

Introduction

- Carrying out two tasks at once (i.e., dual-tasking), or in close succession, requires **multiple action control** and it induces costs on performance speed and accuracy, compared to single-task performance [1].
- These effects are usually exacerbated in **advanced age** [1,2].
- Aim 1:** To investigate how **response-related interference** is affected by aging using a single-onset paradigm with one vs. two simultaneous speeded choice reactions [3,4].
- Aim 2:** Assess the **replicability** of the effects in the MR scanner (Exp. 2)

Methods

Participants

- Exp. 1:** 21 young (13 ♀, 25.2 ± 3.7 years) adults
20 older (12 ♀, 60.0 ± 7.0 years) adults
- Exp. 2:** 45 young (22 ♀, 25.6 ± 3.4 years) adults
36 older (21 ♀, 61.9 ± 5.5 years) adults

Task: Single-onset dual-task paradigm (Fig. 1)

- Respond to high- or low-pitched tones by pressing upper or lower response buttons with one (single-task) or both hands simultaneously (dual-task).
- Stimulus-response [SR] mapping:** Respond either in the compatible (SRC) or incompatible (SRI) direction implied by the pitch
→ Response selection difficulty
- Response-response [RR] congruency:** Motor codes for each response in dual-task blocks either mutually congruent (RRC) or incongruent (RRI)
→ Response initiation difficulty

Statistics:

- Repeated-measures ANOVA of dual-task costs on reaction time (RT), error rate (ER), and a combined measure of speed and accuracy (bin-score, [5]).

Paradigm:

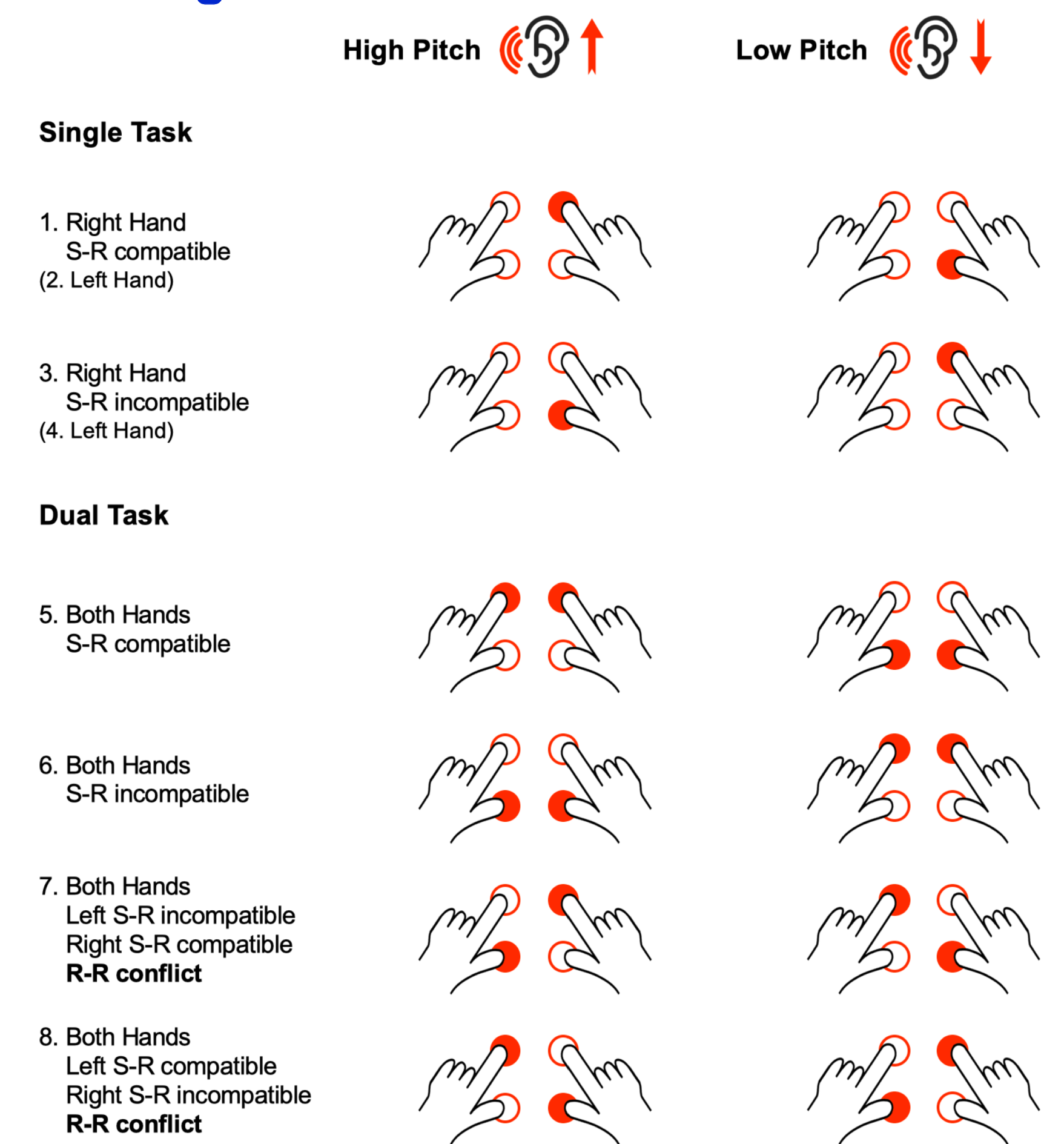


Figure 1. Single-onset dual-task paradigm.

