

Verbal versus nonverbal inference tasks.

Does modality matters in basic cognitive processes related to arithmetic.

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Logical abilities seem important in the modeling of variance in arithmetic abilities, f.i. seriation in kindergarten proved to be a strong predictor in early arithmetic performances (Stock et al., 2010). The current study investigates another logical ability namely inferential reasoning in elementary school children. Sternberg (1986) defines 'inferential reasoning' within his four-component model (encoding, inference, mapping and application) as the detection of the relationship between terms A and B.

We investigated whether the ability to make inferences is related to the modality in which the information is presented, namely in a verbal (written sentences) or nonverbal way (signed sentences). A second topic was the effect of a short learning phase on the ability to make inferences.

Method

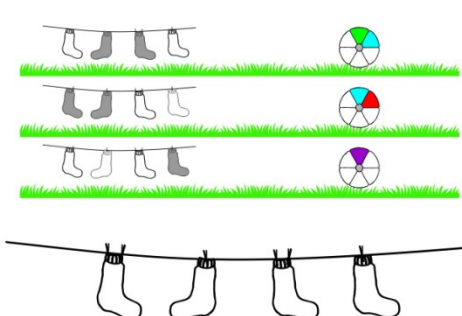
In this study we used an elementary type of inferential reasoning as paradigm, namely the detection of the relationship between given information, and the information in the previous sentences, also referred to as bridging or making anaphorical inferences (Van Vreckem et al., 2010).

We used a design with an *instruction phase*, a nonverbal and a verbal *pretest*, a *learning phase* and a nonverbal and a verbal *posttest*. During the learning phase the child was put in an active-modifying learning situation: the child was asked about the solving process and stimulated to reflect about the cognitive actions. There was no instruction of strategies to solve the tasks.

The participants were 70 children of second ($n=23$), third ($n=26$) or fourth ($n=21$) grade.

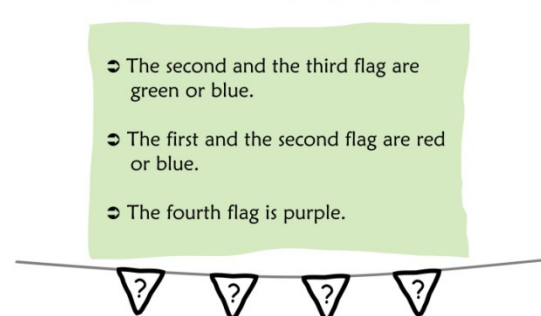
Example of a nonverbal and verbal task. Important: the non-verbal tasks had the same structure and difficulty, each verbal task is a 'translation' of a nonverbal task.

Find the color of the four socks.

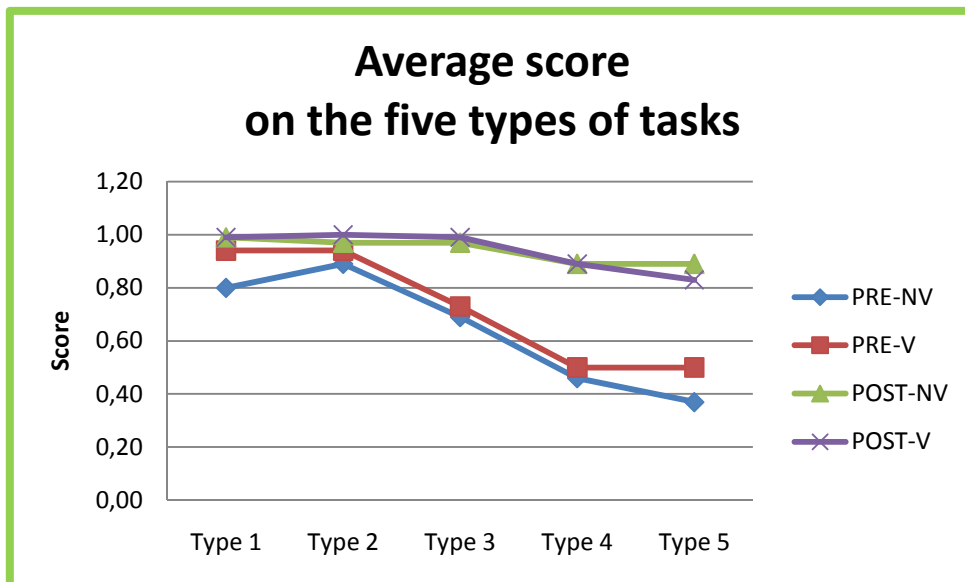


Find the color of the four flags.

