The effect of a modified Brain Break warming-up protocol on executive function and mood state in esport players

Efecto de un protocolo modificado de calentamiento Brain Break sobre la función ejecutiva y el estado de ánimo en jugadores de esports

Authors

Pongsatorn Sritubtim[1]
Tanida Julvanichpong[1]
Garry Kuan[2]
Poonpong Suksawang[1]
Amornpan Ajjimaporn[3]
Chatkamon Singnoy[1]

[1] Burapha University (Thailand)
[2] Universiti Sains Malaysia (Malaysia)
[3] Mahidol University (Thailand)

Corresponding author:
Chatkamon Singnoy
chatkamon@go.buu.ac.th

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Abstract

Introduction: This study explored the influences of a modified brain break warm-up—combining structured physical movement and mindfulness—on various aspects of executive function and mood state in elite Thai esports players.
Objective: To explore the effect of the Modified Brain Break Warm-up (MBBW) program on executive function and mood states in esports players.
Methodology: Sixty players were classified according to proficiency and randomly allocated to either an experimental group performing the MBBW or a control group doing general esports warm-ups. Executive function was measured through inhibitory control, reaction time, task shifting, and working memory updating. Mood state and refocusing were assessed through standard psychological procedures. Between-group analyses of post-intervention results were subjected to statistical analyses.
Results: The protocol led to significantly larger effects on all outcome measures compared to the control condition. Pro-player and amateur experimental groups both trained enhanced inhibitory control, switching task reaction time, and refocusing ability. The program also increased feelings of vigorousness and decreased confusion, depression, fatigue, and anger. It is worth noting that on several cognitive metrics, the low-level experimental group also outperformed the high-level control, indicating very positive effects of the program at both skill levels.
Discussion: The MBBW protocol is an effective and evidence-based means to improve cognitive preparation and negative psychological states prior to competition.
Conclusion: The outcome of this study suggests that the MBBW is effective at promoting executive function and mood state in esports players.

Keywords

Esports players; executive function; brain break warm-up; mood state.

Resumen

Introducción: Este estudio examinó los efectos de un protocolo de calentamiento Brain Break modificado, que combinó movimientos físicos estructurados y ejercicios de atención plena, sobre la función ejecutiva y el estado de ánimo en jugadores tailandeses de deportes electrónicos.
Objetivo: Determinar si el calentamiento Brain Break modificado mejora la función ejecutiva y los estados de ánimo en jugadores de deportes electrónicos.
Metodología: Sesenta jugadores fueron clasificados por nivel de habilidad y asignados aleatoriamente a un grupo experimental, que realizó el calentamiento modificado, o a un grupo de control, que efectuó un calentamiento general. La función ejecutiva se evaluó mediante control inhibitorio, tiempo de reacción, cambio de tarea y actualización de la memoria de trabajo. El estado de ánimo y la capacidad de reenfoque se midieron con escalas psicológicas estandarizadas. Se utilizaron análisis estadísticos para comparar los resultados posteriores a la intervención.
Resultados: El protocolo produjo mejoras superiores al control en todas las variables. Los grupos experimentales profesional y amateur mostraron mejor control inhibitorio, mayor rapidez en el cambio de tarea y mayor capacidad de reenfoque. Asimismo, aumentó el vigor y disminuyeron la confusión, depresión, fatiga y enfado. El grupo amateur experimental superó al grupo profesional de control en varios dominios cognitivos.
Discusión: El calentamiento Brain Break modificado actuó como un método eficaz para optimizar la preparación cognitiva y reducir estados psicológicos negativos antes del rendimiento competitivo.
Conclusiones: Los resultados confirman que el calentamiento Brain Break modificado es una estrategia efectiva para mejorar la función ejecutiva y el estado de ánimo en jugadores de deportes electrónicos.

Palabras clave

Jugadores de esports; función ejecutiva; calentamiento brain break; estado de ánimo.

Introduction

Brain Break (BB) exercises are short, purposeful breaks that are aimed at refocusing neural attention from task-oriented cognitive pathways to other pathways. Such activities usually make use of some form of physical activity, mindfulness, or sensory input to generate neuromodulatory changes that relieve cognitive fatigue and restore the person to the optimal level of readiness for learning or performance (Expertise, 2004). Research on BB activities in educational settings has shown that children are better able to maintain their attentional focus, control their behavior, and improve their academic performance by activating arousal systems through physiological stimulation, which increases blood flow in the brain through cerebral oxygenation and promotes extensive activation throughout the entire brain (Ramsay & Rostain, 2003; Reilly et al., 2012). Small BB activities—especially those lasting no longer than a few minutes—performed often are the most effective in promoting learning and in helping with relaxation, or 'blowing off steam' and frustration (Donnelly et al., 2009; Jensen, 2008).

