

Accepted Manuscript

Title: Where Arithmetic and Phonology Meet: The
Meta-Analytic Convergence of Arithmetic and Phonological
Processing in the Brain

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PII: S1878-9293(16)30153-0
DOI: <http://dx.doi.org/doi:10.1016/j.dcn.2017.05.003>
Reference: DCN 456

To appear in:

Received date: 15-8-2016
Revised date: 6-5-2017
Accepted date: 6-5-2017

Please cite this article as: Pollack, Courtney, Ashby, Nicole C., Where
Arithmetic and Phonology Meet: The Meta-Analytic Convergence of Arithmetic
and Phonological Processing in the Brain. *Developmental Cognitive Neuroscience*
<http://dx.doi.org/10.1016/j.dcn.2017.05.003>

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Where Arithmetic and Phonology Meet: The Meta-Analytic Convergence of Arithmetic and Phonological Processing in the Brain

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Abstract

Arithmetic facts can be solved using different strategies. Research suggests that some arithmetic problems, particularly those solved by fact retrieval, are related to phonological processing ability and elicit activity in left-lateralized brain regions that support phonological processing. However, it is unclear whether common brain regions support both retrieval-based arithmetic and phonological processing, and if these regions differ across children and adults. This study used activation likelihood estimation to investigate functional neural overlap between arithmetic and phonological processing, separately for children and adults. The meta-analyses in children showed six clusters of overlapping activation concentrated in bilateral frontal regions and in the left fusiform gyrus. The meta-analyses in adults yielded two clusters of concordant activity, one in the left inferior frontal gyrus and one in the left inferior parietal lobule. A qualitative comparison across the two age groups suggests that children show more bilateral and diffuse activation than adults, which may reflect attentional processes that support more effortful processing in children. The present meta-analyses contribute novel insights into the relationship between retrieval-based arithmetic and phonological processing in the brain across children and adults, and brain regions that may support processing of more complex symbolic representations, such as arithmetic facts and words.

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