I know it's heavy but I can't make anything of it before I feel It

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Introduction

➢ In autism spectrum disorders, an atypical sensorimotor development has been reported (Provost et al., 2007), with dexterity and gait troubles (Whyatt et Craig, 2012; Bauman, 1992). However, since these troubles have been considered as a secondary consequence of the core social communication impairment, , they have not been deeply investigated.

➢ An optimized motor control requires the use of both an efficient feedback mode of control to correct, and an effective feedforward one to anticipate, the latter one relying on the intact build up of internal representations.

➢ A previous study in children with ASD evidenced an impairment of the feedforward control in a postural task (Schmitz et al., 2003).

➢ We hypothesized that ASD children present a preserved feedback mode of control despite an impairment of the feedforward one.

Objective : to determine the nature and the specificity of motor deficits in ASD by exploring the kinematics translating feedback and feedforward control

Participants & Tasks

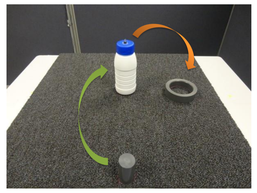
➢ 30 TD children from 5 to 10 years old and 7 ASD children from 9-10 years old

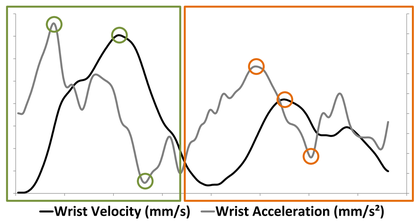
Children	Typically developing			ASD
	5-6 y/o	7-8 y/o	9-10 y/o	9-10 y/o
Age (mean ± SD)	5.85 ± 0.58	8.14 ± 0.42	9.93 ± 0.59	10.10 ± 0.63
Group Size	N = 10 4 girls All right-handed	N = 10 7 girls All right-handed	N = 10 5 girls All right-handed	N = 7 1 girl 2 left-handed

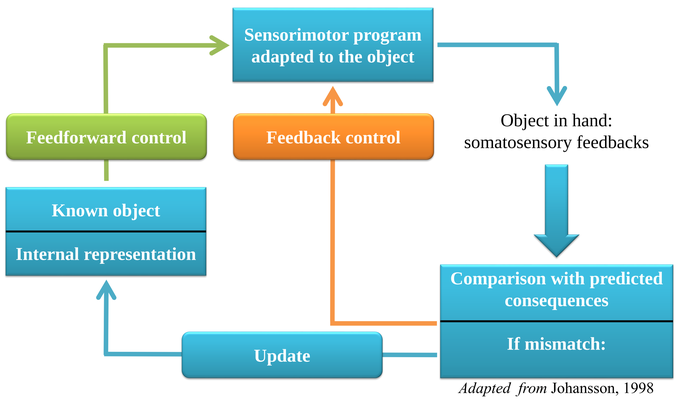
➢ Description of ASD children: positive ADI or ADOS; no diagnosed developmental coordination disorder; 1 Asperger syndrome, 1 PDD-NOS, 5 HFA

➢ Task: reach and grasp a bottle in order to displace it to a lateral location; two visually identical opaque bottles weighting 500g (200g for the 5-6 y/o) , and 50g (or 25g) were presented

- **Known weight:** 15 trials with the heavy object and 15 with the light one (pseudo-random order)
  → **Feedforward assessment in the reaching phase**
- **Unknown weight:** 20 pseudo-random trials with the heavy or the light bottles
  → **Feedback assessment in the displacing phase**







Adapted from Johansson, 1998

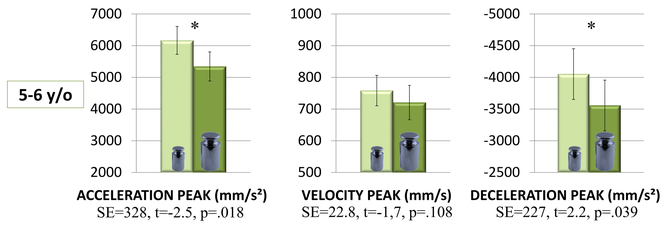
➢ Movement kinematics (marker on the wrist and fingers) were recorded via an Optotrak 3020 system (Northern Digital INC). Sampling rate: 300Hz; spatial resolution: 0.1 mm

