The effect of a competitive Futsal match on psychomotor vigilance in referees

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Abstract

Purpose: Referees' physical and cognitive performance are important for successful officiating in team sports. There is a lack of research on cognitive performance in referees in general, and none in Futsal. The aim of the present study was to assess referees' performance on the Psychomotor Vigilance Task (PVT) before and after competitive Futsal matches during the FA National Futsal League 2015/16. **Methods**: Fourteen Futsal referees (mean ± SD: age 34.3 ± 10.0 years) from the FA National Futsal Group were included. The referees were required to undertake a 10-minute PVT at 60 minute before the match kick-off time (pre-test) and immediately after matches (post-test). They also completed the Brunel Mood Scale (BRUMS) questionnaire before the pre-match PVT and after the post-match PVT. **Result:** Data were analysed by paired t-tests comparing pre- and post-match results. There was a significant difference in BRUMS parameters vigour (9.5 ± 2.5 pre- vs 6.3 ± 2.4 post-match, $p = 0.001$) and fatigue (1.4 ± 1.3 pre- vs 5.6 ± 3.1 post-match, $p < 0.001$). However, PVT performance was significantly improved (mean reaction time 248.3 ± 26.2 ms pre- vs 239.7 ± 22.4 ms post-match, $p = 0.023$). **Conclusions**: The present results show, contrary to our initial hypothesis, that psychomotor performance is improved as opposed to decreased after a single match. The post-match improvement suggests that exercise can acutely enhance cognitive performance, which could be used to inform warm-up practices (e.g. optimal duration and intensity) geared towards optimising cognitive performance of referees during matches.

Keywords: PVT, referees, Futsal; cognitive performance, decision-making

Introduction

Futsal is one of the official FIFA games and is played between two teams consisting of five players per team. Futsal is a high-intensity intermittent team sport with changes in activity every 3.28 seconds [1] and is therefore considered to be quick and demanding (both physically and mentally) for both players and referees [2]. Weston et al. [3] indicated that mental performance is essential in refereeing but there are limited studies investigating referees' cognitive performance and decisions. In addition, the physiological demands placed on the referee are equally essential but there is also limited research and understanding of this specifically in relation to referees in a Futsal game [4].

There are many studies [5,6] that have explored activity analysis and physiological demands in detail for football referees, and also investigated fitness and referee performance [6,7] but to our knowledge there are only three studies on Futsal referees [8–10]. It is crucial to consider factors such as cognitive performance of referees as this plays a vital role in decision-making [11]. Fatigue is known to be greater in the latter stages of matches, and this may contribute to impaired cognitive performance and decision-making [12]. For example, Mallo et al [13] investigated the accuracy of referees' decisions during the FIFA Confederation Cup 2009 (football) and found that incorrect decisions occurred twice as often in the second-half of the match than in the first-half suggesting the influence of fatigue. Futsal and football are different in terms of physiological profile and demands placed on referees and therefore the studies on football should not be assumed to be relevant to Futsal referees. For Futsal referees, we are aware of only one study [8] that examined decision-making performance, which did indicate that there was an increase in the percentage of incorrect decisions and missed fouls in the second-half, possibly due to increased fatigue at this time.

The 10-minute Psychomotor Vigilance Task (PVT) is widely used to assess neurobehavioral performance and cognitive functioning [14]. The 10-minute PVT is suitable for laboratory studies and has been used extensively in sport and exercise contexts [15,16]. As such, the PVT can provide valuable practical insight into the effects of competitive matches on cognitive function in referees. The use of the PVT in field studies before and after real matches has the potential to provide further insight into the effects of actual real-life performance that may have more practical relevance. The Brunel Mood State (BRUMS) [17] is widely used in mental fatigue (MF) research and has been shown to accurately reflect changes in mental fatigue status induced by cognitively demanding tasks and exercise [18,19].

