday/workday differences in the sleep patterns of the entire population from the age of 10 up. Significant differences between workday and weekend rhythms were found not only for sleep duration¹⁵ but also for sleep schedules (see Figure 5) – clear evidence of social jetlag. Sleep rhythms¹⁶ on workdays are absolutely stable, a perfect illustration of what it means to ‘live by the clock’. But the weekend begins on Friday night, as it were, when people stay awake longer. On Saturday and Sunday, the difference from rigid workday wake-up times is reflected in significantly longer sleep durations and later wake-up times. On Sundays, however, Germans do not stay awake as late as on Fridays and Saturdays: the weekend ends on Sunday, as it were, when workday sleep rhythms regain control.

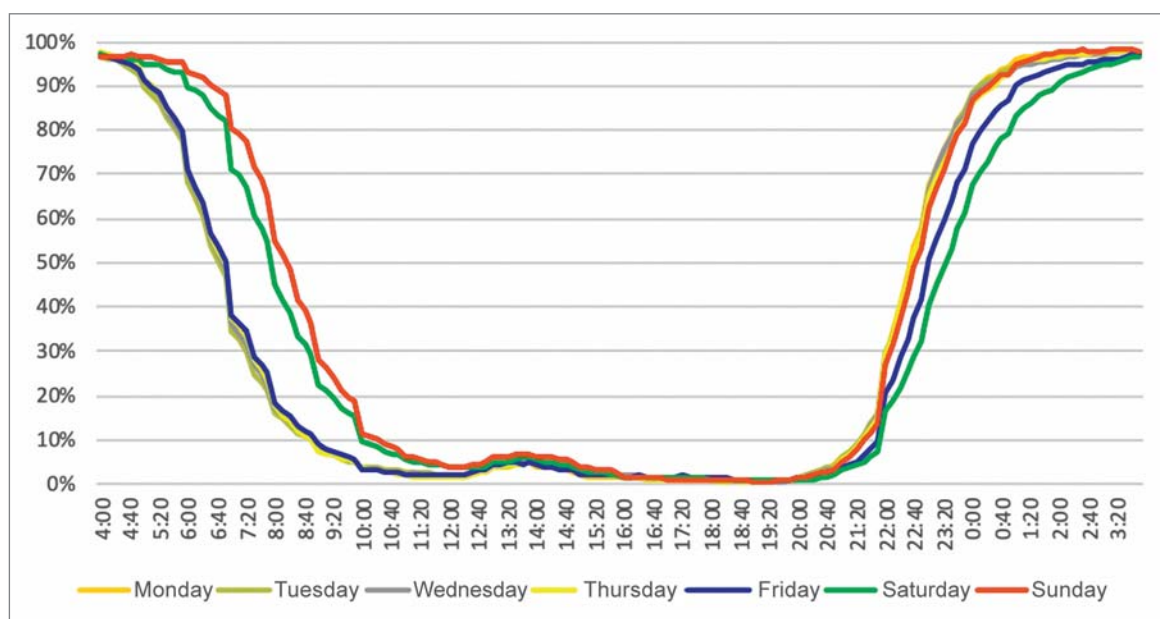


Figure 5: Percentages of the population asleep or ready to fall asleep in Germany, n=32,103

Clock change advocates tend to deny the effects of social jetlag, arguing that in cases of jetlag resulting from a flight across time zones, the body is quick to adjust to the new situation at the point of arrival. But social jetlag is not the same thing as jetlag resulting from long-distance travel: the latter is a *temporary* desynchronisation between the circadian clock, i.e., the alignment with the solar and social times at the point of departure, and the solar and social times at the point of arrival, and resynchronisation is achieved by the local light-dark rhythm which, in turn, is based on the course of the sun. The clock change for DST, however, means that the desynchronisation between solar and social temporal patterns which accounts for the social jetlag is *increased* by one hour. And this increase holds for all of the DST period because one keeps getting up one hour earlier, i.e., keeps living in a ‘different time zone’. At first glance, the effects seem to be similar to those of a real jetlag resulting from a flight across several time zones. But unlike flight-induced jetlag where we readapt after a relatively short time – depending on the number of time zones crossed – because we get to be synchronised with the new solar and social rhythms, the desynchronisation between solar and social rhythms and the increase in social jetlag that come with DST are permanent for the duration of the clock change. For while

15 On workdays, the time spent in bed asleep or ready to fall asleep (dropping off on the living room couch and afternoon naps included) averages 8 hours and 13 minutes; on weekends this average is 9 hours and 8 minutes.

16 Strictly speaking, this should be ‘rhythm of time in bed ready to fall asleep’ since the time use survey of the Bundesarbeitszeitstudie does not use the exact drop-off time but the point in time when people are in bed and ready to fall asleep, with no other activities such as reading or watching television. This difference between the time in bed ready to fall asleep and the actual sleep onset is examined by Till Roenneberg in the Münchener Chronotyp-Studie (Munich ChronoType Study, MCTQ) using a standardized week of the previous month.

the clock time ‘springs forward’ to the east by one hour, the sun does not. With clock time ‘falling back’ in autumn, the DST-induced desynchronisation is reversed. But if DST were to be made permanent, so would desynchronisation. DST does not mean adjusting to a new time, DST means living permanently in this new time, this new light-dark pattern. With *permanent DST*, our day/night rhythm will remain the same while we will permanently – and not only in summer – get up earlier than our circadian clock suggests (Roenneberg 2019a).

In addition to these adverse long-term effects, there are some negative short-term effects, as well, which arise from the clock change itself. These short-term effects, however, are not the same for everybody, the most obvious difference being between early risers (‘larks’) and late risers (‘owls’). Early risers find it much easier to adjust than do late risers. To illustrate these findings, here’s some additional estimates based on the data of the representative survey on time use in Germany.

Figure 6 shows the average percentage of people in the population who are asleep or ready to fall asleep on workdays in the month of the clock change (which is always scheduled for the last weekend in March and October, respectively). No temporal difference in workday ‘turn-in patterns’ emerges in either the weeks of the clock change or across the months in general.¹⁷ This is evidence for the strong impact – in terms of social standardising – on people’s everyday life which remains unchanged and clock-controlled even though the natural solar rhythms have a major influence on our well-being, time-related or other.

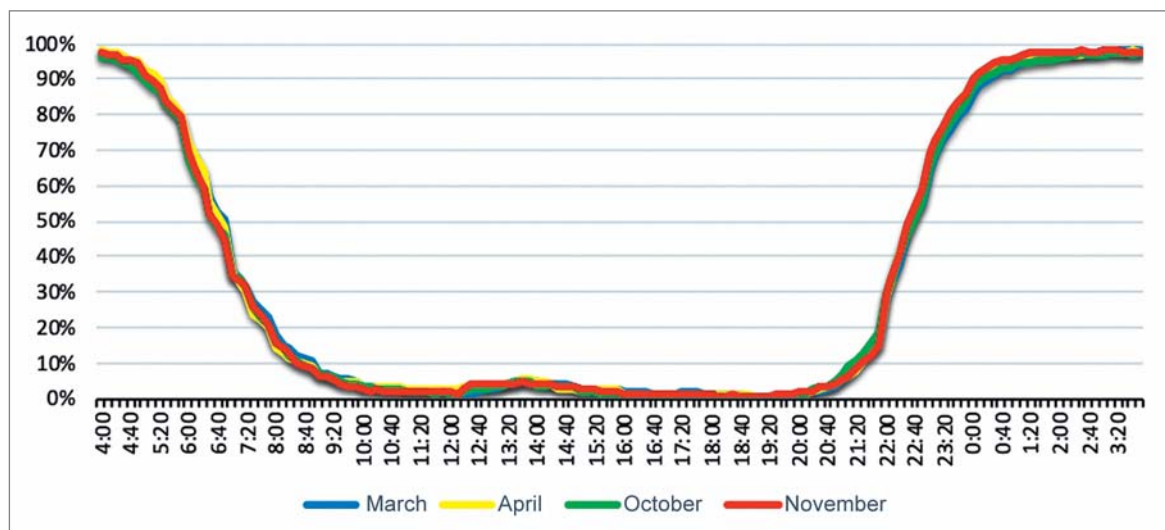


Figure 6: Percentage of people in the population asleep or ready to fall asleep on workdays in the months of the clock change, n=7349

Other recent chronobiological studies show that permanently living in the ‘wrong’ time zone may come with substantial health hazards that are strongly linked to the concomitant sleep deprivation and its consequences for the immune system. There is a significantly higher risk for certain diseases, as studies for the USA, Russia, and China show (Roenneberg 2019a; Roenneberg/Winnebeck/Klerman 2019, and the literature cited by them).

In their study on the effects of social jetlag, i.e., the desynchronisation of social, solar, and biological rhythms, on health and economic outcomes, Giuntella/Mazzonna (2019) look at the situation at a time zone border in the USA (see Figure 7). They start out from the fact that while

¹⁷ As mentioned earlier, these data of the Statistische Bundesamt do not relate to the exact time of sleep onset but to the time when people are in bed and are ready to fall asleep without indulging in other activities. Actual sleep onset may thus differ from this time. The data of the Munich ChronoType Questionnaire (MCTQ) show that subsequent to the clock change, this is indeed the case. Yet people will go to bed at the habitual, socially standardized clock time, irrespective of their chronobiological needs.

the sun sets at the same (solar) time on both sides of the time zone boundary, sunset is one hour earlier, by clock time, for residents living on the eastern side of the time zone boundary than for residents on the western side of the boundary, who have one more hour of evening daylight. The goal of their study is to assess the effects on health and economic outcomes that arise from this extra hour of evening daylight in a context determined by certain temporal patterns of activities, i.e., rigid social schedules.

Here's some of their findings:

- Due to the one-hour (clock time) difference in sunset time, jobholders living on the late (clock time) sunset – i.e., western – side of a time zone boundary will sleep 19 minutes less on average than jobholders in the adjacent time zone on the other – i.e., eastern – side of the time zone boundary: ‘More generally, individuals on the late sunset side of a time zone boundary are more likely to be sleep deprived, more likely to sleep less than 6 hours, and less likely to sleep at least 8 hours. The effects are larger among individuals with early working schedules and among individuals with children of school age’ (ibid.: 212).
- Since earlier rising and working schedules mean that people can spend more time in daylight in the evening, there may be more utility from leisure time. The result is a trade-off between adverse health and income effects and the enjoyment of leisure time. The authors suggest that ‘individuals may have inaccurate self-perceptions of their biological needs and may underestimate the detrimental effects of circadian rhythms disruption on health’ (ibid.: 212)
- When social rhythms (work and school schedules, TV program structures, etc.) lead to conflicts between biological and social rhythms, ‘reshaping social schedules in ways that promote sleeping may have non-trivial effects on health and economic performance’ (ibid.: 225f.).

The findings strongly suggest, to say the least, that clock changes – and suboptimal assignments to and definitions of time zones – have far from trivial effects on the health of a population and, indirectly, even the economy of a country. A literature study conducted by the Dutch National Institute for Public Health and the Environment (2019) comes to similar conclusions and calls for the Netherlands to return to standard time and the time zone of the prime meridian (UTC+0) (after all, the assignment to UTC+1 dates back no further than World War II).

Proceeding on the assumption that the findings by Giuntella/Mazzonna (2019) are generalisable, and in view of the fact that – as mentioned earlier – some European countries live in the ‘wrong’ time zone, one would expect similar health risks to be found in Europe, as well. Regrettably, no comparable studies exist (cf. Roenneberg/Winnebeck/Klerman 2019: 7). Moreover, there are various intervening variables (life styles, diets, etc.) which rule out any simple transfer of findings to other regions with ‘wrong’ time zones (such as, for instance, Spain and France). But even more importantly, living in the wrong time zone for such a long time may lead to the emergence of compensatory behaviours, in particular by a readjustment of social rhythms to solar times. This assumption is supported, on the one hand, by anecdotal evidence, namely that in Europe, social times tend to become later the farther west you go (in Spain, people eat late) – a phenomenon that can also be observed in western China, Tibet, and parts of Russia –, and on the other hand by empirical findings from the database of the Munich ChronoType Questionnaire (MCTQ) (cf. ibid.). ‘Sun beats Franco’, as Braml/Felbermayr (2019: 259) so succinctly put it. This suggests that there are limits to the extent to which the desynchronisation of social

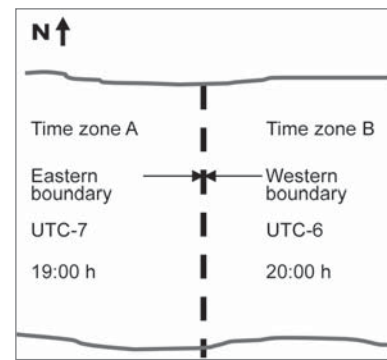


Figure 7: Schematic representation of a time zone boundary in the middle of the USA

and solar rhythms is tolerated and that, as a result, social times are being permanently adjusted, i.e., pushed to later hours (or, as in Russia, that permanent DST is repealed due to public protests).

Figure 8 shows which of the world's regions are in a chronobiologically adequate time zone. Green areas observe 'ideal' standard time, red areas use clock times that are ahead of the chronobiologically optimal time zone. By changing to DST, clocks in the green areas are also put one time zone farther east (one hour ahead) while the situation in the red areas is further exacerbated.

