Chapter 5.7: Individual Countermeasures to Fatigue

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Abstract

This chapter concerns the use of individual countermeasures to fatigue, which are strategies that vehicle operators can use to manage or alleviate mild fatigue. Effective countermeasures and use of ineffective strategies are discussed, as well as the influence of other factors. Before deciding on an appropriate countermeasure, it is vital to understand the cause of fatigue, which here is categorised into sleep-related and task-related fatigue. Taking a break is an effective countermeasure for task-related fatigue; however, it will not alleviate sleep-related fatigue. Although caffeine and napping are the only effective countermeasures for sleep-related fatigue, they are not always the most used strategies within transportation. Effective countermeasure use is a complex process, which can be influenced by several factors such as education and access. Importantly, individual countermeasures should be used strategically as short-term emergency measures, promoted as part of higher-level, operational fatigue management, and supported by an open safety culture.

5.7.1 Introduction

One approach to reducing fatigue risk and managing fatigue is the use of individual countermeasures, defined as strategies individuals can use to manage fatigue. Generally, there are two main types of countermeasures: operational and individual. While the focus of this chapter is individual countermeasures to fatigue, it should be recognised that operational countermeasures (such as fatigue risk management systems, scheduling, hours of work and duty times, and education) can directly or indirectly influence individual countermeasure use. Nevertheless, individual countermeasures are a key consideration in fatigue management. Many operational countermeasures are out of the control of workers themselves. Vehicle operators may, however, be able to implement certain strategies to manage their fatigue and therefore need to know what is effective. It is important to note that the countermeasures discussed in this chapter are short term strategies used to manage mild fatigue. If vehicle operators are severely fatigued, then it is important that they stop and do not continue to operate.

5.7.2 Effective countermeasures

It is vital to understand the cause of fatigue before deciding on an appropriate countermeasure, as this may impact the effectiveness (defined as countermeasures that have objectively been shown to alleviate fatigue). In May & Baldwin's (2009) model of fatigue causation (shown in Chapter xx), contributing factors have been categorized into sleep-related and task-related fatigue. The defining feature of this model is the distinction between the types of fatigue, and it is this distinction that is important when considering effective strategies to counteract fatigue. The appropriate countermeasure for someone who is sleepy would be different to the one for someone who is mentally overladed due to increased task demand. Although May & Baldwin's model was designed for driver fatigue, the information is relevant to all workplace fatigue.

5.7.2.1 Task-related fatigue countermeasures

The main countermeasure for task-related fatigue, both active and passive, is to ensure regular breaks are taken. Rest breaks can help to break up the monotony of tedious tasks and are temporarily beneficial, being suggested as a countermeasure strategy for workplace fatigue (Caldwell et al., 2019). The research for other countermeasures to task-related fatigue is less certain. It follows that if someone is experiencing fatigue through overload, then minimizing additional distractions could aid performance and concentration until a break can be obtained. Conversely, to combat underload, secondary tasks could therefore be effective for mitigating passive fatigue if they do not result in distraction. However, due to the nature of the task, this could be less achievable and more dangerous when driving. Although the most effective countermeasure for task-related fatigue is taking a break, importantly, taking a break without sleep is not effective for sleep-related fatigue. Most of the countermeasure research focuses on sleep-related fatigue, possibly due to the severe consequences of falling asleep during a safety critical task. Therefore, counteracting sleep-related fatigue will be the focus going forward.

5.7.2.2 Sleep-related fatigue countermeasures

The only effective countermeasures to sleep-related fatigue (apart from adequate sleep and only working at times of peak alertness) are napping and caffeine. Although these are promoted as evidence-based mitigation strategies, it is important to recognize that they are not intended to be relied upon or to compensate for regular short or poor-quality sleep. In addition, they should not be promoted at the expense of operational measures, but rather as an addition, to be used strategically when required.

Napping

Napping has been shown to reduce physiological and subjective effects of fatigue on driving performance (Horne & Reyner, 1996; Watling, Smith, & Horswill, 2014). Naps of approximately 30 minutes reduce sleep-related fatigue for one to two hours post nap (Horne & Reyner, 1996), with daytime naps between 10-20 minutes showing decreases in subjective sleepiness, increases in objective alertness and improvements in cognitive performance (Hilditch et al., 2017). However, napping requires time and facilities, which are not always accessible to individuals.