Referees play an extremely important role in the match and they must maintain attention and cognitive performance throughout the match in order to correctly implement the rules of the game and manage the match [20]. This cognitive demand, in combination with the physical demands and fatigue might be expected to contribute to reduced cognitive performance. Any changes in cognitive performance during a match/resulting from a match have the potential to influence referees' performance (such as decision-making) in the latter stages of a match [21] or in subsequent matches if officiating multiple games on the same day (a common occurrence in competitive Futsal tournaments or leagues). Tomporowski and Ellis [22] have shown that physical activities significantly impact cognition and the acute effects on cognitive performance are influenced by the nature of the exercise. Cognitive performance may be

enhanced or decreased depending on the timing of assessment, fitness/training status of the athlete and intensity and duration of the exercise [22,23].

The aim of this study was to determine the effect of a competitive Futsal match on cognitive performance. The study of Ahmed et al [8] observed evidence of fatigue in the latter stages/second-half and this may have been linked to the decrease in decision-making performance (% correct decisions). It was hypothesized, therefore, that referees' PVT performance would deteriorate post-match as a result of physical and/or mental fatigue induced by the match.

Methods

All methods and experimental procedures were approved by the University of Kent, School of Sport & Exercise Sciences, Research Ethics and Advisory Group (Approval reference No: 100_2014_2015), and were carried out in accordance with the declaration of Helsinki. All participants gave their written informed consent before taking part.

Subjects

Fourteen male Futsal referees aged between 18-45 years (mean ± SD: age 34.3 ± 10.0 years; height, 178.2 ± 8.9 cm; weight 82.7 ± 13.3 kg) volunteered to take part in the study. Participants were recruited from the FA National Futsal Group (this represents the whole of the national list of FA Futsal referees in England at the time of the study) and the study took place during the FA National Futsal League 2015/16 season, with permission from the FA. All referees had more than 5 years refereeing experience at the time of testing.

Study Design

Before commencement of this study (with official competitive matches in which referees performance could impact on the match outcome) a pilot study was conducted to ensure that undertaking the 10-minute PVT before the match would not adversely affect referee cognitive performance in the match. The results of the pilot study confirmed that the completion of a10-minute PVT did not influence referees' cognitive or decision-making performance over the subsequent 2 hours. After agreeing to participate, referees were sent a link to an online (http://www.sleepdisordersflorida.com/pvt1.html#responseOut) practice version of the PVT and asked to practice at home for familiarisation. Futsal matches last 40 minutes in total, comprised of two equal periods of 20 minutes (with the half-time interval which must not exceed 15 minutes) [20]. However, the clock must be stopped when the ball is out of play, so actual match-time is typically much longer (for example, the average match-time reported in our earlier study was 79.6 minutes [8].

The present study recorded seven competitive league matches, so fourteen (2 per match) Futsal referees were studied in total. On match day, referees were asked to arrive approximately 1.5

h prior to kick-off time (they are usually instructed by the FA to arrive 1 h before, so the extra 30 minutes allowed the time necessary for research participation without impeding their usual preparation). They first completed the 2- minutes familiarisation of the PVT test (to consolidate the prior familiarisation and also to familiarise them with the specific portable equipment to be used for the actual study test). They then had a 30 minutes rest before they completed the 10-minute PVT at 60 minute before the match kick-off time. They were then free to undertake their usual warm-up and preparation routine (usually 45 minutes to 30 minutes pre-match). After they completed the warm-up, they were fitted with the heart rate (HR) monitor. They then completed the match as normal before repeating these measures as soon as convenient for them after the match (commencing within 4 minutes). They were asked to express session rating of perceived exertion (RPE) 10 minutes after the first-half ended (i.e. during the half-time interval) and 10 minutes after the final PVT "after the second-half" (> 10 minutes and < 30 minutes post-match).

Heart rate

Heart rate was recorded continuously through the match every 1 second for the 1st and 2nd halves using a telemetric chest strap and wrist watch receiver (Vantage NV HR monitor, Polar, Kempele, Finland). The HR monitor was attached to the referees before kick-off and removed 10 minutes post-match.

Session Rating of Perceived Exertion (RPE):

Session RPE has been used as a tool for monitoring physical activity load in team sport athletes (players and officials) [5]. Therefore, each referee was asked to express the session RPE (relating to the half just completed) 10 minutes after the first-half ended (i.e. during half-time interval) and 10 minutes after the second-half ended (post-match) by using the Borg's CR10-scale modified by Foster *et al*. [24].

