

# INSTRUCTION MANUAL

# The Newborn Acuity Cards<sup>®</sup>

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Manufactured Exclusively By:  
**Precision**  

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**Vision<sup>®</sup>**

The Newborn Acuity Cards were designed and developed at the Ohio State University College of Optometry by Precision-Vision, Inc. and Dr. Angela Brown, with support from the National Eye Institute (R41EY022545, R42EY022545).

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## **Introduction.**

Forty-three states in the U.S.A. mandate a hearing test for every newborn infant, but no state mandates vision testing. Neonatologists and ophthalmologists can screen the eyes and visual system of the newborn infant by external inspection of the eyes and lids, ocular alignment and motility assessment, evaluation of the pupils and their responses, and the red light reflex. Specialized eye exams include indirect ophthalmoscopy and other advanced techniques. However, none of these modalities provides an estimate of how well the infant can see.

The Newborn Acuity Cards were designed to fill this gap.

The Newborn Acuity Cards exploit the innate tendency for newborn infants to look at things they can see. The test is fast and convenient: testing generally takes about 12 minutes, it can occur at the bedside without any complex apparatus (Brown et al 2018). Success rates on awake infants are generally over 80%, and if the same infant is tested on two different days, the overall success rate is over 95%. The results of those two tests are within octave of one another in 90% of cases (Brown & Yamamoto 1986).

## **The Newborn Acuity Cards.**

### **Overview.**

During testing, a caregiver holds the infant, keeping the infant happy and awake. The examiner presents the Newborn Acuity Cards in a descending series, starting with easy-to-see gratings and proceeding to harder-to-see gratings, judging whether each grating is “seen” or “not-seen.” The grating with the finest stripes (the highest spatial frequency) that the infant can see is the measure of the infant’s visual acuity.

### **Personnel.**

It is simplest if three people participate in testing. A caregiver (generally a parent or a nurse) holds the infant and tries to keep the infant awake and calm. An examiner presents the cards to the infant and judges whether each card is “seen” or “not-seen.” An assistant selects the cards and hands each card to the examiner in such a way that the examiner cannot see the face of the card before presenting it. This strategy keeps the examiner unaware of the acuity value of each grating and avoids any bias that might arise based on the examiner’s prior opinions about the visual capabilities of the infant. However, with experience, the examiner can select the cards and present them solo, as long as he or she takes precautions to avoid knowing the exact acuity values of the cards before presenting them.

### **Making a measurement.**

The cards should be face down. Someone other than the examiner should arrange the deck of cards in descending order of logMAR, with the unused easy cards in order at the bottom of the

deck. This “cuts the deck” so the examiner does not know the exact value of any card that is to be presented. Adhesive paper loosely covering the acuity values, which are marked on the backs of the cards, can keep the solo examiner masked to the acuity values.

At the beginning of the test, the assistant or the examiner selects the “start-card” and the examiner presents it to the infant. If the examiner judges that the infant saw that card, a “harder” card is selected, while keeping the examiner unaware of its acuity value. It often helps to choose a second card that is two to four cards higher in spatial frequency than the start-card, just to avoid too many card presentations. If the infant does not see the second card, an easier-to-see card, nearer to the start-card, is selected.

Then the remaining cards are presented, in descending order, starting with the hardest card seen so far and stopping when the infant is judged not to have seen a grating.

Making the judgements.

The examiner presents each card to the infant with the grating perpendicular to the infant’s line of sight and at the chosen test distance. As the examiner views the infant’s eyes through the central peephole, the examiner and the infant are looking directly at each other. Of course, the infant cannot see the examiner because the grating card is between them.

If the infant turns to look elsewhere, the examiner attempts to keep the card in the correct position relative to the infant’s line of sight. If the infant maintains fixation of the grating, the examiner displaces the card about 5 centimeters to the right or left and observes whether the infant moves the eyes to keep the grating in view. If desired, the examiner may flip the card front-to-back to present the uniform gray of the back of the card, or else present the “blank” gray card, to observe the infant’s behavior in the absence of the grating.

