

Chromatic visual preference in full-term newborns¹

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Abstract: Introduction: Evidence has indicated that the visual preference for color in children with atypical development may be different, when compared with child without developmental changes. Although this data represents an important mediator on the developmental trajectory, no study has characterized this profile in newborns (NB). Objective: To characterize visual preference for color in full-term NB in the first hours of life. Method: This is a cross-sectional study with 46 NBs. Six cards were presented to evaluate the visual chromatic preference, being half white and half in chromatic color. To compare the prevalence of color choice, the chi-square test was applied and the significance level of 5% was considered. Results: It was found that 75% of the NBs preferred the color blue ($p=0.001$) and although the visual frequency between green and white color was higher for chromatic color, no preference was detected ($p=0.23$). The only cards that had visual frequency higher for white color were yellow and orange, but no preference between them ($p=0.05$ and $p=0.37$, respectively). Conclusion: The chromatic preference for blue in NBs in the first hours of life was observed. Considering that visual problems and visual gains during neonatal period will interfere with development into adult life, it is suggested that an assessment of visual color preference can be incorporated into the routine of the Neonatal occupational therapist even the NB has few hours of life.

Keywords: *Infant, Newborn; Visual Perception; Color Vision; Occupational Therapy.*

Preferência visual cromática em recém-nascidos a termo

Resumo: Introdução: Evidências têm apontado que a preferência visual por cores em crianças com desenvolvimento atípico pode ser diferente, quando comparada à criança sem alterações do desenvolvimento. Embora esse dado representa um importante mediador sobre a trajetória do desenvolvimento, nenhum estudo caracterizou este perfil em recém-nascidos (RN). Objetivo: Caracterizar a preferência visual por cores em RN termo nas primeiras horas de vida. Método: Estudo transversal com 46 RN posicionados no colo das mães. Para a avaliação da preferência visual por cores foram apresentados seis cartões, sendo metade branca e a outra metade na cor cromática. A prevalência entre as cores foi testada pelo teste Qui-quadrado e considerou-se o nível de significância de 5%. Resultados: 75% dos RN preferiram a cor azul ($p=0,001$) e apesar da frequência do olhar entre a cor verde e branca ser maior para a cor cromática, não foi detectado preferência entre esta análise ($p=0,23$). Os únicos cartões que as frequências foram maiores para a o branco foram os cartões com cores amarela e laranja e, ainda assim, não há preferência entre elas ($p=0,05$ e $p=0,37$, respectivamente). Conclusão: Foi possível conhecer a preferência cromática pelo azul em RN já nas primeiras horas de vida. Considerando que os problemas detectados e ganhos visuais que acontecem ainda no período neonatal irão interferir no desenvolvimento para a vida adulta, sugere-se que uma avaliação da preferência visual por cores possa ser incorporada na rotina do terapeuta ocupacional da Unidade Neonatal, mesmo quando o público alvo for um RN com poucas horas de vida.

Palavras-chave: *Recém-nascidos, Percepção Visual, Visão de Cores, Terapia Ocupacional.*

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Received on Aug. 21, 2018; 1st Review on Dec. 20, 2018; Accepted on Mar. 20, 2019.



1 Introduction

Colorimetry is the science used to quantify and describe human perceptions of color, and color perception is a psycho-visual process in which color is perceived and interpreted by the brain (TAYLOR et al., 2013). This ability is essential to guide primates in the social environment, assisting them in discriminating subtle changes in skin color, and providing information about the variations in their emotional states, such as the variation of red when angry or white (pale) in situations of fear (CHANGIZI; ZHANG; SHIMOJO, 2006).

Although the color spectrum is continuous, it is not necessary for humans to identify or memorize an infinite range of colors, since they appear to be segmented into several discrete perceptual categories (YANG; KANAZAWA; YAGAGUCHI, 2013).

In childhood, this spectrum is summarized in categories with low spatial frequencies (WELBY et al., 2017), and although studies report that preschoolers prefer red (FRANKLIN et al., 2008a) or infants prefer blue (ZEMACH; CHANG; TELLER, 2007), there is a consensus that children, with typical development, prefer primary colors (such as red and blue) than secondary colors (such as pink and orange) (ZEMACH; CHANG; TELLER, 2007; TELLER; CIVAN; BRONSON-CASTAIN, 2004; GRANDGEORGE; MASATAKA, 2016; BROWN; LINDSEY, 2013).

Recently, some evidence has indicated that color preference in children with atypical development, such as children with Autistic Spectrum Disorder (ASD) may be different (MASATAKA, 2017; GRANDGEORGE; MASATAKA, 2016; SILBERMAN, 2015). These studies emphasize that children with ASD prefer green (SILBERMAN, 2015) or brown (GRANDGEORGE; MASATAKA, 2016) than red (FRANKLIN et al., 2008a) or yellow (GRANDGEORGE; MASATAKA, 2016).

