

# Tea Expert Newsletter

Issue eight

**Scientific update on  
the psychological  
benefits of black tea**



Unilever

# SCIENTIFIC UPDATE ON THE PSYCHOLOGICAL BENEFITS OF BLACK TEA

**Authors: Suzanne Einöther (MSc), Vanessa Martens (PhD), Scientists, Cognitive Psychology  
Unilever Research and Development, Vlaardingen, The Netherlands**

**Editor: Els de Groene (PhD); Nutrition and Health Director, Refreshment,  
Unilever Research & Development, Colworth, UK**

## “From the editor”

For centuries, tea drinkers have associated their favourite brew with a moment of wellbeing and mental clarity. However, until a decade ago, these alleged mental benefits of tea were mainly anecdotal.

In the past 15 years, the effects of tea consumption on mental performance, especially attention and mood, have been investigated in a number of studies. Together with external experts, Unilever pioneered in the area of the effects of tea and tea ingredients on attention, and reported the findings in over a dozen peer-reviewed publications.

In our previous newsletter on tea and attention, “Tea Expert Newsletter Issue 3: Scientific update on tea and attention”,<sup>1</sup> we presented a selection of findings demonstrating that black tea and the tea ingredients

caffeine and theanine help to improve attention and self-perceived work performance. In this issue we build on this with an update on recent science (2012-2013) on the psychological benefits of tea and tea ingredients.

Specifically, we will broaden the scope of black tea’s psychological benefits by highlighting a selection of studies that indicate how the attention benefits of black tea (and its ingredients) are more widespread than previously assumed. Moreover, we highlight findings that demonstrate why these effects are relevant to consumers in their everyday lives, for example in terms of improved driving performance and improved well-being when managing complex or stressful activities.

# CONTENTS

<b>1. INTRODUCTION</b>	<b>4</b>
<b>2. NEW NEWS ON TEA (INGREDIENTS) AND ATTENTION PERFORMANCE</b>	<b>6</b>
2.1 Performance benefits of water consumption	
2.2 Attention benefits of caffeine consumption	
2.3 Theanine, caffeine and sustained attention	
<b>3. EXTENSION OF TEA (INGREDIENT) BENEFITS TO PERFORMANCE AND WELL-BEING IN EVERYDAY LIFE</b>	<b>9</b>
3.1 Caffeine consumption benefits driving performance	
3.2 Theanine can reduce anxiety and blood pressure after a mental stress task	
<b>4. CONCLUDING REMARKS</b>	<b>11</b>
<b>5. REFERENCES</b>	<b>12</b>
<b>6. AUTHORS - Suzanne Einöther and Vanessa Martens</b>	<b>14</b>
<b>7. NOTES</b>	<b>15</b>



# 1. INTRODUCTION

## PSYCHOACTIVE INGREDIENTS IN TEA

Although tea contains a high number of compounds, the acute psychoactive effects of tea have generally been attributed to two compounds: caffeine, a trimethylxanthine derivative and the non-proteinic amino acid L-theanine (hereafter theanine),<sup>2</sup> both naturally occurring ingredients in tea. Other compounds, such as the polyphenol epigallocatechin gallate (EGCG), have been ascribed neuroprotective effects, focusing on long-term health benefits such as the prevention of cognitive decline or related diseases (i.e. Alzheimer's disease, stroke) in elderly and cognitively impaired populations.<sup>3</sup> Studies investigating the potential acute effects of EGCG did not report any benefits.<sup>4,5</sup>

Caffeine is naturally found in a large variety of foods (e.g. coffee, tea, chocolate) and is the most widely consumed psychoactive ingredient. A typical serving of black tea (200ml) naturally contains approximately 40mg caffeine. Theanine is an amino acid almost exclusively found in the tea plant. A typical serving of black tea will deliver between 4.5mg and 22.5mg theanine, depending upon the variety used, time of infusion, and amount of tea leaves used.

There is plenty of scientific evidence showing that caffeine and theanine have effects in the brain and are highly bioavailable.<sup>6-8</sup> The psychostimulant effects of caffeine have been frequently demonstrated. Specifically, caffeine increases self-reported alertness, improves mood, and enhances psychomotor activity and attention.<sup>9-11</sup> Theanine's psychoactive properties appear to be more complex. Theanine has been repeatedly demonstrated to stimulate alpha brain waves at rest, which are associated with relaxation.<sup>12,13</sup> Moreover, during attention task performance, theanine increased background (resting) alpha activity, yet decreased alpha activity when preparing to attend to the task stimuli, which has been related to better performance.<sup>14,15</sup> Behavioural effects of theanine were largely absent, although it should be noted that these studies were designed to measure brain activity rather than behavioural effects. In addition to the studies investigating the effects of caffeine and theanine in isolation, a number of other studies have also shown benefits of theanine and caffeine in combination on a range of attention outcomes.<sup>16-19</sup>

## ACUTE EFFECTS OF TEA ON ATTENTION

The effects of tea on attention were originally investigated in two studies comparing the effects of tea with coffee and water.<sup>20,21</sup> All caffeinated beverages improved performance and self-reported alertness when compared to decaffeinated beverages. However interestingly, some of the tasks showed benefits of caffeinated tea over caffeinated water (both 100mg),<sup>20</sup> or of tea with 75mg caffeine, when compared to coffee with the same amount of caffeine.<sup>21</sup> These findings suggested that tea effects are not merely due to caffeine content. Notably, both studies were of an open label design and thus did not control for expectations and taste differences between the beverages.

