Chapter 3
Testing Stereopsis in Children

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ABSTRACT

Stereopsis develops very early in life and is thought to be present in a normally developing child by six months of age. In order to develop stereopsis, multiple components of visual development must be intact including visual acuity and bifoveal fixation. Stereopsis is the most sensitive way to assess sensory fusion but can be unreliable in very young age groups due to difficulty understanding the test or instructions. It is best to choose an option with global stereopsis (high level cortical stereo), as local stereopsis may overestimate ability due to available monocular cues. Global is created using random dot stereograms (RDS) – computer-generated patterns to create a stereoscopic form, while local contains line stereograms which create horizontal retinal image disparity giving the perception of depth. Stereopsis can be affected by strabismus, amblyopia, and other binocular vision dysfunctions that interfere with visual efficiency (especially in school-age children). The chapter discusses the most commonly used clinical tests of global and local stereopsis.

INTRODUCTION

Stereopsis testing is a way to quantify the smallest retinal image disparity that provides depth perception. Both visual acuity and ocular alignment must be within normal ranges in order for stereopsis to develop (Schnell, 2020). There are two types of stereopsis that are found in the tests described in this chapter: global and local. When possible, it is best to test global stereopsis, which requires high level cortical stereopsis provided only from bifoveated images. Local stereopsis however, may be elicited using monocular cues (i.e., motion parallax) to detect disparity. Stereopsis testing is most useful in detecting amblyopia and/or strabismus. In older children, it may also aid in detecting or monitoring other binocular dysfunctions affecting sensory or motor function. This chapter will discuss the most commonly used clinical stereo tests of global and/or local stereopsis.

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BACKGROUND

Testing stereopsis in young children is important for assisting in the identification and progression of conditions such as amblyopia, strabismus, and significant refractive error. In older children, it can be additive in detecting or monitoring other types of binocular vision disorders that can affect visual efficiency. Global stereopsis is a random dot stereogram (RDS) that is composed of computer-generated dots giving rise to stereoscopic forms if bifoveally fixated. RDS testing can quickly rule out most strabismus, including microtropias. There are no monocular cues to aid in detection. Local stereopsis on the other hand is a line stereogram using horizontal retinal disparity to elicit the perception of stereopsis. Local stereopsis can be detected through monocular cues, therefore making it less robust in detecting amblyopia and strabismus. It is important for the clinician to minimize the use of these cues by having the patient and stereo book remain still. Stereopsis norms increase with age as well as reliability in these tests (Pai, 2012; Tarczy-Hornoch, 2008). Table 1 outlines general norms for stereoacuity by age.

Table 1. Stereoacuity norms by age

Age (years)	Norm (sec of arc)
3-4	150
4-5	70
5-8	40
11+	20

(Schnell, 2020)

Clinical Pearl: *Some children will need more time to perceive stereopsis targets (especially global); clinicians should be encouraging to garner the child's interest in finding the hidden items.*

Random Dot E

This 2-alternative-forced-choice test uses random-dot stereograms to test global stereopsis. It is sometimes used in vision screenings as it has been shown as an effective screening for amblyopia and refractive error. Conditions that have "coarse" stereopsis (such as anisometropic amblyopes, monofixators and microstrabismics) will not be able to pass this test. It is a great tool for not only screenings, but examinations in young children.

The set of testing plates include a blank, an embossed or model E, and a stereopsis E (Figure 1). The blank plate contains a random-dot stereogram that appears as a random assortment of dots. The model E is visible by all individuals regardless if they have stereopsis. The last plate contains a random-dot stereogram that shows the letter E to individuals wearing polarized glasses who have stereopsis. It is the only stereopsis test not conducted at a near point distance.

Equipment

1. Pediatric polarized glasses
2. Random Dot E plate (blank, demo, and test plates)