

Symposium

Content of the Wandering Mind:
Differentiating Task-Related
Interference from Task-Unrelated
Thought

Symposium Outline

- Facets of a Wandering Mind: A Meta-Analysis of Task-Related Interference and Learning
 - Ebbert, D., Zamecnik, A., Wilson, N., Joksimovic, S., Mirriahi, N., and Dawson, S.
- Automated Assessment of Meta-Awareness of Task-Unrelated Thought during Lecture Video Watching
 - Bühler, B., Bozkir, E., Deininger, H., Goldberg, P., Gerjets, P., Trautwein, U., and Kasneci, E.
- Directing Mind Wandering in Video Learning: Task-Relatedness and Temporal Patterns
 - Anders, G., Buder, J., and Huff, M.
- Interpolated Tests Reduce Task-Unrelated Thoughts during Video Learning in Mathematics
 - Ivan, I. V., Hoch, E., Brucker, B., Linder, M., and Gerjets, P.
- Discussion
 - Gijsen, M.



Facets of a Wandering Mind: A Meta-Analysis of Task-Related Interference and Learning

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Mirriahi, and Shane Dawson

Introduction

Introduction

- Thinking about something unrelated is a common experience
- Sustained attention is impossible (Sharpe & Tyndall, 2025)
- Often used term is mind wandering (Mills et al., 2018)
- Mind wandering is not the only type of thought that occurs while learning

Conceptual Development

Conceptual Development

- Task-unrelated Thoughts (TUTs)
- Task-related Interference (TRI)
- Off-task Thoughts (TUT + TRI)

Task-unrelated Thoughts

- Most commonly used conceptualisation of mind wandering (Mills et al., 2018)
- Thoughts that are not on the task at the point of measurement and are not related to the task at all
- Occur about 30% of the time while learning (Wong et al., 2022)
- Negatively correlated with learning outcomes (Wong et al., 2022)
- Example: “What am I going to have for lunch?”

Task-related Interference

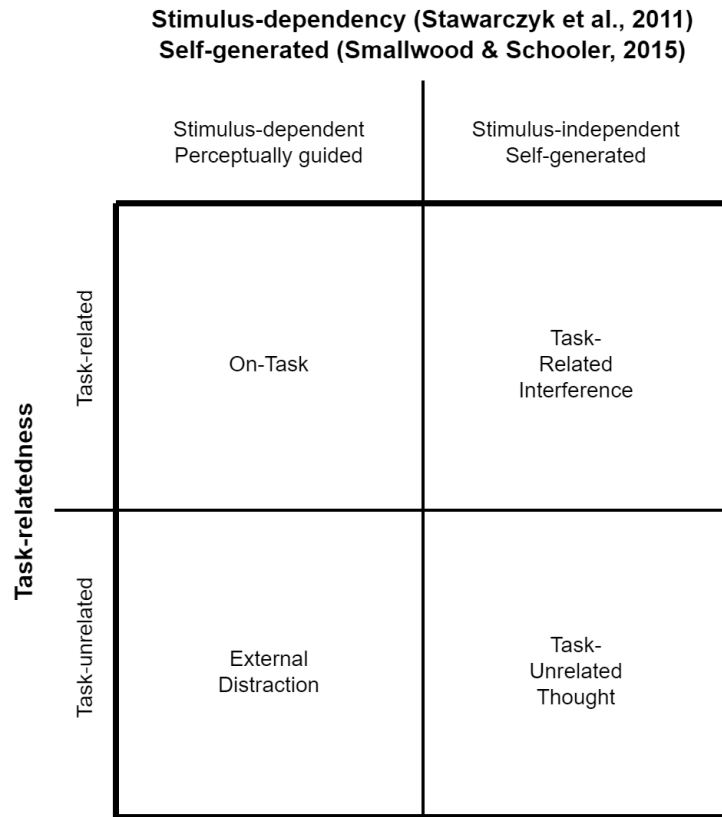
- Hybrid concept between TUTs and on-task thoughts (McVay & Kane, 2012)
- Thoughts that are not fully on the task at the point of measurement but are still somewhat related to the task
- Estimated to occur 20-25% of the time (Welhaf et al., 2020)
- Association with learning outcomes uncertain
- Example: "I don't think I will remember all of this."