Two recent studies, described in greater detail in the earlier newsletter (Tea Expert Newsletter Issue 3: Scientific update on tea and attention),<sup>1</sup> employed a double blind, placebo controlled, cross-over design and more complex attention tasks to further investigate these effects.<sup>22</sup> The first study compared two cups black tea versus two cups of placebo tea (coloured and flavoured water) whereas the second compared three cups of a slightly weaker blend of black tea to three cups of placebo tea on two attention tests. Results showed that participants gave more correct answers on the switch task after consuming black tea in both studies. In the first study, participants also gave more correct answers on the second attention test after black tea. Moreover, the benefits of tea on objective performance were complemented by consistent improvements in subjective performance in both studies: participants reported feeling more alert after drinking tea as compared to placebo, underlining the consumer-relevance of tea's benefits on attention.

From the totality of research on tea it can be concluded that consumption of black tea improves attention and self-reported alertness. These conclusions are further supported by studies on caffeine, and theanine and caffeine in combination.

## EXTENDING THE SCIENCE

Although the findings to date provide a consistent picture of the effects of black tea on attention, a number of questions remain, for example regarding the specificity of the attention effect. The studies to date on black tea and attention largely employed rather simple tests of attention<sup>20,21</sup> or tests of focused attention, which involved switching between different task rules.<sup>22</sup> Other types of attention, such as the ability to remain attentive over prolonged periods of time (vigilance or sustained attention) as well as other cognitive processes which heavily rely on attention (working memory, reasoning) have yet to be investigated in relation to tea consumption.

Moreover, very few studies have been conducted to assess effects of tea and/or tea ingredients outside of the laboratory. Specifically, a cross-sectional study showed benefits of tea consumption on self-reported work performance.<sup>23</sup> Furthermore, the real life performance benefits of caffeine include improved vigilance during military combat,<sup>24,25</sup> simulated driving,<sup>26</sup> improved performance among shift workers,<sup>27</sup> and improved self-reported concentration while attending a university lecture<sup>28</sup>.

Laboratory tasks possess the rigor and control needed to reliably demonstrate effects of ingredients or other interventions, and most scientists argue that findings from laboratory studies can explain and predict behaviour.<sup>29</sup> However, real life tasks and field studies can give a more complete picture of how cognitive processes translate into complex everyday behaviours. Therefore, it is highly relevant to better understand the effects of the consumption of tea (or tea ingredients) on real life activities requiring attention, for example driving.

## CONTENT OF THE NEWSLETTER

In the current newsletter we build on the in the earlier newsletter on tea and attention (Tea Expert Newsletter Issue 3: Scientific update on tea and attention),<sup>1</sup> with an update on recent science around the psychological benefits of tea and tea ingredients.

Specifically, in Chapter 2 we provide an update on research on tea and tea ingredients in relation to attention performance, in order to extend the findings to a different aspect of attention, namely vigilance or sustained attention. In section 2.1 we will discuss a new study on the benefits of water consumption on cognitive performance, in particular vigilance our previous newsletter on tea and attention.<sup>30</sup> In section 2.2, the findings from a large review on attention benefits of caffeine are shared.<sup>11</sup> In section 2.3, we discuss a recent study which investigated the effects of the tea ingredients, theanine and caffeine, on sustained attention.<sup>31</sup>

In Chapter 3 we highlight studies that indicate the benefits of tea ingredients relevant to consumers in their everyday lives, for example in terms of improved driving performance<sup>32</sup> (section 3.1) or in relation to factors of physical or physiological stress which are important in both work and personal life<sup>33</sup> (section 3.2).



## 2. NEW NEWS ON TEA (INGREDIENTS) AND ATTENTION PERFORMANCE

### 2.1 PERFORMANCE BENEFITS OF WATER CONSUMPTION

**Edmonds CJ, Crombie R, Ballieux H, Gardner MR, Dawkins L.**

**Water consumption, not expectancies about water consumption, affects cognitive performance in adults. *Appetite*, 2013; 60(10): 148-153.**

#### ABSTRACT

Research has shown that water supplementation positively affects cognitive performance in children and adults. The present study considered whether this could be a result of expectancies that individuals have about the effects of water on cognition. Forty-seven participants were recruited and told the study was examining the effects of repeated testing on cognitive performance. They were assigned either to a condition in which positive expectancies about the effects of drinking water were induced, or a control condition in which no expectancies were induced. Within these groups, approximately half were given a drink of water, while the remainder were not. Performance on a thirst scale, letter cancellation, digit span forwards and backwards and a simple reaction time task was assessed at baseline (before the drink) and 20 min and 40 min after water consumption. Effects of water, but not expectancy, were found on subjective thirst ratings and letter cancellation task performance, but not on digit span or reaction time. This suggests that water consumption effects on letter cancellation are due to the physiological effects of water, rather than expectancies about the effects of drinking water. effect on the maintenance of weight loss. Of those studies recording information on adverse events, only two identified an adverse event requiring hospitalisation. The remaining adverse events were judged to be mild to moderate.

