PSYCHONOMIC SOCIETY
62ND ANNUAL MEETING

The Synchrony Effect is Not as General and Robust as Previously Thought! Evidence from a Latent-Variable Analysis

Alodie Rey-Mermet & Nicolas Rothen

UniDistance Suisse

Synchrony Effect

- Cognitive performance is assumed to be **better** at the peak of circadian arousal ("**on peak**") than at **off peak** (e.g., May & Hasher, 1993, *Psychol Sci*)

Morning type	Evening type
Participants with a peak at ***morning*** should show better performance in the ***morning*** than in the ***evening***	Participants with a peak at ***evening*** should show better performance in the ***evening*** than in the ***morning***

Previous Research

Construct	Evidence	
	In favor of the synchrony effect	Against the synchrony effect
Episodic memory (= Memory for specific events occurring at a particular time and place)	Intons-Peterson et al., 1999, *J Exp Psychol Gen* Lehmann et al., 2013, *Int Psychogeriatr* May et al., 1993, *Psychol Sci* May et al., 2005, *Psychol Sci* Petros et al., 1990, *Br J Psychol* Yang et al., 2007, *Psychon Bull Rev*	-
Working memory (= Ability to retain access to a limited amount of information)	Rowe et al., 2009, *Q J Exp Psychol* Schmidt et al., 2015, *Front Neurol* West et al., 2002, *J Gerontol B Psychol Sci Soc Sci*	Lewandowska et al., 2018, *Chronobiol Int* Schmidt et al., 2015, *Front Neurol*
Attentional control (= Maintaining a goal and goal-relevant information when facing distraction; von Bastian et al., 2020, *PsyArXiv*)	Hahn et al., 2012, Dev Sci Hasher et al., 2002, Can J Exp Psychol May & Hasher, 1998, *J Exp Psychol Gen* Manly et al., 2002, *Neuropsychologia*	Knight & Matter, 2013, *Exp Aging Res* Li et al., 1998, *Psychol Aging* Matchock & Mordkoff, 2008, *Exp Brain Res* Schmidt et al., 2012, *PLoS One*

Issues

- Most studies were **underpowered**
  (i.e., they included **small sample sizes** in **between-subjects designs**).

- Most studies included **only one task, but the tasks differ across studies**.
  - **Working memory**: unclear to what extent only short-term memory was assessed
  - **Attentional control**: missing convergent validity

    (e.g., Karr et al., 2018, *Psychon Bull Rev*; Rey-Mermet et al., 2018, *J Exp Psychol Learn Mem Cogn*; Rey-Mermet et al., 2019, *J Exp Psychol Gen*; Rey-Mermet et al., 2020, *PLoS One;* Rey-Mermet et al., 2021, *PsyArXiv;* von Bastian et al., 2020*, PsyArXiv*)

The Goal of the Present Study is…

- to test the **synchrony effect** in **working-memory** and **attentional-control processes**

Sample

- **194 young participants** from the general population (M_{age} = 23.9, SD_{age} = 3.0, age range = 18-28, women = 136)

- Inclusion's criteria:
  - **Morning or evening type** according to German version of the Morningness-Eveningness-Questionnaire (D-MEQ; Griefahn et al., 2001, *Somnologie*)
  - German or Swiss German as mother language
  - no color blindness or neurological disease
  - no missing data and multivariate outliers

Testing

- **Online** experiment
  - Participants were **recruited** by the students from UniDistance Suisse.
  - Participants were tested under the **close assistance** of the students (e.g., they phoned the students in case of technical problems or misunderstandings).

- Following previous research (e.g., May & Hasher, 1993, *Psychol Sci;* May & Hasher, 1998, *J Exp Psychol Gen*), **testing** occurs at **08:00** and at **17:00**.

- **All participants** were tested at **both on-peak** and **off-peak** times.

