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SHORT COMMUNICATION

Cognitive Function in Tropical Climate

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ABSTRACT

The physiological and psychological responses to environmental heat stress have been well established. However, in the tropical climate (i.e., hot: 31 ±2 °C and wet climatic environment: 75% ± 10% rH), that concerns millions of people, most studies deals with exercise: Aerobic exercise is negatively affected and the impact of this environment on cognition is unclear. This short communication reviews some studies using cognitive tasks realized in tropical climate or using environmental conditions leading heat stress. In agreement with the literature, it is suggested that, at school, office or university in tropical climates, it is preferable to study in air conditioning or naturally ventilated rooms than in hot and wet climatic conditions in order to reduce feelings of fatigue and thermal discomfort. Further investigations, using cooling or psychological training techniques are needed in order to try to limit the negatives effects of tropical climate on cognition.

***Keywords*:** Heat stress, cognition, mental performance, tropical climate, task complexity

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1. INTRODUCTION

The physiological and psychological responses to environmental heat stress have been well established [1,2]. However, in the tropical climate (i.e., hot: 31° ±2 °C and wet climatic environment: 75 ±10% rH), most studies deals with exercise: Aerobic exercise is negatively affected [3], but the impact of this environment on cognition is unclear. Tropical Climate (TC) concerns millions of people living for examples in the Caribbean (e.g., Guadeloupe, Martinique, Cuba), Central America (e.g., Costa-Rica, Panama), South America (e.g., Guyana, Brazil), Africa (e.g., Cameroun, Senegal), or Asia (e.g., Vietnam, Thailand).

This short communication reviews some studies using cognitive tasks realized in or using environmental conditions leading heat stress.

In the heat, and consequently in TC, there are wide ranges of environmental factors that can influence the cognitive performances. Indeed, task complexity (whereas simple task are not affected or faster performed as simple reaction time, more complex task are negatively affected by TC [4,5-7]), time heat exposition (degradation of performance in sustained attention tasks is proportional to duration, and is amplified under thermal stress [8]), acclimation (at least 10-days in TC is needed to limit the performance decrement [9]), or acclimatization (people born in TC have a better physiological functioning allowing them to better tolerate heat exposure, to better withstand the loss of performance caused by heat stress and to provide less cognitive effort for a similar performance [5]) can affect cognition.

Of these factors, humidity is particularly debilitating. Indeed, a high level of relative humidity impairs cognitive and dual tasks performance [6,8,10].

Moreover, individual subjective states as thermal discomfort (i.e., the condition of mind that expresses satisfaction or dissatisfaction with the thermal environment) and fatigue, which are higher in TC or hot environment [10,11], may be other factors affecting cognitive performance. In addition, the evolution of the positives and negatives affective states must also be taken into consideration: TC reduces positive affect (i.e., how a person feels enthusiastic, active, and alert) by increasing sadness and lethargy without affecting negative affect (i.e., unpleasurable engagement that includes feelings of anger, disgust, guilt, fear, and nervousness).

The performance decrement can be explained by the fact that participants have at their disposal a certain amount of neural resources that can be allocated to different tasks or activities, performance of the latter will deteriorate when the amount of resources is insufficient to deal with both the tasks and environmental constraints (heat stress and relative humidity), such that subjects will be able to maintain their performance level until the resources are overloaded [6-8,12].

According to the Maximal Adaptability Model [13], heat exerts detrimental effects on performance by competing for and eventually draining attentional resources [14]. Indeed, in a dual task realised at 30 °C, it was observed that participants were unable to successfully allocate their attention to both tasks [15]. It may be that when different sources of stress add up, for example, the temperature on the one hand and the difficulty of the task on the other hand, this consumption of resources leads to a decrease in cognitive task performance [6].

2. CONCLUSIONS

TC is a hot and wet climate with temperatures exceeding 31 °C and hygrometry exceeding 70% rH, both of which are environmental stressors. This climate has been associated with a decrease in performance across multiple physical and cognitive tasks. In agreement with the literature, we can suggest that, at school or university in tropical climates, it is preferable to study in air conditioning or naturally ventilated classrooms than in hot and wet climatic conditions in order to reduce feelings of fatigue and thermal discomfort. Further investigations, using cooling (e.g., cold drink) or psychological training techniques (e.g., mental "cold" suggestion or mental imagery), are needed in order to try to limit the negatives effects of TC on cognition, concentration, fatigue and thermal comfort in students and office workers.

References

[1] Cheung S, Sleivert G, Multiple triggers for hyperthermic fatigue and exhaustion. *Exercise Sport Science Reviews* 32 (2004) 100-106.

[2] Gaoua N, Cognitive function in hot environments: A question of methodology. *Scandinavian Journal of Medicine and Science in Sports* 20(3) (2010) 60-70.

[3] Hue O, The challenge of performing aerobic exercise in tropical environments: applied knowledge and perspectives. *International Journal Sports and Physiology Performance* 6 (2011) 443-454.

[4] Deligières D, Influence de la chaleur humide sur le traitement de l'information et la performance. *Etude technique de l'INSEP* (1994) 1-26.

[5] Wijayanto T, Toramoto S, Maeda Y, Sonomi S, Tochihara Y Cognitive performance during passive heat exposure in Japanese males and tropical Asian males from Southeast Asian living in Japan. *Journal of Physiological Anthropology* 36 (2017) 2-11.

[6] Robin N, Coudevylle GR, Hue O, Toussaint L, The influences of tropical climate on imagined walking time. *Journal of cognitive psychology.* 30(1) (2017) 98-107.

[7] Robin N, Coudevylle GR, Hue O, Sinnapah S, Effects of Tropical Climate on Mental Rotation: The Role of Imagery Ability. *American Journal of Psychology* 130 (2017) 455-465.

[8] Hancock P, Vasmatzidis I, Effects of heat stress on cognitive performance: The current state of knowledge. *International Journal of Hyperthermia* 19 (2003) 355-372.

[9] Radakovic S, Maric J, Surbatovic M, Radjen S, Stefanova E, et al, Effects of acclimation on cognitive performance in soldiers during exertional heat stress. *Military Medicine* 172 (2007) 133-136.

[10] Pepler RD, Warmth and performance: An investigation in the tropics. *Ergonomics* 22 (1958) 63-88.

[11] Lan L, Wargocki P, Lian Z, Quantitative measurement of productivity loss due to thermal discomfort. *Energy and Buildings* 43 (2011) 1057-1062.

[12] Hocking C, Silberstein RB, Lau W, Stough C, Roberts W, Evaluation of cognitive performance in the heat by functional brain imaging and psychometric testing. *Comparative Biochemistry and Physiology. Part A, Molecular Integrative Physiology* 128 (2001) 719-734.

[13] Hancock PA, Warm JS, A dynamic model of stress and sustained attention. *Human Factors: The Journal of the Human Factors and Ergonomics Society* 31 (1989) 519-537.

[14] Hancock P, Vasmatzidis I, Effects of heat stress on cognitive performance: The current state of knowledge. *International Journal of Hyperthermia* 19 (2003) 355-372.

[15] Chase B, Karwowski W, Benedict M, Quesade P, Irwin-Chase H, Effects of thermal stress on dual task performance and attention allocation. *Journal of Human Performance in Extreme Environments* 8 (2005) 27-39.