BOLD Lab Website

Exploring the neural basis of symbolic and non-symbolic magnitude processing in rural school children from Côte d'Ivoire

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INTRODUCTION

RQ1: How does magnitude processing relate to math skills in contexts with limited symbolic number exposure?

Studies in the Global North suggest a critical role of **symbolic** – but not non-symbolic – magnitude processing in predicting math skills.[1] However, recent research from West Africa found that **non-symbolic** processing predicted of math skills.[2]

RQ2: How does neural activation for symbolic vs. non-symbolic magnitude processing relate to math skill?

Previous studies find activation in frontal and parietal regions for symbolic and non-symbolic magnitude. Parietal activation is associated with math skill.

fNIRS allows us to investigate whether limited exposure to symbolic number is related to the neurodevelopment of magnitude processing and math skill.

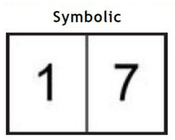
METHODS

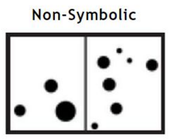
Participants

154 children aged 5-15 (M_{age}= 9.31, SD_{age}=1.67) in rural Côte d'Ivoire

Measures

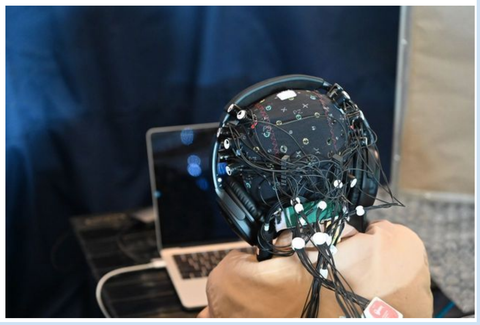
fNIRS symbolic and non-symbolic magnitude comparison task
- Accuracy
- Reaction Time (RT)



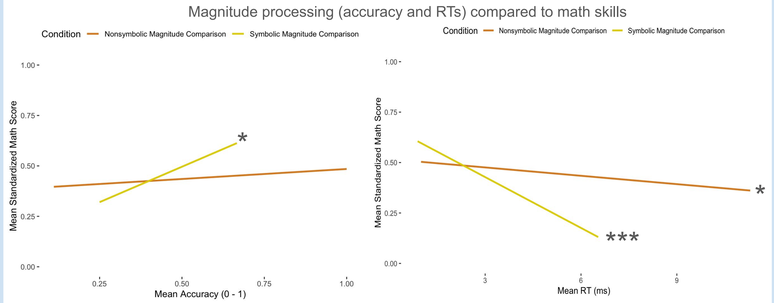


Math skills (EGMA)[4] - Addition, Subtraction

fNIRS
- NIRx NIRSport 2 System
- 32 optodes
- 54 channels



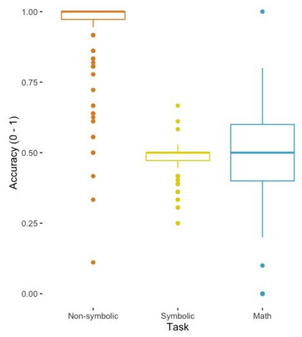
SYMBOLIC MAGNITUDE PROCESSING PREDICTS MATH SKILL



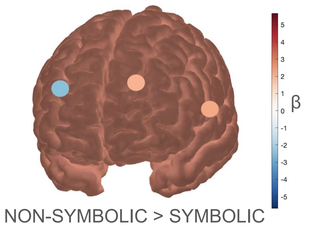
Both symbolic accuracy and RTs are predictive of math skill

Predictors of math skill b(SE), p-value		
	Math skill ~ accuracy	**Math skill ~ RT**
Non-symbolic	0.089(0.105), *p*=.395	0.026(0.011), *p*=.023*
Symbolic	0.590(0.287), *p*=.041*	-0.115(0.017), *p*<0.01***
Age	-0.0008(0.0007), *p*=.255	0.0002(0.0007), *p*=.6939
Sex	0.0002(0.026) *p*=.993	0.0002(0.026), *p*=.993

Performance on symbolic and math tasks is low; non-symbolic accuracy has ceiling effects



DIFFERENTIAL ACTIVATION FOR NON-SYMBOLIC VS SYMBOLIC IN BILATERAL FRONTAL AND LEFT TEMPORAL REGIONS



NON-SYMBOLIC > SYMBOLIC

Activation in right frontal and left temporal negatively related to math skill

NEXT STEPS AND IMPLICATIONS

We find symbolic magnitude processing is a stronger predictor of math skills than non-symbolic, in line with Global North findings. However, these findings differ from previous research in West Africa with a younger sample.

Preliminary fNIRS analyses indicate differential frontal and temporal activation during for non-symbolic vs symbolic tasks; frontal activation is in line with previous findings.

Temporal activation and its relation to math skill, not found in Global North samples, suggest a potential relation between exposure to symbolic number and neurodevelopment of magnitude processing.

Further investigation is required into the relations between magnitude processing and math skill when symbolic number exposure varies.

REFERENCES AND ACKNOWLEDGEMENTS

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FUNDERS