  ⇒ **Within-subject design**

Tasks

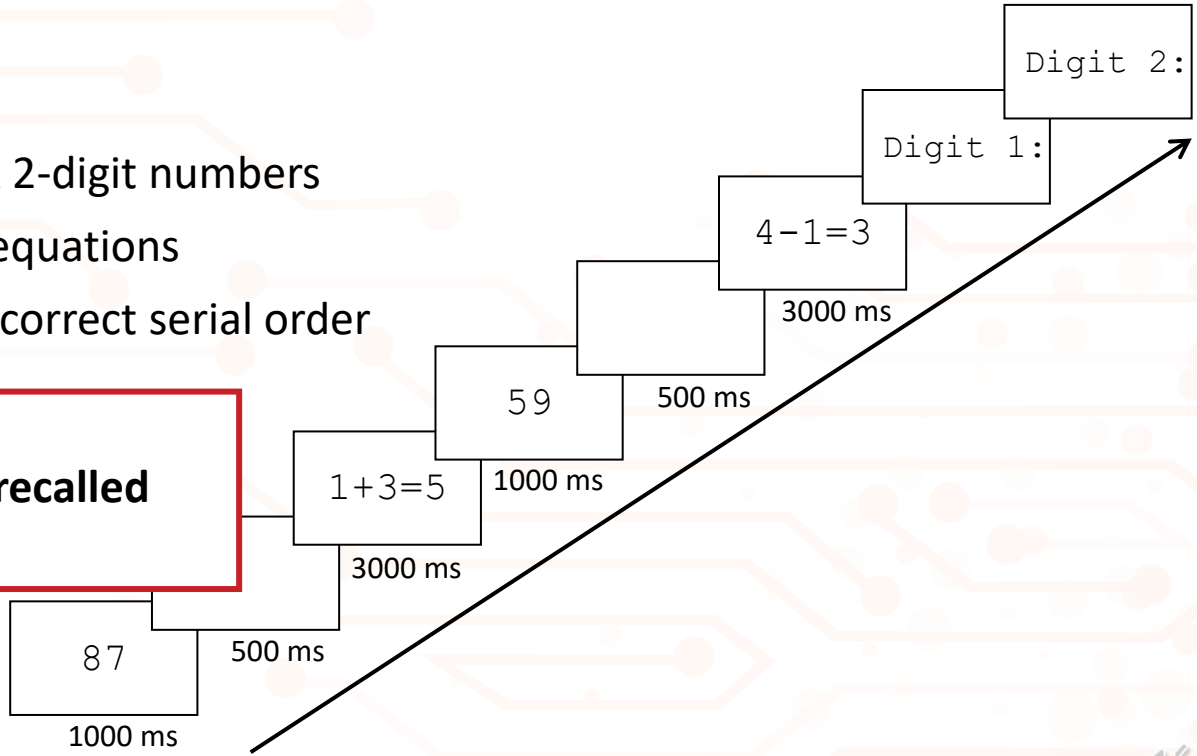
Working memory (WM)	Short-term memory (STM)
Numerical complex span	Numerical simple span
Spatial complex span	Spatial simple span
Numerical updating	Verbal simple span
Spatial updating	Arrow simple span

WM task: Numerical *Complex* Span

Task:

1. to memorize three to six 2-digit numbers
2. to judge the veracity of equations
3. to recall the numbers in correct serial order

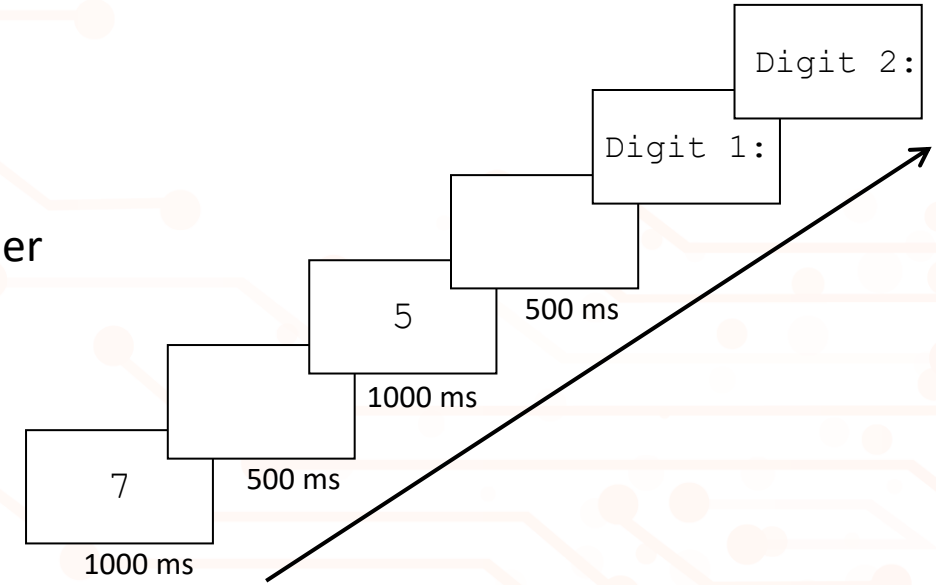
➢ Dependent measure:
Accuracy rates for **items recalled at the correct position**



