

**LA STRUTTURA DELLA MEMORIA DI LAVORO IN BAMBINI  
FRA I 4 E GLI 8 ANNI: ANALISI DEGLI EFFETTI DELL'ETÀ  
E DELLE DIFFERENZE INDIVIDUALI**

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# LA MEMORIA DI LAVORO

## Il modello di Baddeley

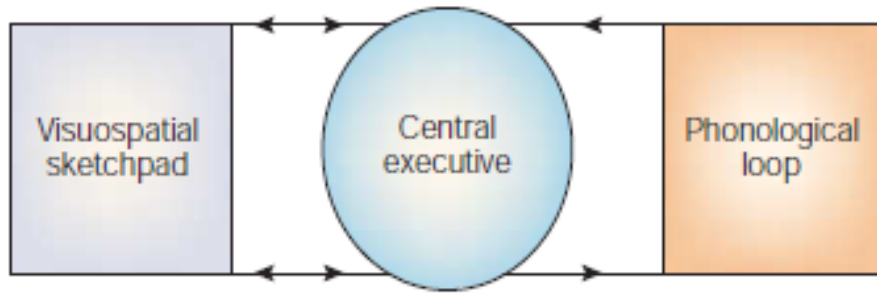
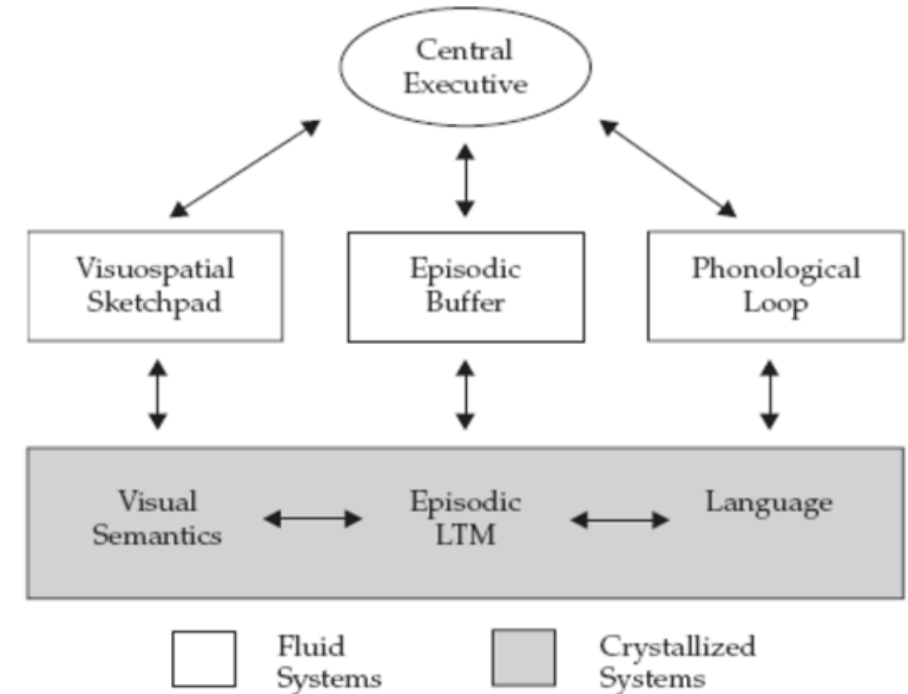
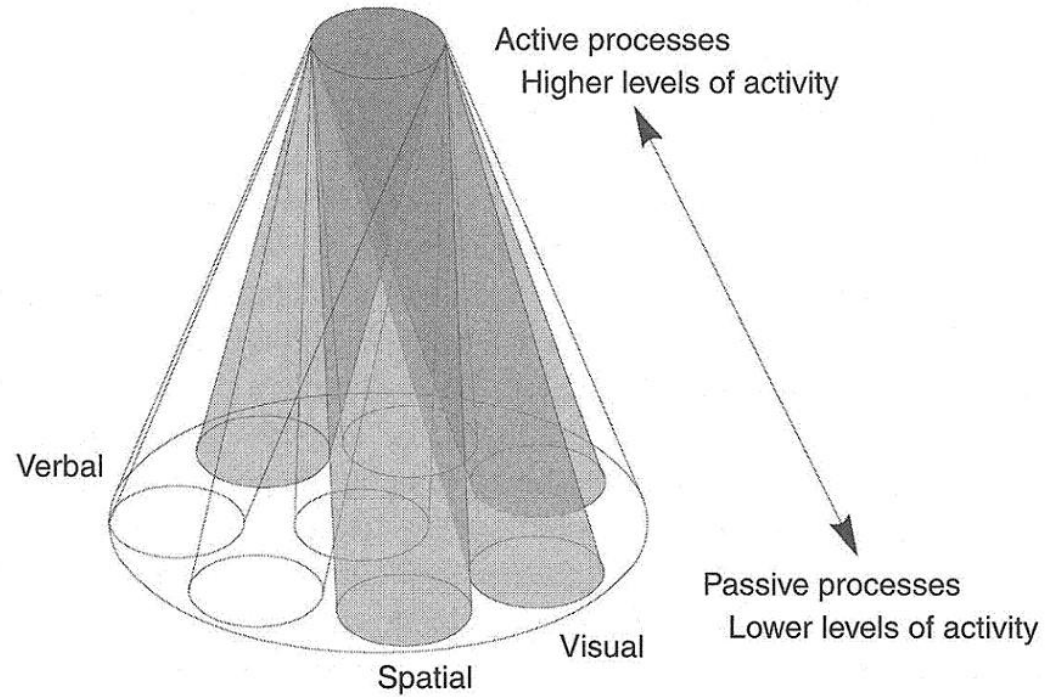


Figure 1 | **The three-component model of working memory.** This model, proposed by Baddeley and Hitch<sup>10</sup>, comprises a control system, the central executive, and two storage systems, the visuospatial sketchpad and the phonological loop.



# LA MEMORIA DI LAVORO



Cornoldi and Vecchi, 2000

# LA MEMORIA DI LAVORO NEI BAMBINI



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# The Structure of Working Memory From 4 to 15 Years of Age

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University of Bristol

The structure of working memory and its development across the childhood years were investigated in children 4–15 years of age. The children were given multiple assessments of each component of the A. D. Baddeley and G. Hitch (1974) working memory model. Broadly similar linear functions characterized performance on all measures as a function of age. From 6 years onward, a model consisting of 3 distinct but correlated factors corresponding to the working memory model provided a good fit to the data. The results indicate that the basic modular structure of working memory is present from 6 years of age and possibly earlier, with each component undergoing sizable expansion in functional capacity throughout the early and middle school years to adolescence.

