

Baby physics



**They can neither talk nor walk,
but babies already have a grasp of the physics of liquids**

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We are born with a basic grasp of physics, just enough not to be surprised when we interact with objects. Scientists discovered this in the past two decades. What they did not know yet was that, as early as five months of age, this “naïve” physics also extends to liquids and materials that do



not behave like solids (for example, sand), as demonstrated by a new study just published in Psychological Science.

If we hold a ball and then let go of it and the ball remains suspended in mid-air, even a baby a few months old will be surprised. Just like an adult, the baby expects the ball to fall to the floor. Even at such a young age humans already have some rudimentary knowledge of the behaviour of solids. Now a new study extends this knowledge to add liquids and other non-solids to the "naïve physics" of infants.

"This new study developed out of previous experiments", explains Alissa Ferry, SISSA research scientist and among the authors of the paper, "in which we observed that infants were surprised when a liquid failed to behave as a liquid (in those experiments we "cheated" by disguising solids as liquids)". Their surprise, explains Ferry, demonstrates that their expectations for a liquid had not been met. "However, what we couldn't establish was whether the infants knew how a liquid should behave or whether they just expected it to be different from a solid".

Ferry and colleagues (the first author is Susan Hespos of Northwestern University in Illinois, USA, where the experiments were conducted) therefore devised a new set of tests with a greater range of materials and "interactions". In a first "habituation" phase, the infants were shown the contents of a glass by tilting the glass in front of them. The glass either contained a solid (which, when not moving, had identical appearance to water) or some water. When the glass was tilted back and forth, the two materials behaved differently: the solid remained perfectly still whereas the water moved. This phase served to teach the infants whether they were looking at a solid or a liquid.

Next, the infants were shown an identical glass to the one seen in the previous phase (making them believe that it was the same glass) which contained either the material they had already seen or the other material. At this point, the infants watched the experimenter either pour the contents (liquid or solid) of the glass into another glass containing a grid or submerge the grid in the liquid (or rest it on top of the solid) inside the glass.

"In the previous experiments we merely poured the contents of the glass. This time we added a grid to find out whether the infants really understood the loose cohesiveness of liquids, which can pass through a perforated surface and recombine in the vessel unlike solids which, being highly cohesive, cannot pass through a grid" explains Ferry.

In the habituation phase, in fact, the infants could know how liquids change shape with movement, but it was unknown if they could use this knowledge to understand other properties of liquids, like loose cohesiveness. "If infants understand the properties of liquids, then they should be surprised when, what they think is a liquid gets trapped on a grid".

And the analysis of the infants' behaviour shows that when they expected a liquid they were



surprised to see it blocked by the grid (or see the grid unable to penetrate the material). Conversely, if they thought they were looking at a solid, then they were surprised when they saw it pass through the grid.

The investigators also used other materials like sand and small glass spheres. “Even in these cases the infants showed that they knew the behaviour of substances”, concludes Ferry. “This is especially interesting because, while we can imagine that 5-month-old infants already have had extensive direct experience with liquids and especially water through meals, baths and 9 months in the amniotic liquid, it’s unlikely that they’ve had many encounters with sand or glass balls, suggesting that infants have a naïve understanding of the physics of nonsolid substances”.

USEFUL LINKS:

- Original paper in Psychological Science: <http://www.ncbi.nlm.nih.gov/pubmed/26744069>

IMAGES:

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