A strong body of research demonstrates the immediate benefits of micro-breaks (<10 min) to mood and executive functioning in various populations. The micro-break has been found to significantly increase vigor and reduce fatigue, contributing to an individual's subjective well-being (Benhard R, 2022). Brief (five-minute) periods of light exercise or being in nature quickly boost positive mood and esteem (Barton & Pretty, 2010). Randomized trials have shown that a five-minute physical BB improves children's inhibitory control and attentional regulation (Chatzopoulos et al., 2024); they have also shown that short periods of rest or of experiencing nature refocuses adults' concentration, increasing their problem-solving performance (Sydney, 2023). Moreover, short breaks in prolonged sitting quantifiably improvements global cognitive thinking, as reported in recent meta-analytic research (Giurgiu et al., 2024).

At the same time, the music used in BB activities improves the latter's psychophysiological effects. Moderate-fast music tempos (e.g., about 105–130 beats per minute (BPM)) are found to maximize arousal, assist motor synchronization, decrease perceived exertion, and improve affective responses (Chen et al., 2021; Lin et al., 2023). These effects are attributed to neural resonance mechanisms, with rhythmic auditory stimulation entraining oscillatory activity in the prefrontal, limbic, and motor networks to facilitate effective executive control and emotional regulation (Graham et al., 2021). Accordingly, the careful choice of music is an important element for achieving low-level sensorimotor, cognitive, and emotional effects related to BB-based interventions.

While more extensive research on esports is needed, accumulating evidence indicates that BB principles apply well to competitive gaming. Experimental studies indicate that some cognitive processes are sensitive to PA, not only before games/sessions but also during game breaks, in a range of computer-based games. Additionally, brief exercise (e.g., short walking breaks) potentiates reaction times, executive control functions, and subjective performances during prolonged gameplay, compared to non-stop play or passive rest (Donoghue et al., 2021). Observational data in childrens's esports training indicate that short, fun activity breaks are associated with better mood and attentional engagement, as well as improved team communication and training quality (Østergaard et al., 2024). The importance of such interventions is reinforced by increasing evidence that esports players suffer from high stress, cognitive load, and emotional fluctuations that negatively impact their performance (Gündoğdu et al., 2021; Zanini et al., 2018).

Esports performance relies on complex psychological processes, specifically the executive functions covering sustained attentional control, decision-making under pressure, and cognitive flexibility, along with the capacity for emotion regulation to maintain competitive proficiency. These extensive cognitive demands, which also include long periods of attention and spatial visual processing, are central in the esports context. Recent comparative evidence has highlighted significant differences in cognitive profiles between active players and non-gamers, underscoring the importance of these executive functions in elite gaming performance (Chainarong et al., 2025; Pedraza-Ramirez et al., 2025). Whereas open-skill sports typically produce larger increases in executive function than closed-skill sports (Gallotta et al., 2020; Gu et al., 2019; Pancar, 2020), new research suggests that esports practice—when combined with modality-appropriate movement-based activities—can elicit acute changes in attention and executive processes (Gong et al., 2019;

Hagiwara et al., 2019). Crucially, the efficacy of these movement-based approaches is often mediated by psychological state; mood state significantly affects cognitive performance, and states of positive affect and vigor facilitate executive control, attention, and cognitive flexibility (Alghadir et al., 2016; Sudo & Ando, 2020). Consequently, researchers have increasingly explored non-invasive cognitive priming tools; for instance, studies of BB interventions routinely show that they improve these functional domains, such as refocusing, attention, and short-term memory (Hajar et al., 2019; Rizal et al., 2019; Weslake & Christian, 2015).

It can be postulated that a modified BB warm-up involving physical-structure movement and rhythmically synchronized music may serve as a potential preparatory strategy to improve the psychological preparedness of esports players. Accordingly, the aim of this study is to assess how a modified BB warm-up affects mood states and executive function (EF), with the ultimate goal of establishing an esports-specific warm-up protocol that can improve cognitive performance and emotional regulation prior to training sessions and competitive play.

Method

Participants

The researchers analyzed 60 esports players. The sample size was determined by the G*Power 3.1 software, with an effect size estimate of f = 0.25, α = .05, and power = .80. Players were recruited through esports clubs, training centers, and online communication channels. The participants were first purposively and then matched - pair randomized into experimental and control groups. Participants were required to be aged ≥18 years, and they were classified as a Pro-player or amateur esports players according to competitive ranking, training experience, and team registration. Recovery from injury and competition suspension were not considered. Written informed consent was obtained from all participants. Ethical clearance has been obtained from the Human Research Ethics Committee, Burapha University (G-HS034/2567(C1)).