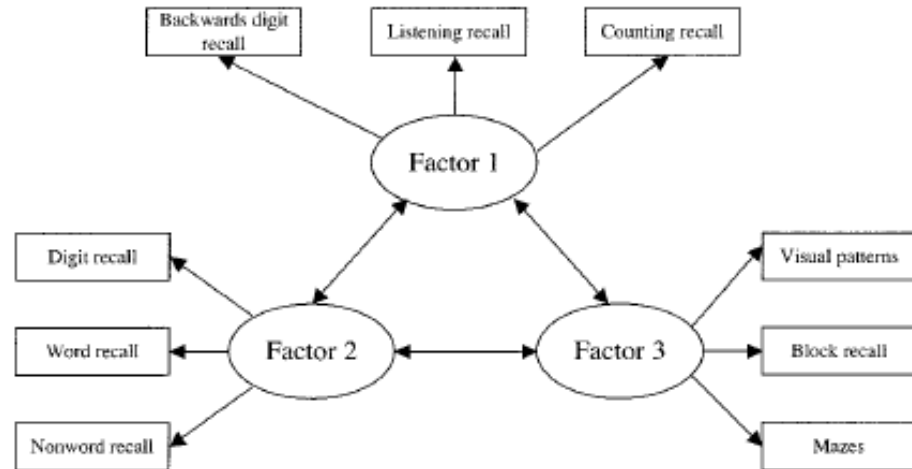


Table 1  
Mean Test Scores as a Function of Age and Sex

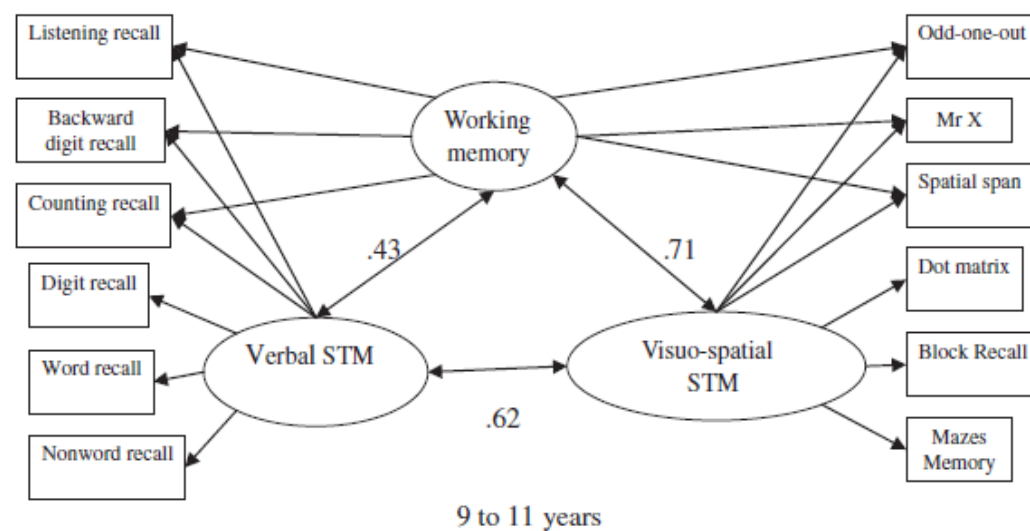
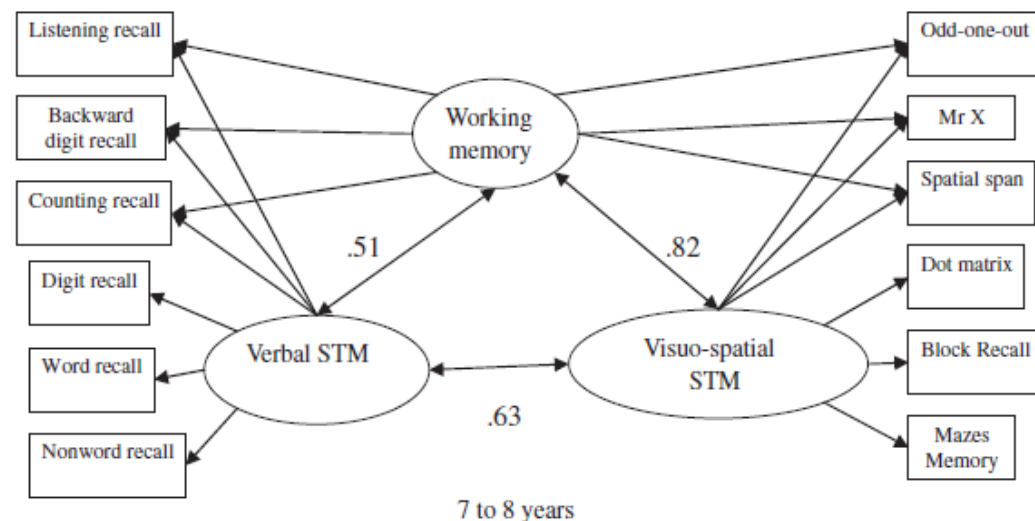
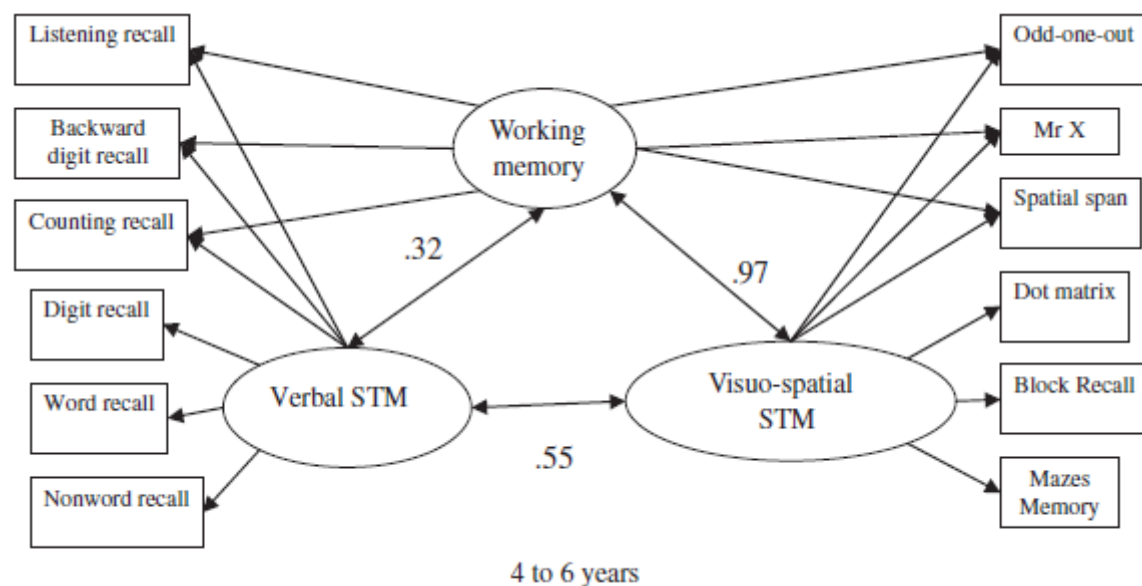
Age (years)	Sex	N	Working memory measure								
			Digit recall	Word recall	Nonword recall	Block recall	Visual patterns	Mazes memory	Backward digit recall	Listening recall	Counting recall
4	M	25	19.8	13.7	10.0	15.4	5.3	—	5.6	—	—
	F	17	19.5	13.9	8.6	15.1	6.0	—	5.8	—	—
5	M	44	22.0	14.6	9.8	20.1	8.2	—	8.0	—	—
	F	57	23.1	15.2	10.3	19.9	8.8	—	8.8	—	—
6	M	40	24.7	16.5	12.2	21.5	10.6	10.7	9.7	8.4	15.4
	F	49	25.5	17.2	12.7	21.8	11.1	8.8	10.5	8.9	16.4
7	M	49	26.4	18.1	11.9	23.7	13.3	13.9	11.4	9.6	19.2
	F	46	25.6	18.6	12.3	24.0	14.0	13.6	12.0	10.4	19.0
8	M	32	26.5	18.8	13.1	25.2	15.8	18.5	12.3	11.5	21.7
	F	30	27.2	19.4	13.5	25.4	15.1	16.7	13.0	11.1	22.0
9	M	47	27.5	20.2	13.8	26.1	17.2	21.0	12.8	12.0	22.6
	F	45	28.2	20.0	13.6	25.6	15.4	18.2	13.0	11.6	22.8
10	M	51	29.2	20.6	14.2	27.8	19.8	22.3	14.2	12.7	24.8
	F	46	29.5	22.0	14.7	27.2	18.6	19.5	14.2	12.7	24.3
11	M	19	29.5	21.1	14.0	28.7	20.6	24.0	15.6	12.8	23.2
	F	16	32.6	21.6	14.4	29.0	21.1	22.8	17.6	14.3	25.1
13	M	25	32.5	22.9	16.2	30.6	20.5	28.6	18.2	14.7	27.4
	F	20	34.0	25.0	16.7	29.9	18.8	28.0	18.5	15.0	27.2
14	M	6	37.3	25.5	19.2	29.7	22.2	28.7	19.0	15.7	29.5
	F	8	33.6	24.0	16.8	29.1	20.1	28.0	19.5	14.8	28.3
15	M	28	33.8	24.0	17.5	33.6	23.1	30.5	18.8	17.8	29.3
	F	18	36.0	24.4	18.2	31.9	19.2	28.5	17.9	15.3	28.2

