Infants' sensitivity to costs and benefits

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- Part I: Infants' registration of the costs in others' action

- Part II: Infants' use of costs and benefits to guide their prosocial behavior

Physical effort as cost

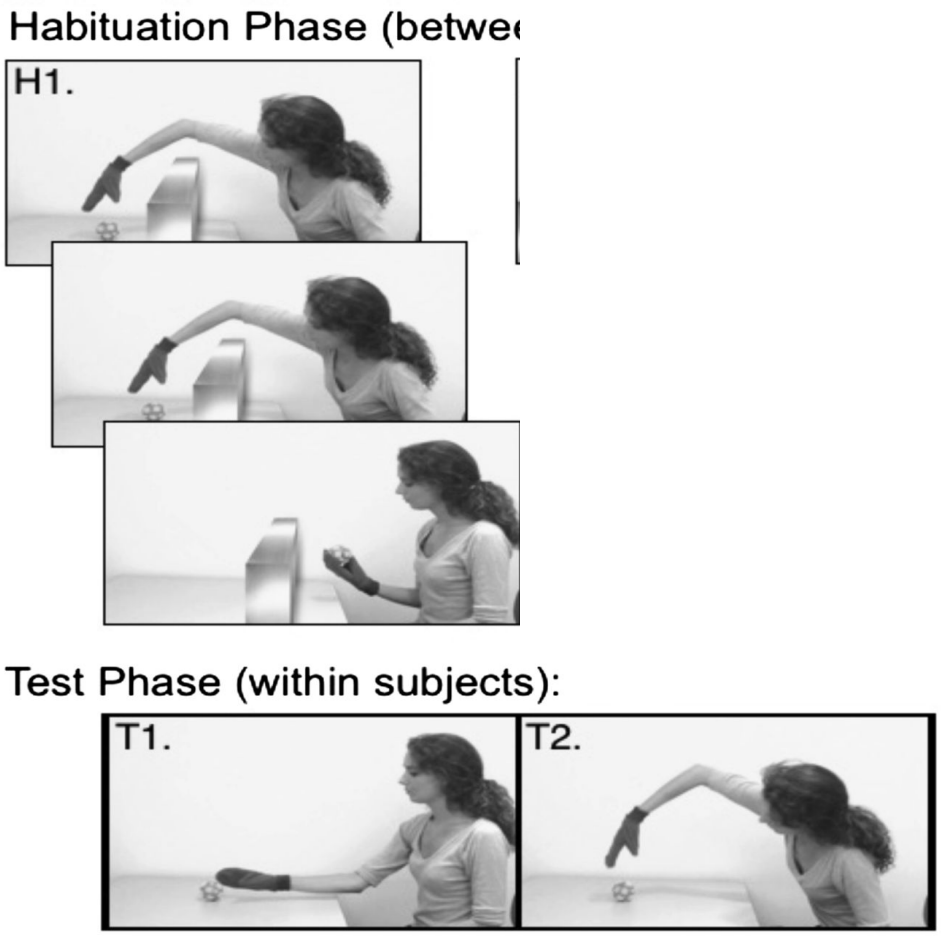
- Minimizing reliance on energetic resources is an important part of survival
- Law of least effort
- Non-human animals engage in cost-benefit decision making where effort is calculated as a cost
- Adults seek to minimize physical and cognitive effort and engage in cost-benefit trade offs

Do infants register costs?

- Evidence of cost registration and minimization in infants' own behavior
  - Infants prefer light to very heavy blocks

- Evidence of cost registration in other's actions
  - Infants expect efficiency in others' action

Do infants register costs?



Registering effort-related costs

Registering effort-related costs

- 12-month-old infants (*N* = 23)

- EEG turn-taking procedure:
  - Action & Observation trials:
    - 70 g., 470 g., 770 g.
  - Baseline trials
    - Checkerboard

Upshaw, Bernier & Sommerville (2015). Developmental Science.