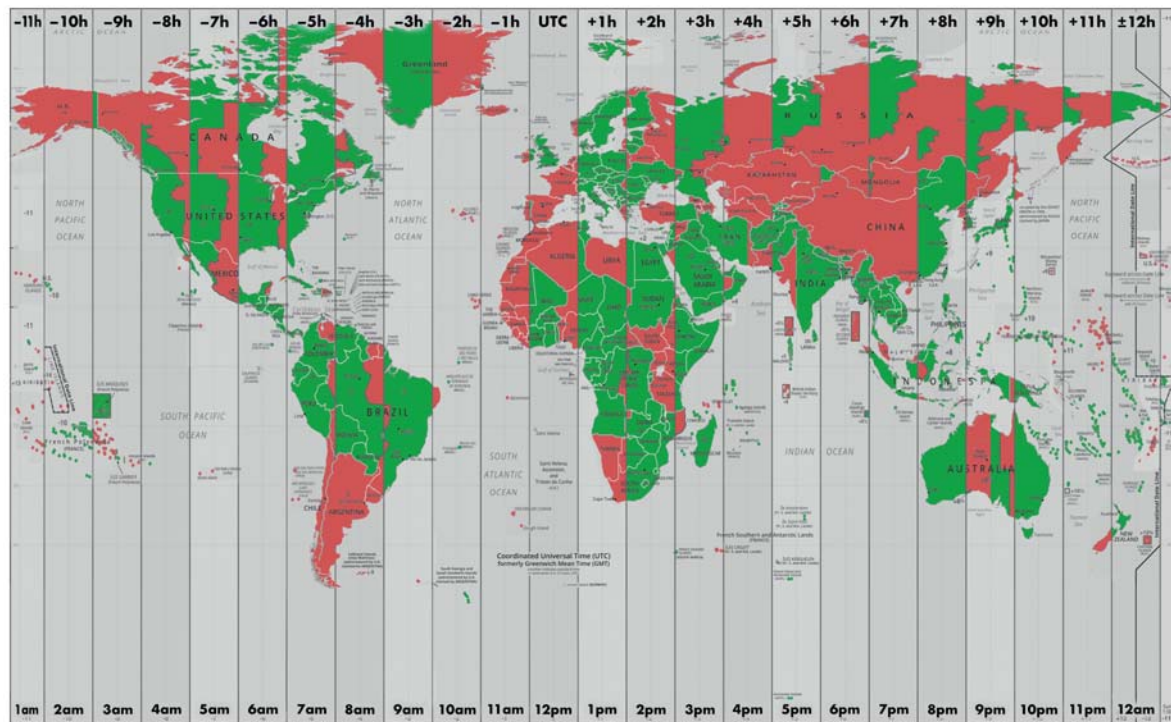


Figure 8: Locations ahead of ideal Standard Time

Locations in **red** observe time zones east of their ideal Standard Time, putting civil clocks ahead of residents' circadian rhythms. **Green** areas' clocks align with circadian rhythms, to the benefit of health, safety, productivity, prosperity, energy. And environment. Daylight Saving Time is equivalent to observing the next time zone east/ahead, it is harmful in **green** areas and doubly harmful in **red**.

Since exacerbated sleep deprivation is an essential aspect of the problems associated with both the clock change and suboptimal time zone assignments, taking a look at findings on the so-called sleep crisis seems indicated. The sleep crisis has many causes, such as, e.g., life style changes, a general extension of activities toward 24/7, new types of and increased exposition to artificial light, and too little exposition to natural light (e.g., Posch et al. 2013). Especially with the advent of light sources with a high proportion of light in the blue light spectrum (LED and the omnipresence of screens – computers, laptops, tablets, mobile phones) and the use of these light sources before turning in, the production of the 'sleep hormone' melatonin is inhibited and sleep onset is delayed. The very fact that 80% of the population need an alarm clock to wake up on time and be able to meet the temporal demands of society is a major indicator of insufficient sleep. Another factor that contributes to the sleep crisis are clock changes and suboptimal time zone definitions (Korf 2017).

The consequences of insufficient sleep have been studied for various fields. If it is true that the clock change leads to systematic sleep deprivation, the DST debate needs to take the relevant findings much more seriously. One such study on the consequences of insufficient sleep in a socially relevant field comes to the conclusion that clock change-induced 'sleep deprivation in judges increases the severity of their sentences' (Cho et al. 2016: 1) – which, in addition, raises issues of justice.

A cross-country comparative RAND Corporation study (Hafner et al. 2016; Hafner 2017) shows that insufficient sleep has a significant impact on the economic performance of a country, in particular in terms of productivity losses due to poor concentration and performance, accidents, and rising health care costs due to injuries to health.

DST advocates tend to relativise the potential effects of the clock change by invoking the widespread use, in developed countries, of shift and night work (e.g., Deutscher Bundestag 2016: 110). They quite rightly point out that many millions of people worldwide have to engage in this type of gainful work and are, thus, necessarily and often for years on end, exposed to a permanent and periodically alternating desynchronisation of biological and social rhythms. For decades, research on these forms of work has provided evidence of the numerous risks that go with them. These risks do not only relate to health effects for those involved but also to an increase in health care costs and in costs arising from higher error and accident rates (most of the major catastrophes of recent decades started in the small hours of the night – the hours between 1:00 and 4:00 a.m. – or were set off by sleep-deprived operating crews (see, e.g., Moore-Ede 1993; Zulley/Knab 2001).

Because of these serious consequences, however, shift work and, even more so, night work are subject to the legal obligation to state reasons. Notwithstanding many exceptions and frequent initiatives to soften regulations, night work – or work at ‘unsocial hours’ as it is often so aptly called – is explicitly limited to lines of work that are necessary for the maintenance of security and order (health care, police, fire brigades) and the proper functioning of the society (primarily technical infrastructures) as well as for industrial processes where interruptions are ruled out for technical reasons (e.g., blast furnaces and other process industries). As a rule, special safety precautions and compensation regulations are in place which, while they cannot prevent or redress damage, are at least meant to provide some compensation for it.

Although there is a general pressure to extend economic activities into the night, and although ‘24/7’ has become the cipher for a society that is active round the clock, even developed societies are still structured by the rhythms which come with the fact that humans are, after all, ‘diurnal primates’: only a minority of the population is active at night, the night work rate in the EU is at about 10% of the labour force (cf. Henckel 2019).

The report of the Office of Technology Assessment argues that compared to the effects of night work, ‘the effects of a singular clock change by one hour in spring and autumn on residents’ well-being (sic!) are likely to be negligible, at least at the current state of knowledge and according to the studies available so far’ (Deutscher Bundestag 2016: 100). But as far as relativising goes, night work as a point of reference is only marginally conclusive, if at all:

- Night work concerns only a minority of the labour force.
- Night work is socially necessary work that is subject to more or less strict regulations and obligations to state reasons.
- Night work is at least in part voluntary.
- The adverse effects of night work are at least in part compensated for.

None of these qualifications applies to the effects of the clock change or the ‘wrong’ time zone assignment:

- The clock change affects an entire population. Exceptions, distribution rules among potential subgroups, and compensations are not feasible or not provided for.
- A temporary or permanent change to DST is equivalent to a move to another time zone and creates a desynchronisation of solar and social rhythms as well as an increase in social jetlag for the entire DST period. From this perspective, focusing on the effects observed immediately

after the clock change falls short of the mark, and the comparison to flights across time zones is also misleading. While long-distance flights indeed require a short-term adjustment which, however, is achieved ‘automatically’ by the different light/dark rhythm that comes with the solar light situation at the new location, a time zone change that is occasioned by a clock change constantly and permanently increases the discrepancy between the internal body clock and the prevailing social rhythms by one more hour. The extent of this impact largely depends on the degree of rigidity of the desynchronisation. The lesser the rigidity and the greater the temporal autonomy in terms of certain in-built rhythms (of the individual as well as the society), the lesser the extent of the effects. Flex time and other forms of flexible working schedules are likely to contribute considerably to a cushioning of these effects. The cases of Spain and western China show that the seemingly late hours of social life – as compared to similar societies – are merely an adjustment to the solar time zone (cf. Braml/Felbermayr 2019: 261).

- Therefore, the obligation to state reasons which is stringent already for night work – even if, arguably, still much too weak – needs to be particularly stringent.

4.4 Social and cultural dimensions

Using the data of the German Socio-Economic Panel and a British database, Kuehnle and Wunder (2015) explore the *short-term* effects of the spring and autumn clock change on life satisfaction. The authors come to the conclusion that while people experience utility losses in the first week after the spring transition, there seem to be no utility gains when clocks are set back in autumn. Furthermore, they confirm findings from other studies that families with young children have the tightest time constraints (22) and experience considerable short-term effects from the clock change. Nevertheless, the authors refrain from conclusions as to whether DST should be maintained or abolished. Their conclusions are limited to stating the need to give individuals greater latitude in how to dispose of their own time (23).

Generally, it can be said that the impact of the desynchronisation of solar and social rhythms is essentially determined by two factors:

- the extent of the discrepancy between social and solar times, and
- the rigidity of social rhythms, or time constraints.

As social rhythms become more flexible and/or people find it easier to suit their actions to their individual temporal needs, the impact of this discrepancy will get weaker (in both the short and the long term) because each individual will be able to ‘live [in accord with] his or her own time zone’ (Braml/Felbermayr 2019: 261; in a similar vein, see Deutscher Bundestag 2016; 84). Giuntella/Mazzonna (2019: 220) show that later school start or work start times may have positive effects on sleep duration (which, however, will arguably be neutralized if DST is implemented on a permanent basis).

‘A defining feature of time regimes seems to be that once people get used to them, which doesn’t take long, they experience them as self-evident, if not natural’ (Mutz 2016: 6). The social time structure that defines the framework for individual action is both a part and a result of the social structure of our society, which in turn both reflects and structures these daily routines. When people’s everyday life changes, the social structure of their society also changes, and with it its temporal structure. When the temporal structure of the society changes, people’s everyday life changes in turn. The routines of everyday life, regulated as they are by temporal standards and laws, serve to facilitate the synchronisation between individuals and social groups or, in other words: in principle, everybody more or less unthinkingly knows how a day is

structured and what are the times for sleeping, eating, gainful work, domestic and caring work, quality time to spend with family, partners, friends, time for recreation and leisure, etc. Since it can be assumed that most of society's temporal standardisations are relatively stable and will remain so, optimising the relationship between social and solar time will be an issue in the future as well.

Various authors (e.g., Braml/Felbermayr 2019; Roenneberg 2019a) assume that large discrepancies will in the medium term erode the temporal standardisations which used to be considered inalterable: 'It can be assumed that sun-oriented lifestyle habits have a much stronger effect on daily routines than any form of artificial timekeeping. If Germany opted for moving to the eastern European time zone (that is, permanent DST), it wouldn't be long before supposedly cast-iron schedules – school start times, take-offs and landings at airports, the scheduling of news magazines, etc. – might have to be rediscussed in order to account for people's actual lifestyle habits' (Braml/Felbermayer 2019: 261). Cases such as western China and Tibet rather support this assumption. However, softening the still relatively rigid social rhythms is likely to be a long-term process. This suggests opportunities, if not imperatives, for time policies to come up with interventions and creative suggestions: time policies comprise political and social measures that affect the temporal conditions of people's everyday life. They aim to promote temporal well-being, temporal welfare, and temporal autonomy, for instance by proposing ways to synchronise the times for work, public and private services, caring, and leisure with people's needs (individuals, families, communities). While time policy as a concept is rather recent, time policies as a form of political action are anything but new. Time policies have always existed and will always exist because they are a basic element of organised life in a society. Time policies can be *implicit* and *explicit*: most time policy measures are *implicit* time policies that affect and shape people's everyday routines and course of life by temporally structuring or controlling them in certain ways but do not focus on the temporal framework itself or on concepts such as temporal welfare. Therefore, implicit time policies are usually not even perceived as such. Historical cases of time policies are the rules that govern monastic life, the history of urbanisation, business opening hours, compulsory education and school schedules, TV program structures, etc.

Explicit time policy, in contrast, is specifically oriented to the creation and modification of the social time structure and aims to improve the time patterns of people's everyday routines and course of life. Explicit policy is time policy in the sense proper. Unlike time management where temporal organisation is considered the responsibility of each individual him- or herself, explicit time policy focuses on the social organisation of time and deals with time conflicts at a collective level, thus making sure that an individual's right to time can be socially granted and protected. Explicit time policy starts out from the various situations in people's everyday life.

Last but not least, there is the question of the role of specific cultural features and/or political signals. For Franco, changing Spain's time zone assignment was a political statement: he wanted to be in the same time zone as Hitler. Under current conditions – and even though many people are probably unaware of the historical context – this signal is more than questionable, and a more adequate synchronisation of solar and social rhythms would seem to suggest itself (initiatives to this effect have indeed been repeatedly launched for quite some time in Spain). The cases of China – and, temporarily, North Korea – show that a politically motivated fussing with the clock is a recurrent practice. Time zone definitions serve to underscore a country's unity (China with Beijing time as the single standard time) or autonomy (North Korea and Pyongyang time). The extent to which these criteria weigh in on the relevant decisions is hard to assess in a more general way. Even though it can be assumed that autocratic regimes are more

likely to revert to this kind of political symbolism, it would certainly be wrong to underestimate the political-symbolic weight of time zone definitions that may be brought to bear on changes yet to come.

Surveys such as the European consultation process, opinions on DST implementation, statements from leisure-oriented industries and, quite recently, a survey among students on their preferred school schedules (FZDW 2019) have repeatedly shown that attitudes towards DST may also be definitely positive. These positive assessments primarily relate to the fact that with DST – ‘summer time’ – there are more hours of daylight after work or school (because by solar time, one got out of bed one hour earlier). This, however, means that unless social rhythms are adjusted accordingly, individual rhythms will extend later in the day and people will on average get less sleep. Giuntella/Mazzonna (2019) suggest that personal benefits/the enjoyment of late-in-the-day lifestyles may outweigh the expected adverse personal effects and, thus, prevent people from adjusting to a lifestyle that is more in accord with solar rhythms. But drawn-out partying (as well as alcohol and substance use) is a risk usually taken voluntarily, so there is a crucial difference from a clock change that is enforced upon society as a whole (cf. Roenneberg 2019a: 209). It would, therefore, have to be demonstrated that evening social life brings so much more life-satisfaction that the risks imposed on society as a whole would be justified. What remains unclear at this point is, primarily, the distribution effects – the individuals and groups that stand to lose by or gain from a specific regulation.