Note. Dashes indicate that 4- and 5-year-olds were not given those tests because the task demands were too difficult for them. M = male; F = female.

# Verbal and Visuospatial Short-Term and Working Memory in Children: Are They Separable?

Tracy Packiam Alloway and  
Susan Elizabeth Gathercole  
*University of Durham*

Susan J. Pickering  
*University of Bristol*





# MEMORIA DI LAVORO VISUO-SPAZIALE

Logie (1995)

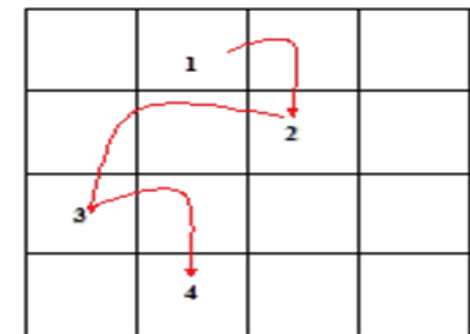
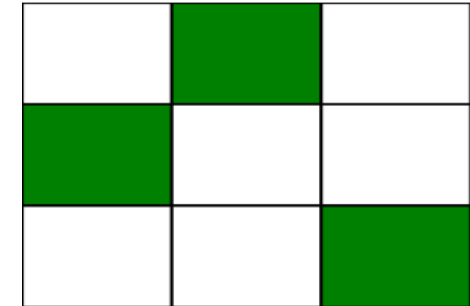
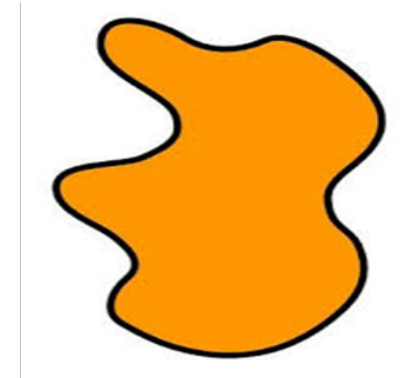
Distinzione tra il Visual Cache, un magazzino temporaneo per le informazioni visive e l'Inner Scribe, un sistema spaziale legato al mantenimento temporaneo di movimenti e sequenze di movimenti.

Pazzaglia e Cornoldi (1999)

ML visiva, ricordo di forme e colori

ML spaziale-simultanea, ricordo di configurazioni di posizioni presentate simultaneamente

ML spaziale-sequenziale, ricordo di configurazioni di posizioni presentate sequenzialmente



# STUDIO 1: LA MEMORIA DI LAVORO IN BAMBINI DI 4-7 ANNI

- Considerando le componenti verbale, visiva, spaziale-simultanea e spaziale sequenziale
- Cercando dei compiti utili ad esplorare anche le prestazioni dei bambini prescolari



## Compiti passivi

*Rievocazione*

## Compiti medi

*Ricordo selettivo*

## Compiti attivi

*Doppio compito*

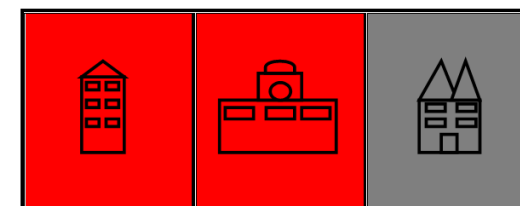
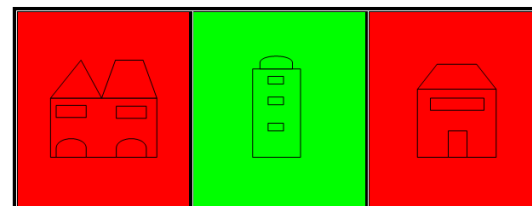
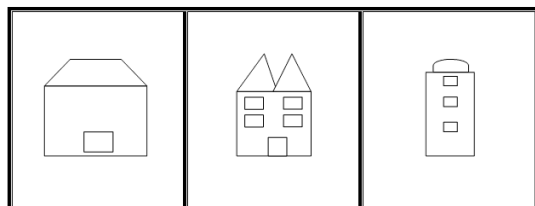
**Verbale**

PALLA SOLE MELA

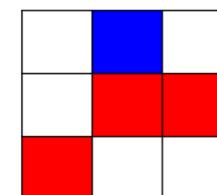
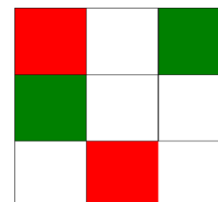
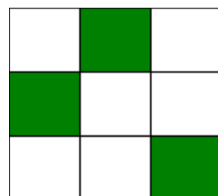
SOLE, mela, cane;  
PALLA, luna, mamma

SOLE pera **palla**  
mamma

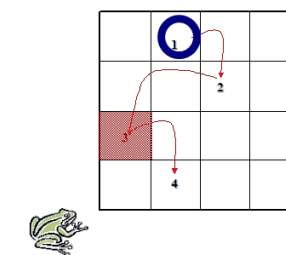
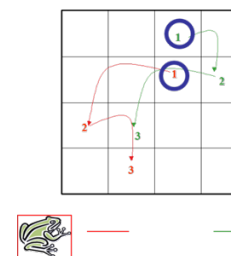
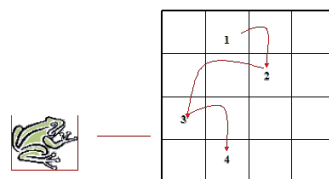
**Visiva**