Registering effort-related costs

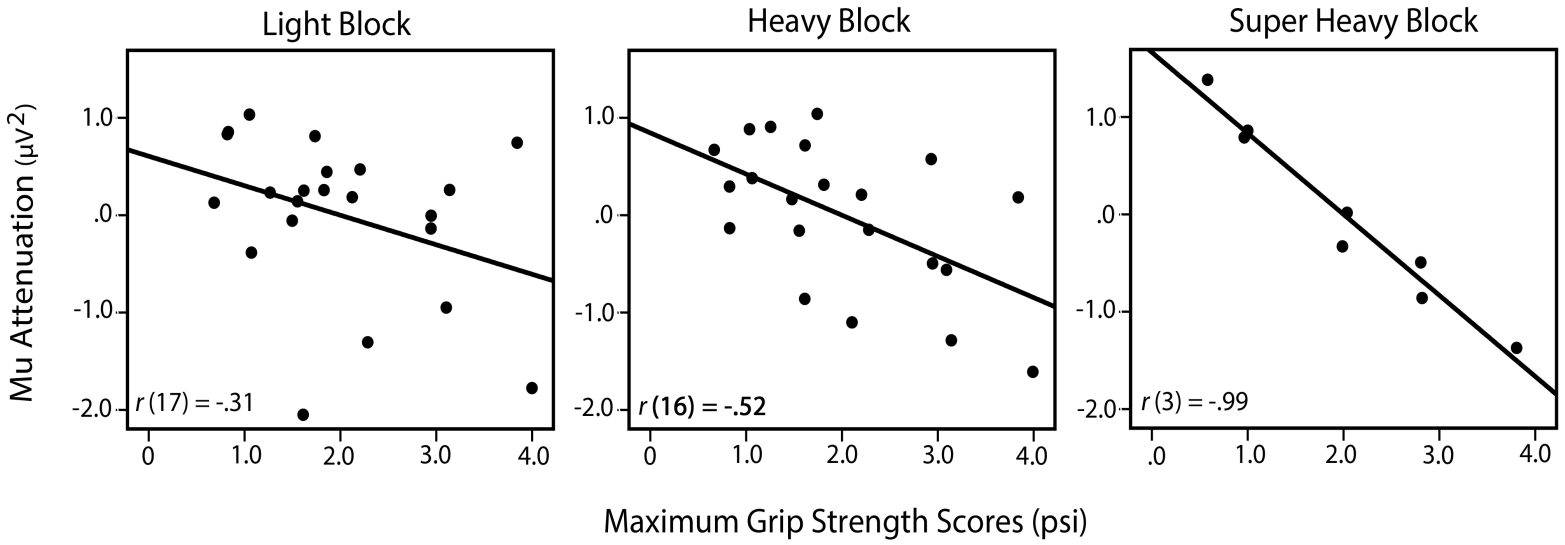
- Looked at suppression of sensorimotor alpha rhythm (mu attenuation)
- At rest, sensorimotor neurons fire spontaneously in synchrony which leads to large amplitude EEG oscillations in the alpha frequency band
- When sensorimotor cortex is activated (via action execution or observation) there is a decrease in the power of sensorimotor alpha oscillations
- Measure of sensorimotor cortex activation

