Lookit: the online child lab

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Why put studies online?

Reducing practical constraints on the questions we can ask…

- Large sample sizes (small effects or many conditions)
- Longitudinal designs
- Special populations
- Behavior at home
- More representative samples

Designing for:

- Accountability and replicability
- Science education and outreach (“citizen science”)
- Bringing together computational, clinical, cognitive, & educational approaches to development

Outline

Overview of the system / demo

Lessons learned from early test studies

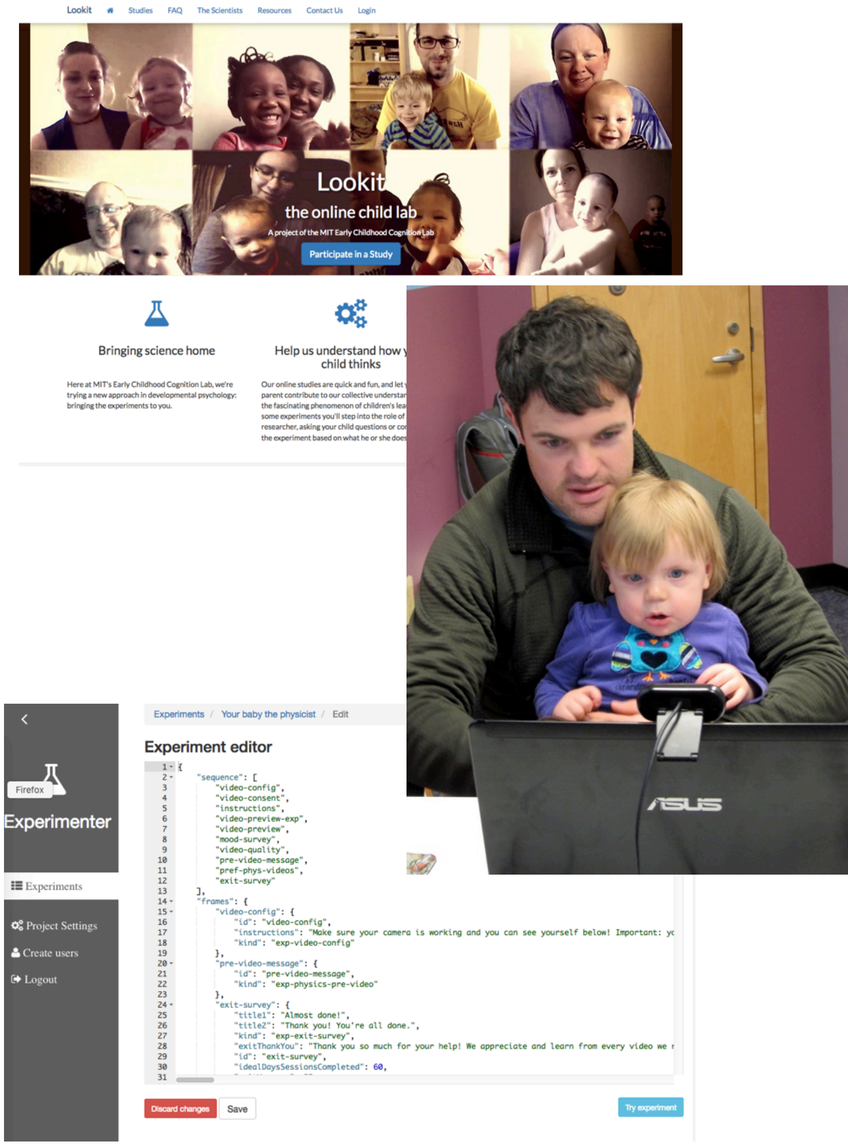
- Test study protocols / results
- Yield
- Demographics
- Looking measures
- Verbal responses

Example use case: dense longitudinal measurements online

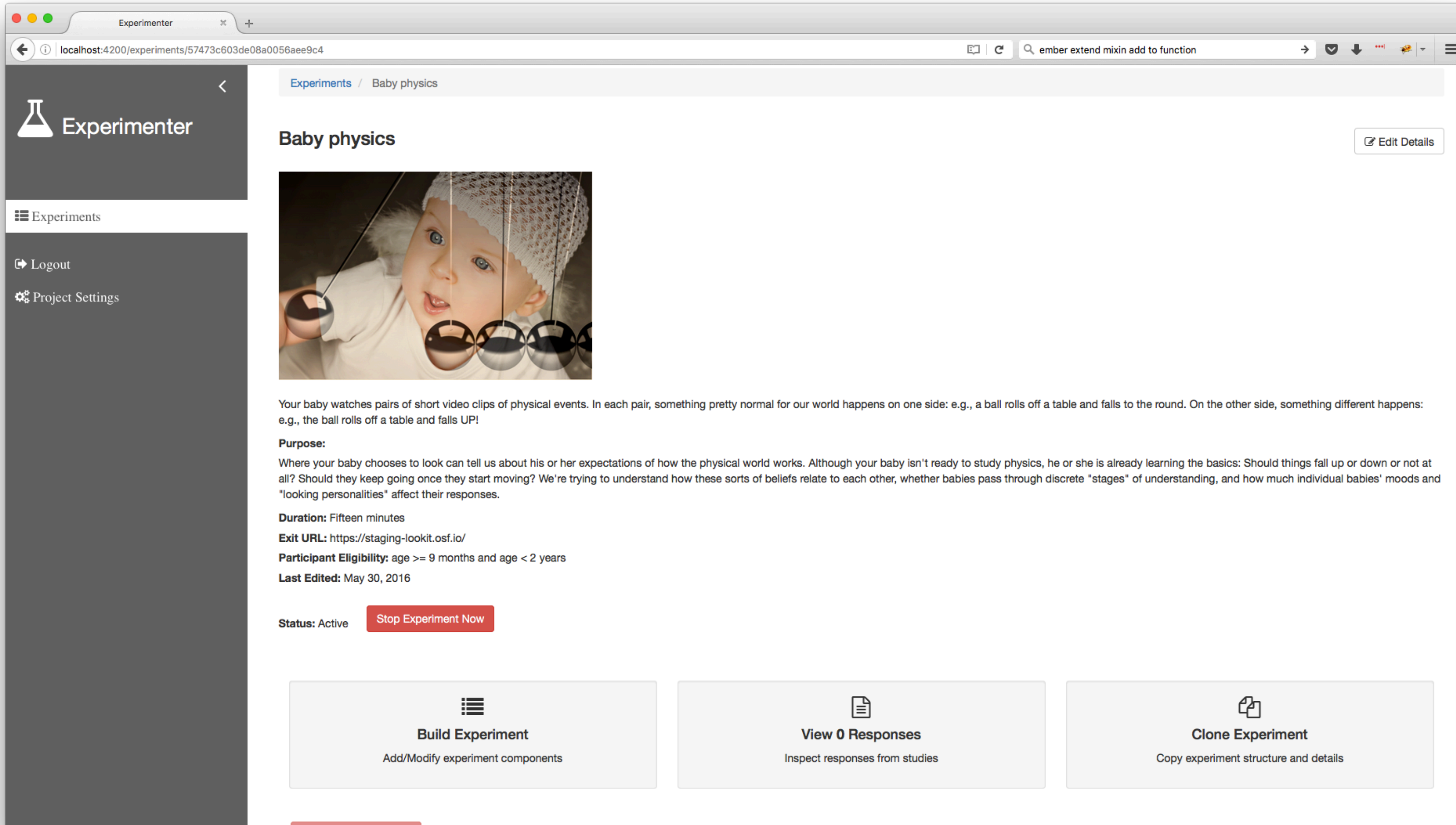
Status & ongoing work on the experimenter platform

How it works: https://lookit.mit.edu

- Parents register, complete child profiles, find and do studies in the web browser
- Researchers define & control studies from an ‘experimenter’ platform (hosted on OSF)
- Studies implemented using EmberJS components for reusable ‘frames’
- Video recording mixin allows researchers to specify periods to record.
  - Flash (eventually, HTML5!) → HDFVR → Wowza media server → Amazon S3 → lab
- User and study data stored using MongoDB
- Email to participants mediated by SendGrid
- Prototype site: ad-hoc study code, no experimenter interface
- Recruitment: test studies used Mechanical Turk, currently volunteers



Lookit experimenter interface



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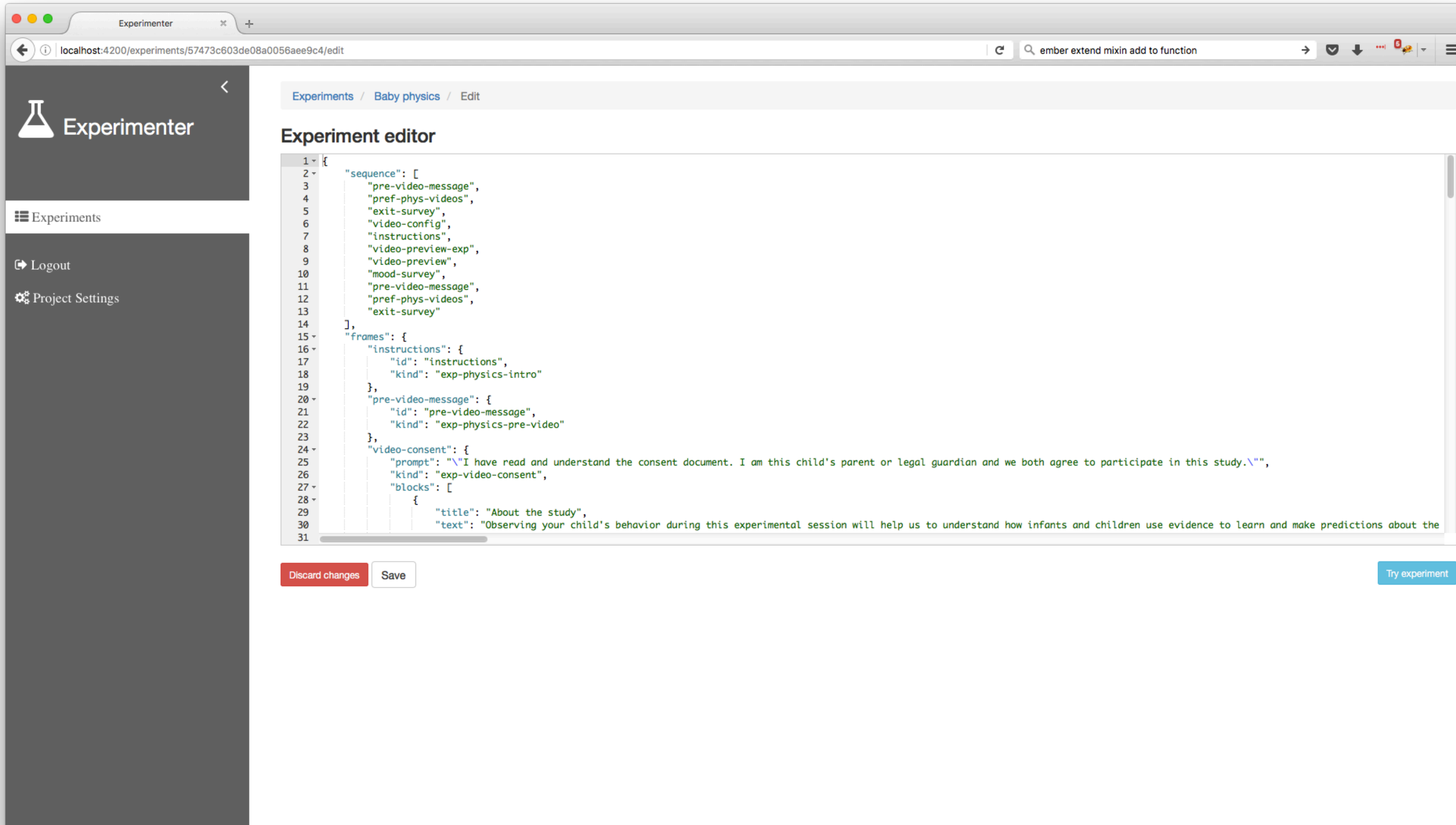