Task-related Interference & Metacognition

- Is task-related interference related to metacognition?
- Difference arises from different research paradigm
- TRI is usually measured using probes (experience sampling)
- Asking a learner what they are thinking about could result in an expression of metacognition, which would be classified as TRI (Jordano, 2018)

Off-task Thoughts

- Combination of TUT and TRI
- Thoughts that are not fully on the task at the time of measurement
- Refers to ongoing thoughts, not the trigger (Cleary et al., 2023; Faber & D'Mello, 2018)



Previous Knowledge about Off-Task Thoughts

- Task-related Interference
 - Occurrence: estimated 20-25%
 - Correlation with learning outcomes: unknown
- Task-unrelated Thoughts
 - Occurrence: ~30%
 - Correlation with learning outcomes: negative
- Off-task Thoughts
 - Occurrence: unknown
 - Correlation with learning outcomes: unknown

Research Questions

Research Questions

- **RQ1:** What is the frequency of TRI, and how are these thoughts associated with learning outcomes?
- **RQ2:** What is the frequency of TUT, and how are these thoughts associated with learning outcomes?
- **RQ3:** What is the frequency of off-task thoughts, and how are these thoughts associated with learning outcomes?

Method

- Meta-analysis
 - Systematic search of the literature
 - Screening
 - Extraction of frequencies and effect sizes
 - Analyses

- Problem informing the search strategy
 - TRI is often studied in the context of TUT but not reported in the abstract

Search Strategy

- Sources:
 - Previous related meta-analyses: Wong et al. (2022) and Bonifacci et al. (2023)
 - Databases: PsycINFO, PsycARTICLES, ERIC, Scopus, Web of Science, PsycExtra, IEEE Xplore, and ACM
- Terms used:
 - **Learning-related Terms:** learning, education, comprehension, "processing information", retention, recall, memory
 - **Task-Related Interference Terms:** "task-related interference", "task related interference", "lecture-related thought", "comprehension-related thought", "lecture-related off-task thought", "comprehension-related off-task thought"
 - **Task-Unrelated Thought Terms:** mind wandering, "mind-wandering", daydreaming, "task-unrelated thought", "off-task thought"

Eligibility Criteria

- Original research analysing TRI and learning outcomes
- Published in peer-reviewed journals or conference proceedings
- Available in English
- Involved an education-relevant learning task with assessment (e.g. comprehension tests, performance on a quiz)
- Reporting frequencies and effect sizes

- Meta-analytical
 - Frequencies: meta-analysis of single means
 - Correlations: mixed-effects model with samples nested within sources

Results

Open Call for Data (n = 1)

Records identified from :
 Databases (n = 2,240):
 Scopus (n = 748)
 PsycINFO (n = 552)
 Web of Science (n = 550)
 PsycARTICLES (n = 137)
 ERIC (n = 78)
 Wong et al. (2022) (n = 71)
 PsycExtra (n = 39)
 Bonifacci et al. (2023) (n = 24)
 IEEE Xplore (n = 23)
 ACM (n = 18)

Records removed before screening :
 Duplicate records identified manually (n = 65)
 Duplicate records identified automatically
 by Covidence (n = 1,106)

Records screened
 (n = 1,069)

Records excluded
 (n = 965)

Reports sought for retrieval
 (n = 104)

Reports not retrieved
 (n = 0)

Reports assessed for eligibility
 (n = 104)

Reports excluded:
 Did not study task-related
 interference (n = 83)
 Did not include a learning task (n = 4)
 Sample already included (n = 2)
 Unable to obtain relevant
 statistical values after contacting
 authors (n = 3)

Total studies included in review
 (n = 12)

Total studies included in review
 (n = 13)

