Behavior and neurophysiological correlates of sensitivity to positional regularity in a novel statistical learning test

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Introduction

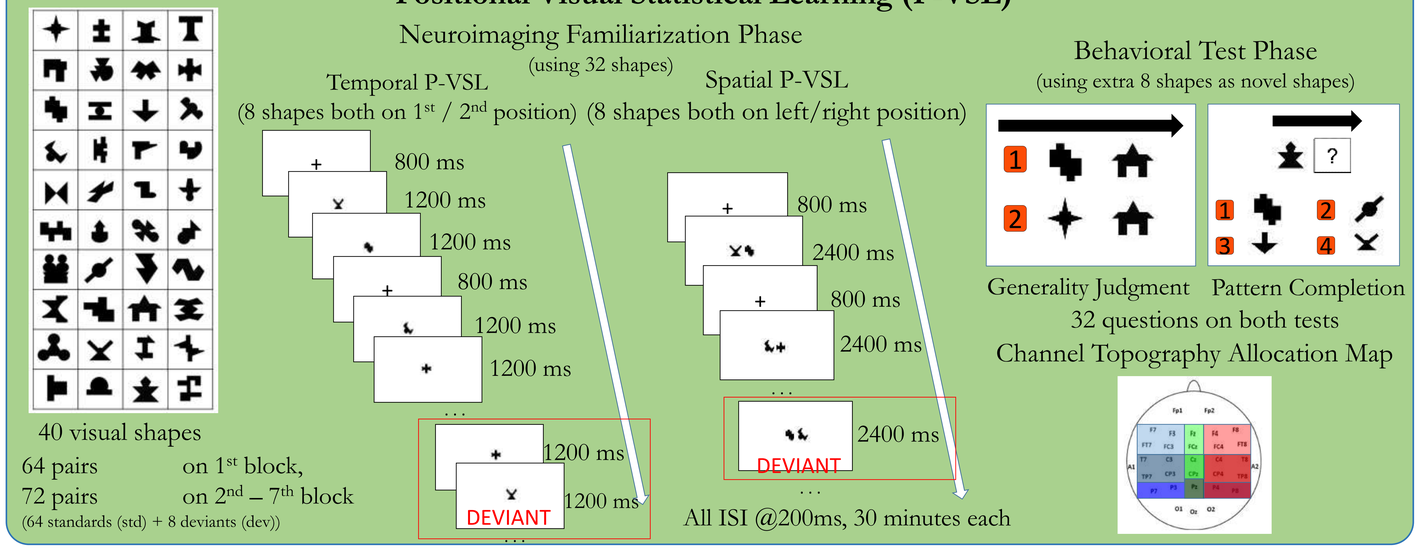
- Statistical Learning (SL) is the ability to detect regularity in the environment.
- Although previous research has shown that participants were sensitive to positional temporal and spatial regularity that resembles characteristics of alphabetic and logographic orthography respectively, whether and how this sensitivity is reflected in neuronal correlates is unexplored.
- In the present study, we modified the temporal and spatial positional visual SL (P-VSL) tests to be employed with simultaneous EEG recording.

Participants

- 20 Taiwanese participated in this study (mean age : 21.75 (20-26))
- Tests were conducted for 2 sessions, 3-7 days apart, counterbalanced

Method

Positional Visual Statistical Learning (P-VSL)



Discussion

- At least 50% participants were able to extract the regularity in P-VSL, suggesting the validity and the individual differences in the design
- There are more participants exceeding the individual significant learning threshold in the spatial P-VSL (65%) rather than the temporal P-VSL (50%).
- The correlation between Temporal and Spatial P-VSL behavioral accuracy is significant ($r=0.517$, $p<0.05$)
- In Temporal P-VSL, the interactions involving learner variable suggested that the deviant pairs elicited a larger N400 component than the standard pairs in the posterior region of the scalp, only in those participants whose behavioral performance was above the threshold.
- In the Spatial P-VSL, due to the absence of interaction in the learner variable, an alternative analysis correlating behavioral accuracy and ERP showed a relatively sparse MMN difference in the anterior region
- Only Temporal P-VSL displayed relatively robust ERP sensitivity compared to Spatial P-VSL despite better performance in Spatial P-VSL.