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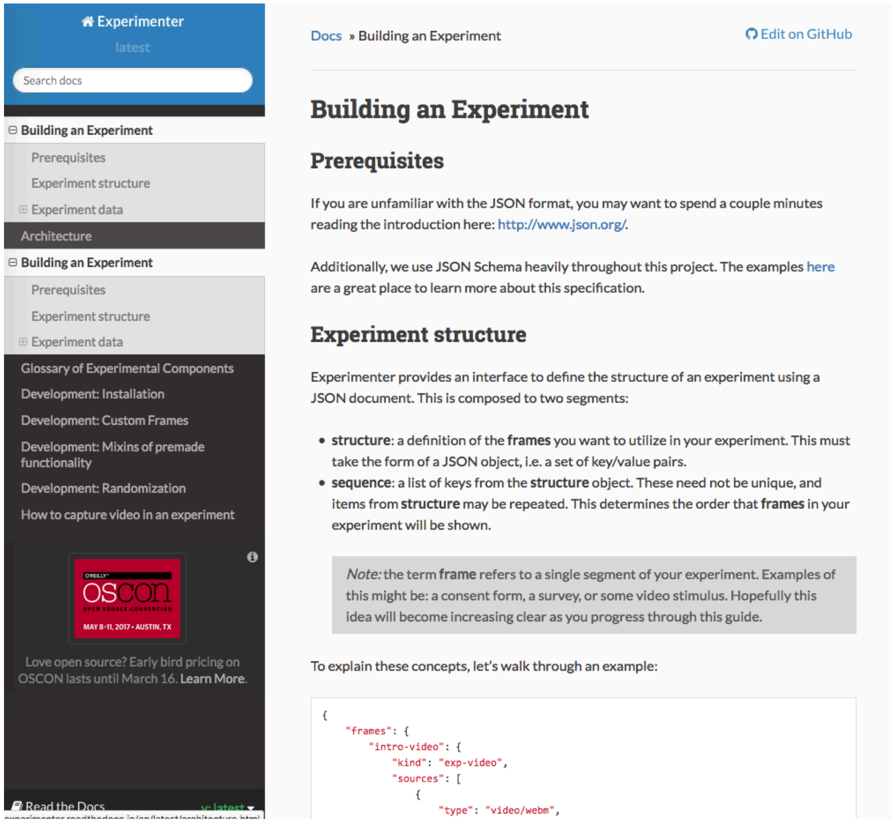

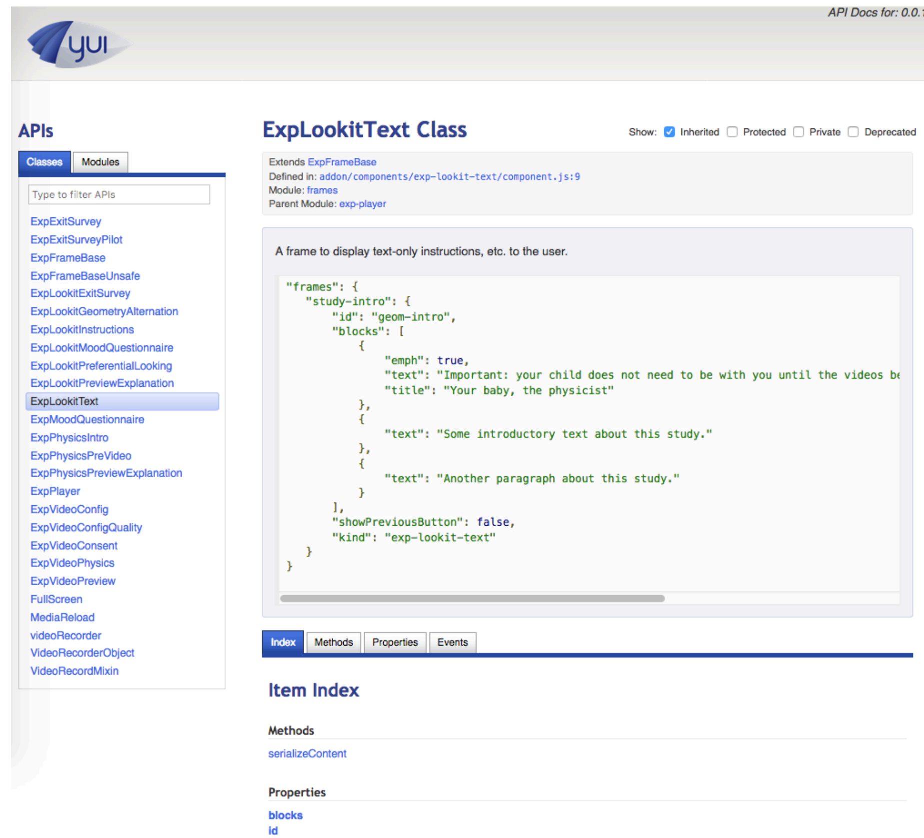

Privacy & informed consent

"I have read and understand the above information. I am this child's legal guardian and we both agree to participate in this study."

Parents read a statement aloud, showing (a) they understand written English and (b) they understand they're being videotaped.

Consent videos are checked before coders access the remaining data.

Parents select a privacy level & choose whether to share with Databrary at the end of the study

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Test studies on Lookit prototype

User case studies to try out prototype – span several age ranges, dependent measures, domains

759 unique participants in their study's age range, with valid consent video

Intuitive probability

Age range: 11-18 months.

Infants have rich expectations about how the world works. Can they estimate how probable a completely new event is? In this study your child will see some 'lottery drawings' of shapes, for instance a yellow ball coming out of a mostly-blue container. We're interested in which outcomes he or she finds most surprising.

Learning new verbs

Age range: 2-year-olds (24-36 months).

In this experiment, your child will watch several clips of conversations that introduce a new verb, followed by side-by-side movies of experimenters pantomiming two different verbs. We are interested in how children use information from the conversations to figure out which action matches the new verb.

Learning from others

Age range: 3-, 4-, and 5-year-olds.

How do children filter through many sources of information to learn robustly from other people? In this study two women will name familiar objects with varying accuracy. We're interested in how your child chooses which one to trust when the same women name new objects as well.

Scott, K., & Schulz, L. (2017). Lookit (Part 1): A new online platform for developmental research. *Open Mind*.
Scott, K., Chu, J., & Schulz, L. (2017). Lookit (Part 2): Assessing the viability of online developmental research, results from three case studies. *Open Mind*.

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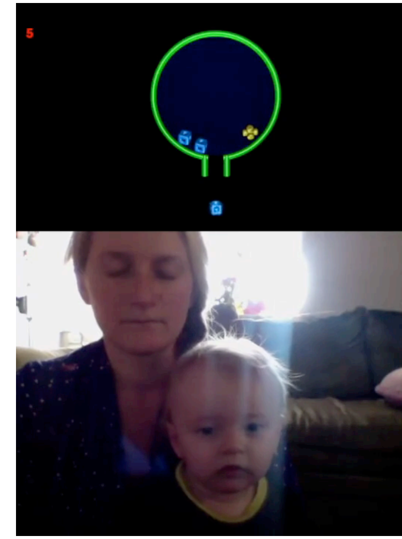
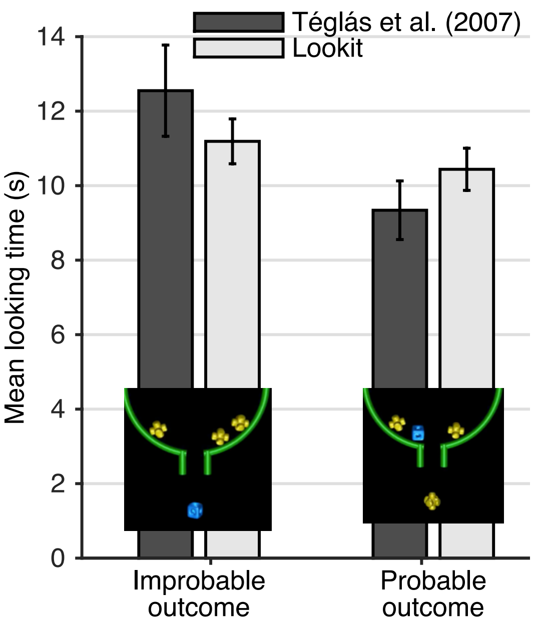
Study 1: One-shot probability

- Replicating Teglas et al. (2007): 12-month-olds look longer when the minority object exits a lottery container
- Four warmup (2:2) and four test (3:1) trials; parents close their eyes for the outcomes.
- Measure **looking time** until first continuous 1 s lookaway on each trial.
- 49 children included, **11-18 months**. Received records from 269 unique children, 112 with potentially usable video.