Table 1. Participant Characteristics

Group	Level	Players (n)	Male (n)	Female (n)	Primary Games
PE (Pro-player Experimental)	Pro	15	15	-	ROV, PUBG, VALORANT
PC (Pro-player Control)	Pro	15	15	-	ROV, PUBG, VALORANT
AE (Amateur Experimental)	Amateur	15	9	6	ROV, PUBG
AC (Amateur Control)	Amateur	15	9	6	ROV, PUBG

From Table1 The demographics of the participants are shown in Table 1. This analysis serves to ensure that with a overall sample size (N = 60), participants are equally distributed between the four groups (Experimental and Control; Pro-player and Amateur). This allocation provides a reasonable foundation for subsequent analysis and allows inspection of any differences between the treatment (MBBW) and control (General Warm-up) conditions within both playing levels.

Procedure

All participants began with baseline assessments of mood state and executive function. They were then categorized in terms of expertise level and randomly assigned to the experimental or the control group. The experimental group completed the Modified Brain Break Warm-up (MBBW) before training sessions 3 times weekly over a 6-week period, while the control group completed what is currently considered a 'traditional' esports warm-up (mobility, stretching, and game-related activation exercises). Unrestricted esports training was allowed during the intervention. At the end of the 6-week period, all participants took post-tests with the same as the baseline. Participants were told to keep their sleep patterns as constant as posible (minimum 7 hours of sleep) and to avoid caffeine, energy drinks, and alcohol for at least 24 hours before the test, as avoiding these substances has been shown to reduce confounding variables. All the MBBW sessions were performed in a training-camp-like environment with standard temperature (25°C), light, and noise levels.

Testing was synchronized with the structured schedules of the teams and were held at identical periods during the day.

Instrument

The Modified Brain Break Warm-up (MBBW) program included rhythmic movement at 105 BPM for esports players; it was validated for content relevance. Mood was assessed by the Thai Athlete Mood Scale (TAMS), a questionnaire consisting of 5 subscales (depression, anger, fatigue, confusion, and vigor) to determine each mood domain's reliability. The measure of executive function was based on four validated tests:

Trail Making Test (TMT-A/B): processing speed and task shifting

Stroop Color and Word Test: inhibition and reaction time

Digit Span (Forward/Backward): short-term and working memory

Mindfulness Inventory for Sport (MIS-Thai): refocusing ability

All assessments were administered individually under controlled testing conditions.

Data were collected at two timepoints: pre-test and post-test. Five executive function domains and five mood state dimensions were measured across these two points to determine the efficacy of the 6-week intervention.

Data analysis

Data were analyzed using jamovi. The effects of the intervention were assessed using a 2 (Group: Experimental vs. Control) × 2 (Level: Pro-player vs. Amateur) × 2 (Time: Pre-test vs. Post-test) mixed-design ANCOVA. The 10 outcome variables were the five measures of executive function and five dimensions of mood states. Statistical significance was set at $p < .05$.

Results

The intention of these results is, first, to reveal the efficacy of the MBBW in a statistical comparison with a general active warm-up and, second, to highlight that MBBW leads to identical effects when performed by Pro-player and amateur esports players.

Effects on Executive Functions

Table 2. Reaction Time (Stroop Test) and Inhibition of Dominant Responses (Stroop Interference Score)

Group	Variable	Pre-Test M ± SD	Post-Test M ± SD	P-value
PE (MBBW)	Congruent RT	188.62 ± 32.37	181.15 ± 30.69	.004*
	Incongruent RT	430.97 ± 48.43	381.88 ± 58.00	.001*
	Stroop Interference Score	242.29 ± 45.33	200.73 ± 65.40	.001*
AE (MBBW)	Congruent RT	261.57 ± 41.76	249.52 ± 38.02	.001*
	Incongruent RT	566.53 ± 56.85	489.31 ± 57.31	.001*
	Stroop Interference Score	304.96 ± 73.63	239.79 ± 72.40	.001*

*Significant differences, $p < .05$

Paired-samples *t*-test analyses are presented in Table 2; they indicate greater pre- to post-test improvements in reaction time performance in the Pro-player Experimental (PE) and Amateur Experimental (AE) groups after the MBBW intervention (all $p < .01$). In both groups, participants were also faster in the congruent and incongruent Stroop trials, representing improved processing speed and attentional efficiency. Significant reductions in Stroop Interference Scores were also reported for both groups, indicating increased inhibition of a dominant automated response and greater executive control. Taken together, these results suggest that the MBBW intervention improved medial-brain-related core components of EF in terms of selective attention, cognitive inhibition, and interference control, regardless of skill level.