Although the preference for primary colors in childhood represents an important mediator on a developmental trajectory in visual perception of colors, no study attempted to characterize this profile in the neonatal period (TAYLOR et al., 2013; GOMES et al., 2015). Observing early irregularities on this trajectory can contribute not only to the early investigation of neurosensory disorders but also to guide the construction of stimulation protocols and to rescue a regular development in the neonatal period (PEREIRA et al., 2017). Thus, this study aims to characterize the visual preference of color in full-term newborns (NB) in the first 48 hours of life.

2 Method

This is a cross-sectional study with in full-term newborns, evaluated in the first 48 hours of life, approved by the Research Ethics Committee (CEP) with human beings from the Health Sciences Center of the Federal University of Pernambuco (CCS/UFPE), under opinion 1,169,021. A written informed consent form was given to all families who agreed to participate in the study.

The research was conducted at the Neonatal Intermediate Care Unit of a reference hospital for neonatal care in the city of Recife, PE. Participation in the study was voluntary and the convenience sampling was obtained from hospitalizations during the study period. The study of Zemach, Chang and Teller (2007) was used to calculate the sample size, which also proposes to evaluate the chromatic visual preference in childhood. With an estimate of 80%, a 10% error and a total of 80 hospital beds, the sample size was 44 NBs.

Newborns with gestational age > 37 weeks, suitable for gestational age and hemodynamically stable (without the use of vasoactive drugs, mechanical ventilation or intravenous medications) were included. Newborns with a diagnosis of visual and/or neurological alteration; with congenital malformation and/or genetic syndrome were excluded.

Clinical data and biological characteristics, such as mother's age, gestational age, gender and birth weight were collected during hospitalization, by consulting the medical record and evaluating the visual chromatic preference, using the Teller cards adapted for this study (ZEMACH; CHANG; TELLER, 2007).

Six matte cards, measuring 25.5 x 51cm, were shown with a hole in the center. These cards had a half white and half blue, or violet, or green, or yellow, or orange, or red.

The newborns were placed in the mother's lap 55 cm from the cards and the distance was kept fixed throughout the test. A team with two examiners participated in the study. A first examiner kept the cards on their lap facing down, and a second examiner judged the behavioral reactions of the newborn in front of the card presented. To judge whether or not the newborn perceived the stimulus, the movements of the eyes and head towards the stimulus (right or left) were considered (PEREIRA et al., 2017). The evaluations were carried out in an environment with pleasant lighting and temperature and isolated from any visual noise.

The data were analyzed in SPSS software, version 18. To compare the prevalence of color selection, the Chi-square test was applied and the significance level of 5% was considered.

3 Results

There were 46 NBs with gestational age > 37 weeks who participated in the study. Clinical data and biological characteristics are shown in Table 1.

It was found that 75% of the NBs preferred the color blue than white ($p = 0.001$; $X^2 = 10.52$), and although the frequency of the look between the green and white color was higher for the chromatic color, no preference was detected between this analysis ($p = 0.23$, $X^2 = 1.39$). The only cards with the highest frequency for achromatic color (white) were the cards with yellow and orange colors, and yet there was no preference among them ($p = 0.05$, $X^2 = 10.73$ and $p = 0.37$, $X^2 = 0.78$, respectively). Figure 1 shows the frequency of

chromatic colors compared to white for different wavelengths.

4 Discussion

The results of this study lead to think that the higher the degree of colorimetric purity the greater the preference of color over white. This study obtained similar results between achromatic or chromatic, only when white was compared to yellow and orange, suggesting that at birth, chromatic stimuli in yellow and orange are not preferable for newborns.

This result was originally shown by Bornstein (1975) and Brown and Lindsey (2013) who also stated that the higher the colorimetric purity, the greater the visual preference for color.

The performance of an evaluation of preference for color in NBs with few hours of life was one more relevant topic of this study. The results indicated that even with a few hours of life, the NBs have the visual chromatic ability to expressing their preference for chromatic stimuli.

Other studies (ZEMACH; CHANG; TELLER, 2007; GRANDGEORGE; MASATAKA, 2016; TELLER; CIVAN; BRONSON-CASTAIN, 2004; YANG; KANAZAWA; YAMAGUCHI, 2013) had already indicated the preference for primary colors in children; however, none of these studies have evaluated NBs with few hours of life, which makes our data complementary to the findings so far published.

Although chromatic evaluation studies in NBs are from decades past, visual stimulation approaches

Table 1. Clinical data and biological characteristics of the 46 NBs included in the study.

