

## IS VIGILANCE RELATED TO ROCK CLIMBING PERFORMANCE?

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### Abstract

**Purpose:** To investigate the association between both vigilance (or sustained attention) and self-reported on-sight climbing ability. **Methods:** On-sight climbing ability, accuracy of response (ACC), and reaction time (RT) from a vigilance task using Vienna Test System, and cardiorespiratory fitness ( $VO_{2max}$ ) were assessed in thirty-three climbers (10 females). **Results:** Linear regression analysis revealed that ACC from the vigilance task was associated significantly with the highest self-reported on-sight climbing ability. Following adjustment for covariates, a 1-ACC measure increase in the vigilance task was associated with an increase of 0.986 (0.273-1.700) of an on-sight ability (IRCRA). **Conclusion:** Our results suggest that vigilance (or sustained attention) measured objectively is positively associated with climbing ability after controlling for potential confounding factors. Rock climbers and coaches should endorse vigilance in their climbing training program to increase or maintain climbing performance.

**Keywords:** sustained attention, climbing ability, physical condition

### Résumé

**Objectif:** Étudier l'association entre la vigilance (ou l'attention soutenue) et la capacité de grimper à vue sur soi-même. **Méthodes:** La capacité de grimper sur la vue, l'exactitude de la réponse (ACC) et le temps de réaction (RT) d'une tâche de vigilance utilisant Vienna Test System et la condition cardiorespiratoire ( $VO_{2max}$ ) ont été évaluées chez trente-trois grimpeurs (10 femelles). **Résultats:** L'analyse de régression linéaire a révélé que l'ACC de la tâche de vigilance était significativement associée à la capacité d'escalade à vue la plus élevée autodéclarée. Après ajustement pour les covariables, une augmentation de la mesure de vigilance de 1-ACC a été associée à une augmentation de 0,986 (0,273-1,700) d'une capacité de vision à vue (IRCRA). **Conclusion:** Nos résultats suggèrent que la vigilance (ou l'attention soutenue) mesurée objectivement est positivement associée à la capacité de montée après contrôle des facteurs de confusion potentiels. Les grimpeurs et les entraîneurs devraient endosser la vigilance dans leur programme d'entraînement d'escalade pour augmenter ou maintenir la performance d'escalade.

**Mots clés:** attention soutenue, capacité d'escalade, condition physique

## INTRODUCTION

The cognitive sport requirements of rock climbing have characteristics associated with preparatory and attentional factors (location, duration, distribution, intensity), similar to other self-paced sports (Singer, 2000). Climbers' attention is directed in a sustained manner on the challenge and situation (climbing wall, hold, hand, foot, etc.) and has to be directed away from thoughts of self-doubt and the fear of failing, as well as away from an awareness of such external distractors. This ability to maintain attentional focus on a task is termed vigilance. Vigilance, otherwise known as sustained attention (vigilance will be referred to throughout), is a higher-order cognitive function that refers to the capacity to maintain attention over time and the ability to respond appropriately to relevant stimuli (Sarter, Givens, & Bruno, 2001).

In general, the literature for sport climbing has suggested that reducing cognitive resources (as attention) associated with the task may adversely affect rock climbing performance (Bourdin, Teasdale, & Nougier, 1998; Green & Helton, 2011; Nieuwenhuys, Pijpers, Oudejans, & Bakker, 2008; Young, 2011). Those studies recognised the interaction between physiological (i.e., indoor climbing performance) and psychological factors on rock climbing ability. However, there are no known studies analysing indicators of attentional capacity, vigilance in rock climbing. To our knowledge, it is not known if spatial visual attention demands measured objectively are related to rock climbing ability. Therefore, the main aim of the present study was to investigate the associations for a vigilance attention task, using as performance indicators the accuracy of response (ACC) and reaction time (RT), and self-reported on-sight climbing ability.

## METHOD

### *Participants*

Thirty-three sports climbers (10 women) age range 19 to 42 years volunteered to take part. Climbers had a best 6-month on-sight ability ranging from 6a+ to 8a+ (IRCRA scale 12 to 24). All participants were healthy, non-smokers, and did not take any vascular medication. Participants read and signed the informed consent prior to participation in the study. The study protocol was performed in accordance with the ethical standards and was approved by the Review Committee for Research Involving Human Subject of the University of Cádiz prior to recruitment and data collection. Data from this study comes from the High-Performance International Rock-Climbing Research Group C-HIPPER.