Table 3. Task Shifting (Trail Making B) and Processing Speed (Trail Making A)

Group	Variable	Pre-Test M ± SD	Post-Test M ± SD	P-value
PE (MBBW)	Trail Making A	19.42 ± 2.82	17.91 ± 1.40	.003*
	Trail Making B	44.63 ± 8.09	37.97 ± 4.68	.001*
AE (MBBW)	Trail Making A	21.10 ± 3.39	18.92 ± 1.33	.002*
	Trail Making B	47.60 ± 8.78	42.72 ± 4.89	.001*

*Significant differences, *p* < .05

Table 3 shows that paired-samples *t*-test results pre- and post-MBBW show significant improvement behavior observed only for the PE and AE groups on processing speed which is represented in the TMT-A and task-shifting ability as reflected with represented in the TMT-B (all *p* < .01). Specifically, both groups showed significantly reduced completion times for the TMT-A, indicating better visual scanning efficiency and psychomotor velocity, similarly, the large reductions in TMT-B completion reflected a gain in cognitive flexibility and executive control. Together these results indicate that the MBBW program is successful in training improvements in core executive functions at both skill levels.

Table 4. Short-term memory (Digit Span Forward) and Working Memory Updating (Digit Span Backward)

Group	Variable	Pre-Test M ± SD	Post-Test M ± SD	P-value
PE (MBBW)	Digit Span Forward	13.0 ± 1.44	15.13 ± .92	.001*
	Digit Span Backward	8.80 ± 2.48	10.93 ± 2.05	.001*
AE (MBBW)	Digit Span Forward	12.53 ± 1.81	14.07 ± 1.10	.001*
	Digit Span Backward	5.93 ± 1.98	7.87 ± 2.17	.001*

*Significant differences, *p* < .05

Table 4 illustrates paired-samples *t*-test analyses that compared pre- to post-test changes in short-term memory storage capacity (Digit Span Forward) and working memory updating ability (Digit Span Backward) for PE and AE groups post-MBBW intervention (all *p* < .001). Forward span scores were higher in both groups, which reflects increased immediate verbal storage and attentional encoding; larger gains were also observed in backward span performance, which is indicative of enhanced manipulation and updating of information in working memory. Together, these findings indicate that the MBBW program is effective in enhancing memory-related executive functions in participants of different skill levels.

Table 5. Refocusing Ability (MIS)

Group	Test-Statistic	Pre-Test M ± SD	Post-Test M ± SD	P-value
PE (MBBW)	t(14) = 6.18	4.44 ± 0.33	4.84 ± 0.28	.001*
AE (MBBW)	t(14) = 2.90	4.29 ± 0.77	4.59 ± 0.49	.012*

*Significant differences, *p* < .05

Table 5 shows paired-samples *t*-test results wherein refocusing ability measured by the MIS Mindfulness Attention and Awareness Scale–Intervention Subscale significantly increased after completion of the MBBW intervention in both the PE and AE groups. The PE group demonstrated a significant higher MIS score (t(14) = 6.18, *p* = .001), which indicates an increased ability to refocus attention after distraction. Similarly, the AE group showed significant improvement and increase in refocusing performance (t(14) = 2.90, *p* < .012) with greater recovery of attention and cognitive re-engagement. Taken together, these results indicate that the MBBW program significantly improves participant's ability to refract attention a crucial aspect of attention regulation and self-monitoring.

Effects on Mood States (*TAMS*)

Table 6. Paired-Samples Comparisons on Mood Dimensions

Group	Variable	Pre-Test M ± SD	Post-Test M ± SD	P-value
PE (MBBW)	Depression	1.45 ± .12	1.34 ± .12	.004*
	Vigor	3.44 ± .51	3.60 ± .32	.042*

	Confusion	2.00 ± .13	1.42 ± .08	.001*
	Fatigue	2.08 ± .49	1.82 ± .33	.020*
	Anger	1.50 ± .21	1.30 ± .14	.001*
AE (MBBW)	Depression	2.13 ± .40	1.70 ± .22	.001*
	Vigor	3.12 ± .25	3.50 ± .17	.001*
	Confusion	2.07 ± .14	1.50 ± .18	.001*
	Fatigue	2.78 ± .19	2.50 ± .21	.001*
	Anger	1.92 ± .12	1.48 ± .22	.001*

*Significant differences, $p < .05$

Paired-samples *t*-test analyses of pre- and post-test results are shown in Table 6: significant changes were evident across various mood dimensions in both the PE and AE groups after participants had completed MBBW. The drops in depression, confusion, fatigue and anger were all quite large for the PE group, and vigor increased to a much greater extent than other factors. Similarly, the AE group presented respective reductions in negative mood (depression, confusion and fatigue) and anger, associated with a significant increase in vigor compared to the pre-test phase, which indicates a significant improvement of overall mood profile. Taken together, these results indicate a positive impact of MBBW on emotional well-being as a result of increased mood regulation and reduced negative affect regardless of the skill level.