#### SUMMARY

The aim of the study was to examine whether the cognitive benefits of hydration come from expectations around benefits, rather than actual benefits. Participants first completed a baseline assessment. Next, they were allocated to 1 of 4 conditions based on whether they a) were informed about potential water consumption benefits, and whether they b) subsequently received a glass of water. Thus, group 1 was informed about expectations and was given 200ml water to drink, group 2 was informed about the same expectations but was not given water, group 3 was not informed about these expectations but was given a glass of water to drink, and finally group 4 was also not informed about expectations and also did not drink water. After 20 and 40 minutes participants repeated the assessment and following the last session they reported their mood and thirst levels. Performance on a visual attention task improved after water consumption, regardless of the water expectations. The other tasks (digit span backwards and forwards, simple reaction time) and the mood rating showed no significant differences related to water consumption or the expectations information. The results indicate that positive effects found after water consumption were not due to expectations and thus that consumption of water can benefit performance. Moreover, performance improved at both 20 and 40 minutes post consumption as compared to the no water controls.

#### INTERPRETATION

This study contributes to the growing research on the benefits of hydration. It is the first study to show that water can improve visual attention, regardless of expectations around its consumption. This is in contrast to expectancy effects found for caffeine.<sup>34</sup> It thus seems that benefits of drinking water should be sought in its hydrating properties. Relating physiological measures of hydration to performance could further support these conclusions. Although visual attention appeared particularly sensitive to water consumption in children<sup>35</sup> this is the first replication in adults. Contrary to earlier studies, water consumption did not affect self-reported mood. The authors speculate that adults may need to consume a larger amount of water to perceive its mood benefits. Notably, the tests used in this study are relatively simple attention tests compared to the tests used in the tea and attention studies. Whereas improved hydration may affect simple attention processes as compared to a no water condition, there is no evidence to date for more complex attention processes such as involved in the Switch task. Moreover, black tea containing theanine and caffeine resulted in improved performance as compared to a placebo which was also hydrating.<sup>22</sup> Thus, tea ingredients seem to benefit performance on top of the natural hydrating effects of 200ml water.

## 2.2

## 2.2 ATTENTION BENEFITS OF CAFFEINE CONSUMPTION

**Einöther SJ, & Giesbrecht T.**

**Caffeine as an attention enhancer: reviewing existing assumptions.**

**Psychopharmacology 2013; 225(2): 251-274.**

### ABSTRACT

**Rationale:** Despite the large number of studies on the behavioural effects of caffeine, an unequivocal conclusion had not been reached. In this review, we seek to disentangle a number of questions. **Objective:** Whereas there is a general consensus that caffeine can improve performance on simple tasks, it is not clear whether complex tasks are also affected, or if caffeine affects performance of the three attention networks (alerting, orienting and executive control). Other questions being raised in this review are whether effects are more pronounced for higher levels of caffeine, are influenced by habitual caffeine use and whether there effects are due to withdrawal reversal. **Method:** Literature review of double-blind placebo controlled studies that assessed acute effects of caffeine on attention tasks in healthy adult volunteers. **Results:** Caffeine improves performance on simple and complex attention tasks, and affects the alerting, and executive control networks. Furthermore, there is inconclusive evidence on dose-related performance effects of caffeine, or the influence of habitual caffeine consumption on the performance effects of caffeine. Finally, caffeine's effects cannot be attributed to withdrawal reversal. **Conclusions:** Evidence shows that caffeine has clear beneficial effects on attention, and that the effects are even more widespread than previously assumed.

### SUMMARY

This paper reviewed 66 publications on acute effects of caffeine on attention performance (1992-2012) and specific hypotheses were investigated. Firstly, the authors examined the specificity of these effects, using two well-known models of attention: the traditional model which distinguishes simple and complex attention processes<sup>36</sup> and the Attention Network Theory (ANT),<sup>37</sup> which distinguishes alerting, orienting, and executive function. In relation to the traditional model caffeine positively affected both simple and complex attention processes. It also appeared that the effect of caffeine consumption on complex attention processes was not solely dependent on its effect on simple processes. In relation to the ANT model, caffeine positively affected task components of alerting and executive control, but not orienting. Secondly, it was investigated whether a higher dose of caffeine would exert stronger benefits. Effects were apparent even at relatively low doses (50mg), and if anything medium doses (200mg) appeared most effective, but it must be noted that these were also most frequently tested. Furthermore, concerning the role of habitual caffeine consumption, studies comparing low, medium and/or high habitual consumers as well as consumers who normally did not drink caffeinated beverages showed no consistent influence of habitual consumption on these effects. The last hypothesis concerned the influence of caffeine withdrawal.

