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Intuitions about magic track the development of intuitive physics

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ABSTRACT

Many successful magic tricks violate our assumptions about how physical objects behave, but some magic tricks are better than others. We examined whether the interest adults express in a magic trick is predicted by the age at which infants first respond to violation of the corresponding physical principle. In Experiment 1, adults ($N = 319$) rated their interest in magic tricks mimicking stimuli from violation-of-expectation experiments with infants. We found a clear correlation between how interesting a trick is and the age at which infants demonstrate a sensitivity to its underlying principle. In a second experiment ($N = 350$), we replicated this finding and also used three additional tricks for which there is no established age of acquisition to predict the age at which those physical principles might be acquired. A third experiment ($N = 368$) replicated these findings measuring adults' surprise at physical violations rather than their interest in magic tricks. Our results suggest that adults' intuitions reflect the development of physical knowledge and show how magic can reveal our expectations about the physical world.

1. Introduction

Psychology and conjuring are natural partners, being the science and the art, respectively, of understanding the limits of the human mind. The two disciplines have a shared history that goes back more than a century (Binet, 1894; Triplett, 1900). Over the last few years, this relationship has been reinvigorated through a significant increase in research (for a review, see Kuhn, 2019; Rensink & Kuhn, 2015) and a number of collaborations between psychologists and magicians (e.g., Macknik, King, Randi, Teller, & J., & Martinez-Conde, S., 2008; Mohr, & Koutrakis & Kuhn, G., 2015; Phillips, Natter, & Egan, 2015). However, much of this research is focused on the mechanisms by which human perception and thinking can be deceived, rather than what it is that makes that deception seem magical (for exceptions, see Griffiths, 2015; McCoy & Ullman, 2019; Parris, Kuhn, Mizon, Benattayallah, & Hodgson, 2009; Shtulman & Morgan, 2017).

For something to seem like magic, it has to defy a mundane explanation (Ortiz, 2006). To that end, people's intuitions about magic must reflect their intuitions about the mundane. Intuitions about magic can thus be a guide to the implicit notions we have about how the world around us works. Two recent studies have supported this idea. First, Griffiths (2015) showed that people's intuitions about magical transformations revealed an implicit ontological hierarchy among objects, with transformations moving in the direction of allowing more predicates (reflecting animacy and intelligence) being more compelling as magic tricks. For example, transforming a glass of milk into a white dove is more compelling than the reverse. Second, McCoy and Ullman (2019) showed that magical acts perceived as more substantial violations of physical principles were also believed to require more effort on the part of the magician. These studies raise a new question: what is it that makes some physical principles seem harder to violate than others?

In this article we explore a potential answer to this question, drawing on the substantial literature on the development of physical intuitions about object solidity, continuity, contact causality, support, etc. in infancy (for reviews, see Baillargeon, 2004; Xu, 2019). The grasp of a principle is typically assessed in a violation-of-expectation paradigm, measuring infants' looking times (Sim & Xu, 2019; Spelke, Breinlinger, Macomber, & Jacobson, 1992; Wang, Baillargeon, & Brueckner, 2004). In violation-of-expectation paradigms, infants are first given a set of habituation trials in which they become familiar with the experimental stimuli and events (e.g., a toy car rolls down a ramp and goes behind an occluder). Then, infants view a test event which is consistent with the physical principle being studied (e.g., the car stops when it hits a solid wall – a demonstration of solidity) and a test event which is inconsistent

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with the physical principle (e.g., the car stops at the far end of the solid wall as if it has passed through it – a violation of solidity). In these studies in the infant literature, longer looking time during inconsistent trials is commonly interpreted to provide evidence for three things: "first, infants possess the expectation being examined; second, they have detected a violation of that expectation; and third, they are surprised by the violation, measured as increased attention or interest" (Sim & Xu, 2019, p. 155).