Results

Experiment 1

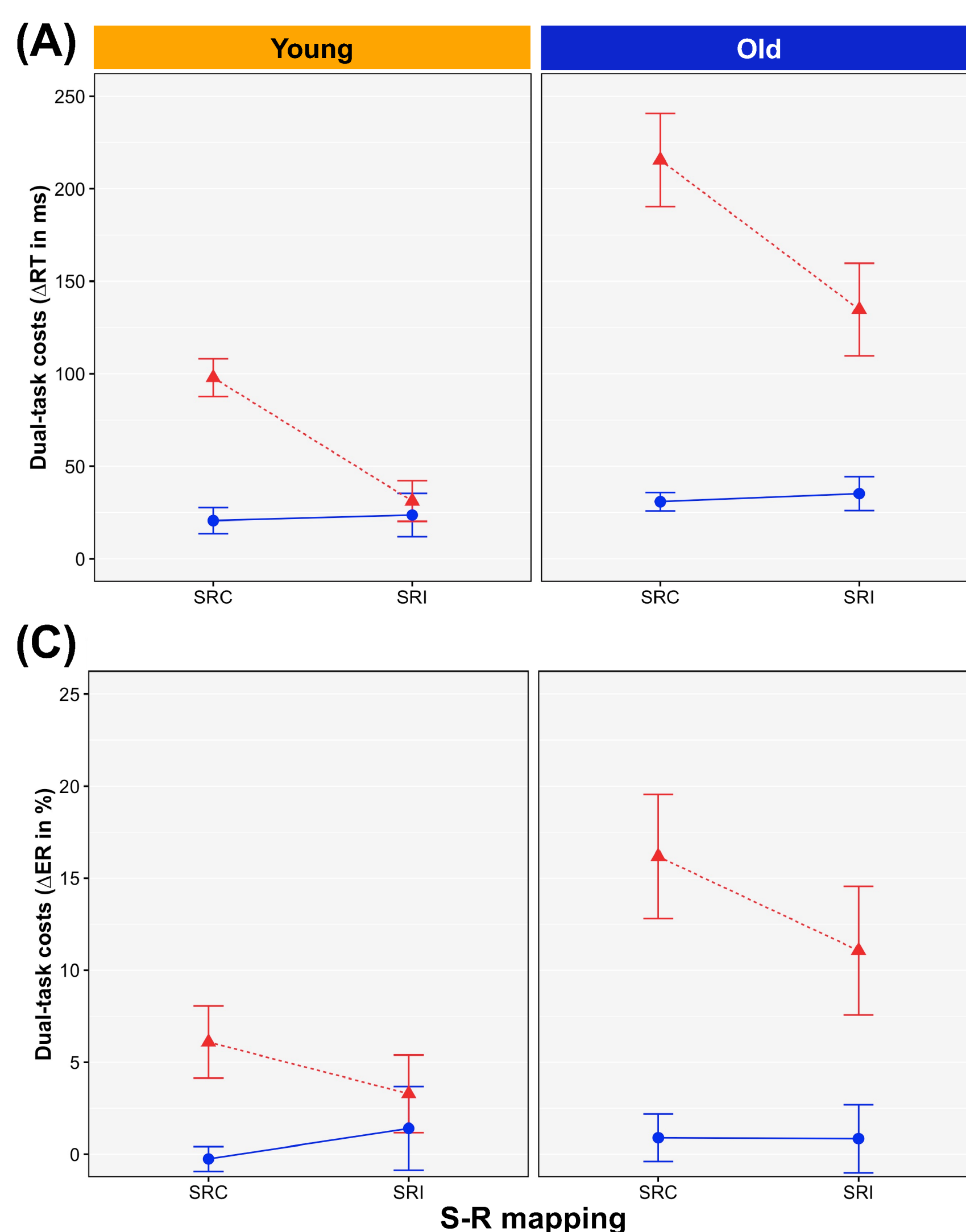
