

Exploring the role of complexity and modality in pleasurable polyrhythm perception

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Introduction

- Interpersonal synchrony, particularly during music-dance, appears to have important social implications (Savage et al., 2021).
- Synchrony may be aesthetically pleasing because it is easier to process than non-synchrony (Bamford, 2022).
- However, real music rarely features total synchrony between all parts.
- May be an optimum level of complexity to promote music-induced movement (Witek et al., 2014)
- Polyrhythms feature in many musical genres and allow us to study different levels of rhythmic complexity.
- May be expressed as a ratio (see Figure 1).

Figure 2. Video stimuli with two human figures moving at different rates according to the complexity condition.

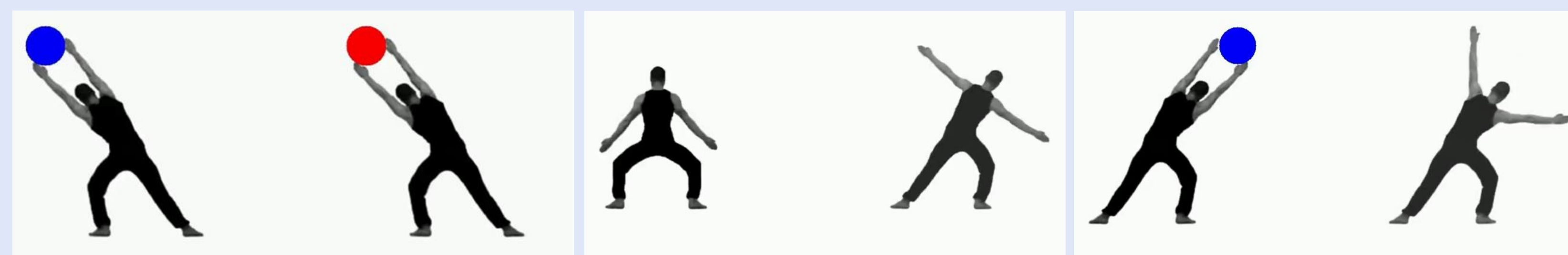


Figure 1. Visual representation of 3:2 and 4:3 polyrhythms, as presented to participants in training

3 against 2 polyrhythm	
2-beat rhythm	X X X X X X X X X X X X
3-beat rhythm	X X X X X X X X

4 against 3 polyrhythm	
3-beat rhythm	X X X X X X X X
4-beat rhythm	X X X X X X X

Method

- online psychophysics pilot study (N=8)
 - Most participants 32-28 years old, living in Europe and Australia.
- Stimuli contained two figures moving with sound in different coordination modes, based upon Sadaphal et al. (2023; Figure 2):
 - Seven levels of complexity (1:1, 1:2, 1:3, 2:3, 3:4, 4:5, irregular)
 - Three different modalities (Visual Only, Audio Only, Audio-Visual)
- Participants asked to identify the polyrhythm, after receiving information about polyrhythms (Figure 3)
- Two measures:
 - Accuracy
 - Self-reported urge to move (groove)

Results and Discussion

- Preliminary results show higher groove ratings for simple ratio polyrhythms (Figure 3, Table 1), and...
- More accurate responses for simple ratio polyrhythms (Figure 4, Table 2).
- There was also an independent effect of modality, with Visual Only being the least accurate, followed by Audio-Visual (Figure 5). Audio Only was the most accurate except at the highest rhythmic complexity.
- These results will inform future polyrhythm perception experiments.

