Primary School Children's and College Students' Recency Effects in a Gaming Situation

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- When people consider probability they use heuristics (intuitive reasoning) and they are susceptible to many biases (e.g. Kahneman, Slovic & Tversky, 1982)
- The adaptive value of heuristic/intuitive modes of reasoning has been documented (Gigerenzer & Todd 1999; Evans & Over 1996).
- From a psychological point of view, heuristic processing may lead to better reasoning or better decision making.

- Teachers of statistics and mathematics have to deal with the following matter:
  - students use intuitions when dealing with probability that has a cognitive foundation
  - sometimes intuition coincides with scientifically accepted statements, but sometimes it may contradict them (Fischbein & Gazit 1984)
  - some probability rules are *counter-intuitive*
- Probability is a hard subject to learn and to teach (Fischbein 1975; Kapadia & Borovcnik 1991; Shaughnessy 1992).

- **Representativeness heuristic:** People estimate the likelihood of an event by taking into account how well the event represents its parent population.
- The application of this heuristic can cause some predictable errors (biases) in certain situations (Kahneman & Tversky, 1973):
  - Negative recency effects
  - Positive recency effects

Negative Recency Effect (*Gambler's Fallacy*)

?

Gambler's fallacy

(regardless of the base-rates & the independence of the events)

Positive Recency Effect (*Hot Hand Fallacy*)

?

Hot Hand fallacy

(regardless of the base-rates & the independence of the events)

- Studies that have investigated age related trends in **recency effects** (Fischbein, & Schnarch 1997; Chiesi, Primi & Gronchi, 2007) have shown that:
  - **Negative recency effect:** The effect of age has not been completely clarified.
  - **Positive recency effect:** From the age of ten this effect is almost absent whereas eight-year-old children show this bias.

Aims

- To investigate recency effects in a gaming situations
- To describe primary school children's ways of handling probability issues
  - independence of events
  - base-rates

  that have been introduced in mathematics curricula* at the Italian fourth and fifth Grade primary level.
- These topics were investigated by comparing children primary school and college student performance to explore age-related differences.

* Riforma della scuola - XV legislatura- DL del 19.02.2004 (in S.O. n.31, G.U. del 2.03.2004, n.51)

Methods

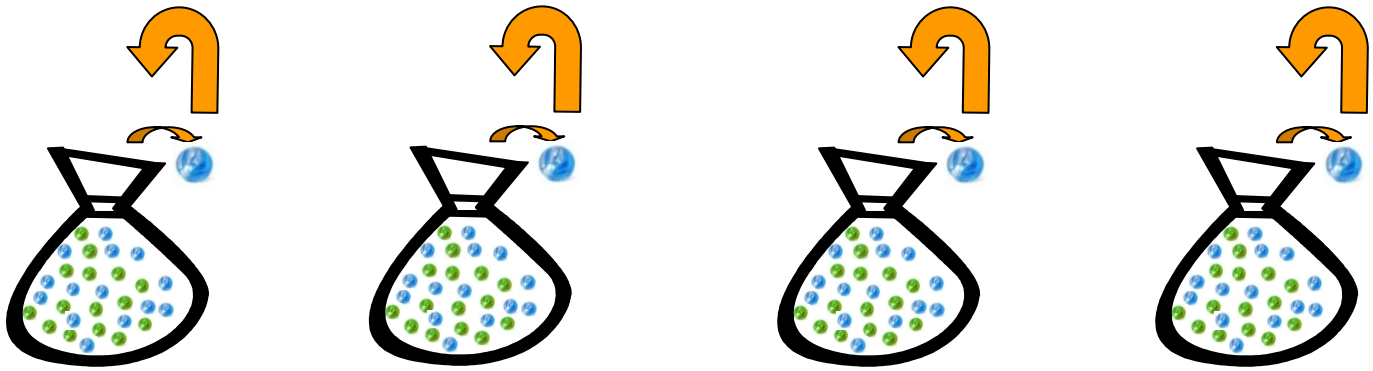
Participants

- 48 Primary School Children:
  - 23, 3rd Graders
    (M=7, F=16; Mean Age= 8.7, SD =0.3 yrs)
  - 25, 5th Graders
    (M=10, F=15; Mean Age= 10.9, SD=0.3 yrs)

- 35 College Students
  (M=10, F=25; Mean Age= 25.3, SD=3.8 yrs)

