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The implications of daylight saving time: A quasi-natural experiment on cognitive performance and risk taking behaviour

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ABSTRACT

This article explores the effects of transition to daylight saving time (DST) on economically relevant behavioural measures – cognitive performance and risk-taking behaviour. Using a unique quasi-experimental design, we exploit the exogenous 'treatment' that the New South Wales residents are subjected to when their clock time is moved forward by an hour relative to the Queensland in springtime. The participants in our study are homogeneous with similar demographic and socio-economic conditions, which allows suitable comparison of the affected versus unaffected individuals over time. The results suggest that exposure to the DST transition does not significantly impact cognitive performance or risk-taking behaviour.

1. Introduction

Although the number of countries with Daylight Saving Time (DST) has diminished over time, more than 1.6 billion men and women in around 78 countries and territories still move their clocks forward in the spring and backward in the autumn, usually by one hour.[1] The aim of this study is to investigate the effect of DST transition on behavioural variables, i.e. risk preferences and cognitive performance using a quasi-natural experiment. To this end, we exploit the interstate variation in the transition to DST at the onset of spring in the neighbouring Australian states of Queensland and New South Wales. The 'treatment' of DST transition only affects the population in New South Wales, who move their clock forward by one hour on the DST day relative to the comparison population in Queensland who do not observe DST. We focus on a highly homogenous group of population residing close to and either side of the interstate border, which allows us to attribute any changes in risk taking behaviour or cognitive performance to the effect of DST. Both behavioural measures are relevant variables to get a better understanding of DST transition on economic and health related behaviour.

A key argument against DST is its implications for behaviour and physiology, especially as they relate to human performance. Aviation history is replete with accidents caused by sleep-deprived pilot error (e.g., the crash of American Airlines Flight 1420). Such tragedies as the explosions of the space shuttle Challenger and the Chernobyl nuclear power plant, as well as the Exxon Valdez oil spill, can also be traced to human error caused by disruption of the sleep cycle (Coren, 1996a, as cited in Kamstra et al., 2000: 1005). More recent research finds adverse effects of compromised quantity and quality of sleep on academic (Baert et al., 2015), health, and labour market outcomes (Jennum et al., 2014). By directly disrupting the circadian rhythm, the DST transition leads to abrupt and acute discrepancies between biological and social time that may throw the body into a condition of internal desynchronisation with potentially adverse effects on health (Kantermann et al., 2007). Not only does fatigue negatively affect cognitive functioning (Noy et al., 2011), even minor sleep deprivation due to one-hour spring forward of clock-time can seriously compromise attention, alertness, and cognitive ability and induce errors of judgment (Kamstra et al., 2000). Number of automobile crashes is found to increase immediately following the shift to DST (Monk, 1980; Hicks et al., 1983; Coren, 1996b, 1998; Varughese and Allen, 2001) with the exception of Vincent, (1998) and Lambe and Cummings (2000). Barnes and Wagner (2009) provide evidence that both the frequency and severity of workplace injuries increase on the Monday following the DST switch. More recently researchers have investigated the physiological effects of transition to DST. Gaski and Sagarin (2011) evaluate the effects of DST-induced sleep deprivation using three primary measures: cognitive performance, motor

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[1] See Kotchen and Grant (2011); for the latest information see: http://www.timeanddate.com/time/dst/2015.html

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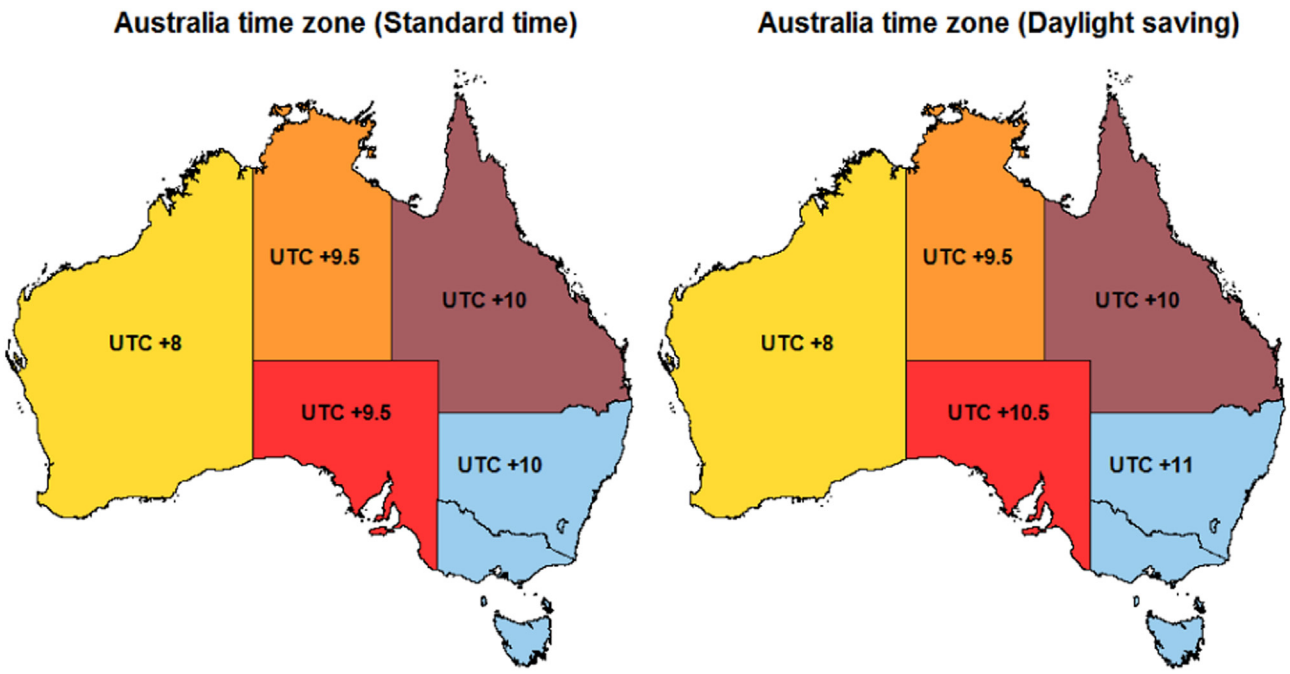