In the majority of studies on caffeine effects, volunteers were deprived of their habitual caffeine intake for a certain period before the intervention. Therefore, one may argue that beneficial effects merely reflect the reversal of caffeine withdrawal. While in some studies this appeared to be the case, the majority showed that caffeine effects cannot be attributed to withdrawal reversal.

### INTERPRETATION

High doses of caffeine are generally thought to affect simple attention processes and performance of alerting type of tasks. This review concludes that consumption of various doses of caffeine positively affected performance on a wide range of attention tasks, in line with the mechanism of action of caffeine. It can also be concluded that effects can be found regardless of the amount of caffeine that is normally consumed by the study participants or by caffeine withdrawal the night before the study. In sum, this review indicates caffeine has clear beneficial effects on attention performance, and that these effects are even more widespread than previously assumed. This means that relatively low doses of caffeine as consumed in tea (50mg) can reliably affect different aspects of attention, and that this is a net benefit, not merely a case of withdrawal reversal.





## 2.3 THEANINE, CAFFEINE AND SUSTAINED ATTENTION

**Foxe JJ, Morie KP, Laud PJ, Rowson MJ, De Bruin EA, Kelly, SP.**

**Assessing the effects of caffeine and theanine on the maintenance of vigilance during a sustained attention task. *Neuropharmacology* 2012; 62(7): 2320-2327.**

### ABSTRACT

*Caffeine and L-theanine, both naturally occurring in tea, affect the ability to make rapid phasic deployments of attention to locations in space as reflected in behavioural performance and alpha-band oscillatory brain activity (8–14 Hz). However, surprisingly little is known about how these compounds affect an aspect of attention that has been more popularly associated with tea, namely vigilant attention: the ability to maintain focus on monotonous tasks over protracted time-periods. Twenty-seven participants performed the Sustained Attention to Response Task (SART) over a two-hour session on each of four days, on which they were administered caffeine (50mg), theanine (100mg), the combination, or placebo in a double-blind, randomized, cross-over fashion. Concurrently, we recorded oscillatory brain activity through high-density electroencephalography (EEG). We asked whether either compound alone, or both in combination, would affect performance of the task in terms of reduced error rates over time, and whether changes in alpha-band activity would show a relationship to such changes in performance. When treated with placebo, participants showed a rise in error rates, a pattern that is commonly observed with increasing time-on-task, whereas after caffeine and theanine ingestion, error rates were significantly reduced. The combined treatment did not confer any additional benefits over either compound alone, suggesting that the individual compounds may confer maximal benefits at the dosages employed. Alpha-band oscillatory activity was significantly reduced on ingestion of caffeine, particularly in the first hour. This effect was not changed by addition of theanine in the combined treatment. Theanine alone did not affect alpha-band activity.*

### SUMMARY

In this study, participants visited the lab on four occasions.<sup>27</sup> On each occasion they received one of four treatments (placebo, 50mg caffeine, 100mg theanine, or 50mg caffeine combined with 100mg theanine) dissolved in 200 ml cold water and completed a sustained attention task before and after consumption. During task performance high-density electroencephalography (EEG) was used to measure brain activity in the alpha band. The results showed that caffeine, theanine, and caffeine and theanine in combination improved task performance on the SART as compared to placebo in terms of reduced number of errors, while caffeine alone improved response speed. Furthermore, EEG results showed that consumption of caffeine and caffeine and theanine in combination decreased alpha activity, which has been associated with improved attention focus. There were no significant effects of theanine alone on alpha activity. Nor were there differences between the caffeine only and caffeine plus theanine conditions that could indicate a synergistic effect.

### INTERPRETATION

Sustained attention, or the ability to maintain vigilance over protracted periods of time, is an integral part of cognitive performance in daily life. This study shows that caffeine and theanine, both alone and in combination, can improve vigilance. The caffeine and theanine combination did not improve vigilance compared to caffeine and theanine alone. The authors propose that the improvements by caffeine may have led to a ceiling effect, leaving no room for further improvement when theanine was added. In contrast to earlier studies, theanine alone showed no effects on alpha brain activity.<sup>38</sup> The authors conclude that theanine dose plays an important role, and a logical next step would be to investigate this in a dose-response study.

