

Infant Vision Pillows Interpretation Guide

Exploring Infant Vision, Color Preferences, and Face Perception

The “Infant Vision Pillows” activity was developed to help caregivers learn about the development of their infant’s vision, including visual acuity (how clear someone’s vision is), color perception, and the ability to recognize faces. Caregivers can see how cognitive scientists learn about babies’ abilities by using similar methods to observe their infants behavior. Caregivers will note their children’s responses to different objects, make predictions about what their children will choose to look at, and test their hypothesis about their children’s behavior using the available pillows and mobile in the Infant Area.



Why are these ideas important?

For Science

Studying how infants of different ages perceive the world and act upon it helps scientists understand how we develop over time. Knowing what information babies are taking in, and what behaviors they exhibit in response to that information, helps scientists figure out what is going on in their minds, since babies cannot tell us what they are thinking! Visual perception is important for helping babies learn about cause-and-effect relationships, number, recognizing others, understanding emotions, and communication.

For Museum Educators

Cognitive science research, particularly child development studies, is not widely understood by the public. Talking about these ideas with caregivers gives them a better sense of what this kind of scientist does. In addition, informing them about the methods of infant research give caregivers the opportunity and ability to investigate their child’s development on their own, giving them a personal connection to the research, and a way to learn more about their child.

For Caregivers

By encouraging caregivers to use the techniques that scientists use to observe and learn about their own child, you are providing them with the tools they need to become informed advocates for their children. The more caregivers explore how children in general (and their child in particular) learn and grow, the better they can help their child in that process. The questions, observations, and methods associated with this research will often be intriguing to caregivers, who spend much of their time interacting with their child and wondering about the changes that occur as their child develops.

How can visitors act like scientists who study infant vision and development?

How do you design an experiment when your participant is a baby who cannot tell you what they are thinking and will not follow any instructions that you give? To solve these

problems, scientists set up situations to observe what infants do naturally. After observing, scientists make a hypothesis, or guess, about why the infant acted that way and design a follow-up experiment to test their ideas.

Start with a Question: Interpreters facilitate this activity by helping caregivers ask questions and test questions about infant vision using the pillows in the infant area. Three general topics are discussed below, each associated with specific questions that might interest caregivers. For more suggestions of the types of questions caregivers could ask, you can utilize the cards from the *Studying Vision* and *Infant Vision* activities. The Studying Vision cards give explicit suggestions for questions. The Infant Vision cards show infants' vision at different ages, and can be used to prompt caregivers: "What do you notice? What colors are most noticeable? What kind of patterns will they be able to see best?" Observing the changes in infant vision may give caregivers ideas about what their baby might be able to see best.

Figure out How to Test It: The types of questions inspired by the Studying Vision and Infant Vision cards can be answered using the same methods that cognitive scientists use to study infant vision. Using the mobile pillows, caregivers can see which pillows the infants look at the longest. These methods tell you if infants can tell the difference between the images, colors, or patterns on the pillows and if they have a preference for one of them. Infant vision develops over a baby's first six months, and the changes affect what a baby sees and prefers to look at.

Find out More: Interpreters can further facilitate this activity by prompting the caregiver with follow-up questions after they have observed the child's behavior. If the original question was "Do you think your baby will like the blue pillow or the yellow pillow?" and the baby looked at the blue one, the interpreter could follow-up by asking the caregiver why that might have occurred. The caregiver may come up with a few ideas about why the baby liked blue better: "He can see dark colors better? He likes blue better than the other colors?" The interpreter can guide the caregiver to a way to test the new question: "Are there other comparisons you can make that would help narrow it down?" The caregiver could pair a different dark color with the yellow or compare two dark colors to see if the baby prefers blue.

The interpreter and caregiver do not need background knowledge in cognitive development to do this activity! The Infant Vision and Studying Vision cards and the pillows will provide all the necessary information. The focus of this activity is not to tell caregivers what is already known in the cognitive science field, but rather to help caregivers understand the types of questions a scientist might ask, the methods used to study these questions, and how to apply these methods to observe and learn about their own child. Caregivers may come to some of the same conclusions as scientists when they test out their ideas, but individual babies do not always act in predictable ways. There are no wrong answers when observing children!