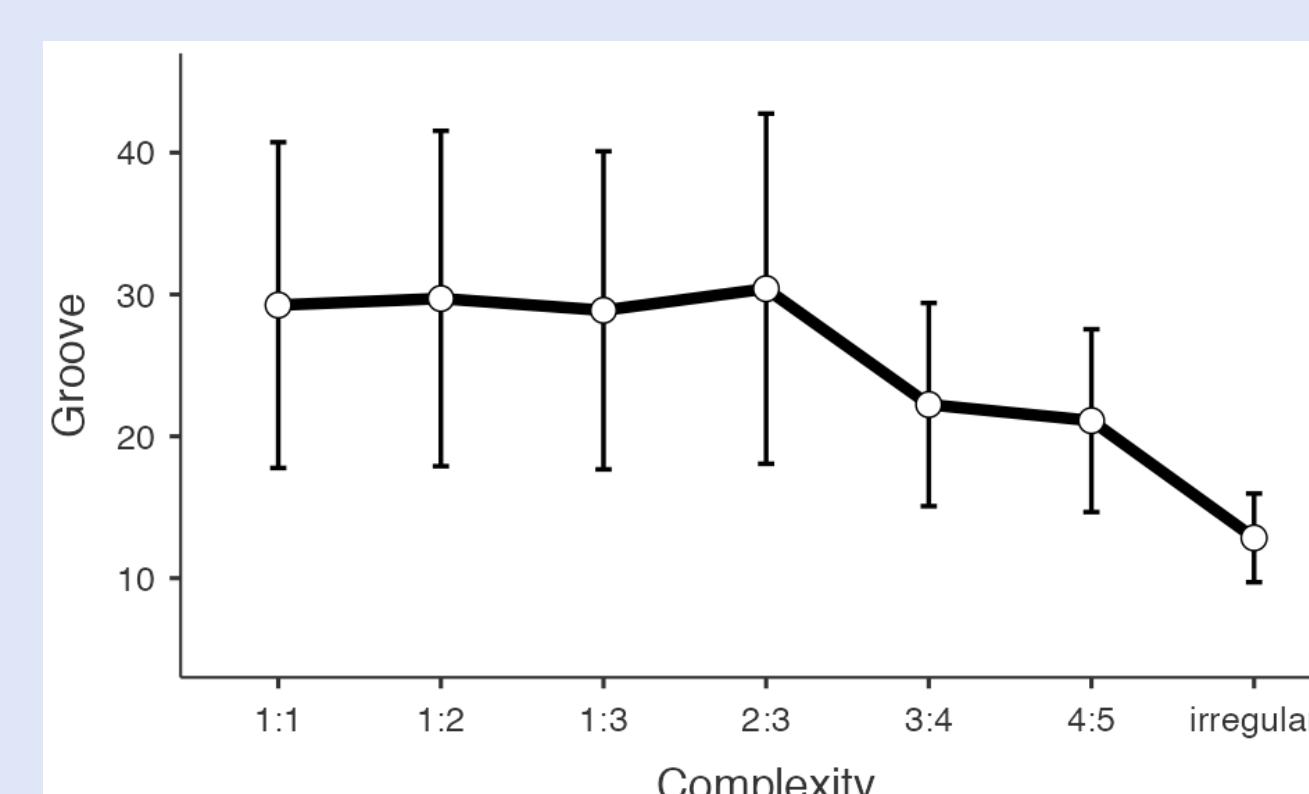


Figure 3. Groove ratings (0-100) by complexity level.

Figure 4. Answer accuracy (0-1) by complexity level and modality condition.