There is also the issue of 'readiness to sleep', as people may struggle to nap 'on cue'. Perception may be another barrier, associating napping with 'sleeping on the job' or with an inability to cope with the work, which is linked to workplace culture. The benefit of a nap depends to some extent on the time of day they are taken, and the level of fatigue experienced. For example, a 10-minute nap following a day without sleep offered limited benefit to driving performance following a night shift (Hilditch et al., 2017).

Napping can result in instances of sleep inertia, resulting in reduced alertness and performance decrements. Severe symptoms can last 15 - 30 minutes after sleep but can take over an hour for full recovery (Hilditch & McHill, 2019). The length and timing of a nap influences sleep inertia, with performance decrements being exacerbated by previous sleep loss and time of day (Hilditch & McHill, 2019). For instance, a 10-minute nap at night, although not as effective as during the day, produced minimal sleep inertia and helped to mitigate some short-term impairments to performance during a simulated night shift (Hilditch et al., 2016), whereas a 30-minute nighttime nap resulted in sleep inertia. Caffeine before a short nap reduces subsequent sleep inertia (Centofanti et al., 2020; Horne & Reyner, 1996); however, the inclusion of caffeine requires additional planning. It is important that fatigue education discusses napping and awareness of sleep inertia to ensure individuals allow sufficient recovery time (~20 to 30 minutes, up to an hour in severe cases) before continuing.

Caffeine

Caffeine is one of the most researched and established countermeasures in Western society for sleep-related fatigue. Caffeine is effective as it has a physiological effect on the brain, promoting wakefulness by blocking adenosine receptors. It can be found in a variety of forms such as coffee, tea, energy drinks, tablets; however, the caffeine content can vary, as shown in Table x.1. It is worth noting that certain products have fixed amounts of caffeine in them (e.g., energy drinks, tablets), whereas some products will have an approximated amount that will vary depending on various factors (e.g., bean, brewing time, size of drink etc.).

Table x.1 Approximate caffeine content of regularly consumed products (U.K.)

Product	**Approximate caffeine content (U.K.)**
Instant coffee (2g serve)	50mg – 90mg
Energy Drink (250ml)	80mg
Coffee shop drink (large latte, cappuccino, flat white)	66mg
Caffeinated tablet (per tablet)	50mg
Cup of tea (I bag)	30mg - 50mg
Carbonated soft drink (330ml)	32mg
Chocolate (milk; dark, 50g)	< 10mg; <25mg

It is well established that caffeine counteracts sleepiness, with low to moderate doses effectively reducing the impact of sleep loss on alertness, vigilance, and cognitive performance (McLellan et al., 2016). A recent review of the effects of caffeine consumption found improvements in response time and accuracy on attention tests and information processing tasks, improvements in executive function and enhancements to certain vehicle measures in driving tests, concluding caffeine to be an effective countermeasure to the cognitive and physical impairments associated with sleep loss (Irwin et al., 2020). Driving simulator studies have shown that alertness is increased, and performance improved 20 minutes following caffeine consumption (e.g., Horne &

Reyner, 1996; Reyner & Horne, 2002), with ongoing benefits to performance and sleepiness during prolonged driving (Mets et al., 2011). Repeated doses of caffeine (in the form of chewing gum) have also been shown to mitigate fatigue-related driving performance impairments, reducing drowsiness and the impact on driving errors (Aidman et al., 2018). Caffeine therefore has been suggested as an effective fatigue countermeasure, with reports of increased use in workers who experience disruptions to sleep or increased sleep-related fatigue, such as truck drivers (Filtness et al., 2020; Pylkkönen et al., 2015).

However, it is difficult to determine the effectiveness of caffeine as a driver sleepiness countermeasure for habitually high caffeine consumers. High caffeine consumers become accustomed and therefore likely need increased amounts to maintain alertness, with little research exploring the influence of a caffeinated countermeasure for habitual caffeine use. However, self-report truck driver data indicates that high caffeine consumers are associated with poor health behaviours and report more crashes and worse driving safety indicators compared to low caffeine consumers (Filtness et al., 2020). There are also differences for individuals in terms of sensitivity to the effects of caffeine (e.g., effectiveness as a fatigue countermeasure) as well as sensitivity in terms of tolerance to caffeine (which can impact sleep quality and duration). Increased caffeine consumption can also result in increased need for facilities, which can be a barrier to its use (Pilkington-Cheney et al., 2020).