Registering effort-related costs

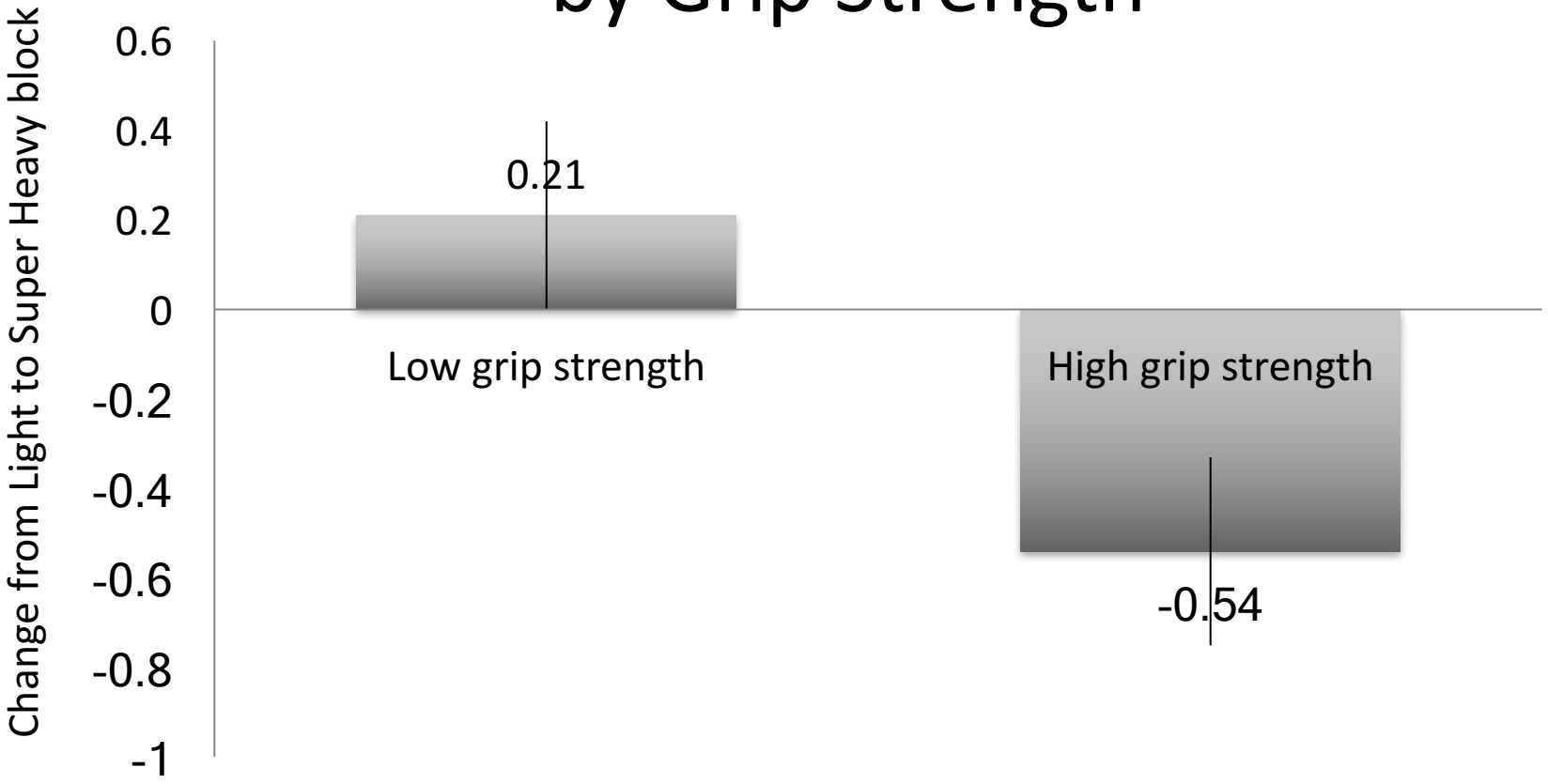
- Grip strength assessment
  - Infants' maximum grip strength
- Also measured:
  - Infants' weight
  - Motor skills checklist
  - Frequency of block lifts in task

Upshaw, Bernier & Sommerville (2015). Developmental Science.

Sensorimotor Alpha Suppression during Observation of Block Lifts and Grip Strength (by block weight)



Changes in Sensorimotor Alpha Suppression during Observation of Lifting by Grip Strength



Infants' registration of effort-related costs

- Activation of sensorimotor cortex during observation of weight block lifts varies as a function of block weight
  - Recognition of the differential degrees of effort associated with lifting blocks of different weights

- Infants' ability to make this distinction is tied to their own strength
  - Strength likely gates their experience lifting heavy objects which may have implications for their ability to recognize effort associated with objects of different weights

- Part I: Infants' registration of the costs in others' action

- **Part II: Infants' use of costs and benefits to guide their prosocial behavior**

Prosocial behavior

- Infants are highly prosocial
- Two questions/debates:
  - When does prosocial behavior become selective/strategic?
    - Early or late
  - What is the underlying motivation for prosociality?
    - Need based (empathic concern), social affiliation, goal completion, etc

Prosocial behavior

- Impact of costs on infants' prosocial behavior is not well studied or understood
  - Personal costs: mixed evidence
  - Energetic/physical costs: understudied

- **Will anticipated physical effort influence infants' prosociality?**

Effort-related costs & infants' helping behavior

- 18-month-old infants (N = 48; 24/condition)
- Training phase: infants lift increasingly heavy blocks (170 g.; 1970 g. to 2720 g.)
- Test phase: experimenter on opposite side of room needs block to complete a tower
  - Low effort condition: lightest block left behind (170 g.)
  - High effort condition: heaviest block infant can lift left behind (1970 g. – 2720 g.)