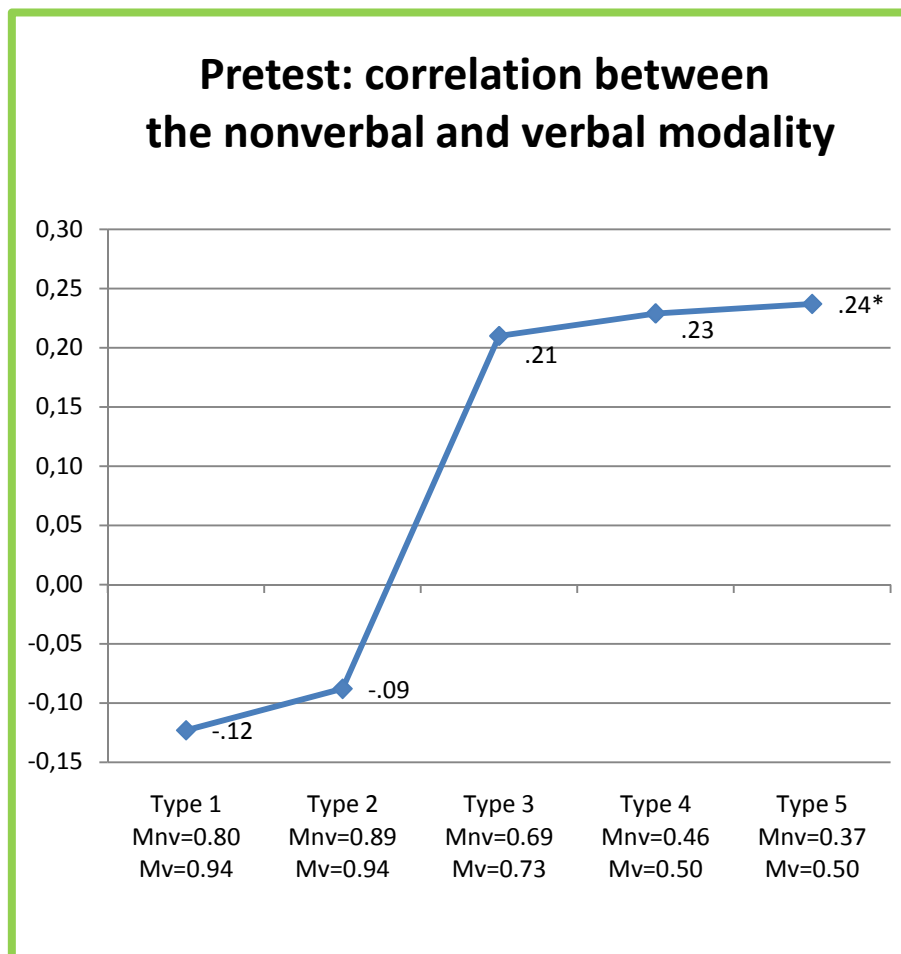
- ↪ The second and the third flag are green or blue.
- ↪ The first and the second flag are red or blue.
- ↪ The fourth flag is purple.



The tasks were ordered according to difficulty: decrease of clear one-one cues, increase of complexity by ambiguous cues.