Group Comparisons of Executive function

Table 7. ANCOVA Comparisons Between Modified Brain Break Warm-Up (MBBW) and Control Groups

Metric	Post-Hoc Comparison	$P_{scheffe}$	Proof of Efficacy
	PE vs. PC	.045*	MBBW Better
Reaction Time (Incongruent)	AE vs. AC	.005*	MBBW Better
	PE vs. AE	.965	No significant
	PE vs. PC	.001*	MBBW Better
Short-Term Memory (Digit Span forward)	AE vs. AC	.002*	MBBW Better
	PE vs. AE	.201	No significant
	PE vs. PC	.012*	MBBW Better
Updating Memory(Digit Span Backward)	AE vs. AC	.015*	MBBW Better
	PE vs. AE	.002*	Pro-player Better*
	PE vs. PC	.001*	MBBW Better
Refocusing Ability (MIS)	AE vs. AC	.035*	MBBW Better
	PE vs. AE	.242	No significant

*Significant differences, $p < .05$

This section presents the ANCOVA outcomes and Scheffé post-hoc comparisons are presented between the experimental groups and control group across all cognitive performances. For the sake of clarity, PC designates the Pro-player Control group, and AC designates the Amateur player Control group. The associated *p*-value (*p*_Scheffé) for each difference is reported; an asterisk (*) denotes statistical significance at $p < .05$. The “Proof of Efficacy” in the table specifies the direction of the effect, namely which group showed a better outcome.

The findings indicate that the MBBW intervention has a significant and positive impact on various cognitive performance measures. MBBW participants persistently demonstrated greater performance than the control group, with faster reaction times, better performances in short-term memory and working memory, and a more effective refocusing efficiency. Apart from the working memory task, where pro-player participants are better than amateur participants after the warm-up, it seems that improvement (in terms of effect size) after the MBBW treatment is at least similar for both groups. In short, the present data endorse the effectiveness of short preparatory work in improving performance-related cognitive functions.

Table 8. One-Way ANOVA (Non-parametric) Kruskal–Wallis H test Comparisons Between Modified Brain Break Warm-Up (MBBW) and Control Groups

Metric	Post-Hoc Comparison	P	Proof of Efficacy
Reaction Time (Congruent)	PE vs. PC	.037*	MBBW Better
	AE vs. AC	.003*	MBBW Better
	PE vs. AE	.506	No significant
Inhibition Responses(Stroop Interference)	PE vs. PC	.030*	MBBW Better
	AE vs. AC	.001*	MBBW Better
	PE vs. AE	.493	No significant

*Significant differences, $p < .05$

Kruskal–Wallis H tests (non-parametric one-way ANOVA) reveal significant group differences in reaction time (congruent condition) and inhibitory control performance (Stroop interference). Compared with the control groups, both PE and AE participants showed significantly faster RTs on the congruent task of Stroop and better inhibitory control (i.e., less interference in Stroop scores on inhibition). No difference was found between the PE and AE groups on either cognitive measure, indicating that the cognitive benefits of engaging in MBBW practice are similar regardless of expertise level. Collectively, these results highlight that the substantial cognitive benefits of the MBBW intervention do not depend on previous exposure, and they reinforce evidence suggesting that a brief (warm-up) intervention can produce similar gains in trained vis-a-vis untrained participants.

Table 9. ANOVA (Game-Howell)(Tukey) Comparisons Between Modified Brain Break Warm-Up (MBBW) and Control Groups

Metric	Post-Hoc Comparison	P	Proof of Efficacy
Processing Speed, Attention(TMT-A) (Game-Howell)	PE vs. PC	.002*	MBBW Better
	AE vs. AC	.031*	MBBW Better
	PE vs. AE	.776	No significant
Shifting Between Tasks(TMT-B) (Tukey)	PE vs. PC	.001*	MBBW Better
	AE vs. AC	.042*	MBBW Better
	PE vs. AE	.709	No significant

*Significant differences, $p < .05$

Post hoc analyses by using the Games–Howell procedure showed a significant better performance of both PE and AE on TMT-A than control groups. Specifically, the difference in reaction times was statistically significant in favor of the PE group vs. The PC group ($p = .002$). Likewise, the AE group scored better on TMT-A than the AC ($p = .031$). There was no significant difference between the two levels of the experimental group (PE vs. AE, $p = .776$), indicating that both professional and amateur players can achieve similar gains in processing speed and attentional abilities through the MBBW intervention. Together, these findings indicate that the MBBW program promotes processing speed and attention as compared to a non-intervention control groups, with stable cognitive advantages that persist across skill-matched controlled conditions.