Interpretation Method

Recruiting: Visitors who bring infants to the museum often assume that there are not many ways for themselves and museum educators to interact with their child. With these activities, we want to show caregivers that babies have many abilities, and that it can be surprising and fun to observe they can and cannot do. These activities can be initiated anywhere in the space by using the Infant Vision or Studying Vision cards to start a discussion with an adult with an infant: “Have you ever thought about what a baby can see? How do you think scientists try to study infant vision?” If not already in the infant area, the discussion can then move to the Infant Vision Mobile. These caregivers are often visitors who might not otherwise approach you for an interaction, but will be appreciative to learn about activities they can try with their baby.

Materials:

- Studying Vision cards (pictures of the mobile pillows with prompts on the back)
- Infant Vision cards (pictures of what infants can see at different ages)
- Infant Vision mobile and patterned pillows

Activity Instructions:

1. Recruit a visitor, using the Infant Vision or Studying Vision cards: “Have you ever thought about what a baby can see? How do you think scientists try to study infant vision?”
2. If not already there, suggest moving to the infant area to use the Infant Vision Mobile. However, you can also conduct this activity in other parts of the space by using the Studying Vision cards or bringing the pillows to the caregiver.
3. Use the Infant Vision or Studying Vision cards, your background knowledge, or the caregiver’s ideas to come up with a question to test.
4. Help the caregiver figure out which pillows are appropriate for the question, and show them hang them on the mobile to see which the baby prefers to look at.
5. If it is not clear which pillow the baby looked at, or if the baby did not look at either pillow: take pillows away, flip their positions behind your back, and try showing them to the baby again. Scientists often repeat the comparisons they present to make sure that babies are making a consistent choice and not choosing randomly. If the baby still does not prefer one to the other, maybe this baby does not have a preference between them. Why might that be? Perhaps the baby can’t tell the difference between the two pillows, or perhaps they are both “boring.”
6. You can also try showing the pillows one at a time, to see how long the baby looks at each individually, or setting them out and letting the baby reach or crawl towards one or the other.
7. After observing the baby’s behavior, prompt the caregiver with follow-up questions (suggestions can be found elsewhere in the guide). Does the caregiver have any guesses about why the baby acted that way? How could the caregiver test that guess?
8. Suggest ways that the caregiver can continue to think and act like a scientist elsewhere in the museum, or at home. It is fun to observe baby behavior and figure out the reasons for it!

Additional Challenges

- See the sections below for suggestions of similar activities to try at the museum or at home.
- Encourage caregivers to explore their own ideas, ask questions, and experiment to test their hypotheses!
- If the infant has an older sibling, see if there are any differences when the sibling and the caregiver are interacting with the infant. Can the older sibling try asking questions and designing experiments?

Activity Tips

- *How do I help caregivers observe their child?* The main focus of this activity is having caregivers ask questions, observe their child's behaviors, and make hypotheses about how their child perceives the world. Helping caregivers stay engaged, pay attention, and watch their child is therefore even more important than usual. Using phrases such as "See what your baby is doing?" "Why do you think your baby is acting that way?" "What do you think your baby can see?" or "What is your baby thinking?" can prompt caregivers to observe their child, and helps model the types of questions they can ask.
- *How do I keep the infant interested?* If the baby is distracted by other events in the museum, have the caregiver try to get the baby's attention by smiling or talking. Remove the toys you are currently using and bring them out again, to see if you can recapture the infant's attention. However, if the baby is truly not interested, you can use that as an opportunity to ask the caregiver why the baby might not be interested in the toys you are currently using, and talk about how watching when babies get bored could be used as an experimental technique. What kind of questions could you test this way?
- *How do I keep caregivers interested?* Many caregivers think that their infant is too young to participate in many activities in the museum, and might not understand why you want to talk with them. Try to emphasize that they can use the research techniques developed to study young infants to observe and learn about their own child. Pose provocative questions, especially ones where you know the answer is not obvious. For example, "Do you think your baby has perfect vision from birth?" Encourage caregivers to ask their own questions; they will be more engaged if they are investigating a question they are genuinely interested in.
- *How do I extend this activity to other ages?* This activity is designed for infants, and works best for infants from birth to 12 months. For slightly older children (one-year-olds), the activity can be modified to include reaching for or crawling for one of the pillows, instead of just looking at them. This allows these children to work on some of the motor skills they are developing as caregivers observe their behavior! For older children with language skills, caregivers can present the pillows and ask "Which is your favorite?" or "What is the difference between these?" These children might even enjoy joining with the caregiver to figure out how babies see and how you could test that.