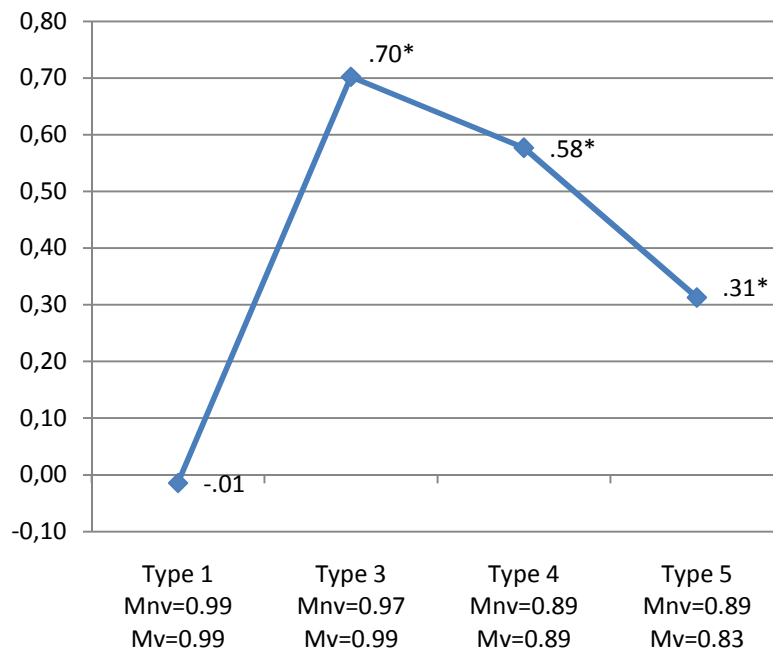
In the pretest the verbal items ($M = 0.72$; $SD = 0.23$) score better than the nonverbal ones ($M = 0.64$; $SD = .27$). Because all children completed first the nonverbal items, we can suppose that the children applied their previous acquired knowledge from the nonverbal items to the verbal ones. In the posttest there was no difference between verbal ($M = 0.94$; $SD = 0.13$) and nonverbal items ($M = 0.94$; $SD = 0.15$).



* $p < .05$

The lack of significant positive correlations on the 'easy' tasks may suggest that the impact of modality depends on the difficulty of tasks.

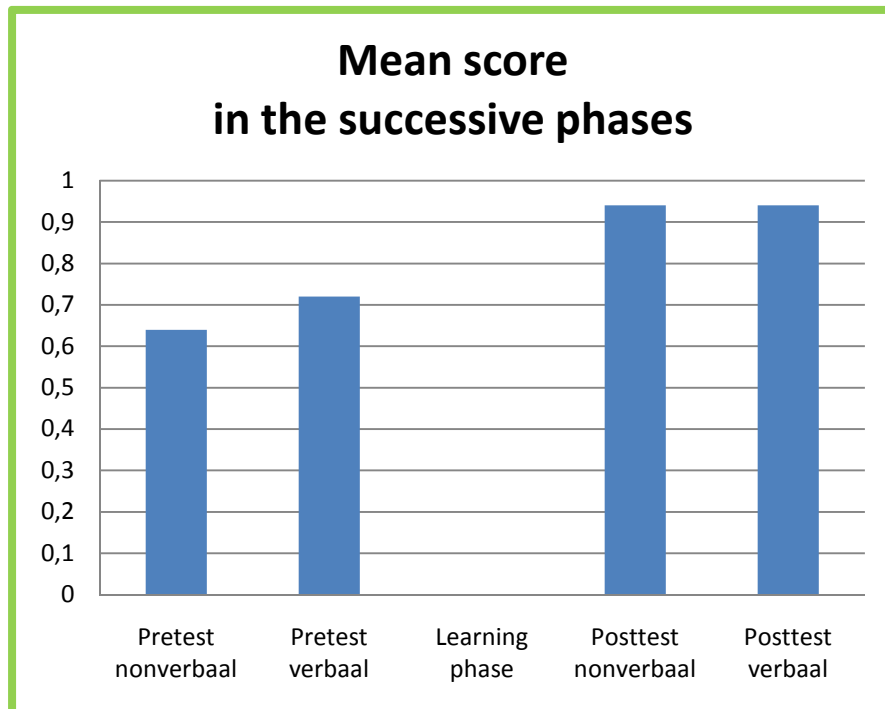
Posttest: correlation between the nonverbal and verbal modality



* $p < .01$.

There was not enough variation on the type 2 tasks to compute the correlations between the variables. There were significant correlations between type 3, 4 and 5 tasks.

After the training phase all children did better (M were higher than in the pretest) and there was a significant correlation between type 2, 4 and 5 tasks. This might suggest that they learned 'general' or domain independent strategies that they could use in both types of tasks.



The evolution of the mean scores in the pretest suggests that children learned themselves by solving a task to achieve better in the next one.

