

Haptic Perception and Motor Behaviors in Infants Users of Ergonomic Pacifiers*

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Babies react to changes in the characteristics of objects, presenting haptic recognition after a period of familiarization. We aimed to verify if infants responded to the different spatial orientations of an ergonomic pacifier in the mouth. With informed consent, 10 babies (271.6 ± 60.8 days), users of ergonomic pacifiers, revealed motor behaviors that were divisible into three categories, sometimes through successive actions (i.e., perception-action cycles were present): (i) repositioned correctly the pacifier, through different modes; (ii) repositioned it, but incorrectly, through different modes; and (iii) rejected the pacifier. So, these babies detected the incorrect position of the pacifier, and acted according to the principle of motor equivalence, since they implemented variations of a solution for the same need.

Keywords: haptic perception, infants, mouth, ergonomic pacifier

Infants haptically react to changes in object characteristics (Rochat, 1987; Streri, Lhote, & Dutilleul, 2000), being able to explore the space and be sensitive to different orientations of a rod by the hands (Gentaz & Streri, 2002). One-year-old babies show haptic recognition memory after a short period of haptic familiarization, manipulating novel objects differently from familiar ones (Gottfried & Rose, 1980).

Non-nutritive sucking (NNS) is defined as sucking without the delivery of fluid, and is a naturally occurring phenomenon recognized as a pacifying mechanism for preterm and term infants. Thumb sucking and other sucking movements have been seen in human foetuses as early as the 12th week of gestation (Hepper,

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Shahidullah, & White, 1991).

During familiarization to hard nipples, two-month-old infants revealed decreasing of the amount of irregular mouthing oral activity, while the amount of NNS increased, supporting the hypothesis that information about the object is detected during mouthing rather than during NNS (Pêcheux, Lepecq, & Salzarulo, 1988).

Oral exploration and mouthing increase up to the age of seven months and then decline until the age of 11 months, while manual skills progress and diversify between the ages of five and 11 months (Ruff, Saltarelli, Capozzoli, & Dubiner, 1992).

The purposes of this paper is to verify whether infants detect different spatial orientations of the pacifier in the mouth; and if so, to describe infants' motor behaviors when constrained with different spatial orientations of an ergonomic pacifier.

Method

Participants

The sample consisted of 10 infants (decimal age: 271.6 ± 60.8 days, minimum: 191 days, maximum: 352 days): five females, belonging to two kindergartens, users of ergonomic pacifier users (sucking ratio: 1.07 ± 0.85). Informed consent was obtained. The assent was assumed if the baby did not avoid the experimenter's pacifier and did not cry, sleep, or reject the experimenter's presence. The babies' pacifier was used.

Materials and Procedure

Infants' own ergonomic pacifiers were placed by the same experimenter in the babies' mouths in three positions relative to the standard orientation: (i) rotated 90 degrees clockwise (CW); (ii) rotated 90 degrees counterclockwise (CCW); and (iii) rotated 180 degrees (T) (see Figure 1).

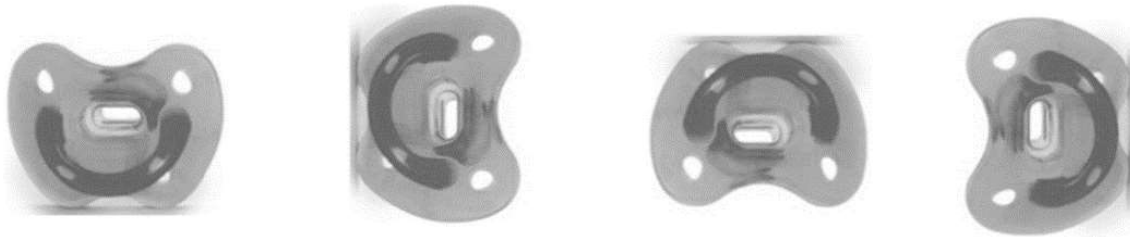


Figure 1. From the left to the right (users view): standard position; rotated 90° clockwise (CW); rotated 180° (T); and rotated 90° counter clockwise (CCW).