However, there is some debate surrounding the extent to which looking time is an accurate measure of surprise. Wang et al. (2004) note that when they refer to violation-of-expectation paradigms as measuring infants' surprise, "surprise" is shorthand for a state of attention or interest. While there is wide consensus that a difference in looking time indicates detection of a difference between the two events, some have argued that this attention or interest could be caused by familiarity with the event or prediction of an event, rather than by surprise at a violation of an expectation, thus providing no evidence for an understanding of the physical principle in question (e.g., Bogartz, Shinskey, & Speaker, 1997; Jackson & Sirois, 2009). However, as Hamlin (2014) explains, the evidence for infants' surprise at an event is distinct from evidence for infants' prediction of an event, and well-designed research can distinguish between these two interpretations. The studies used in the experiments reviewed here were specifically selected because they conform to best practices in violation-of-expectation research, thus minimizing the concern that they fail to accurately measure infants' surprise through looking times (Cohen, 2004). While our findings should be considered in light of this debate about looking time as a measure of infants' surprise and physical reasoning, further discussion is beyond the scope of this paper (for further reading, see Aslin, 2007; Bogartz et al., 1997; Hamlin, 2014; Tafreshi, Thompson, & Racine, 2014; Sim & Xu, 2019; Stahl & Feigenson, 2015).

Violation-of-expectation experiments suggest a timeline for the acquisition of physical principles based on careful testing of failures (i.e., infants not distinguishing between the expected and unexpected outcomes, measured by their looking time; this lack of difference has been interpreted as the infants not being surprised to see a violation and therefore not yet understanding the physical principle in question) and successes (i.e., infants looking longer at the unexpected outcome than the expected outcome; this difference has been interpreted as surprise to see a violation and therefore understanding of the physical principle) with infants of different ages, these experiments suggest development trajectories in physical intuitions, with infants being sensitive to some physical principles earlier than others and a clear progression in the ages at which sensitivity to different principles emerges (e.g., Baillargeon, 1999; Spelke et al., 1992). Furthermore, there is evidence that alternative explanations, such as development of the visual system, are insufficient to explain why infants appear to "succeed" in demonstrating understanding of physical concepts at certain ages, as infants still "fail" these paradigms even as they demonstrate sensitivity to visual features of the task (e.g., Wang & Baillargeon, 2008).

Prior work has demonstrated similarities between infants' and adults' physical reasoning. For example, Turk-Browne, Scholl, and Chun (2008) argue that habituation trials in infant studies are analogous to habituation trials in adult functional neuroimaging studies since both depend on attenuating interest after repetition and both measure preference for novelty. Along a similar vein, Strickland and Scholl (2015) argue that both infants' and adults' visual processing is structured by representations of event-types (e.g., occlusion, containment). These studies provide evidence that in terms of habituation and visual processing, infants and adults may reason about the physical world similarly. This continuity between results with infants and adults leads us to the hypothesis that the ages at which infants show violation of expectation reactions to an anomalous physical event may provide a clue as to why some magic tricks are better than others. Specifically, we predict that violating principles that infants become sensitive to earlier will make for stronger magic.

We can imagine different causal mechanisms by which the age of acquisition of physical principles could come to be related to adult responses to the violation of those principles. Some principles may be more fundamental because of the evolved architecture of the human mind: we may be innately endowed with a small set of principles about the physical world (e.g., Spelke & Kinzler, 2007) with those principles that are most fundamental to making sense of physical events being those that emerge earliest. Another possibility is that some physical principles may be more fundamental because abundant statistical evidence in the environment makes those principles easier to learn (e.g., Baillargeon's model of adding physical variables to event types over time; see Baillargeon, 1998) and these principles are strengthened by more statistical evidence from the real world over the course of development. Under either of these mechanisms, or some combination of them, the more entrenched our beliefs are about the physical world – measured by age of acquisition – the more surprising and interesting it is to witness a violation of such beliefs, as in magic tricks. Showing a relationship between age of acquisition and the strength of a magic trick would thus provide further support for the idea that our intuitions about magic reflect the unconscious commitments we have about the world around us.

