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Why should we abolish Daylight Saving Time?

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Abstract

Local and national governments around the world are currently considering the elimination of the annual switch to and from Daylight Saving Time (DST). As an international organization of scientists dedicated to studying circadian and other biological rhythms, the Society for Research on Biological Rhythms (SRBR) engaged experts in the field to write a Position Paper on the consequences of choosing to live on DST or Standard Time (ST). The authors take the position that, based on comparisons of large populations living in DST or ST or on western versus eastern edges of time zones, the advantages of permanent ST outweigh switching to DST annually or permanently.

Four peer reviewers provided expert critiques of the initial submission and the SRBR Executive Board approved the revised manuscript as a Position Paper to help educate the public in their evaluation of current legislative actions to end DST.

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Conflict of Interest Statement

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Keywords

circadian; DST; entrainment; sleep; health; light

Less than 200 years ago, humans organized their daily routines by the *sun clock* (set by the rotation of Earth) which was in synchrony with their *body clock* (set by our individual biological clock). Now most of us live in cities, work mostly in buildings, use electric light at night and organize our daily lives by a *social clock* (set by human societies) that is rarely in synch with the *sun clock* or the *body clock*. These new conditions challenge our health and can cause safety problems; these challenges become even worse under Daylight Saving Time (DST). In this paper, we describe how the three clocks came to drift apart and how that can create problems.

Why is light important for our health?

Living creatures have a body clock that creates daily rhythms. This body clock organizes our biology, such as when we eat and sleep, when we can run fastest and when our brain works at its best (Young, 2000). The body clock must be made to match our 24-h environment. In a "natural day", the light of the sun and darkness at night are the main signals that adjust the timing of our body clock. This is true even within cities, where we experience less outdoor light during the day and more electric light during the night. Electric light can also adjust body clocks to match 24-h days, but natural daylight is usually 100–1,000 times brighter than indoor light (Wright Jr et al., 2013) and therefore more effective. We must recognize the important role of light in shaping our daily behavior and the important role of our body clock in maintaining our health and wellbeing.

Why is the natural day important?

The earth rotates towards the east. That is why the sun seems to travel from the east in the morning via its highest point near midday towards the west where it sets in the evening. Although we live according to the same clock time within a time zone (which we will call *social clock*), our *body clocks* still receive the timing signal from the sun defined by its east-west path (*sun clock*). It takes the sun 4 minutes to cross each longitude from east to west. Longitudes are imaginary lines that run between the North and the South Pole and cut the earth into 360 even 'apple slices'. The zero line has been defined to go through Greenwich east of London in England. This means that the sun rises and sets 4 minutes later every longitude line as it "travels" to the west, taking one hour across the 15 longitude lines that are generally one time zone. Since country or state lines do not exactly match longitude lines, the time zone of a specific place may not be the same as expected by the longitude lines. Some countries (like China) have combined neighboring time zones to make their time zones bigger, so that the sun needs even longer than 1 hour to cross the time zone. We live according to the same *social* clock time within a time zone, but as long as we still can see the natural day (through windows or on our way to or from work or school), our *body clocks* still follow more or less the time of the *sun clock* defined by the sun's east-west path. *Body clocks* are later relative to the *social clock* in winter, when nights are longer with earlier sunsets and later sunrises (Hadlow et al., 2018, 2014; Hashizaki et al., 2018; Kantermann et

al., 2007), and *body clocks* are earlier at the eastern edge of a time zone and become gradually later towards the western edge (Borisenkov, 2011; Hadlow et al., 2018; Randler, 2008; Roenneberg et al., 2007). Several studies found that the further west people live within a time zone the more health problems they may experience and the shorter they live on average (Borisenkov, 2011; Gu et al., 2017; VoPham et al., 2018). The best explanation for these findings is that the difference between our *social clock* – set by humans – and our *body clock* – set by the sun – increases towards the western edges of time zones. Thus, when two people wake up at 7 AM for work, the *body clock* of the person in the eastern edge may be set to 7 AM, but that of the person on the western edge may be set to 6 AM and the difference between the two clocks leads to health and safety problems.