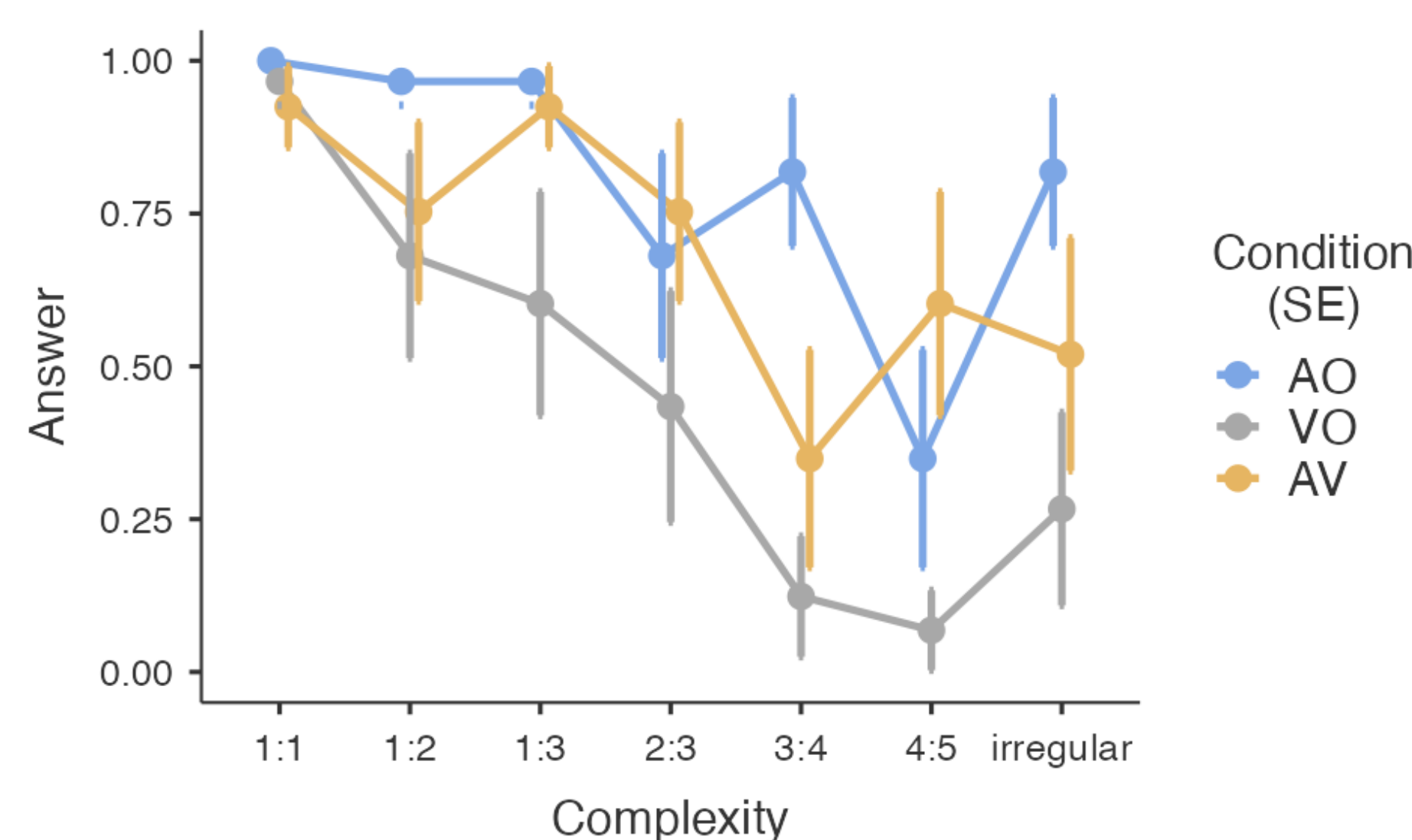


Table 1. Results of Generalised Linear Mixed Model with Gamma distribution and "inverse" link function for groove ratings.

Fixed Effect Omnibus tests (Groove)			
	χ^2	df	p
Complexity	14.853	6.00	0.021
Condition	0.905	2.00	0.636
Complexity * Condition	5.976	12.00	0.917

Table 2. Results of Generalised Logistic Mixed Model with Logistic distribution and "logit" link function for answer accuracy.

Fixed Effect Omnibus tests (Answer)			
	χ^2	df	p
Complexity	37.3	6.00	< .001
Condition	10.7	2.00	0.005
Complexity * Condition	16.2	12.00	0.184

References

- Bamford, J. S. (2022). *Social bonding through processing fluency for interpersonal synchronisation* [Doctoral Thesis, University of Oxford]. <http://dx.doi.org/10.5287/bodileian:KZyPr9JQg>
- Sadaphal, D. P., Keller, P. E. & Fitch, T. S. (2023). Exploring the interaction of rhythmic complexity and social-bondedness in an online perspective taking paradigm. In M. Tsuzaki, M. Sadakata, S. Ikegami, T. Matsui, M. Okano, & H. Shoda (Eds.), *The e-proceedings of the 17th International Conference on Music Perception and Cognition and the 7th Conference of the Asia-Pacific Society for the Cognitive Sciences of Music*. Nihon University. <https://jsmpc.org/CMPC17/program/e-proceedings/>
- Savage, P. E., Loui, P., Tarr, B., Schachner, A., Glowacki, L., Mithen, S., & Fitch, W. T. (2021). Music as a coevolved system for social bonding. *Behavioral and Brain Sciences*, 44, e59. <https://doi.org/10.1017/S0140525X20000333>
- Witek, M. A. G., Clarke, E. F., Wallentin, M., Kringelbach, M. L., & Vuust, P. (2014). Syncopation, Body-Movement and Pleasure in Groove Music. *PLOS ONE*, 9(4), e94446. <https://doi.org/10.1371/journal.pone.0094446>