Visual Acuity:

Background

How do we know how clear infants vision is at different ages? Eye doctors (and scientists!) can test infants' **visual acuity** very early in life using the same methods that we encourage caregivers to use in the mobile activity. To see how sharp an infants' vision is, the doctor shows a baby one object that is black-and-white striped and another one that is plain grey. Which do you think is more interesting to a baby? A striped pattern is generally more interesting to look at than a plain grey shape...but only if you can see the stripe!

The part of the eye that focuses light and is responsible for visual acuity is called the fovea. It is located at the back of the eye next to the retina. In young infants, visual acuity is limited because the fovea is immature. It is hard to get a clear picture of an image to the brain and many objects appear blurry. As the fovea develops (changes over time to become more mature), the images the brain receives are clearer, and the baby will be able to see more details.

When testing an infant's visual acuity, the doctor (or scientist) starts out by using one pattern with a very wide stripe and one that is plain grey. The baby tends to look at the pattern with the easy-to-see stripes. The doctor will gradually make the stripes thinner and thinner until the baby no longer shows a preference for the striped object (i.e., looks at the striped object and the grey object equally), suggesting that the baby can no longer see the stripe. How thin a stripe the baby is able to see tells the doctor how sharp the baby's vision is. To see for yourself what a baby's vision feels like, cross your eyes while reading lines of text in a newspaper. The lines blur together and look like a solid grey blob.

Optometrists test adults' vision in similar ways. For example, your eye doctor might ask you to read letters on an eye chart. At a critical point, the lines that make up the letters just blur together. In addition, the optometrist may show you two images and ask you: "Which one looks clearer?" This method is similar to the one we encourage caregivers to use to observe their infant. However, unlike adults, who can just tell the doctor what they see, infants tell us by looking at the object that is more interesting to them.