**Spaziale  
simultanea**



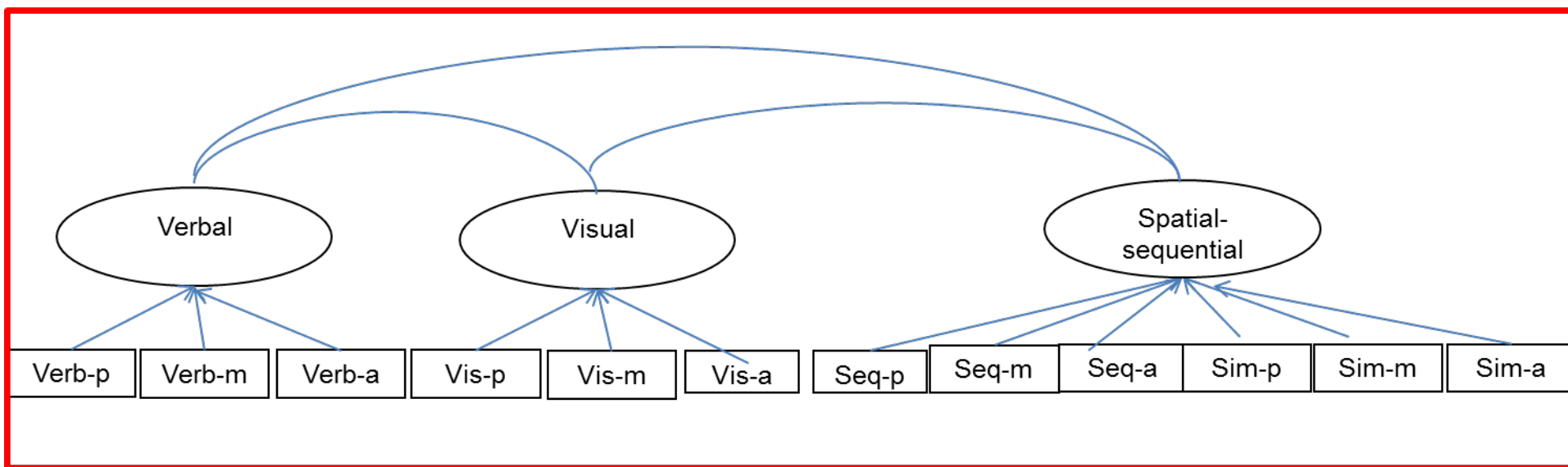
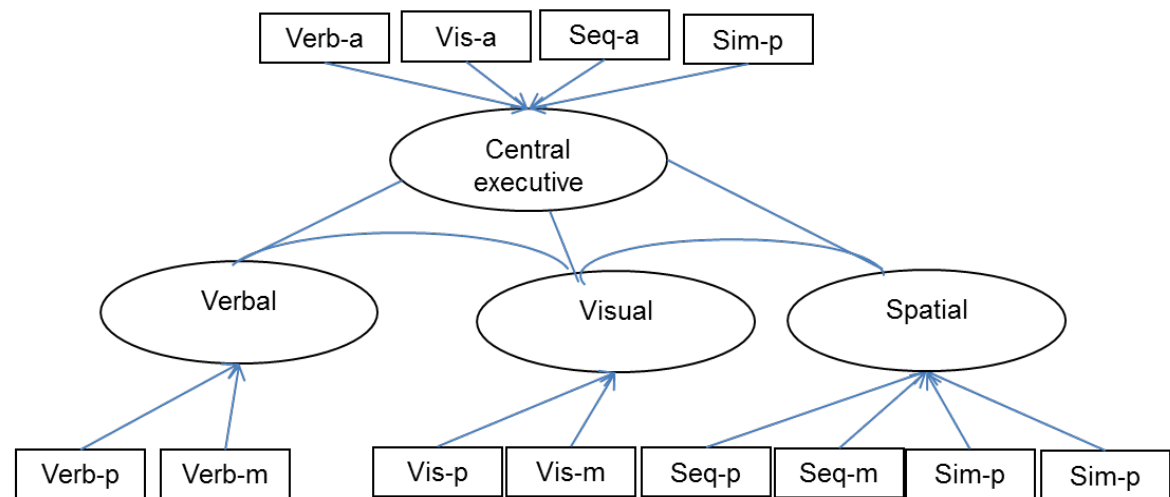
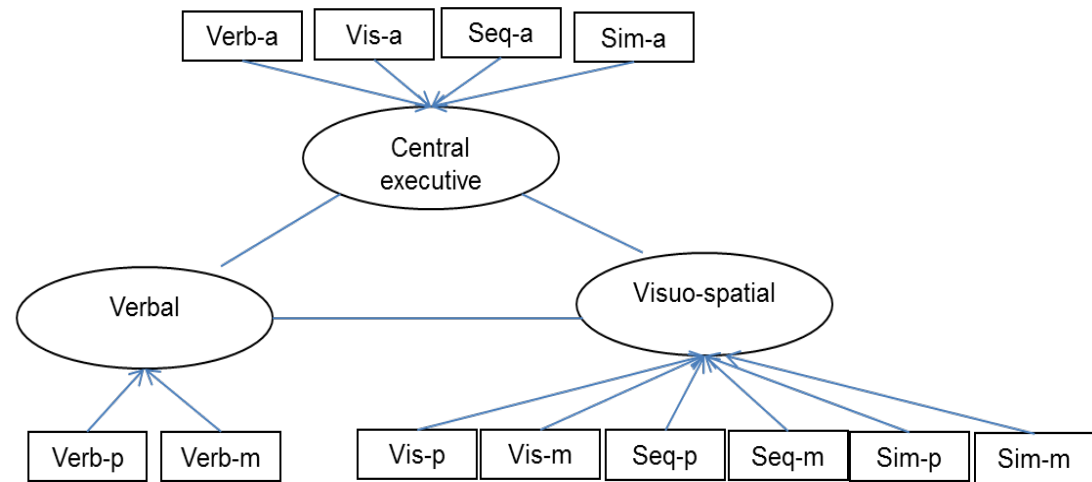
**Spaziale  
sequenziale**