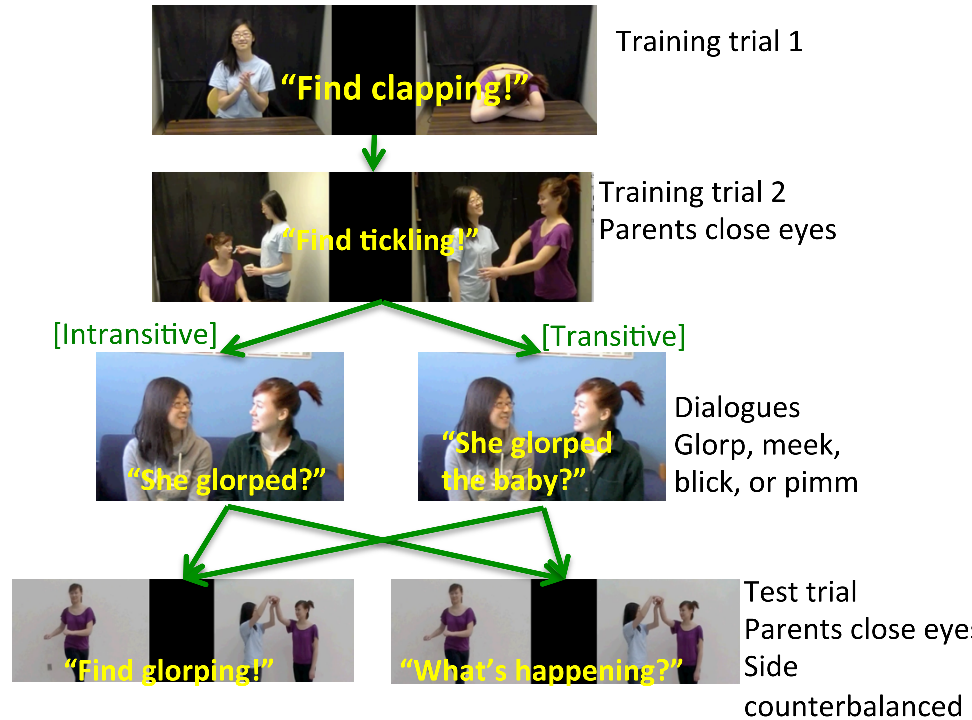
	B	SE B	p	95% CI
Intercept	12.82	0.86		[11.10, 14.55]
Improbable	0.83	0.61	0.17	[-0.37, 2.03]
Order (1, 2, 3, 4)	-0.80	0.27	0.004	[-1.34, -0.26]
Fussy/distracted	-4.63	1.11	5.0E-05	[-6.83, -2.44]

Difference in looking time, Téglás et al.: 3.21 s [0.36, 6.1]
(replicated internally)

Téglás, E., Girotto, V., Gonzalez, M., & Bonatti, L. L. (2007). Intuitions of probabilities shape expectations about the future at 12 months and beyond. Proceedings of the National Academy of Sciences, 104(48), 19156-19159.

Study 2: Syntactic bootstrapping

- Replication of Yuan & Fisher (2009): 2-year-olds use combinatorial information about a new verb to interpret its meaning
- Those who heard a transitive verb introduced looked longer than those who heard an intransitive verb at two-participant videos when asked to "find blicking!"
- No effect of transitivity when asked "what's happening?" instead



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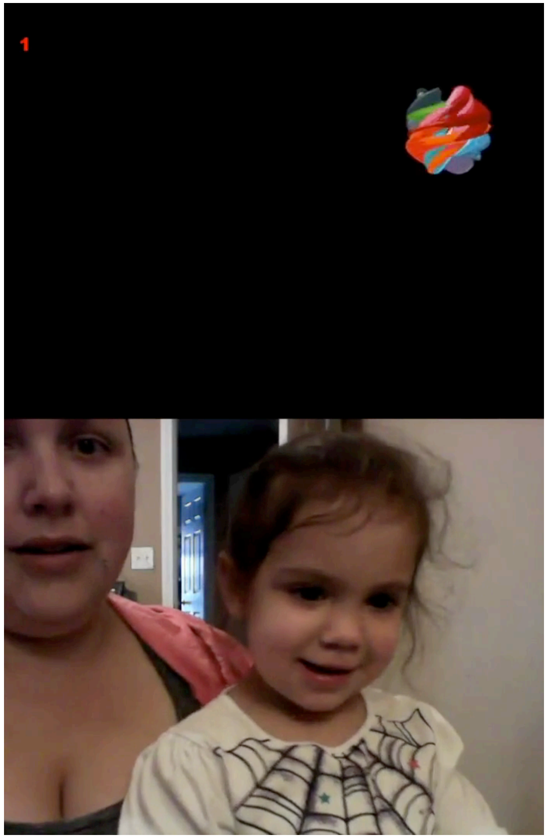

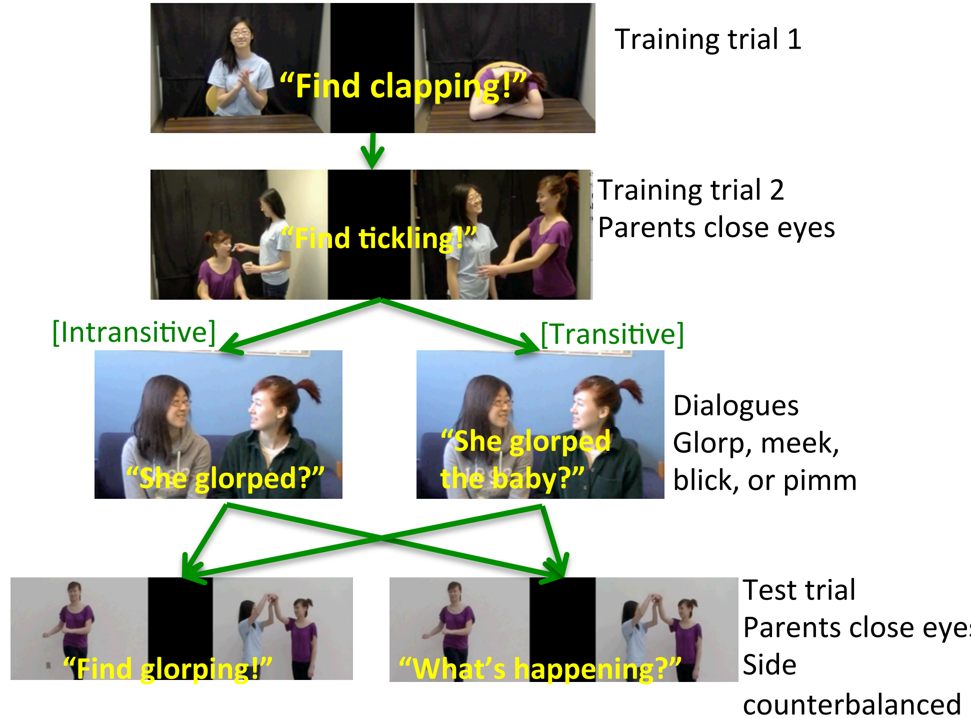

- **Preferential looking, 67 toddlers (24-36 months)**
- Received records from 329 unique children
- 140 have potentially usable video

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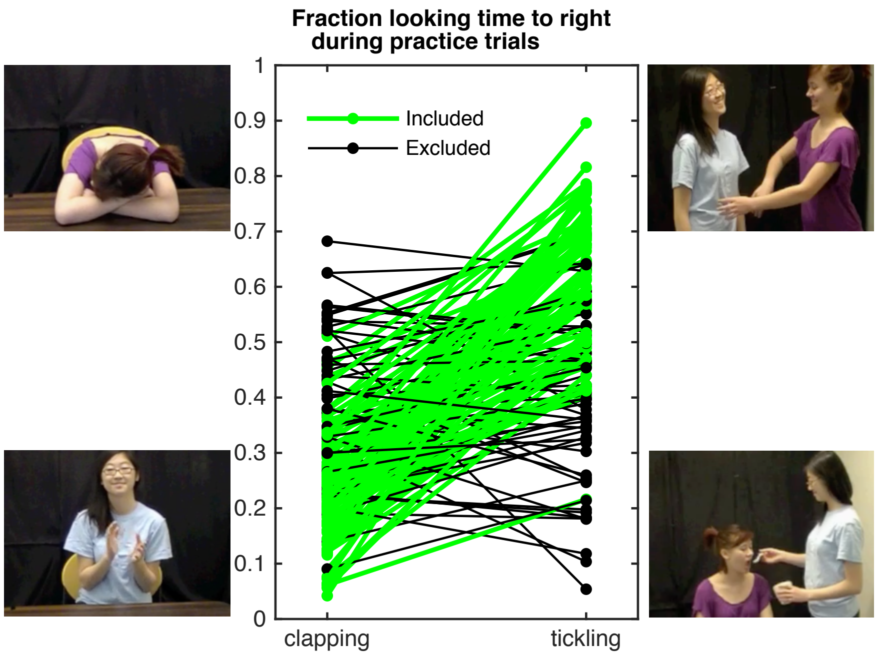
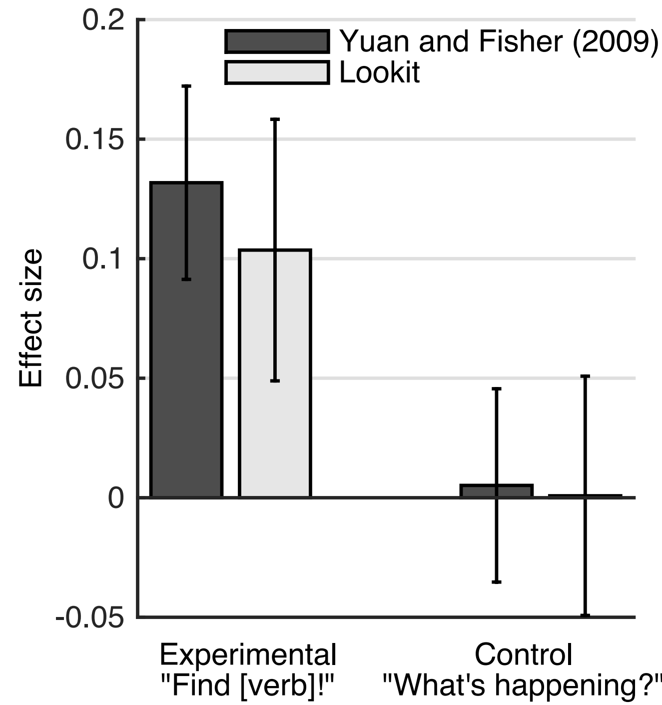