STM task: Numerical *Simple* Span

Task:

1. to memorize three to nine digits
2. to recall the digits in correct serial order



➢ Dependent measure:
Accuracy rates for **items recalled at the correct position**

Attentional Control?

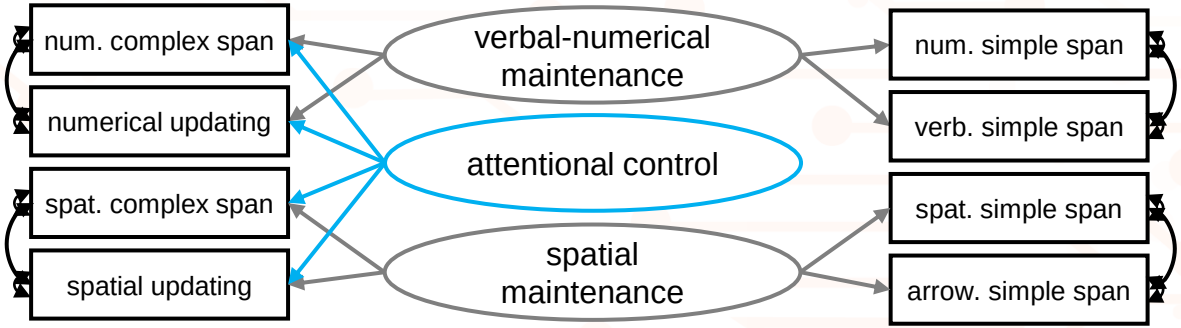
According to previous research (e.g., Engle et al., 1999, *J Exp Psychol Gen;* Kane et al., 2004, *J Exp Psychol Gen*), **WM tasks** are assumed to involve:

- **domain-specific memory/maintenance processes**
- **domain-general attentional-control processes**.

Attentional Control?

According to previous research (e.g., Engle et al., 1999, *J Exp Psychol Gen;* Kane et al., 2004, *J Exp Psychol Gen*), **WM tasks** are assumed to involve:

- **domain-specific memory/maintenance processes**
- **domain-general attentional-control processes**.



Reliability Estimates

Construct	Task	Off peak	On peak
WM	numerical complex span	.88	.87
	spatial complex span	.92	.92
	numerical updating	.95	.96
	spatial updating	.92	.92
STM	numerical simple span	.89	.89
	spatial simple span	.87	.85
	verbal simple span	.87	.88
	arrow simple span	.75	.80

Note. Spearman-Brown corrected split-half reliability computed using a permutation-based split-half approach with 5000 random splits (see Parsons et al., 2019, *AMPPS*)