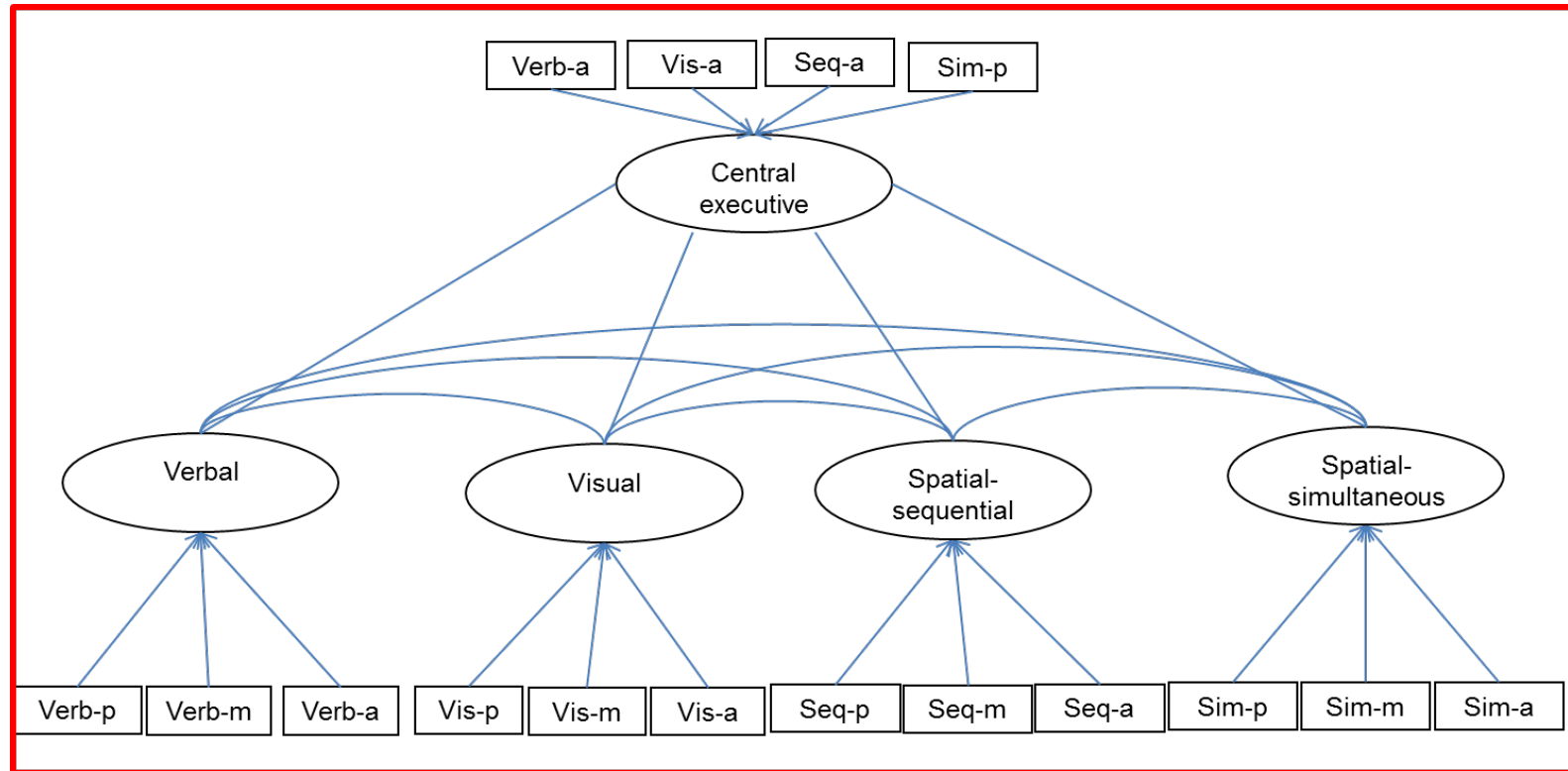
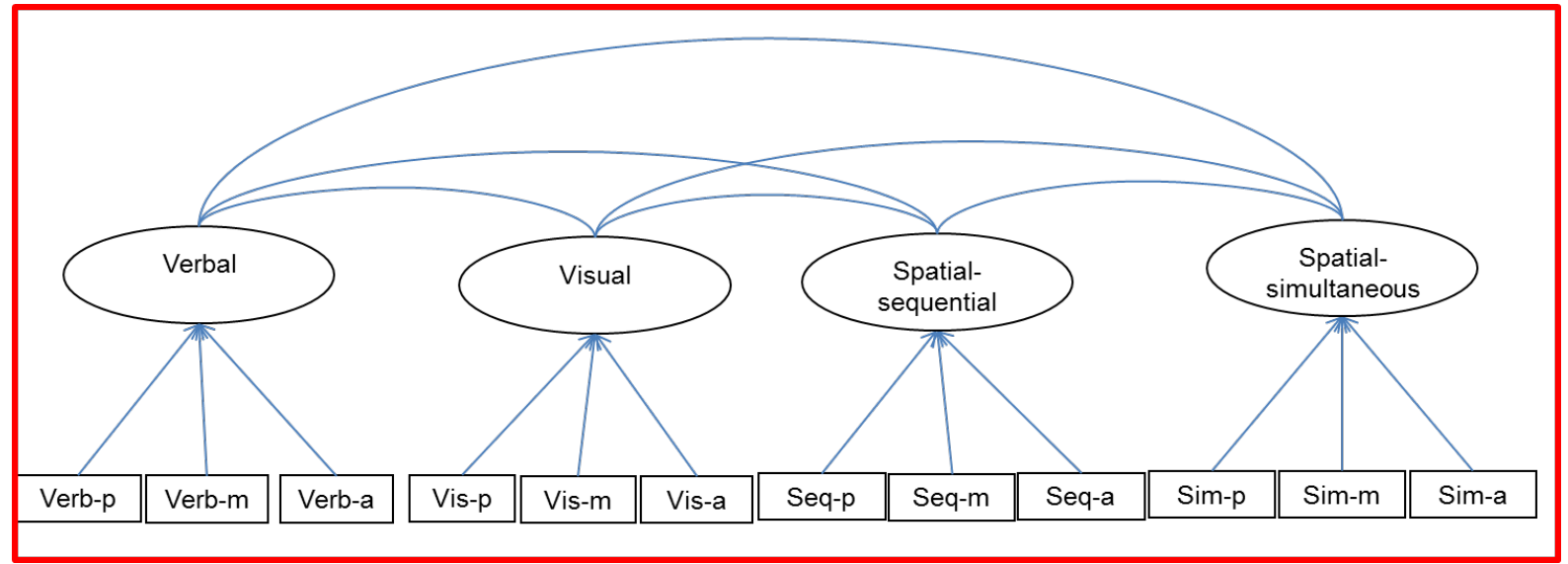


# STUDIO 1: LA MEMORIA DI LAVORO IN BAMBINI DI 4-7 ANNI


## *Partecipanti*

241 bambini (51% maschi) frequentanti la scuola dell'infanzia ed i primi due anni della scuola primaria, di età compresa fra i 4 ed i 7 anni e 6 mesi ( $M = 62$  DS = 10 mesi).