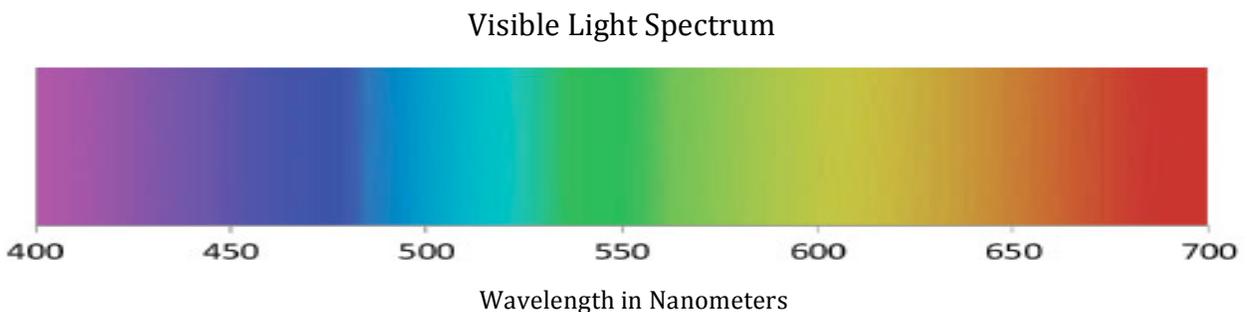
Questions to Prompt Caregivers

- What do you notice about the changes in infants' vision on the Infant Vision cards? What could you do to test whether your child actually sees this way?
- Does your baby like the pillow with wide black and white stripes more than the solid grey one? Does this change if the stripes are smaller?
- Does your baby prefer stripes or solid colors? Pick two pillows at a time and see if you can find out! Why might your baby like one of the pillows you chose more than the other?
- Does your baby prefer to look at striped pillow that is close or far away? Does this change if the stripes are smaller or bigger?
- Does your baby focus better on patterns that are closer or far away? How can you find out? How do you usually talk to your baby, up close or from far away?

Color Vision:

Background

How do we know what colors infants can see and prefer at different ages? Optometrists and scientists study babies' retinas to learn about the development of their **color vision**. Your retina has two types of cells: rods and cones. Rods detect the difference between light and dark, and help us detect contrasts and see at night. Cones detect different wavelengths of light, and allow us to perceive colors. Although rods are mostly developed at birth, cones continue to develop throughout the first few months of life. Because their cones cannot yet detect all wavelengths of colors, babies have trouble seeing all the colors that adults can see. Infants as young as two weeks old have color vision, but it is limited to distinguishing a red object from a green or blue one. These colors are very distinctive because they are at



the opposite ends of the color spectrum. By three months old, babies can detect yellows and greens (which are in the middle of the color spectrum), but they still can't distinguish very pale or subtle shades of color, such as pastels, because the fovea (see **Visual Acuity** above) is not fully developed. By four to six months old, babies' eyes are mature and they can make subtle color discriminations. At this point, babies can see the full visual spectrum of colors and shades.

Questions to Prompt Caregivers

- What colors should be the easiest to see for your child, according to the Infant Vision cards? How could you test whether this is the case for your child?
- What colors does your baby prefer? Show two pillows at a time and see if you can find out!
- Does your baby like black and white or colored patterns better? Can you guess why?
- Does your baby prefer yellow or blue? Use these pillows to find out! Can you guess why one color might be more interesting?
- Does your baby prefer red or yellow? Can you guess why? Use the pillows to test your ideas!
- Does your baby have a favorite color? Pick two pillows at a time and see if you can find out! Why might your baby like one color more than another?
- Does your baby prefer to look at pastels or brighter colors? Can you guess why?

Face Perception:

Background

What kind of shapes do babies prefer looking at? Do babies recognize and prefer to look at faces? To answer these questions, cognitive scientists study the development of **form perception**—how infants perceive different shapes, and their preferences for certain types of shapes. Because we cannot ask babies to tell us what shapes they see or whether they like them, scientists have developed methods to determine what babies are seeing and thinking. In these setups, babies are shown a set of patterns; the experimenter records how long the baby spends looking at each pattern. Sometimes scientists measure how long the baby looks at a single pattern (“looking time”) and other times scientists measure which pattern the baby looks at more (“preferential looking”).

Studying infants’ form perception sometimes leads to surprising results. For example, researchers studying infant vision in the 1960s hypothesized that new, visually complex patterns (such as a bull’s eye or text) would hold a baby’s interest for a longer amount of time than familiar, visually simple patterns (such as a face) would. However, these researchers found that babies preferred to look at a human face, which they encounter often in their visual environment, for longer than they look at any other pattern. These researchers suggested that babies are born with an innate ability to recognize and prefer looking at human faces, knowing that they belong to people who will feed and take care of them. These results suggest that caregivers can benefit from closely observing their child, because they, like scientists, can often be surprised by what infants can and cannot do.

Further research using similar methods has supported the theory that face perception is an innate, important part of human vision. When shown different patterns, babies of all ages, even newborns, prefer to look at a face-like pattern (two eyes and a mouth, or two dark spots above one dark spot) than other patterns. This behavior is an example of nature AND nurture: although looking at faces is an innate preference, the behavior is reinforced because it is the main visual input for newborns, and caregivers encourage attention to faces by responding with noises and expressions when babies look at them.