Dependent variable: Fraction of total looking time during two test trials spent looking at the two-participant actions

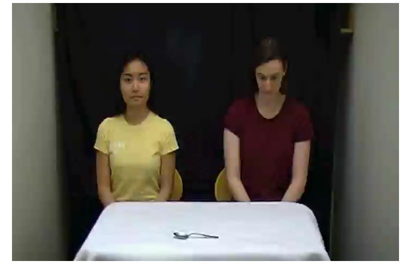
Lookit: regression on experimental/control x transitive/intransitive and stimulus set (dummy-coded), weighted by variance estimated from practice trials: variance ~ $(1 - \text{PracticeScore})^2$

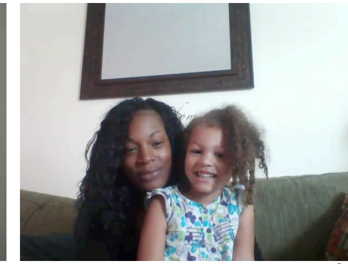
Study 3: Trust in testimony

Replicating Pasquini et al. (2007)'s original "trust in testimony" work: Preschoolers use past reliability of informants to to identify who was more accurate and endorse her labels for novel objects

- **Verbal responses**
- Between-subjects design (each child only sees one pair of informants)
- Conditions:
  - 100% vs. 0%
  - 100% vs. 25%
  - 75% vs. 0%
  - 75% vs. 25%
- **148 preschoolers (3-4 years old), 234 with potentially usable video**

1. Familiar objects

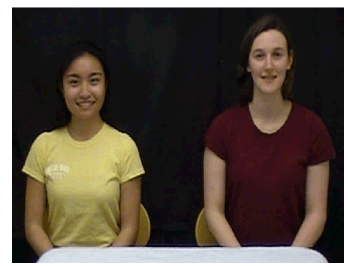


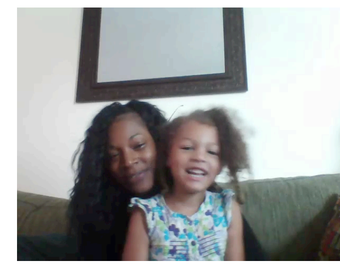


x 4

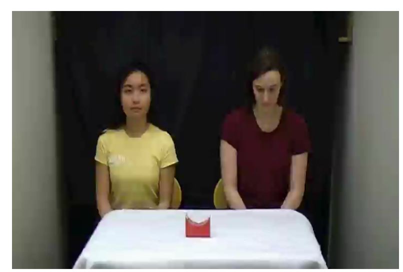
Counterbalance who's more accurate and when incorrect answers happen

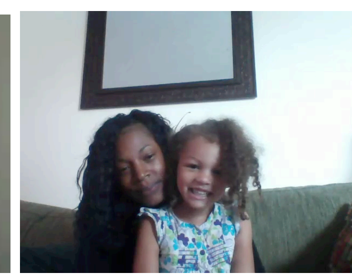
2. Explicit judgment





3. Novel objects

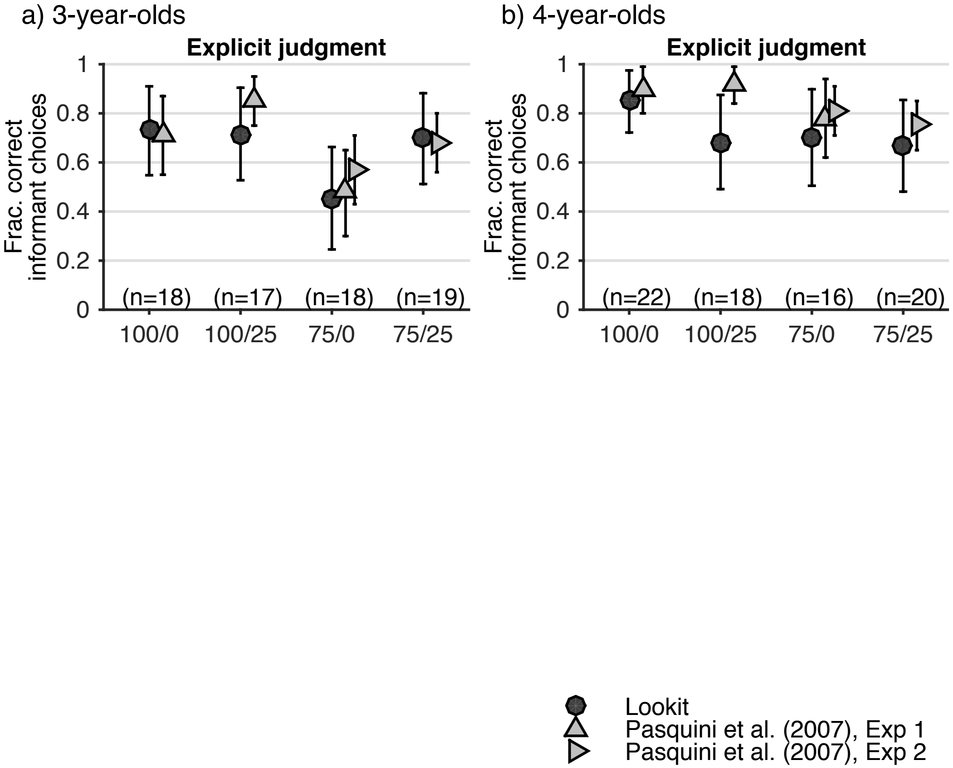




Pasquini, E. S., Corriveau, K. H., Koenig, M., & Harris, P. L. (2007). Preschoolers monitor the relative accuracy of informants. Developmental psychology, 43(5), 1216.

Study 3: Trust in testimony

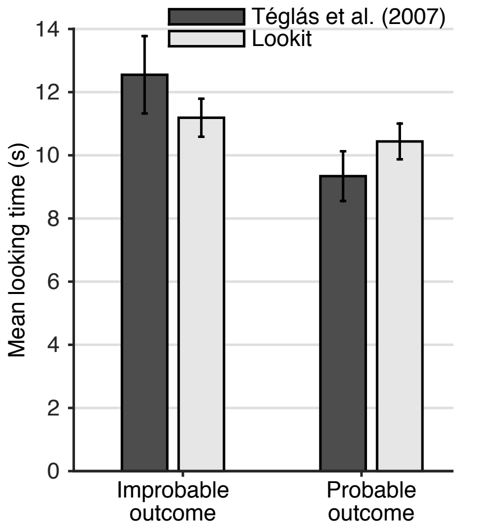
- Main measure: explicit judgment
- Performance very similar to the original results
- Novel-object performance is slightly worse, probably largely due to non-responding



Test study results

Oneshot probability: 12-month olds look longer at less probable events, even without prior experience

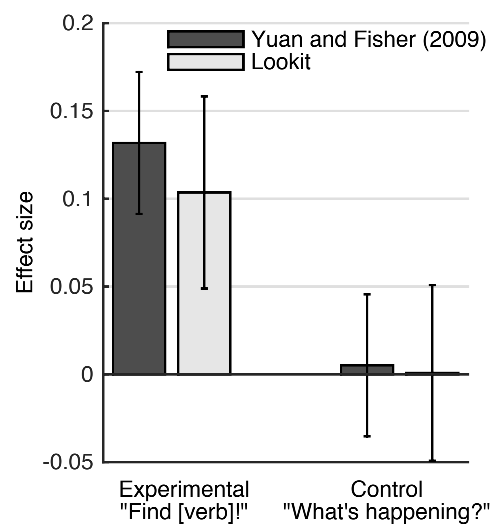
Looking time, 49 infants



Téglás, E., Girotto, V., Gonzalez, M., & Bonatti, L. L. (2007). Intuitions of probabilities shape expectations about the future at 12 months and beyond. Proceedings of the National Academy of Sciences, 104(48), 19156-19159.

Syntactic bootstrapping: 2-year-olds use combinatorial information about a new verb to interpret its meaning (semantic bootstrapping)

Preferential looking, 67 toddlers



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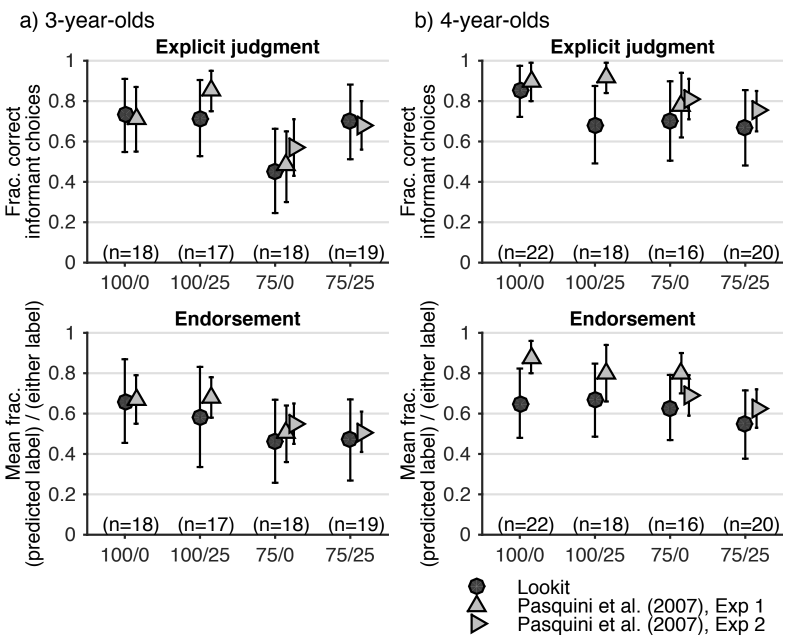
Trust in testimony: Preschoolers use past reliability of informants to choose whose labels of novel objects to identify who was more accurate and endorse her labels

