Synthesizing evidence about developmental patterns in human visual acuity as measured by Teller Acuity Cards

R.O. Gilmore[1], J. DiFulvio[1], B. Beamer[1], N. Cruz[1]
[1]Department of Psychology, The Pennsylvania State University, University Park, PA

Motivation

Replication is a cornerstone of scientific rigor and a prerequisite for cumulative science. Direct replication is common in some subfields and topics, but less so in others. This project synthesized evidence from published research across a four decade period that employed a widely used measure of grating visual acuity (VA), Teller (Teller, McDonald, Preston, Sebris, & Dobson, 1986) Acuity Cards (TAC). We sought to capture findings about the development of VA in early childhood, harmonize them into an aggregated dataset, and share the dataset openly. The ultimate goal is to characterize how grating visual acuity develops.

Methods

To achieve this, we did the following:

1. Searched Google Scholar for the terms "teller acuity cards", "visual acuity cards", or "teller cards".
2. Determined which papers had full-text or PDFs available.
3. Evaluated each paper to determine whether it had extractable data or contained summaries of data presented elsewhere.
4. Harmonized the data into a soon-to-be-shared Google sheet.
5. Created visualizations and summaries of the data.

Figure 1: QR code for poster

Results: Sources synthesized

- *n*=751 found
- *n*=432 had PDFs or full-text versions available
- *n*=28 had extractable data in a form suitable for synthesis (acuity values, age, sample size)
- Synthesis is ongoing

Results: Typically developing children

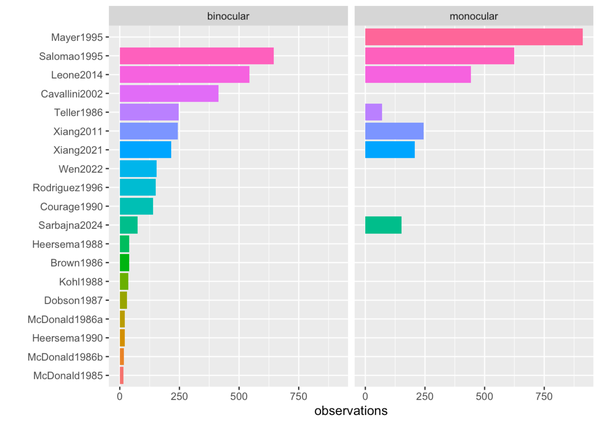

Figure 2: Number of participants by eye(s) tested for papers reporting by-condition sample sizes.

Across the *n*=20 papers, *n*=5,700 participant observations are included. The *n*`s per age group are in [1, 84] with a median of *n*=20.

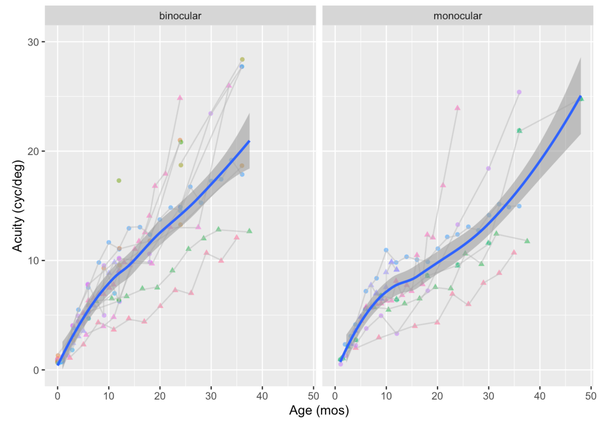

Figure 3: Mean or median visual acuity (in cyc/deg) by age (in mos) across *n*=20 papers. Binocular values (left column); monocular values (right column). Loess fit with SEM in blue.