What is Daylight Saving Time?

Many decades ago, politicians introduced Daylight Saving Time (DST). DST commonly lasts from spring to autumn and changes the *social clock* so that we simply start the *social day* one hour earlier relative to the *sun clock*. DST was thought to save energy because people would use less electric light in the evenings (Kotchen and Grant, 2011; Mirza and Bergland, 2011). Although this turned out not to be true (Aries and Newsham, 2008), DST is still kept to allow people to start work earlier by *social clock* time in summer. However, DST disrupts the relationship between *social* and *sun* clocks. For example, New York's *social clock* closely matches the *sun clock* in winter during Standard Time: when the *social clock* says it's noon, it is very close to midday, the sun's highest point in the sky. During DST however, New York's *social clock* shows noon when it is only 11 AM by the *sun clock*. People, who have to get up at 6 AM by the *sun clock* in winter, have to get up at 5 AM by the *sun clock* under DST despite the *social clock* showing 6 AM. Essentially, they have to go to work in one time zone further to the east. This means that people in Chicago have to work during the office hours of New York, and people in Berlin have the office hours of St. Petersburg. Instead of seeing DST as working according to one time zone to the east, one can also think of it as people's *body clocks* being pushed further west within their time zone (or *social clock*). Since the *body* clock follows the *sun clock*, these changes can affect our health.

How does Daylight Saving Time affect our health?

There are good sides to DST, such as coming home earlier (by the *sun clock*) from school or work and having more hours of daylight during our free time after work. But DST also creates problems, which can either be short-term (*acute*) or long-term (*chronic*). The first days after the sudden switch to DST in spring cause acute effects including shorter sleep duration (Barnes and Wagner, 2009; Harrison, 2013), worse performance (Gaski and Sagarin, 2011) and worse health; heart attacks are, for example, higher during that time compared to other weeks (Janszky and Ljung, 2008; Manfredini et al., 2018) and there may be more traffic accidents (Carey and Sarma, 2017; Coren, 1996a, 1996b; Hicks et al., 1983; Lahti et al., 2010). The chronic effects may last throughout the months of DST because in many people *social clocks* and *body clocks* remain set to different times as explained in the previous section; the *body clock* does not adjust to DST *social clock* time even over months (Hadlow et al., 2014).

The chronic effects of DST have not been studied directly, but we know that DST increases the time difference between the *social clock* and the *body clock* (Borisenkov et al., 2017). More and more studies show that time differences between the *social clock* and the *body clock* challenge our health (Koopman et al., 2017; Mota et al., 2017; Parsons et al., 2015; Roenneberg et al., 2012; Rutters et al., 2014; Wong et al., 2015), are associated with decreased life expectancy (Borisenkov, 2011), shorten sleep (Borisenkov et al., 2017; Wittmann et al., 2006), cause mental (Foster et al., 2013; Levandovski et al., 2011) and cognitive problems (Díaz-Morales and Escribano, 2015; Haraszti et al., 2014), and contribute to the many sleep disturbances in our societies that are estimated to cost approximately 2% of the GDP (Hafner et al., 2017). If we established DST throughout the year, the chronic effects would become more severe not only because we have to go to work an hour earlier for an additional five months every year, but also because *body clocks* are usually later in winter than in summer with reference to the *sun clock* (Kantermann et al., 2007). The combination of DST and winter would therefore make the differences between *body clocks* and the *social clock* even worse and would negatively affect our health even more.

What should we do – what do scientists recommend?

The choice of DST is political and therefore can be changed. If we want to improve human health, we should not fight against our *body clock* and therefore we should abandon DST and return to Standard Time (which is when the *sun clock* time most closely matches the *social clock* time) throughout the year. This solution would fix both the acute and the chronic problems of DST. We therefore strongly support removing DST changes or removing permanent DST and having governing organizations choose permanent Standard Time for the health and safety of their citizens.

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