Verbal responses, 148 preschoolers



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Yield: online vs. in-lab

- Overall yield (included sessions / all non-repeat sessions): 26%
- **Mostly** due to online-specific issues early in (or before) data collection - but also more variation in behavior/interference
- Looking time study
  - Lookit: excluded 56% (18% for parent interference or technical issues, 38% due to infant behavior)
  - Téglás et al. (2007) excluded 50% due to infant behavior
- Preferential looking study
  - Lookit: excluded 51% (practice trial performance 36%, 10% parent interference, 5% attention)
  - Yuan & Fisher (2009) only excluded 10% due to all causes
- Verbal response study
  - Lookit: excluded 37% (20% for incorrectly naming familiar objects, 17% for insufficient answers to test questions)
  - Pasquini et al. (2007) excluded 6%, due to familiar object performance
- Time cost is **still** lower to collect data online

	Study 1	Study 2	Study 3
Unique participants	269	329	399
Invalid consent	52	51	58
Out of age range	20	13	28
Unusable video	85	125	79
Potentially included	112	140	234

Range of video quality (early prototype)

Common exclusion criteria for **test studies**:

Invalid consent (16%)

Out of age range (6%)

Unusable video (29%) – of these, about

50% no video at all

15% incomplete

20% low framerate or too dark/blurry

1% eyes generally not visible on screen

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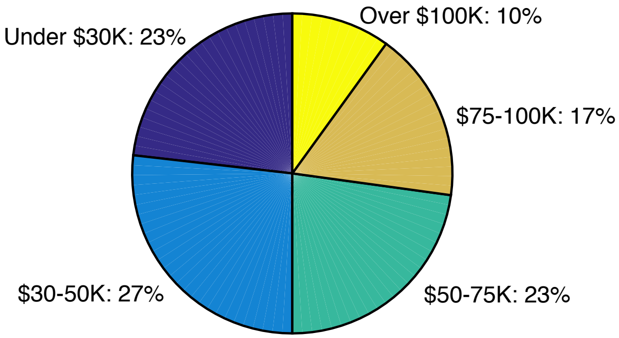
Participant demographics

Family income

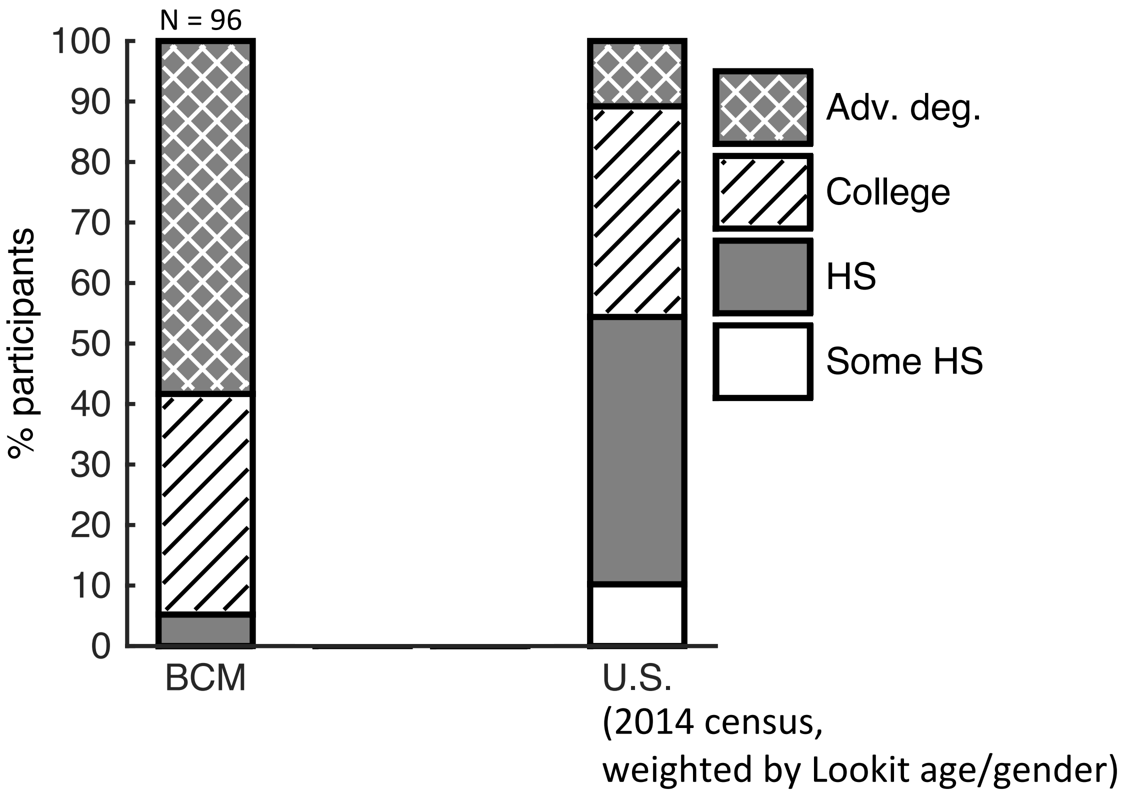


Race of child & Hispanic origin

	Lookit	US population
Hispanic	9.6	17.4
White	79.6	77.4
Black	7.1	13.2
Asian	1.6	5.4
American Indian, Alaska Native, Native Hawaiian, or Pacific Islander	0.4	1.4
2 or more races	11.3	2.5

- Based on 572 surveys (75% response rate) from families who gave valid consent to participate in at least one test study
- Almost all recruited from MTurk
- Languages:
  - 8% at least bilingual
  - 21 Languages represented: Arabic, ASL, Azerbaijani, Bengali, Chinese, Czech, French, German, Hindi, Hungarian, Japanese, Korean, Portuguese, Romanian, Russian, Spanish, Tagalog, Telugu, Turkish, Urdu, Vietnamese
- Still mostly moms (84%)

Participant demographics



Participant demographics

- Do demographic variables affect inclusion?
  - Logistic regression of whether each participant was included in the final sample (*N* = 176) or not (*N* = 345)
  - Predictors: income, maternal education, multilingual status, Hispanic origin, and White race as predictors
  - Model was not significant (chi-square = 1.71, *df* = 6, *p* = .89) and no individual predictors were significant (all *ps* > .2)
- Does SES affect "performance" within studies?
  - Preferential looking study: No correlation between practice-verb scores and SES measures (income, maternal education), n = 103
  - Verbal responses study: no effect of composite SES score on explicit judgment measure, n = 105

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Qualitative behavior coding

One of our postgraduate students kindly agreed to provide reliability coding for another postgraduate student, who had found null results in a visual habituation study. These two students had both been trained on lab procedures, including criteria for eliminating untestable infants. Despite this, their working definitions of excessive “fussiness” were apparently different, because as the reliability coder watched the videotapes she was surprised to see that a number of the infants completed their looking task while simultaneously squirming in their seats, making whining noises and in some cases overtly weeping.

For all looking studies, two coders recorded for each clip:

- **fussiness**
- **distraction**
- **parental interference,**

Slaughter, V., & Suddendorf, T. (2007). Participant loss due to “fussiness” in infant visual paradigms: A review of the last 20 years. Infant Behavior and Development, 30(3), 505-514.

Qualitative behavior coding

- For all looking studies, two coders recorded for each clip:
  - **fussiness**
  - **distraction**
  - **parental interference, specific to the study** (talking, peeking, pointing, etc.)
- Good intercoder agreement on judgments (for an initial coding scheme)

	Intuitive probability (113 infants)			Learning new verbs (141 toddlers)		
	Agreement	Cohen's κ	Frequency	Agreement	Cohen's κ	Frequency
Fussy (crying or trying to get out of parent's lap)	85%	0.55	13%	99%	0.42	1%
Actively distracted (lookaway caused by external event)	85%	0.40	10%	97%	0.37	2%
Parent's eyes open	98%	0.67	4%	97%	0.70	5%
Parent's eyes not visible	97%	0.35	4%	99%	0.91	7%
Parent peeks	90%	0.36	9%	90%	0.36	11%
Parent's eyes open briefly at very start of clip	77%	0.49	38%	93%	0.68	13%
Parent talks to child	98%	0.16	2%	95%	0.70	9%

Child attentiveness

Common concern: home is “noisier” than the lab…

Indeed,

- Distractions may be frequent enough (up to 10%) to require careful planning of analysis for looking time

BUT…

- Looking times similar to those found in lab (~10 s)
- Excellent attention (>80% looking) to dialogue videos during preferential looking study

Parent cooperation: looking measures

- Most parents report that they did keep their eyes closed (63%, 67%) or that they tried (28%, 25%).
  - "I always kept my eyes closed except for once when my child was moving the computer with his feet."
  - "yes, and she reprogrammed my laptop smashing keys."
  - "Looked when he said uh oh, just to make sure he wasn't talking about his siblings"
  - "Well, I did until my 6 year old came in unexpectedly. Sorry"

- But never peeking was hard: 22% of parents peeked during at least one test trial, including 10% of parents who said they didn't.

Data we can collect

Looking time (looking vs. not) blind coders agree 95% of the time (N = 112 children, SD = 6%)

- Two blind coders record whether the child is looking to or away from the screen (or that direction of gaze can't be determined) using VCode.
- Starts/ends of looks adjusted to the nearest frame; trials with substantial disagreement (looking times differing by >= 1 s) recoded.

Data we can collect

Looking time (looking vs. not)
blind coders agree 95% of the time (N = 112 children, SD = 6%)

Preferential looking (right vs. left)
Blind coding done close to real-time; mean disparity between coder's judgments of looking time to left/right is 4% of trial length (SD = 2%, N = 140 children)

- Two blind coders record whether the child is looking left, right, or away from the screen (or that child's eyes are out of frame) using VCode.
- Three calibration trials informally used as a reference; in all 140 coded videos, children look more to the "correct" than incorrect sides of these videos on average.
- First round of coding is done close to real-time; trials with substantial disagreement are recoded frame-by-frame.

Looking measures: lessons learned

Can reliably code looking time & preferential looking from webcam!