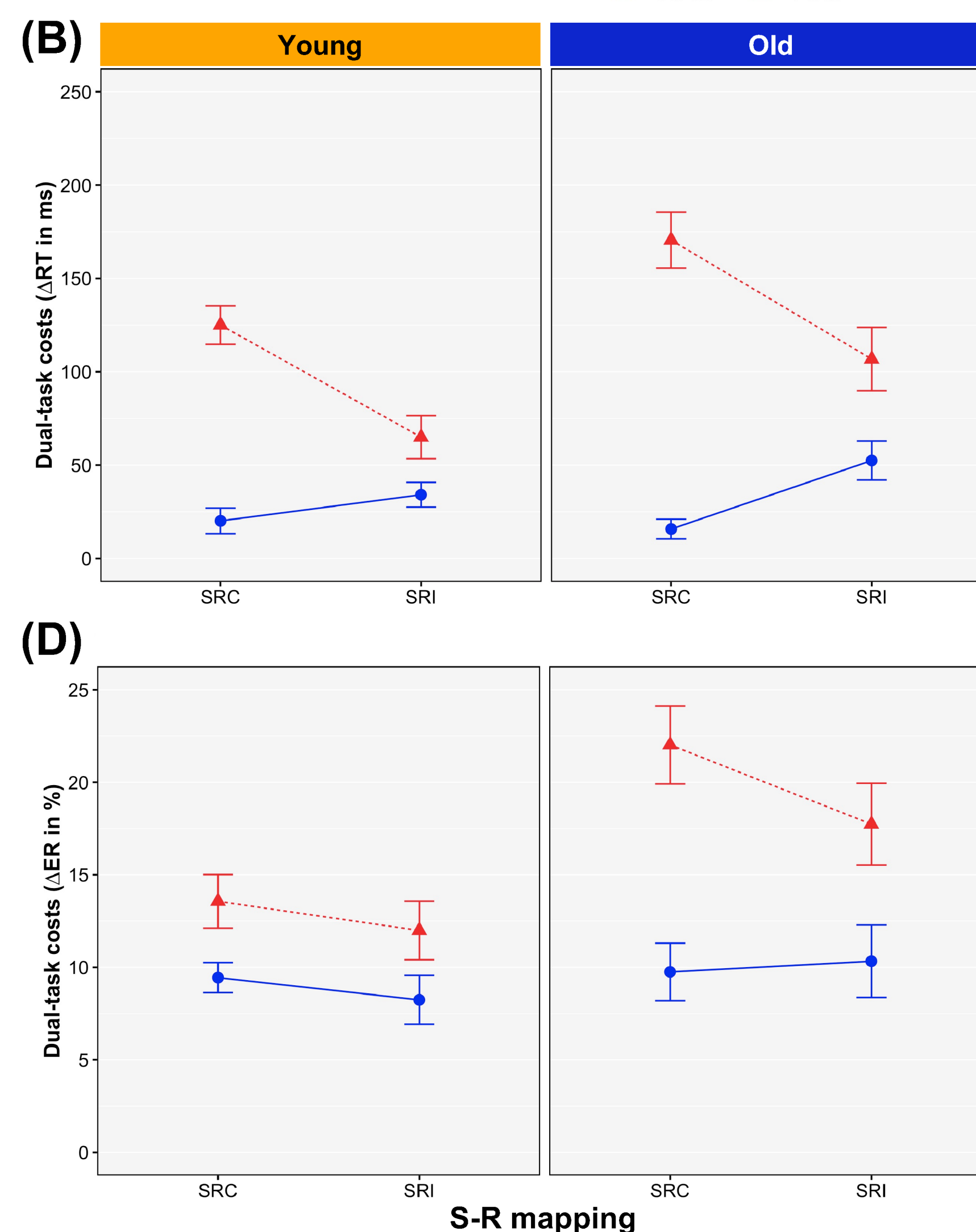