To evaluate this hypothesis, we conducted three experiments in which people viewed magic tricks and judged how interesting they found each trick to be. The magic tricks mimicked stimuli shown to infants in classic violation-of-expectation experiments (e.g., Baillargeon, 1995; Spelke et al., 1992), which suggest ages of acquisition for the physical principles underlying each trick. In the first experiment, we compared these ages of acquisition to participants' interest ratings to determine whether there is a relationship. In the second experiment, we replicated the first experiment and also collected interest ratings of three magic tricks for which there is no established age of acquisition. These ratings allowed us to predict ages at which infants might become sensitive to the physical principles underlying these tricks.[1] Finally, these first two studies operationalized infants' looking time as an adult measure by asking for interest ratings. However, as we have discussed, there is some debate over how exactly infants' looking times should be interpreted. For this reason, we ran a third experiment measuring adults' "surprise" at physical events. Using this alternative measure and removing the magical context, we confirmed that adults' interest in magic tricks tracks their surprise at the corresponding anomalous physical events, providing additional evidence for continuity between our approach and the violation-of-expectation paradigm used with infants.

2. Experiment 1

2.1. Method

2.1.1. Participants

Participants in Experiment 1 were 319 adults recruited via Amazon Mechanical Turk. An additional 86 participants were excluded for failing an attention check (described below). Participants were paid at a rate of $7.50 an hour (i.e., $1.25 for a 10-min experiment) and participation was restricted to workers in the United States who had completed at least 500 prior tasks with a 95% approval rating. The sample size was selected so as to reach a power greater than 0.95 for the main correlation analysis on the basis of the results of a pilot study with participants on Mechanical Turk.

[1] The reported experiments were approved by the Institutional Review Board at Princeton University under protocol #10859 (Computational Cognitive Science). Experiments 1 and 2 were preregistered and are available at https://aspredicted.org/blind.php?x=6b6u84 (Experiment 1) and https://aspredicted.org/blind.php?x=6dv58v (Experiment 2).

2.1.2. Materials and procedure

Participants in all studies completed an online task on Qualtrics. Magic tricks were presented one at a time in a random order, each followed by an interest rating question. For each trick, participants viewed a three-panel picture of the trick accompanied by text describing each panel. Each trick was displayed for ten seconds before an interest rating question – "How interesting is this magic trick?" – was presented. Participants responded on a "1 - Not interesting" to "10 - Very interesting" scale.

The tricks were selected by reviewing the literature on infants' acquisition of physical principles. We carefully selected a set of physical principles and their corresponding suggested ages of acquisition from violation-of-expectation studies based on several selection criteria. We aimed to select studies which: (1) found evidence of an age of acquisition, (2) adhered to best practices in infant research, (3) had similar levels of visual simplicity (e.g., all tricks were presented in grayscale and featured spheres, cylinders, and cubes as the primary object), (4) employed a specific version of the looking-time method consistently, therefore allowing us to test the developmental trajectory in adults without having to delve into the controversy surrounding different ways of employing the looking time methods (e.g., Bogartz et al., 1997), (5) are representative of work standardly reviewed in discussions of physical reasoning in infancy (e.g., Carey, 2009) and textbooks on developmental psychology (e.g., Siegler, Saffran, Eisenberg, & Gershoff, 2020). All ages of acquisition were determined using the earliest age at which there was evidence suggesting that infants could comprehend the physical principle as measured in violation-of-expectation paradigms. For most of the tricks, this age was reported in a published paper, but for two of the tricks (3 and 5), we used ages cited in unpublished manuscripts that were referenced in published work. For some tricks we used three-panel illustrations from the original publications; new illustrations were made for the remaining tricks. Each picture panel was accompanied by text describing a magician's actions (see Fig. 1). We also included an attention check, which had a three-panel picture-and-text format, but replaced some text in the middle panel with instructions to select option 10 as the interest rating. In total, participants in Experiment 1 viewed ten magic tricks and one attention check (see Table 1 and supplemental material).