Advice:

- Have parents hold children looking over their shoulder
- Play audio to confirm the next segment has indeed started properly
- Use parents rather than recorded audio if possible
- Let parents see all the stimuli ahead of time if they want to and clearly explain why this is important
  - "I admit I got suspicious when I had to close my eyes because [Child] would start responding out loud to whatever was on the screen. But I kept them closed! Everything ran great."
  - "I peeked a tiny bit but was careful to make no reaction. Even though I am sure that you are a reputable research group, as a parent, I feel that it is my responsibility to monitor what she is watching and seeing."
  - "I opened them once to make sure my child was being shown appropriate things (people are strange out there!)"
- Use methods robust to distractions
  - preferential looking over looking time where possible
  - hierarchical linear models or Bayesian analysis to deal with missing trials

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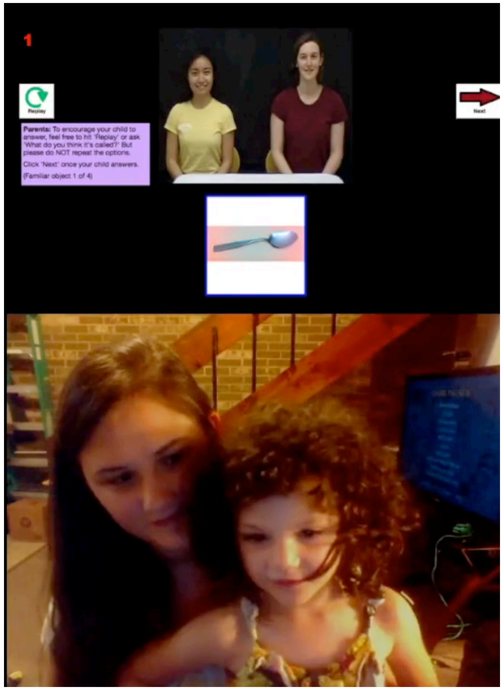
Data we can collect

- Parent and child speech transcribed
- Parent interference and interaction types recorded
- Only responses given before any parent interference are used.
    - What do you think, mom? [I want your answer, not what mommy thinks.] **Red**.
    - I don’t know how to say those words. [Try it, which one are you trying to say? What do you think it is?] I don’t know how to say those words. [Just try it, you're doing good. Try to pronounce it.] I can't, I can't though. [Okay. Do you want to listen to it again?] Yeah. [REPLAY.] A **toma**? [Then say it again...] A toma!
    - [What do you think it's called?] **A duck**. [What do you think that is?] A spoon. [A spoon] It's not a duck. [It's not a duck it's a spoon.] Yeah
    - Um. [Which one? What colour? Yellow?] Yeah



Verbal responses

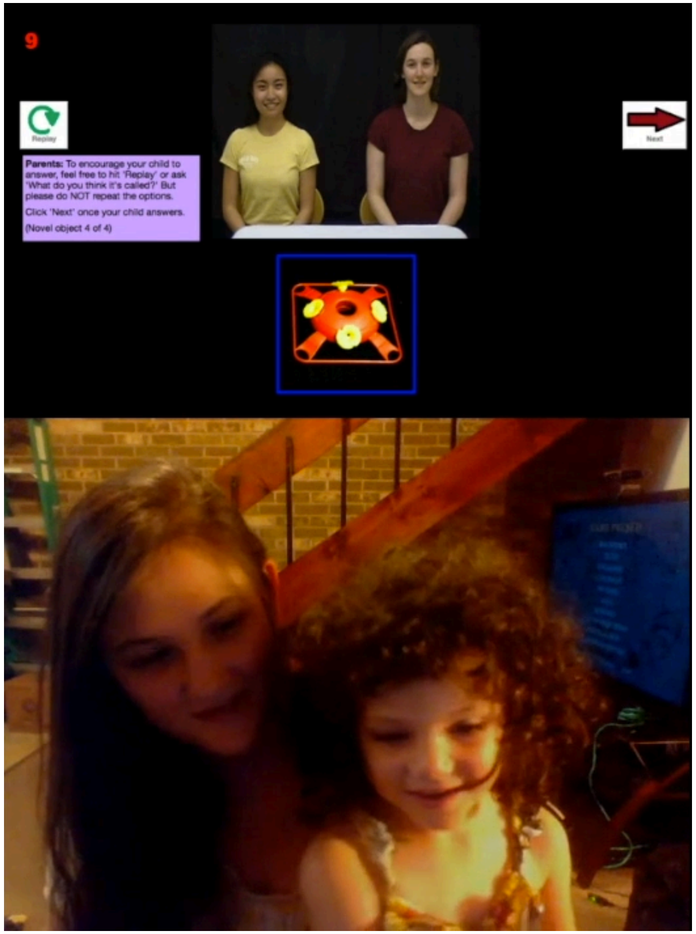
Recorded questions asked to children, with parent instructions for prompting (125 three-year-olds, 109 four-year-olds with usable video)

Lessons learned: verbal responses

Can collect verbal responses online!

Advice

- Main challenge is non-responses
- Encourage responses
  - Involve the parent where possible rather than asking the child to respond directly to the computer
  - Give computer-based contingent responses (even if that’s just “Okay, a modi!”)
- Design studies to be robust to non-responding on individual questions
  - Many short, independent questions
  - Analysis to use whatever evidence you get
- Show parents exactly what to do/what to avoid
  - Include video examples if possible
  - Give practice trials before data is critical



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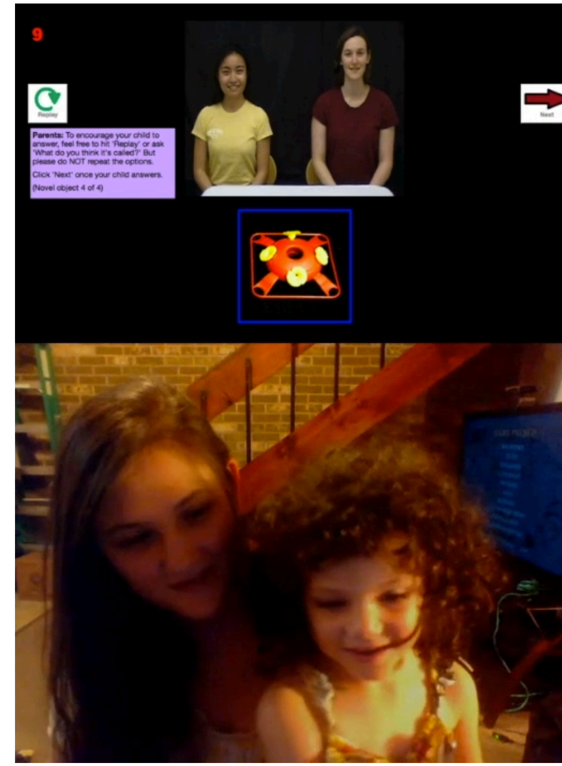

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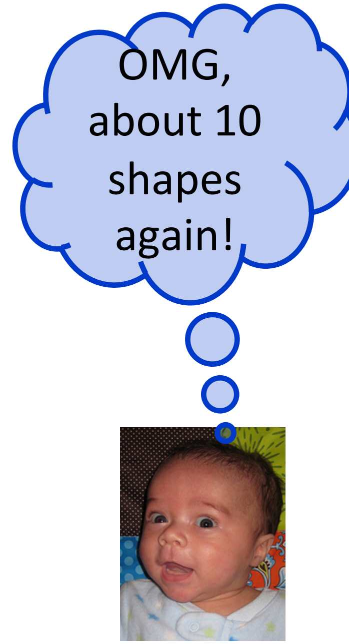
Sample use case: individual profiles

Why get more data from individual babies?

- Understand our methods: how much does a child's *expression* of competence depend on…
  - Behavioral/emotional states
  - General looking behaviors?
- Understand other findings: What does "13 out of 16 infants" mean?
- Learn how abilities relate to each other: do babies need to be able to do X before they can do Y?
- Learn what partial knowledge of a domain looks like (e.g. incorrect vs. weak prediction)
- Connect behavioral and brain measures



Dense measurements of intuitive physics judgments

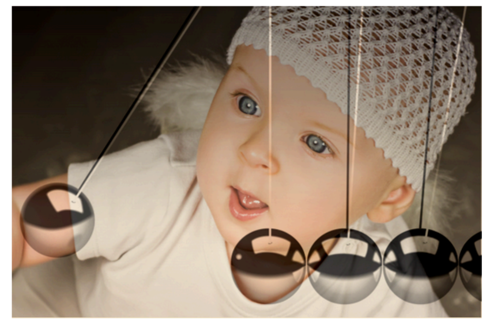
Ongoing study: “Your baby, the physicist”

- 50 infants (4- to 12-months) participate online in a preferential looking study
- Each trial: introduce an object, then show a pair of more- and less-surprising events (loosely related to gravity, inertia, and support)
- Control measures about looking patterns interspersed
- Repeated measures: 24 trials per session, 15 sessions over 1-2 months.
- Also collect mood survey

Lookit | Studies | FAQ | The Scientists | Resources | Contact Us | Login

Participate in "Your baby the physicist"

Back to list



Thank you for your interest in this study! We'll help you learn more and get started.

Log in to participate

Eligibility criteria: For babies between 4 and 12 months old at first session

Age range: between 4 months and 14 months

Duration: 15 minutes

What happens: Your baby watches pairs of short videos of physical events. On one side, something pretty normal happens on one side: e.g., a ball rolls off a table and falls to the round. On the other side, something surprising happens: e.g., the ball rolls off a table and falls UP! Where your baby chooses to look can tell us about his or her expectations of how the physical world works. To better understand individual children's responses, we especially need dedicated families to complete multiple experiment sessions. If you complete 15 sessions in two months, we'll be able to send you a personalized report about your child's looking patterns once video coding is done!

What are we studying?: Although your baby (probably) isn't ready to study physics, he or she is already learning the basics: Should things fall up or down or not at all? Should they keep going once they start moving? We're trying to understand how these sorts of beliefs relate to each other, whether babies pass through discrete "stages" of understanding, and how much individual babies' moods and "looking personalities" affect their responses.