The order of the conditions was alternated between participants. Data were collected with the infant awakened and in a good mood, using their reclined chair at approximately 110-130 degrees (D. D. Harrison, S. O. Harrison, Croft, Harrison, & Troyanovich, 1999), in an environment with few objects and minimal noise, and the camera positioned diagonally, at mouth level. The pacifier was presented at the eye level of the child's midline and at approximately 50 cm (Banks, 1980). Each infant made one trial in each condition, with no time limit. During the recordings, there was no verbal, gestural or facial interaction with the infant. Parents were invited to answer to the following open question, relative to possible observed behaviors of their infants with the pacifier: "If you have ever observed your child playing with his/her pacifier (for example, biting it, rotating it with his/her mouth or hand, grinding it with his/her teeth...), please, describe those behaviours".

Data Treatment

Face validity of coded behavioral categories was achieved by a panel, composed of experts in child development, motor development, and education; and was based on video observations and discussion of observers' narrative records of participants' motor behavior or sequences of motor behaviors.

Statistical Analysis

For statistical data treatment, Shapiro-Wilk test was used to verify normal distribution. For between comparisons Mann-Whitney (U) test was used, with Monte Carlo Test verification and effect size r estimation. For comparison among conditions, Friedman test (Q) was used, with effect size Kendall's test value estimation (W). Spearman's rank correlation coefficient was used to assess relationship between variables (ρ). Confidence level was 0.05, two-sided.

Results

When confronted with pacifiers' spatial constraints, all infants presented active motor behaviors, divisible in four categories: (i) relocated the pacifier to the standard spatial position, through three possible ways—turning it with the mouth; grasping it and turning it with the hand; or spitting it and putting it in the mouth, with a total of 14 occurrences; (ii) relocated the pacifier, but to 180 degrees relative to the standard spatial position, through the same actions named in (i), with a total of seven occurrences; (iii) pacifier rejection, by the means of spitting it or biting it, with a total of 14 occurrences; and (iv) no attempt, keeping pacifier in the same position and without occurrence of NNS, with four occurrences in the T condition, two in the CCW condition, and one in the CW condition. Successful mouth turning behavior occurred eight times (in 30 possible trials), while successful grasp turning occurred twice. In some cases, infants made successive actions to relocate the pacifier, e.g., in the CCW, a male infant with 221 days of age grasped and rotated the pacifier and, also, rotated it with his mouth, and a female infant with 303 days of age spat it, grasped and put it back in her mouth, then rotated it with her mouth. On request through open question (If you have ever watched your child playing with his/her pacifier, for example, bite it, rotate it with its mouth or hand, grind it with its teeth..., please describe those behaviors), parents mentioned the following: (i) forward and backward displacements with the mouth; (ii) make it tremble with his/her mouth; (iii) grab it and look at it; (iv) bite it; (v) rotate it with its mouth; and (vi) remove it and put it back in its mouth. No gender differences were found in the frequency of the set of the categories in all conditions ($Z = 0.876$, $p = 0.381$, $r = 0.28$). No association was found between decimal age and frequency of the set of the categories in all conditions ($\rho(10) = 0.267$, $p = 0.456$). No significant difference occurred between conditions on the frequency of motor behaviors in the defined categories ($Q = 4.571$, $p = 0.102$, $W = 0.23$).