# 3. EXTENSION OF TEA (INGREDIENT) BENEFITS TO PERFORMANCE AND WELL-BEING IN EVERYDAY LIFE

## 3.1 CAFFEINE CONSUMPTION BENEFITS DRIVING PERFORMANCE

**Sharwood LN, Elkington J, Meuleners L, Ivers R, Boufous S, Stevenson M.**  
**Use of caffeinated substances and risk of crashes in long distance drivers of commercial vehicles: case-control study. *British Medical Journal* 2013; 346: f1140.**

### ABSTRACT

The objective of this article is to determine whether there is an association between use of substances that contain caffeine and the risk of crash in long distance commercial vehicle drivers. A case-control study in New South Wales (NSW) and Western Australia (WA), Australia was conducted. Five hundred and thirty (530) long distance drivers of commercial vehicles who were recently involved in a crash attended by police (cases) and 517 control drivers who had not had a crash while driving a commercial vehicle in the past 12 months were studied. The likelihood of a crash associated with the use of substances containing caffeine after adjustment for factors including age, health disorders, sleep patterns, and symptoms of sleep disorders as well as exposures such as kilometres driven, hours slept, breaks taken, and night driving schedules was studied. The results show that 43% of drivers reported consuming substances containing caffeine, such as tea, coffee, caffeine tablets, or energy drinks for the express purpose of staying awake. Only 3% reported using illegal stimulants such as amphetamine ("speed");<sup>3,4</sup> methylenedioxymethamphetamine (ecstasy); and cocaine. After adjustment for potential confounders, drivers who consumed caffeinated substances for this purpose had a 63% reduced likelihood of crashing (odds ratio 0.37, 95% confidence interval 0.27 to 0.50) compared with drivers who did not take caffeinated substances. Caffeinated substances are associated with a reduced risk of crashing for long distance commercial motor vehicle drivers. While comprehensive mandated strategies for fatigue management remain a priority, the use of caffeinated substances could be a useful adjunct strategy in the maintenance of alertness while driving.

### SUMMARY

This epidemiological study explored the use of caffeinated substances during driving in relation to the risk of crashing. Researchers conducted interviews with 1047 long distance drivers of commercial vehicles: 530 case drivers, who were reported by the police to have crashed their commercial vehicle but without serious injuries while on a long distance trip, and 517 control drivers not involved in crashes in the previous 12 months. Self-reported consumption of caffeinated beverages over the past month was recorded in terms of the substances the drivers normally used to stay awake during a long drive. Results showed that drivers in the control group used more caffeine to stay awake during driving than the drivers who had crashed; 37% of the control drivers were high habitual users (i.e. consuming over 400mg of caffeine a day) versus 13% of case drivers. There was a lower risk of crashes for drivers who consumed caffeinated beverages and this was maintained after adjusting for potential confounders.

### INTERPRETATION

The current study, albeit of an epidemiological and not of experimental nature, is the first to confirm benefits of caffeine on real-world driving outside of the laboratory. The findings from this study are consistent with those from lab studies, in which caffeine helps participants to sustain attention during a vigilance task,<sup>31</sup> as well as benefits of caffeine during simulated driving.<sup>26</sup> Notably the results apply to caffeinated beverages in general, thus including tea as well as other substances containing caffeine.





## 3.2 THEANINE CAN REDUCE ANXIETY AND BLOOD PRESSURE AFTER A MENTAL STRESS TASK

**Yoto A, Motoki M, Murao S, Yokogoshi H.**

***Effects of L-theanine or caffeine intake on changes in blood pressure under physical and psychological stresses. Journal of Physiological Anthropology 2012; 31(1): 1-9.***

### ABSTRACT

*L-theanine, an amino acid contained in green tea leaves, is known to block the binding of L-glutamic acid to glutamate receptors in the brain, and has been considered to cause anti-stress effects by inhibiting cortical neuron excitation. Both L-theanine and caffeine, which green tea contains, have been highlighted for their beneficial effects on cognition and mood. In this study, we investigated the effects of orally administered L-theanine or caffeine on mental task performance and physiological activities under conditions of physical or psychological stress in humans. Fourteen participants each underwent three separate trials, in which they orally took either L-theanine + placebo, caffeine + placebo, or placebo only. The results after the mental tasks showed that L-theanine significantly inhibited the blood-pressure increases in a high-response group, which consisted of participants whose blood pressure increased more than average by a performance of a mental task after placebo intake. Caffeine tended to have a similar but smaller inhibition of the blood-pressure increases caused by the mental tasks. The result of the Profile of Mood States after the mental tasks also showed that L-theanine reduced the Tension-Anxiety scores as compared with placebo intake. The findings above denote that L-theanine not only reduces anxiety but also attenuates the blood-pressure increase in high-stress-response adults.*

### SUMMARY

The researchers examined whether administration of theanine or caffeine could reduce effects of mental and physical stress. Fourteen participants visited the lab on three occasions. On each occasion they first performed baseline measures of mood, blood pressure and skin temperature, and then received a capsule containing one of three treatments (placebo, 200mg theanine, or 100mg caffeine). After intake, participants performed two difficult tasks designed to induce mental stress for a total of 40 minutes, a target detection task and an arithmetic task. Afterwards, mood, blood pressure and skin temperature were measured again and a physical stress task was executed by participants putting their hand into a bucket of slushy ice water before a final measurement. Based on the blood pressure data, participants were split into two groups, those that strongly reacted to the stressors (high-response) and those that did not (low-response). In the period after the mental stress task, theanine significantly decreased both systolic and diastolic blood pressure as compared to placebo but only for the high response group. Caffeine's effects, although present, were less pronounced. Theanine also decreased the perceived tension and anxiety after the mental stress task both in the high and the low-response group, as compared to placebo. Neither ingredient affected outcomes after the physical stress task.

