Social Risk and Routine in Context: Relating Social Network Structure to Principles of Brain Organization in Colombian Spider Monkeys

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Introduction

Hemispheric specialization is thought to be reflected by side biases in behavior. The prevailing pattern of lateralization in vertebrates suggests social behavior is delineated to the right hemisphere, yet research across species has failed to test the cerebral lateralization hypothesis across different social interaction types, particularly in socially complex species. We previously described a right hemispheric pattern of laterality potentially driven by qualitative differences in social risk during embracing, and absence of laterality during grooming, potentially owing to the routine state of the behavior. To explore if social network structure diverges similarly to patterns of laterality, we leveraged social network analysis to identify structural differences between embrace, face-embrace, and grooming.

Methods

Behavioral Data Collection. We previously captured 186 hours of observation on 15 socially housed Colombian spider monkeys (*Ateles fusciceps rufiventris*), and described two sub-types of embracing in a dimension related to social risk given the close contact between individuals: embrace, which involves contact along the torso with arms wrapped around the body and face-embrace, which involves mutual cheek contact. To explore if social network structure is related laterality, we leveraged social network analysis to identify structural relationships across embrace, face-embrace, and grooming.

Network Construction. Behavioral data were exported to Excel and uploaded to Cytoscape (Shannon et al., 2003) for network analyses. Degree centrality, the total number of direction connections among nodes, was calculated for each individual across the three behaviors. Red nodes denote females and blue nodes denote males.

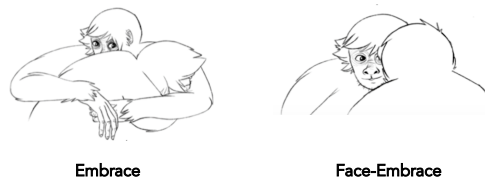Embrace   Face-Embrace

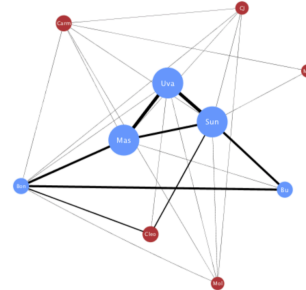Fig 4. Embrace and Face-Embrace comparison
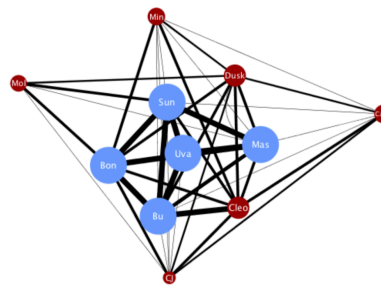

Fig 1. Face-Embrace Network
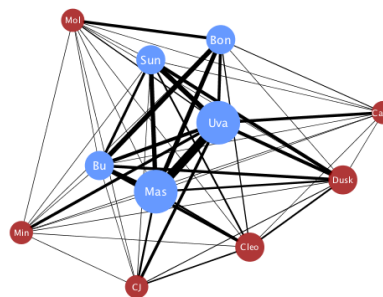

Fig 2. Embrace Network

Fig 3. Grooming Network

Results

The degree centrality analyses indicate that embrace and grooming have similar social network structures, with multiple similar individuals achieving degree centrality. Face-embrace, however, was only comprised of three individuals achieving degree centrality, with most individuals on the periphery of the network. Statistical tests indicated a significant structural difference between the three networks, $F(2,40) = 6.31$, $p = 0.004$. Post-hoc comparisons indicate no significant difference between embrace and grooming, $t(30) = 1.51$, $p = 0.14$, while differences between face-embrace and embrace, $t(19.64) = 3.38$, $p = 0.003$, and face-embrace and grooming, $t(30) = 3.56$, $p = 0.001$, were both significant.

Conclusion

These findings are presented in the context of a social risk spectrum where grooming is the least risky, embrace is moderately risky, and face-embrace is of the highest risk. We suggest that grooming is a routine behavior akin to a state. Although embrace and face-embrace are both risky given the physical positioning, face-embrace is considerably more risky given the close face contact. This is also evident in the differences in social structure, where embrace and grooming networks are similar, both comprised of multiple individuals with high connectedness whereas in face-embrace only three have centrality (Fig 5). Together these findings build on our previous results in which embrace and face-embrace were lateralized but grooming was not. The current findings suggest that social structure is related to laterality, and is dissociated by social risk.
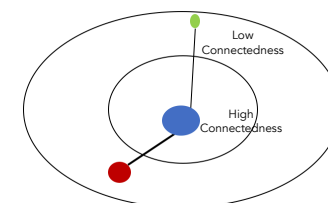

Fig 5. Connectedness diagram

References

Available upon request.