The Brunel Mood Scale (BRUMS)

Mood questionnaires (BRUMS) were recorded before PVT (pre-match) and post PVT after the game (post-match) to assess the presence of mental fatigue. The BRUMS questionnaire [17] was used to assess current mood (''How do you feel right now?'') on a 24-item questionnaire, which provides scores for six subscales (Anger, Confusion, Depression, Fatigue, Tension and Vigour). Participants rate responses on a 5-point Likert scale (0 = not at all, 1 = a little, 2 = moderately, 3 = quite a bit; 4 = extremely), with a completion time of approximately 1 to 2 minutes.

PVT Procedures

The PVT was conducted using a portable electronic device (PVT-192-PVTCommW/REACT Software: PVTCommW version 2.61, Ardsley, Westchester County, New York, United States). In this test, subjects were instructed to attend closely to a stimulus window and to press the response button with the thumb of the dominant hand (by pressing either the right or the left push button) as soon as a red stimulus counter appeared on the Cathode Ray Tube (CRT) screen, making an effort to keep response times as short as possible throughout the task. The stimulus, occurred randomly at intervals from 2 to 10 seconds and was a digital counter (displaying milliseconds) that appeared in red in a light-emitting diode (LED) window located on the device. The counter increased (in milliseconds) until the response button was pushed (stopping the counter and displaying the reaction time to the subject).

Statistical Analysis

Parametric tests were used when the parametric assumptions were met (PVT parameters and BRUMS fatigue). Two-way repeated measures analysis of variance (ANOVA) was used to compare the 10 minute PVT pre- and post-match data (2 factors: condition has 2 levels, pre-match and post-match; time has 10 levels comprised of the average score for each 1 minute segment in the 10 minute PVT). Paired sample t-tests were performed for comparison of overall mean PVT parameters (for the whole 10 min test) between pre and post-match (Reaction Time (RT), Slowest 10% RT and Fastest 10% RT). When the data were not normally distributed (and could not be normalised with transformations) non-parametric tests were used (Wilcoxon matched-pairs test) for BRUMS tension, depression, anger, vigour and confusion (pre- and post-match), HR (First and second halves), sRPE (half-time and post-match) and other PVT performance measurements (Total Errors, Lapses, and Square Root Transformed lapses [Lapse-XFRM]).

Result

Two-way repeated measures ANOVA showed a significant main effect of condition (pre-match vs post-match: $F = 6.65$, $p = 0.023$) and time ($F = 3.93$, $p = 0.009$) but no condition × time interaction ($F = 0.64$, $p = 0.761$): see Figure 1. There was a significant difference in the overall 10 minute PVT mean reaction time pre- and post-match (248.3 ± 26.2 ms pre- vs 239.7 ± 22.4 ms post-match, $p = 0.023$). There was no significant difference for other PVT results (Total Errors, Lapses [RT > 500ms], Lapse-XFRM, Slowest 10% [1/RT] and Fastest 10% reaction times) as shown in Table 1. Individual results for each referee can also be found in Supplementary Table 1.

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BRUMS vigour and fatigue were significantly different post-match: vigour 9.5 ± 2.5 pre- vs 6.3 ± 2.4 post-match ($p = 0.001$), fatigue 1.4 ± 1.3 pre- vs 5.6 ± 3.1 post-match ($p = 0.001$) (Table 2). There were no differences for any of the other BRUMS parameters (tension, depression, anger and confusion) as shown in Table 2, however there was a trend for Tension to decrease post-match ($p = 0.053$) (Table 2).

***** Please insert Table 2 near here *****

The mean HR was 123.6 ± 20.3 bpm. Referees showed significant differences in HR (first-half compared to second-half) and session RPE in relation to the 1st vs 2nd halves, as shown in Table 3.