In certain regions, the clock change, that is, the misalignment between solar times and clock times, may also lead to conflicts in religious practice, primarily for orthodox Jews and practicing Muslims. Thus, in Israel, DST is since 2005 scheduled to end before Jom Kippur, and in 2011, the Palestinian Authority ruled that DST be abandoned during Ramadan between 1 August and 29 August. ‘The rules, in force since 1852, that govern the use of the Church of the Holy Sepulchre in Jerusalem and the Church of the Nativity in Bethlehem by the various denominations do not provide for DST. Therefore, opening and prayer times are set according to standard time also in summer while outside the church, DST is observed’ (Wikipedia 2020, and the sources cited in the article, as well as Downing 2005: 156).

5 The obligation to state reasons, and some reflections on procedure

If citizens’ right to their own time (Mückenberger 2004, 2016; Council of Europe 2010) – which is still far from being codified – is taken seriously and considered part and parcel of citizens’ general right of self-determination, if ‘time’ is accepted as the second dimension (besides ensuring material livelihood) of the welfare state (Goodin et al. 2008), then questions of temporal justice arise (Henckel/Kramer 2019). From this point of view, temporal regulations and their modifications must be considered a serious intervention into citizens’ right of temporal self-determination and, thus, subject to the obligation to state reasons. Many protection laws that regulate temporal hardships such as shift work, night work, work at ‘unsocial hours’ are implicitly governed by this logic. Because of the – abundantly documented – damage that comes with these types of gainful work, they are as a rule (with many exceptions!) only permissible in lines of work where continuous operation is inevitable (healthcare, police, fire and rescue services, many sections of the technical infrastructure). Depending on the country concerned, regulations may be more or less lax, and the leeway for using this type of work for purely economic

reasons more or less wide. Typically, working hours in shift and night work require higher rates of compensation (either materially or by time off in lieu). This means that long-term damage (in terms of health hazards for the individuals involved and thus, indirectly, higher costs for the healthcare system) is accepted in view of maintaining the functionality of the society.

So, given the contradictory positions on the clock change, the further debate will have to address the following questions:

- Are there benefits for society that would justify (maintaining) the clock change – considering that the economic arguments initially put forward, i.e., the hoped-for conservation of resources, have turned out to be invalid?
- Are there substantial reasons for abolishing the clock change?
- If there are reasons for abolishing the clock change, which option should be chosen?
- Which procedures should be chosen for implementing potential change?

An acceptable arrangement should meet the following criteria:

- High degree of temporal autonomy, that is, individuals' right to decide about their own time. As long as 80% of the population need an alarm clock to wake up, there is no temporal autonomy to speak of.
- Temporal autonomy at the same time means the lowest possible degree of heteronomous temporal rules even though, indisputably, there can be no social embeddedness and social coordination without certain forms of heteronomy.
- Since humans are biological beings and diurnal primates, optimal synchronisation of social and solar rhythms seems indicated.
- In an economically and socially closely interconnected world, solar time zone definitions should be the result of a highly coordinated transnational decision-making process.
- As a matter of principle, great care should be taken that the potential positive and negative effects are carefully balanced against each other – in full awareness of the evaluation problems arising from certain details – and that no change is implemented unless there is a positive net effect.
- Due to the complexity of the issue, there is no solution, and can be no solution, that meets all demands and satisfies all desires, so what this is necessarily about is a workable compromise based on a minimisation of disadvantages.
- The objective is to rely on the available knowledge in order to come to a solution which is consensus-oriented and has majority support.

The following chapter will now offer an overall evaluation, in the light of these criteria, of the findings presented in the above, as well as an outline of the possible options.

Given the dynamics created by the European consultation process – which was based on very insufficient data – and the relatively rapid and far-reaching conclusions drawn by the European Parliament, the then President of the Commission, Jean-Claude Juncker, and other leading politicians, it is to be feared that the political process thus created is heading for the worst possible outcome. Several authors have compared the outlook to the Brexit dynamics (Rinderspacher 2018, Roenneberg 2019). Roenneberg even coined the term 'Cloxit' by analogy.¹⁸

¹⁸ The symbolical relevance of the clock change has been highlighted by a number of authors. Geißler (2018) writes: 'The authority to define and decree what is time – e.g., an hour, a minute, a second – lies with the legislators. This claim to power is biannually, in spring and in autumn, renewed and tested for its acceptance in the population'. In a similar vein, Kuchenbuch states: 'Thus, DST comes across as a residuum of an older, downright disciplining time regime' (2018: 3). Mutz highlights the ritual aspect: 'Changing the clock by one hour in spring and in autumn is one of the most widespread rituals in western industrialized societies' (2015: 139).

6 Evaluation

6.1 Overall context

Facing up to the question of the future of the clock change and evaluating the relevant findings in order to arrive at a proposal for an optimal option is indeed a pressing issue. This is the obvious conclusion to be drawn from the review of findings on the various dimensions of the effects arising from the biannual spring and autumn clock change implemented in the EU (and many other countries) as well as from the longstanding initiatives for abolishing the clock change and, last but not least, from the EU consultation process among EU citizens and the subsequent initiative of the EU Parliament.

Even though the European consultation process is not representative and the survey is deficient in more than one respect – and first of all in its wording of the questions –, it has had far-reaching consequences, with the then President of the EU Commission Jean-Claude Juncker extrapolating a will of the people from it and promising the rapid realisation of the majority opinion, i.e., repeal the clock change. But since the legal requirements are much too complicated to allow for a rapid revision, there will be no decision any time soon. The Commission's Report on the consultation process is already much more tentative in this respect (EU Commission 2018: 11), considering the consultation neither representative nor a citizens' vote: 'Its outcome has to be considered in the context of the wider policy debate about the future of EU summertime arrangements'. So, there is no getting around the necessity to comprehensively evaluate the various dimensions of the effects as well as the options of change and, then, work out a political decision. In legal terms, any change means that Directive 2000/84/EC which lays down the current change from standard time to DST needs to be amended.

It's a complicated situation because

- different goals are pursued by different stakeholders (politics, science, business, citizens) with different vested interests;
- different jurisdictions (EU vs. nation states) come into conflict;
- a common, or concerted, rearrangement implies an extensive coordination and concertation process;
- in many fields, findings are not sufficiently clear to allow for a conclusive statement, thus leaving scope for interpretation and evaluation.

The report of the Office of Technology Assessment (Deutscher Bundestag 2016) is the most comprehensive document currently available, yet for various reasons it has a number of shortcomings and weaknesses which limit its use as a basis for action in dealing with the clock change:

- The relationship between solar and social rhythms, that is, the question of whether there is synchronisation or desynchronisation between these two, is not systematically considered although it is crucial for any impact assessment.
- The relationship between the clock change and the definition of time zones, which is crucial for the degree of desynchronisation between social and solar rhythms, is inadequately considered although in the context of a systematic discussion of the DST problem, this would seem to suggest itself.
- Chronobiological knowledge has significantly increased in recent years – as explained above – and meanwhile allows for more conclusive statements.

It has become obvious that there can be no meaningful discussion of the biannual clock change and European cohesion unless the time zone issue is taken into account. Suboptimal time zone

assignments and/or DST mean that large territories are ahead of standard time (as defined by the sun being in the zenith at 12:00).

All in all, the findings on economic aspects in the narrower sense, more specifically with regard to resource saving which served as a name giver for Daylight Saving Time, do not offer any substantial evidence that might make the biannual clock change seem any more meaningful.

Regarding the social aspects – safety, accidents, etc., – the findings are too contradictory to allow for any definite conclusion.

Chronobiological and medical findings are most explicit in their description of the risks created by the clock change, on the one hand, and suboptimal time zone assignments, on the other. Chronobiologists highlight the conflicting effects of the solar (light/dark) and the social cycle on the rhythms and the health of the individual, arguing that while individuals are strongly affected by the solar cycle, the social structures provide a framework for collective behaviour which does not account for individuals' natural rhythms. The serious consequences of large discrepancies between social and solar rhythms have been demonstrated for various countries. The study by Giuntella/Mazzonna (2019) shows the effects for residents living on the eastern and the western side, respectively, of a time zone border in the USA. But in Germany, too, the compromise in place, i.e., 'Central European Time', or 'Middle European Time', means that there is a discrepancy of up to one hour in solar time between different parts of the country. This raises a number of open questions:

- What are the effects of these discrepancies on people's attitudes towards the clock change in Germany and Europe?
- What are the morbidity rates that come with living in the wrong time zone, for instance in Spain or in France?
- What is the role of social adjustments, that is, the adjustment of schedules and social life to later hours in response to clock times that are too 'late' in relation to the solar cycle? Could it be that in Spain, for example, living in the 'wrong' time zone since the times of Franco has led to very far-reaching adjustments? Have the social rhythms been adjusted in a way – think of 'nominal time' – that the Spanish are again living in synchrony with solar time?
- What is the role of siestas, midday naps, etc., which used to be common practice in Germany, as well, and are in parts making a comeback?
- What data from historical and medical-historical sleep research (cf., e.g., Ahlheim 2018) can substantially contribute to the issue?
- What will be the future role of social standards and their binding effects? Will they significantly weaken, as some authors (e.g., Geißler 2019) suggest, with flexibilization allowing for such a high degree of temporal autonomy that everybody is free to follow their own rhythm and live in their 'individual time zone', as it were?

Parts of the population, certain sections of the economy (primarily leisure-relevant industries), and clearly also school students welcome the possibility of having more daylight leisure time after work and school. Thus, a key question of the evaluation is how much weight should be given to this position as compared to the finding that DST compels the entire population to rise one hour earlier, with a substantial percentage of them experiencing sleep deprivation and increased health risks. Whether the clock change is abolished or maintained, both options will have their winners and their losers. What is obvious is that the effects of the clock change and the time zone assignment (which is partially the same thing) are all but trivial: they will affect all EU residents if there is an EU-wide coordinated arrangement, and the entire population and economy of each nation state and, furthermore, the coordination across national borders if the decision is referred back to national governments.

Since the clock change – and the time zone assignment – has a major impact on many dimensions of social life, any modification of regulations (regardless of the alternative chosen), i.e., any departure from the status quo (no matter how questionable the rationale that led up to it) needs to rely on stringent and well-founded arguments and decision-making processes. Since the clock change issue is a matter of conflicting rather than clearly outlined objectives and expectations, a careful balancing of the reasons and the effects as well as a well-designed process would seem to be imperative. As it is, nothing of the sort is currently underway, or only to a very limited extent.

6.2 Options for the future

Against the background of what has been discussed in this paper, the following options for the future are in principle conceivable:

- maintaining the current arrangement,
- implementing universal time,
- abolishing the clock change.

Note that with all of these options the different levels involved (EU, nation states) must be taken into consideration.

Maintaining the current arrangement

Maintaining the current arrangement would mean that we will continue to biannually change the clocks – ‘spring forward’ by one hour in spring (which is equivalent to a move one time zone to the east), ‘fall back’ by one hour in autumn.

In this case, the legislative initiative of the European Parliament would have to be repealed. Even in the light of growing dissatisfaction with the clock change, and considering the dynamics of the debate, this seems unlikely.

Implementing universal time (UTC)

The most far-reaching reform would be the implementation of ‘earth time’, or Coordinated Universal Time (UTC), which already is a long-standing practice in international aviation and maritime traffic, among other fields. This arrangement would certainly simplify many things. The same clock time would apply all around the globe, facilitating coordination across time zones and helping to avoid misunderstandings. On the other hand, considering the role of clock time in its relation to the course of the day, this radical formal solution would require extensive local adjustments and massive cultural change in most parts of the world. Only in London and all the other locations that happen to be on the Greenwich meridian, 12:00 would be associated with the idea of noon whereas in Beijing or Manila, 12:00 would mark the start of the newscasts which for us is habitually connoted with 20:00 clock time, while three time zones further east, most people would be asleep.¹⁹ Considering these far-reaching consequences and the immense efforts at global coordination that would come with the implementation of UTC, it can reasonably be concluded that global UTC is, at best, ‘pie in the sky’ (Braml/Felbermayr 2019: 259).

Abolishing the clock change

In the light of the decision reached by the European Parliament, abolishing the clock change seems the most likely alternative. Even so, given the results of the survey and the current state of the debate, several options are conceivable:

¹⁹ In an ironic exaggeration, Gleick (2016) concludes: ‘Perhaps you’re asking why the Greenwich meridian gets to define earth time. Why should only England keep the traditional hours? Yes, it’s unfair, but that ship has sailed. The French don’t like it either. “The U.K. would turn into a time theme park,” an English Twitter user, John Powers, suggested “where you could experience 9 o’clock as your grandparents knew it”.’

- implementing permanent DST,
- abolishing DST and returning to standard time,
- abolishing DST and adjusting the time zones.

Implementing permanent DST

The implementation of permanent DST, which is the preference expressed by a majority of those having opted against the clock change in the EU consultation process as well as by leading politicians in Germany (among them Federal Minister of Economy Peter Altmaier and Federal Minister of Health Jens Spahn), would be equivalent to a permanent reassignment to the East European time zone. This would have far-reaching consequences since with DST, morning daylight would come very late in winter and people would be out and about in the dark for a longer period (see Figure 9). Furthermore, DST would intensify the adverse social-jetlag effects: permanent DST would mean living with these effects all year round rather than just during the DST period (see Chapter 4.3, and Roenneberg 2019a).