### INTERPRETATION

The findings show that a high dose of theanine is promising in counteracting mental stressors. Administration of theanine, and to a lesser extent caffeine, both present in green tea as well as black tea, can reduce increases in blood pressure induced by a mental stress task. These findings further build on earlier findings showing that theanine can antagonise the detrimental effect of caffeine (200mg) on blood pressure.<sup>39</sup> Moreover, participants also felt less anxious or tense after the mental stress task when they had ingested theanine before the task. This supports earlier findings on the acute relaxing properties of theanine from animal studies and EEG studies measuring alpha activity, which has been related to relaxation.<sup>12,13</sup> Moreover, they provide a potential mechanism of action for other findings, such as reduced stress markers and increased subjective relaxation after tea consumption,<sup>40</sup> and a strong relation between high consumption of green tea (>5 cups daily) and lower levels psychological distress.<sup>41</sup> Interestingly, the tasks used can be easily translated to everyday work-related and personal activities requiring complex calculations and vigilance that can induce stress in consumers.

## 4. CONCLUDING REMARKS

### FROM THIS OVERVIEW OF THE RECENT SCIENCE, SEVERAL KEY MESSAGES EMERGE:

#### **Tea and its ingredients have widespread benefits on attention.**

On top of the hydrating benefits of tea on attention performance,<sup>30</sup> tea ingredients caffeine and theanine further improve attention

- Relatively low doses of caffeine as consumed in tea (40mg) can reliably affect different aspects of attention, and this reflects a net benefit, not merely a case of withdrawal reversal.<sup>11</sup>
- Caffeine and theanine in combination can improve the ability to maintain vigilance over prolonged periods of time, which is an integral part of cognitive performance in daily life.<sup>31</sup>

#### **Moreover, such benefits are not only relevant and perceivable in a lab context, but also in situations relevant to everyday performance and well-being.**

- Consumption of caffeinated beverages including tea may help sustain attention during driving as it is associated with a reduced risk of car crashes among long distance commercial vehicle drivers.<sup>32</sup>
- Consumption of theanine, an ingredient unique to tea, is promising in counteracting everyday mental stressors; theanine, more so than caffeine, can reduce increases in blood pressure induced by a mental stress task and makes participants feel less anxious or tense.<sup>33</sup>

Summarising, this newsletter further builds on the evidence for the psychological benefits of tea and tea ingredients by extending the existing research to other aspects of attention (e.g. sustained attention) and to outcomes that are relevant to consumers in their everyday lives (e.g. improved driving performance and stress reduction).



