Background

- Research on dual-task gait is heavily based on straight-ahead walking, yet most daily activities require transition movements, such as turning or sit-to-stand.
- It is unclear how older adults perform dual-task processing during functional mobility that includes not only straight-ahead walking, but also transitions (e.g., turning, sit-to-stand).
- The dual-task Timed Up-and-Go (TUG) may allow examination of attentional processing under changing postural demands inherent to the various phases of the TUG: straight-ahead walking (SitWalk), sit-to-stand (SitStand), turning (Turn), and turn-to-sit (TurnSit).
- Other studies on aging using dual-task TUG assessed general performance such as total duration, but in turn completion does not always provide successful assessment of at-risk older adults. Indeed, Shumway-Cook et al. (2000) found no added utility in predicting falls in dual-task TUG in comparison to regular TUG.
- Assessing individual phases may allow targeted assessment on which specific phases are compromised in aging when subjected to dual-task challenge.

Methods and Materials

Participants:
- Healthy, community-dwelling participants:
  - 12 young adults (26.13 ± 5.36y)
  - 12 older adults (74.18 ± 5.21y)

Procedures:
- Instrument: 6 wireless inertial sensors (Opal system, APDM, Portland, OR) on both wrists and ankles, and upper and lower trunk, which recorded kinematic data during TUG performance.
- Protocol: Performed the 7-meter instrumented TUG (iTUG) under the following dual-task conditions, counterbalanced by order, 3 trials each:
  1. Serial-3 subtractions (COG)
  2. Carrying full cup of water (MAN)
  3. Combined subtractions with carrying water (CM)
  4. Dialing cellphone (PHONE)

- Phases of the iTUG and associated outcome measure:
  1. SitWalk: duration (s) of straight-ahead walking; peak trunk velocity (deg/s) in the sagittal plane
  2. SitStand: duration (s) to complete sit-to-stand transitions; peak angular velocity (deg/s) of trunk in sagittal plane
  3. Turn: duration (s) to complete 360° turn; peak angular velocity (deg/s) of trunk
  4. TurnSit: duration (s) to complete turning to sit; peak angular velocity (deg/s) of trunk

- Dual-task effect (DTE): %DTeffect = [(Dual-task – Single-task) / (Single-task)] × 100
  - %DTeffect_COG = [(Dual-task – Single-task) / (Single-task)] × 100
  - %DTeffect_MAN = [(Dual-task – Single-task) / (Single-task)] × 100

- Negative DTE value represents performance cost
- Positive DTE value represents performance benefit

Statistical analyses:
- To determine effect of age (young, old) and phase (SitWalk, SitStand, Turn, TurnSit) on DTE on the iTUG, mixed design ANOVA was used. Design included random-nested factor of subject, and fixed factors of age and phase. Analyses performed separately for each condition and outcome measure.
- To assess counting performance during COG and CM, similar mixed design univariate ANOVA was used for subtraction rate, and subtraction accuracy.

Research Aims and Hypotheses

Objectives:
- To examine age-related decrements in mobility during specific phases of the dual-task TUG.
- To characterize the dual-task effect on phases of the TUG during simple and complex secondary tasks.

Hypotheses:
- 1. Older adults will demonstrate greater dual-task decrements than young adults during transition movements than straight-ahead walking.
- 2. Older adults will demonstrate greater dual-task decrements than young when performing secondary tasks with combined cognitive-manual modalities than simple cognitive or simple motor tasks.

Age-related dual-task costs peaked to peak trunk velocity appeared during SitWalk when performing one complex task (CM) but not the other (PHONE).

Cognitive task performance was similar for older and young adults. Subtracting was better during SitWalk and most compromised during SitStand.

Conclusions

1. Dual-task processing differs by phases of the TUG for both age groups, regardless of secondary task complexity.
2. Age-related dual-task costs to walking increase with complex secondary tasks: CM - subtractions carry water PHONE; working memory dialing phone.
3. The complex cognitive-manual tasks differ in their impact on age-related dual-task costs to straight-ahead walking, possibly due to differences in demands specific to the manual task. Carrying water requires damping of arm movements in straight walking and possibly greater vigilance to avoid splits.

References