Demographic data of the 46 NBs evaluated			
<i>PRENATAL</i>			
Gestational age (weeks)		39 (± 1.33)	
Mother's age (years old)		27 (± 3.35)	
<i>PERINATAL</i>			
Gender	Male	54.34% (25)	
	Female	45.66% (21)	
Birth weight		3233 (± 515.25)	

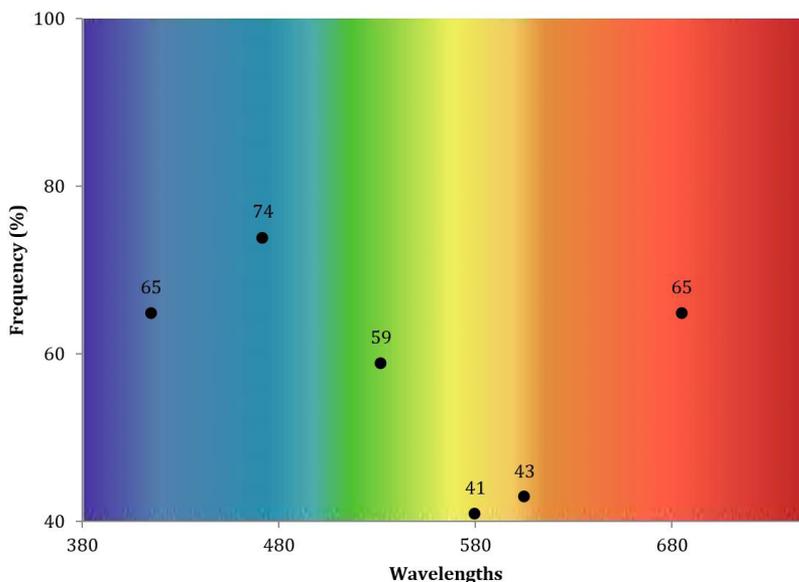


Figure 1. Frequency (%) of chromatic colors compared to white for different wavelengths.

using artifacts with black and white contrasts are easily accepted in neonatal care units, whether they are interspersed with black and white streaks or with a concentric circle in the color gray and white (PEREIRA; MORAN, 2014).

Considering the chromatic preference of the NBs evaluated in this study, it is suggested some questions, such as, why is the evaluation instrument (hoop) used in some visual evaluation tests presented in red color?, since red is indicated as preferred only in preschool children (FRANKLIN et al., 2008b).

Why is the artifact used in the neonatal period for visual stimulation is white and black?, since the studies with infants (TELLER; CIVAN; BRONSON-CASTAIN, 2004; FRANKLIN et al., 2010; BROWN; LINDSEY, 2013; ZEMACH; CHANG; TELLER, 2007) and the results of this study indicate the preference for chromatic and primary colors, such as blue.

Why does the health professional guide the giver/caregiver when using the newborn to use strong, bright color props to catch the attention of the newborn?, since, primary colors and low spatial frequency are preferred among them (FRANKLIN et al., 2010).

Why has a protocol of color preference evaluation not been indicated as a neonatal screening tool to mediate the developmental trajectory of the visual perception of colors and, thus, point out possible irregularities? (GOMES et al., 2015). Interventions for screening, identification, evaluation, follow-up of evolution and stimulation of early childhood development, avoid future complications for children at risk and/or atypical development (ARAUJO; NOVAKOSKI; BASTOS, 2018).

Although the results show the preference for a chromatic stimulus and this data corroborates with the findings of classic studies previously published (FRANKLIN et al., 2010; BROWN; LINDSEY, 2013; ZEMACH; CHANG; TELLER, 2007), the difficulty in proposing an electrophysiological analysis, or even characterizing the profile of NBs at different ages (premature, term and post-term) are indicated as limitations of the study.

During the study, only 10 preterm infants were evaluated and, due to the difficulty in maintaining a comparison analysis between the groups, it was decided to exclude these data and present only the results of in full-term newborns. Bosworth and Dobkins (2013) performed a study with premature and in full-term NBs to assess luminance and chromatic contrast sensitivity. In this study, the

authors verified that the responses were similar, regardless of gestational age for luminance, and lower for chromatic sensitivity in preterm NBs, highlighting the importance of knowing the color preference also in this population. In any case, similar studies including a sample of preterm newborns are suggested.

5 Conclusion

The results showed that it is possible to know the chromatic preference of in full-term newborns in the first hours of life and indicate that blue is the preferred color among them. Considering that the detected problems and visual gains of the neonatal period are factors that will interfere in adult life development, it is suggested that an assessment of color preference can be incorporated into the routine of the Neonatal occupational therapist even when the public target is a newborn with few hours of life. It is also suggested that similar studies be carried out including a sample of preterm infants.