***** Please insert Table 3 near here *****

Discussion

To the best of our knowledge, this is the first study to assess perceptual-cognitive performance of Futsal referees following actual competitive matches. The main findings of the present study are that officiating a competitive Futsal match improved PVT performance. This differs to our original hypothesis as it was expected the combined physical and mental demands of the match would have negative effects on cognitive performance. Comparable results have been found in previous studies [25,26] with football players in which psychomotor performance was found to improve after different running activities (low and high intensity). The explanation given was that different exercise activities (low and moderate) activate central nervous system (CNS) functions and thus psychomotor performance can be improved [25]. Therefore, it is likely that the combined physical and mental stress of the match in the present study was not sufficiently demanding to have a negative effect on performance, and may actually have been beneficial.

It has been shown that moderate intensity exercise enhances brain function and improves cognitive performance [27,28]. This was suggested to be related to the effects of exercise on the CNS and levels of neurotransmitters [27]. In the present study the average intensity (as indicated by HR) was lower than those reported in previous studies on Futsal referees [8–10]. This suggests that overall intensity (and physiological demand) of the matches was relatively low-to-moderate in the present study compared to others. It is likely that the acute effects of exercise are determined by the nature of the exercise, including intensity and duration (and thus the amount of fatigue experienced), [27,28]. It was reported that after prolonged exercise (for 40 or 60 minutes), cognitive performance improved, even if fatigue symptoms appeared classically reported [28]. In addition, in the review of Tomporowski [29], it was indicated that the capacity for attention and cognition improved after prolonged exercise/aerobic exercise compared with pre-exercise. In contrast, several studies [23,29] indicated that exercise did not improve cognitive

function. Indeed, acute exercise could impair/decrease cognitive performance [27,28]. It seems, therefore, that the specific, relative demands of the exercise dictate the direction of the effect on cognitive performance. Indeed, Tomporowski [29] noted the complex nature of the relationship between exercise-induced arousal and cognitive performance. On the other hand, Elsworthy, Burke and Dascombe [30] conducted a study on football and rugby referees in a laboratory and found that there was no difference between pre- and post-exercise response of reaction time, even though their physical performance (total distance coverage) declined in the second-half. It is possible that the referees self-select to reduce their work output (i.e. slower and/or less distance) when fatigued and this reduction in physical performance is protective against consequent decreases in mental performance and may explain differences compared to findings with exhaustive exercise or laboratory studies where total work or exercise intensity is externally controlled (e.g. fixed intensity to exhaustion) or maximal performance in a time-trial is used [18,19]. This cannot be fully determined in the present study but the decrease in mean HR in the second-half lends at least some tentative support to this. It would have been useful to be able to assess cognitive performance at half-time, or at regular intervals during the match (when fatigue levels may have been higher), but this is not feasible in a real match situation. Therefore, laboratory simulation studies may be useful to provide further insight into this.

The present results suggest that referees were able to maintain their cognitive performance over the course of a match, which could suggest resilience to negative effects of physical and mental fatigue. It could be that the actual physical demand was relatively low (i.e. their specific fitness was sufficient) so that the match was equivalent to moderate exercise, which is known to acutely enhance cognitive function [28]. It is also possible that the referees were well trained and adapted (accustomed) to the demands of the match (including the cognitive demands) and so the match did not represent a significant challenge for them. Indeed, the fact that they have at least 5 years of experience mean that they may be well 'trained' for and resistant to these demands. Indeed, it has been shown that cognitively demanding training [18] and elite status [31] are associated with resistance to the effects of physical and mental fatigue on both physical and cognitive performance, although these studies were not in referees. This cannot be fully determined in the present study but the decrease in mean HR in the second-half lends at least some tentative support to this. It would have been useful to be able to assess cognitive performance at half-time, or at regular intervals during the match (when fatigue levels may have been higher), but this is not feasible in a real match situation. Therefore, laboratory simulation studies may be useful to provide further insight into this.

This study found that referees improved cognitive performance post-exercise. This could provide practical implications of relevance to pre-match strategies (e.g. warm-up) for optimising subsequent performance. However, since this was not a main objective of this study, it can only show that an increase in performance (i.e. speeding of RT) was present pre- to post-exercise. Future studies should further explore the relationship to identify the optimal type (including duration and intensity) of exercise (or perhaps the minimal amount needed) for optimal benefit to cognitive performance.