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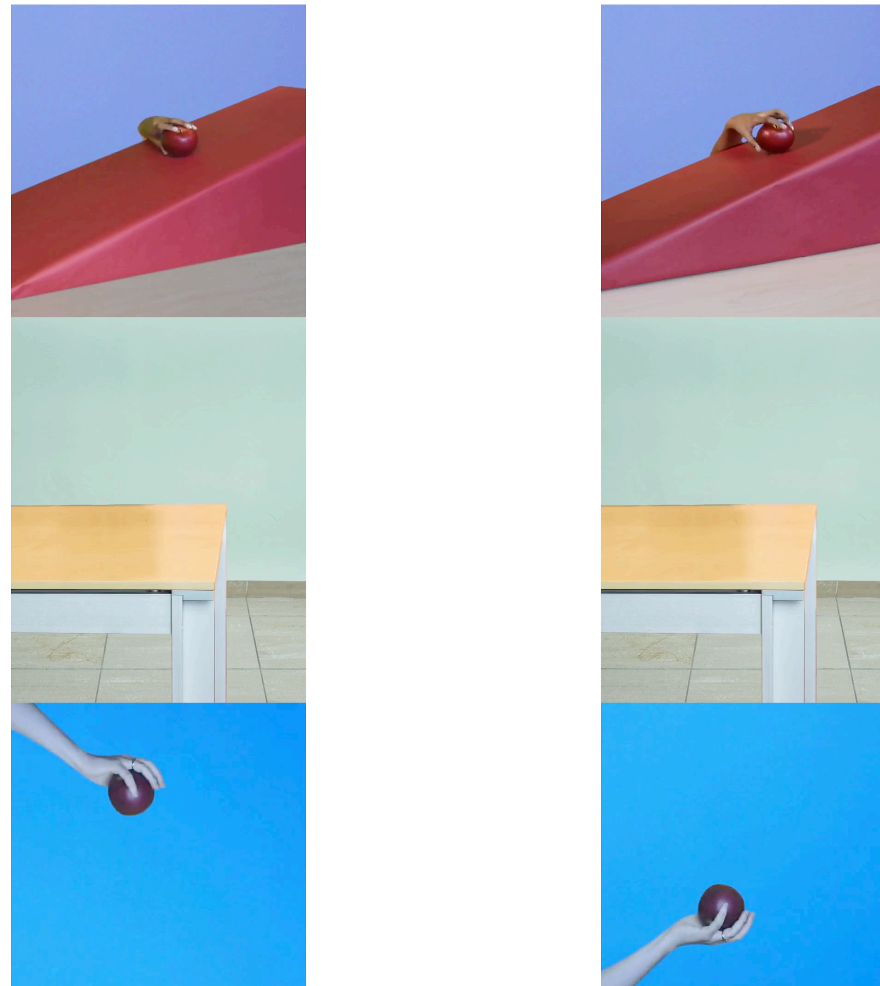
Gravity comparisons



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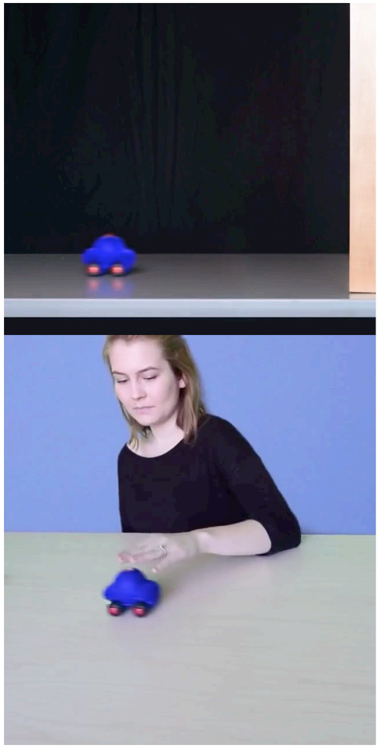
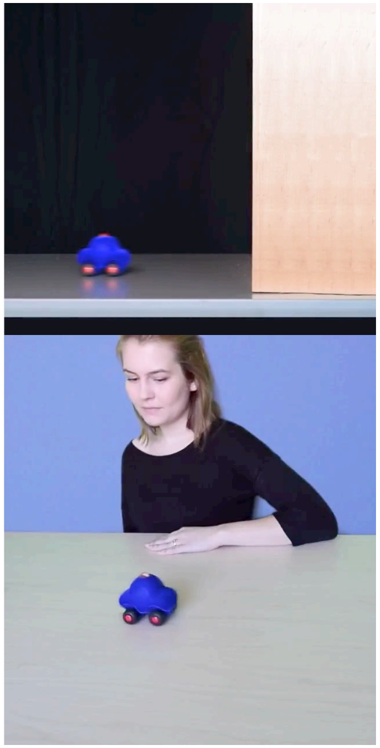
Inertia comparisons





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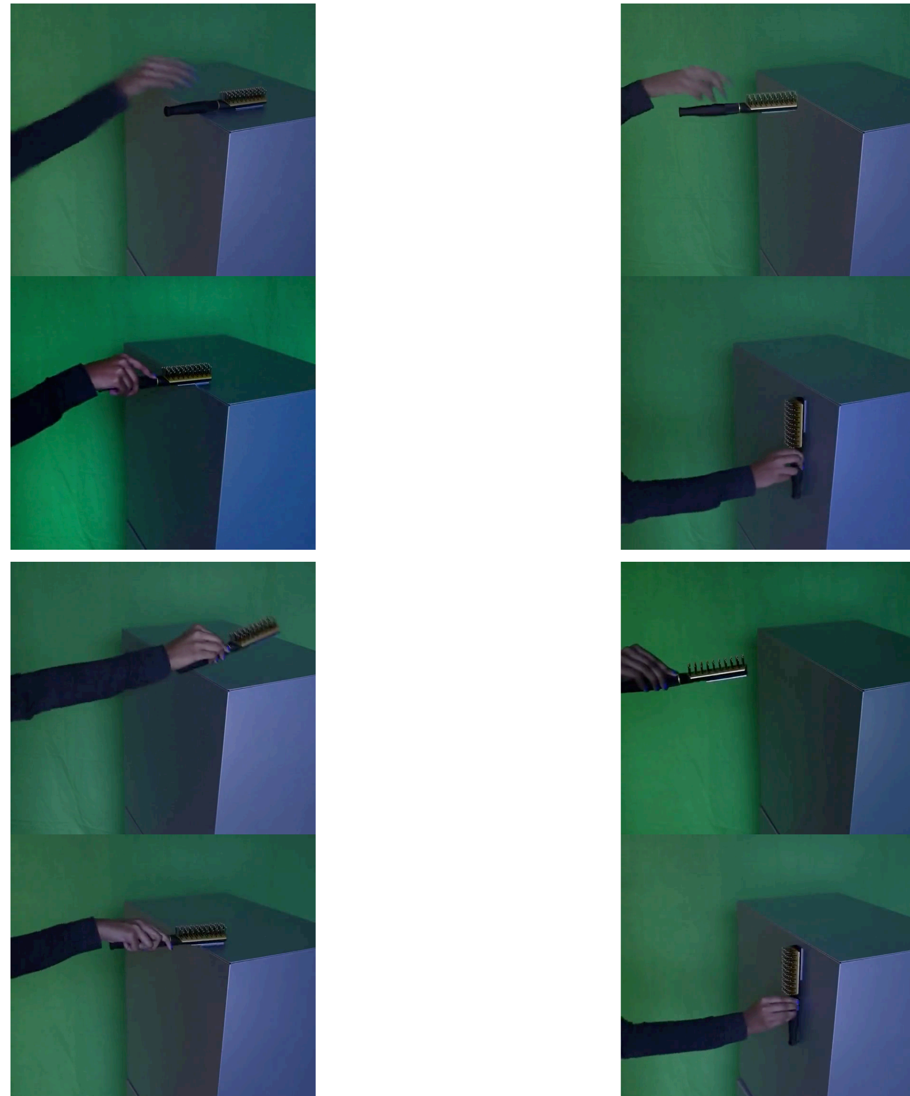
Support comparisons

Stay

Fall



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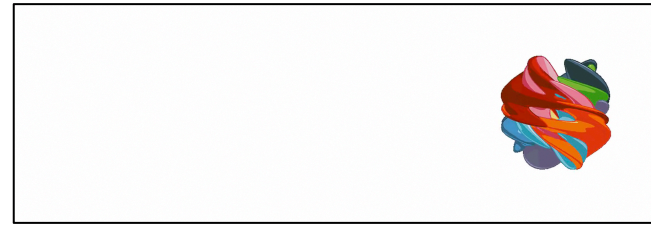
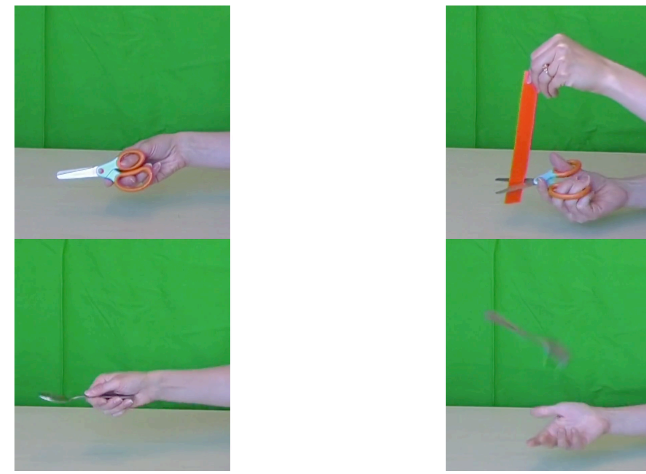
Calibration



Salience



Similar

Dense measurements of intuitive physics judgments

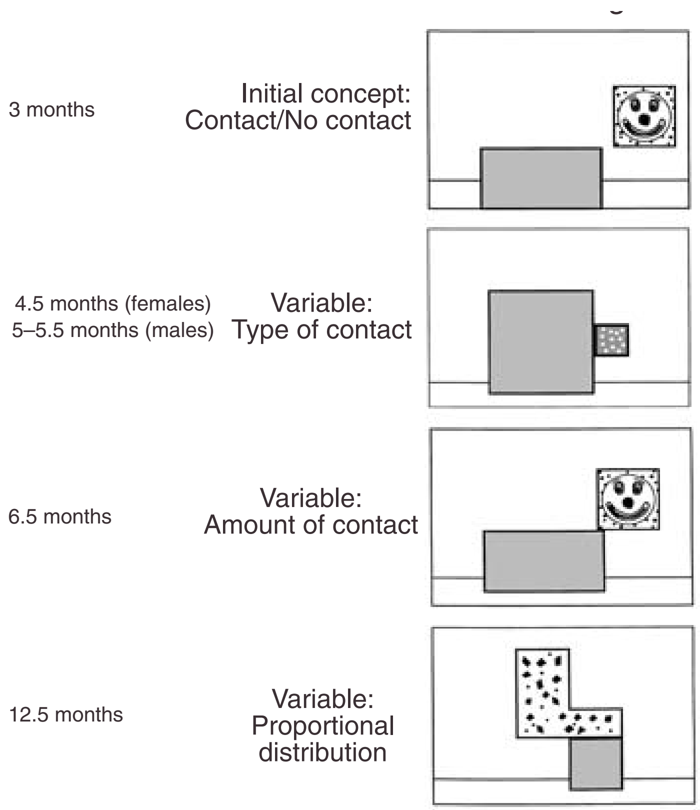
Exact clips vary:

- multiple objects
- camera angles
- backgrounds
- L/R position
- flipped individual clips

(1264 unique side-by-side videos)

Dense measurements of intuitive physics judgments

- How stable are kids' looking patterns across sessions?
  - Individual components
  - Differences among tasks
  - How much can controls – stickiness, sensitivity – explain variation? How do these relate to measures of mood?
- Overall structure of tasks
  - Gravity, inertia, support: do responses cluster by "concept"?
  - Are support responses consistent with a rule-based account? (exploratory)
- From children with at least one session: tighter bounds on age-grouped performance and task correlations

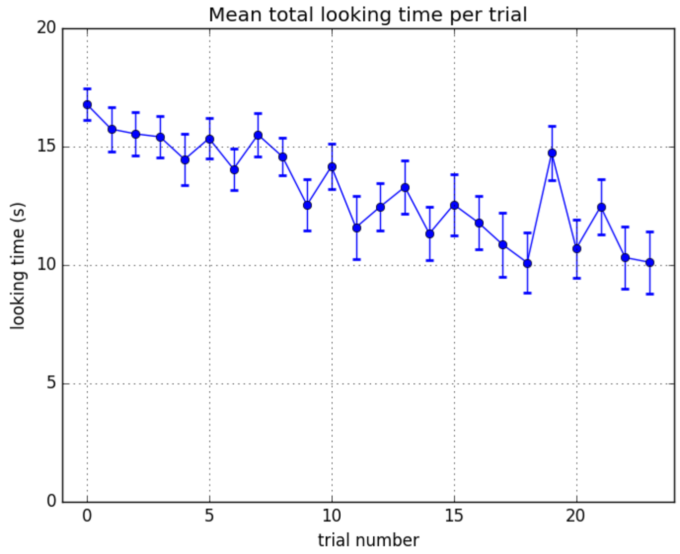


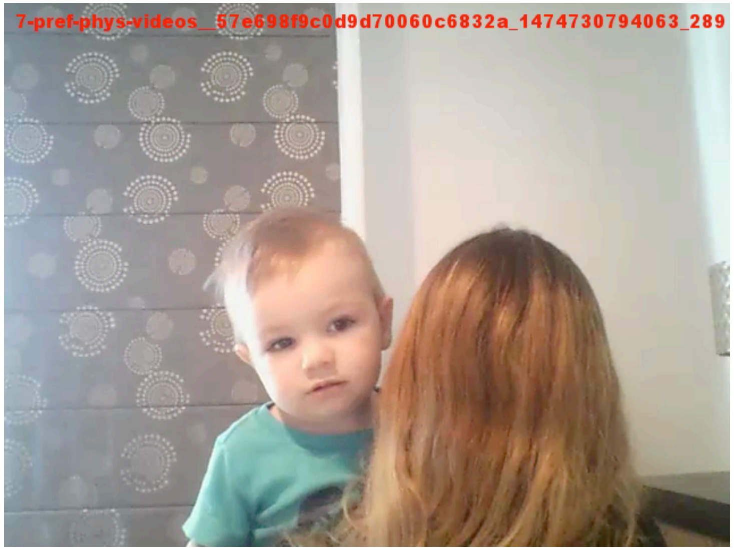
Baillargeon, R. (2002). The acquisition of physical knowledge in infancy: A summary in eight lessons. Blackwell handbook of childhood cognitive development, 1, 46-83.

Dense measurements of intuitive physics judgments

Current status:

- Completed piloting this fall to check overall length of study reasonable, calibration and salience controls work
- Recently started data collection: 14 participants, 3 subjects with at least 10 sessions completed





Outline

Overview of the system / demo

Lessons learned from early test studies

- Test study protocols / results
- Yield
- Demographics
- Looking measures
- Verbal responses

Example use case: dense longitudinal measurements online

Status & ongoing work on the experimenter platform

Next steps: a platform for everyone

CENTER FOR OPEN SCIENCE

- Currently working with the Center for Open Science on web development
- Vision: large, collaborative online lab where any researcher can post studies & collect data about early childhood development
- Committed to open-source development and to encouraging data and protocol sharing
- Current platform includes experimenter interface for study management, simple JSON schema for describing studies

Code:

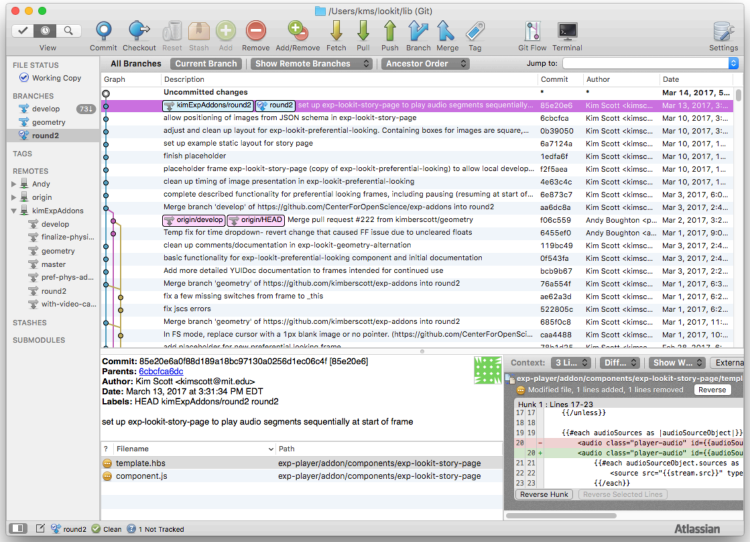
https://github.com/CenterForOpenScience/lookit

https://github.com/CenterForOpenScience/experimenter

What we're working on

Functionality still needed:

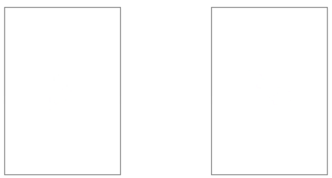
- **Graded permissions for accounts on Experimenter**
- **Expanded set of well-documented, ready-made frames for experiments**
- Siloing code for studies from various groups
- Improved testing functionality within Experimenter
- Export a static version of an experiment
- More options for displaying studies to parents
- Participant email functionality
- Tools for viewing and basic processing of data
- Eventually: switch from Flash to HTML5 video; support mobile devices; support payment to participants



What we’re working on

Expanded set of well-documented, ready-made frames for experiments

Geometric concepts
Preferential looking
Alternation paradigm

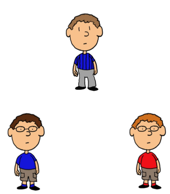


With Molly Dillon & Liz Spelke

Labels & concept formation
Preferential looking
Looking-while-listening paradigm

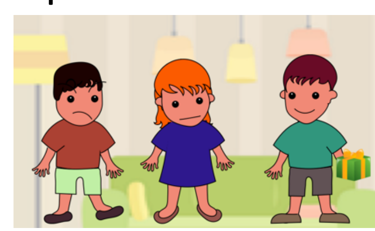
With Bria Long & Mike Frank

Ingroup/outgroup moral obligations
Verbal responses



With Lisa Chalik & Yarrow Dunham

Judgments of politeness
Verbal responses



With Erica Yoon & Mike Frank

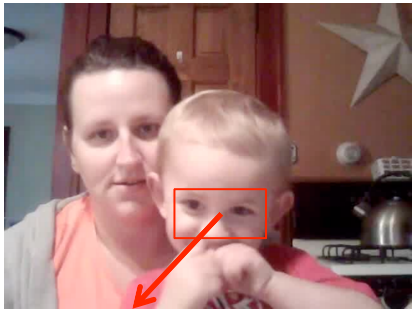
Looking ahead: directions & challenges

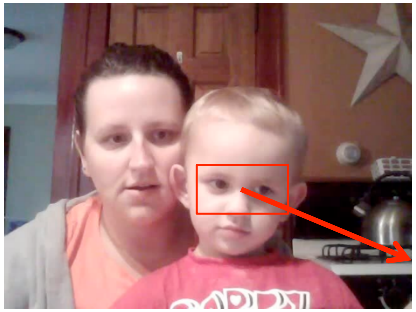
Recruitment

- Plenty of parents on the internet & discussing their kids (Facebook, BabyCenter, CafeMom, …) – how to reach them & get them engaged with research?
- Economies of scale in recruitment if we can build a large userbase for the shared platform

Automated gaze coding

- Remaining bottleneck for infant studies is gaze coding (looking time, preferential looking)
- Automated coding will also enable online contingent displays
- Existing algorithms don't quite work on infant videos (movement, etc.) – but possibly would with minimal human input!





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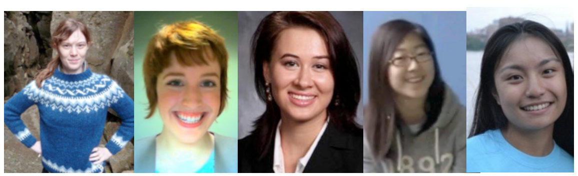
many thanks to

participating children and families on Lookit and at the Boston Children's Museum!

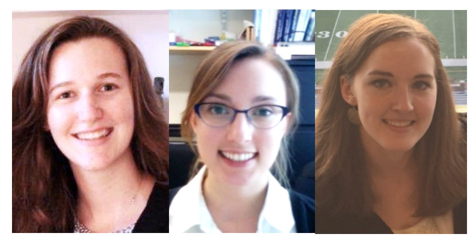
Undergraduate research assistants: Katy Hanling, Vivienne Wang, Jean Chow, Rianna Shah, Annie Dai, Jean Yu, Daniela Carrasco, Hope Fuller-Becker, Junyi Chu, Joseph Alvarez, Audrey Ricks, Jessica Zhu



Melissa Kline and 9.S93 students who made stimuli: Emily Lydic, Larissa Pachuta, Tina Zheng, Alice Lu

Kris Brewer

Laura Schulz
Liz Spelke
Josh Tenenbaum
Rebecca Saxe



ECCL lab managers:
Rachel Magid
Sammy Floyd
Kary Richardson

Cynthia Fisher, Kathleen Corriveau, and Ernő Téglás who graciously shared original stimuli and/or data

Early Childhood Cognition Lab

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