Fig. 1. Time zones in Australia under standard and daylight saving time. Queensland, the Northern Territory and Western Australia are the states that do not observe daylight saving. The figure has been generated with data from the Australian Bureau of Statistics (2011). The states and territories belonging to different time zones are distinguished by the following colours: Queensland (maroon), New South Wales/Victoria/Tasmania (sky blue), Northern Territory (ochre), South Australia (red) and Western Australia (gold). (For interpretation of the references to color in this figure legend, the reader is referred to the web version of this article.)

performance, and mood. A one-hour time shift due to DST transition is an annual ritual that most residents in the affected regions are expected to internalise and adapt to. Yet, quite remarkably, human behaviour and performance are affected as though the time shift is unanticipated. Our study builds on this observed premise.

Methodologically, it is difficult to establish a causal role of DST shift using observational data, as in the traffic studies, because it is hard to distinguish whether the accidents resulted from cognitive impairment related to sleep cycle asynchrony or such confounding ambient factors such as, darker, colder, or even icier early morning conditions during the weeks following the springtime leap forward (Harrison, 2013). According to the evidence, which is heavily focussed on basic attentional and complex processes (Lim and Dinges, 2010), sleep deprivation increases perceptual and cognitive distortions and negatively affects vigilance (Krueger, 1989). However, because it is difficult to incentivise sleeplessness in a natural environment for a large number of individuals, most

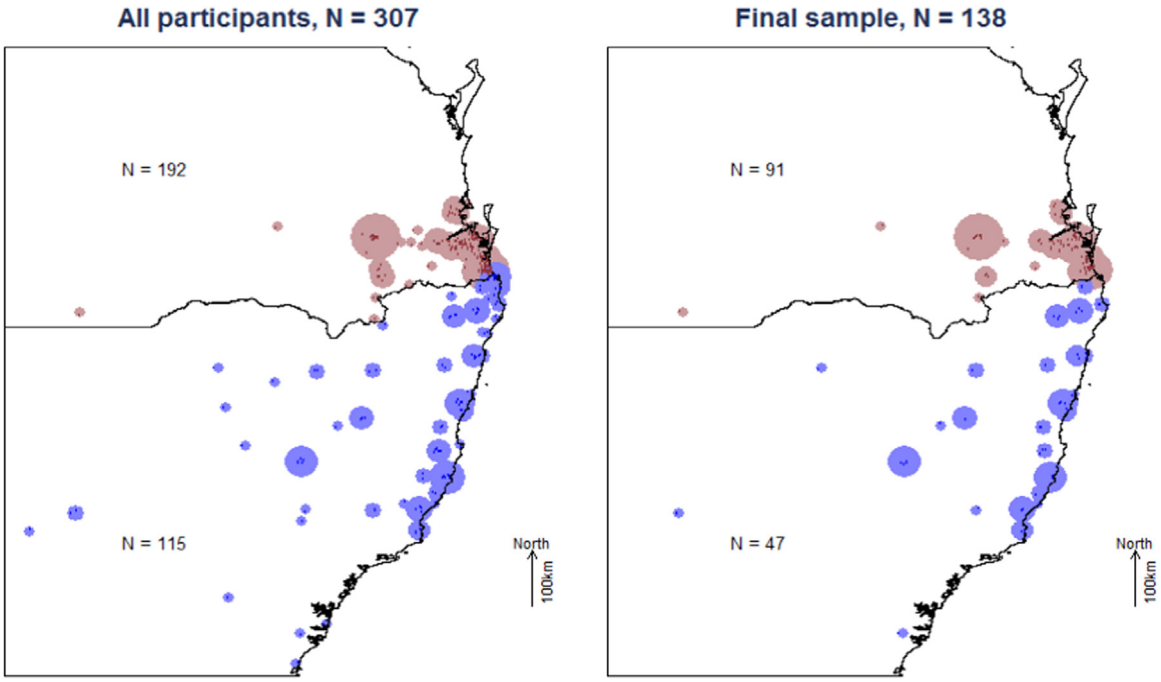

Fig. 2. Regional distribution of the observations. Red part: Queensland; Blue one: New South Wales. Left hand-side depicts all participants who conducted the first wave, while the right-hand side shows the final set of observations used in the analysis (those who participated in all three waves). (For interpretation of the references to color in this figure legend, the reader is referred to the web version of this article.)