Mood states results indicated that there was no significant difference between pre- and post-match findings in tension, depression, anger and confusion. However, increased fatigue and decreased vigour post-match fit the profile of mental and physical fatigue (suggesting referees did experience some mental fatigue post-match). However, in line with the results for HR and session RPE, these results suggest that the match was not as physically demanding as seen in a previous study [8]. As such, if the matches were more demanding as reflected by higher mean HR, session RPE and greater changes in relevant BRUMS scores (e.g. more comparable with physiological and mental fatigue profiles seen in previous studies in Futsal referees [8] or general exercise/mental fatigue studies [18,19]) it is possible that PVT results would be adversely affected. It is only possible to speculate on this at present, and further study is required with more demanding matches and/or laboratory simulation studies with a higher overall exercise-intensity. It is also possible that the increased BRUMS fatigue scores expressed post-match (when psychomotor performance was improved) are just an expression of referees' perception due to the physical demands only (or an expectation that they should increase).

Limitations

A limitation of the present study is that the overall physical demand (indicated by mean HR and session RPE) was lower than that reported in other studies ([8,10]). The effects of more strenuous matches (and/or repeated matches on the same day) may differ to the findings of this study. Future research should seek to explore this further by studying a variety of matches to cover a range of demands from easy to very intense and strenuous. This 'dose-response' effect could be further explored/validated with lab-based simulation studies. Since there is some evidence that cognitively demanding training and elite status are associated with resistance to the effects of physical and mental fatigue (in other sports) it would also be useful for future research to compare referees of different levels and/or experience.

It is also a limitation that the PVT can only be administered before and after the match, as this might miss the most intense and demanding (or fatiguing) times during the match. It would not be practical or feasible to undertake additional PVTs during a real match but this would be possible in a simulated lab-based match or a 'friendly' match organised just for the purposes of a research study, in which it would be possible to stop the match for PVTs to be undertaken at various times during the game.

It was also not possible to video the matches in this study. If this was possible it would allow further exploration of the relationships between changes in cognitive performance (e.g. PVT) post-match and decision-making performance in the later stages of the match. This is an area that could be explored further in future studies.

Practical Applications

As the PVT performance was improved post-exercise, it is possible that this could be used to inform pre-match preparation (e.g. warm-up) with a view to optimising cognitive preparation/performance although further work is required to identify the optimal durations

and intensities of exercise required to elicit this. The findings of the present study are applicable to single matches, however and the effects may be different in situations where referees are required to officiate multiple matches in a single day or over consecutive days, which is common in many tournament situations in Futsal.

Conclusion

In conclusion, the present findings were in opposition to the initial hypothesis that the PVT performance would decrease post-match, due to mental and physical fatigue. These results suggest that referees were able to maintain their cognitive performance over the course of a match even though perception of BRUMS fatigue increased and vigour decreased post-match. This could be due to the relative demands (both physical and cognitive) being moderate (associated with enhanced function via activation of the CNS) and/or a high level of resistance to decrements in referees. The latter could be an innate characteristic of top level referees or something that develops with training/practice (since all referees had at least 5 years of experience).

