

Age-Related Differences in Dual-Task Crosstalk



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Brain & Behaviour

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 responserelated 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: High Pitch (S) Low Pitch ((S) Single Task 1. Right Hand S-R compatible (2. Left Hand) 3. Right Hand S-R incompatible (4. Left Hand) **Dual Task** 5. Both Hands S-R compatible 6. Both Hands S-R incompatible 7. Both Hands Left S-R incompatible Right S-R compatible **R-R conflict**

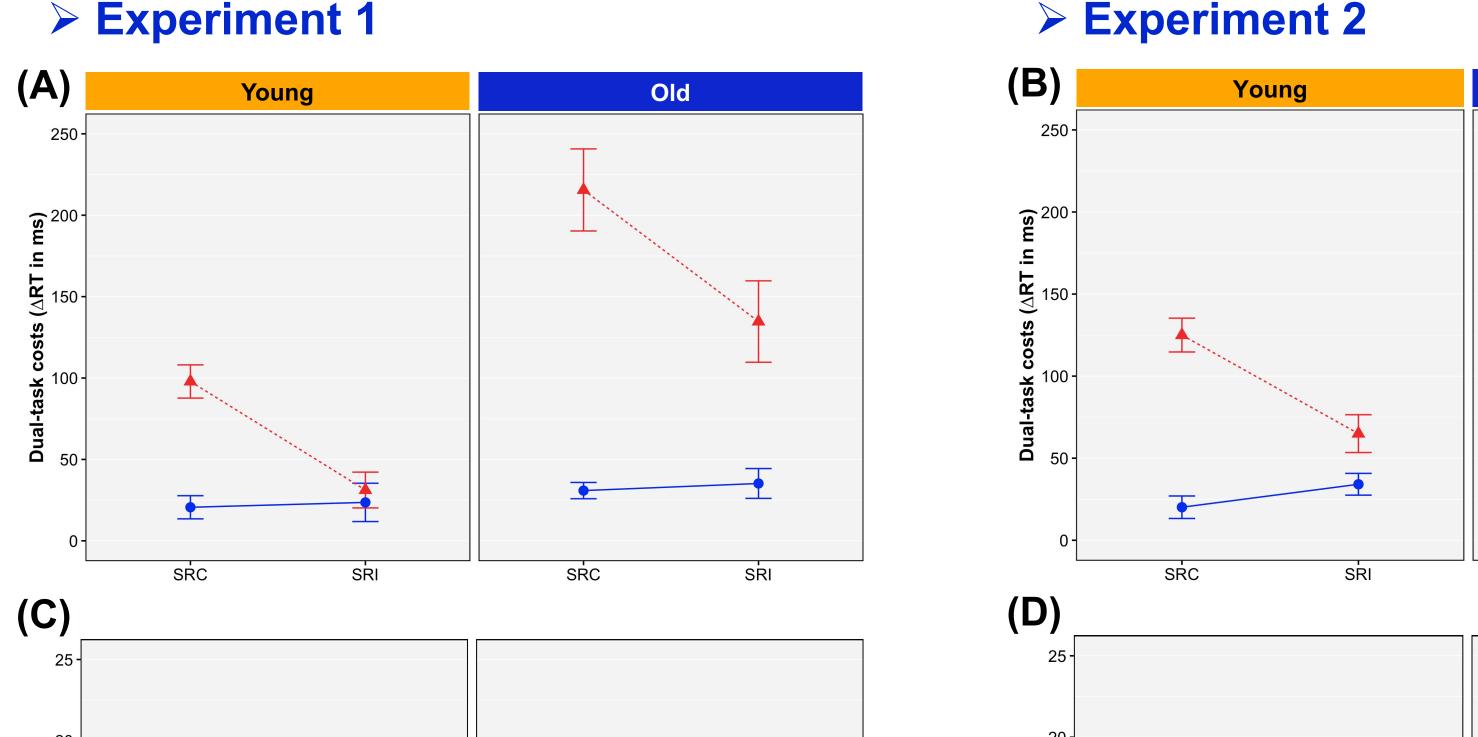
Results

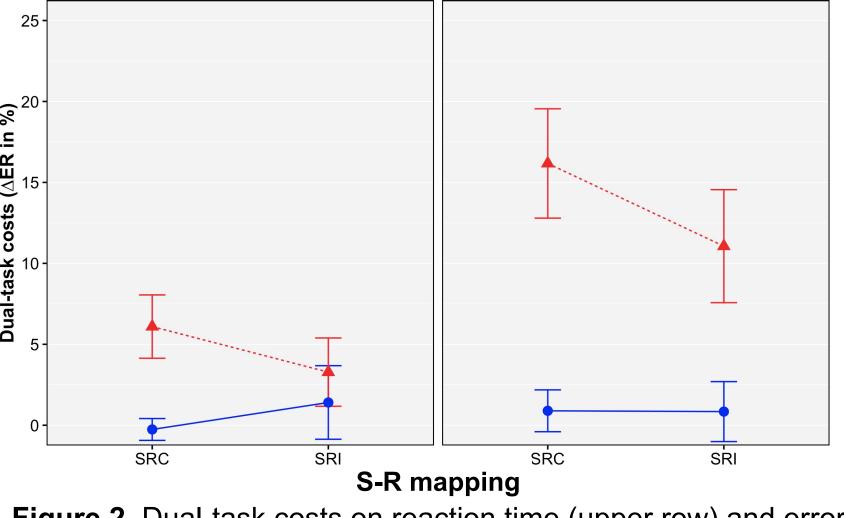
R-R congruency

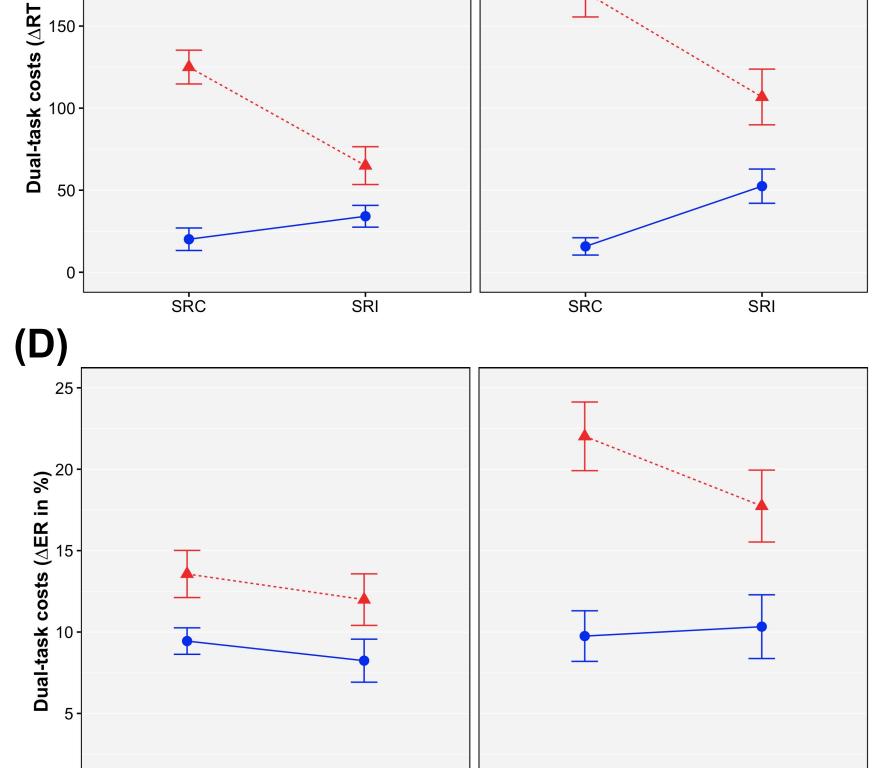
Old

SRI

→ RRC → RRI







S-R mapping
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 \times R-R congruency interaction (p < .001; p = .033)
 - S-R mapping \times 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 \times R-R congruency interaction (p = .029; p = .027)
 - S-R mapping × R-R congruency interaction (p = .005; p = .027)

Bin-score (speed and accuracy)

Figure 1. Single-onset dual-task paradigm.