5.7.3 Ineffective countermeasure use

Caffeine and napping are not always the preferred strategies for fatigue management. Below is a list of commonly reported strategies which have <u>little or limited evidence of effectiveness for sleep-related fatigue</u>:

- Cold air/fresh air/air conditioning
- Turning up music/radio
- Talking to someone (passenger, or the phone)/singing to self
- Splashing cold water on the face
- Changing driving position/stretching/going for a walk/taking a break
- Sugar

A large questionnaire study of the Swedish public found that the most used countermeasures to increase alertness when driving were to take a walk (54%), turn on the radio (52%), open a window (47%), drink coffee (45%), and converse with a passenger (35%) (Anund et al., 2008). Of this list, only drinking caffeinated coffee would offer any benefit to sleep-related fatigue. Research exploring the effectiveness of countermeasures following 5hour sleep restriction during extended, monotonous simulated driving found that cold air to the face and listening to the radio provided no significant benefit in terms of driving incidents or participant sleepiness (Reyner & Horne, 1998). However subjectively, listening to the radio resulted in lower sleepiness reports for most of the drive. A more recent real-road driving study (both day and night driving) found no effect of opening a window, and minor acute effects of listening to music on subjective sleepiness and blink duration, concluding that these measures have little practical relevance in counteracting the effects of night driving or driving duration, and therefore driver sleepiness (Schwarz et al., 2012). Taking a break without a nap also provides no benefit to sleepy drivers (Horne & Reyner, 1999), or if any benefit is gained, it is short-lived (Phipps-Nelson et al., 2011). Despite reports of use by drivers to manage fatigue (Pilkington-Cheney et al., 2020), the evidence surrounding the efficacy of sugar as a countermeasure is inconsistent, with reports of sleepiness worsening over time following consumption, particularly during afternoon simulated driving (Horne & Baulk, 2004).

A lack of association has been found between effective sleepiness countermeasures such as stopping, taking a nap, utilising caffeine, and swapping drivers, with reports of driving while sleepy (Watling, Armstrong, Obst, et al., 2014). Despite knowing these countermeasures to be effective (Anund et al., 2008), they are used less often than ineffective strategies (e.g., opening a window or turning on the radio) or alongside effective strategies (Pylkkönen et al., 2015). It may be that the use of ineffective strategies to counteract sleepiness is due to convenience or accessibility, as well as some expectation of an alerting effect.

Differences have been noted between professional and non-professional drivers in relation to countermeasures (Gershon et al., 2011). Listening to the radio and opening a window were frequently used and perceived as highly effective strategies by both groups. However, more tactical countermeasures were reported by some professional drivers such as planning for rest stops and using napping and caffeine. Interestingly, most professional respondents were truck drivers (52%), who have also been reported using both napping and rest breaks to counteract sleep-related fatigue (Pylkkönen et al., 2015). Within aviation, strategic use of caffeine and napping are frequently used to increase alertness (Sallinen et al., 2017), with pilots using controlled rest (in seat, on the flight deck) and bunk rest (in a designated crew rest facility) to manage fatigue. In comparison, tram drivers report the use of light meals and talking to others during rest breaks to manage fatigue (Onninen et al., 2020). Outside of rest breaks, caffeine and ‘self-activation’ strategies (e.g., moving around, opening a window, changing driver behaviour or position, talking to self) are commonly used by tram drivers, with similar strategies being reported by train drivers (Filtness & Naweed et al., 2017). Similarly, in a recent study with city bus drivers (Pilkington-Cheney et al., 2020), although caffeine and napping were occasionally used, strategies which have limited evidence of effectiveness were also heavily relied upon, such as opening a window, stretching, singing, talking and using forms of sugar. It is possible that constraints of the workplace (e.g., scheduling, break location, facilities, sole driver) inadvertently encourages the use of ineffective strategies which are less influenced by workplace constraints.

The use of ineffective strategies (or strategies with limited evidence of effectiveness) alongside or instead of effective countermeasures highlights the importance of education, both in terms of effectiveness of countermeasures but also in understanding the cause of fatigue. It is vital that for individual fatigue countermeasures to work, vehicle operators know what is effective. Importantly, individuals will use what is available to them to manage fatigue, or what they think will work. Therefore, there is a need for education and discussion around countermeasure effectiveness, and accessibility to effective strategies, so that vehicle operators can make informed choices on what to do when fatigued.

