Is Strategic Reasoning Robust to the Impact of Age in Competitive Environments?

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Abstract

In this research, we investigated adult-age differences in competition with equal and unequal resources. Younger and older adults (N = 240) made strategic allocation decisions in competition against others of similar age (Study 1) or against others of a different age group (Study 2) in the zero-sum Colonel Blotto game. Both younger and older adults were sensitive to their strength relative to that of their opponents and allocated resources adaptively. Nonetheless, younger adults made superior strategic allocations and won more frequently in competition against older adults. Fluid cognitive and numerical abilities could partially account for age differences in strategic competition.

The Colonel Blotto Game

- Competitive use of limited resources (e.g., allocation of political funds or advertising) has been modeled with the classic game of Colonel Blotto.[1, 2]

- We use this paradigm to investigate age-related differences in symmetric and asymmetric competition.

- Game-theoretic normative analyses[3] indicate that weaker agents should give up on some occasions to match stronger agents on remaining ones.

- Specifically, assuming that available resources to two competitors are a and b, (with $a \geq b \geq 0$): the optimal strategy for a stronger player (or for players in symmetric competition) is to divide resources in a uniform distribution (ranging from 0 to twice the player's average resources across fields). The weaker player should leave a proportion of $1-(b/a)$ fields empty and distribute across remaining ones to match stronger player.[3]

- Example of a round in the game:
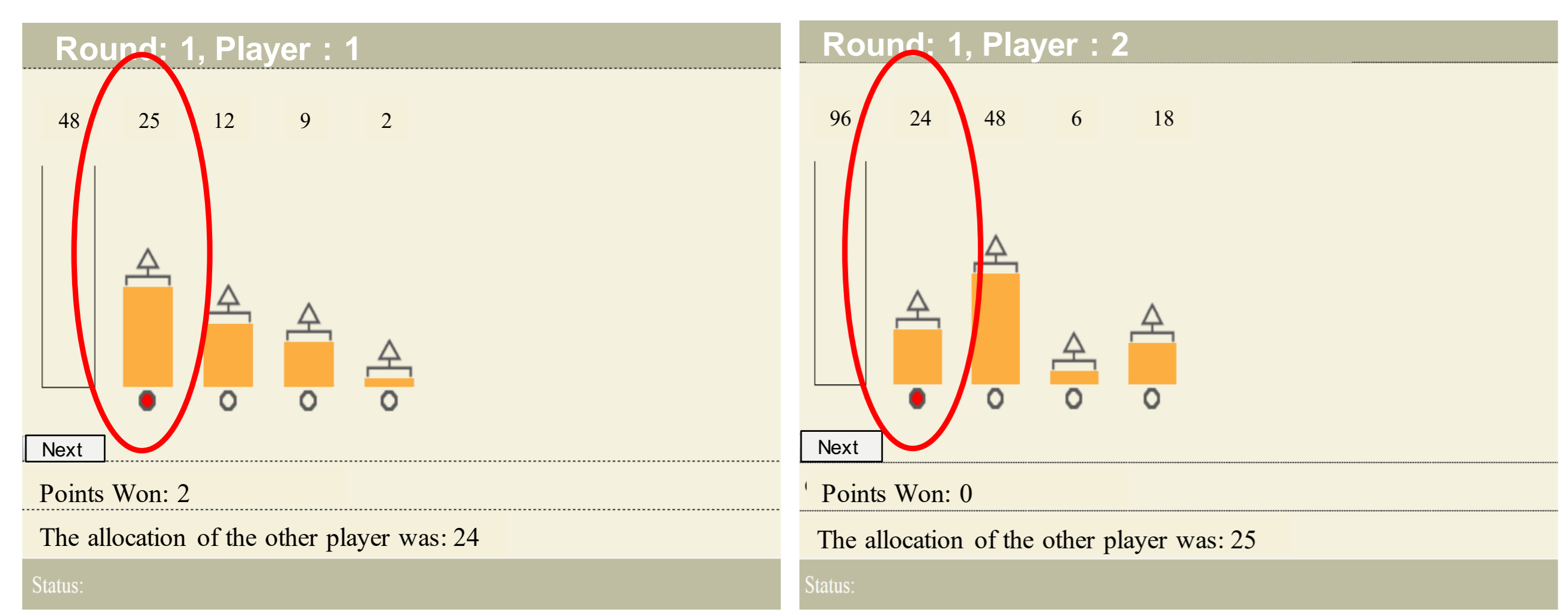
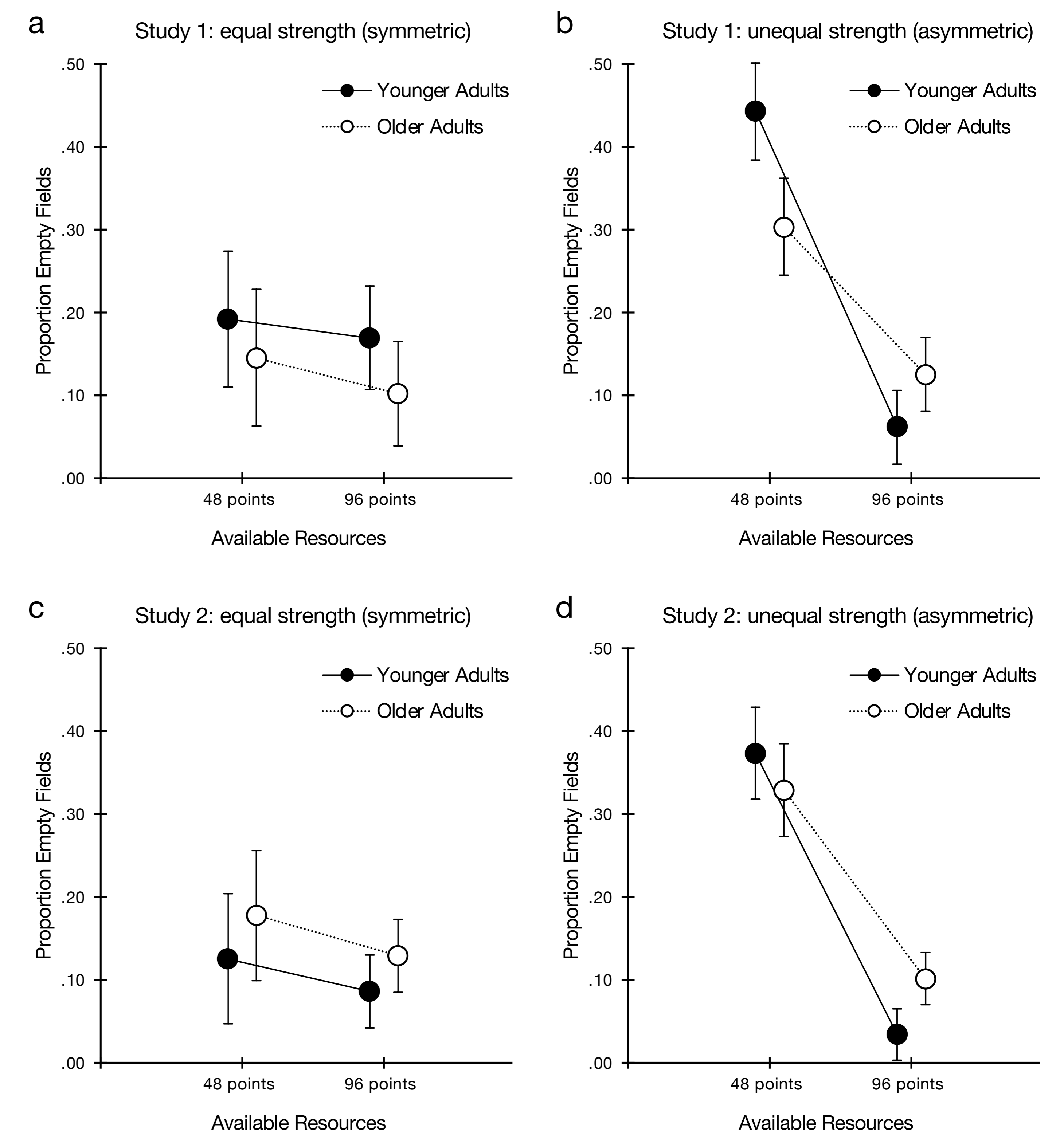## Aging and Strategic Decisions in Competition

