Effort and effortlessness in the development of word recognition fluency among Hebrew- and Arabic-speaking children: A longitudinal pupillometric study

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Research topic: This investigation explores the development of cognitive effort in word reading among young readers of Hebrew and Arabic through the lens of pupil dilation as an index of cognitive effort. In this study, the specific research questions addressed are:

1) Is printed word learning (the "unfamiliar-to-familiar" transition elaborated by Share, 2008) reflected in declining cognitive effort, as measured by decreasing pupil size in the course of development of reading proficiency in both Hebrew and Arabic?

2) To what extent is the time course of changes in cognitive effort, as measured by pupil size, associated with individual differences in the development of decoding skills (i.e., accuracy, speed, and fluency) in both Hebrew and Arabic?

3) What are the developmental changes in word reading effort from 2nd grade to 6th grade?

4) Are there differences between Hebrew and Arabic in word reading effort, possibly with less automatization of word reading in Arabic (owing to its complex visual-orthographic features - cursivity, letter shape similarity, allography, and non-linearity) and consequently greater word reading effort compared to Hebrew?

Why is my study unique? This is the first longitudinal study to apply pupillometric methods to the early development of printed word learning and to explore the links between pupil dilation and traditional measures of word reading skill, through a cross-linguistic comparison.

Analyses underway: The current study will follow up a previous study (Shechter & Share, 2020) in which we found that reading unfamiliar words involves more cognitive effort (as indicated by greater pupil dilation) than reading familiar words, in both oral and silent reading modes, among adults and 4th-6th graders. Here, we will study a representative sub-sample from the Safra longitudinal study, consisting of 100 Hebrew-speaking children and 100 Arabic-speaking children. This sample will be followed longitudinally across the elementary years from 2nd grade to 6th grade. Our analyses will include pupil size data (as an index of cognitive effort), as well as standard behavioral measures of word reading (i.e., accuracy, speed, and fluency).

Significance of this work and relevance for education: The DSM-5 (2013) defines a learning disorder in reading as "*inaccurate or slow and effortful reading*". Whereas speed and accuracy are

routine measures of reading ability, our work is the first that seeks to develop an objective measure of effort. Thus, this approach has the potential to provide a deeper understanding of the concept of fluent, "effortless" word recognition and to help inform practitioners about how this might be attained in terms of the nature, conditions, and amount of reading practice. Furthermore, pupillometry has the potential of offering researchers a more sensitive moment-by-moment glimpse of the dynamics of printed word learning for individual readers – both typical and disabled.