STUDENT PROJECT 1

Does singing together strengthen spontaneous unintentional coordination?

Overview. When two people perform a motor task alongside each other, their movements become mutually entrained leading to the emergence of specific, stable patterns of coordination (i.e., in-phase and anti-phase synchrony) as a result of information exchange (for overviews see Oullier & Kelso, 2009; Schmidt & Richardson, 2008). Visual information about the movements of a co-actor is most typically implicated (Richardson, Marsh, Isenhower, Goodman, & Schmidt, 2007), but is not the sole medium for interpersonal coupling. For example, when two people engage in a cooperative verbal task (e.g., converse with one another to solve a puzzle) the subtle fluctuations of their postural activity become entrained (Shockley, Santana, and Fowler, 2003; Shockley, 2005). In this class project, students will investigate whether interpersonal coordination is promoted by a different kind of cooperative verbal task: singing together. This project will provide students with practical experience with Cross Recurrence Quantification Analysis, which will be used to characterize interpersonal interactions.

Method. Two or three pairs of participants will be recruited. Participants will perform a simple, rhythmic precision aiming task. For that, they will sit in front of a computer screen displaying two stationary targets. They will be asked to use a mouse to repeatedly move a cursor on the screen between right and left targets at a comfortable pace for 30 seconds. The task will be performed alone (no interaction condition or baseline) and with a partner (interaction condition). When performing together, participants will be either in silence (interaction condition 1: visual coupling only) or singing together a simple song, like *"pat-a-cake"* (interaction condition 2: visual plus "verbal" coupling). During the interaction conditions, each participant will use his/her own computer screen and mouse and they will be positioned alongside each other (note: visual information about the partner's movement will be minimal so this will serve as a second control condition).

Commenté [PS1]: Feel free to adjust according to feasibility, specially now that students are online. Even one pair would be okay for practice. But more of course would be better.

Note: To collect data use Mouse Motion Application

Analysis. The horizontal displacements produced by each participant in each trial and condition will be used to investigate the effect of the type of coupling on spontaneous interpersonal coordination. Cross Recurrence Quantification Analysis will be performed to quantify interpersonal coordination in the baseline (control), visual coupling, and visual plus verbal coupling conditions. Summary measures of coupling strength or coordination stability (i.e., mean Maxline; mean %Det) will be computed for each condition. The expectation is that (a) mean Maxline and %Det will be higher for the interaction conditions than baseline; and (b) mean Maxline and %Det will be higher for the visual plus verbal interaction condition that the visual only condition.

Note: Applications will be provided for Data Analysis

References

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STUDENT PROJECT 2

Dynamics of Dual-Task Prioritization: Cognitive vs Motor

Overview. Everyday life involves numerous situations in which a motor task and a cognitive task are performed simultaneously. For example, we walk through the supermarket while trying to remember the shopping list; we talk to a friend while navigating busy streets. These dual task situations are so mundane that, at first sight, they seem easy to manage. However, there is consistent evidence that even simple motor and cognitive tasks are performed better in isolation than concurrently (e.g., Dault, Geurts, Mulder, & Duysens, 2001; Maylor, Allison, & Wing, 2001; Maylor & Wing, 1996; Pellechia & Shockley, 2005). These findings suggest that attentional resources are shared across tasks and, therefore, prioritization at limiting situations is essential. For instance, when walking and talking concurrently, not paying sufficient attention to the motor domain may lead to falls and have severe consequences—a problem seen in the elderly (Springer, Giladi, Peretz, Yogev, Simon, & Hausdorff, 2006). Importantly for present purposes, there is evidence that the dynamical organization of motor tasks is modified when performed in coordination with a cognitive task (Pellechia & Shockley, 2005), which might be a reflection of the process of resource sharing. In this project, students will probe this conjecture. In particular, students will evaluate the effect of prioritization on the dynamical organization of a motor task performed in coordination with a cognitive task. This project will provide students with practical experience with Recurrence Quantification Analysis, which will be used to characterize the dynamics of the motor task.

Method. Four to six participants will be asked to perform a motor task alone (baseline) or in combination with a cognitive task (dual tasking). The motor task will be a circle drawing task with speed and precision demands and the cognitive task will be to count backwards by 3s. For the circle drawing task, participants will be seated in front of a computer screen displaying a circle. They will use a mouse to move a cursor as fast and as closely as possible to the circle tracing for 30 seconds. For the counting back task, participants will be given a random 3-digit number from which to start counting. Participants will be instructed to first recite the starting

Commenté [PS2]: Again, feel free to adjust this according to feasibility.

number and then count backward by 3s from that number (e.g., for starting number 359, correct responses would be 359, 356, 353, and so on).

When dual-tasking, participants will be asked to (a) prioritize the motor task, (b) prioritize cognitive task, or (c) not to prioritize either task. For (a) participants will be told something like: *"Focus on the motor task. It is ok if you make mistakes on the counting task. If that happens just keep going until you get back on track"*. Similarly, for (b) participants will be told something akin to "*Focus on the counting task. It is ok if you make mistakes on the circle drawing task, just make sure you do not stop moving while you try to catch up"*. For (c) participants will be told to focus on both tasks and try to do their very best on both. Two trials will be collected on each condition (baseline, dual-motor focus, dual-cognitive focus, dual-no prioritization), for a grand total of 8 trials.

Note: To collect data use Mouse Motion Application

Analysis. The horizontal and vertical displacements produced by each participant in each trial and condition will be used to investigate the effect of dual tasking prioritization on the organization of the motor task. Recurrence Quantification Analysis will be performed to explore the temporal structure of vertical and horizontal displacements produced during circle drawing. Recurrence measures will be computed for each condition and participant. Descriptive statistics of these measures (e.g., mean values of %REC, %DET, etc) will provide insight into changes in the organization of motor activity brought about by different prioritizations during dual tasking.

We expect, based on previous studies (Pellechia & Shockley, 2005) that movement patterns will exhibit greater variability (as measured by SD) yet more deterministic (regular) recurrent patterns (as measured for instance by %DET) in the presence of cognitive demands. More precisely, %DET will be higher for dual task conditions vs simple task, regardless of movement direction, with the difference depending on prioritization (smaller for *dual-motor focus condition* and higher for *dual-cognitive focus condition*). An increase in determinism in movement patterns might indicate that the allocation of resources to a concurrent cognitive task reduces the flexibility of the motor system. This might be a strategy to maintain motor performance as best as possible with less attentional resources when cognitive demands must be prioritized. Other measures will be computed and differences explored though no predictions are possible at the moment.

Note: Applications will be provided for Data Analysis

References

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