Scientists study how infants recognize faces by measuring how long they look at pictures of familiar and unfamiliar people. Infants tend to look longer at a picture of their mother than a picture of a female stranger. How do infants recognize faces? Scientists have found that if both women are wearing headscarves that cover their hairlines, newborns no longer prefer the picture of their mother. This finding suggests that young babies rely on the high contrast areas of the face (such as the hairline) to recognize faces. However, by three months old, babies prefer to look at their mother even when both faces are wearing headscarves, suggesting that their vision is now sharp enough to distinguish people’s eyes, nose, and mouth, and use these traits to recognize people (see the Visual Acuity section, or the Infant Vision cards, for more information). Infants can also use people’s voices to recognize their faces, since hearing is a sense that is fully developed at birth.

This affinity for faces helps babies learn to recognize others, to understand emotional facial expressions, and to learn how to communicate. Think about how hard it would be to communicate with others if you didn’t recognize who they were, what their emotions were,

or whether they were looking at you. These are some characteristics of children with autism, who have difficulty with social interactions and often have delays in language development. Some researchers think that these children may not perceive and process faces the same way that typically-developing children do. However, please stress to caregivers that our activities are not designed to clinically assess children's abilities. There could be many reasons a child does not spend time looking at the face pillow. The experiments that led to these findings were run in controlled environments, many times over, to make sure the results were genuine. In our environment, a baby could easily be distracted or bored, and that will affect their behavior. The caregiver can use this as an opportunity to observe how the child behaves in different situations and environments!

Questions to Prompt Caregivers

- What colors should your baby be able to see best, according to the Infant Vision cards? How could you test if this is the case for your child?
- Does your baby like to look at faces or at other patterns? Make a guess and use these pillows to test it out!
- Does your baby prefer to look at patterns or solid colors? Do some patterns get more attention than others? Can you make a guess why?
- Will your baby prefer to look at a striped pattern or at a different pattern? Why might one pattern be more interesting to a baby than the other?
- Can your baby distinguish eyes and a mouth to perceive a face? How could you test this with one of the non-face patterns?
- Does your baby prefer to look at the face pillow or your face? Does your baby prefer to look at your face or a stranger's face? Can you make a guess why?
- Why might faces be more interesting than other objects for a baby?
- If you were a newborn, how could you recognize people's faces? Could you use their eyes, nose, or mouth? How else could you recognize the people around you?
- How does your baby respond to books with pictures of other babies or humans, compared to books about trees or toys?
- How does your baby react to the face of a stranger, compared to someone your baby knows well, such as a grandparent?
- Does your baby react differently to cartoons with human characters, live action movies, and real life people? Can you make a guess why?

Questions Caregivers May Ask:

1. *Can I do this on my own?* The experiment is designed so that one adult can conduct it without assistance. However, some caregivers may want help from staff. We recommend caregivers trying it by themselves, first because babies may be distracted or influenced by the presence of a stranger, but also because one of our goals for this exhibit is for caregivers to be the scientist!

2. *Is my baby too old for this activity?* The infant area is restricted to children less than 12 months old or who do not yet walk on their own. Babies under the age of 6 months are less likely to roll and/or move while under the mobile, but some older babies do stay still. With older infants, you can also skip the mobile altogether and just hold the two pillows in front of them (one to either side of your body) to see which one they prefer to look at. You can also brainstorm other ways that a caregiver could test these questions!

3. *My baby did not spend much time looking at the human face, what does it mean?* Babies in the Discovery Center are not in a controlled environment like scientists use. There are a wide variety of unavoidable distractions in the exhibit (i.e., the water table, bright lights, other babies playing/crying/moving in the vicinity). We've tried to minimize these potential distractions, but we do not expect caregivers to consistently get the same results as researchers. Also, when scientists run their experiments, they use many babies, and show the same images many times. Trying this activity one time will not always produce the same results as an experiment, which uses an average from all of the babies that participated. The mobile exhibit illustrates the methods used in cognitive development experiments, but we do not expect it to always produce the same results!