Correlations

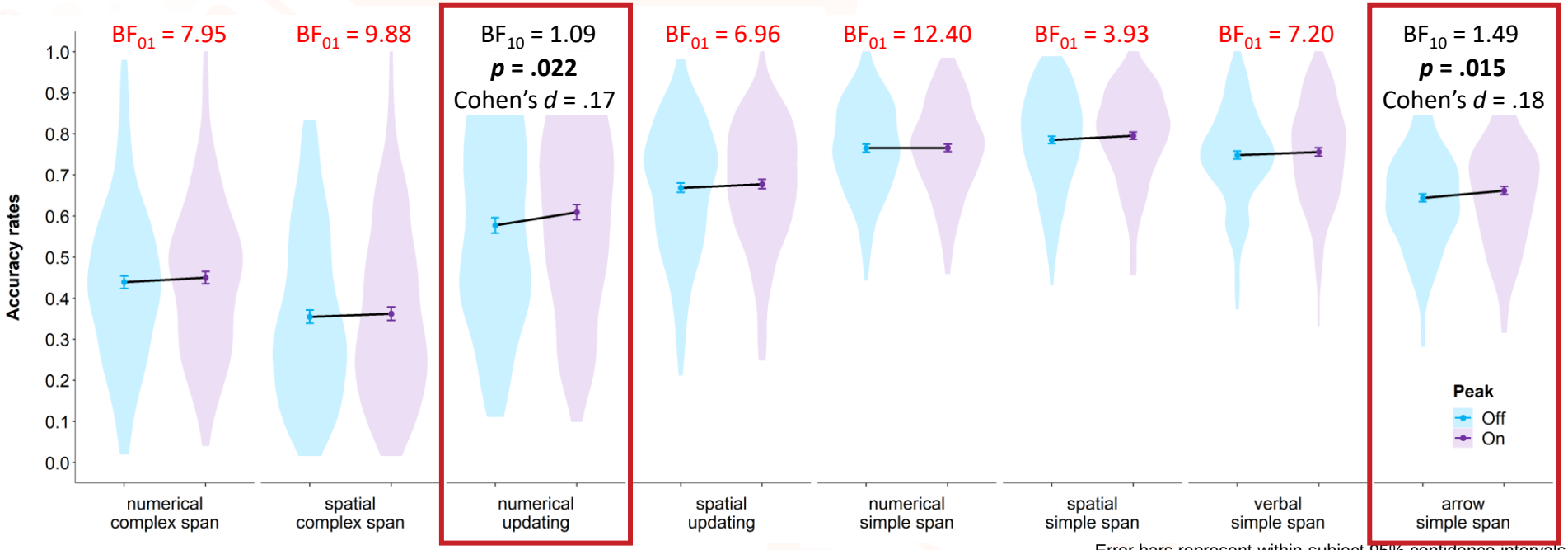
			Off								On							
			WM				STM				WM				STM			
			1.	2.	3.	4.	5.	6.	7.	8.	1.	2.	3.	4.	5.	6.	7.	8.
Off	WM	1. numerical complex span	-															
		2. spatial complex span	**.46**	-														
		3. numerical updating	**.40**	**.43**	-													
		4. spatial updating	**.38**	**.52**	**.52**	-												
	STM	5. numerical simple span	**.55**	**.33**	**.35**	**.34**	-											
		6. spatial simple span	**.35**	**.55**	**.40**	**.57**	**.27**	-										
		7. verbal simple span	**.53**	**.36**	**.36**	**.33**	**.68**	**.30**	-									
		8. arrow simple span	**.44**	**.41**	**.46**	**.49**	**.39**	**.58**	**.35**	-								
On	WM	1. numerical complex span	**.63**	**.32**	**.36**	**.25**	**.41**	**.30**	**.52**	**.36**	-							
		2. spatial complex span	**.34**	**.73**	**.29**	**.46**	**.28**	**.51**	**.32**	**.31**	**.41**	-						
		3. numerical updating	**.32**	**.41**	**.64**	**.43**	**.29**	**.34**	**.36**	**.33**	**.49**	**.44**	-					
		4. spatial updating	**.31**	**.43**	**.35**	**.73**	**.31**	**.49**	**.32**	**.41**	**.29**	**.46**	**.44**	-				
	STM	5. numerical simple span	**.44**	**.36**	**.29**	**.28**	**.67**	**.33**	**.63**	**.39**	**.52**	**.43**	**.38**	**.33**	-			
		6. spatial simple span	**.25**	**.41**	**.26**	**.46**	**.28**	**.68**	**.32**	**.54**	**.31**	**.46**	**.36**	**.50**	**.37**	-		
		7. verbal simple span	**.49**	**.29**	**.26**	**.29**	**.60**	**.27**	**.68**	**.33**	**.51**	**.39**	**.34**	**.37**	**.66**	**.32**	-	
		8. arrow simple span	**.35**	**.39**	**.37**	**.46**	**.31**	**.56**	**.27**	**.69**	**.41**	**.39**	**.41**	**.43**	**.42**	**.56**	**.32**	-