Group Comparisons on Mood States

Table 10. ANCOVA Comparisons Between Modified Brain Break Warm-Up (MBBW) and Control Groups

Metric	Post-Hoc Comparison	$P_{scheffe}$	Proof of Efficacy
Depression	PE vs. PC	.001*	MBBW Better
	AE vs. AC	.001*	MBBW Better
	PE vs. AE	.165	No significant
Fatigue	PE vs. PC	.063	No significant
	AE vs. AC	.009*	MBBW Better
	PE vs. AE	.057	No significant

*Significant differences, $p < .05$

Overall, the data show a consistent trend in effects of the MBBW on mood measures. In PE vs. PC group comparisons, significant results were found for depression (p_Scheffé < .05), indicating that the effects of MBBW did not differ across skills levels. The column “Proof of Efficacy” presents this data in compilational form and shows for each comparison where the MBBW groups have significantly better mood state scores than controls groups and whether non-significant differences were observed. In general, the results from Table 10 show that the MBBW intervention had a better effect on both depression and fatigue compared to the control conditions, and there is no evident difference in the intervention's effectiveness among different levels of expertise.

Table 11. One-Way ANOVA (Non-parametric) Comparisons Between Modified Brain Break Warm-Up (MBBW) and Control Groups

Metric	Post-Hoc Comparison	P	Proof of Efficacy
Confusion (DSCF)	PE vs. PC	.001*	MBBW Better
	AE vs. AC	.001*	MBBW Better
	PE vs. AE	.849	No significant
Anger (DSCF)	PE vs. PC	.014*	No significant
	AE vs. AC	.001*	MBBW Better
	PE vs. AE	.001*	Amateur Better*
Vigor (DSCF)	PE vs. PC	.143	No significant
	AE vs. AC	.001*	MBBW Better
	PE vs. AE	.468	No significant

*Significant differences, $p < .05$

The results of a non-parametric one-way ANOVA with Dwass–Steel–Critchlow–Fligner (DSCF) post-hoc comparisons between the groups are shown in Table 11 The comparisons comprise PE vs. PC, AE vs. AC, and PE vs. AE. Asterisks (*) indicate differences are statistically significant ($p < .05$). The column "Proof of Efficacy" reports whether the MBBW resulted in better effects or whether no difference was found between groups. Overall, the outcomes indicate that MBBW practice succeeded in decreasing confusion among both PE and AE participants. Furthermore, the AE group showed lower levels of anger and higher vigor after the intervention; however, the influence of the MBBW on anger and vigor in PE participants was limited, and no significant changes were found. Altogether, these data suggest that the MBBW intervention prototype may induce important psychological benefits for amateur esports players, with significant decreases in anger and increases in vigor being particularly prominent among amateur players; at the same time, professional and amateur followers reported equal decreases in confusion.

Discussion

The current study reveals that the Modified Brain Break Warm-up (MBBW) program delivers broad cognitive and emotional effects to esports players across several domains of Executive function and mood state. In general, the results indicate that coupling short-term cognitive stimulation with mild physical activity significantly promotes neural readiness, attentional control, memory operations, emotional regulation, and psychological preparedness. These effects are consistently observed in professionals as well as amateurs, suggesting that the MBBW works at both novice and expert levels of expertise and can reduce performance differences between novices and experts.

One key result relates to reaction time improvements. Participants who experienced the MBBW exhibited faster responses in both the congruent and incongruent Stroop conditions, indicating increased cognitive throughput and a faster stimulus–response transformation. These findings are in line with previous research finding that brief cognitive tasks and hybrid warm-ups "prime" the central nervous system, thereby increasing neural efficiency and vigilance for quick decision-making (Díaz-García et al., 2025; Zhu et al., 2022). The improvements reported here are in line with the so-called "Goldilocks effect", in that moderate arousal improves performance without inducing fatigue. It should also be noted that MBBW amateurs either matched or outperformed professional controls; thus, effective experimental design can overcome lower experience levels and begin to close the expertise gap.

Performance on dominant responses also improves after MBBW: lower Stroop Interference scores reflected greater inhibitory control, a key aspect of executive functioning that is necessary for inhibiting automatic responses and maintaining strategic attention. These results are consistent with work demonstrating that athletes and professional video gamers typically have more efficient inhibitory systems (Becker et al., 2018; Toth et al., 2019; Wu et al., 2024). The current findings build on this work by demonstrating that specific short-term interventions can improve inhibitory control even in highly-skilled players. Additionally, the hybrid physical–cognitive MBBW design seemed to activate areas that mediate self-regulation and attentional filtering, which aligns with previous research showing significant improvements in executive functioning directly after moderate exercise and cognitive engagement (Díaz-García et al., 2025; Tsuk et al., 2019).

