

## Variability in DDK rate productions in typically-developing children in Scotland

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Diadochokinesis (DDK) skills are routinely assessed in clinical practice to evaluate potential motor involvement in a child's speech difficulty. Research on the development of this skill in typically developing children shows a developmental trajectory of DDK rate, with an increased DDK rate and reduced variability in performance as children grow<sup>[1, 2, 3]</sup>. However, Williams & Stackhouse (2000) found in their cohort of 3-5-year-olds that while consistency of DDK productions improved with age, there was still considerable variability in the rate of DDK productions by age. Further, a review of several studies<sup>[4]</sup> established high variability in DDK productions within a larger range of age groups (2-17 years). The high level of variability reported for DDK rate warrants further research to better understand the role of variability in charting children's developmental patterns for DDK performance.

To this end, the present study investigated variability in 5-10-year-old children's DDK performance to establish the range of variability in typically-developing speech. DDK productions were collected from 77 Scottish primary children using a custom-built iPad app. The data forms part of the first sweep of data collection of speech and non-speech tasks within a larger project investigating variability in child speech. Children were between the ages of 5 to 10 (boys = 34, girls = 43, mean = 7 years; 9 months, SD= 1.75), corresponding to Scottish primary school cohorts (P1 = 5-6 years; P3 = 7-8 years; P5 = 9-10 years). Two attempts were collected per child to test maximum performance for monosyllabic DDK (/pɛ/, /tɛ/, /kɛ/) and trisyllabic DDK rate (/pɛtɛkɛ/), respectively. Measures of mean syllable duration were extracted from the data using praat<sup>[5]</sup>. DDK rate was computed and tested against cohort as an indicator of differences in performance by age.

Results showed a significant difference in DDK rate between age groups for the sounds /pɛ/ (p=0.008) and /tɛ/ (p=0.013) but not for /kɛ/ (p=0.056). There was a significant difference in /pɛtɛkɛ/ DDK rate between age groups (p=0.011): 9–10-year-olds showed a significantly faster DDK rate than 7–8-year-old children, who were in turn significantly faster than 5–6-year-olds. In addition, 9-10-year-olds showed greater variability in their DDK rates compared to 7–8-year-olds and 5–6-year-olds:

- 9–10-year-olds: /pɛ/ SD =0.72, /tɛ/ SD=0.76, /kɛ/ SD =0.76, /pɛtɛkɛ/ SD =1.07
- 7–8-year-olds: /pɛ/ SD =0.57, /tɛ/ SD=0.43, /kɛ/ SD =0.48, /pɛtɛkɛ/ SD =0.79
- 5–6-year-olds: /pɛ/ SD =0.66, /tɛ/ SD=0.57, /kɛ/ SD =0.60, /pɛtɛkɛ/ SD =1.00

Our results confirm previous findings of a clear developmental trajectory for DDK rate to increase with age<sup>1, 2, 3]</sup>. We also found that the 9–10-year-olds in our study were more variable in their DDK rates in both monosyllabic and trisyllabic productions compared to younger children. This confirms findings from previous studies that variability between speakers does not necessarily reduce with age<sup>[1,4]</sup>, suggesting variability may not be a developmentally sensitive measure for all age groups. This means that both, DDK performance profiles and the level of variability in typically developing children, need to be considered when assessing and interpreting oral-motor skills in children with speech difficulties.

### References

- [1] Williams, P., & Stackhouse. (2000). Rate, accuracy and consistency: Diadochokinetic performance of young, normally developing children. *Clinical Linguistics & Phonetics*, 14(4), 267–293.
- [2] Ha, S. (2023). Oral diadochokinetic production in children with typical speech development and speech-sound disorders. *International Journal of Language & Communication Disorders*, 58(5), 1783–1798.
- [3] Modolo, D. J., Berretin-Felix, G., Genaro, K. F., & Brasolotto, A. G. (2011). Oral and Vocal Fold Diadochokinesis in Children. *Folia Phoniatrica et Logopaedica*, 63(1), 1–8.

- [4] Kent, R. D., Yunjung Kim, & Chen, L.-M. (2021). Oral and Laryngeal Diadochokinesis Across the Life Span: A Scoping Review of Methods, Reference Data, and Clinical Applications. *Journal of Speech Language and Hearing Research*, 65(2), 574-623.
- [5] Boersma, P., & Weenink, D. (2023). Praat: Doing phonetics by computer (6.2.14) [Computer software].