bold = p < .05

$BF_{10} > 3$

$BF_{01} > 3$

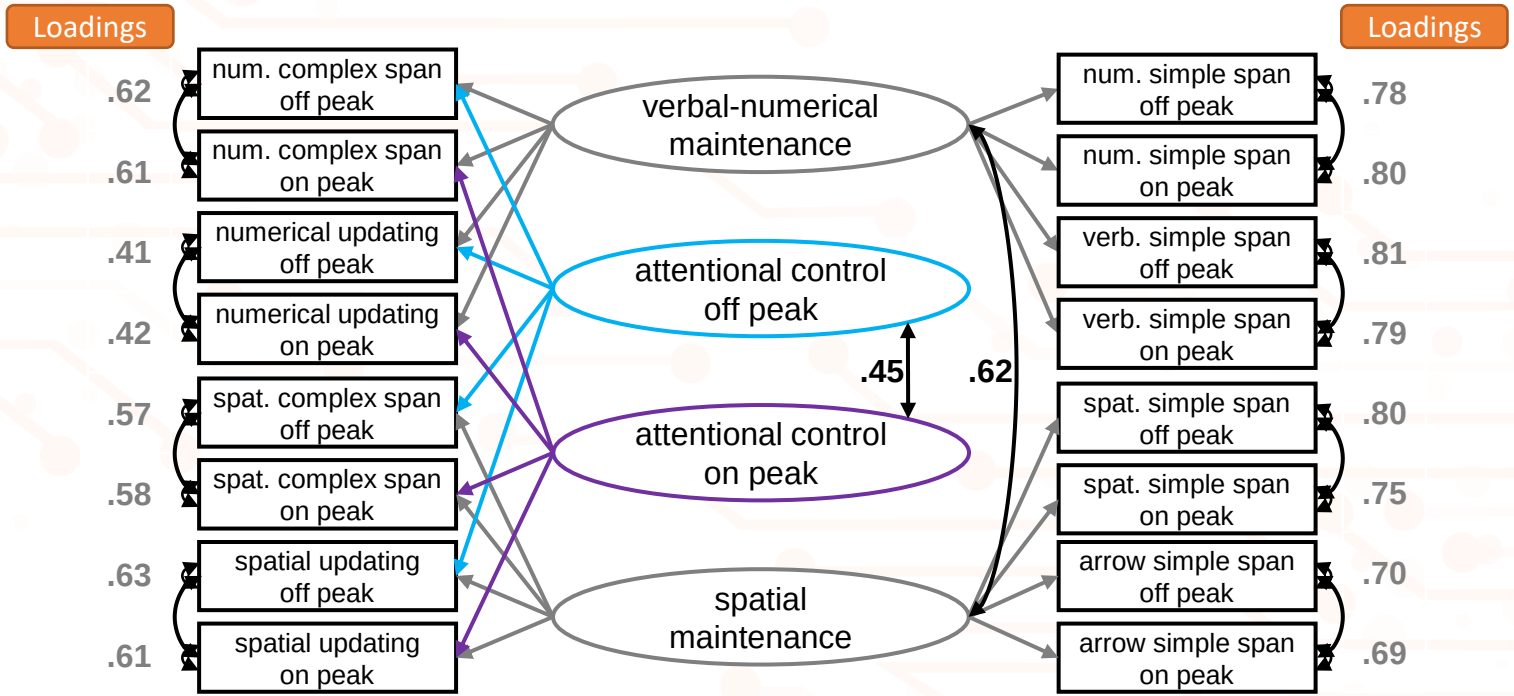
Synchrony Effect at the Individual-Task Level



