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# Colour Perception and Emotion in Infants

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## Summary

- Newborn babies have poor vision. Over the first three months they will develop colour vision but their colour discrimination is very poor. They may be unable to distinguish pale colours (especially greens, yellows and blues) from grey. Often red hues are the first colours that can be seen.
- Infants develop good colour vision between the ages of 3 and 6 months but full colour discrimination may not be achieved until adolescence.
- Infant colour preference is normally assessed by measuring how long they look at certain colours. It is believed that their colour preferences are similar, on average, to adults; that is preference for blue > red/purple > green > yellow.
- Although on average infants may prefer blue to yellow there will likely be some individual variation.
- Autistic infants may find strong, chromatic colours to be stressful and overwhelming. Autism usually develops in the first 18 months of life.

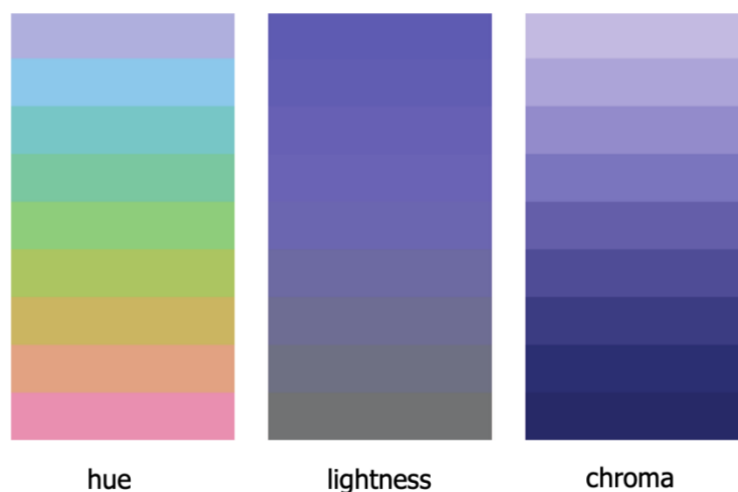


*Evolution of colour vision in Infants*

## Colour Vision

Colour vision in humans is mainly mediated by three types of photoreceptors in the eye that are called cones (S cones, optimally sensitive to short wavelengths of light, M cones, optimally sensitive to medium wavelengths, and L cones, optimally sensitive to long wavelengths). When light enters the eye it generates signals from these cones that are combined to create luminance, red-green and yellow-blue channels. This retinal processing probably accounts for the three-dimensional nature of our perceptual colour vision (we use the word trichromatic to describe normal colour vision although note that some people are dichromats and some are tetrachromats). The signals (luminance, red-green and yellow-blue) from the cones eventually reach the brain in an area called the visual cortex which is located towards the back of the head. It is estimated that most people can typically discriminate between about 5 million different colours.

However, note that we don't all see colour the same. Some people are colour blind – some of these are dichromats, for example, and only have two of the cone types – and this condition leads to much reduced colour discrimination. Some people are tetrachromats; their vision is based on four cone types and they may have enhanced colour vision.



*Colour vision is three-dimensional; hue, lightness and chroma*

Although some people believe that infants cannot see colour and only see in black and white (or shades of grey), in fact, even newborn babies can see some colour. However, they have very poor colour vision. In one study it was shown that the colours that can best be discriminated by a newborn baby are highly chromatic red-hued colours. Young infants have difficulty to discriminate yellows, greenish yellows, purples, bluish purples and some blues from white. It is believed that this difficulty to discriminate colour in newborn babies is mainly caused by lack of development of the photoreceptors (cones) in the eye. There is also evidence that the red-green channel develops in infants before the yellow-blue channel which might explain why it is easier for very young infants to

see red hues than the other hues. The red-green channel develops very early, and then the yellow-blue channel develops up to two months later. During infant development, the eyes are first able to recognise red hues.

By about three months of age, we would expect an infant to have trichromatic colour vision. By age six months, infants show evidence of colour categorisation and colour constancy. However, full colour vision (with equivalent discrimination to that of an adult) probably does not occur until adolescence) meaning that strongly chromatic colours are easier for children to discriminate. It is likely that there is development in the brain that occurs over the first couple of decades of life that is important in this regard. The observation that young children can see strong chromatic colours more easily is almost certainly a factor in why bright colourful colours are used a lot on children's toys and other products intended for children (e.g. packaging of food).