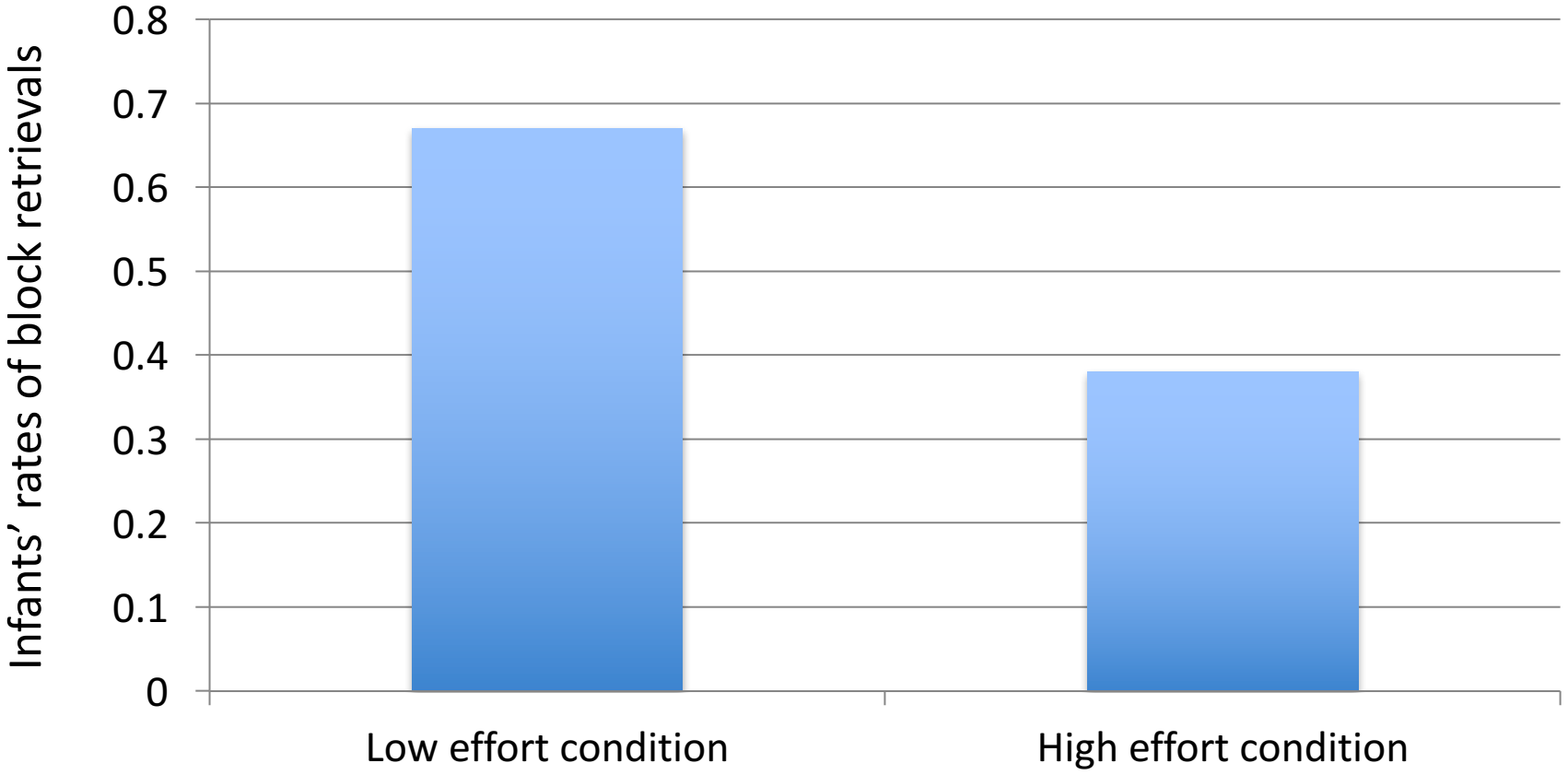
Effort-related costs & infants' helping behavior

- Coded block retrievals – carrying block to experimenter
- Recorded infants' walking experience (months walking)
  - Carrying a heavy block across a room is more effortful for less versus more experienced walkers
  - Predicted either a selective relation between walking experience and block retrievals in high effort condition, or a stronger relation

Low effort condition

High effort condition

Infants' block retrievals



X^2 (1, N = 48) = 4.09, p = .043, ϕ = .29

- Walking experience significantly predicted infants' block retrievals in the high effort condition, *OR* = 2.12, p = .016, (95% CI 1.15 - 3.90), but not the low effort condition, *OR* = 1.10, p = .72, (95% CI .67 – 1.81).