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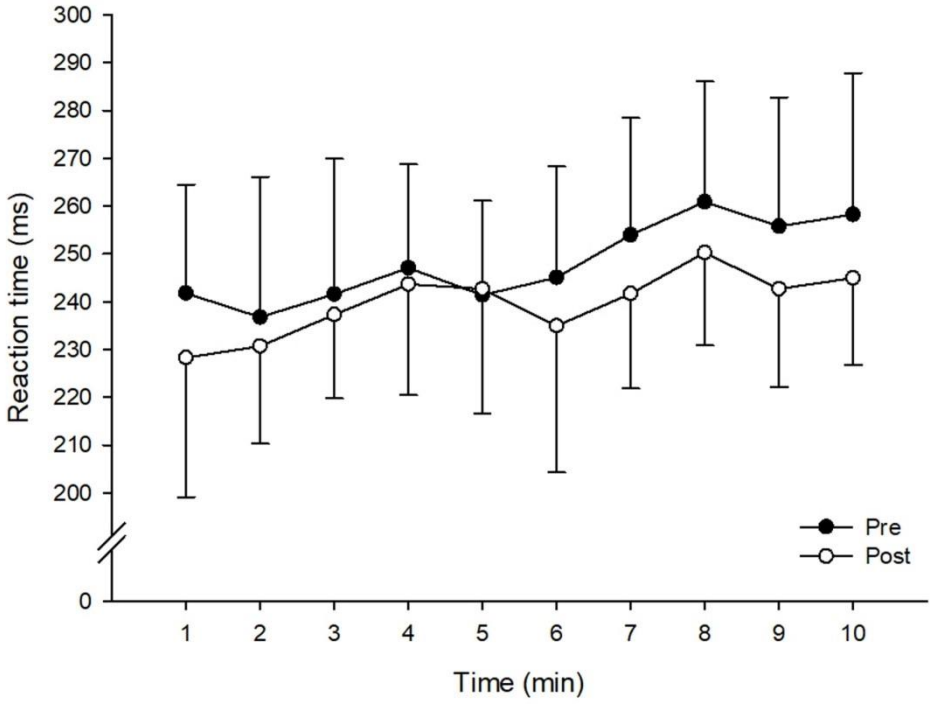

Figure 1: Psychomotor vigilance test reaction time (PVT) pre and post-match.

Individual results for each referee can also be found in Supplementary Table 1.

Table 1: Psychomotor vigilance test (PVT) parameters pre and post-match.

PVT measures	Pre-match	Post-match	Statistical analysis values (t/z, p)
Total Errors	3.1 ± 4.8	3.8 ± 4.9	z = - 1.23, p = 0.127
Lapses (RT > 500ms)	0.8 ± 1.1	0.6 ± 0.8	z = - 0.33, p = 0.739
Lapse-XFRM	1.8 ± 1.1	1.8 ± 0.9	z = 0.00, p = 1.000
Slowest 10% (1/RT)	2.8 ± 0.4	2.9 ± 0.3	t = - 1.05, p = 0.309
Fastest 10% (1/RT)	5.3 ± 0.6	5.4 ± 0.5	t = -0.72, p = 0.482

Data are presented as mean ± SD (n=14). RT (mean reaction time, RT). Total Errors (in whole 10 min test). Lapses (RT > 500ms). Lapses-XFRM (Lapses square root transformed). Slowest 10% (1/ slowest 10% RT). Fastest 10% (fastest 10% RT).

Table 2: BRUMS conditions pre and post-match.

	BRUMS Q		Statistical analysis values (t/z, p)
	Pre-match	Post-match	
Tension	0.7 ± 0.9	0.2 ± 0.6	z = - 1.93, p = 0.053
Depression	0.1 ± 0.3	0.2 ± 0.6	z = - 1.41, p = 0.157
Anger	0.2 ± 0.6	0.4 ± 0.6	z = - 0.70, p = 0.480
Vigour	9.5 ± 2.5	6.3 ± 2.4	z = - 3.18, p = 0.001
Fatigue	1.4 ± 1.3	5.6 ± 3.1	t = - 4.91 p < 0.001
Confusion	0.3 ± 0.6	0.2 ± 0.6	z = - 0.37, p = 0.705

Data are presented as mean ± SD (n=14)

Statistical analysis values (t/z, p) show comparisons between pre and post-match (t when parametric, z when non-parametric tests used).

Table 3: Heart rate and RPE.

Heart rate	First half	Second half	Statistical analysis values (z, p)
	125.6 ± 20.5	121.7 ± 20.8	z = -2.10, p = 0.035
Session RPE	Half-time	Post-match	Statistical analysis values (z, p)
	3 ± 1	4 ± 1	z = -2.38, p = 0.017

Data are presented as mean ± SD (n=14)

Statistical analysis values (z, p) show comparisons between pre and post-match (t when parametric, z when non-parametric tests used).