References

- ARAUJO, L. B.; NOVAKOSKI, K. R. M.; BASTOS, M. S. C. Caracterização do desenvolvimento neuropsicomotor de crianças até três anos: o modelo da CIF no contexto do NASF. *Cadernos Brasileiros de Terapia Ocupacional*, São Carlos, v. 26, n. 3, p. 538-557, 2018.
- BORNSTEIN, M. H. Qualities of color vision in infancy. *Journal of Experimental Child Psychology*, Estados Unidos, v. 19, n. 3, p. 401-419, 1975.
- BOSWORTH, R. G.; DOBKINS, K. R. Effects of prematurity on the development of contrast sensitivity: testing the visual experience hypothesis. *Vision Research*, Reino Unido, v. 19, n. 82, p. 31-41, 2013.
- BROWN, A. M.; LINDSEY, D. T. Infant color vision and color preferences: a tribute to Davida Teller. *Visual Neuroscience*, Reino Unido, v. 30, n. 5-6, p. 243-250, 2013.
- CHANGIZI, M. A.; ZHANG, Q.; SHIMOJO, S. Bare skin, blood and the evolution of primate colour vision. *Biology Letters*, London, v. 2, n. 2, p. 217-221, 2006.
- FRANKLIN, A. et al. Color perception in children with autism. *Journal of Autism and Developmental Disorders*, New York, v. 38, n. 10, p. 1837-1847, 2008a.
- FRANKLIN, A. et al. Saliency of primary and secondary colour in infancy. *British Journal of Developmental Psychology*, Leicester, v. 26, n. 4, p. 471-483, 2008b.
- FRANKLIN, A. et al. Biological components of color preference in infancy. *Developmental Science*, Reino Unido, v. 13, n. 2, p. 346-354, 2010.

- GOMES, P. T. et al. Autism in Brazil: a systematic review of family challenges and coping strategies. *Jornal de Pediatria*, Rio de Janeiro, v. 91, n. 2, p. 111-121, 2015.
- GRANDGEORGE, M.; MASATAKA, N. V. *Atypical color preference in children with autism spectrum disorder*. Switzerland: Frontiers in Psychology, 2016.
- MASATAKA, N. Implications of the idea of neurodiversity for understanding the origins of developmental disorders. *Physics of Life Reviews*, Amsterdam, v. 20, p. 85-108, 2017.
- PEREIRA, S. A. et al. A comparison between preterm and full-term infants' preference for faces. *Jornal de Pediatria*, Rio de Janeiro, v. 93, n. 1, p. 35-39, 2017.
- PEREIRA, S. A.; MORAN, C. A. Estimulação visual precoce para recém-nascidos prematuros internados na unidade neonatal. *Pediatria Moderna*, São Paulo, v. 50, n. 8, p. 358-362, 2014.
- SILBERMAN, S. *Neuro tribes: the legacy of autism and the future of neurodiversity*. New York: Avery, 2015.
- TAYLOR, C. et al. Color preferences in infants and adults are different. *Psychonomic Bulletin & Review*, Austin, v. 20, n. 5, p. 916-922, 2013.
- TELLER, D. Y.; CIVAN, A.; BRONSON-CASTAIN, K. Infants' spontaneous color preferences are not due to adult-like brightness variations. *Visual Neuroscience*, Reino Unido, v. 21, n. 3, p. 397-401, 2004.
- WELBY, E. et al. Isolation and comparative transcriptome analysis of human fetal and iPSC-derived cone photoreceptor cells. *Stem Cell Reports*, Cambridge, v. 9, n. 6, p. 1898-1915, 2017.
- YANG, J.; KANAZAWA, S.; YAMAGUCHI, M. K. Can infants tell the difference between gold and yellow? *PLoS ONE*, Estados Unidos, v. 8, n. 6, p. 64-65, 2013.
- ZEMACH, I.; CHANG, S.; TELLER, D. Y. Infant color vision: prediction of infants' spontaneous color preferences. *Vision Research*, Reino Unido, v. 47, n. 10, p. 1368-1381, 2007.

Author's Contributions

Wilsineth Borges Teixeira Ferreira and Rayssa Béder César Paiva: text design, text writing. Silvana Alves Pereira: text design, the organization of sources and/or analysis, final review. Norrara Scarlytt de Oliveira Holanda: the organization of sources and/or analysis, after the review. Juliana Fonsêca de Queiroz Marcelino and Raquel Costa Albuquerque: the organization of sources and/or analysis, final review. All the authors approved the final version of the text.

Notes

- ¹ The study is part of a research with newborns and was approved by the Committee of Ethics in Research in Human Beings of the Health Sciences Center of the Federal University of Pernambuco (CCS/UFPE), under the opinion 1,169,021.