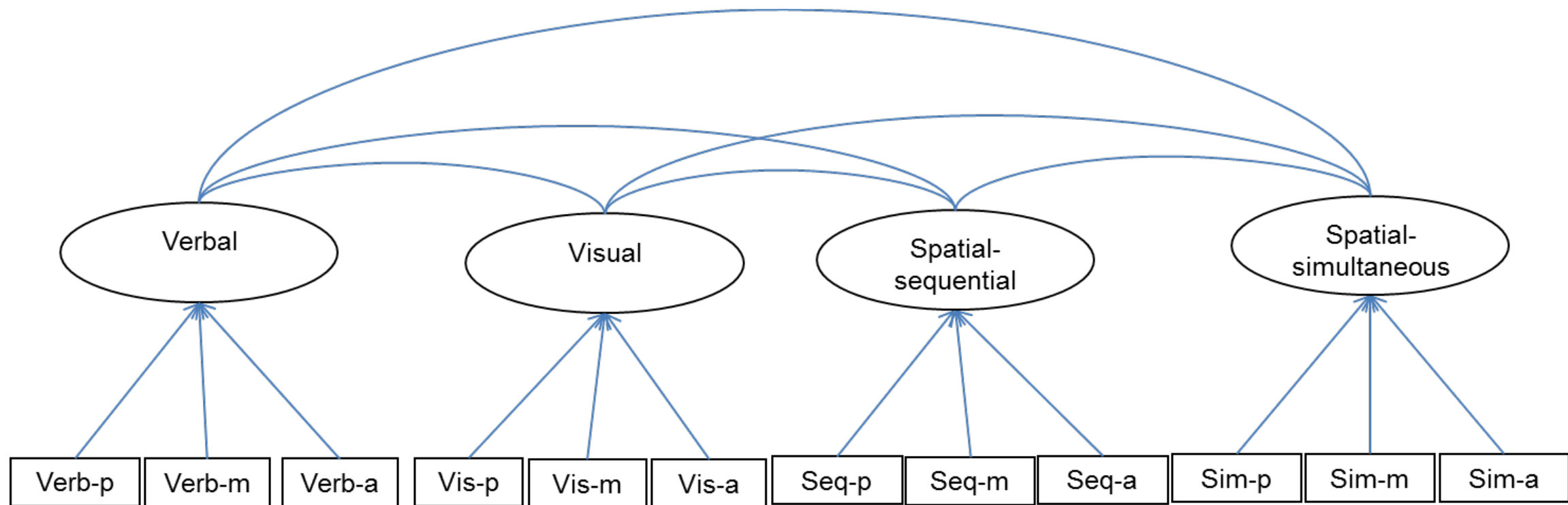


## Metodo di stima bayesiano



	CCrit	PPAMSE	WAIC	WAIC.se	SRMR	SRMR.hdi	CD	CD.hdi
M001	100	0.95	22764.37	141.57	0.07	0.068-0.077	0.97	0.963-0.982
M002	100	0.93	22755.19	140.52	0.07	0.069-0.08	0.98	0.971-0.985
M003	100	0.90	22695.91	140.09	0.06	0.059-0.070	0.98	0.972-0.982
M004	100	0.85	22530.78	136.84	0.06	0.048-0.063	0.99	0.990-0.994
M005	100	0.90	22743.45	141.51	0.08	0.07-0.093	0.99	0.985-0.993

**Table 2.** Fit indices of factorial models ( $n = 498$ ): CCrit = Convergence Criterion, PPAMSE = *Posterior Predictive Average Root Mean Square Error* (Yang-Wallentin et al., 2010), WAIC = Widely Applicable Information Criterion (Watanabe, 2010), WAIC.se = WAIC standard error, SRMR = Standardized Root Mean Square Residual (Jöreskog & Sörbom, 1996), CD = Coefficient of Determination (Bollen, 1989; Jöreskog & Sörbom, 1996); hdi indicates the 89% highest density interval of posterior distribution (McElreath, 2016).



# STUDIO 2 LE DIFFERENZE INDIVIDUALI: ETA' E LIVELLO INTELLETTIVO

## PARTECIPANTI

498 bambini frequentanti la scuola dell'infanzia e la scuola primaria di età compresa fra i 3 e gli 8 ( $M = 65$   $SD = 14$ ).

ETA'	N
3 anni- 5 anni e 6 mesi	312
5 anni e 7 mesi- 8 anni	186



# ETA'

Differenza standardizzata tra le correlazioni osservate e quelle predette. Un valore inferiore a .08 è generalmente considerato un buon fit.

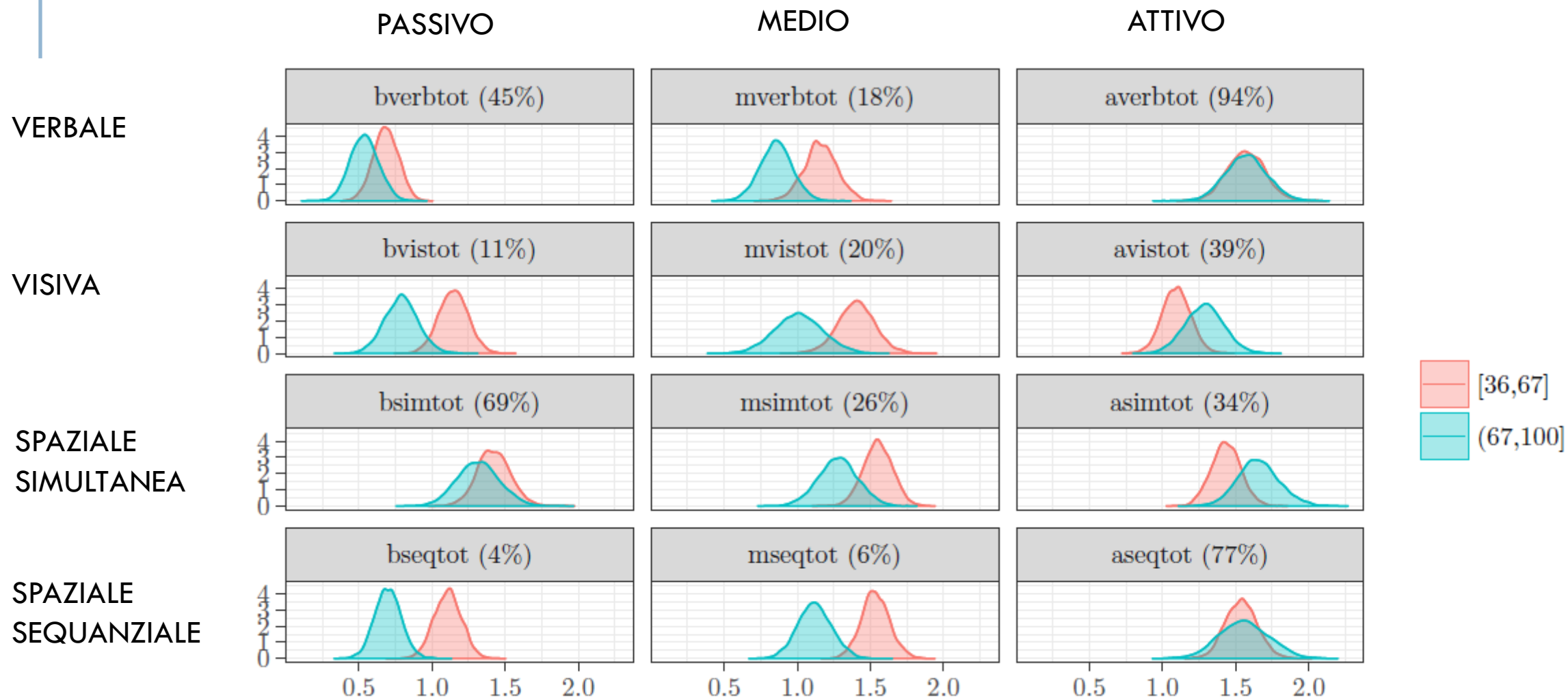
References

5

	n	CCrit	PPAMSE	WAIC	WAIC.se	SRMR	SRMR.hdi	CD	CD.hdi
age[36,67]	312	100	0.91	14061.45	116.36	0.07	0.061-0.077	0.99	0.988-0.994
age(67,100]	186	100	0.71	8089.74	88.35	0.07	0.054-0.079	0.98	0.97-0.99

