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## Effect of Sport Stacking on Motor and Cognitive Function in Grade Three Learners

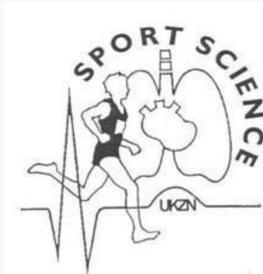
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# Effect of Sport Stacking on Motor and Cognitive Function in Grade Three Learners

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## Abstract

Sport Stacking has been reported to promote performance, cognitive health and learning via improvements in hand-eye coordination, reaction time, ambidexterity, quickness, brain activity and concentration. Empirical evidence describing these benefits and the mechanisms responsible is limited. **PURPOSE:** To determine the effect of sport stacking on motor and cognitive function in grade three children. **METHODS:** Thirty-two children (mean age = 8.5 ± 0.5 yrs, BMI = 16.8 kg/m<sup>2</sup>; 17 females, 15 males) were randomized to either a control (arts/crafts) or treatment group (Sport Stacking) with the intervention performed over 12 sessions (4 times a week for 3 weeks, 30 min/session). This was followed by a 3 week wash-out period after which there was a cross-over and the intervention was repeated. Pre-test (within 48 hr pre) and post-test measures (48 hr post) included performance on the Integrated Visual and Auditory Continuous Performance Test (IVA+PLUS CPT) that measures motor and cognitive parameters. Data was analyzed using paired t-tests to compare treatment and control groups. Alpha was set at p<.05. **RESULTS:** Significant improvements of the treatment group occurred in terms of Visual Consistency (95.6 ± 15 vs 100.2 ± 17 a.u., +4.8%, p = 0.0091), Visual Steadiness (85.5 ± 29 vs 95.4 ± 16 a.u., + 11.5%, p = 0.0252) and Fine Motor Regulation (99.2 ± 12 vs 103.1 ± 10 a.u., +3.9 %, p = 0.02). Significant reductions of the treatment group occurred in terms of Visual Dependability (102.2 ± 13 vs 92.0 ± 12 a.u., -10%, p = 0.01) and Combined Dependability (101.5 ± 11 vs 94.6, ± 13 a.u., -6.8%, p = 0.026). **CONCLUSION:** Sport Stacking improved the participants' ability to stay on a task (consistency), to remember and follow rules under high demand (steadiness), and to control fine motor activity. Their ability to respond accurately, reliably and quickly under low demand (dependability) decreased. This implies that the motor and cognitive adaptations to Sport Stacking are specific to the high-demand nature of the sport and that it does not impact positively on all cognitive and motor parameters. This finding highlights the importance of understanding an individual's motor and cognitive profile prior to performing Sport Stacking if the intervention is being used in an educational, learning or remedial context.

## Background

- Sport stacking participants work with 12 specialized cups, using both hands to make a pyramid (“up stacking”) and then returning the cups into stacks (“down stacking”) in predetermined sequences (1). The task requires moving the hands across the body’s midline (2).
- Limited research suggests that sport stacking improves cognitive factors, development of basic motor proficiency, hand-eye coordination, reaction time, ambidexterity, quickness and concentration (3).
- The Integrated Visual and Auditory Continuous Performance Test (IVA-CPT) is used in neuropsychological evaluations to measure speed of processing, as well as different types of visual and auditory attention characteristics (4).

## Purpose

The purpose of this study was to investigate the effect of sport stacking on motor and cognitive function, specifically, auditory and visual attention function in grade three children.

## Methods

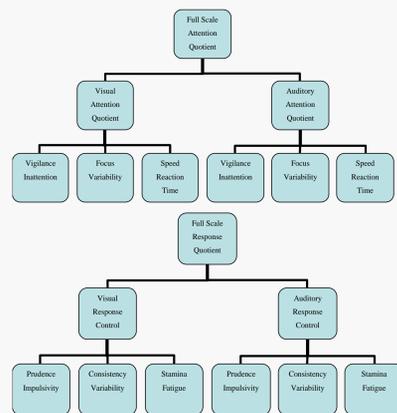
### Participants

- 32 grade 3 learners (17 females and 15 males)

### Procedures

- Children were randomly assigned to a sport stacking (*n* = 16) or arts/craft group (*n* = 16) with these activities performed over 3 weeks (12, 30-min. sessions, 4 X per week).
- This was followed by a 3-week wash-out period after which there was a cross-over and the 3-week intervention repeated.
- Performance on the IVA-CPT was assessed before and after each of the 3-week interventions for each group.

Fig. 1. Major global & sub-scales measured by the IVA-CPT



### Statistical Analyses

- Paired Student's *t* test compared the effects of sport stacking and arts/crafts on auditory and visual attention global scales and subscales.
- The IVA-CPT data are presented as standard quotient scores, means, standard deviations with 95% confidence intervals for changes in the mean and the mean as Cohen Effect Sizes. Statistical significance was set at *p*<.05.

## Results

Table 1. Characteristics of Grade 3 Learners (N=32).