The results of processing speed and attention (evaluated using the TMT-A) also provide evidence for the efficacy of the MBBW: both professional and amateur players demonstrated an accelerated processing speed and greater attentional control following the intervention. This finding is supported by research demonstrating increased capacities for attentional resources and information-processing speed following cognitive warm-ups, active breaks, and short bursts of physical activity in both sports (Donoghue et al., 2021; Fischetti et al., 2024) and occupation (Hagiwara et al., 2020). Other evidence comes from reviews in sports science that highlight the efficacy of physical–cognitive warm-up tasks on cognitive performance (memory, attention control, and cognitive flexibility) (Gaige, 2024; Toth et al., 2020). While professionals usually demonstrate better baseline performance (Özçetin et al., 2019; Voss et al., 2010), the MBBW generated meaningful gains for both groups of expertise, in line with the additive nature of the benefits of experience and cognitive activation.

The MBBW also leads to a much larger improvement in task-switching performance. Enhanced cognitive flexibility is in line with previous findings showing that warm-ups involving a cognitive-related task improve task-switch ability and working-memory operations (Gentile et al., 2020; Ring et al., 2025). The current findings suggest that MBBW serves as an effective probe of the cerebro-cerebellar systems involved in rapid switching between complex sources of resonant stimuli (a core demand of esports performance). The finding that both professional and amateur players outperformed controls underlines the insufficiency of normal warm-up routines (i.e., without cognitive stimulation) for optimizing high-level executive functions.

The experiment also demonstrates pronounced effects of the intervention on immediate memory: participants who underwent MBBW significantly increased their scores on the Digit Span Forward test (i.e., improved temporary storage and retention of information). These findings are in line with the cognitive priming hypothesis as well as with studies finding that increased cognitive activation during warm-ups activates attention and memory-related neural systems (Ren et al., 2025; Vo et al., 2024). The fact that no differences were seen between professionals and amateurs at the baseline is consistent with findings that short-term verbal memory improvements are not a consequence of esports experience (Zioga et al., 2024). Nevertheless, MBBW improved memory performance in both levels of expertise, with amateur MBBW players performing even better than professional controls; this indicates that structured cognitive preparation can increase cognitive readiness beyond experience alone

Performance on the Digit Span Backward test, which measures working memory updating, also profited from the MBBW. The positive effects were strongly demonstrated in both professional and amateur participants, but the more salient response was observed among the professionals (who already had a higher baseline performance). These findings are consistent with previous models of cognitive plasticity, which postulate that even players at an expert skill level can benefit from improvement in executive functioning when they experience targeted cognitive activation (Nicholson, 2021). The fact that control amateur players did not improve—and in fact showed a slight decrease in control—provides further evidence to this point; generic warm-ups do not stimulate updating systems (and may even induce some degree of cognitive fatigue), in line with task-specificity principles seen in cognitive training work (Vo et al., 2024).

Reflexes—a cornerstone of high-speed esports environments—and the ability to refocus—an essential attentional skill in esports—were also greatly improved by use of the MBBW. Both experimental groups performed better than both control groups, irrespective of level of expertise, which indicates that cognitive warm-ups help players to focus their attention on relevant stimuli. Similarly, the observation that both professional and amateur participants benefited from BBs reflects the intervention's capacity to be applied across skill levels, even if professional participants showed more enhanced attentional capacities at baseline due to richer experience and neural efficiency (Miao et al., 2024; Watson et al., 2025). These results correspond to attentional-based training methods like ATT, which train focus recovery and present-moment focus (Moen & Firing, 2015).

The findings also demonstrate mood state effects: all dimensions of negative mood—including depression, confusion, fatigue and anger—decreased significantly after the MBBW, while vigor increased. These changes support athlete readiness models, specifically the Iceberg Profile wherein low negative mood and high vigor predict optimal performance (Ferreira Júnior et al., 2018; Li et al., 2025; McDonald, 2023). The mood-enhancement effects can further be explained by increased oxygenation, regulation of neurochemicals, reduction of stress, and psychological decompression by means of light exercise together with cognitive relaxation (Edutopia.com, 2023; Palanichamy et al., 2020). Most notably, the MBBW provided larger benefits to amateurs across several mood constructs, which can be attributed to their higher vulnerability to pre-competitive anxiety and less-advanced emotion regulation abilities.

