Can training background offset the disadvantage associated with relative age effect on perceptual-cognitive skills from childhood into adolescence?

Xiaoyu Zhang*[1], Freddy Maso[2], Brigitte Ekpe-Lordonnois[3], Tom Poncelet[4], Gael Ennequin[1], Anthony J. Blazevich[5], and Sébastien Ratel[1]

[1]Laboratoire des Adaptations Métaboliques à l'Exercice en Conditions Physiologiques et Pathologiques – Université Clermont Auvergne – France

[2]Montferrand sports association, F-63000 Clermont-Ferrand, France – Montferrand sports association – France

[3]Optimeyes, F-63000 Clermont-Ferrand, France – Optimeyes – France

[4]Laboratoire des Adaptations Métaboliques à l'Exercice en Conditions Physiologiques et Pathologiques – Université Clermont Auvergne – France

[5]Centre for Human Performance, School of Medical and Health Sciences, Edith Cowan University, Joondalup, Western Australia, Australia – Australie

Résumé

Introduction: Perceptual-cognitive skills, defined as the ability to extract and process contextual information from dynamic visual scenes, are critical for anticipation and decision-making in sports (Casanova et al., 2009). Tools like the NeuroTracker (NT) are widely used to assess these abilities (Faubert & Sidebottom, 2012). However, their development during youth may be influenced by individual factors such as relative age, stereopsis, and training background. Relative age effect (RAE), arising from differences in birth dates within the same selection year, are well-documented in youth sports (Huertas et al., 2019), though their influence on perceptual-cognitive development is underexplored. Some evidence suggests that training may mitigate RAE, potentially explaining RAE reversal observed at the senior level (Fumarco et al., 2017). Stereopsis has also been shown to enhance 3D-MOT performance in children (Plourde et al., 2017). Despite their relevance, few studies have examined the interactive effects of these variables across development. The aim of this study was to investigate the extent to which RAE impacts the development of perceptual-cognitive skills and how training background may potentially offset RAE from childhood into adolescence. **Method:** One hundred and sixty-five 10- to 16-year-old male participants were divided into eight groups based on their birth quartiles (BQ1 (January-March), BQ2 (April-June), BQ3 (July-September), BQ4 (October-December)) and training background (moderately-trained: 1-2 sessions/wk and well-trained: 4-5 sessions/wk). Their perceptual-cognitive skills were evaluated using a 3D-MOT task (i.e., the NT) with (3D) and without (2D) stereopsis. **Results:** ANOVA revealed main effects of relative age ($F(3,314) = 4.415$, $p < 0.01$, p2 = 0.040) and stereopsis ($F(1,314) = 17.762$, $p < 0.001$, p2 = 0.054), but no significant three-way interaction effect on NTMT performance. A significant interaction between relative age and

*Intervenant

training background emerged (F (3,314) = 3.254, p=0.022, p2 = 0.030). Among moderately-trained children, NTMT scores declined from BQ1 to BQ4, with BQ4 performing significantly worse than BQ1–BQ3 ($p< 0.01$), regardless of stereopsis. In contrast, well-trained children showed no quartile differences, and BQ4 well-trained participants matched the performance of moderately-trained BQ1–BQ3 peers. **Discussion:** The present results indicate that children born earlier in the selection year (BQ1-BQ3) with moderate training background generally outperform their later-born peers (BQ4) in perceptual-cognitive tasks, likely due to their relatively more advanced neurocognitive development (Helsen et al., 2005; Huertas et al., 2019). However, training neutralized this RAE, supporting the "RAE reversal" hypothesis (Sierra-Díaz et al., 2017). Stereopsis consistently enhanced performance regardless of age or training, highlighting its independent role in perceptual-cognitive processing (Plourde et al., 2017). These findings support inclusive training strategies to reduce RAE-related disparities and promote equitable talent development. **Conclusions:** Training background significantly offsets the RAE in perceptual-cognitive performance from childhood through adolescence. While RAE creates a disadvantage for moderately-trained children born later in the selection year, training of 4-5 sessions a week can mitigate or reverse this effect. These insights are crucial for coaches and talent development programs aiming to mitigate selection biases and promote equitable skill development across age cohorts.

References:

Casanova, F., Oliveira, J., Williams, M., & Garganta, J. (2009). Expertise and perceptual-cognitive performance in soccer: a review. *Revista Portuguesa de Ciências do Desporto*, *9*(1), 115-122.

Faubert, J., & Sidebottom, L. (2012). Perceptual-cognitive training of athletes. *Journal of Clinical Sport Psychology*, *6*(1), 85-102.

Fumarco, L., Gibbs, B. G., Jarvis, J. A., & Rossi, G. (2017). The relative age effect reversal among the National Hockey League elite. *PLoS One*, *12*(8), e0182827.

Helsen, W. F., Van Winckel, J., & Williams, A. M. (2005). The relative age effect in youth soccer across Europe. *Journal of Sports Sciences*, *23*(6), 629-636.

Huertas, F., Ballester, R., Gines, H. J., Hamidi, A. K., Moratal, C., & Lupiáñez, J. (2019). Relative age effect in the sport environment. Role of physical fitness and cognitive function in youth soccer players. *International journal of environmental research public health*, *16*(16), 2837.

Plourde, M., Corbeil, M.-E., & Faubert, J. (2017). Effect of age and stereopsis on a multiple-object tracking task. *PLoS One*, *12*(12), e0188373.

Sierra-Díaz, M. J., González-Víllora, S., Pastor-Vicedo, J. C., & Serra-Olivares, J. (2017). Soccer and relative age effect: a walk among elite players and young players. *Sports*, *5*(1), 5.