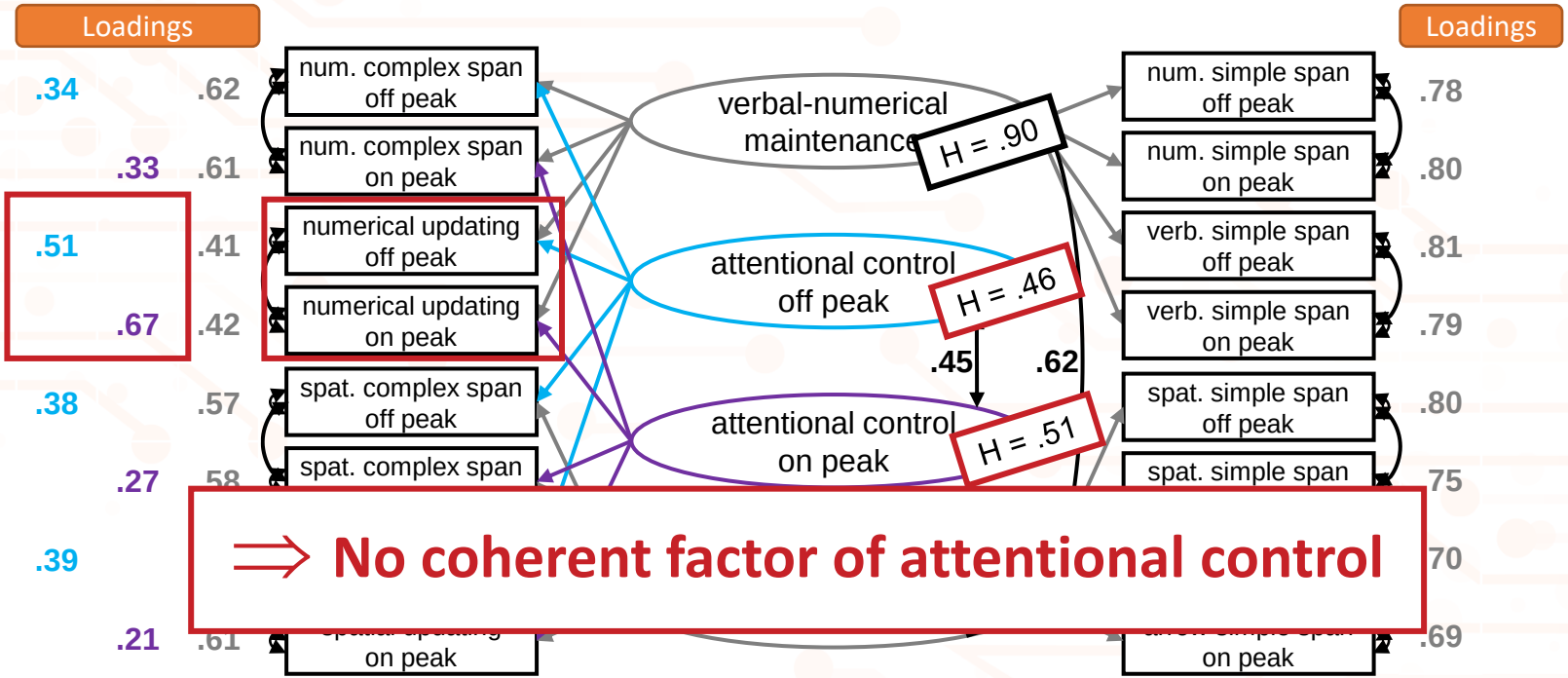
Error bars represent within-subject 95% confidence intervals
(Cousineau, 2005, *Tutor Quant Methods Psychol*; Morey, 2008, *Tutor Quant Methods Psychol*)

#psynom21

Synchrony Effect at the Latent-Variable Level



Synchrony Effect at the Latent-Variable Level



⇒ **No coherent factor of attentional control**

#psynom21

Summary

- At the **individual-task** level:
  - The **synchrony effect** was **rare** and **task specific**, but neither construct specific (WM or STM) nor domain specific (verbal-numerical or spatial).
  - The **synchrony effect** was **small**.

- At the **latent-variable** level:
  - **No synchrony effect** in the **short-term maintenance processes**
  - **Synchrony effect** in **attentional control**: **???**
    - ***Issue in measuring attentional control as a psychometric construct even when using WM and STM tasks***

Take-Home Message

- The **synchrony effect** is not as **general** and **robust** as the last 30 years of research may have suggested.

- The present findings call into question the **necessity of assuming a synchrony effect**.

Thank you for your attention!

Email: alodie.rey-mermet@fernuni.ch