TITLE
Children's developing theories of motion: Subjectivity and shift

AUTHOR
Hast, Michael

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CHILDREN'S DEVELOPING THEORIES OF MOTION: SUBJECTIVITY AND SHIFT

Michael Hast

St Mary's University College, Twickenham

St Mary's University College Twickenham London

INTRODUCTION

- Younger children believe a light ball will roll down an incline faster than a heavy ball – matching their beliefs about horizontal motion – but older children believe the heavy ball will roll down faster – matching their conceptions about fall (cf. Hast & Howe, 2012, 2013).
- Why does this shift occur?
  - (1) Do children perceive speeds for a heavy and a light ball down an incline to be as great as for horizontal motion or fall, and how might this change with age?
  - (2) Does the height of the incline play any role; do children believe there is an incline height where the balls behave differently from the initial prediction?
- Two studies conducted with primary school children from Years 1 (5-6 years), Year 2 (6-7 years), Year 4 (8-9 years) and Year 6 (10-11 years) addressed these key questions.

STUDY 1

Method

- Children (N = 210) asked to make paper-based predictions about speeds of two balls of different mass along a horizontal, down an incline and in fall.
  - Asked to identify position of one ball along the trajectory at the same time as the shown ball.
  - Both disparity (how much faster or slower is the drawn ball?) and direction (which ball is predicted to be faster?) measured.

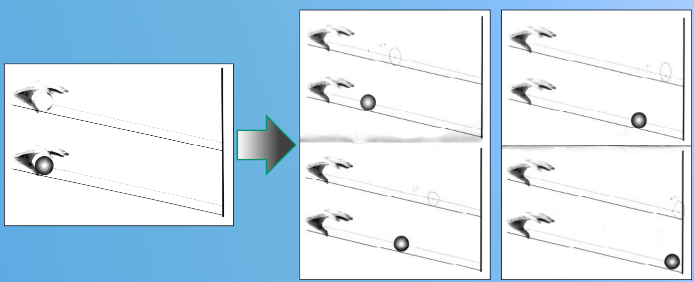

Figure 1. Example of incline motion task with heavy ball shown and light ball drawn in. Disparity measured from centre of shown ball to centre of drawn ball along trajectory.

Results

- Absolute disparity (i.e. regardless of positive or negative direction):
  - No significant dimension or age effects.
- Relative disparity:
  - Significant main effects of dimension, $F(2,412) = 96.41$, $p < .001$, $\eta^2_p = .32$, and age, $F(3,206) = 5.61$, $p < .05$, $\eta^2_p = .08$, and significant dimension x age interaction, $F(6,412) = 3.08$, $p < .05$, $\eta^2_p = .04$.
  - Significant age changes for horizontal motion, $F(3,206) = 5.13$, $p < .05$, $\eta^2_p = .08$, and for incline motion, $F(3,206) = 5.57$, $p < .05$, $\eta^2_p = .07$, but not for fall.
  - Incline disparity never as extreme as for horizontal (Years 1 and 2) or fall (Years 4 and 6) – consideration of both horizontal and vertical in incline reasoning likely.
  - Fall stable across age – horizontal element becoming less salient with age for incline motion?

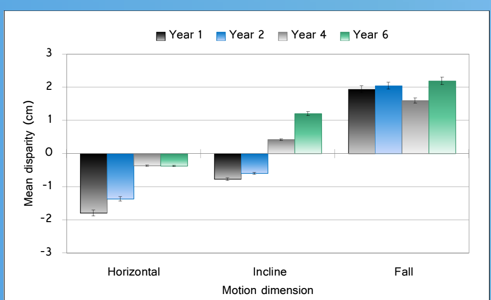

Figure 2. Mean relative disparity by motion dimension and age. The x-axis denotes the trajectory of the light ball.

STUDY 2

Method

- Children (N = 144) asked to make predictions about speeds of two balls of different mass down an incline.
  - Asked to compare speeds and to indicate whether incline can be manipulated so that speeds are same.
  - Asked to indicate height where the two balls would have the same speed and asked to predict what would happen beyond that point.

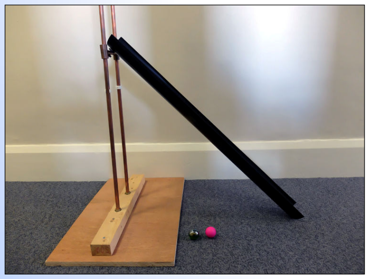

Figure 3. Set-up of task and balls.

Results

- Significant change with age which ball will roll down faster, $H(3) = 34.83$, $p < .001$.
  - Scores increase with age, $J = 2350$, $z = -5.82$, $r = -.49$, indicating shift from light as faster to heavy as faster.
- Significant change with age whether incline can be manipulated, $H(3) = 12.43$, $p < .05$.
  - Older children more likely to indicate no manipulation, $J = 2884$, $z = -3.42$, $r = -.29$, thus being more persistent in their incline motion predictions.
- When incline can be manipulated, significant age effect on incline angle for initial light-faster prediction, $F(3,51) = 15.53$, $p < .001$, but not for initial heavy-faster prediction.
  - Angle at which speeds are same, and at which light-faster and heavy-faster switch decreases with age.
  - Vertical element (fall = heavy-faster) increasingly gaining salience over horizontal element?

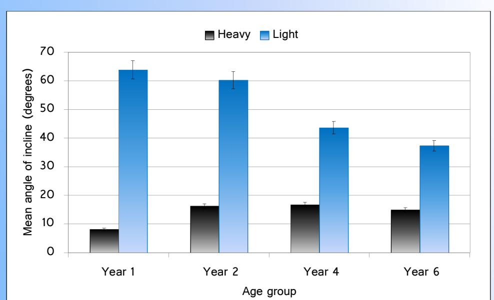

Figure 4. Mean angle of incline after manipulation by age and initial incline speed prediction

CONCLUSION

- Together, the two studies explored reasons for the shift in incline motion observed in previous research.
  - Indication that both horizontal and vertical elements play a role in making predictions about incline motion across all age groups.
  - But shift is evident in shifting role of horizontal and vertical elements, with horizontal becoming less salient and vertical becoming more salient.
- Findings contribute towards a clearer understanding of how commonsense theories of motion develop in childhood.

REFERENCES

- Hast, M., & Howe, C. (2012). Understanding the beliefs informing children's commonsense theories of motion: The role of everyday object variables in dynamic event predictions. *Research in Science & Technological Education, 30*, 3-15.
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- For further details please contact michael.hast@smuc.ac.uk