Discussion

The results reveal that these infants have detected the incorrect position of the pacifier in the mouth, supporting the hypothesis that information about the object is detected during mouthing (Pêcheux et al., 1988). An equifinality principle was present in their motor actions, i.e., they had variations of a motor solutions for the same need, e.g., rotating the pacifier in both directions, clockwise and counter clockwise; or different solutions for the same need, e.g., rotating the pacifier using their mouth or their hand. Some infants revealed the capability to try to solve their problem through successive motor actions, meaning that a perception-action cycle was present, i.e., after perceptual detection of incorrect pacifier position a motor action was made, and if

pacifier position detected was again incorrect a new motor movement was made. All these actions reveal that infants detect and search for the ergonomic affordance of the pacifier, to have it comfortably inside their mouths (cf., Rochat, 1987). The occurrence of this perception-action cycle proves that mouth haptic perception is present and is used by infants to solve a spatial problem through motor actions. Based on parents' reports, pacifiers are taken as implements by the infant, using them for functional play, i.e., play essentially based on motor and perceptual exploration of objects functional properties (Zelazo & Kearsley, 1980). The diversity of actions revealed by infants and described by their parents is assumed to correspond to the emergence of cognitive metamorphosis (Zelazo & Leonard, 1983); meaning that the transition from reflexive nutritive sucking to NNS, or from stereotyped movements to functional play, maybe a result of a conscious mental representations of real-world objects (P. R. Zelazo & P. D. Zelazo, 1998).

Conclusion

These infants revealed capacity to detect perceptual information about an implement; and, use that information to adjust implement and organismic constraints or to ludically explore implement properties and motor actions with their tongue, teeth and mouth. Infants also revealed the capacity to explore different, sometimes articulated, motor solutions for the same problem, with or without the involvement of hands, as additional instruments for problem resolution. The results of this study support ecological and cognitivist hypotheses of child perceptual development.

References

- Banks, M. S. (1980). The development of visual accommodation during early infancy. *Child Development*, 51(3), 646-666.
- Gentaz, E., & Streri, A. (2002). Infants' haptic perception of orientations. *Current Psychology Letters: Behaviour, Brain and Cognition*, 9, 61-73.
- Gottfried, A. W., & Rose, S. A. (1980). Tactile recognition memory in infants. *Child Development*, 51(1), 69-74.
- Harrison, D. D., Harrison, S. O., Croft, A. C., Harrison, D. E., & Troyanovich, S. J. (1999). Sitting biomechanics part I: Review of the literature. *Journal of Manipulative and Physiological Therapeutics*, 22(9), 594-609.
- Hepper, P. G., Shahidullah, S., & White, R. (1991). Handedness in the human fetus. *Neuropsychologia*, 29(11), 1107-1111.
- Pêcheux, M. G., Lepecq, J. C., & Salzarulo, P. (1988). Oral activity and exploration in 1-2-month-old infants. *British Journal of Developmental Psychology*, 6(3), 245-256.
- Rochat, P. (1987). Mouthing and grasping in neonates: Evidence for the early detection of what hard or soft substances afford for action. *Infant Behavior and Development*, 10(4), 435-449.
- Ruff, H. A., Saltarelli, L. M., Capozzoli, M., & Dubiner, K. (1992). The differentiation of activity in infants' exploration of objects. *Developmental Psychology*, 28(5), 851-861.
- Streri, A., Lhote, M., & Dutilleul, S. (2000). Haptic perception in newborns. *Developmental Science*, 3(3), 319-327.
- Wing, A. M. (2000). Motor control: Mechanisms of motor equivalence in handwriting. *Current biology*, 10(6), 245-248.
- Zelazo, P. R., & Kearsley, R. B. (1980). The emergence of functional play in infants: Evidence for a major cognitive transition. *Journal of Applied Developmental Psychology*, 1(2), 95-117.
- Zelazo, P. R., & Leonard, E. L. (1983). The dawn of active thought. In K. W. Fischer (Ed.), *Levels and transition in children's development: New directions for child development* (Vol. 21, pp. 37-50). San Francisco: Jossey-Bass.
- Zelazo, P. R., & Zelazo, P. D. (1998). The emergence of consciousness. In H. H. Jasper, L. Descarries, V. F. Castellucci, and S. Rossignol (Eds.), *Consciousness: At the frontiers of neuroscience* (Vol. 77, pp. 149-165). Philadelphia: Lippincott-Raven.