

small window of opportunity just before getting blown away, where information is available to compute the direction of the impending passive displacement. The solution does not reside in the ant itself, but arises from its interaction with the environment. This illustrates the inseparable relationship between organisms and their environmental niches.

#### Supplemental Information

Supplemental Information includes experimental procedures and two movies and can be found with this article online at <http://dx.doi.org/10.1016/j.cub.2013.10.072>.

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## Parental misperception of youngest child size

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After the birth of a second child many parents report that their first child appears to grow suddenly and substantially larger. Why is this? One possibility is that this is simply a contrast effect that stems from comparing the older sibling to the new baby: “everything looks big compared to a newborn”. But, such reports could be the result of a far more interesting biopsychological phenomenon. More specifically, we hypothesized that human parents are subject to a kind of ‘baby illusion’ under which they routinely misperceive their youngest child as smaller than he/she really is, regardless of the child’s age. Then, when a new baby is born, this illusion ceases and the parent sees, for the first time, the erstwhile youngest at its true size. By this account the apparent growth results from the mismatch of the parent’s now accurate perception with the stored memories of earlier misperceptions. Here we report that the baby illusion is a real and commonly occurring effect that recasts our understanding of how infantile features motivate parental caregiving [1].

Our study began with an online perceptual recollection survey of 747 mothers to validate the anecdotal reports of this perceptual experience. Over 70% of respondents indicated that the erstwhile-youngest child suddenly appeared bigger after the new infant’s birth (for details see the Supplementary Information available on-line with this issue).

While the survey data are suggestive, it does not definitively inform us as to whether mothers routinely misperceived the sibling’s size before the birth or were temporarily subject to a contrast effect afterwards. To more directly assess the baby illusion hypothesis we asked: do parents routinely misperceive their youngest child as smaller than he/she truly is?

To answer this question we conducted a height estimation experiment in which mothers estimated the height of one of their children (aged 2–6 years) by marking a featureless wall in the presence of an investigator. This estimation was then compared to an actual measurement of the child’s height to calculate an estimation error.

Children were considered to belong to one of two birth order groups: Elder-children, who have at least one younger sibling; and Youngest-children, who have no younger siblings. The Youngest-children group includes ‘only children’, as there were no meaningful differences in estimates of Youngest-children who did and did not have an older sibling (see Supplementary Information).

The results of this experiment were striking: Youngest-children’s heights were significantly underestimated by an average of 7.5 cm (SD = 7.2;  $t(38) = -6.44$ ,  $p < 0.0001$ ), whereas Elder-children estimates were basically accurate (average overestimation of 0.4 cm; SD = 5.6,  $t(37) = 0.48$ ,  $p = 0.64$ ) (Figure 1).

To assess any effects of child age, child sex, and actual child height, a subsequent full-factorial regression analysis used birth order, child age, child sex, and z-score for actual child height (i.e., statistical deviance from the population mean height of children of the same age and sex) to predict height estimation errors. Birth order was a significant predictor ( $F(1, 61) = 36.18$ ,  $p < 0.0001$ ,  $\eta^2 = 0.39$ ), demonstrating that estimation errors differed significantly for Youngest-children compared with Elder-children.

The representational shift occurring when a new baby is born seems to happen suddenly rather than gradually. A gradual shift account would predict some residual underestimation to new Elder-children because they had recently been the youngest themselves. However, estimations of Elder-children (with one younger sibling) were not influenced by the age of the younger sibling ( $r(36) = 0.17$ ,  $p = 0.30$ ). A regression on Eldest-child estimation errors with Eldest-child and younger sibling age as predictors also failed to demonstrate any role of younger sibling age in the baby illusion ( $F(1, 37) = 0.18$ ,  $p = 0.67$ ,  $\eta^2 = 0$ ).



Figure 1. Actual and estimated heights of Youngest- and Elder-children plotted as a function of child age.

Youngest-child estimates were significantly lower than their actual heights while Eldest-child estimates did not differ significantly from their actual heights. Individual estimation points are denoted with 'E' and individual actual measured heights are denoted with 'A'. Lines were smoothed with JMP statistical analysis software (version 10).

In sum, mothers typically hold an inaccurately small representation of their youngest child and that this 'baby illusion' is likely the cause of their apparent surprise at their older child's height when a new baby is born. The baby illusion is of further significance in that it recasts our understanding of the 'baby schema' [2]. The baby schema refers to a set of infantile physical features (including body size [1]) that are typically regarded by adults as cute and attractive. Prior experimental research on baby-schema effects describe it as an evolutionarily adaptive, bottom-up process, where baby-like perceptual features drive a positive emotional reaction which in turn drives motivation to provide care and protection [3–5]. Our findings show that there are also top-down processes at play. That is, a parent's knowledge that a child is the youngest can lead her to misperceive her child as having baby-schema attributes.

The baby illusion should thus contribute to greater affection and attentive caregiving to one's most needful child, regardless of that child's age. This is especially important in a one-child family where passing on one's genetic material

depends on that child's survival. In the multi-child family, human and non-human animal research shows that parents experience conflict regarding how to divide their care and attention among offspring — providing more care to either the older or younger depending on a range of ecological and biological factors [6–8]. In this case, the baby illusion, by exaggerating the smallness of the younger child, would help parents to more readily distinguish relative age and importance of care at a perceptual level and allocate resources accordingly.

It is important to note that while this research focused specifically on the perception of a child's height, some parents might not experience a size- or height-shift but could notice a change in perceived age or perceived cuteness. Therefore, our findings likely underestimate the degree to which parents experience some form of the 'baby illusion'. Regardless, we now know that mothers of new babies who were surprised and alarmed at the almost magical overnight growth of their older child are in good company. Indeed, this effect gives us a new perceptual starting point for further study on how and why parents shift their focus from an older sibling;

and for the examination of birth order effects purported to influence many aspects of child development [9,10].

#### Supplemental Information

Supplemental Information includes additional information on the survey and height estimation methods, survey and height estimation results, and two figures; and can be found online with this article at <http://dx.doi.org/10.1016/j.cub.2013.10.071>.

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