2.2. Results

Supporting our main hypothesis, we found a significant negative correlation between individual participants' interest ratings and age of acquisition for each trick ($r(317) = -0.16$, $p < .001$). To account for variation across participants, we normalized each participant's interest rating and also found a significant negative correlation between the individual normalized ratings and age of acquisition ($r(317) = -0.21$, $p < .001$). As a more rigorous way of capturing individual variation, we used the lmerTest library in RStudio (Kuznetsova, Brockhoff, & Christensen, 2017; RStudio, 2020) to fit a multilevel model with age of acquisition as a predictor of interest rating, with random intercepts and slopes for each participant. The model showed that age of acquisition was a significant predictor ($\beta = -0.16$, $t = -10.91$, $p < .001$), providing evidence that the age at which a physical principle was acquired offers information about how interesting a magic trick is. As an additional analysis using the same multilevel model, we re-ran the regression by item, predicting mean ratings for each trick from the acquisition age (see Fig. 2). To give a sense for the effect size, the correlation between the average ratings and the age of acquisition was $r(8) = -0.59$.[2]

[2] We focus on effect size rather than statistical significance here because there are only ten observations, an intrinsic result of the limited number of studies on physical intuitions in infants. With ten observations, the Pearson correlation would need to exceed 0.8 for an experiment to have a power of 0.95 for detecting it.

Inspection of Experiment 1 in Fig. 2 shows that Tricks 3 and 5, the tricks for which we used ages cited in unpublished manuscripts, deviate most significantly from the negative linear relationship. For this reason, we conducted follow-up exploratory analyses using only published ages. This resulted in changing the age of acquisition for Trick 3 from 3 months to 4.5 months and removing Trick 5 from analyses. With these changes, we again found a significant negative correlation between raw interest ratings and age of acquisition ($r(317) = -0.16$, $p < .001$), and between normalized interest ratings and age of acquisition ($r(317) = -0.21$, $p < .001$). In addition, the magnitude of the correlation between averaged ratings and age of acquisition increased ($r(7) = -0.63$), and age of acquisition remained a significant predictor of rating when ages cited in manuscripts were removed from the multilevel model ($\beta = -0.15$, $t = -10.23$, $p < .001$). Taken together, these results suggest that the earlier a physical principle is learned, the more interesting its violations are in the context of magic tricks. We aimed to replicate this effect in Experiment 2.

3. Experiment 2

3.1. Method

3.1.1. Participants

Participants in Experiment 2 were 350 adults recruited via Prolific.[3] An additional 50 participants were excluded for failing an attention check. Participants were paid at a rate of $7.50 an hour and participation was restricted to workers in the United States who had completed at least 100 prior tasks with a 95% approval rating.

3.1.2. Materials and procedure

Experiment 2 materials and procedures were the same as Experiment 1, with two changes. First, the age acquisition of Trick 3 was changed from 3 months to 4.5 months, consistent with the earliest *published* results (Needham & Baillargeon, 1993). Second, the stimuli included three exploratory tricks that were presented alongside the other tricks, but analyzed separately. These included Trick 5, which was removed from our main analyses because there was no published evidence of an age of acquisition for the relevant principle, and two additional tricks for which there was no published age of acquisition (see Table 1 and supplemental material).

3.2. Results

By only using tricks for which there is a published age of acquisition, we were able to replicate the findings of Experiment 1 in which we removed manuscript ages (see Fig. 3). For the nine tricks earmarked for our main analyses, we found a significant negative correlation between participants' raw interest ratings and age of acquisition ($r(348) = -0.19$, $p < .001$) and normalized interest ratings and age of acquisition ($r(348) = -0.25$, p $< .001$). A multilevel model with age of acquisition as a predictor of rating and random intercepts and slopes for each participant revealed a significant main effect of age of acquisition ($\beta = -0.16$, $t = -12.88$, $p < .001$). The observed relationship between average ratings and age of acquisition was still strong ($r(7) = -0.63$).