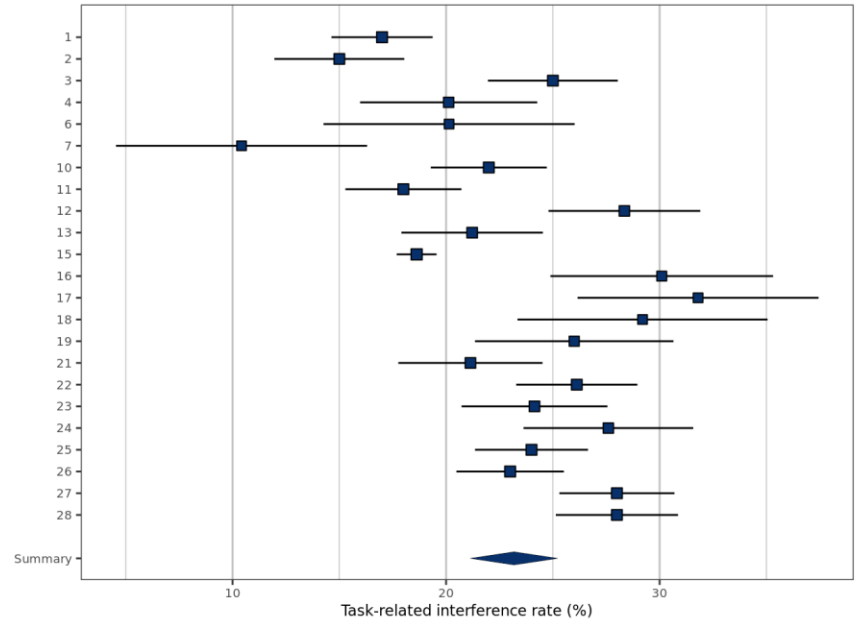
- 13 studies
- 28 samples

Small Number of Studies

- Only 13 includes studies
- Differing conceptualisations used across studies
 - e.g. comprehension-related off-task thoughts, lecture-related off-task thoughts, mind wandering, on-task thoughts

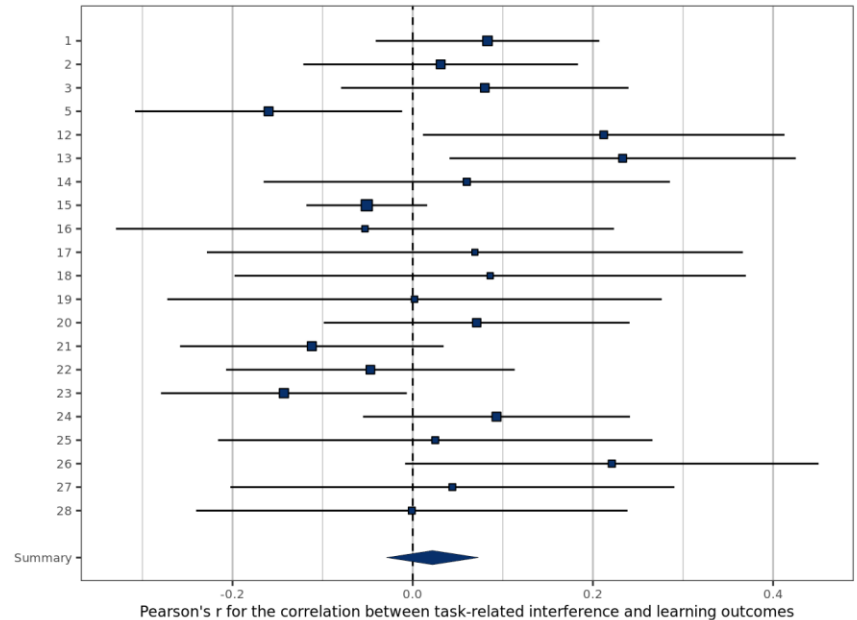
TRI Frequency (RQ1)

- 23.18%
 - SE = 1.04%
 - 95% CI [21.14%, 25.22%]
 - $z = 22.2651$
 - $p < .0001$



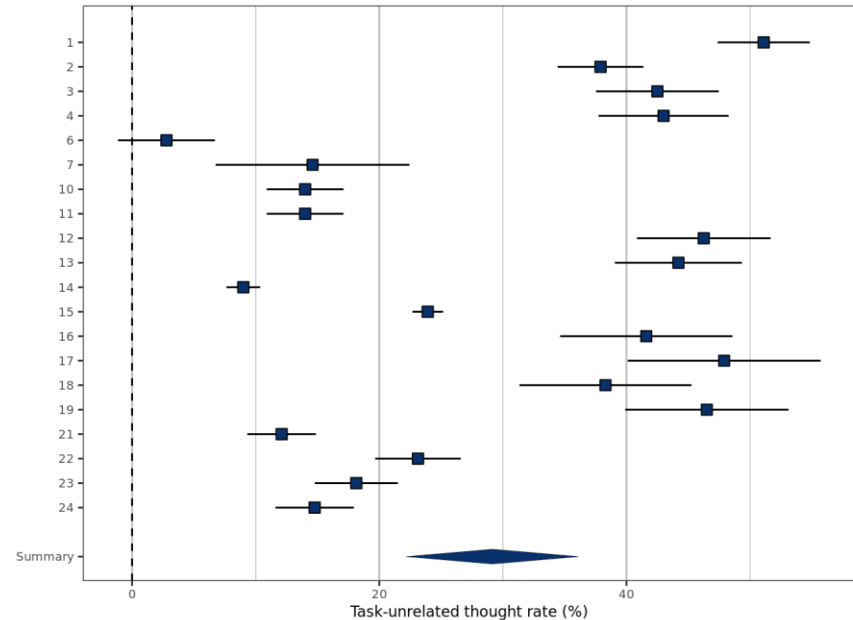
TRI Correlation (RQ1)