Figure 9: Light conditions with standard time and permanent DST on 21 December

Notwithstanding the negative findings concerning the energy saving effect, i.e., its having failed to materialise, and the adverse health and, indirectly, economic effects of DST, the respective arguments still seem to lack the persuasiveness needed to rule out efforts at promoting permanent DST. As the outcomes of the EU consultation process as well as other surveys and various legislative initiatives in the USA (e.g., ‘The Sunshine Project Act’, cf. Chuck 2019) have shown, abolishing the clock change and maintaining DST is sometimes even a majority preference. The reasons given primarily relate to the possibility of pursuing leisure activities by daylight in the evening (e.g., jogging by daylight after work or enjoying a mild summer evening in the beer garden). Associations such as these can be assumed to have a major influence on people’s reasoning about DST, governed as it obviously is by the positive connotations of ‘summer’. Basically, the argument is that with permanent DST, more daylight is gained, or can be more fully enjoyed. However, the number of daylight hours does not change, the only change is in the way they are ‘distributed on the clock’ by being moved later into the evening. From the point

of view of chronobiology, this redistribution leads to enhanced adverse effects especially in autumn and winter since morning daylight is the main factor that triggers the daily ‘setting’ of the biological clock.

But there are also other reasons for criticising the argument that ‘longer days’ enable people to enjoy more leisure activities by daylight:

In the summer, the day in terms of daylight duration is longer, but the day as such isn’t. ‘Extending’ leisure activities into the evening hours would come at the cost of other activities. Furthermore, any such ‘extension’ means either later bedtimes or shorter sleep duration (and most likely the latter, considering the rigid social time structure with its more or less fixed bedtimes and the need to use alarm clocks).

Certain sectors of the leisure industry, in particular, press for permanent DST (see Chapter 4.2). But when more time is spent on certain leisure activities in the evening daylight, less time is spent on other activities people used to engage in. In the field of economic activities, one sector’s gain is another sector’s loss.

Furthermore, the length of the day in terms of daylight duration has no direct effect on the *temporal* position (the ‘scheduling’) of people’s ‘active wake time’ on weekdays. Thus, there is no real ‘extension’ of activities into the evening with DST, be it temporary or permanent.²⁰ Drawing on the representative data of the time use survey of the Statistisches Bundesamt, Figure 10 shows the percentage of the population (from the age of 10 up) asleep or ready to fall asleep²¹ on weekdays in June and in December. It also shows sunrise and sunset times on the summer and winter solstices, that is, on the shortest and the longest day of the year, at the approximate geographical centre of Germany.

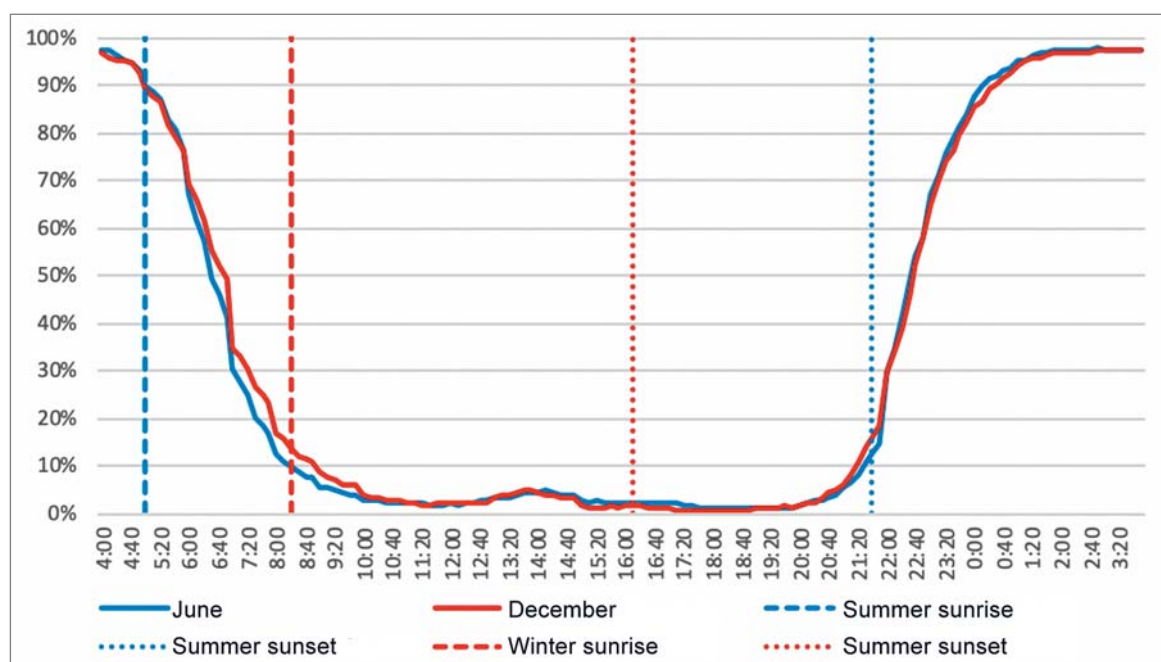


Figure 10: Percentage of the population asleep or ready to fall asleep on weekdays in June and December, and sunrise and sunset times on the summer and winter solstices at the geographical centre of Germany, n=3496

In June, the effect of longer daylight duration is obvious: people rise somewhat earlier,²² and some go to bed somewhat later, between 21:00 and 21:50. Apart from that, daylight duration

²⁰ What changes are the types of activities. See also the discussion below.

²¹ The data of the time use survey of the Statistische Bundesamt do not represent the exact drop-off time but only the point in time when people are in bed and waiting for sleep without doing anything else (such as, e.g., reading).

²² Although only weekdays without holidays are shown, it could be that on the days off school and off work at the end of December, people get out of bed later, on average, and that this may account for part of the later get-up times.

has no effect on people's socially standardised 'active wake time' on weekdays. And it is precisely this weekday rigidity of get-up and, thus, turn-in times regardless of chronotypical sleep patterns²³ that creates social jetlag for the different chronotypes. Permanent DST would, thus, intensify the social jetlag on a permanent basis.

Another likely reason why DST is so popular with so many people are the strong positive connotations of 'summer time', such as, for instance, spending much time outside and enjoying mild summer's evenings. The 'longest' day is 21 June, after which, in our latitudes, daylight duration begins to decrease again, that is, it begins to get dark earlier again. But while daylight conditions in July and August are exactly the same as in April and May, temperatures keep rising till the height of summer in August. The mild summer evenings which doubtless account for much of the positive connotations of 'summer time' are more likely to occur in the warmer months of July and August rather than in June where there is also very late evening daylight but where temperatures are indeed lower. But when we analyse the total of activities for all the months of the year as reported in the representative time use survey of the Statistisches Bundesamt, it turns out that while the *time* dedicated to leisure activities does not increase over the months, the *types* of activities change – depending not on daylight duration but, rather, on temperatures (see Appendix 2). If daylight duration really had an impact on the way evening leisure time is used, then months with the same daylight duration should show similar activity profiles. Between the solstices, that is, the shortest and the longest days – in terms of daylight duration – of the year at the end of June and the end of December, there are the spring and autumn equinoxes at the end of March and the end of September. Daylight durations in July and August are the same as in May and April. Watching TV is always the dominant evening activity. The only times that clearly stand out in this respect are the warm summer months from June through August when less time is spent watching TV and more time is dedicated to social activities such as, for instance, meeting with friends. If daylight durations were the decisive factor for less TV and more outside activities, then the activity patterns of the months with similar daylight durations should also be more similar. This again suggests that optimal daylight use as an argument in favour of permanent DST is not compelling. The temporal position of the hours of evening sun light is not consistent with the argument of optimal daylight use. The almost identical times for going to bed in the evening as shown in Figure 10 (percentage of people asleep or ready to fall asleep on weekdays in June and December, sunrise and sunset times on the summer and winter solstices) are due to the fact that along with our clock-governed social schedules, we have access to artificial light, any place, any time, and especially in the 'dark months'. Artificial light differs significantly from natural twilight in its spectral composition: white light uses a higher proportion of the blue spectrum and, thus, prompts the circadian system (the internal clock) to reduce melatonin production, with the result that regardless of the actual daylight situation, we do not get tired but can live by the clock that governs our social rhythms (Grubisic et al. 2019). Now, let's consider the concrete sunrise and sunset times for Germany's geographical centre as shown in Figure 10: at the end of June, the sun rises at 5:00 at Germany's geographical centre, it reaches its zenith at about 13:20, dusk sets in at about 21:45, and artificial light will be needed from around 22:15. Without DST, all of this would happen one hour earlier: sunrise at 4:00

23 The chronotypes ascertained by the Munich Chronotype Questionnaire (MCTQ) show a wide variance in average sleep onset times. This variance represents the diverse chronobiological needs. The variance, however, is not reflected by the average turning-in times found by the time use survey. And this is the very description of what creates the social jetlag. Some people, for instance, have to 'force' themselves to go to bed because each weekday the alarm clock will go off at a certain time when they are actually still in their sleep phase. So, having turned in, they cannot fall asleep for a long time. This discrepancy between the 'time in bed and ready to fall asleep' of the time use survey and the actual sleep onset time ascertained by the MCTQ is, therefore, not a contradiction but describes a fundamental problem of rigid social time structures.

instead of 5:00, high noon at 12:20, dusk setting in at 20:45, and artificial light needed from 21:15. So, even with standard time in summer there should be ‘enough light’: with dusk setting in at 20:45, one should think that it is perfectly possible to enjoy after-work evening daylight doing sports in the park or relaxing in the beer garden. Whether DST or standard time – in terms of daylight duration, summer days are ‘long’, anyway.

In winter, the sun rises at about 8:30 and reaches its zenith at about 12:20, dusk sets in at 16:10, and it is dark at about 16:50. With permanent DST, all this would happen one hour later, i.e., the sun would not rise before 09:30, reach its zenith at 13:20 and start setting at 17:10 (see also Figure 9 and Appendix 1). Since winter daylight ends too early for most people, anyway, the ‘park and beer garden’ argument (as a token for ‘optimal daylight use’) doesn’t make much sense in winter, whereas no sunrise before 09:30 would indeed create a whole range of problems. Thus, the argument of optimal daylight use with DST applies to the evenings, at most – and only to summer evenings at that. As a matter of fact, it is precisely with standard time that daylight use is optimal – all year round and regardless of the length of the individual (daylight) day.

The Russian experience suggests that social pressure can fairly rapidly lead to either an abolition of permanent DST or a weakening of schedules which used to be considered unalterable (work start times, school start times, shift changes, etc.), that is, to their being pushed to later hours. Lifestyle habits would durably adjust, as the example of Spain shows. However, for this to happen, an appreciable weakening of rigid social rhythms would have to be achieved in a relatively short time. Given the years of debate, as reiterative as it is unsettled, about school start times this does not strike one as particularly realistic.

Returning to standard time

Returning to standard time as primarily advocated by chronobiologists would be equivalent to an optimised synchronisation of solar and social rhythms, in particular under conditions of the temporal frameworks (temporal institutions) currently in place, which in spite of efforts at flexibilization are still relatively rigid.

Returning to standard time and readjusting time zones

A more comprehensive variant, brought into play by Till Roenneberg (e.g., 2019a), is a return to standard time coupled with a readjustment of European time zones – an option which, in the Netherlands, is even recommended by a state institute (National Institute for Public Health and the Environment, 2019). With this option, time zones in Europe would be redefined and optimised in accord with solar rhythms. This solution (see Figure 11) has the additional merit that it largely coincides with European nation state boundaries.

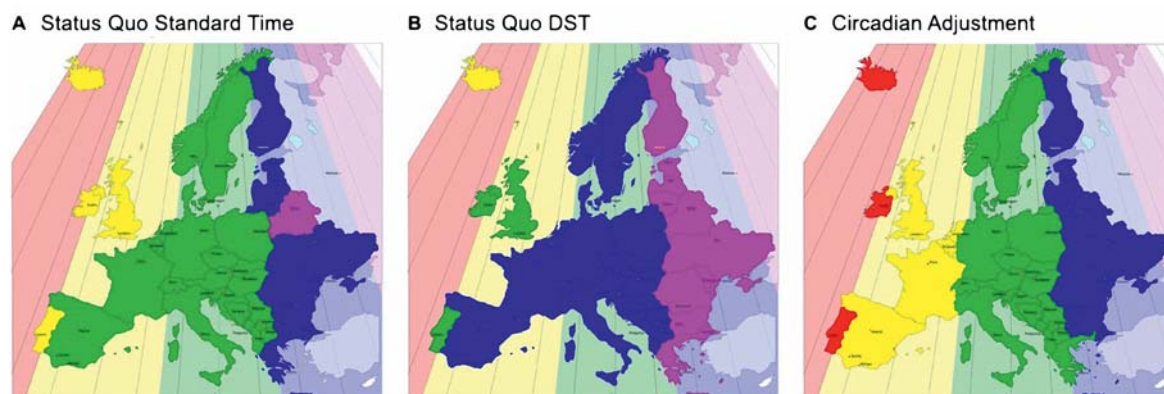


Figure 11: Time zones in Europe: A Standard time ('winter time'), B DST ('summer time'), C Proposed adjustment

European time zones (pale background colours) are based on the respective position of the sun. In many countries, however, there is a discrepancy between solar and social times (strong colours) already with standard time (left). With DST (middle), this discrepancy is even larger. The map on the right shows the solution proposed by the chronobiologist Till Roenneberg: the chronobiologically adequate division into time zones would fairly closely coincide with national borders. But even this variant would still hold considerable potential for conflict: according to Roenneberg's proposal, The Republic of Ireland and Northern Ireland would be assigned to different time zones. But introducing a time zone border between these two territories would in all likelihood lead to substantial (political-symbolic) conflicts. (The potential reintroduction of the Irish border was an almost unsurmountable point of conflict in the Brexit negotiations.) Furthermore, implementing the Roenneberg option would require a very extensive coordination and synchronisation process not only across EU member states but, for some elements, even with the other European countries. However, considering the current conflicts within the EU and the various needs for status affirmation which are likely to play a major role also in this context, there seems little hope for this solution to come to pass, even though it seems safe to say that it is one of the 'minor' areas of conflict as compared to other unresolved EU issues.