Next, we calculated the means of the three tricks for which there is no published age of acquisition. Trick 5 received a mean rating of 3.56 (CI = [3.33, 3.78]), Trick 11 received a mean rating of 4.35 (CI = [4.12, 4.59]), and Trick 12 received a mean rating of 6.43 (CI = [6.19, 6.67]).

[3] Recruitment for Experiment 2 was changed to Prolific due to data quality issues experienced on Mechanical Turk. In piloting Experiment 2 on Mechanical Turk, we found that only 61% of participants passed the attention check used in Experiment 1, suggesting a higher incidence of bots or unfocused workers at the time of the study. This change has the added benefit of replicating with a slightly different population.

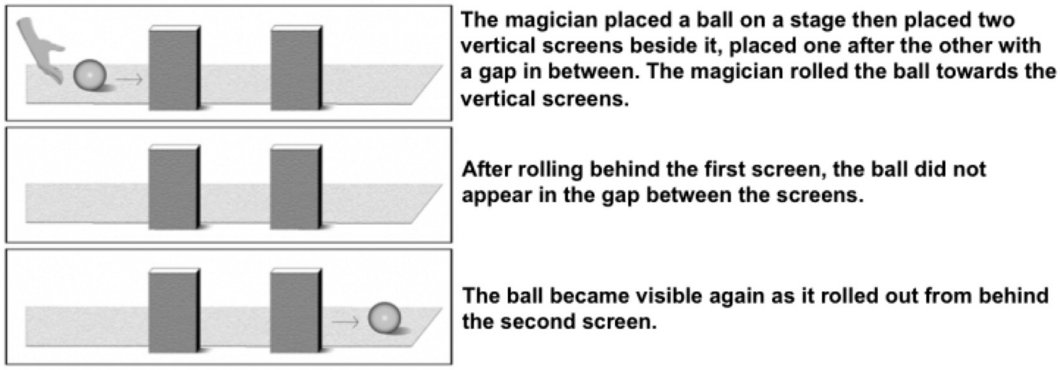

Fig. 1. Example of a trick shown to participants. Aguiar and Baillargeon (1999) report that the physical principle underlying this trick is understood by 2.5-month-olds.

Table 1
Ages of acquisition and sources of stimuli used in Experiment 1.

Trick number	Age of acquisition (months)	Source
1	2.5	Spelke et al., 1992
2	2.5	Aguiar & Baillargeon, 1999
3*	3 (Exp. 1); 4.5 (Exps. 2, 3)	Needham & Baillargeon, 1992 (m.s. cited in Needham & Baillargeon, 1993); Needham & Baillargeon, 1993
4	3.5	Baillargeon & DeVos, 1991
5*	5 (Exp. 1); N/A (Exps. 2, 3)	Baillargeon, Raschke, & Needham, 1994 (m.s. cited in Baillargeon, 1995)
6	6.5	Leslie & Keeble, 1987; Oakes, 1994
7†	6.5	Baillargeon, Needham, & DeVos, 1992
8	7.5	Hespos & Baillargeon, 2001
9	8.5	Aguiar & Baillargeon, 1998
10	12	Wang, Baillargeon, & Paterson, 2005
11*	N/A	Spelke et al., 1992
12*	N/A	Spelke et al., 1992

* In Experiments 2 and 3, the age of acquisition for Trick 3 was adjusted to 4.5 months, Trick 5 was removed from main analyses, and Tricks 11 and 12 were added.

† In the original study, a finger pushes a smiley-faced box to the edge of a striped platform. In our version (see Appendix), a hand lowers a plain gray box to the edge of a plain platform. These features were changed so they would not be more visually salient than other tricks.