Supplementary table 1: Psychomotor vigilance test (PVT) reaction time pre- and post-match - individual referees' results

values show RT in ms

	PRE_minute 1	PRE_minute 2	PRE_minute 3	PRE_minute 4	PRE_minute 5	PRE_minute 6	PRE_minute 7	PRE_minute 8	PRE_minute 9	PRE_minute 10	**Trial average**
Ref 1	254.4	250.7	228.1	255.9	254.9	249.7	251.2	269.2	251.7	263.1	**252.9**
Ref 2	237.5	228.6	260.6	266.5	253.5	258.5	243.9	254.9	283.1	269.1	**255.6**
Ref 3	234.2	212.1	229.7	239.1	224.9	265.6	243.9	267.6	271.5	289.9	**247.8**
Ref 4	222.9	202.6	200.2	214.3	216.8	196.7	225.2	254.7	219.6	230.2	**218.3**
Ref 5	252.5	241.6	241.4	235.9	273.8	264.0	295.7	289.3	295.6	314.4	**270.4**
Ref 6	210.9	184.4	218.4	231.5	211.9	218.1	255.3	299.8	267.7	258.7	**235.7**
Ref 7	221.7	265.1	236.9	247.8	239.9	258.8	287.7	264.8	261.0	241.0	**252.5**
Ref 8	230.9	242.6	213.1	232.1	231.0	237.2	242.9	225.7	237.4	225.1	**231.8**
Ref 9	225.6	208.7	222.0	235.5	210.0	232.4	232.3	232.2	211.3	221.2	**223.1**
Ref 10	240.1	244.6	235.7	238.1	247.0	232.7	212.7	251.6	211.9	213.0	**232.7**
Ref 11	291.6	288.5	292.4	287.0	293.3	290.9	271.8	312.5	271.0	285.8	**288.5**
Ref 12	278.8	215.6	291.3	259.0	233.3	228.7	281.6	240.8	285.5	283.9	**259.9**
Ref 13	256.4	260.0	275.3	287.6	266.2	251.1	272.1	248.3	261.4	262.9	**264.1**
Ref 14	227.5	269.4	237.4	228.8	222.8	247.6	239.9	241.7	252.0	257.8	**242.5**

	POST_minute 1	POST_minute 2	POST_minute 3	POST_minute 4	POST_minute 5	POST_minute 6	POST_minute 7	POST_minute 8	POST_minute 9	POST_minute 10	**Trial average**
Ref 1	248.1	243.9	258.6	248.6	259.0	245.1	225.1	255.8	266.3	243.4	**249.4**
Ref 2	255.9	257.3	246.9	278.6	246.6	263.5	257.5	250.4	267.7	243.9	**256.8**
Ref 3	223.9	225.2	239.6	222.5	271.3	231.8	228.9	244.4	238.8	227.5	**235.4**
Ref 4	216.4	222.0	240.7	228.4	223.9	237.5	266.3	240.3	212.8	236.5	**232.5**
Ref 5	273.0	243.8	250.8	248.2	247.1	247.8	285.5	286.8	228.7	280.6	**259.2**
Ref 6	183.7	187.5	228.2	208.9	242.2	175.1	212.4	252.7	279.0	267.0	**223.7**
Ref 7	205.3	242.3	243.7	244.9	217.9	214.5	223.1	250.3	229.8	235.1	**230.7**
Ref 8	224.5	214.2	218.2	230.5	226.4	220.1	236.6	215.6	221.8	207.8	**221.6**
Ref 9	195.9	222.1	229.2	266.6	236.3	190.3	235.5	227.5	235.7	247.9	**228.7**
Ref 10	227.7	208.8	214.8	229.0	219.4	219.0	228.0	226.0	218.4	227.0	**221.8**
Ref 11	288.3	255.1	210.6	266.5	241.9	284.6	252.3	266.7	239.4	252.1	**255.7**
Ref 12	216.8	257.8	272.8	282.5	281.2	241.2	254.3	257.0	265.1	257.0	**258.6**
Ref 13	229.3	226.3	243.8	213.8	241.5	237.4	230.6	278.3	240.5	258.3	**240.0**
Ref 14	207.4	222.9	224.1	242.4	242.9	281.4	247.6	252.1	253.8	245.9	**242.1**