- An increasing number of older adults make financial, health-related, and political decisions.

- It is currently unknown if and how younger adults (YAs) and older adults (OAs) differ in strategic decisions in competitive environments. We considered three hypotheses:

  - *Decline-in-strategic-cognition hypothesis:* decisions in complex competitive games require fluid cognitive and numerical abilities, which decline with age.[4] OAs make less beneficial decisions that deviate more strongly from game-theoretic benchmarks than YAs.

  - *Increase-in-cautiousness hypothesis:* OAs focus on accuracy and preventing errors, suggesting that aging gives rise to a cautious mindset.[5] OAs make generally more cautious strategic allocations (risk diversification) than YAs, as preferences change with age.

  - *Successful-selection hypothesis:* OAs have more experience than YAs in allocating scarce resources and may use strategies of life management, like loss-based selection.[6] OAs may thus selectively focus on specific occasions and perform as well as (or possibly better) than YAs in the Colonel Blotto game because they may be able to co-opt strategies that have proven valuable for dealing with limited resources.

Participants and Design

- Study 1: n = 60 OAs and n = 60 YAs. Same-age opponents
- Study 2: n = 60 OAs and n = 60 YAs. Different-age opponents
- Mixed design:
  2 (Age Group) × 2 (Strength 48 vs. 96) × 2 (Symmetric vs. Asymmetric)

Age Group	Experimental Group (symmetric vs. asymmetric competition)	Strength (48 or 96 available points)	
		Phase 1 (25 rounds)	Phase 2 (25 rounds)
younger adults	symmetric (control) N = 20	48-48	96-96
	asymmetric N = 40	48-96	96-48
older adults	symmetric (control) N = 20	48-48	96-96
	asymmetric N = 40	48-96	96-48

Results

a Study 1: equal strength (symmetric)

b Study 1: unequal strength (asymmetric)

c Study 2: equal strength (symmetric)

d Study 2: unequal strength (asymmetric)

Summary

- Both YAs and OAs adaptively gave up on fields to stand a chance as weaker players in asymmetric competition. Hence, their strategy differed strongly as a function of the opponent's resources.

- In line with the *decline-in-strategic-cognition-hypothesis*, YAs made strategically superior allocation decision than OAs and won more frequently when competing against older adults. Measures of fluid cognitive and numerical abilities partially accounted for these age differences in strategic performance.

References

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