The linear regression model based on the main set of nine tricks was used to predict the ages of acquisition of these additional tricks from their average interest ratings. Assuming that the relationship between age of acquisition and ratings is linear, our model predicts that sensitivity to Trick 5 would be acquired at 9.61 months (CI = [5.18, 14.05]), Trick 11 at 7.57 months (CI = [4.91, 10.23]), and Trick 12 at 2.26 months (CI = [−2.29, 6.82]).

4. Experiment 3

4.1. Method

4.1.1. Participants

Participants in Experiment 3 were 368 adults recruited via Prolific. An additional 32 participants were excluded for failing an attention check. Participants were paid at a rate of $7.50 an hour and participation was restricted to workers in the United States who had completed at least 100 prior tasks with a 95% approval rating.

4.1.2. Materials and procedure

Experiment 3 comprised two between-subjects conditions. In the *interest* condition ($N = 180$), materials and procedures were the same as Experiment 2. In the *surprise* condition ($N = 188$), participants were asked "How surprising is this event?" and responded on a "1 - Not surprising" to "10 - Very surprising" scale. The *surprise* condition contained no references to magic and instructed participants that they would be

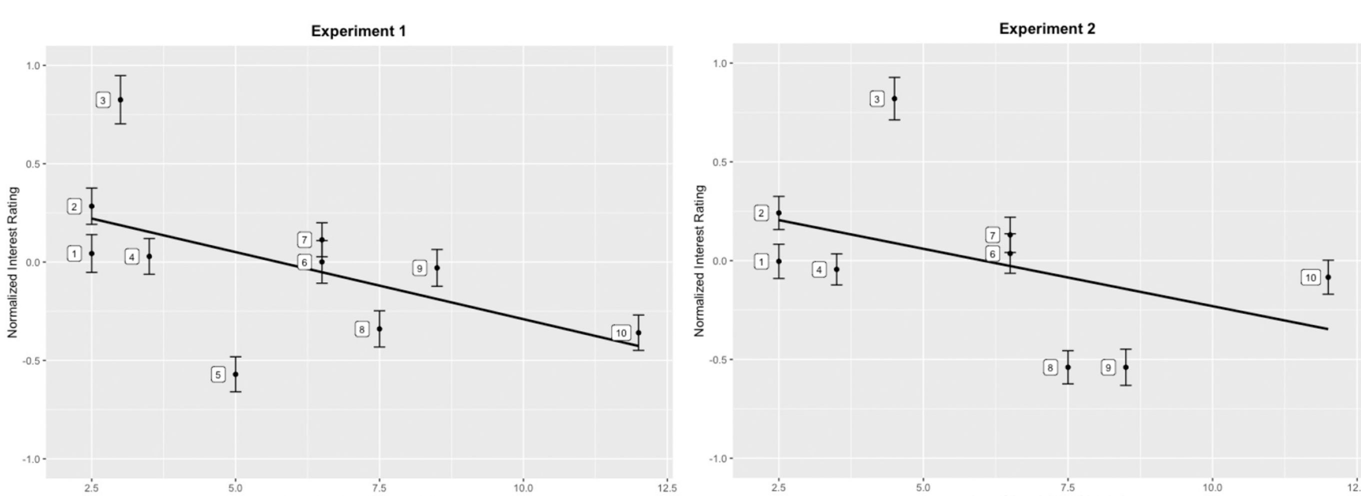

Fig. 2. Results of Experiments 1 (left) and 2 (right): mean normalized participant interest ratings plotted against the age of acquisition of each magic trick, and the best fit line from Pearson regression analysis. Error bars indicate 95% CI.