### **Colour Preference**

A great deal of research has been carried out on adult colour preference. In general, people exhibit greatest preference for blues and the least preference for yellows and yellowish greens (particularly when dark). Probably the most likely explanation of colour preferences is the ecological valence theory which postulates that people like colours that remind them of things that they like (in other words, it is associative). Some studies have shown that by age 8, the colour preferences of children are very similar to those of adults. Sex differences in colour preference (e.g. an aversion of boys to pink) emerge from about 2.5 years old which is the same time that sex-stereotyped behaviours also appear. Studies of infant colour preference are often carried out by recording how long infants look at colour stimuli; by age 4 months, infants spend the longest looking at blues, a long time looking at reds and purples, and the least time looking at greens and yellows. Although how long an infant looks at something is not necessarily the same as colour preference, the relationships between these inferred colour preferences in infants and the average colour preferences in adults is striking (i.e. blue > red/purple > green > yellow). Some studies suggest that for very young infants red hues may be most preferred and that preference for blue hues may not emerge until about year 7.

### **Colour Emotion**

There are strong links between colour and emotion in adults. That said, although on average there are some consistencies (e.g. blue is often viewed as a calming colour and red is seen as being energising and alerting) it is important to understand that colour emotion varies from person to person and can also depend upon the environmental context. It seems unlikely that there are strong associations for colours in the first few years of life since infants may not have the capacity to understand the concepts that relate to colour. However, by year 3, there is evidence, for example, that children possess the conceptual framework that is necessary. Some research suggests that children as young as 3 years old associate colour with emotional meaning.

Bright colours are associated with happiness and dark colours with sadness by infants as young as 3 years old. In terms of hue, yellow is associated with happy and blue with sad. Highly saturated, vivid colours are more stimulating to babies.

## Autism and Neurodivergence

It is estimated that at least 1 in 100 people worldwide have autism and some estimates suggest it could be 1 in 25. Autism spectrum disorder (ASD) signs usually occur in the first 18 months and many individuals are clinically diagnosed by age 3.

Neurodivergence is a broader term that includes ADHD, autism, dyslexia, and dyspraxia and as many as 1 in 5 people may be classed as neurodivergent. People who are autistic may have different colour preferences (often preferring muted blues and greens) than neurotypical people and may find bright, bold colours overwhelming and stressful.

## Potential Applications to Baby Bottles

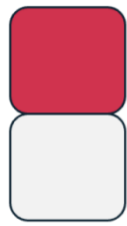
The colour palette below was generated by searching for baby feeding bottle online in China and shows a wide variety of colours being used.



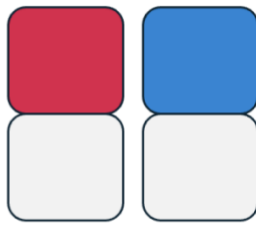
The following conclusions have been drawn from these initial considerations.

1. Feeding bottles are mainly used in the first 12 months (sometimes 18 months) of a baby's life.
2. We analysed the colours of feeding bottles in the Chinese market and concluded that a wide range of hues are used and that both pale (weak) and saturated (strong) colours are used.
3. After several months the most distinguishable and preferred hue is red. Bright, strong colours would be more noticeable (and preferred) than pale (pastel colours).
4. For older infants blue may be preferred.
5. Within the first 18 months some infants will develop autism and bright strong colours (especially reds) should probably be avoided.

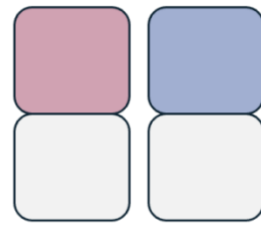
Based on these studies it is suggested that for very young babies bright red hues would be good colours to use and that strong contrasts might be preferable. For older infants (around 9-12 months) colour preference may develop and many infants might show a preference for blue. Again, a strong bright blue would be preferable with high contrast. Warm red-hued colours reflect less of the environmentally stimulating 'blue light' that can affect vision.



(a)



(b)



(c)

*If we consider baby colour vision then*

- (a) a bright red hue with high contrast would be preferred.*
- (b) For slightly older infants red hues are still a good choice but blue will increasingly be preferred.*
- (c) Adults are likely to gravitate towards softer pastel colours (possibly gendered with pink for girls and blue for boys)*

## **Final Recommendations**

For maximum stimulation of babies strong red hues are advisable and babies will more easily see strong contrasts.

For older infants blue may increasingly become preferred to red hues.

Adult preferences (for pale pinks and soft blues) may be inconsistent with these observations.

Of course, which colours should be used depends upon how the product is marketed. There is an argument for focussing a marketing proposition on babies rather than adults and in avoiding gender stereotypes.

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