Tasks and procedure

- *Simon and John are playing together with a bag in which there are **15 Green** and **15 Blue** marbles. Simon drew marbles from the bag four times. Each time the drawn marble is put back into the bag. One after the other, Simon drew four Blue marbles.*

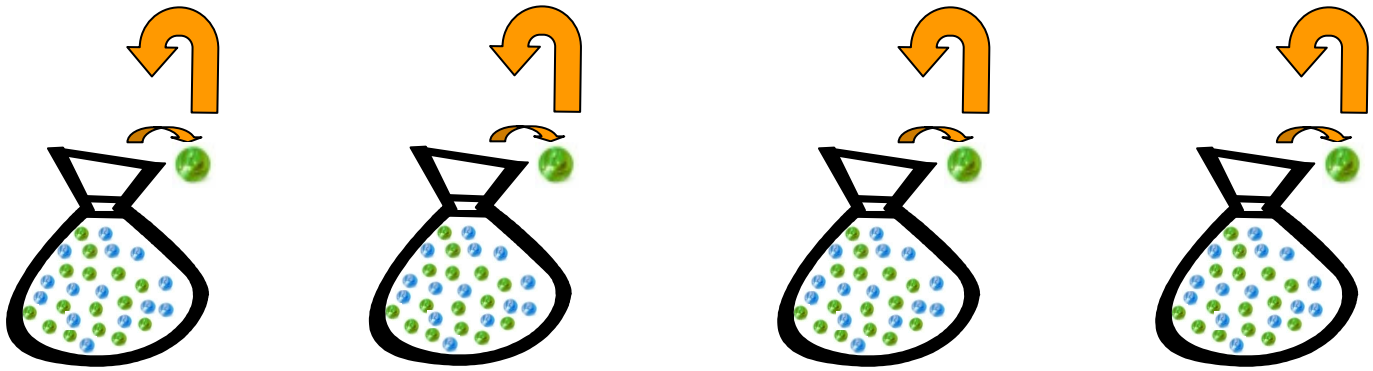


1° drawn marble **2° drawn marble** **3° drawn marble** **4° drawn marble**

Sequence of outcomes:

- ***What do you think Simon is more likely to draw next, a Blue or a Green marble, or is each colour just as likely?"***

- *Simon and John are playing together again, with the same bag in which there are **15 Green** and **15 Blue** marbles. Simon drew marbles from the bag four times. Each time the drawn marble is put back into the bag. One after the other, Simon drew four Green marbles.*

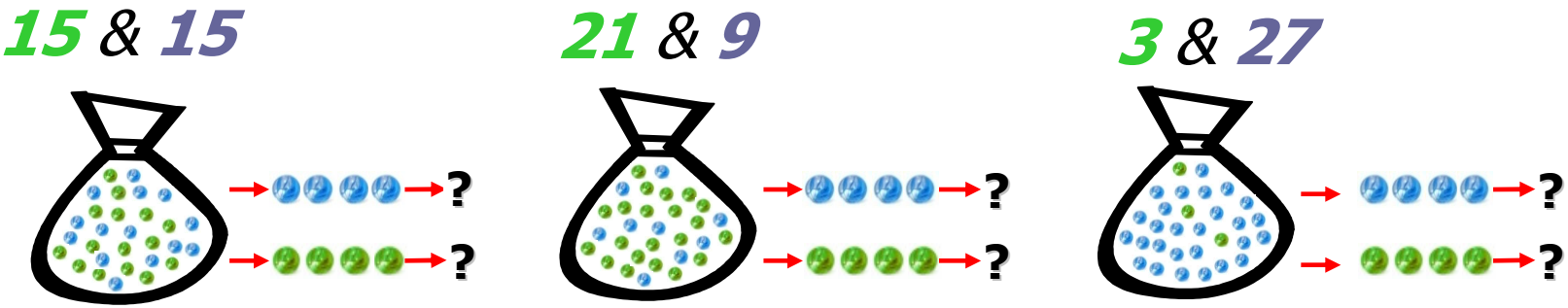


1° drawn marble **2° drawn marble** **3° drawn marble** **4° drawn marble**

Sequence of outcomes:

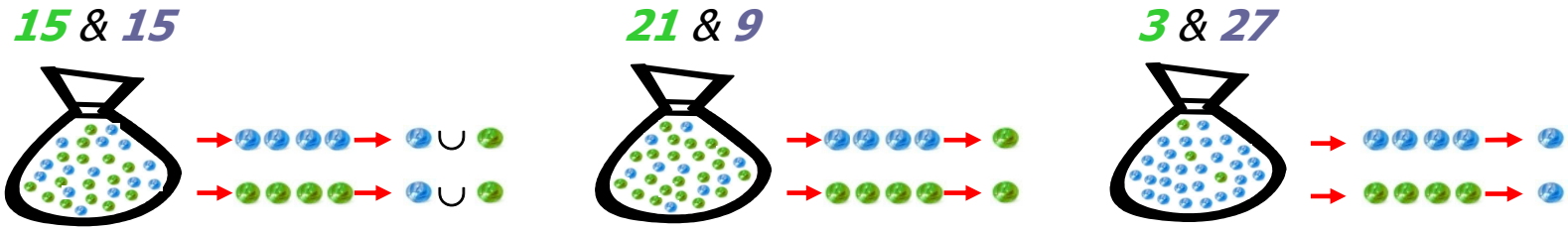
- ***What do you think Simon is more likely to draw next, a Blue or a Green marble, or is each colour just as likely?"***

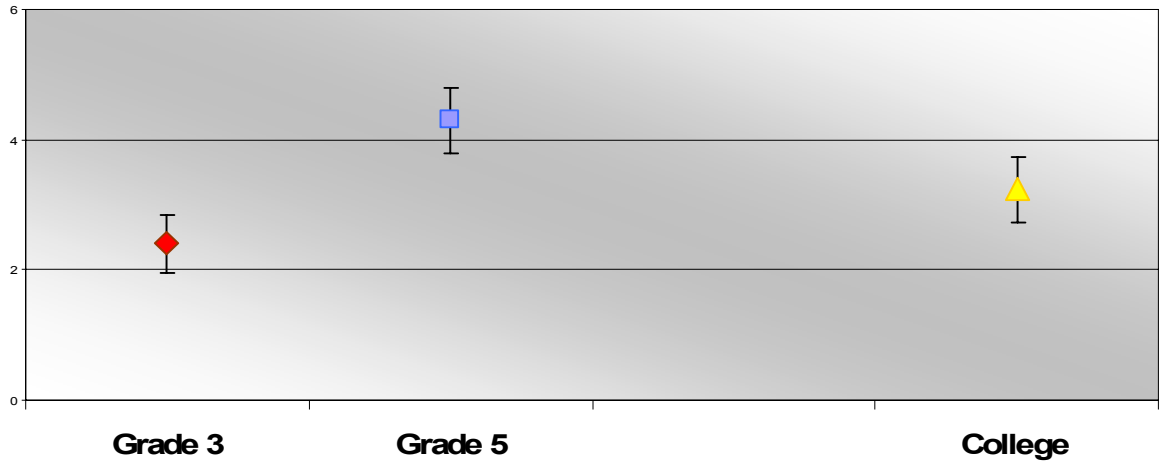
- Tasks were repeated with bags with different proportions of marbles:



Results

Normative reasoning

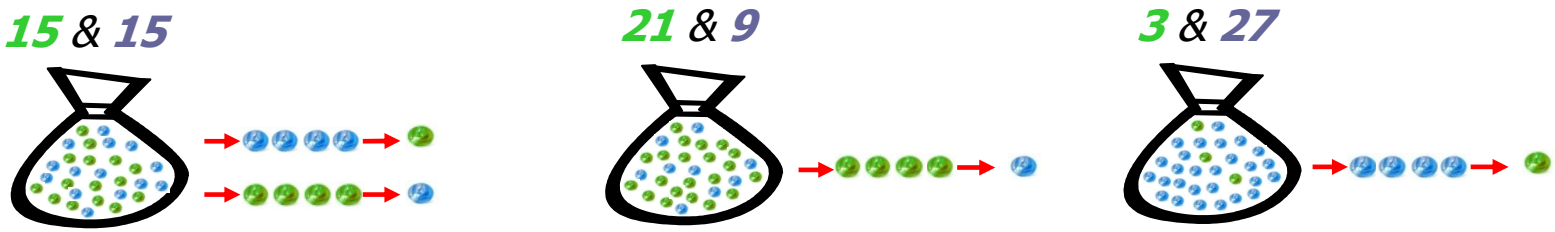


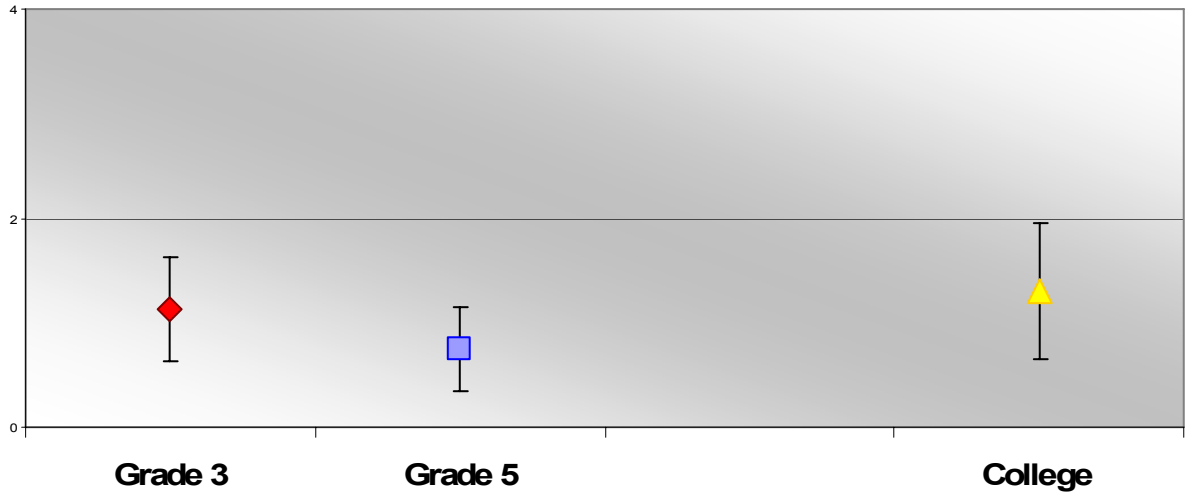


$F(2, 76)= 12.71$, $p<.001$, $\eta^2= .25$

- Grade 5 & Grade 3 ($p< .001$)
  & College ($p< .05$)