Effort-related costs & infants' helping behavior

- Infants are less likely to help under high effort conditions
  - The fact that infants can lift the target block suggests that it is effort not ability that governs their performance
- Costs operate at both an "objective" level (heavy blocks are generally harder to carry), and a "subjective" level (exact costs are further defined by individual differences; e.g., walking experience)

Intrinsic benefits & infants' helping behavior

- Is infants' willingness to engage in high effort prosocial behavior influenced by the motivational benefits of prosocial responding?
- Early prosocial responding appears to be immune to extrinsic rewards
- Intrinsic rewards?
- Infants possess affiliative biases for similar or "ingroup" members
  - Functional consequences: important for cultural learning

The impact of benefits on infants' helping behavior

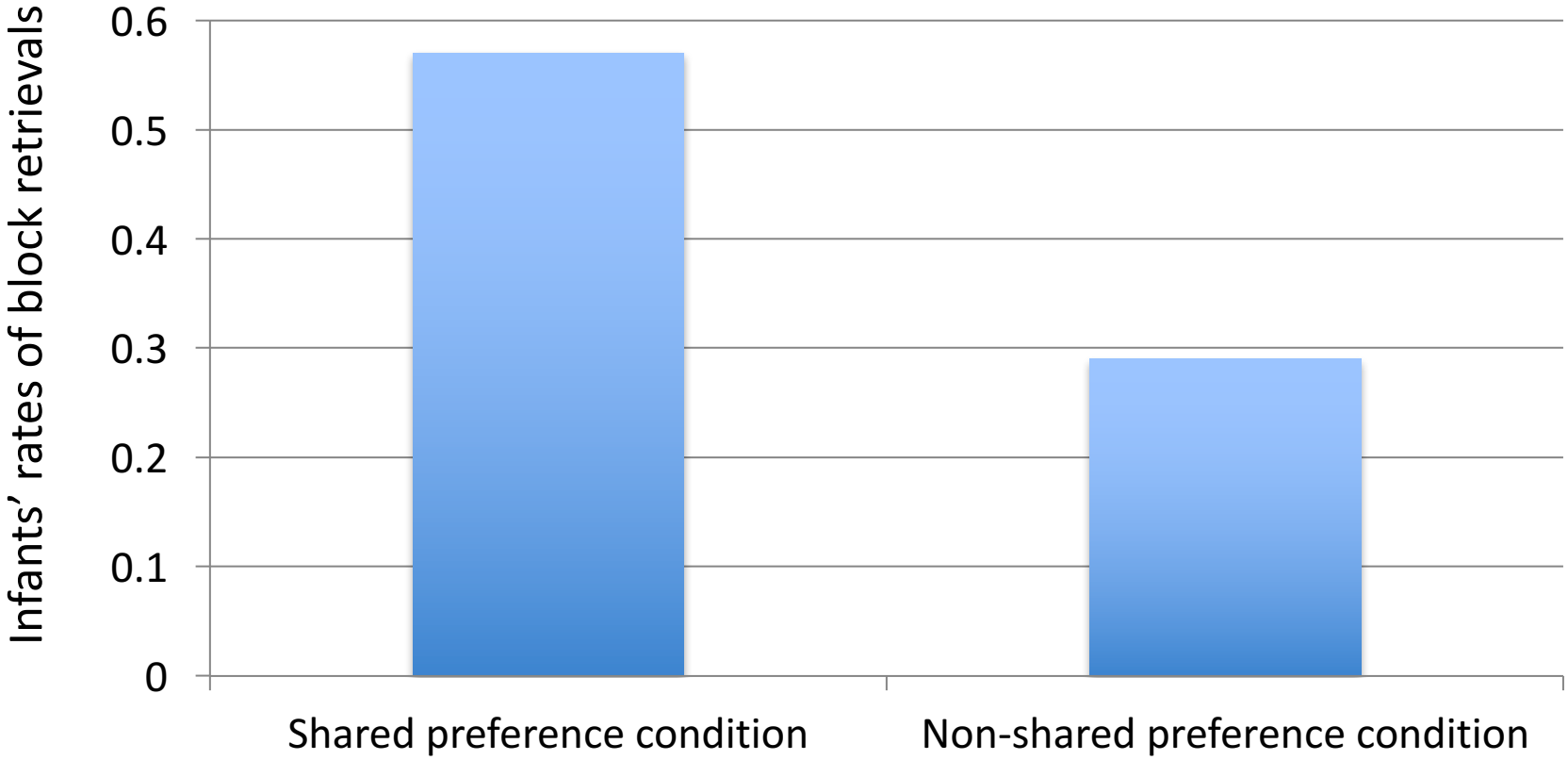
- 17.5-month-old infants (N=56; 28/condition)
- Training:
  - Infant chooses one of two toys
  - Experimenter shares their toy preference or does not
- Test phase: experimenter on opposite side of room needs block to complete a tower
  - For infants in both the shared or non-shared preference conditions 2220 g. block is left behind
- Post-test phase: infants encouraged to lift increasingly heavy blocks (2220 g., 2570 g., 2720 g.)