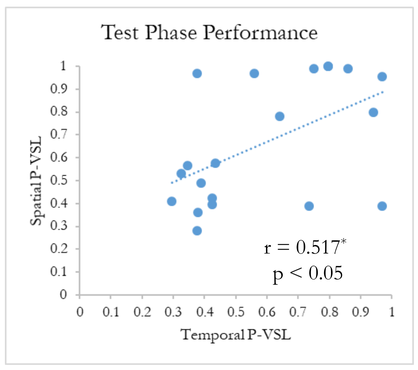
Results

4-Way ANOVA on Learner x Stimuli x Laterality x Caudality

(Learner/Non-Learner) (Standard/Deviant) (Left/Mid/Right) (Frontal/Central/Parietal)

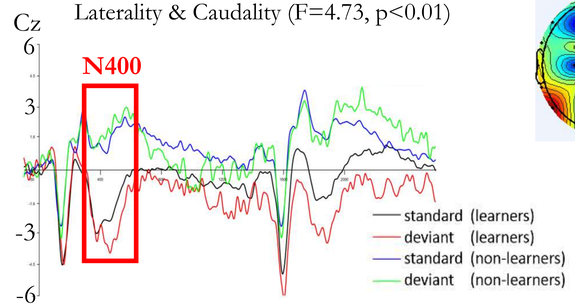
Behavioral Grouping
(based on individual significant learning threshold)

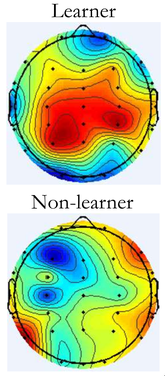
	Temporal P-VSL		Spatial P-VSL	
	Learner	Non-learner	Learner	Non-learner
n	10	10	13	7
mean	0.80	0.38	0.82	0.38
SD	0.14	0.04	0.20	0.05



N400 Effect on Temporal Positional VSL

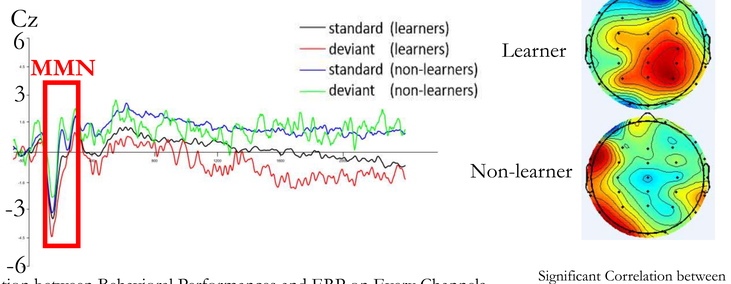
- Main effects of :
  - Learner ($F=31.34$, $p<0.01$)
  - Laterality ($F=5.89$, $p<0.01$)
  - Caudality ($F=43.86$, $p<0.01$)
- Significant interactions on :
  - Learner & Stimuli ($F=8.08$, $p<0.05$)
  - Learner & Laterality ($F=5.79$, $p<0.01$)
  - Learner & Caudality ($F=8.96$, $p<0.01$)
  - Laterality & Caudality ($F=4.73$, $p<0.01$)



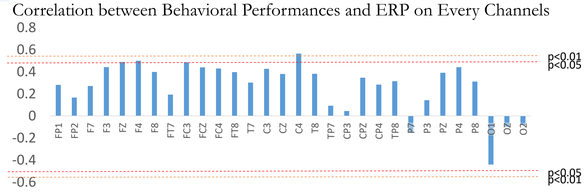


MMN Effect on Spatial Positional VSL

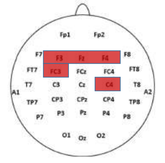
- Main effects of :
  - Laterality ($F=5.89$, $p<0.01$)
  - Caudality ($F=43.86$, $p<0.01$)
- Significant interactions on :
  - Laterality & Caudality ($F=4.73$, $p<0.01$)



Correlation between Behavioral Performances and ERP on Every Channels



Significant Correlation between Behavioral Accuracy and ERP



Conclusion

- The relationship between behavioral and neurophysiological P-VSL results were reflected in different component, despite a significant correlation to each other, suggesting different mechanisms underlying the sensitivity to temporal and spatial regularity in P-VSL tests.
- Further data collection by recruiting foreign subjects whose literacy experience differs to Taiwanese may give more insight regarding this issue.

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