4. *Does the order of the patterns matter?* This is a question that can be experimentally tested! Does your child respond differently if you show the pillows in different orders? In scientific studies, researchers randomize the order of the patterns that they show so that they can make sure they interpret their results correctly.

5. *What if my baby looks away and then looks back?* If a baby's gaze falls to the side and looks away, or if there is a major distraction (like the entrance of a stranger, another parent, or a voice of another baby) and the baby looks away, then disregard that "look" and reshoot that pattern later in the activity. If the baby just looks away without a noticeable distraction having taken place, then that indicates that the baby became "bored" of the pattern. Some researchers even purposefully make babies "bored" during their experiments to see what sparks their attention again!

6. *Where can I get more information?* The Living Lab website (<http://www.mos.org/discoverycenter/livinglab/air/list>) has information about infant research and links to publications and popular press articles.

7. *Can my baby participate in scientific research experiments like the ones described here?* We have researchers here in the museum through the Living Lab, but their experiments are often with slightly older children. However, researchers at universities are always looking for young subjects! Contact the Psychology, Cognitive Science, or Child Development department at your local university to see if you can participate in their studies!

Activities for Caregivers to Try at the Museum:

Observe like a Scientist!

Encourage caregivers to observe their child playing in the museum. Ask caregivers:

- What behaviors can you see? What do these behaviors tell you about the way your baby's senses, thought processes, and motor skills are operating?
- How does your baby's behavior change over time?
- Do you have any questions about your child's behavior?

Test like a Scientist!

Caregivers can use toys other than the pillows to test out their ideas about their baby's perception, behavior, and preferences. Ask caregivers:

- Which other toys or books do you think your baby will like? Why?
- Are there any that you think your baby will not like? Why not?
- Can you test your ideas?
- Is there anything you can do to change your baby's reactions?

Think like a Scientist!

Caregivers may have further questions about the research that has been conducted with infants. We have a set of research papers related to these topics that they can peruse, or they can visit <http://www.mos.org/discoverycenter/livinglab/air/list> for more information on what research has helped scientists learn about infants!

Activities for Caregivers to Try at Home:

My Favorite Things

Caregivers can conduct similar activities with all kinds of objects at home. Toys have different colors and patterns, different levels of darkness and brightness, and some might even have faces on them, while others won't. By noticing what their baby looks at when given a choice, caregivers can learn what kinds of objects are most interesting to infants. Instead of handing a toy to your baby, try letting your baby choose between two or three objects (by looking at or reaching for the toy).

Mom, is that you?

Because babies love to look at faces, caregivers can also do some fun face-recognition tests with their babies at home.

Very young babies have blurry vision and recognize people based on their hairlines and face shapes. How could caregivers trick their child? Try putting on a hat or a scarf that covers your hair, and see what the baby's reaction is. Your baby might not recognize you until you speak – then your child will probably recognize your voice. When you take off the scarf your baby will see that it's you! This is the same method that scientists used to study what infants use to recognize faces.

Caregivers can also investigate what makes faces special. If your baby is looking at your face, try not smiling or moving your face at all, and not speaking or making any noise. Hold your face very still with a serious expression. Your baby will probably start to fuss and may

stop looking at you. Babies love to look at faces because they are so dynamic and rewarding. When a baby looks at an adult, the adult usually responds by smiling, opening their eyes wide, and making lots of silly noises – responses that are very fun and exciting for a baby to experience! This behavior encourages babies to keep looking at the faces all around them, strengthening the preference that they were born with.

Copy Cat

From a young age, infants are able to imitate the facial expressions of those around them. Try sticking out your tongue or opening your mouth wide. Does your baby copy your expression? Paying attention to other people's faces, and copying what they do, may be important for helping babies understand and express emotion, learn language, and interact socially.

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