### *Self-reported climbing ability*

In accordance with the Position Statement by the International Rock Climbing Research Association (IRCRA) (Draper et al., 2016), performance grades were converted from French Sport to specific numerical values for all statistical analysis. All data were found to be normally distributed and had equal variances. Linear regression was performed to assess the predictive capability of vigilance and discrimination task for self-reported on-sight climbing ability. Associations were assessed using two levels of adjustment. Model 1 unadjusted and Model 2 adjusted for age, climbing experience (years climbing) and  $\dot{V}O_{2max}$ . The alpha level of significance was set at 0.05. All analyses were performed using Statistical Package for Social Sciences (SPSS, IBM, Version 20).

### *Cardiorespiratory fitness*

Cardiorespiratory fitness (CRF) was determined by assessing oxygen uptake from a maximal treadmill test. Specifically, for the determination of  $\dot{V}O_{2max}$  an incremental running test to volitional fatigue on a treadmill (Mercury LT med, HP Cosmos<sup>®</sup>, Germany) was used, i.e., athlete led protocol (Draper & Marshall, 2014). Oxygen uptake was measured using a portable breath-by-breath expired air analyzer (K4b<sup>2</sup> Cosmed, Rome, Italy) weighing 1.5kg. Data were transferred continuously via telemetry to a portable laptop. Breath by breath data were recorded continuously pre, during and post running. Breath by breath data were averaged over 10s intervals and exported to Excel and SPSS for final data analysis.

### *Vigilance or sustained attention*

Participants performed the standard form of Signal Detection Task (SIGNAL, 26.04 versions) using the Vienna Test System (26.04 software version; Schuhfried, Austria) to measure vigilance. During the Signal task, white dots pseudo-randomly disappear and appear on a black background screen. Participants were instructed to press the indicated key with the index finger of their dominant hand each time they detected a programmed stimulus constellation, created by four points that formed a square (see Figure 1).

The Signal task had a total duration of 840 sec (including the familiarizations and practice phases). The main practice phase had 1000 point changes with a total of 60 stimuli constellations. The number of response on time as an indicator of ACC in the execution of the task and RT as a measure of response speed were collected for analysis. Participants used headphones while performing the tasks to reduce distraction because of background noise.



**Figure 1:** Form S1: Standard (white dots on black background).

## **RESULTS**

Mean baseline age of the participants was 43.8 years (range, 18-44 years). Male showed lower values for the vigilance task.

Association of vigilance task with climbing ability is shown in Table 1. Linear regression analysis revealed that ACC from the vigilance task was associated significantly with the highest self-reported on-sight climbing ability. Following adjustment for covariates, a 1-ACC measure increase in the vigilance task was associated with an increase of 0.986 (0.273-1.700) of an on-sight ability (IRCRA).

**Table 1:** Association between vigilance task and on-sight climbing ability.

On-sight climbing ability	$\beta$	LCI	UCI	<i>P</i>	$R^2$
<i>Model 1</i>					
ACC measure	0.731	.0840	1.378	<b>0.028</b>	0.14
RT measure	-0.004	-0.018	0.011	0.613	0.01
<i>Model 2</i>					
ACC measure	0.986	0.273	1.700	<b>0.022</b>	0.32
RT measure	-0.003	-0.020	0.014	0.636	0.08

Model 1: unadjusted. Model 2: age, climbing experience (number of months experience rock climbing) and  $\dot{V}O_2$ .  $\beta$  = beta, regression equation; LCI= lower confidence interval (95%); UCI= upper confidence interval (95%).

## DISCUSSION

The present study is the first attempt to assess vigilance objectively in a group of climbers of intermediate to elite ability, analysing its association with climbing ability while also taking into account age, climbing experience and CRF. The results suggested that the accuracy of the response during the signal detection task was significantly associated with climbing ability, i.e., the greater ACC is the greater is climbing ability. It was observed that following adjustment for covariates, a 1-ACC measure increase in the vigilance task was associated with an increase of 0.986 (0.273-1.700) of on-sight climbing ability (IRCRA). These results support rock climbing as a sport that demands attention in order to progress along a route without falls. Moreover, it is also likely that it is important not to attend to external factors, such as the risk of fall, since such a diversion of attention could also affect performance. The performance advantages in vigilance task found on this article could also explain why better climbers level were less affected by anxiety during on-sight climbing (Draper et al., 2011). Further, considering a grade of 0.4 separated the top four competitors in the 2015 International Federation Sport Climbing World Cup (Fryer et al., 2016), this finding suggests that vigilance attention demand may be an important aspect of rock-climbing performance.

## CONCLUSION

In conclusion, our results suggest that vigilance (or sustained attention) measured objectively is positively associated with climbing ability after controlling for potential confounding factors. Rock climbers and coaches should endorse vigilance in their climbing training program to increase or maintain climbing performance.

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