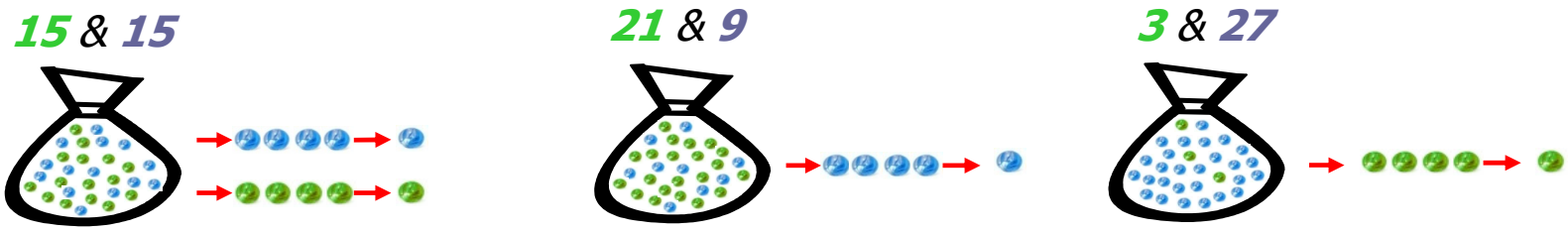
Negative recency

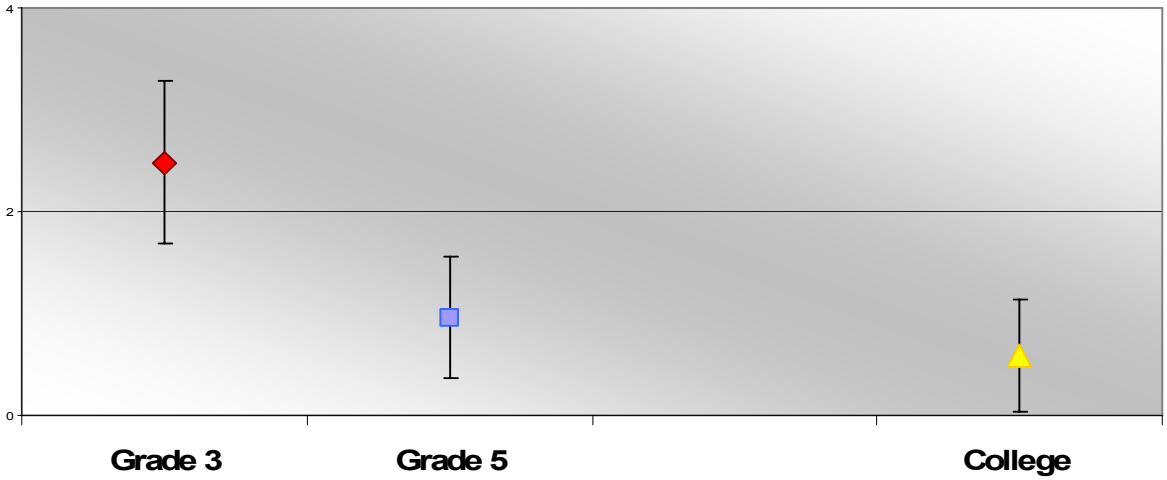




$F(2, 76)= 1.22$, $p=.30$, $\eta^2= .03$

Positive recency

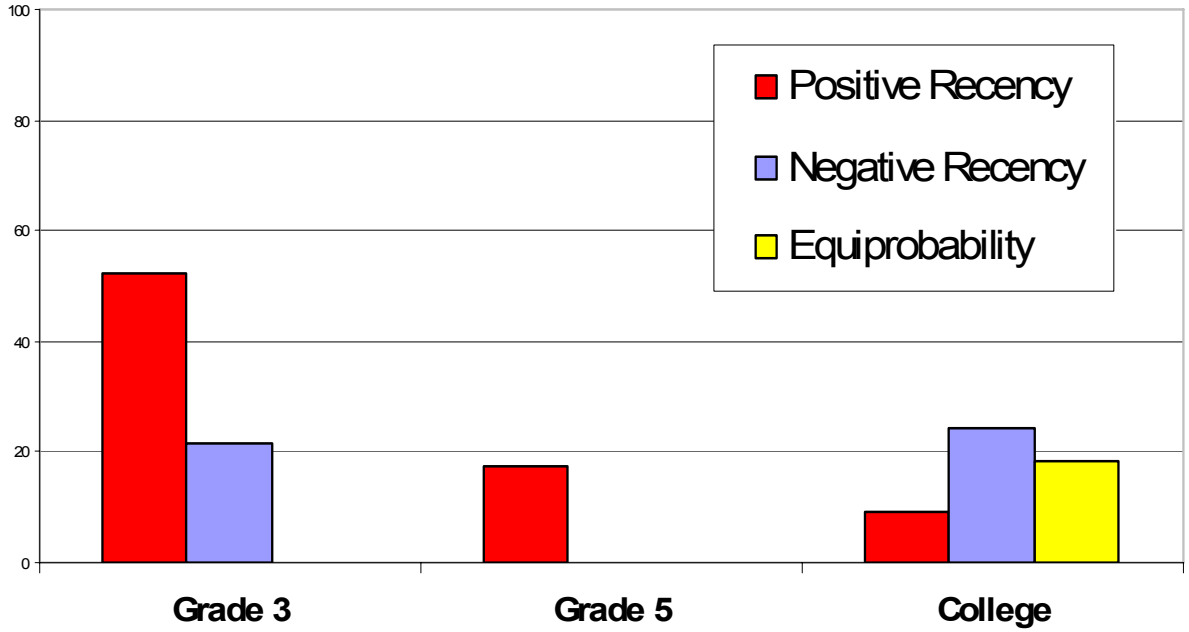




$F(2, 76)= 13.95$, $p<.001$, $\eta^2= .27$

- Grade 3 & Grade 5 ($p< .01$)
  & College ($p< .001$)

Typologies of heuristic responding



Discussion

3rd Graders :

- They rarely took base-rates into account. They used the sequence of previous independent events as a cue to estimate the likelihood of future outcome.
- It can be claimed that their misleading primary intuitions on probability revealed their nature to be " causal thinkers".

5th Graders:

- They took into account the value of base-rates. They used it to make normatively correct decisions.
- As a consequence, they used fewer heuristic modes of reasoning than did the other two groups. The positive recency effect and the negative recency bias were rarely used.
- It can be claimed that learning environments overrode their primary intuitions and they develop appropriate probabilistic reasoning

College students:

- Their performance, as well as that of the 3rd Graders, was poor. They showed both: the negative recency bias, and the equiprobability bias.
- We can argue that the task context elicited information derived from both informal and formal prior experiences.

Conclusions

- Probability is a hard subject to learn and to teach since:
  - students apply informal conceptions to probabilistic domains

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  - educational experiences help in conceptualize randomness, and formal conceptions are acquired

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  - formal conceptions sometimes have no lasting effect, and misleading intuitions could arise from them