5.7.4 Influence of other factors

The decision to use a fatigue countermeasure is a complex process which involves a chain of decisions (see Figure x.3 in Chapter xx), all of which need to be met to result in appropriate countermeasure use. Firstly, a vehicle operator must be able to recognize that they are fatigued. There has been debate relating to the extent individuals can accurately identify their sleepiness. For example, during experimental research, participants are frequently asked to report on their state, alerting them to their increasing sleepiness levels, which may be different to real-world driving. However, a recent systematic review concluded that drivers are aware of sleepiness when driving (Cai et al., 2021). Despite this, individuals continue to drive. This relates to the next step in the chain of decisions, that individuals need to be motivated to act on this feeling. Individuals can be motivated to act by using a countermeasure, or they may be motivated to continue driving, which may be exacerbated by pressure to continue working or the urge to get home following work, overriding acknowledgement of increasing sleepiness. Additionally, individuals are not able to predict the exact moment that they will fall asleep. Related to this, drivers must be aware of the consequences and risks of continuing to drive while fatigued. There are questions as to whether drivers acknowledge the risk of sleepiness, with research suggesting that sleepy driving is considered a risky behaviour, but not as risky as other driving behaviours, for example, speeding (Watling, Armstrong, Smith & Obst, 2016). Thinking back to May & Baldwin's model of fatigue causation (2009), individuals must also understand the cause of the fatigue and be aware of the appropriate strategies to counteract this. Finally, vehicle operators must not be prevented to act for example by barriers or restrictions such as limited access to facilities, incorrect knowledge or workplace culture.

As individual countermeasures are, by definition, strategies that an individual themselves choose to use (or not use) to reduce fatigue, education relating to effective countermeasures is essential, as it has the potential to inform decisions. Educating about the importance of adequate sleep and the risks and dangers of fatigue, as well as the availability of scientifically supported strategies to promote sleep and increase alertness is cited as a necessary component of workplace fatigue management (Caldwell et al., 2019). It is vital that individuals know how to recognize and understand the cause of fatigue, when to act (e.g., when to use an appropriate countermeasure and when to stop) and what to do when they are fatigued, and this can be facilitated by educational interventions and operator support. All workers within the transportation industry would benefit from education informing people about the basics of sleep health, and importantly, what is and what is not effective at reducing fatigue. It is clear from the research that individuals do *something* to manage their fatigue, and it is therefore essential that they know and understand the effectiveness of *what* they are using.

However, although education is important, it is not enough to mitigate fatigue as a standalone intervention. Any education must consider environment and accessibility, as restrictions may prevent individuals from using effective strategies. Education will not be effective if individuals are prevented from implementing knowledge gained. Access to facilities is key for individuals to be able to engage with effective strategies such as caffeine and napping, both requiring adequate facilities, and time. Workers are reliant on their organization for access. Therefore, even if individuals have been educated in effective strategies to reduce fatigue, if access to adequate facilities (e.g., canteens, toilets and napping areas) are not provided, then that knowledge cannot be used. Similarly, private drivers are reliant on access to safe places to stop to engage with strategies (e.g., service stations), with personal safety being an important consideration in terms of napping.

In relation to environment, certain professional groups have been shown to use caffeine and napping and this is likely influenced by their workplace. For example, truck drivers face fewer restrictions than public transport service providers, as, although they typically drive alone with restrictions on work hours and driving time, they can plan stops to engage with countermeasures. Private car drivers are also likely to be in control of their schedule and choosing when and where to stop. However, other transport drivers experience additional barriers to countermeasure use. Public service providers (e.g., bus, train, and tram drivers) are often the sole driver on duty responsible for their vehicle and are typically not in control of the timing or location of their rest breaks. These factors impact the use of countermeasures for both sleep- and task-related fatigue and could explain reliance on less effective strategies to manage fatigue as reported in section 5.7.3.

A final consideration, but arguably one of the most important, is workplace culture. As discussed in Chapter xx, an open safety culture is a key feature of successful fatigue management. In terms of countermeasures, decisions to use caffeine and napping strategies may be influenced by organizational perception, resulting in less engagement with effective measures even if there is adequate access to them. Open culture needs to be established to help facilitate conversations about fatigue and encourage engagement with effective countermeasures and educational interventions. However, as culture change takes time, other measures could be introduced to help alleviate fatigue risk (e.g., education) whilst working towards an open safety culture. Taking the time to develop this culture should lead to fatigue being discussed openly between workers and managers, resulting in honest conversations and increased incidence reporting. This is vital, as individual fatigue countermeasures should only be used in the short term, with the longer-term goal of addressing the root cause of any fatigue related problems being the main aim.