- $\beta = 0.0255$
 - $SE = 0.0324$
 - 95% CI [-0.0380, 0.0890]
 - $z = 0.7865$
 - $p = 0.4316$



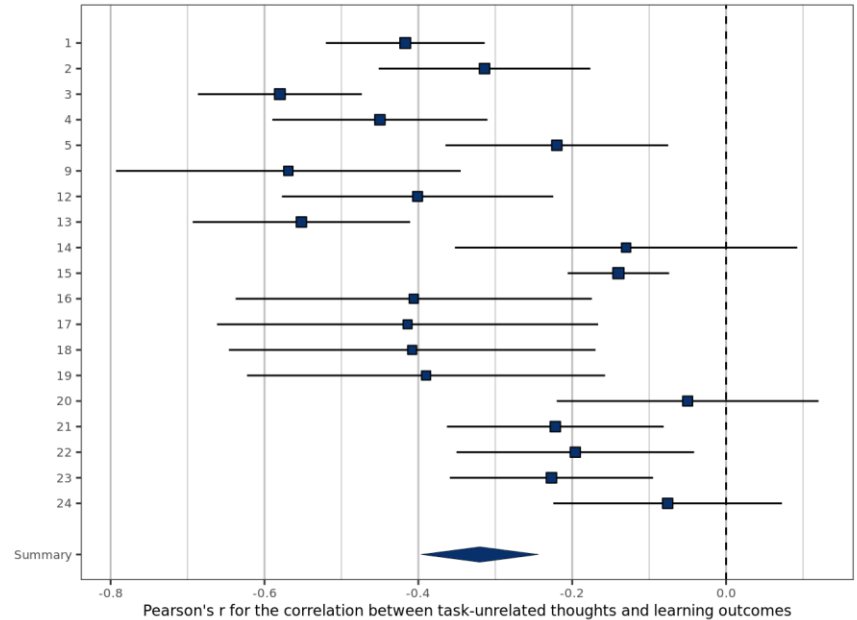
TUT Frequency (RQ2)

- 29.14%
 - SE = 3.55%
 - 95% CI [22.18%, 36.10%]
 - $z = 8.2018$
 - $p < .0001$



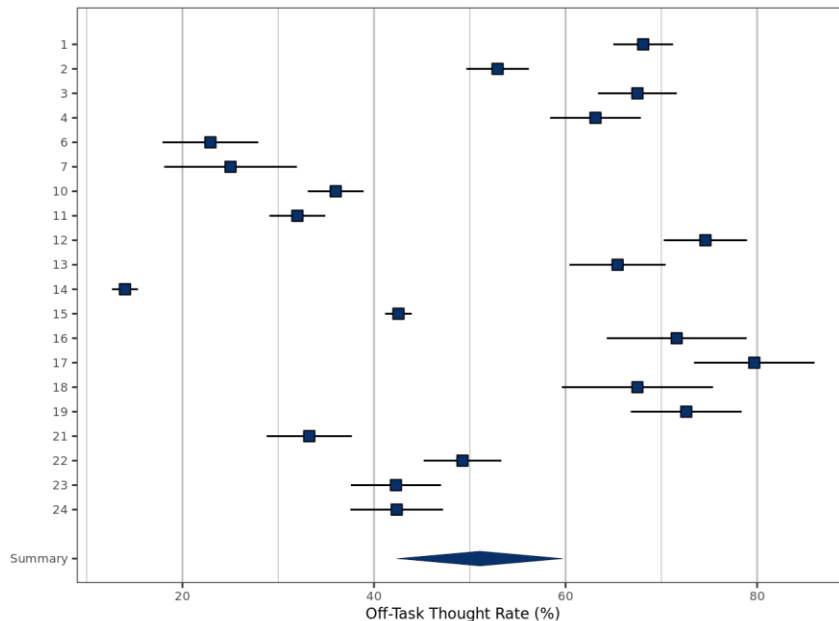
TUT Correlation (RQ2)