Another area of conflict in this far-reaching proposal would arguably be the change in time zone assignment provided for Spain and France, among others, both of which would be assigned to the Western European time zone. Both countries have lived in the 'wrong' time zone for more than 70 years but have adjusted their social life accordingly. It is unclear what social adjustments and changes in temporal institutions (work start times, school start times, etc.) would be required.

6.3 Fragmentation, the right to time, and flexibility

Considering the number of variants which – with the exception of the last one – will as a consequence of the EU Parliament's initiative again become a matter of sovereign decision-making by national governments, the result could well be an uncoordinated pattern of regulations. While this is anything but desirable, it would in all likelihood not be harder to cope with than the current European experience of living with three time zones, nor would it lead, as far as we can tell from the present findings, to large-scale 'fragmentation effects.' Moreover, the USA as well as Canada, Brazil, Australia, Russia, and Indonesia, among other countries, have different time zones within their territory, if not, as in the USA, within individual US states,²⁴ and have obviously learned to get along with them. All options imply more temporal flexibility and less temporal rigidity, which will increase the temporal autonomy of the individual, that is, result in a more adequate synchronisation of natural solar, individual biological, and shared social times. Enhancing individual flexibilities is an objective which is desirable as such and should be pursued independently of the clock change issue, with further supportive arguments to this effect provided by the debates about

- the right to time, that is, the legal integration of a right to temporal self-determination (Mückenberger 2004, 2016);

²⁴ However, Downing (2005) very clearly shows that standardisation has played and continues to play an important role in the process of economic integration and that the USA, in particular, but not only the USA, have repeatedly contributed to temporal fragmentation by a lot of uncoordinated 'fussing with the clock' (alternately implementing and abolishing DST or changing time zone assignments even for smaller territorial units). A rational and harmonized revision could turn out to require a huge effort: 'The diverging interests of the member states, the initiative of the Commission and the Parliament, and the long-drawn-out negotiation process make the DST issue a lesson in European diplomacy. It has taken more than two decades for the idea to be implemented, with no way of knowing how it would end. This shows how hard it was to implement a technically induced integration even in a seemingly soft policy field' (Mutz 2016: 8).

- temporal welfare as a supplementary and independent dimension of material prosperity (Rinderspacher 2002, DGfZP 2004, 2011, Goodin et al. 2008, Mückenberger 2011, Gernig 2011);
- the right to sleep (Roenneberg 2019a), along with a farewell to the alarm clock;
- a farewell to the clock (Geißler 2019), along with the idea that the regulatory function of the clock, and especially the notion of punctuality, will massively lose in importance.

Any farewell to clocks and punctuality is likely to be premature, to say the least. Even though Geißler's description of the partly diminishing relevance of punctuality is quite adequate, there can be no doubt that especially in highly interconnected societies with a massive dependence on technology, the need for pinpointed coordination will remain, if not gain in importance.

7 Conclusions, and a call to action

The clock change debate is a model case of time policy issues. On the face of it, it's just an administrative act of fussing with the clock – albeit with far-reaching and inadequately considered effects. The temporal organisation of society always rests on conventions and arrangements. But variants may be better or worse. From a perspective of time policy, these are the stakes involved:

- organising the political process of and legal framework for an 'order of time';
- optimising the synchronisation between solar, social, and individual rhythms because the higher the degree of desynchronisation the greater the adverse effects;
- ensuring and enhancing temporal welfare and temporal well-being as an explicit time-policy objective;
- defining adequate time zones in due consideration of their intricate link with the clock change issue;
- asserting time policy-based pragmatism against the primacy of power and symbolism;
- evaluating and weighting the various findings;
- acknowledging that there can be no solution that is satisfactory to all parties; and, as a consequence,
- finding a workable compromise.

Kant has been credited with stating that our need to make decisions exceeds our capacity to know. This is particularly true for the issues of clock change and time zone assignments: it is decision-making under imperfect information. However, the bulk of evidence on the adverse effects of the clock change that has by now emerged seems sufficient to invalidate the initial rationale for its implementation and justify a new decision. Due to conflicting interests, any such decision will remain a compromise, subject to being rechallenged in the light of potential future findings.

Since it is by now more or less evident that any revision of the existing arrangement will be much more complex and also procedurally much more time-consuming than it at first seemed likely, contrasting the possible options in view of reaching a substantially reasonable compromise seems indicated – always bearing in mind that finding the perfect solution for all individuals, stakeholders, locations, etc. is simply impossible. Furthermore, this is a politically and symbolically highly sensitive process, so it is far from evident that even a solution that seems rational enough will be effectively implemented.

Relying on the argumentation developed in this paper, the Deutsche Gesellschaft für Zeitpolitik (DGfZP; German Society for Time Policy) calls for the following arrangement to be sought:

- The current arrangement, i.e., switching from standard time to DST and back again, is fraught with disadvantages. Therefore, it should be abandoned in favour of a permanent return to standard time.
- Due to certain historical constellations, time zones in Europa also contribute to the less-than-optimal synchronisation between social and solar times. A pragmatic optimisation would consist in a redefinition of the current time zones in accordance with UTC time zones which are basically aligned with the solar cycle. For Europe, this would have the additional advantage that UTC time zone borders roughly coincide with national borders.

However, for any such reordering of 'time regimes' and time zones to be achieved in a democratic setting, comprehensive procedural requirements need to be met. Whatever the political level – local, national, international –, time policy is a very demanding policy field.

8 New time zone definitions in the EU as a result of democratic time policy

8.1 Time policy and time zone regimes in Europe

The abolition of the EU-wide clock switch from standard time to DST and back (Directive 2000/84/EC) in favour of a coordinated arrangement with decisions on time regimes referred back to national governments offers the opportunity, as we have shown, to couple the standard time regulation with the issue of time zone definitions. But such a reordering is a process of gigantic dimensions – profoundly affecting as it does people's everyday life and economic and political coordinates in every member state. In the current EU situation, it cannot go ahead at the supranational level ('top-down', as with the 1984 Directive and, basically, also its 2019 repeal). Rather, it is something to be tackled at the intergovernmental, or transnational, level (by 'coordination' between member states) and in compliance with the principles of both democracy and subsidiarity. This, however, opens up some very interesting perspectives – perspectives of real European time policy.

8.2 Precepts of democracy in the EU and the member states

For the EU, seeking such a procedure is first of all a requirement arising from the precept of democracy. In the past decades, the precept of democracy has seen a sharp rise in normative (if not necessarily practical) relevance as a fundamental EU value. In the Treaty of Lisbon, in particular, democracy became a normative core feature of European identity. Article 2 of the Treaty on European Union (TEU) includes democracy in its list of supreme values: 'respect for human dignity, freedom, democracy, equality, the rule of law and respect for human rights, including the rights of persons belonging to minorities'. The Treaty of Lisbon (art. 10 and art. 11 TEU) broke away from the idea that democracy was, basically, only a value adhered to by the member states. Rather, the EU is itself subjected to the precept of democracy, with art. 10, par. 1 stating: 'The functioning of the Union shall be founded on representative democracy'. Art. 10 and 11 TEU broadened the reach of the value of democracy beyond electoral and institutional processes, opening it up to direct citizen participation. Thus, art. 10, par. 3 confirms: 'Every citizen shall have the right to participate in the democratic life of the Union. Decisions shall be taken as openly and as closely as possible to the citizen'. Art. 11 opens up the European political

process to the participation of the European civic society – including the establishment of the European Citizens’ Initiative, which is as a consequence set out in art. 11, par. 4 TEU.

Basically, as a value, the democratic principle means that standards are set by self-determined action in the body politic. The TEU ties the principle of democracy to the principle of subsidiarity. The latter implies that the state is supposed to actively enable the directly involved actors to engage in self-determined standard-setting actions. These are the very principles that should be applied to the processes that must follow from the EU decision to abolish EU-wide DST.

With EU Commission President Ursula von der Leyen’s commitment to a high level of citizen participation in the European renewal, the ‘basic democratic’, as it were, principle – already implied by the European Right of Petition and the European Citizens’ Initiative – has gained new momentum: ‘I want Europeans to build the future of our Union. They should play a leading and active part in setting our priorities and our level of ambition. I want citizens to have their say at a Conference on the Future of Europe, to start in 2020 and run for two years’ (von der Leyen, quoted from European Commission 2020: 1). If we take the new EU Commission at its word, the clock change problem could be a first material case to raise the issue of citizen participation.

8.3 Ways to create a European time policy: the example of standard time and time zones

The task is little short of trying to square the circle: on the one hand, coping with the joint problems of clock change and time zone redefinition requires a European initiative if we don’t want to end up with a fragmented puzzle of time pieces; on the other, this initiative must not create the impression that the EU is remote-controlling our everyday life by way of bureaucracy.

Democratic European time policy can be conceived of as a variform and time-phased procedure: An initial phase could consist in an awareness, exploration, and discussion process. This process could be composed of many transnational planning cells where citizens of different member states exchange experiences and findings that are of relevance to the clock change issue, discuss them with experts from the fields of politics, business, and science, and develop proposals for an arrangement that meets the requirements of daily life.

This general raising of awareness for the relevance of the current arrangement, i.e., the biannual clock change and the role and possible redefinition of time zones, could be paralleled by an EU-wide consultation process on concrete proposals, albeit without the flaws of the previous consultation process.

This in turn could pave the way for a European Future Conference with transnational representative citizen participation. Citizens would be called on to examine the results of the Conference, discuss them with representatives from the fields of politics, business, and science, and concretise them into a workable plan.

The decision to implement a new arrangement rests, of course, with the democratically legitimised EU bodies. But their legitimacy does in no way preclude the EU Commission, Council, and Parliament from committing themselves, prior to the broad-based participative discussion process, to respecting and implementing any consensual results likely to arise from citizen participation. This commitment would be the solution, as it were, to the squaring of the circle.

Literature

- Ahlheim, Hannah (2018): Der Traum vom Schlaf im 20. Jahrhundert: Wissen, Optimierungsphantasien und Widerständigkeit. Göttingen (Wallstein).
- Barbara, Adam; Geißler, Karlheinz; Held, Martin (1998): Die Nonstop-Gesellschaft und ihr Preis. Vom Zeitmissbrauch zur Zeitkultur. Stuttgart (Hirzel).
- Braml, Martin T., Felbermayr, Gabriel J. (2019): Ökonomie der Zeit: Does Time Matter? In: Wirtschaftsdienst 2019, H. 4, S. 257-261.
- Cho, Kyoungmin; Barnes, Christopher M.; Guanara, Cristiano L. (2016): Sleepy Punishers Are Harsh Punishers: Daylight Saving Time and Legal Sentences. In: Psychological Science, <https://doi.org/10.1177/0956797616678437>.
- Chuck, Elizabeth (2019): Ditch the switch? Call to go on permanent daylight saving time grows. Aug. 17, 2019, 10:41 AM GMT+2 / Updated Aug. 17, 2019, 8:12 PM GMT+2. https://www.nbcnews.com/news/us-news/ditch-switch-call-go-permanent-daylight-saving-time-grows-n1043051?cid=sm_npd_nn_tw_ma, Zugriff 20. 08. 2019.
- Council of Europe – The Congress of Local and Regional Authorities, 19th Session 26–28 October 2010: Recommendation 295 (2010): ‘Social time, leisure time: which local time planning policy?’
- Crary, Jonathan (2013): 24/7. Late Capitalism and the Ends of Sleep. London (Verso).
- Deuber, Lea (2018): Uhrenumstellung. Warum China keine Sommerzeit hat. In: Wirtschaftswoche 23 März 2018, <https://www.wiwo.de/politik/ausland/uhrenumstellung-warum-china-keine-sommerzeit-hat/21107496.html>, Zugriff 31. 05. 2019.
- Deutscher Bundestag (2016): Bericht des Ausschusses für Bildung, Forschung und Technikfolgenabschätzung (18. Ausschuss) gemäß § 56a der Geschäftsordnung Technikfolgenabschätzung (TA): Bilanz der Sommerzeit, Drucksache 18/8000, 18. Wahlperiode (Büro für Technikfolgen-Abschätzung beim Deutschen Bundestag (TAB), TAB-Bericht Nr. 165), 31. 03. 2016.
- DGfZP (2004): Zeitpolitisches Glossar (herausgegeben von Martina Heitkötter und Manuel Schneider). <http://www.zeitpolitik.de/pdfs/zeit-glossar.pdf>, Zugriff 04. 06. 2020.
- DGfZP (2011): Jahrestagung 2011 „Was ist eigentlich Zeitwohlstand?“, Vorträge zum Download auf <http://www.zeitpolitik.de/veranstaltungen.html>, Zugriff 18. 02.2020.
- Dohrn-van Rossum, Gerhard (1992): Die Geschichte der Stunde. Uhren und moderne Zeitordnungen. München, Wien (Hanser).
- Donath, Daniel (2018): Zeitumstellung in Russland Wie man es macht, macht man es falsch. ARD-Tagesschau, Stand: 16.08.2018. <https://www.tagesschau.de/ausland/zeitumstellung-russland-101.html>, Zugriff 31. 05. 2018.
- Downing, Michael (2005): Spring Forward: The Annual Madness of Daylight Saving Time. Washington, D.C. (Shoemaker & Hoard).
- Downing, Michael (2018): 100 years later, the madness of daylight saving time endures. In: The Conversation: <http://theconversation.com/100-years-later-the-madness-of-daylight-saving-time-endures-93048>, Zugriff 19. 02. 2020.
- Europäische Kommission (2020): Mitteilung der Kommission an das europäische Parlament und den Rat: Gestaltung der Konferenz zur Zukunft Europas. COM(2020) 27 final, Brüssel, den 22.1.2020; https://ec.europa.eu/info/sites/info/files/communication-conference-future-of-europe-january-2020_de_0.pdf, Zugriff 27. 02. 2020.
- European Commission (2018): Commission Staff Working Document. Public Consultation on EU Summertime Arrangements. Report of Results. https://g8fip1kplyr33r3krz5b97d1-wpengine.netdna-ssl.com/wp-content/uploads/2018/09/discontinuing-seasonal-changes-time-swd-406_en.pdf, Zugriff 12. 05. 2019.
- Europäisches Parlament (EP 2019): P8_TA-PROV(2019)0225 Abschaffung der jahreszeitlich bedingten Zeitumstellung ***I. Legislative Entschließung des Europäischen Parlaments vom 26. März 2019 zu dem Vorschlag für eine Richtlinie des Europäischen Parlaments und des Rates zur Abschaffung der jahreszeitlich bedingten Zeitumstellung und zur Aufhebung der Richtlinie 2000/84/EG (COM(2018)0639 – C8-0408/2018 – 2018/0332(COD)).
- Fietze, Ingo; Kantermann, Thomas; Zully, Jürgen (2019): Zeitumstellung: Plädoyer für die Winterzeit. In: Spektrum: <https://www.spektrum.de/news/plaedoyer-fuer-die-winterzeit/1676820>, Zugriff 27. 10. 2019.
- Forschungszentrum Demografischer Wandel (FZDW), Frankfurt University of Applied Sciences (Hrsg.) (2019): Newsletter zur Panelstudie G U S Gesundheitsverhalten und Unfallgeschehen im Schulalter, August 2019.
- Fritz, Josef; Vo Pham, Trang; Wright, Kenneth P., Jr.; Vetter Celine (2020): A Chronobiological Evaluation of the Acute Effects of Daylight Saving Time on Traffic Accident Risk. In: Current Biology, online first, <https://doi.org/10.1016/j.cub.2019.12.045>.
- Geißler, Karlheinz A. (2018): Viel Lärm um nichts. Deutsches Manuskript eines Textes für die New York Times (vom Autor zur Verfügung gestellt).
- Geißler, Karlheinz A. (2019): Die Uhr kann gehen. Das Ende der Gehorsamkeitskultur. Stuttgart (Hirzel).