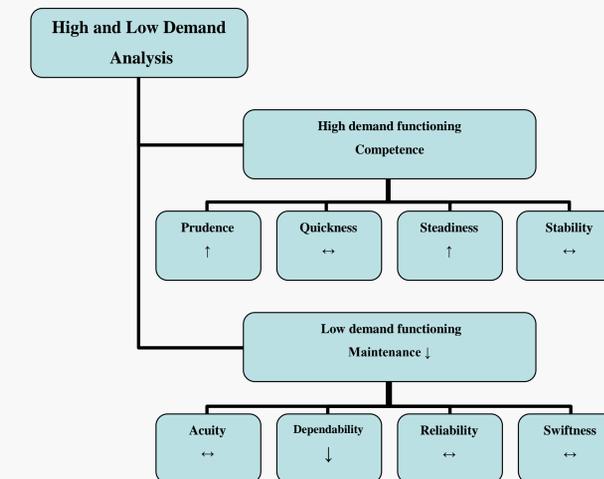
Variable	Mean ± SD
Age (yrs)	8.5 ± 0.5
BMI (kg.m <sup>-2</sup> )	16.6 ± 2.3
Waist to hip ratio	0.8 ± 0.04
Total daily energy expenditure (kcal/day)	2219 ± 711

Table 2. IVA-CPT parameters after participation in sport stacking and arts/crafts programs

IVA-CPT Parameter (quotient scores)	Pre test		Post test		Effects		Significance
	M	SD	M	SD	95% CI <sup>#</sup>	Cohen Effect Size*	
<b>HIGH DEMAND FUNCTIONING</b>							
<b>Combined Steadiness</b>							
Sport stacking	73.9	38.7	82.9	30.3	2.9, 17.2	0.30	.007
Arts/crafts	84.2	32.7	86.3	30.2	-7.3, 12.8	0.08	.58
<b>Auditory Steadiness</b>							
Sport stacking	77.4	40.6	84.6	25.9	0.3, 19.1	0.23	.05
Arts/crafts	91.9	24.7	87.1	28.3	-12.9, 4.2	-0.18	.31
<b>Visual Steadiness</b>							
Sport stacking	79.5	36.6	88.4	27.6	0.9, 18.8	0.27	.03
Arts/crafts	84.6	34.6	91.9	26.4	-2.6, 18.5	0.23	.13
<b>Auditory Prudence</b>							
Sport stacking	100.6	16.9	106.1	9.7	-0.2, 11.2	0.33	.05
Arts/crafts	103.5	16.8	106.9	9.6	-2.4, 9.1	0.20	.24
<b>LOW DEMAND FUNCTIONING</b>							
<b>Visual Dependability</b>							
Sport stacking	102.9	12.7	92.4	12.7	-17.9, -2.7	-0.81	.01
Arts/crafts	89.8	22.2	94.2	17.2	-4.1, 12.1	0.18	.23
<b>Combined Dependability</b>							
Sport stacking	102.7	11.5	95.1	13.4	-12.1, -0.9	-0.57	.03
Arts/crafts	92.4	17.4	96.8	11.7	-2.8, 10.6	0.23	.13
<b>Combined Maintainability</b>							
Sport stacking	99.5	17.6	90.1	23.2	-13.9, 0.18	-0.39	.05
Arts/crafts	88.8	25.2	93.5	19.1	-2.9, 15.5	0.25	.17
<b>Visual Maintainability</b>							
Sport stacking	96.8	20.9	87.7	23.3	-16.6, -0.8	-0.42	.03
Arts/crafts	87.3	29.2	90.6	21.4	-5.0, 14.3	0.16	.33
<b>ADDITIONAL SCALES</b>							
<b>Fine Motor Regulation</b>							
Sport stacking	99.2	12.2	103.1	10.3	0.5, 7.1	0.32	.02
Arts/crafts	104.2	8.2	103.7	9.6	-4.4, 3.3	-0.07	.77
<b>Visual Sensory Motor</b>							
Sport stacking	98.8	13.1	95.1	16.4	-9.4, -0.9	-0.31	.02
Arts/crafts	99.2	13.6	98.8	13.1	-5.2, 5.9	0.02	.91

## Results, cont.

Fig. 2. Global and subscales of low and high demand functioning (arrows display sport stacking effect ↑ = improvement, ↓ = decline, ↔ = no change)



## Summary and Conclusions

- Sport stacking improved the participants' ability to stay on a task (consistency), to remember and follow rules under high demand (steadiness), to reduce impulsivity (prudence), and to control fine motor activity.
- Sport stacking slowed visual simple reaction times, and responding accurately, reliably and quickly under low demand (Dependability and Maintainability).
- Auditory and visual attention adaptations to sport stacking may be specific to the high demand nature of the task.
- Findings have implications for the use of sport stacking in educational, learning or remedial contexts.

## References

1. Hart, M. A., Smith, L. A., & DeChant, A. (2005) Influence of participation in a cup-stacking unit on timing tasks. *Perceptual and Motor Skills*, 869-876 (101).
2. Uhrich, T. A., & Swalm, R. L. (2007) A pilot study of a possible effect from a motor task on reading performance. *Perceptual and Motor Skills*, 1035-1041 (104).
3. Udermann, B. E., Murray, S. R., Mayer, J. M., & Sagendorf, K. (2004) Influence of cup stacking on hand-eye coordination and reaction time of second-grade students. *Perceptual and Motor Skills*, 409-411 (98).
4. Sandford, J. A., & Turner, A. (2009) Integrated visual and auditory performance test administration manual. Richmond, VA, Brian Train, Inc.