- $\beta = -0.3276$
 - $SE = 0.0553$
 - 95% CI [-0.4361, -0.2192]
 - $z = -5.9201$
 - $p < .0001$



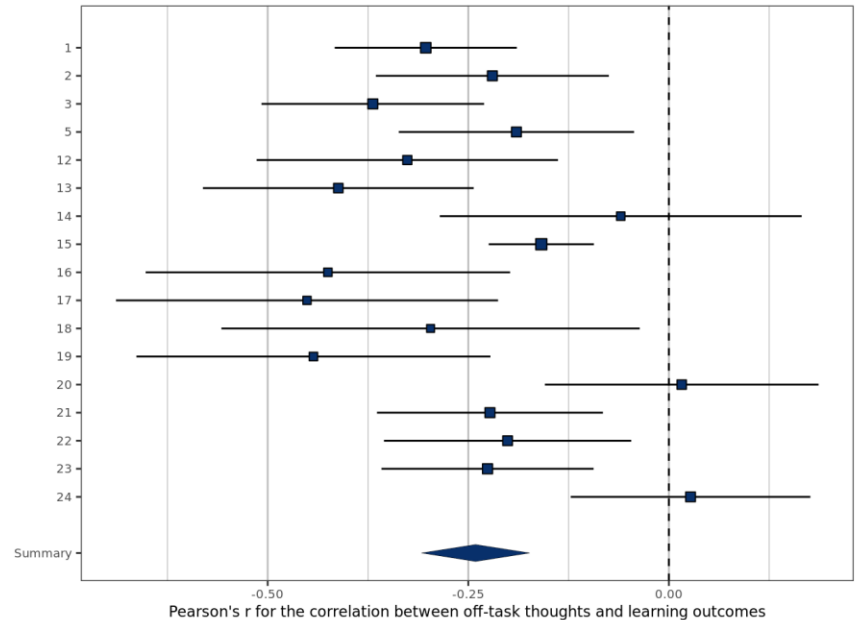
Off-task Thought Frequency (RQ3)

- 51.06%
 - SE = 4.22%
 - 95% CI [42.40%, 59.71%]
 - $z = 11.5585$
 - $p < .0001$



Off-task Thought Correlation (RQ3)

- $\beta = -0.2301$
 - $SE = 0.0454$
 - 95% CI $[-0.3191, -0.1410]$
 - $z = -5.0656$
 - $p < .0001$



Discussion

Theoretical Implications

- Conceptualisation of TRI might be too broad
 - Differentiation between lecture-related off-task thoughts and comprehension-related off-task thoughts
 - Both were considered TRI, but impact on learning differs
 - Content of thought might require more detailed consideration, especially if it is metacognitive

Theoretical Implications

- Cascade model of inattention by Smallwood et al. (2007)
 - Shifting from externally stimulated to internally stimulated thoughts results in a disruption of task-relevant information
 - Disruption leads to decline in learning outcomes
 - Results for TUT support theory, results for TRI do not

Future Research

- Always differentiate between TUT and TRI, and possibly other types
- Always specify conceptualisation of TRI, akin to how the conceptualisation of TUT should be specified (Seli et al., 2018)

Implications for Educational Practice

- Learners are engaged in an internal stream of thought about 50% of the time while learning
- Implications vary by setting
 - Classroom: Include collaborative learning elements (Knopps & Wissman, 2023)
 - Online learning:
 - Prompt learners with learning activities once they are off-task (Mills et al., 2021)
 - Personalisation of learning (Xu & Metcalfe, 2016)

Limitations

Limitations

- Conceptual alignment
 - Some sources had measured TRI but not conceptualised it as such -> we had to interpret these as TRI
- No moderator analysis as subgroups were too small

Conclusion

Conclusion

- TRI occurs less frequently than TUT and does not affect learning outcomes
- Differentiation and conceptualisation is needed for future research
- Adjust learning materials and teaching to adjust for learners not paying attention about 50% of the time

Thank you!

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