The examiner then decides, based on the totality of the infant’s behavior, whether the infant saw the grating or not. A judgment that the infant saw the grating could be based on several indicative behaviors. The main ones are continued fixation rather than looking away and movements of the eye or the body to keep the grating in view as the examiner displaces it. If the infant continues to stare at the card only when the grating is present, and if the infant looks away when the examiner presents a blank gray stimulus, that is also a good indicator that the infant saw the grating. A judgment that the infant did not see the grating could be based on other behaviors. For example, the infant may refuse to look at the grating at all, or may look away after the grating is correctly positioned, may stare repeatedly at the same point in space even when the grating moves.

Scoring the results.

The visual acuity is the number associated with the narrowest stripes the infant is judged to see. See the Appendix for a discussion of units of measure.

### Examiner training.

We have been using these cards for many years. We find that some examiners require more training than others, but any observant person can make these judgments, regardless of qualification. The main requirement is that the examiner must be very patient and comfortable with newborn infants.

The Newborn Acuity Cards can only be used on infants who are awake, and finding infants awake in this age range is sometimes a challenge. Examiners should encourage the caregiver holding the infant to keep them awake if possible. Also, some infants fall asleep during testing, and if that occurs, the examiner should repeat the test later when the infant is awake. Infants over 4 to 6 weeks gestational age tend to habituate to the gratings, so the examiner should use a preferential looking card test on those older infants.

### Light levels.

The Newborn Acuity Cards are gray in color, but the gratings are fully black-and-white. Based on work with 7-week-old infants, we consider an absolute minimum luminance to be  $1.5 \text{ cd/m}^2$ , or about 1 lux falling upon the surface of the gray cards (Brown et al 1987).

### Test distance.

The Newborn Acuity Cards are designed to be used at a test distance of 38 or 57 cm. Generally, 38 cm works better because the card subtends a larger area of the infant's visual field, and the examiner has a better view of the infant's eyes. It is important to maintain the chosen distance, because the acuity values of the cards depend on distance. The appendix is a table of the visual acuity values, in various units, for testing at 38 cm and 57 cm.

### Care of the cards.

The Newborn Acuity Cards are laminated, and the examiner or the assistant can sanitize them by gently wiping them using hospital surface wipes before each use. The backs of the cards are the same gray as the fronts and are also laminated, and they also should be wiped to prevent deposits from forming around the peepholes.

### Literature cited.

- Brown AM, Dobson V, Maier J. 1987. Visual acuity of human infants at scotopic, mesopic, and photopic luminances. *Vision Res* 27: 1845-58
- Brown AM, Opoku FO, Stenger MR. 2018. Neonatal Contrast Sensitivity and Visual Acuity: Basic Psychophysics. *Transl Vis Sci Technol* 7: 18
- Brown AM, Yamamoto M. 1986. Visual acuity in newborn and preterm infants measured with grating acuity cards. *American journal of ophthalmology* 102: 245-53

## Appendix. Units of Visual Acuity

### A. Test distance = 38 cm

card number	grating frequency	stripe-width	Snellen	logMAR
1	0.125 cy/cm	4	20/7200	2.56
2	0.17 cy/cm	3	20/5400	2.43
3	0.25 cy/cm	2	20/3600	2.26
4	0.33 cy/cm	1.5	20/2700	2.13
5	0.5 cy/cm	1	20/1800	1.95
6	0.75 cy/cm	0.665	20/1200	1.78
7	1 cy/cm	0.5	20/900	1.65
8	1.4 cy/cm	0.355	20/638	1.5
9	2 cy/cm	0.25	20/450	1.35
10	3 cy/cm	0.165	20/300	1.18

**B. Test distance = 57 cm**

card number	grating frequency	stripe-width	Snellen	logMAR
1	0.125 cy/cm	4	20/4800	2.38
2	0.17 cy/cm	3	20/3600	2.26
3	0.25 cy/cm	2	20/2400	2.08
4	0.33 cy/cm	1.5	20/1800	1.95
5	0.5 cy/cm	1	20/1200	1.78
6	0.75 cy/cm	0.665	20/800	1.6
7	1 cy/cm	0.5	20/600	1.48
8	1.4 cy/cm	0.355	20/425	1.33
9	2 cy/cm	0.25	20/300	1.18
10	3 cy/cm	0.165	20/200	1
11	0 cy/cm	n.a.	n.a.	n.a.