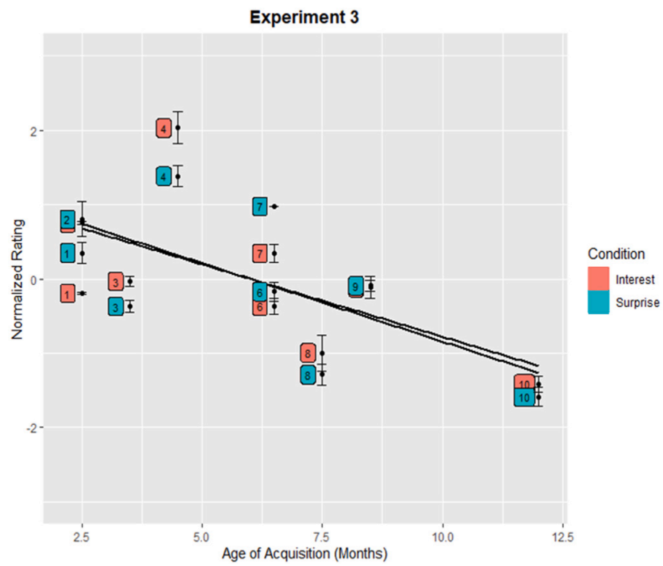

Fig. 3. Results of Experiments 3 for the *interest* and *surprise* conditions: mean normalized participant interest ratings plotted against the age of acquisition of each magic trick, and the best fit line from Pearson regression analysis. Error bars indicate 95% CI.

presented with a series of physical events and that we would like to know how surprising it would be to see each of these events actually occur.

4.2. Results

By including surprise ratings as a dependent variable in addition to interest ratings, we were able to directly replicate the findings of Experiment 2 and demonstrate that they extend to ratings of surprise, a term which may better reflect infant violation-of-expectation measures. For the nine tricks earmarked for our main analyses, we found a significant negative correlation between participants' raw interest ratings and age of acquisition (*interest*: $r(178) = -0.19$, $p < .001$; *surprise*: $r(186) = -0.18$, $p < .001$) and normalized interest ratings and age of acquisition (*interest*: $r(178) = -0.26$, $p < .001$; *surprise*: $r(186) = -0.26$, $p < .001$). A multilevel model with age of acquisition as a predictor of rating and random intercepts and slopes for each participant revealed a significant main effect of age of acquisition (*interest:* $\beta = -0.17$, $t = -9.82$, $p < .001$; *surprise:* $\beta = -0.17$, $t = -9.09$, $p < .001$). The observed relationship between average ratings and age of acquisition was still strong (*interest:* $r(7) = -0.61$; *surprise:* $r(7) = -0.66$).

Next, we calculated the means of the three tricks for which there is no published age of acquisition. In the *surprise* condition, Trick 5 received a mean rating of 5.54 (CI = [5.13, 5.94]; *interest:* $M = 3.34$, CI = [3.01, 3.68]), Trick 11 received a mean rating of 5.82 (CI = [5.43, 6.22]; *interest:* $M = 4.03$, CI = [3.69, 4.36]), and Trick 12 received a mean rating of 7.27 (CI = [6.89, 7.66]; *interest:* $M = 6.38$, CI = [6.03, 6.72]). The linear regression model based on the main set of nine tricks was used to predict the ages of acquisition of these additional tricks from their average interest ratings. Assuming that the relationship between age of acquisition and ratings is linear, our model for the *surprise* condition predicts that sensitivity to Trick 5 would be acquired at 8.44 months (CI = [5.27, 11.61]; *interest:* 9.37 months, CI = [4.92, 13.82]), Trick 11 at 7.70 months (CI = [5.07, 10.32]; *interest:* 7.87 months, CI = [4.85, 10.89]), and Trick 12 at 3.96 months (CI = [1.10, 6.83]; *interest:* 2.71 months, CI = [−1.65, 7.07]).

5. Discussion

We explored whether adults' interest in magic tricks is related to the age at which children become sensitive to the physical principles which underlie the tricks, as suggested by violation-of-expectation studies. In Experiment 1, we found evidence of a relationship between age of acquisition and interest ratings such that the most interesting magic tricks were those which violate the physical principles learned earliest in infancy, and vice versa. In Experiment 2, we replicated these findings with published ages of acquisition and were able to predict the ages of physical principles for which there is not yet evidence in the literature. In Experiment 3, we again replicated these findings and found that they extend beyond the magical context to ratings of surprisingness of physical events, which may more closely parallel infant violation-of-expectation paradigms.

