

# Fractal Associations, Sync Events, Circulating Pacemakers

## A Qualitative Analysis of Intentional Entrainment

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### Introduction

Expertise in bluegrass musicianship relies on in-person entrainment with more experienced players. This tends to concentrate expertise geographically, posing a challenge to aspiring bluegrass musicians in distant locations. (1,2)

*How do peripheral communities overcome geographical obstacles to foster local expertise?*

### Materials and methods

A 'Monroe Number'—a qualitative metric representing bluegrass music expertise—was assigned to each participant and longitudinally tracked using five years of ethnographic data collected through participant observation within the Barcelona bluegrass community. (3, 4)

### Fractal Association

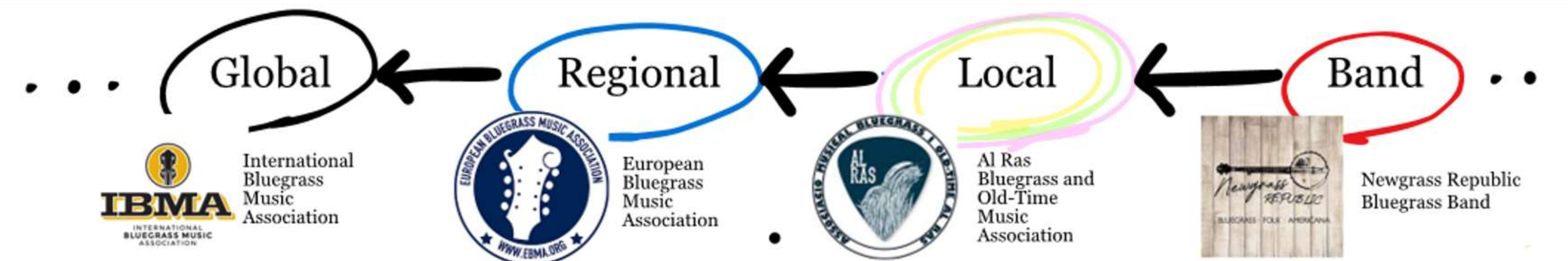
Musicians form voluntary associations to organize sync events, driven by a strong desire for enhanced coordination. Emerging from the musical experience, these associations are nested within one another, progressively converging toward the center of musical expertise, while functioning as self-propelled oscillators that exhibit regular periodicity in sync event production and demonstrate resilience to disruptions like the COVID-19 pandemic. (5)