Collectively, the results demonstrate that the MBBW is a useful holistic tool for better cognitive and emotional preparation in esports performance. Its hybrid physical–cognitive nature stimulates the neural networks implicated in attention, memory, executive control, and emotion regulation while minimizing fatigue and negative affect. The improvement in executive functioning observed in the MBBW group is consistent with earlier studies finding that acute physical interventions positively influence cognitive flexibility and inhibitory control in young adult populations (Fischetti et al., 2024). Our results further extend these extant findings by demonstrating that a protocol combining mindfulness and physical movement is specifically effective for the esports context. The fact that the MBBW could bring amateur performance closer to professional levels—even surpassing control professional levels—demonstrates its potential as a scalable and time-effective intervention for accelerating esports performance.

Conclusions

The results of the study showed that the MBBW provides systematic and manifold improvements in key psychological and cognitive components that are applicable to esports performance. All measured variables provided evidence supporting the achievement of the research goal, thereby indicating that a structured physical–cognitive warm-up is an effective strategy for facilitating competitive readiness in both high-skilled and low-skilled players.

Reaction Time and Inhibitory Control

The intervention appeared to increase players' responsiveness through a more efficient setup of perceptual and central processes, relative to traditional warm-ups. This represents progress in a pre-performance approach, as it demonstrates how short cognitive–motor activity could improve stimulus–response translation, which underlies efficiency in high-speed play. It also enhances players' ability to inhibit a prepotent response, thereby demonstrating meaningful improvement in executive functioning. This finding reveals that inhibition—a factor influencing high-order decision-making proficiency—may be dynamically adjusted by organized activation of the mind immediately prior to competition.

Task Shifting and Processing Speed & Attention

The intervention was associated with significant improvements in speedy processing of information and attentional alertness, suggesting that multi-modal cognitive–physical engagement provides a more efficient deployment of resources. These results are used to highlight a scalable approach to hone the fundamental attentional skills needed for success in esports. Intervention participants also became faster in switching between tasks under time pressure, indicating that the MBBW effectively pre-activated the cerebrocerebellar networks implicated in cognitive flexibility. This finding confirms the value of warm-ups that are focused on mental switching in environments with fast multi-tasking demands (such as esports).

Short-Term Memory and Working Memory Updating

The intervention enhanced immediate memory functions and coincided with rapid cognitive activation in anticipation of the need to store relevant game information in a short-term retention system. This contributes further evidence to the possibility of enhancing short-term memory through pre-performance routines. The intervention also increased the factoring and passing of information—something that is key to higher-level esports decision-making. This finding highlights the plasticity of working memory processes even in high-skilled participants and extends general knowledge of cognitive warm-up effects.

Refocusing Ability

Improvements in attentional refocusing indicated that players were better able to re-orient attention after a distraction, which a critical function when navigating rapidly changing digital contexts. These results indicate that focused mental preparations could increase the stability of attentional control for both expert and novice participants.

Mood State

The warm-up attenuated depressive affect, suggesting that the short relaxation-based elements of the intervention facilitate emotional control and precompetitive calmness. This result adds some evidence for psychological decompression to esports preparation. Reductions in confusion suggest that cognitively engaging warm-ups generate clarity and mental organization. This provides evidence for the importance of mental arousal in reducing cognitive noise before task performance. The results further indicate that the intervention reduced indicators of emotional fatigue, whereby BBs appear to function as micro-recovery periods. This contributes valuable insights on pre-match fatigue management, which is a frequently reported issue in esports.

The decrease in anger across experience levels suggests that very short cognitive–movement sequences serve as emotional stabilizers. This outcome has practical implications for the minimization of tilt susceptibility and consequent variation in performance. The increases in vigor at post-test indicate that the warm-up enhanced positive activation and readiness—two important components of optimal esports performance. This finding is in line with sport psychological profiling models that identify high energy as an indicator of optimal performance states.

In summary, the results demonstrate that the MBBW, a novel contribution to esports psychology programming, combines robust cognitive and physical principles to create an efficient, convenient, and effective pre-competition routine. The success of the protocol on all measures, for both professional and amateur players, indicates its potential to improve cognitive performance, emotional stability, and psychological preparation in a field where milliseconds can have a significant impact on competitive results. Further research should study the lasting effects of repeated BB use, investigate the neurophysiological mechanisms associated with these enhancements, and develop game-specific versions. Furthermore, the application of BBs in professional team training, youth development programs, and live tournament settings may assist in building consensus around mental preparation methodologies across the esports ecosystem.

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Authors and translators' details:

Pongsatorn Sritubtim	62810096@go.buu.ac.th	Author
Tanida Julvanichpong	tanida@buu.ac.th	Author
Garry Kuan	garry@usm.my	Author
Poonpong Suksawang	poonpong@buu.ac.th	Author
Amornpan Ajjimaporn	Amornpan.ajj@mahidol.ac.th	Author
Chatkamon Singnoy	chatkamon@buu.ac.th	Author