- Gernig, Björn (2011): Bericht über die DGfZP-Jahrestagung 2011. In: Zeitpolitisches Magazin, Jahrgang 8, Ausgabe 19, http://www.zeitpolitik.de/pdfs/zpm_19_1211.pdf, S. 14-16.
- Gleck, James (2016): Time to Dump Time Zones. In: New York Times Nov. 5. 2016, <https://www.nytimes.com/2016/11/06/opinion/sunday/time-to-dump-time-zones.html>, letzter Zugriff 12. 05. 2019.
- Giuntella, Osea; Mazzonna, Fabrizio (2019): Sunset Time and the Economic Effects of Social Jetlag Evidence from US Time Zone Borders. In: Journal of Health Economics, Volume 65, May 2019, S. 210-226. <https://doi.org/10.1016/j.jhealeco.2019.03.007>.
- Goodin, Robert E.; Rice, James Mahmud; Parpo, Antti; Eriksson, Lina (2008): Discretionary time: A new measure of freedom. New York, u. a. (Cambridge University Press).
- Grubisic, Maja; Haim, Abraham; Bhusal, Pramod; Dominoni, M. D.; Gabriel, M. A. K.; Jechow, Andreas; Kupprat, Franziska; Lerner, Amit; Marchant, Paul; Riley, William; Stebelova, Katarina; van Grunsven, H. A. Roy; Zeman, Michal; Zubidat, E. A. & Hölker, Franz (2019): Light Pollution, Circadian Photoreception, and Melatonin in Vertebrates. In: Sustainability, 11 (22): online first, DOI: 10.3390/su11226400.
- Hafner, Marco et al. (2016): Why Sleep Matters – the economic costs of insufficient sleep. Rand Europe. http://www.rand.org/pubs/research_reports/RR1791.html.
- Hafner (2017): Warum Schlaf wichtig ist. Volkswirtschaftliche Kosten des Schlafmangels. In: Zeitpolitisches Magazin, H. 30. http://www.zeitpolitik.de/pdfs/zpm_30_0717.pdf, S. 13-14.
- Hanke, Steve H.; Henry, Richard Conn (2012): Changing Times. The Cato Institute <https://www.cato.org/publications/commentary/changing-times>, Zugriff 18. 02. 2020.
- Hassid, Jonathan; Watson, Bartholomew C. (2014): State of mind: Power, time zones and symbolic centralization. In: Time and Society Vol. 23 (2); S. 167-194.
- Havranek, Tomas; Herman, Dominik; Irsova, Zuzana (2016): Does Daylight Saving Save Energy? A Meta-Analysis. Munich Personal RePEc Archive, MPRA Paper No. 74518, <https://mpa.ub.uni-muenchen.de/74518/>, Zugriff 10. 02. 2020.
- Henckel, Dietrich (2019): The 24/7 City as a Myth? <http://unsichtbare-stadt.de/2019/07/29/the-24-7-city-a-myth/>, Zugriff 16. 08. 2019.
- Henckel, Dietrich; Kramer, Caroline (Hrsg.) (2019): Zeitgerechte Stadt. Hannover (Akademie für Raumforschung und Landesplanung).
- Herf, Michael (2019): Position Letter to the California Senate: AB-7, permanent Daylight Saving Time. <https://medium.com/@herf/position-letter-to-the-california-senate-ab-7-permanent-daylight-saving-time-1a065e19f7c1>, Zugriff 23. 06. 2019.
- Jin, Lawrence; Ziebarth, Nicolas R. (2020): Sleep, health, and human capital: Evidence from daylight saving time. In: Journal of Economic Behavior and Organization 170, S. 174-192.
- Kantermann, Thomas; Juda, Myriam; Merrow, Martha; Roenneberg, Till (2007): The Human Circadian Clock's Seasonal Adjustment Is Disrupted by Daylight Saving Time. In: Current Biology, 17 (22), S. 1996-2000.
- Knab, Barbara (2018): Schlafforschung: Warum wir ohne Zeitumstellung besser schlafen. <https://www.zeit.de/wissen/gesundheit/2018-08/schlafforschung-zeitumstellung-sommerzeit-abschaffung-jean-claude-juncker#sommerzeit-1-tab>, Zugriff 23. 07. 2019
- Korf, Horst-Werner (2017): Sommerzeit – Soziales Jetlag – Schlafdefizit: Zeitpolitisches Magazin, H. 30. http://www.zeitpolitik.de/pdfs/zpm_30_0717.pdf, S. 10-12.
- Kotchen, Matthew J.; Grant, Laura E. (2008): Does Daylight Saving Time Save Energy? Evidence from a Natural Experiment in Indiana. National Bureau of Economic Research, NBER Working Paper No. 14429 October 2008: <https://www.nber.org/papers/w14429.pdf>, Zugriff 17. 02. 2020.
- Kuehnle, Daniel; Wunder, Christoph (2015): Using the life satisfaction approach to value daylight savings time transitions. Evidence from Britain and Germany. Berlin (SOEppapers on Multidisciplinary Panel Data Research 744).
- Kuchenbuch, David (2018): Ein Atavismus der Hochmoderne? Die Sommerzeit als „social engineering“ (1907–1980). In: Historische Zeitschrift Bd. 307, S. 1-41.
- Livingston, Amy (2019): Is Daylight Savings Time Helpful or Harmful? – History & Effects. In: Money Crasher, <https://www.moneycrashers.com/daylight-savings-time-history-effects/>, Zugriff 18. 07. 2019.
- Maier-Borst, Haluka; Wiederkehr, Anna (2019): Winterzeit für immer! Das sollten wir alle wollen. Neue Zürcher Zeitung 04.04.2019. <https://www.nzz.ch/visuals/zeitumstellung-statt-sommerzeit-sollte-winterzeit-die-regel-sein-ld.1472381>, Zugriff 12. 05. 2019.
- Melbin, Murrey (1987): Night as frontier: colonizing the world after dark. New York, London (Piatkus).
- Moore-Ede, Martin (1993): The 24-hour Society: The Risks, Costs and Challenges of a World that Never Stops. London (Piatkus).
- Mückenberger, Ulrich (2004): Metronome des Alltags. Berlin (edition sigma).

- Mückenberger, Ulrich (2011): Zeitwohlstand: Eine aktuelle Debatte und ihre Wurzeln; das Konzept von Bob Goodin und seine zeitpolitischen Implikationen. Einführungsvortrag auf der Jahrestagung der Deutschen Gesellschaft für Zeitpolitik 2011. <http://www.zeitpolitik.de/pdfs/VortragMueckenberger.pdf>, Zugriff 27. 01. 2020.
- Mückenberger, Ulrich (2016): The right to one's own time, local time policies and ‚Zeitgerechtigkeit‘. Vortrag im Rahmen des Treffens des Arbeitskreises „Zeitgerechte Stadt“ am 23. 02. 2016 in Hannover.
- Mumford, Lewis (1923/ 1955): *Technics and Civilization*, London (Routledge & Kegan Paul Ltd).
- Münch, Mirjam; Brøndsted, Adam E.; Brown, Steven A.; Gjedde, Albert; Kantermann, Thomas; Martiny, Klaus; Mersch, Danielle; Skene, Debra J. & Wirz-Justice, Anna (2017): The effect of light on humans. In: *Changing perspectives on daylight: Science, technology, and culture. A supplement*. In: *Science*, 358 (6363), S. 16-23.
- Mutz, Mathias (2015): Der Mehrwert einer Stunde: Deutungen der Sommerzeit im 20. Jahrhundert. In: *Der Faktor Zeit: Perspektiven kulturwissenschaftlicher Zeitforschung*. Stuttgart (Franz Steiner Verlag), S. 139-171.
- Mutz, Mathias (2016): Die Synchronisierung Europas. Die Einführung der Sommerzeit als Instrument der Krisenbewältigung und europäischen Harmonisierung, 1973–1996. Themenportal Europäische Geschichte: <https://www.europa.clio-online.de/essay/id/fdae-1693>, Zugriff 12. 06. 2020.
- National Institute for Public Health and the Environment (2019): Standard time, summer time and health. A literature study into the health effects of different time settings. Bilthoven, The Netherlands (RIVM Report 2019-0173).
- Ogle, Vanessa (2013): Whose Time Is It? The Pluralization of Time and the Global Condition, 1870s–1940s. In: *The American Historical Review* Vol. 118; S. 1376-1402.
- Ogle, Vanessa (2015): *The Global Transformation of Time 1870–1950*. Cambridge, Mass. (Harvard University Press).
- Padova, Thomas de (2017): *Leibniz, Newton und die Erfindung der Zeit*. München (Piper, 4. Auflage.)
- Posch, Thomas; Hölker, Franz, Freyhoff, Anja, Uhlmann, Thomas (Hrsg.) (2013): *Das Ende der Nacht. Lichtsmog: Gefahren – Perspektiven – Lösungen*. Weinheim (Wiley-VCH).
- Rifkin, Jeremy (1988): *Uhrwerk Universum. Die Zeit als Grundkonflikt des Menschen*. München (Kindler).
- Rinderspacher, Jürgen P. (Hrsg.) (2002): *Zeitwohlstand. Ein Konzept für einen anderen Wohlstand der Nation*. Berlin (sigma).
- Rinderspacher, Jürgen P. (2019): Mehr Licht! Der Ausstieg aus der Zeitumstellung bedeutet einen Wohlstandsverlust für die Menschen und ein Risiko für die Einheit der EU. Unveröffentlichtes Manuskript.
- Roenneberg, Till (2019a): *Das Recht auf Schlaf. Eine Kampfschrift für den Schlaf und ein Nachruf auf den Wecker*. München (dtv).
- Roenneberg, Till (2019b): Interview im Tagespiegel 29.03.2019: Chronobiologe zur dauerhaften Sommerzeit „Die Menschen werden spüren, dass es ihnen nicht gut geht“. <https://www.tagesspiegel.de/wissen/chronobiologe-zur-dauerhaften-sommerzeit-die-menschen-werden-spueren-dass-es-ihnen-nicht-gut-geht/24156316.html>, Zugriff 18. 04. 19.
- Roenneberg, Till (2019c): Chronobiologie: Neue Erkenntnisse über den gesunden Schlaf. In: *Technology Review* 4/2019. Ausschnitte im Netz: <https://www.heise.de/newsticker/meldung/Neue-Zeitzone-fuer-Europagemaess-der-Chronobiologie-4354908.html?view=print>, Zugriff 25. 05. 2019.
- Roenneberg, Till (2019d): Chronobiologische Aspekte der Sommerzeit. In: *Somnologie* 23, S. 247–252.
- Roenneberg, Till; Winnebeck, Eva C.; Klerman, Elizabeth B. (2019): Daylight Saving Time and Artificial Timezones – A Battle Between Biological and Social Times. In: *Frontiers in Physiology*. doi10.3389/fphys.2019.00944
- Roenneberg, T.; Wirz-Justice, A.; Skene, D. J.; Ancoli-Israel S.; Wright K. P.; Dijk, D.-J., , et al. (2019): Why Should We Abolish Daylight Saving Time? *Journal of Biological Rhythms*, 34(3), S. 227–230. <https://doi.org/10.1177/0748730419854197>.
- Scheffler, Tatjana; Kyba, Christopher C.M. (2016): Measuring Social Jetlag in Twitter Data. In: *Proceedings of the Tenth International AAAI (Association for the Advancement of Artificial Intelligence) on Web and Social Media (ICWSM 2016)*, 675-678.
- Schivelbusch, Wolfgang (1984, Originalausgabe 1977): *Geschichte der Eisenbahnreise. Zur Industrialisierung von Raum und Zeit im 19. Jahrhundert*. Frankfurt/M., Berlin, Wien (Ullstein Taschenbücher).
- Shanghai China (o.J.): *Zeitzone von Shanghai*. <https://www.shanghai-china.de/sommerzeit-china-zeitzone.html>, Zugriff 31. 05. 2019.
- Sobel, Dava (2007): *Längengrad*. Berlin (Berliner Taschenbuch Verlag, 4. Auflage).
- Sorokin, Pitirim A. & Merton, Robert K. (1937): Social Time: A Methodological and Functional Analysis. In: *American Journal of Sociology*, 42 (5), S. 615-629.
- Timeanddate.de (2019): Sommerzeitstatistik, <https://www.timeanddate.de/sommerzeit/statistik>, Zugriff 27. 07. 2019.