### Sync Events

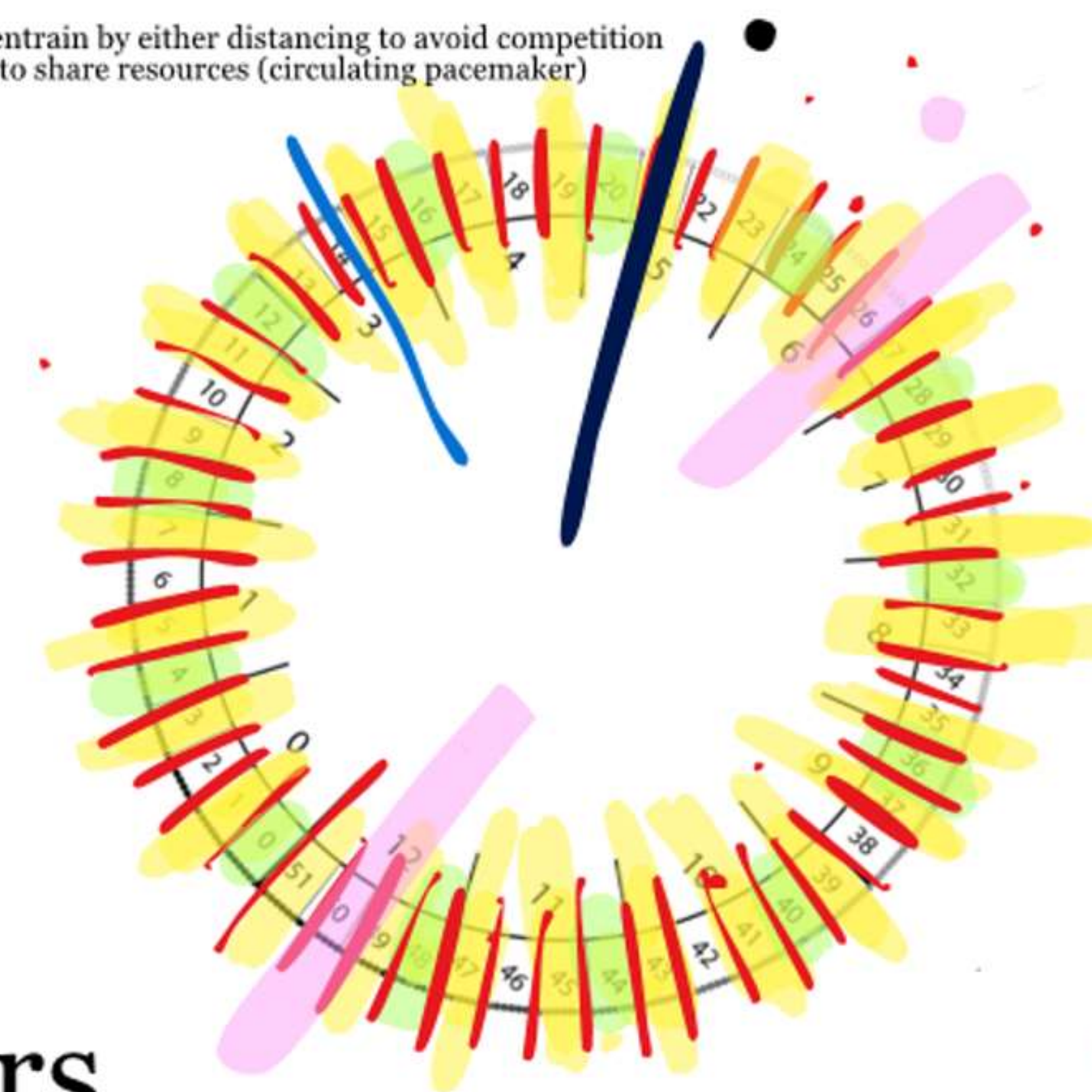
The cyclical nature of synchronization events, organized by fractal associations, is depicted in the accompanying graph, which maps their periodic occurrence across the 52 weeks of the year and illustrates the phenomenon of entrainment between these associations. During each such event, musicians achieve mutual entrainment, resulting in musical performance. (6,7)

### Circulating Pacemakers

Individuals and the community enhance their expertise by entraining at higher-level synchronization events. Those with the means travel to centers of expertise, subsequently disseminating this acquired expertise upon their return. Local associations also bring regional or global experts to multiday sync events for entrainment with local musicians. This expertise diffuses throughout the community, reaching even those outside local jam sessions via band rehearsals with those who have engaged with these 'circulating pacemakers'.