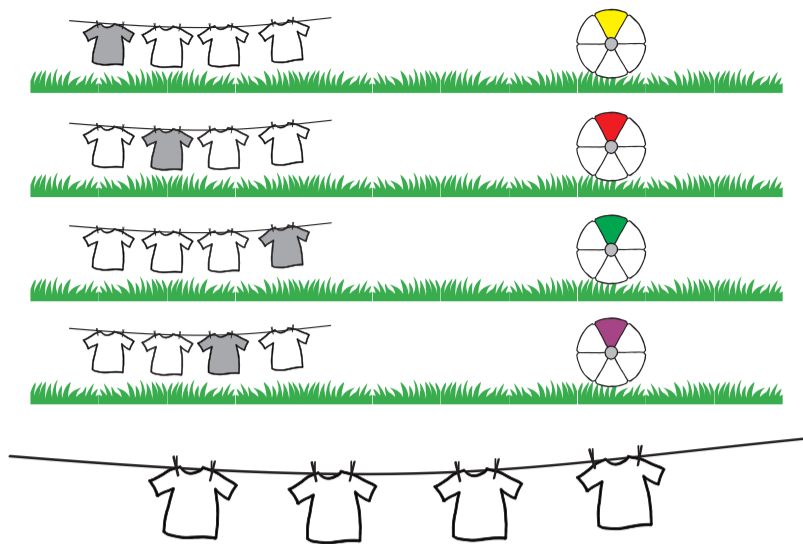
The increase of the scores after the active-modifying learning situation offered by an adult was not that distinctive to conclude that there was an extra effect up to the self-learning effect.

Conclusion

This study revealed that the impact of modality depends on the difficulty of tasks. In more difficult tasks the impact of modality decreased because the children used 'general' or domain independent strategies. Just 'asking to reflect' on the cognitive process wasn't more efficient than 'experienced learning'.

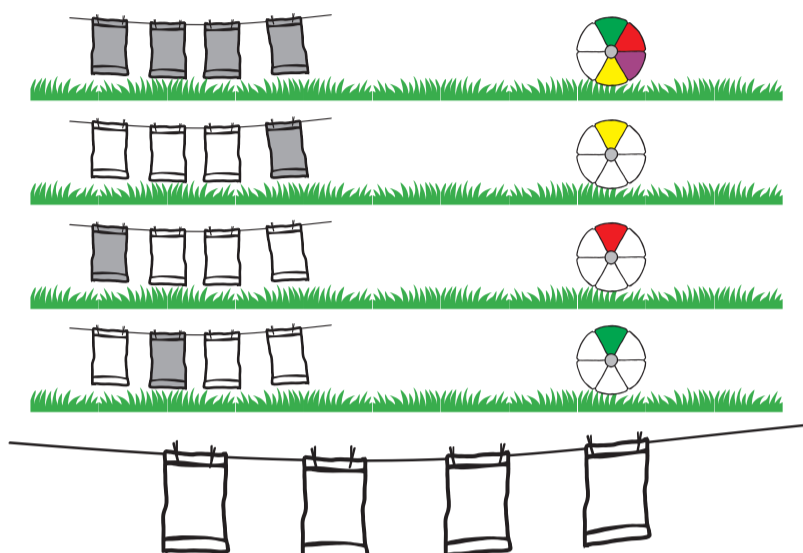
Stock, P., Desoete, A., & Roeyers, H. (2010). Detecting children with arithmetic disabilities from kindergarten: Evidence from a three year longitudinal study on the role of preparatory arithmetic abilities. *Journal of Learning Disabilities, 43*, 250-268.

Van Vreckem, C., Desoete, A., De Paepe, L., & Van Hove, H. (2010). *Vlaamse Test Begrijpend Lezen*. Gent: Academia Press.