Figure 2. Dual-task costs on reaction time (upper row) and error rate (lower row) according to age, stimulus-response (SR) mapping and response-response (RR) congruency in experiments 1 (left panel) and 2 (right panel). Error bars represent standard error of the mean.

- Dual-task costs on reaction time – Both experiments (A; B):**
 - Significant main effects (age, S-R mapping and R-R congruency)
 - Age × R-R congruency** interaction ($p < .001$; $p = .033$)
 - S-R mapping × R-R congruency** interaction ($p < .001$; $p < .001$)

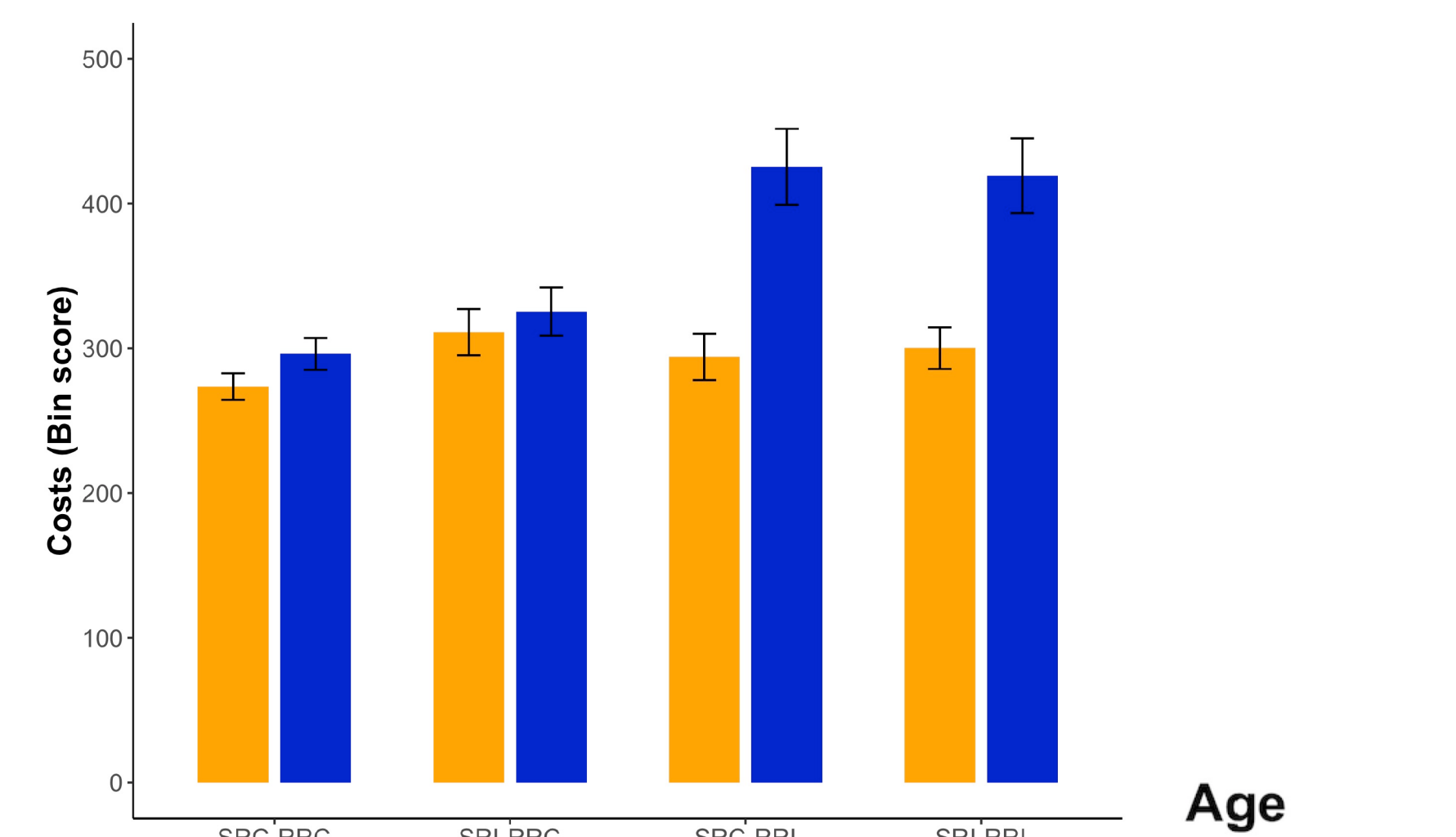
- Dual-task costs on error rate – Both experiments (C; D):**
 - Significant main effects (S-R mapping and R-R congruency)
 - Age × R-R congruency** interaction ($p = .029$; $p = .027$)
 - S-R mapping × R-R congruency** interaction ($p = .005$; $p = .027$)

Experiment 2



Bin-score (speed and accuracy)