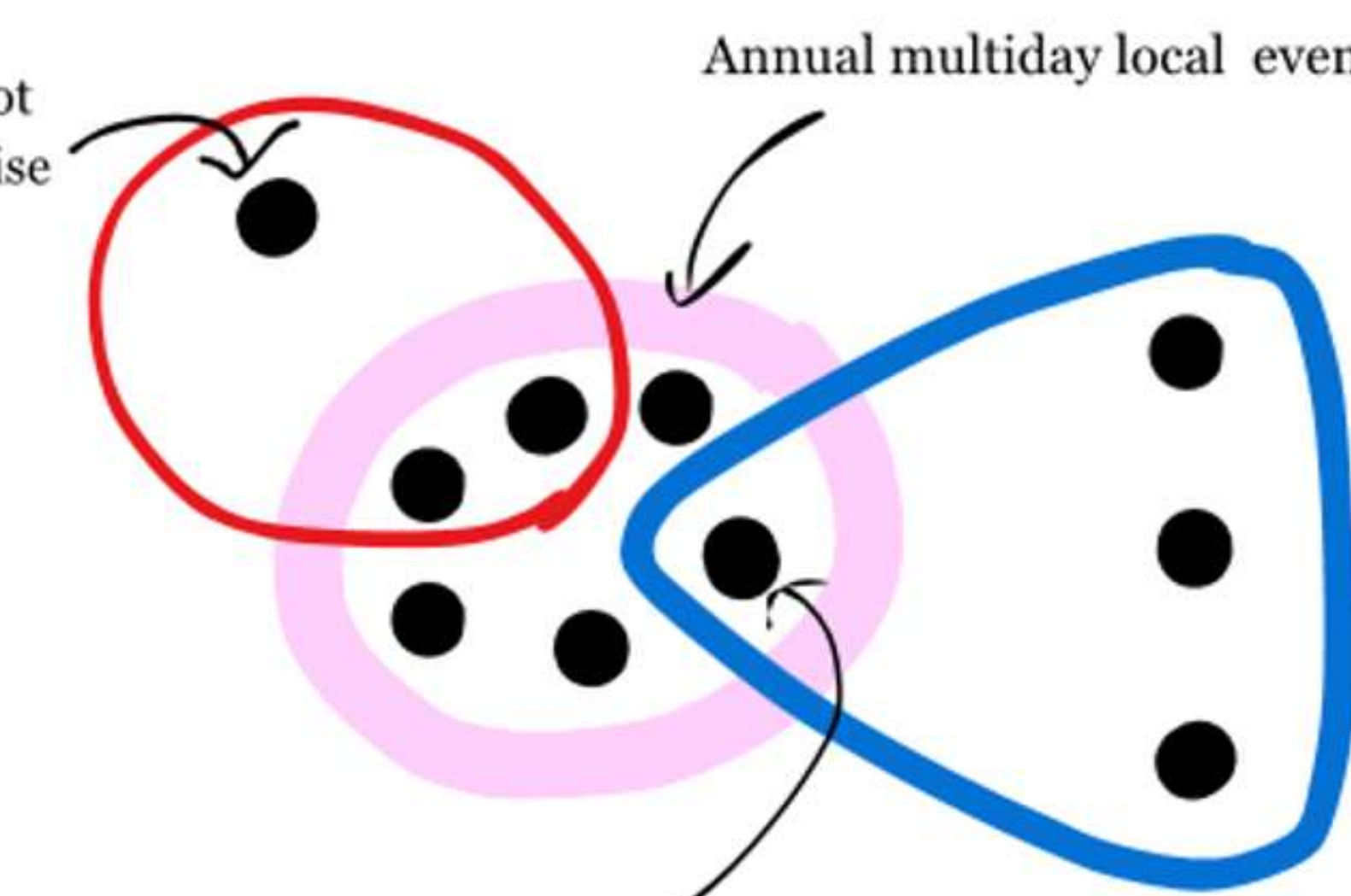
Regional events entrain by either distancing to avoid competition or merging to share resources (circulating pacemaker)



- Weekly rehearsal with band  
The skill level can be quite varied, and develop their own style, often diverging from Bluegrass
- Bimonthly local jam  
The best musicians lead the jam from the center of the circle, with less experienced on the periphery
- Once a month local "slow" jam  
A beginners jam, used to bring the expertise of beginners up enough to attend the regular jam. The expertise here will be lower.
- Twice a year multiday local event  
The highest local expertise entrains with visiting expertise from regional or global associations
- Annual multiday regional event  
The best musicians from several local associations entrain with each other, and with the visiting global and regional expertise
- Annual multiday global event  
The very center of bluegrass, where the elite entrain to one another and with members of regional and local associations

The overall level of bluegrass expertise of a sync event represents the collective potential of the musicians present, constrained by the limitations of the least experienced while benefiting from the contributions of the most experienced.

Band member who does not attend will also gain expertise



Circulating pacemaker entrains with local musicians

### Outcomes

#### Modified Kuramoto Model

The 'circulating pacemaker' insight suggests interesting modifications to the Kuramoto model, currently under development at the University of Barcelona under the supervision of Conrad Pérez.

#### Modeling Intentional Entrainment

A descriptive framework for intentional entrainment is being developed, grounded in set theory, to capture its fractal nature and the interplay of different timescales arising from a single sync event. This framework will also address how circulating pacemakers establish regions of non-variance.

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- (3) Corbin, J., & Strauss, A. 2015. *Basics of Qualitative Research: Techniques and Procedures for Developing Grounded Theory*. SAGE Publications.
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- (5) Pikovsky, A., Rosenblum, m., & Kurths, J. 2001. *Synchronization: A Universal Concept in Nonlinear Sciences*. Cambridge University Press.
- (6) Clayton, M., Jakubowski, K., Eerola, T., Keller, P., Camurri, A., Volpe, G., & Alborn, P. 2020. "Interpersonal Entrainment in Music Performance: Theory, Method, and Model." *Music Perception* 38, no. 2. University of California Press
- (7) Faulkner, R., & Becker, H. 2009. *Do You Know...?: The Jazz Repertoire in Action*. University of Chicago Press.

### Acknowledgments



### Further information

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 European Bluegrass Music Association: [ebma.org](http://ebma.org)  
 Al Ras Bluegrass Music Association: [alrasfestival.com](http://alrasfestival.com)  
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