The impact of benefits on infants' helping behavior

- Coded infants' block retrievals
- Recorded infants' walking experience (months walking)

- Investigated helping as a function of the response period
  - First half vs. overall
  - Early differences that attenuate over time suggest differences in degree of motivation to help

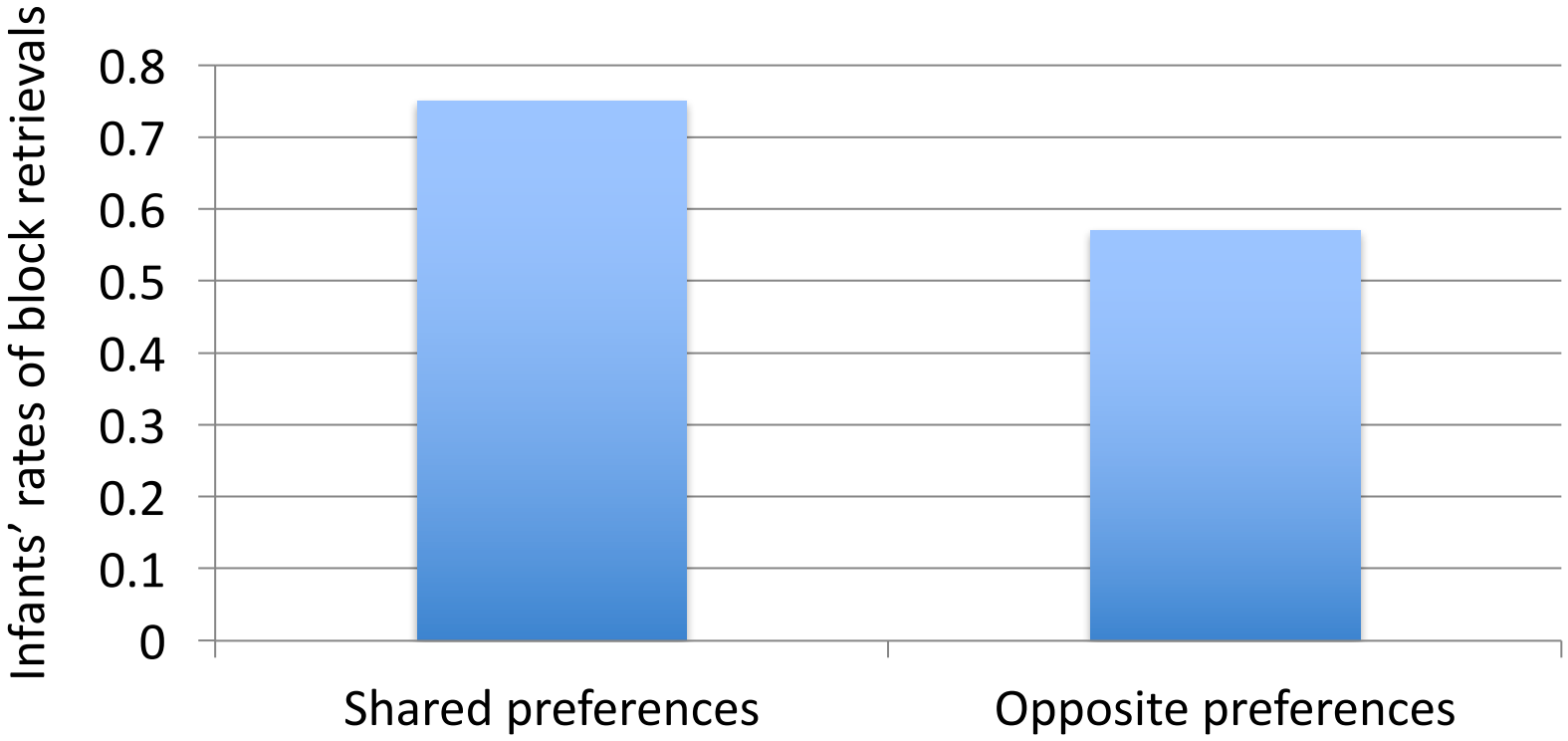
Infants' block retrievals: First half



X^2 (1, N = 56) = 4.67, p = .031, ϕ = .29

- Walking experience significantly predicted infants' block retrievals in the non-shared preference condition, *OR* = 1.88, p = .033, (95% CI 1.05 - 3.36) ; but not the shared preference condition *OR* = 1.45, p = .151, (95% CI .87 – 2.41).