Exp. 1



Exp. 2

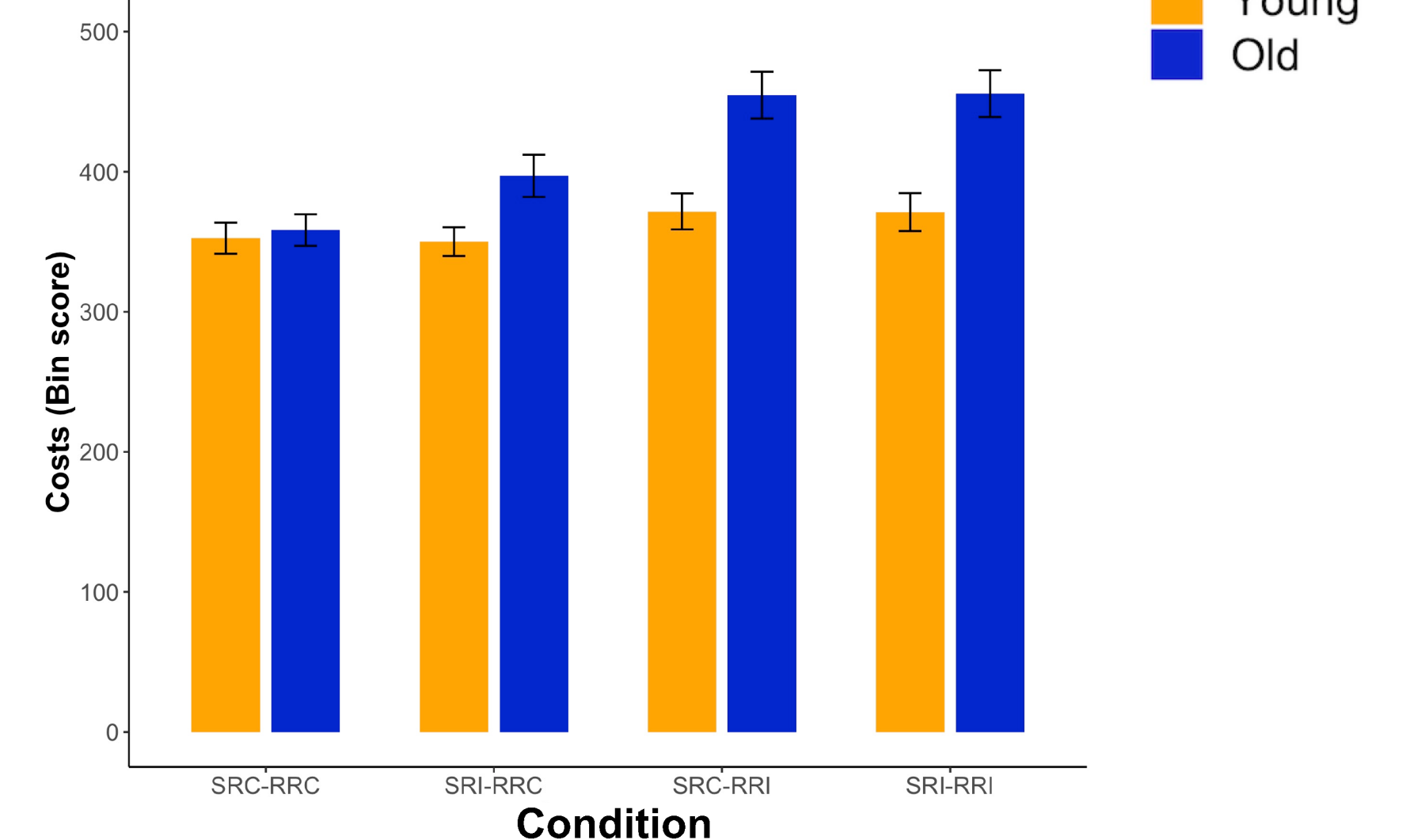


Figure 3. Bin-score costs as a function of age and dual-task conditions in experiments 1 (upper row) and 2 (lower row). Bars represent mean ± std. error of the mean.

Both experiments:

- Significant main effects (age and R-R congruency)
- Age × R-R congruency** interaction ($p = .001$; $p = .006$)

- Exp. 1:** Sign. main S-R mapping effect; and **S-R mapping × R-R congruency** interaction ($p = .007$).

- Exp. 2:** **Age × S-R mapping × R-R congruency** interaction ($p = .040$)

Discussion

- R-R congruency** significantly increased dual-task costs in all performance scores (RT, ER and bin-score), which was further enhanced with age.
- S-R mapping and R-R congruency significantly interacted in both experiments → **Reversed S-R compatibility effect in RR-incongruent trials:**
 - Dual-task costs on reaction time and error rates were larger for SR-incompatible than SR-compatible responses when both responses were mutually congruent.
 - Opposite for RR-incongruent trials: SR-compatible responses suffered more from being paired with an SR-incompatible one; this occurred in both age groups.

Conclusions

- S-R compatibility and R-R congruency** have a **differential and interacting impact** on performance costs in dual-tasking, but the effects are differently modulated by age: Only **response-specific interference** in dual-tasking was **pronounced with age**.
→ Particular age-related deficits in the cognitive control of action.
- Effects can be **reproduced** inside the MR scanner.
- Bin-scores** might yield an informative alternative measure to assess dual-task costs, specially to analyze **interindividual-differences** because it showed higher reliability, as compared to standard difference scores (dual-task costs).