➢ We used mixed models to analyze the known and unknown conditions and their differential effects in TD and ASD

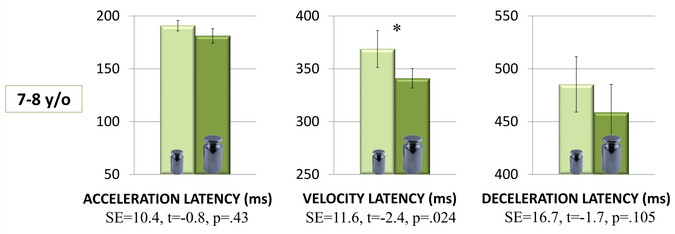
1a/ A progressive building of feedforward in TD children

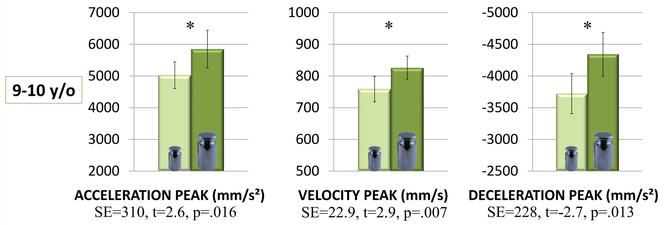
Known weight – Reaching phase

➢ Statistical analysis:
- Weight effects for the three groups
- Interactions between the 5-6 y/o and the two older groups (6 parameters out of 8 for the 7-8 y/o and 4 for the 9-10 y/o, all $p < .05$)



Five to six y/o children differently scaled their movement as a function of the object weight however the adopted strategy was still immature





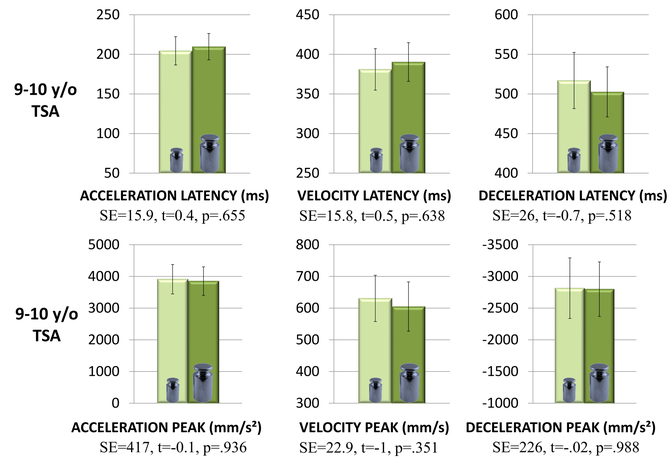
➢ The two groups didn't modulate the same parameters but used the same strategy

From seven to ten y/o we observed an efficient feedforward control

1b/ A failure in feedforward control in ASD children

Known weight – Reaching phase

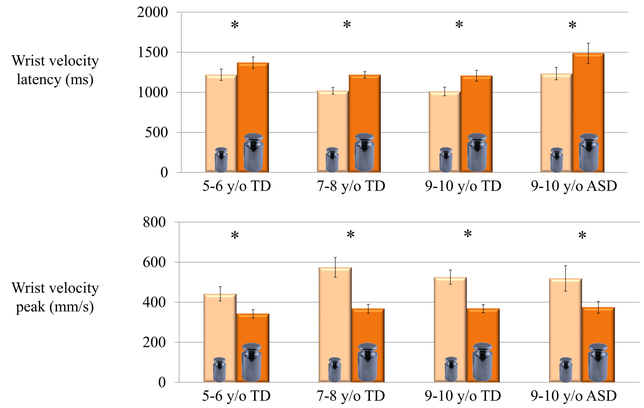
➢ Statistical analysis:
- No weight effect for the ASD group
- Interactions with the 9-10 y/o TD children for velocity peak (SE=29.6, t=3.0, p=.009) and a trend to significance for the deceleration peak (SE=292, t=-2.1, p=.057)