## 5. REFERENCES

1. Einother, S.J.L., Giesbrecht, T., & De Bruin, E.A. (2012). Tea Expert Newsletter Issue 3: Scientific update on tea and attention.
2. Bryan, J. (2008). Psychological effects of dietary components of tea: caffeine and L-theanine. *Nutrition reviews*, 66(2), 82-90.
3. Song, J., Xu, H., Liu, F., & Feng, L. (2012). Tea and cognitive health in late life: current evidence and future directions. *Journal of Nutrition and Healthy Aging*, 16, 31-34.
4. Scholey, A., Downey, L.A., Ciorciari, J., Pipingas, A., Nolidin, K., Finn, M., Wines, M., Catchlove, S., Terrens, A., Barlow, E., Gordon, L., & Stough, C. (2012). Acute neurocognitive effects of epigallocatechin gallate (EGCG). *Appetite*, 58, 767-770.
5. Wightman, E.L., Haskell, C.F., Forster, J.S., Veasey, R.C., & Kennedy, D.O. (2012). Epigallocatechin gallate, cerebral blood flow parameters, cognitive performance and mood in healthy humans: a double-blind, placebo-controlled, crossover investigation. *Human Psychopharmacology*, 2, 177-186.
6. Magkos, F., & Kavouras, S.A. (2005). Caffeine use in sports, pharmacokinetics in man, and cellular mechanisms of action. *Critical Reviews in Food Science and Nutrition*, 45, 535-562.
7. Dager, S.R., & Friedman, S.D. (2000). Brain imaging and the effects of caffeine and nicotine. *Annals of Medicine*, 32, 592-599.
8. Van der Pijl, P., Chen, L., & Mulder, T. (2010). Human disposition of L-theanine in tea or aqueous solution. *Journal of Functional Foods*, 2, 239-244.
9. Ruxton, C. H. S. (2008). The impact of caffeine on mood, cognitive function, performance and hydration: a review of benefits and risks. *Nutrition Bulletin*, 33, 15-25.
10. Smith, A. (2002). Effects of caffeine on human behaviour. *Food and Chemical Toxicology*, 40, 1234-1255.
11. Einöther, S. J., & Giesbrecht, T. (2013). Caffeine as an attention enhancer: reviewing existing assumptions. *Psychopharmacology*, 225 (2), 251-274.
12. Kobayashi, K., Nagato, Y., Aoi, N., Juneja, L. R., Kim, M., Yamamoto, T. et al. (1998). Effects of L-theanine on the release of alpha-brain waves in human volunteers. *Nippon Nogeikagaku Kaishi-Journal of the Japan Society for Bioscience Biotechnology and Agrochemistry*, 72, 153-157.
13. Nobre, A. C., Rao, A., & Owen, G. N. (2008). L-theanine, a natural constituent in tea, and its effect on mental state. *Asia Pacific Journal of Clinical Nutrition*, 17, 167-168.
14. Gomez-Ramirez, M., Higgins, B. A., Rycroft, J. A., Owen, G. N., Mahoney, J., Shpaner, M., & Foxe, J. J. (2007). The deployment of intersensory selective attention: a high-density electrical mapping study of the effects of theanine. *Clinical neuropharmacology*, 30(1), 25-38.
15. Gomez-Ramirez, M., Kelly, S. P., Montesi, J. L., & Foxe, J. J. (2009). The effects of L-theanine on alpha-band oscillatory brain activity during a visuo-spatial attention task. *Brain topography*, 22 (1), 44-51.
16. Haskell, C.F., Kennedy, D.O., Milne, A.L., Wesnes, K.A., & Scholey, A.B. (2008). The effects of L-theanine, caffeine and their combination on cognition and mood. *Biological Psychology*, 77, 113-122.
17. Owen, G. N., Parnell, H., De Bruin, E. A., & Rycroft, J.R. (2008). The combined effects of L-theanine and caffeine on cognitive performance and mood. *Nutritional Neuroscience*, 11, 193-198.
18. Einöther, S. J. L., Martens, V. E. G., Rycroft, J. A., & De Bruin, E. A. (2010). L-Theanine and caffeine improve task switching but not intersensory attention or subjective alertness. *Appetite*, 54, 406-409.
19. Giesbrecht, T., Rycroft, J.A., Rowson, M.J., and De Bruin, E.A. (2010). The combination of L-theanine and caffeine improves cognitive performance and increases subjective alertness. *Nutritional Neuroscience*, 13, 283-290.
20. Hindmarch, I., Quinlan, P. T., Moore, K. L., & Parkin, C. (1998). The effects of black tea and other beverages on aspects of cognition and psychomotor performance. *Psychopharmacology*, 139, 230-238.
21. Hindmarch, I., Rigney, U., Stanley, N., Quinlan, P., Rycroft, J., & Lane, J. (2000). A naturalistic investigation of the effects of day-long consumption of tea, coffee and water on alertness, sleep onset and sleep quality. *Psychopharmacology*, 149, 203-216.
22. De Bruin, E. A., Rowson, M. J., Van Buren, L., Rycroft, J. A., & Owen, G. N. (2011). Black tea improves attention and self-reported alertness. *Appetite*, 56 (2), 235-240.
23. Bryan, J., Tuckey, M., Einöther, S. J., Garczarek, U., Garrick, A., & De Bruin, E. A. (2012). Relationships between tea and other beverage consumption to work performance and mood. *Appetite*, 58 (1), 339-346.
24. McLellan, T.M., Kamimori, G.H., Voss, D.M., Bell, D.G., Cole, K.G., & Johnson, D (2005). Caffeine maintains vigilance and improves run times during night operations for Special Forces. *Aviation, Space and Environmental Medicine*; 76, 647-654.