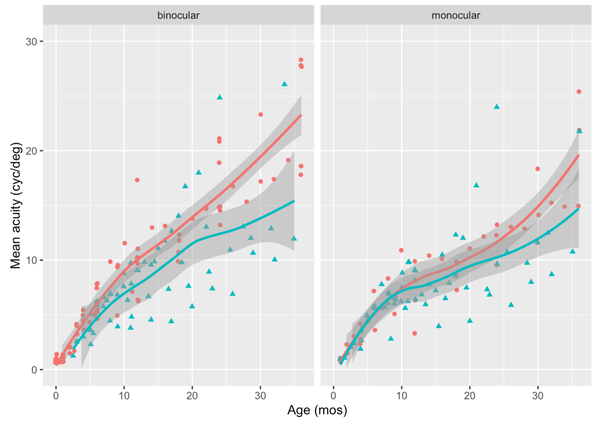

Figure 4: Developmental time course of grating acuity (in cyc/deg) for typically developing children (0-36 mos) as assessed by two types of Teller Acuity Cards, TAC-I (red circles) and TAC-II (cyan triangles) with loess fits.

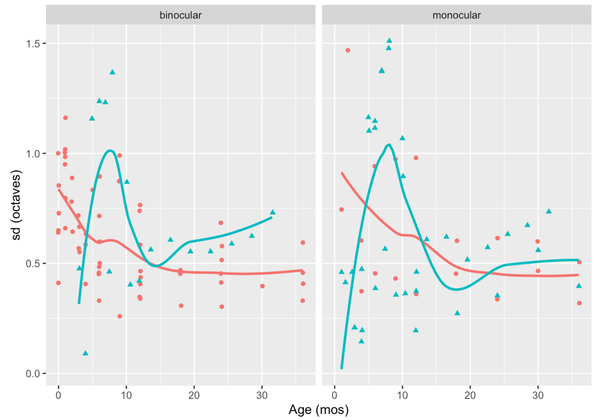

Figure 5: Relationship between the standard deviation (SD in octaves) of estimated visual acuity (cyc/deg) observed in typically developing children (0-36 mos) as assessed by Teller Acuity Cards and child age in months for both card types: TAC-I (red circles) and TAC-II (cyan triangles).

Results: Atypically developing children

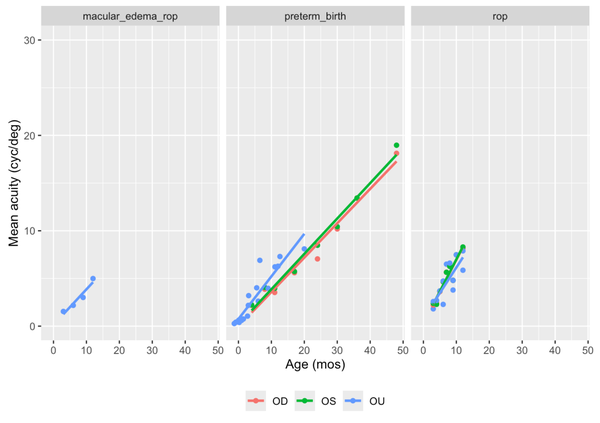

Figure 6: Developmental group mean acuity patterns for atypically developing children with varied diagnoses: Retinopathy of Prematurity (ROP), macular edema + ROP, and preterm-birth.

Conclusions

- Synthesizing evidence about core facets of human visual development is important and illuminating.
- Variation in mean acuity thresholds at different ages and by card type pose challenges for norm-setting (Neijzen et al., 2025).
- Idiosyncratic practices for reporting data in published papers make evidence synthesis challenging, even when researchers use a common method.
- Vision scientists should adopt open data sharing practices more widely and should curate shared data in ways that make synthesis, aggregation, and reuse easier.

Bibliography

Neijzen, C. M., Wit, F. M. de, Hettinga, Y. M., Boer, J. H. de, Genderen, M. M. van, & Wit, G. C. de. (2025). Reference values for the Teller Acuity Cards II (TAC II) in infants and preverbal children, a meta-analysis. *Acta Ophthalmologica*. https://doi.org/10.1111/aos.17447

Teller, D. Y., McDonald, M. A., Preston, K., Sebris, S. L., & Dobson, V. (1986). Assessment of visual acuity in infants and children: the acuity card procedure. *Developmental Medicine and Child Neurology*, *28*(6), 779–789. https://doi.org/10.1111/j.1469-8749.1986.tb03932.x