It is important to recognize that restrictions and barriers will likely lead individuals away from effective countermeasures, encouraging reliance on ineffective strategies that are less influenced by e.g., workplace constraints, or result in a lack of engagement with countermeasures at all (e.g., not taking any action to alleviate fatigue). This highlights the complex issue of individual countermeasure use, and the importance of an holistic approach.

5.7.5 Conclusion

The use of individual countermeasures is an important issue in the management of fatigue, with a need for effective strategies that vehicle operators can use before, during and after duty. However, these should be used strategically as short-term measures for mild fatigue and not relied upon. It is vital that increasing the uptake of effective countermeasures does not lead to overuse or encourage individuals to continue working when they are excessively fatigued. Individuals need to be educated in the use of countermeasures and have the ability and opportunity to use this knowledge when needed. Barriers that may restrict effective countermeasure use or encourage the use of ineffective measures need to be recognised and addressed. Importantly, there is a need to develop a culture whereby the management of fatigue, including effective countermeasures, can be discussed openly, ultimately reducing fatigue risk.

- It is important to understand the cause of fatigue to be able to use an appropriate countermeasure. This will require education.
- Caffeine and napping strategies can be effective as strategic, short-term countermeasures to sleep-related fatigue. Taking regular breaks can be effective for task-related fatigue.
- Restrictions impact countermeasure use, e.g., adequate access. Facilities should be reviewed and, where possible, provided, and initiatives introduced to enable workers to engage with effective countermeasures.
- Initiatives relating to individual countermeasures should not be provided in isolation, but as part of operational fatigue management, supported by an open safety culture.

5.7.6 References

Aidman , E., Johnson, K., Paech, G. M., Della Vedova, C., Pajcin, M., Grant, C., Kamimori, G., Mitchelson, E., Hoggan, B. L., Fidock, J., & Banks, S. (2018). Caffeine reduces the impact of drowsiness on driving errors. *Transportation Research Part F: Traffic Psychology and Behaviour, 54,* 236-247.

Anund, A., Kecklund, G., Peters, B., & Åkerstedt, T. (2008). Driver sleepiness and individual differences in preferences for countermeasures. *Journal of Sleep Research, 17*(1), 16–22.

Cai, A. W., Manousakis, J. E., Lo, T. Y., Horne, J. A., Howard, M. E., & Anderson, C. (2021). I think I'm sleepy, therefore I am–Awareness of sleepiness while driving: A systematic review. *Sleep Medicine Reviews, 60*, 101533.

Caldwell, J. A., Caldwell, J. L., Thompson, L. A., & Lieberman, H. R. (2019). Fatigue and its management in the workplace. *Neuroscience & Biobehavioral Reviews, 96*, 272–289.

Centofanti, S., Banks, S., Coussens, S., Gray, D., Munro, E., Nielsen, J., & Dorrian, J. (2020). A pilot study investigating the impact of a caffeine-nap on alertness during a simulated night shift. *Chronobiology International, 37*(9-10), 1469-1473.

Filtness, A. J., Hickman, J. S., Mabry, J. E., Glenn, L., Mao, H., Camden, M., & Hanowski, R. J. (2020). Associations between high caffeine consumption, driving safety indicators, sleep and health behaviours in truck drivers. *Safety Science, 126*, 104664.

Filtness, A. J., & Naweed, A. (2017). Causes, consequences and countermeasures to driver fatigue in the rail industry: The train driver perspective. *Applied Ergonomics, 60,* 12–21.

Gershon, P., Shinar, D., Oron-Gilad, T., Parmet, Y., & Ronen, A. (2011). Usage and perceived effectiveness of fatigue countermeasures for professional and nonprofessional drivers. *Accident Analysis & Prevention, 43*(3), 797–803.

Hilditch, C. J., Centofanti, S. A., Dorrian, J., & Banks, S. (2016). A 30-minute, but not a 10-minute nighttime nap is associated with sleep inertia. *Sleep, 39*(3), 675-685.

Hilditch, C. J., Dorrian, J., Centofanti, S. A., Van Dongen, H. P. A., & Banks, S. (2017). Sleep inertia associated with a 10-min nap before the commute home following a night shift: A laboratory simulation study. *Accident Analysis & Prevention, 99*(Part B), 411–415.

Hilditch, C. J., & McHill, A. W. (2019). Sleep inertia: Current insights. Nature and Science of *Sleep, 11*, 155–165.