**Table 3.** Fit indices of factorial model M004 in age groups: CCrit = Convergence Criterion, PPAMSE = *Posterior Predictive Average Root Mean Square Error* (Yang-Wallentin et al., 2010), WAIC = Widely Applicable Information Criterion (Watanabe, 2010), WAIC.se = WAIC standard error, SRMR = Standardized Root Mean Square Residual (Jöreskog & Sörbom, 1996), CD = Coefficient of Determination (Bollen, 1989; Jöreskog & Sörbom, 1996); hdi indicates the 89% highest density interval of posterior distribution (McElreath, 2016).

# ETA'



# LIVELLO INTELLETTIVO

LIVELLO INTELLETTIVO (RAVEN)	N
GR 1 <85	42
GR 2 85-116	327
GR 3 116-130	87
GR 4 >130	42

# LIVELLO INTELLETTIVO

Fig. 3. Model M004 multigroup analysis: posterior distributions of factor loadings by age.

	n	CCrit	PPAMSE	WAIC	WAIC.se	SRMR	SRMR.hdi	CD	CD.hdi
QI[38.9,85]	42	100	1.04	1960.10	45.08	0.13	0.087-0.169	0.99	0.983-0.998
QI(85,116]	327	100	0.78	14410.11	111.31	0.06	0.045-0.067	0.99	0.992-0.996
QI(116,130]	87	100	0.91	4105.22	49.68	0.10	0.078-0.12	0.99	0.98-0.994
QI(130,161]	42	100	1.10	2076.28	25.50	0.15	0.125-0.17	0.99	0.989-0.999

Table 4. Fit indices of factorial model M004 in Raven groups: CCrit = Convergence Criterion, PPAMSE = *Posterior Predictive* Average Root Mean Square Error (Yang-Wallentin et al., 2010), WAIC = Widely Applicable Information Criterion (Watanabe, 2010), WAIC.se = WAIC standard error, SRMR = Standardized Root Mean Square Residual (Jöreskog & Sörbom, 1996), CD = Coefficient of Determination (Bollen, 1989; Jöreskog & Sörbom, 1996); hdi indicates the 89% highest density interval of posterior distribution (McElreath, 2016).

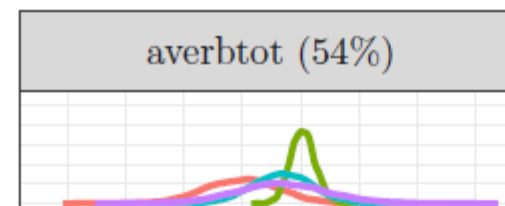
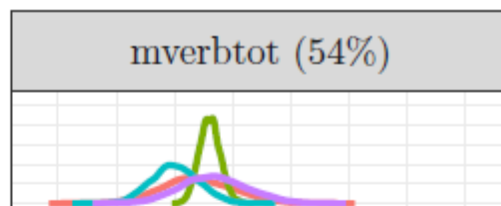
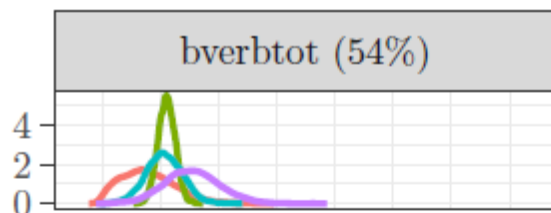
# LIVELLO INTELLETTIVO

PASSIVO

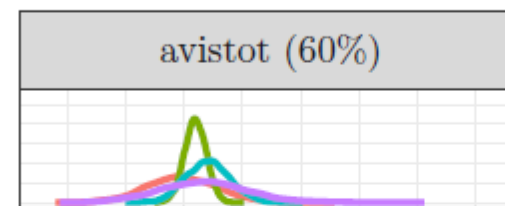
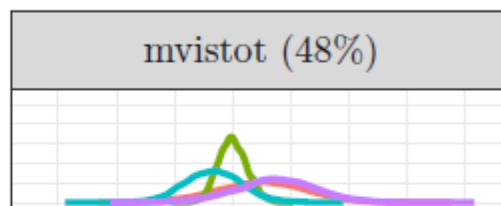
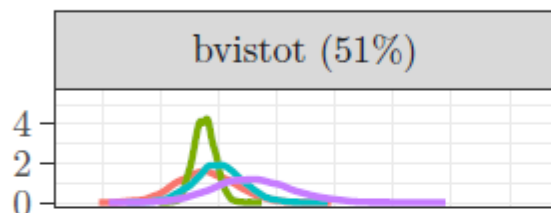
MEDIO

ATTIVO

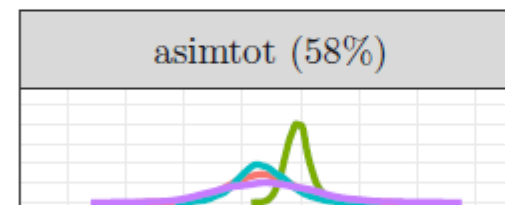
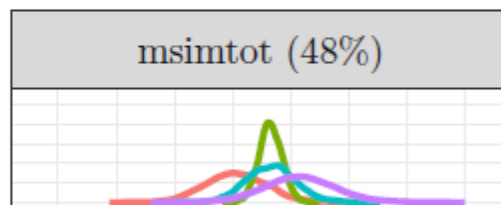
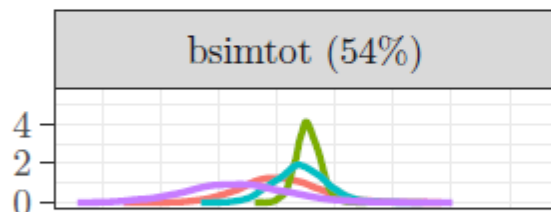
VERBALE