8. Both Hands

R-R conflict

Left S-R compatible Right S-R incompatible

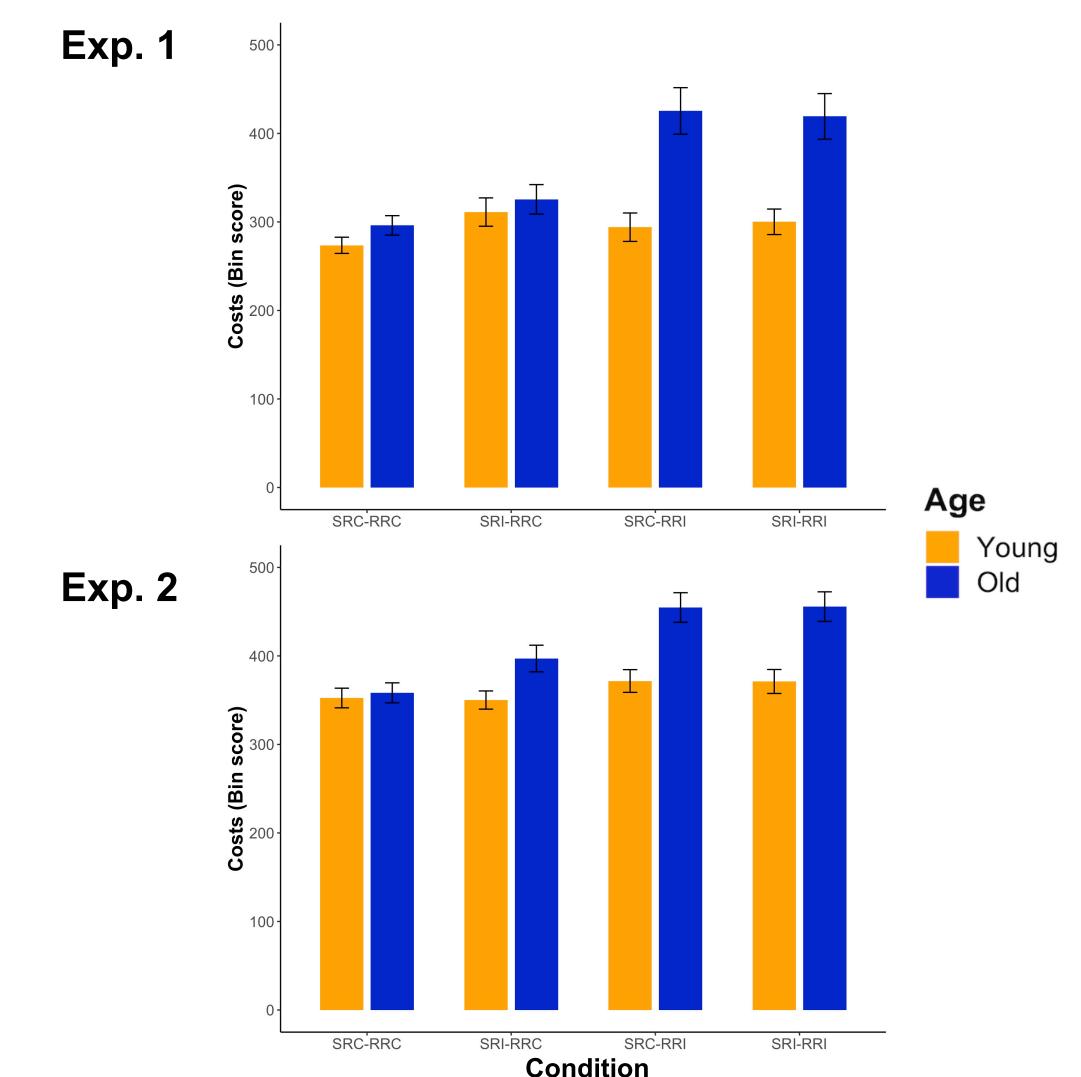


Figure 3. Bin-score costs as a function of age and dual-task conditions in experiments 1 (upper row) and 2 (lower row). Bars represent mean \pm std. error of the mean.

> Both experiments:

- Significant main effects (age and R-R congruency)
- Age \times 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

References:

- > 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.

[1] Koch I, et al. (2018) Psychol Bull, 144:557–83.

[4] Pieczykolan A, Huestegge L (2018) Psychol Res, 82:109–20.

> Bin-scores might yield an informative alternative measure to asses dual-task costs, specially to analyze interindividual-differences because it showed higher reliability, as compared to standard difference scores (dual-task costs).

[2] Verhaeghen P, et al. (2003) Psychol Aging, 18:443–60. [3] Huestegge L, Koch I (2009) JEPHPP, 35:352–62. [5] Draheim C, et al. (2016) Persp Psychol Sci, 11:135-155.