- Wagner, Marie Katharina (2018): Erfahrungen aus Russland: Jetzt die ewige Winterzeit. In: FAZ -net, 27.10.2018. <https://www.faz.net/aktuell/gesellschaft/menschen/diese-erfahrungen-hat-russland-mit-der-zeitumstellung-15856619.html>, Zugriff 31. 05. 2019.
- Watson, Nathaniel F. (2019): Time to Show Leadership in the Daylight Saving Time Debate. In: Journal of Sleep Medicine, 15 (6). <http://dx.doi.org/10.5664/jcsm.7822>, Zugriff 23. 06. 2019.
- Wei-Haas, Maya (2019): Tired of daylight saving time? These places are trying to end it. In: National Geographic: <https://www.nationalgeographic.com/science/2019/03/tired-of-daylight-saving-time-these-states-trying-to-end-clock-changes/> Zugriff 09. 09. 19
- Wikipedia (2020): Sommerzeit. <https://de.wikipedia.org/w/index.php?title=Sommerzeit&oldid=194496087>, Zugriff 26. 02. 2020.
- Zapatka, Cory (2020): How time zones are subtly messing with you. Youtube (14.01.2020): <https://www.youtube.com/watch?v=tzvUGDaG62l>, Zugriff 01. 02. 2020.
- Zulley, Jürgen; Knab, Barbara (2001): Unsere Innere Uhr. Freiburg (Herder).

Charts

Front page: Sonny Ross for NBC News

Source: https://media1.s-nbcnews.com/j/newscoms/2019_33/2969386/190812-daylight-savings-time-main-kh_469a3f0451d4f71d318339f10cb1159a.fi_t-2000w.jpg, accessed: 15. 02. 2020 (reproduced with kind permission of the author)

Figure 1: 1 – Circle of latitude, 2 - Meridian

Source: <https://upload.wikimedia.org/wikipedia/commons/5/57/Meridian-International.PNG>, accessed: 18. 02. 2020

Figure 2: Global time zone map

Source: https://upload.wikimedia.org/wikipedia/commons/thumb/8/88/World_Time_Zones_Map.png/1920px-World_Time_Zones_Map.png, Accessed: 18. 02. 2020.

Figure 3: Map of time zones and clock change arrangements in Europe

Source: <https://c.tadst.com/gfx/750w/tzmap-europe-2015-de.png?1>, accessed: 23. 05. 2019

Figure 4: Current global clock change practices

Source: <https://www.timeanddate.de/sommerzeit/statistik>, Accessed: 27. 07. 2019

Figure 5: Percentages of the population asleep or ready to fall asleep in Germany

Source: Calculation and chart by Björn Gernig (in his doctoral dissertation), based on data of the time use survey of the Statistisches Bundesamt (Federal Office of Statistics)

Figure 6: Percentage of people in the population asleep or ready to fall asleep on workdays in the months of the clock change

Source: Calculation and chart by Björn Gernig (in his doctoral dissertation), based on data of the time use survey of the Statistisches Bundesamt

Figure 7: Schematic representation of a time zone boundary in the middle of the USA

Source: Authors' own schematic

Figure 8: Locations ahead of ideal Standard Time

Source: https://pbs.twimg.com/media/ELNA-e_UcAENIPb?format=jpg&name=4096x4096, Accessed: 12. 12. 2019 (reproduced with kind permission of the author)

Figure 9: Light conditions with standard time and permanent DST on 21 December

Source: <https://pbs.twimg.com/media/D2qphsfW0AA2beB?format=jpg&name=large>, accessed: 14. 05. 2019 (reproduced with kind permission of the author)

Figure 10: Percentage of the population asleep or ready to fall asleep on weekdays in June and December, and sunrise and sunset times on the summer and winter solstices at the geographical centre of Germany

Source: Calculation and chart by Björn Gernig (in his doctoral dissertation), based on data of the time use survey of the Statistisches Bundesamt

Figure 11: Time zones in Europe:

A Standard time ('winter time'), B DST ('summer time'), C Proposed adjustment

Source: Roenneberg, Till; Winnebeck, Eva C. & Klerman, Elizabeth B. (2019): Daylight Saving Time and Artificial Time Zones – A Battle Between Biological and Social Times. In: Frontiers in Physiology, 10 (944), DOI: 10.3389/fphys.2019.00944. (Creative Commons License)

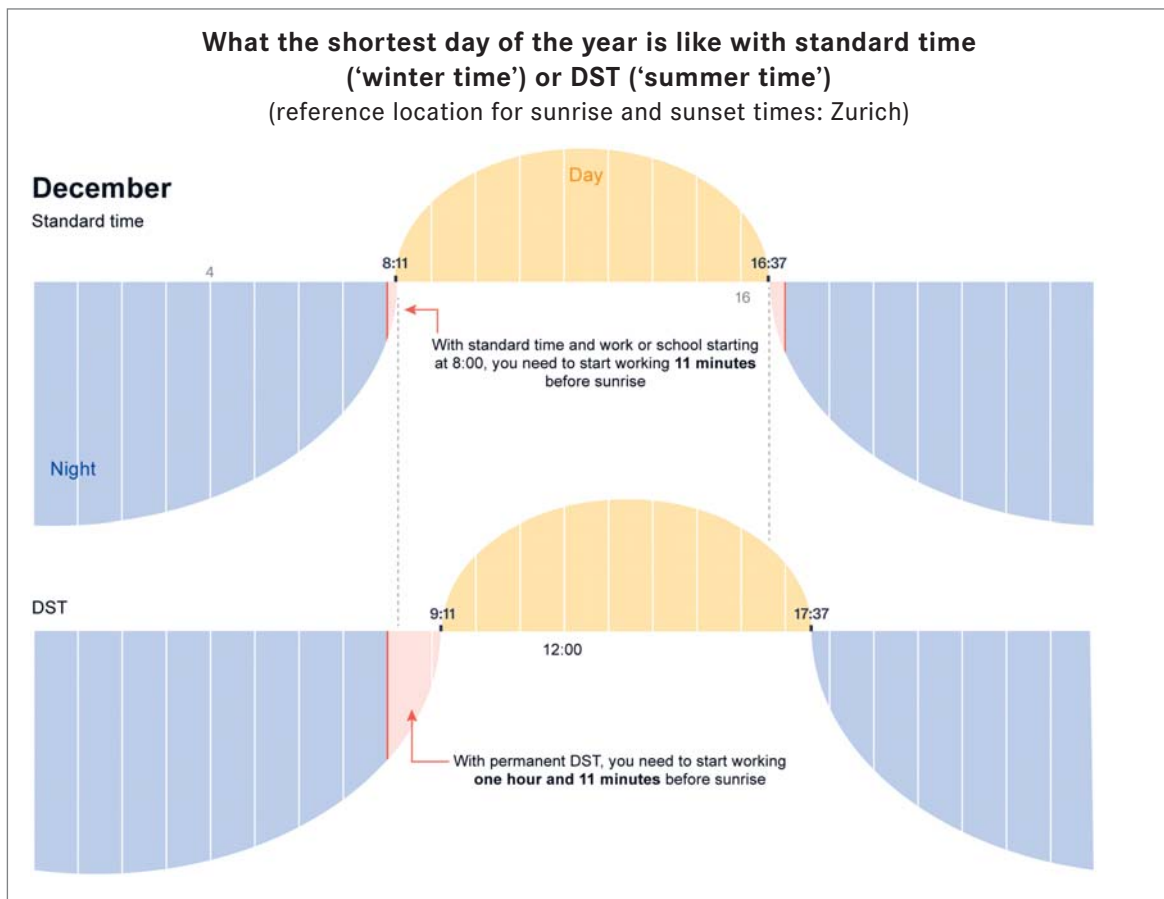
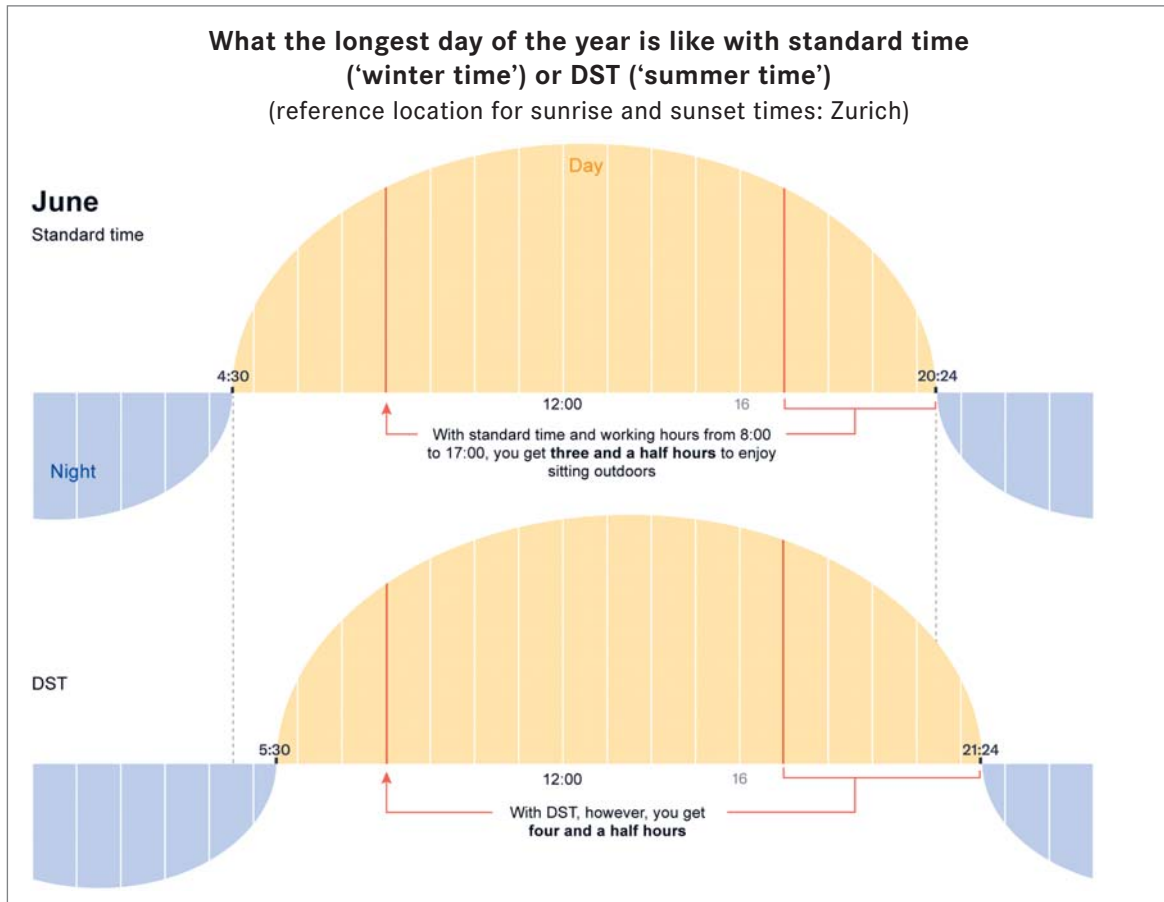
Appendix 1

Source: <https://www.nzz.ch/visuals/zeitumstellung-statt-sommerzeit-sollte-winterzeit-die-regel-sein-ld.1472381> (reproduced with kind permission)