Horne, J. A., & Baulk, S. D. (2004). Awareness of sleepiness when driving. *Psychophysiology, 41*(1), 161–165.

Horne, J. A., & Reyner, L. A. (1996). Counteracting driver sleepiness: Effects of napping, caffeine and placebo. *Psychophysiology, 33*(3), 306–309.

Horne, J. A., & Reyner, L. A. (1999). Vehicle accidents related to sleep: A review. *Occupational and Environmental Medicine, 56*(5), 289-294.

Irwin, C., Khalesi, S., Desbrow, B., & McCartney, D. (2020). Effects of acute caffeine consumption following sleep loss on cognitive, physical, occupational and driving performance: A systematic review and meta-analysis. *Neuroscience & Biobehavioral Reviews, 108*, 877–888.

May, J. F., & Baldwin, C. L. (2009). Driver fatigue: The importance of identifying causal factors of fatigue when considering detection and countermeasure technologies. *Transportation Research Part F: Traffic Psychology and Behaviour, 12*(3), 218–224.

Mets, M. A., Ketzer, S., Blom, C., Van Gerven, M. H., Van Willigenburg, G. M., Olivier, B., & Verster, J. C. (2011). Positive effects of Red Bull® Energy Drink on driving performance during prolonged driving. *Psychopharmacology, 214*(3), 737-745.

McLellan, T. M., Caldwell, J. A., & Lieberman, H. R. (2016). A review of caffeine's effects on cognitive, physical and occupational performance. *Neuroscience & Biobehavioral Reviews, 71*, 294–312.

Onninen, J., Hakola, T., Puttonen, S., Tolvanen, A., Virkkala, J., & Sallinen, M. (2020). Sleep and sleepiness in shift-working tram drivers. *Applied Ergonomics, 88*, 103153.

Phipps-Nelson, J., Redman, J. R., & Rajaratnam, S. M. (2011). Temporal profile of prolonged, night-time driving performance: Breaks from driving temporarily reduce time-on-task fatigue but not sleepiness. *Journal of Sleep Research, 20*(3), 404-415.

Pilkington-Cheney, F., Filtness, A. J., & Haslam C. (2020). A qualitative study exploring how city bus drivers manage sleepiness and fatigue. *Chronobiology International, 37*(9-10), 1502-1512.

Pylkkönen, M., Sihvola, M., Hyvärinen, H. K., Puttonen, S., Hublin, C., & Sallinen, M. (2015). Sleepiness, sleep, and use of sleepiness countermeasures in shift-working long-haul truck drivers. *Accident Analysis & Prevention, 80*, 201–210.

Reyner, L. A., & Horne, J. A. (2002). Efficacy of a "functional energy drink" in counteracting driver sleepiness. *Physiology & Behavior, 75*(3), 331–335.

Reyner, L. A., & Home, J. A. (1998). Evaluation of 'in-car'countermeasures to sleepiness: cold air and radio. *Sleep, 21*(1), 46-51.

Sallinen, M., Sihvola, M., Puttonen, S., Ketola, K., Tuori, A., Härmä, M., Kecklund, G., & Åkerstedt, T. (2017). Sleep, alertness and alertness management among commercial airline pilots on short-haul and long-haul flights. *Accident Analysis & Prevention, 98*, 320–329.

Schwarz, J. F. A., Ingre, M., Fors, C., Anund, A., Kecklund, G., Taillard, J., Philip, P., & Åkerstedt, T. (2012). In-car countermeasures open window and music revisited on the real road: popular but hardly effective against driver sleepiness. *Journal of Sleep Research*, *21*(5), 595–599.

Watling, C. N., Armstrong, K. A., Obst, P. L., & Smith, S. S. (2014). Continuing to drive while sleepy: The influence of sleepiness countermeasures, motivation for driving sleepy, and risk perception. *Accident Analysis & Prevention*, *73*, 262–268.

Watling, C. N., Armstrong, K. A., Smith, S. S., & Obst, P. L. (2016). Crash risk perception of sleepy driving and its comparisons with drink driving and speeding: Which behavior is perceived as the riskiest? *Traffic Injury Prevention, 17*(4), 400–405.

Watling, C. N., Smith, S. S., & Horswill, M. S. (2014). Stop and revive? The effectiveness of nap and active rest breaks for reducing driver sleepiness. *Psychophysiology, 51*(11), 1131–1138.