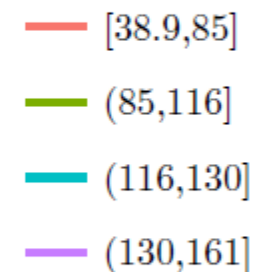
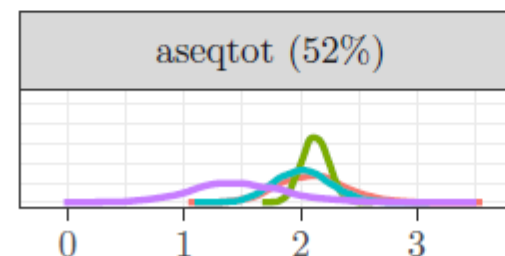
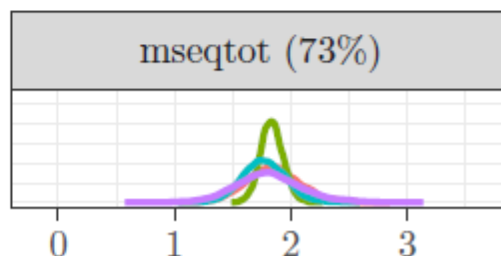
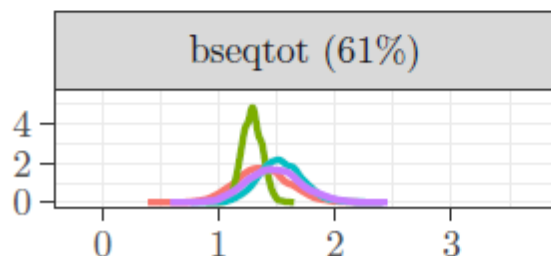
VISIVA

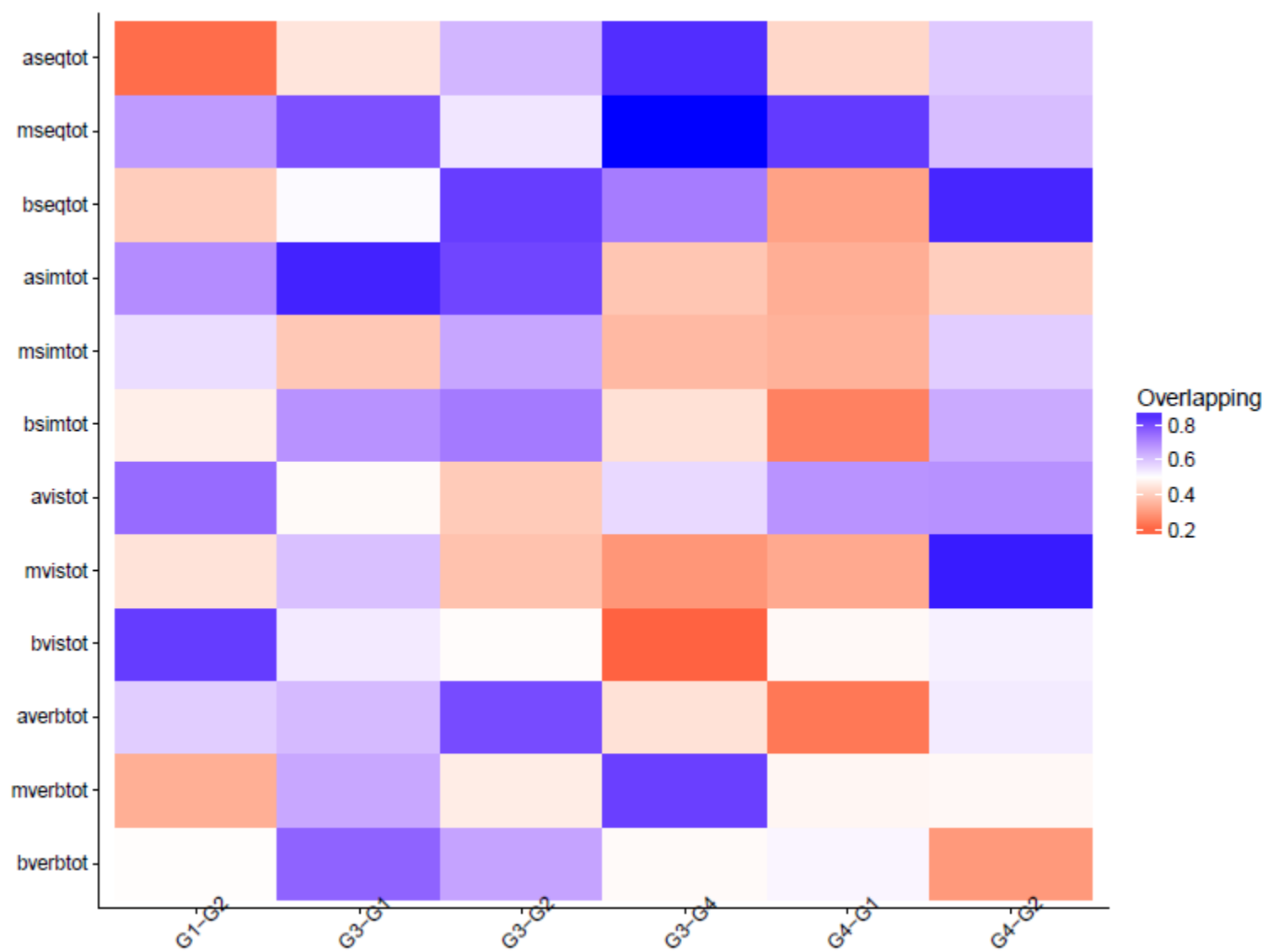


SPAZIALE  
SIMULTANEA



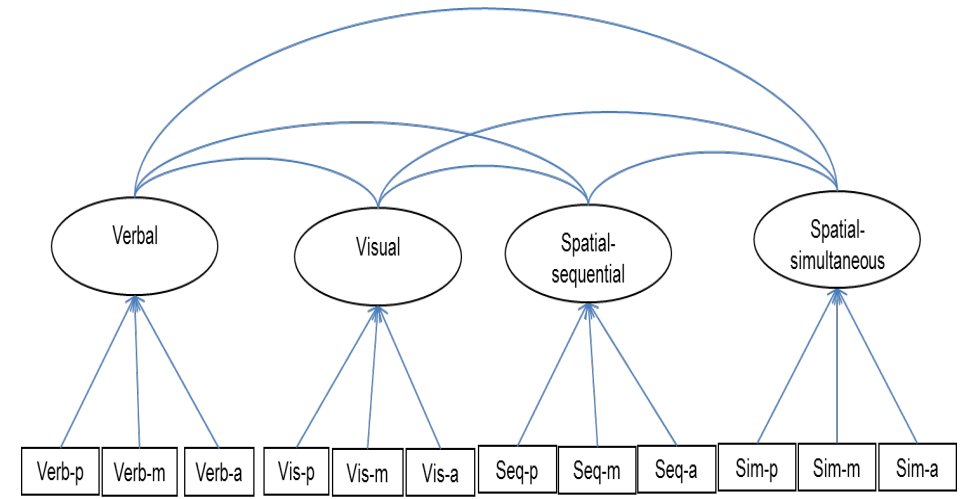
SPAZIALE  
SEQUANZIALE





# CONCLUSIONI

- I risultati di questo studio ci fanno ipotizzare che con lo sviluppo la memoria di lavoro subisca delle trasformazioni di tipo qualitativo con una progressiva modularizzazione dei processi dominio specifici
- Il processo è simile a qualsiasi livello intellettuale





Grazie per l'attenzione!