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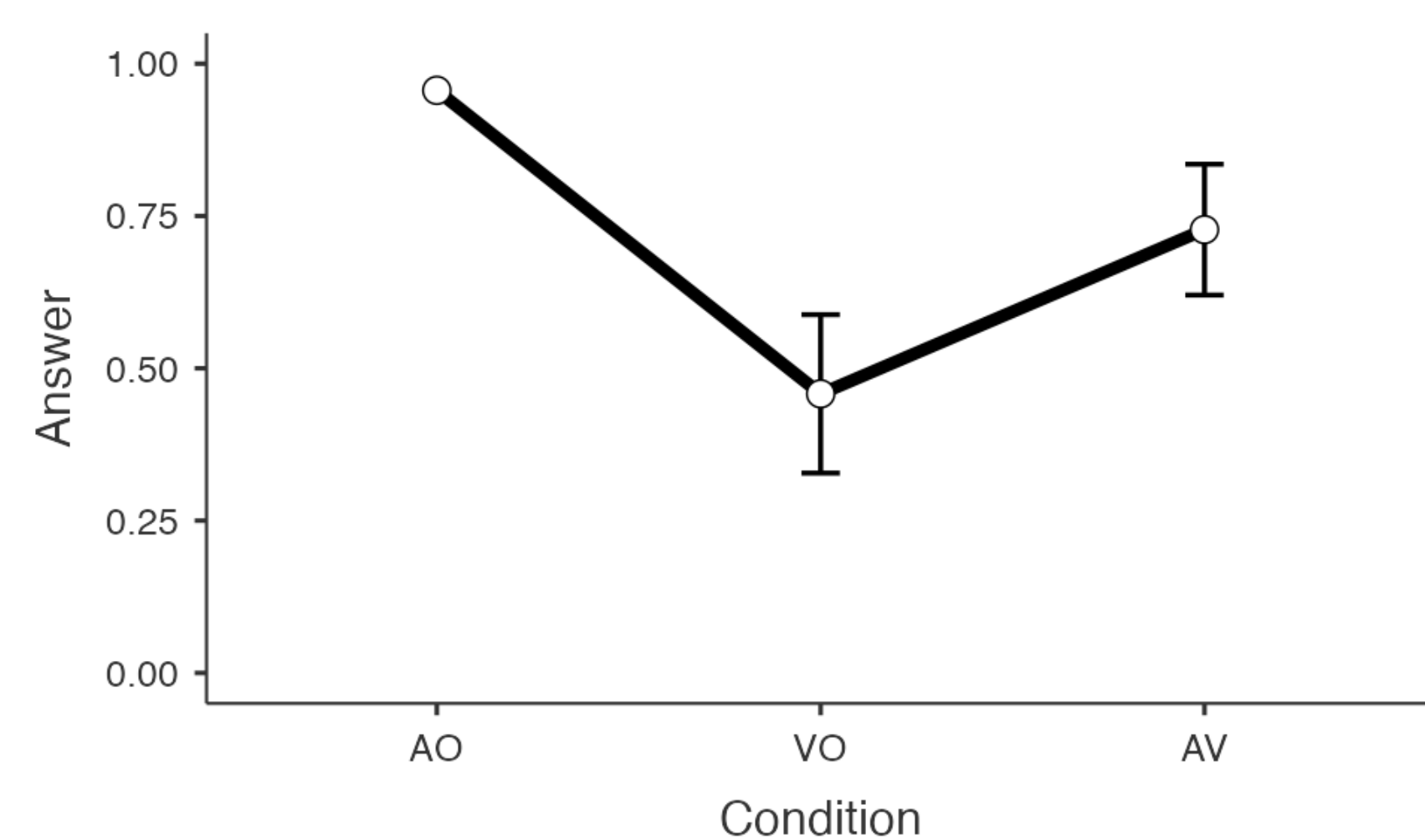


Figure 5. Answer accuracy (0-1) by modality condition.