Infants' block retrievals: Overall



X^2 (1, N = 56) = 1.91, p = .158, ϕ = .19

Intrinsic benefits & infants' helping behavior

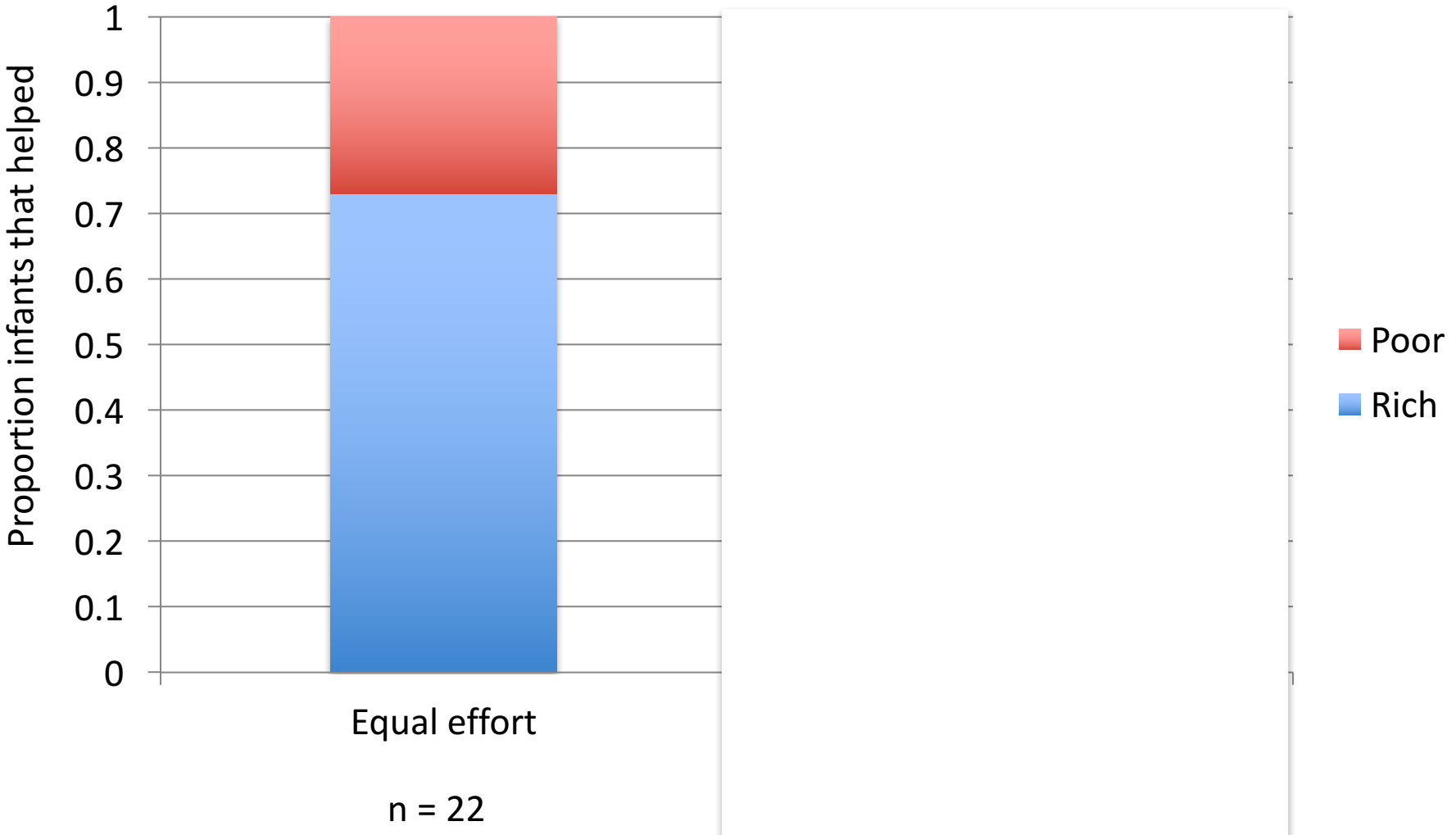
- Infants' willingness to engage in high cost helping is affected by intrinsic motivational factors
  - Infants are more likely to carry a heavy block to help someone who shares their preferences (versus someone who does not)