# 5.

25. McLellan T.M., Kamimori, G.H., Voss, D.M., Tate, C., & Smith, S.J. (2007). Caffeine effects on physical and cognitive performance during sustained operations. *Aviation, Space and Environmental Medicine*, 78, 871-877.
26. Brice, C. & Smith, A. (2001). The effects of caffeine on simulated driving, subjective alertness and sustained attention. *Human Psychopharmacology*, 16: 523-531.
27. Ker K., Edwards P.J., Felix L.M., Blackhall K., Roberts I. (2010). Caffeine for the prevention of injuries and errors in shift workers. *Cochrane Database Systematic Reviews*, CD008508.
28. Peeling, P., & Dawson, B. (2007). Influence of caffeine ingestion on perceived mood states, concentration, and arousal levels during a 75-min university lecture. *Advances in physiology education*, 31: 332-335.
29. Wilson, T. D., Aronson, E., & Carlsmith, K. (2010). The art of laboratory experimentation. In S. T. Fiske, D. T. Gilbert, & G. Lindzey (Eds.), *Handbook of social psychology* (Vol. 1, pp. 51-81). Hoboken, NJ: Wiley.
30. Edmonds, C. J., Crombie, R., Ballieux, H., Gardner, M. R., & Dawkins, L. (2013). Water consumption, not expectancies about water consumption, affects cognitive performance in adults. *Appetite*, 60 (10), 148-153.
31. Foxe, J. J., Morie, K. P., Laud, P. J., Rowson, M. J., De Bruin, E. A., & Kelly, S. P. (2012). Assessing the effects of caffeine and theanine on the maintenance of vigilance during a sustained attention task. *Neuropharmacology*, 62 (7), 2320-2327.
32. Sharwood, L. N., Elkington, J., Meuleners, L., Ivers, R., Boufous, S., & Stevenson, M. (2013). Use of caffeinated substances and risk of crashes in long distance drivers of commercial vehicles: case-control study. *British Medical Journal*, 346, f1140
33. Yoto, A., Motoki, M., Murao, S., & Yokogoshi, H. (2012). Effects of L-theanine or caffeine intake on changes in blood pressure under physical and psychological stresses. *Journal of physiological anthropology*, 31 (1), 1-9.
34. Dawkins, L., Shahzad, F. Z., Ahmed, S. S., & Edmonds, C. J. (2011). Expectation of having consumed caffeine can improve performance and mood. *Appetite*, 57(3), 597-600.
35. Edmonds, C. J. (2012). Water, hydration status and cognitive performance. In L. Riby, M. Smith, & J. Foster (Eds.), *Nutrition and mental performance. A lifespan perspective*. UK: Palgrave Macmillan.
36. Lim, J., & Dinges, D.F. (2010) A meta-analysis of the impact of short-term sleep deprivation on cognitive variables. *Psychological Bulletin*, 136, 375-389
37. Posner, M.I., & Petersen, S.E. (1990). The Attention System of the Human Brain. *Annual Review of Neuroscience*, 13, 25-42.
38. Kelly, S. P., Gomez-Ramirez, M., Montesi, J. L., & Foxe, J. J. (2008). L-theanine and caffeine in combination affect human cognition as evidenced by oscillatory alpha-band activity and attention task performance. *The Journal of nutrition*, 138(8), 1572S-1577S.
39. Rogers, P. J., Smith, J. E., Heatherley, S. V., & Pleydell-Pearce, C. W. (2008). Time for tea: mood, blood pressure and cognitive performance effects of caffeine and theanine administered alone and together. *Psychopharmacology*, 195(4), 569-577.
40. Steptoe, A., Gibson, E.L., Vuononvirta, R., Williams, E.D., Hamer, M., Rycroft, J.A., Erusalimsky, J.D., & Wardle, J. (2007) The effects of tea on psychophysiological stress responsivity and poststress recovery: a randomised double-blind trial. *Psychopharmacology*, 190, 81-89.
41. Hozawa, A., Kuriyama, S., Nakaya, N., Ohmori-Matsuda, K., Kakizaki, M., Sone, T., Nagai, M., Sugawara, Y., Nitta, A., Tomata, Y., Niu, K., & Tsuji, I. (2009). Green tea consumption is associated with lower psychological distress in a general population: the Ohsaki Cohort 2006 Study. *American Journal of Clinical Nutrition*, 90, 1390-1396.



## 6. AUTHORS



**Suzanne Einöther** is a Scientist at Unilever R&D in Vlaardingen, The Netherlands. Suzanne obtained her MSc degree in Psychology at the University of Maastricht, The Netherlands (2005), with a specialization in Cognitive Psychology.

Since joining Unilever in 2005 as a cognitive psychologist, Suzanne has been involved in researching the effects of food products and food ingredients on human cognitive performance, and mood and well-being. Mainly, she has been involved in several studies investigating the psychological benefits of tea and tea ingredients. In 2012, Suzanne was an invited speaker for the 5th International Symposium on Tea and Human Health (Washington DC) and she frequently gives presentations on tea benefits at scientific conferences as well as symposia organized by the Lipton Institute of Tea.



**Vanessa Martens** is a Scientist at Unilever R&D in Vlaardingen, The Netherlands. She obtained her PhD in Cognitive Psychology at the University of Amsterdam, The Netherlands (2006), focusing on children developing reading ability, after having completed two MSc degrees in Cognitive Psychology and Applied Linguistics at the University of Nijmegen (both 2001), with a focus on language processing.

Since 2006, Vanessa has worked at Unilever, mainly on projects investigating links between food (components) and human cognition (e.g. attention, memory, learning, perception, mood) in both adults and children, and the impact of communication on consumer perception, for a range of product categories including tea and tea ingredients.





Unilever  
[www.unilever.com](http://www.unilever.com)



Published October 2013  
Information for expert scientists  
All information correct at time of going to press