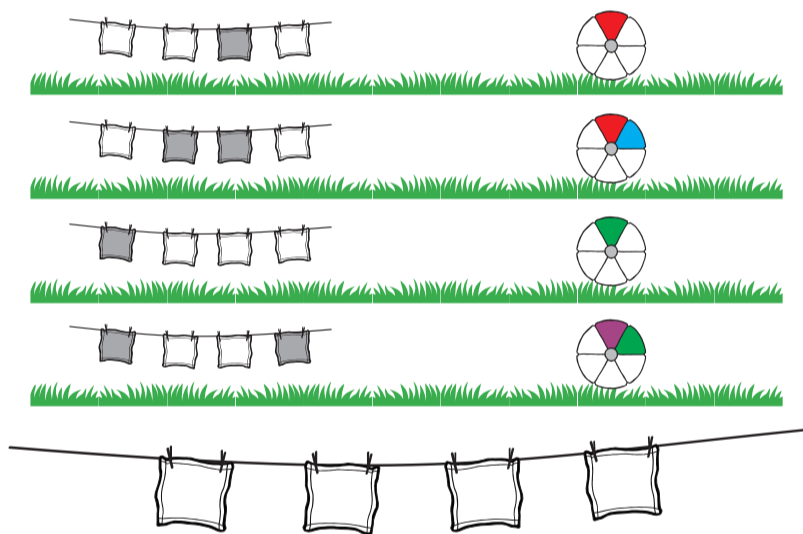
1

- ⇒ De eerste vlag is rood.
- ⇒ De tweede vlag is paars.
- ⇒ De vierde vlag is blauw.
- ⇒ De derde vlag is groen.



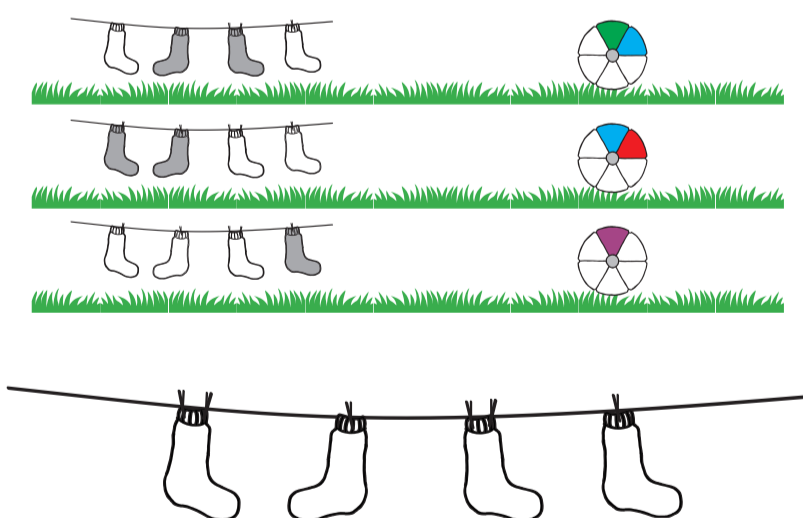
2

- ⇒ Alle vlaggen kunnen blauw, paars, groen of rood zijn.
- ⇒ De vierde vlag is rood.
- ⇒ De eerste vlag is paars.
- ⇒ De tweede vlag is blauw.



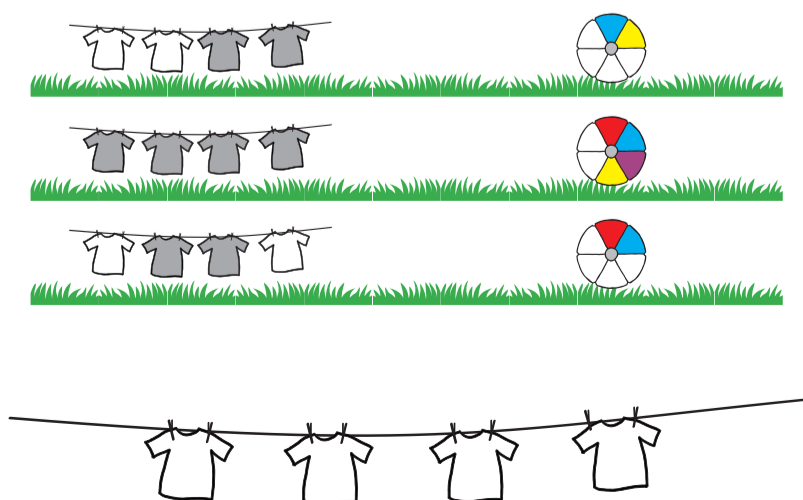
3

- ⇒ De derde vlag is paars
- ⇒ De tweede en derde vlag kunnen paars of geel zijn.
- ⇒ De eerste vlag is blauw.
- ⇒ De eerste en vierde vlag kunnen groen of blauw zijn.



4

- ⇒ De tweede en derde vlag kunnen blauw of geel zijn.
- ⇒ De eerste en tweede vlag kunnen geel of paars zijn.
- ⇒ De vierde vlag is groen.



5

- ⇒ De derde en vierde vlag kunnen geel of rood zijn.
- ⇒ Alle vlaggen kunnen paars, geel, groen of rood zijn.
- ⇒ De tweede en derde vlag kunnen paars of geel zijn.