ASD children didn't modulate their reaching phase according to the weight of the bottle to grasp

2/ A preserved feedback control in ASD children

Unknown weight – Displacing phase



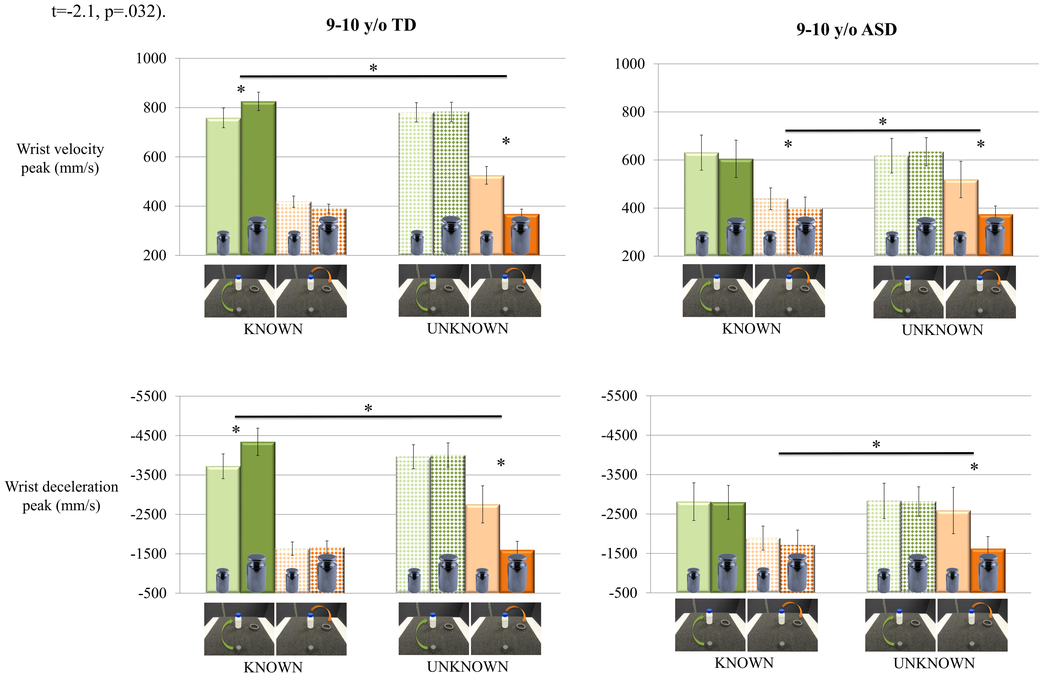
➢ Statistical analysis: mixed model
- Weight effects for each group (all $p < .05$): latencies increase and peak amplitude reduction
- No interaction between TD and ASD

➢ Once in hand, the heavy object slowed down the movement

When they didn't know the weight, ASD children controlled their movement as TD children did, testifying of a preserved online control

3/ A preserved weight representation in ASD children ?

➢ Statistical analysis:
- Interactions between weight, knowledge and group in the reaching phase for acceleration peak (SE=461, t=3.8, p<.001) and velocity peak (SE=33, t=3.1, p=.002) and in the displacing phase for acceleration peak (SE=349, t=3.6, p<.001) and deceleration latency (SE=70, t=-2.1, p=.032).



➢ 9-10 y/o TD children: when anticipated in the reaching phase, the weight effect did not persist in the displacing phase (Roy et al., 2013)
➢ 9-10 y/o ASD children:
- **The weight was not anticipated in the first phase**
- **However:** weight effect was smaller in the known weight condition as compared to the unknown one

ASD children benefitted from weight information

Summary and Conclusion

➢ TD children use a steady feedforward mode of control as early as 5, yet this control becomes efficient and adequate only at the age of 7.

➢ ASD children exhibit a failure in feedforward control, but a preserved on-line control. They were nevertheless able to take weight information into account but needed somatosensory feedback to do so (bottle in hand).

Motor impairments in ASD might originate from a deficit in the executive part of the feedforward control, rather than a failure to build up a sensori-motor representation. Feedback is preserved.

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