Our results contribute to the growing literature demonstrating the ways in which magic can help us understand aspects of cognition beyond perception. Asking participants a simple question about how interesting they find a magic trick recapitulates the time course of the development of physical expectations. Although the literature on infant physical reasoning suggests that we commit to physical expectations rapidly – for example, all of the tricks we tested are thought to be typically understood within the first year of life[4] – the order in which we likely acquire them can still be parsed using adults' intuitions. This finding is consistent with other results showing that early intuitions about the world persist into adulthood in many domains (e.g., Keil, 2011; Lombrozo, Kelemen, & Zaitchik, 2007; Shtulman & Harrington, 2016). One tantalizing implication is that we may be able to use adults' intuitions to guide infant research.

Of course, our predictions for the ages of acquisition of the additional tricks in Experiments 2 and 3 are estimates based on an assumed linear relationship and are most informative when considered relative to the other principles tested. Future work could provide more evidence for these predictions and the relationship between age of acquisition and magic trick interest by testing, using an infant violation-of-expectation paradigm, at what age infants acquire the physical principles underlying our additional tricks. This paradigm would provide additional support that magic is a useful tool for furthering our understanding of infant cognition.

In order to connect distant dots across development we have bridged different experimental paradigms: infant studies assessing looking time, on the one hand, and adult interest and surprise ratings, on the other hand. In both infant violation-of-expectation tasks and in the present experiments, the aim is to measure the clearest expression of interest that each participant group can provide. Since infants cannot verbally communicate, researchers rely on whatever indications of engagement with a task that infants can provide; in younger infants and most violation-of-expectation publications, this is looking time. In some studies with older infants, this is their physical exploration of an object that has violated a physical principle (e.g., Sim & Xu, 2017). These dependent variables – looking time or engagement with an object – are taken by researchers to be an indication of infants' interest in and surprise at an expectation-violating event. Adults, on the other hand, are capable of providing a more direct measure of interest: self-reporting. We have therefore used participants' reported interest in magic tricks and surprise at physical violations.

As mentioned in the introduction, we can imagine different mechanisms by which age of acquisition and adult intuitions might be related. The first is consistent with the view that the development of physical intuitions is strongly shaped by innate constraints (e.g., Spelke et al., 1992; Spelke & Kinzler, 2007). Under this view, the age of acquisition might reflect the strength of those constraints, a factor that has enduring influences even into adulthood. The second mechanism instead emphasizes the role of learning. Under this view, the reason some physical

[4] However, as noted in the Introduction, there is debate surrounding violation-of-expectation paradigms which test understanding of these phenomena. Our results should be considered in light of this debate.

principles are acquired earlier is the abundance of statistical evidence in the world in favor of those principles. Age of acquisition thus tracks a property of the world – the extent to which the principle is manifest, something that we might expect to correlate with the extent to which it seems immutable. Teasing apart these two possible mechanisms is an intriguing direction for future research.

Beginning in infancy, our observations of the world around us quickly turn into expectations. We expect that solid objects cannot pass through one another, that things cannot teleport to another location, and so on. As researchers, we can learn when infants develop these expectations by measuring whether they look longer at events in which physical laws are violated. In a similar way, as we have shown, adults' interest in magic tricks allows us to measure their assumptions about physical objects. Since magic tricks, like stimuli in developmental research, go against what we typically see in everyday life, they allow us to discover our ontological commitments.

Open practices

All data and stimuli have been made publicly available via the Open Science Framework and can be accessed at https://osf.io/pj3uh/?view_only=57a7ce2eca9c434fbd5bdb814df25278. Both experiments were preregistered and can be accessed at https://aspredicted.org/blind.php?x=6b6u84 (Experiment 1) and https://aspredicted.org/blind.php?x=6dv58v (Experiment 2).

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Declaration of Competing Interest

None.

Appendix A. Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.cognition.2021.104762.

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