Cost-benefit trade offs in infants' helping behavior

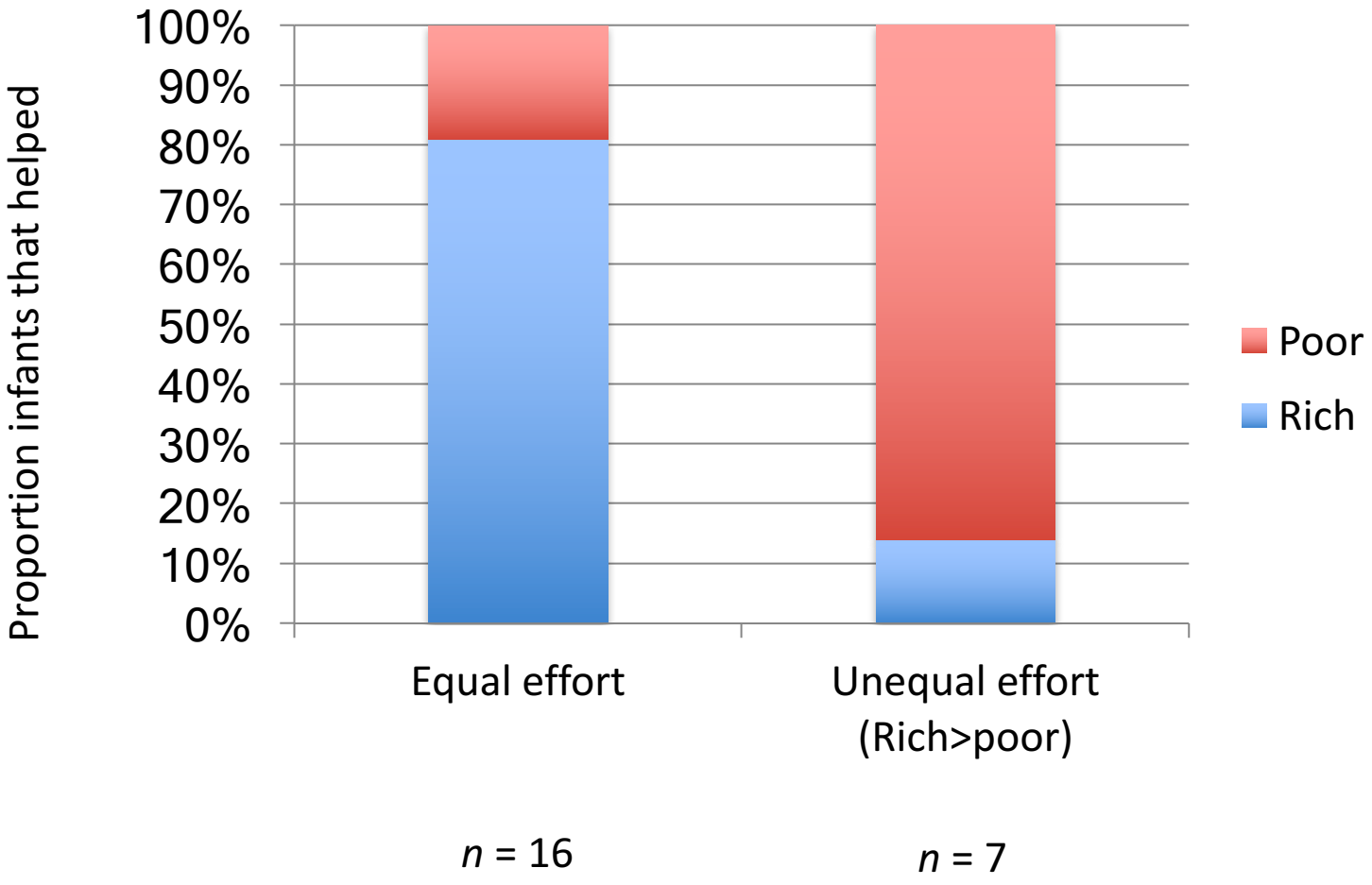
- Expanding the scope of benefits: Rich vs. poor experimenters
  - Young children (3- and 4-year-olds) share more with rich versus poor recipients; affiliative bias toward rich individuals
  - Receive prior information that one actor has a lot of resources and one actor has few resources

- Equal effort vs. unequal effort (short vs. long walk)

Infants' block retrievals by wealth and effort



Infants' block retrievals by wealth and effort



Implications for infants' prosocial behavior

- Cost-benefit analyses underlie infants' helping behavior
- By 18 months infants' prosocial behavior is "strategic" in the sense that they appear to minimize costs and maximize motivational benefits
- Underlying motivation to help is influenced by a tendency to want to affiliate with certain individuals

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Future questions

- Identifying “currency”
  - What counts as a cost and a benefit?
- How are costs “read”?
  - Some costs may be obvious from the get go; others experientially derived
- Do infants have a category of costs?

Acknowledgements

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Resource: Brains, Minds and Machines Summer Course

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