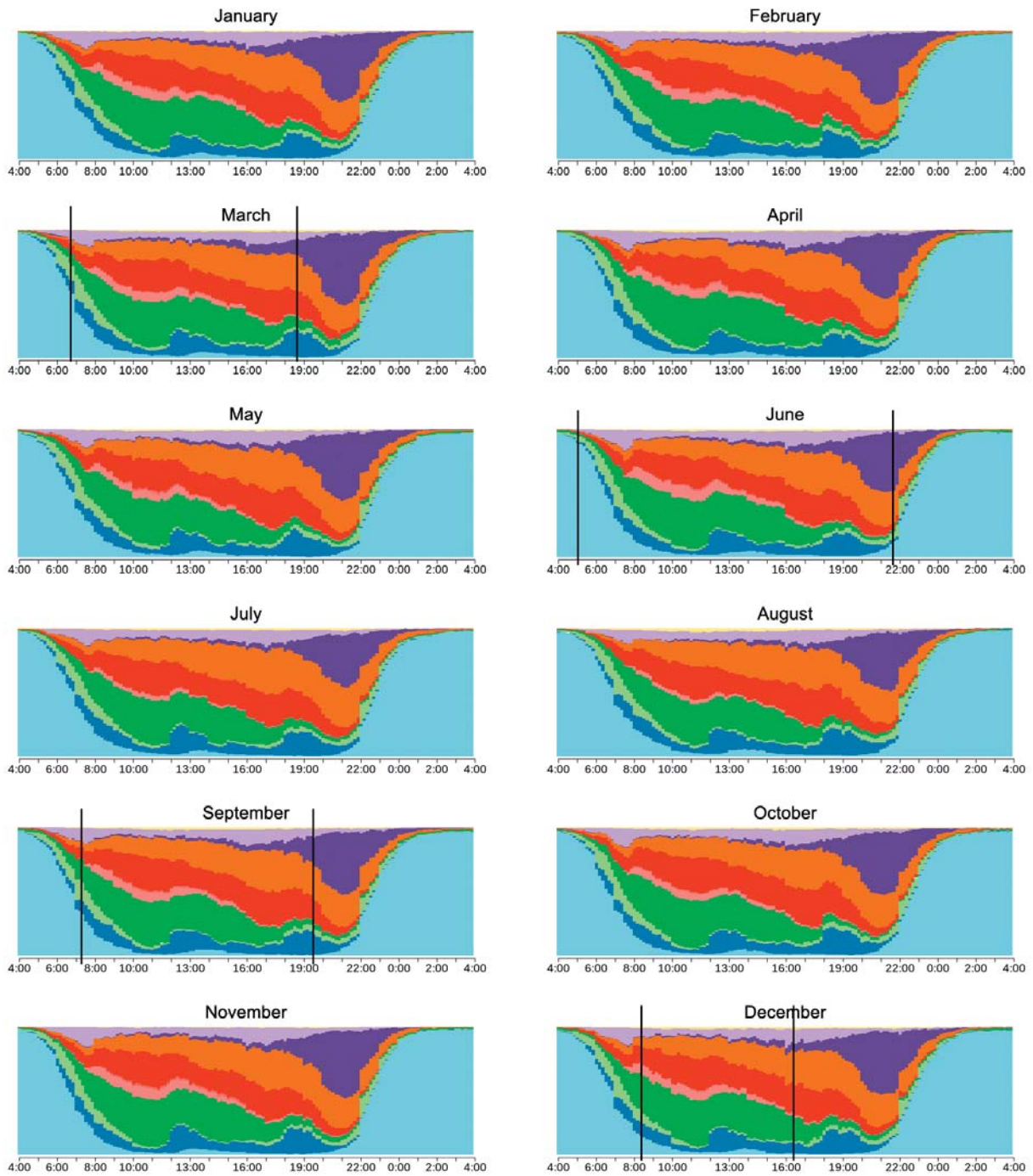
Appendix 2

Source: Charts by Björn Gernig, based on his own calculations

Appendix 1



Appendix 2



- Sleep
- Eating/Drinking
- Selfcare
- Gainful work
- Education/Culture
- Domestic work
- Social activities
- Sports/Hobbies
- TV
- Mobility
- Other

The black vertical lines mark the sunset and sunrise times on the solstices and the equinoxes.

German Society for Time Policy – Deutsche Gesellschaft für Zeitpolitik (DGfZP)

About us: Give Time a Voice

The German Society for Time Policy (Deutsche Gesellschaft für Zeitpolitik e.V. – DGfZP) is a network of researchers and practitioners who try to bring to the fore the temporal conditions prevalent in society. Our members are affiliated with different institutions such as universities, schools, advanced training, local authorities, non-governmental organizations, the arts, enterprises, churches, care institutions, trade unions etc. The mission of the DGfZP as a time-related think tank is: to analyse temporal conflicts, develop societal knowhow on temporal conditions and their consequences for societal well-being, bring available knowledge and knowhow together, suggest topics for in-depth analyses, develop instruments for explicit temporal interventions and policies, promote public discourse in view of political and societal decision-making.

The DGfZP was founded in October 2002 with the aim of bringing together isolated projects and individuals working on temporal issues in society. Initially there were six major lines of research and activism: working times, ecology of time, times of the city, temporal welfare, gender and time structures in everyday life, time and (health) care. Even though time policy is steadily gaining in importance – in everyday life and the life course, at the workplace, in associations and politics, in the media – awareness of its relevance is still insufficient. Therefore, sensitizing the public for temporal issues and the often-hidden temporal impacts of different policies is a core competence of the DGfZP.

Our work is crucially committed to temporal autonomy and individual as well as collective temporal welfare, the basic concepts being the right to time and temporal justice. The right to time was developed within the DGfZP and became part of a Council of Europe's Resolution (313 (2010)). We seek to make time a matter of public debate and a constituent part of political decision-making – to **give time a voice**.

Time policy-making in the DGfZP relies on the contributions of individuals from a wide range of professions and activities. Funding is provided by the contributions of our members and by donations. All work done within the DGfZP is voluntary work by the members and the board.

Three publications might serve as calling cards of our Society:

Mückenberger, U. (2011): Local Time Policies in Europe. In: *Time and Society* 20 (2), S. 241-273.

Henckel, D., et al. (eds.) (2013): *Space Time Design for the Public City*. Dordrecht.

DGfZP (2015): *Time Policy in Europe*, ZpM No 26, July 2015.

http://www.zeitpolitik.de/pdfs/zpm_26_0715.pdf

In addition to our webpage (www.zeitpolitik.de) there are two formats of outreach which are especially important:

The annual conferences, with a different topic every year; conference outcomes have frequently led to public minutes and manifestos and/or book publications.

Our semi-annual online journal *Zeitpolitisches Magazin* (Time Policy Magazine) (<http://www.zeitpolitik.de/zeitpolitikmagazin.html>). Summer issues focus on the contributions and results of the previous year's conference; winter issues are dedicated to varying topics. Both issues also feature reports, reviews, conference notifications, members' portraits, and information on time policy projects.

Moreover, members contribute to and engage in conferences, hearings, publications, interviews in a great variety of contexts. We also try to develop cooperation with time researchers, activists, artists in German speaking countries and within the EU. More recently, we have initiated several campaigns, some of them with an explicit focus on international cooperation:

In cooperation with partners in France, Spain and Italy we published a European Memorandum “The Right to Time, an urgent topic on the European Agenda”, describing the need for explicit time policies and the establishment of a European Time Academy (available in five languages): <http://www.zeitpolitik.de/impulse.html#memo>.

To promote the discussion on the abolishment of the time switch (from standard time to DST) the DGfZP published a dossier “The Future of Daylight Saving Time” (available in German and English): http://www.zeitpolitik.de/pdfs/future_of_DST.pdf.

On the basis of a research project funded by the Federal Government the DGfZP developed a proposal for a model of temporal options during the life course: https://www.fis-netzwerk.de/fileadmin/fis-netzwerk/Optionszeiten_Abschlussbericht_DJIBroschuere_Endg.pdf

We welcome any support and ideas you might contribute. If you have a time policy concern, the extended board is open for cooperation – in giving time a voice.

www.zeitpolitik.de



Permanent Standard Time: A Position Statement from the National Sleep Foundation

Historical Context: Daylight Saving time (DST) began during World War I when the United States decided to move forward an hour to save electricity in the evening. The current federal policy was enacted in 1966 as the Uniform Time Act.ⁱ Several changes occurred along the way (mostly changing the dates of starting and ceasing DST) and the current enactment was part of the Energy Policy Act of 2005.ⁱⁱ While originally enacted to save energy by ensuring more daylight in the evening hours, some studies of DST have called into question the degree of energy savings. Still, other studies have shown negative effects on people's circadian rhythms and health because of time changes, potentially linked to a higher number of heart attacks, car crashes, and workplace injuries in the days after a time change.ⁱⁱⁱ

Background: The National Sleep Foundation's (NSF) mission is to improve the sleep health and well-being of the public through education and advocacy. The debate between transitioning from DST to Standard Time (ST) each year in the United States has been ongoing for decades. NSF has addressed the issue in the past by asserting the importance of maintaining a regular sleep schedule, and by providing recommendations and educational resources to mitigate the negative effects of the time transition. Recent research conducted by NSF suggests meaningful gaps between public attitudes and observed consequences of DST, as well as misalignment between public preferences and established scientific principles.

Circadian biologists support permanent ST, citing the importance of light in the morning.^{iv,v} The Society for Research and Biological Rhythms issued a statement asserting that ST is better synchronized with the biological clock and people will go to sleep earlier relative to their work and school times.^{vi} A recent JAMA Neurology paper reviewed evidence on how DST transitions affect processes that involve the brain, heart, sleep patterns, and genes that control the sleep-wake cycle.^{vii} The American Academy of Sleep Medicine recently published their position in support of ST, noting the shift to DST has been associated with increased cardiovascular morbidity, stroke, and hospital admissions.^{viii}

Conclusion: The human circadian system does not adjust to annual clock changes. Sleep becomes disrupted, less efficient, and shortened.^{ix} DST forces our biological clocks out of sync with the rising and setting of the sun (the sun clock). The link between our biological clock and the sun clock has been crucial to human health and well-being for millennia.^x

As the global voice of sleep health, NSF always seeks better, more conclusive data. More than 60% of the world is on ST, indicating the international community understands the negative effects of DST on their health. Internationally, organizations such as the European Biological Rhythms Society and the Society for Research on Biological Rhythms advocate for the elimination of clock changes and adoption of permanent ST. Existing data support the elimination of seasonal time changes in favor of a fixed, year-round time.

Position: *It is the position of the National Sleep Foundation that seasonal time-changes are disruptive to sleep health and should be eliminated. Evidence supports permanent Standard Time because of its alignment with our circadian biology and relevance to sleep health and safety. NSF, therefore, advocates for the adoption of permanent Standard Time as the appropriate option for public health.*

ⁱ PUBLIC LAW 89-387-APR. 13, 1966

ⁱⁱ H.R.6 - Energy Policy Act of 2005

ⁱⁱⁱ Gray TR, Jenkins JA. Congress and the political economy of daylight-saving time. Hoboken, NJ: Wiley; 2018

^{iv} Roenneberg T, Winnebeck EC, Klerman EB. Daylight saving time and artificial time zones- a battle between biological and social times. Front Physiol. 2019; 10:944.

^v Duffy JF, Czeisler CA. Effect of light on human circadian physiology. Sleep Med Clin. 2009;4(2):165-177

^{vi} European Biological Rhythms Society; European Sleep Research Society; Society for Research on Biological Rhythms to the EU Commission on DST

^{vii} Malow BA, Veatch OJ, Bagai K. Are daylight saving time changes bad for the brain? JAMA Neurol. 2020.

^{viii} Rishi MA, Ahmed O, Barrantes Perez JH, et al. Daylight-saving time: an American Academy of Sleep Medicine position statement. J Clin Sleep Med. 2020;16(10):1781-1784.

^{ix} Watson, Nathaniel, Time to Show Leadership on the Daylight-Saving Time Debate, J Clin Sleep Med. 2019 Jun 15; 15(6): 815-817.

^x Kantermann T, Juda M, Merrow M, Roenneberg T. The human circadian clock's seasonal adjustment is disrupted by daylight saving time. Curr Biol. 2007: 1996-2000.

SRBR Talking Points about Daylight Saving Time (DST)

The talking points are meant to briefly address some key points raised by the media and laymen responses per Public Outreach Committee (POC) of the Society for Research on Biological Rhythms (SRBR). This is by no means the full scope of references, but we do have the key references, as well as the SRBR Position Paper on DST enclosed in this press kit to support our responses to the media. Please feel free to reach out to a SRBR POC at srbroureach@gmail.com in case you have any suggestions or comments.

Why do we care about Daylight Saving Time (DST)?

Approximately 1.6 billion people worldwide change their clocks twice a year to and from DST. This one-hour change in clock time to DST leads to decreased exposure to morning sunlight for some individuals (while DST is in place during the summer months in the US). Our body's internal biological clock needs exposure to morning sunlight to adjust to local time. When the exposure to sunlight in the morning is reduced, our biological clocks will drift later and later, making it harder to wake up. The one-hour shift in clock time during DST also exposes people to more evening light, which further pushes the biological clock to a later time and makes it more difficult to fall asleep. Because of the effect of reduced morning light and increased evening light on the biological clock, DST leads to sleep loss and a mismatch between the body clock and local time (also called social jetlag). Both sleep deprivation and social jetlag have negative effects on physical and mental health, including increased risks for diabetes, obesity, heart disease, depression, and some forms of cancer. Therefore, keeping DST during summer or all year round in the US, will have serious implications for public health and safety. These negative effects can be prevented by not switching to DST.

Why is permanent DST worse than permanent standard time?

DST means that we wake up in darkness and are exposed to more evening light, especially in the western parts of each of the time zones. Adhering to DST throughout the year would result in even more hours of morning darkness during winter for many people. This makes waking up more difficult for everyone, from school kids to adults, and is likely to worsen conditions such as seasonal affective disorders. Darker mornings and brighter evenings will push the circadian system later, and thus lead to later sleep timing. However, work and school hours do not change, so these later sleep times will result in more sleep deprivation and social jetlag (internal misalignment). As already mentioned, sleep deprivation and social jetlag have negative effects on physical and mental health, including increased risks for diabetes, obesity, heart disease, depression, and some forms of cancer. Brighter days and darker nights are critical for a healthier population year round. Thus, DST should be abolished, and we as biological rhythms experts clearly favor permanent Standard Time (when the clock times matches sun times).

Have we done permanent DST before?

In 1974, the United States decided to try permanent DST for two years, in order to save energy. At first, people were optimistic, with 79% in favor of the change. However, by February, after the first winter, support had dropped to 42%. This change of mind is likely due to the fact that waking up in the dark is harder. Keeping DST year-round also increases the duration of dark mornings in the winter! Most notably, energy savings were not seen under this permanent DST in 1974. In fact, permanent DST in 1974 in the US didn't make it for full two years: Congress rolled back the measure in a 383-to-16 vote, clearly demonstrating that this was a bad idea. Let's not replicate the errors of the past!

Is an increase in exercise during DST a good reason to stick to permanent DST?

Currently, DST occurs in spring, and ends after the summer. Those times of year are typically associated with more outdoor activities because of warmer temperatures. Although it has been argued that DST is associated with more physical activity during the summer months, it is more likely that the change in season is responsible for changes in physical activity patterns. It is also noteworthy that there is no direct evidence suggesting that permanent DST would be beneficial for physical activity during the winter months. Conversely, keeping Standard Time throughout the year (rather than DST) will not affect the seasonality of warmer temperatures and longer evening light in summer. Thus, it is unlikely that locking into Standard Time instead of DST will abolish the positive effects of exercise during the summer months.