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Period Basin of Entrainment for Unintentional Visual Coordination

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ABSTRACT. Researchers have demonstrated that a person's rhythmic movements can become unintentionally entrained to another person's rhythmic movements or an environmental event. There are indications, however, that in both cases the likelihood of entrainment depends on the difference between the uncoupled periods of the two rhythms. The authors examined the range of period differences over which unintentional visual coordination might occur in 16 participants (Experiment 1) and 15 participants (Experiment 2). Cross-spectral coherence analysis and the distribution of continuous relative phase revealed that visual entrainment decreased as the difference between participants' preferred period and the experimenter-determined period of the environmental stimulus increased. The present findings extend the dynamical systems perspective on person–environment coupling and highlight the significance of period difference to the emergence of unintentional coordination.

Keywords: coherence, period, relative phase, unintentional coordination, visual coordination

The phenomenon of rhythmic synchronization occurs naturally within and across many different systems, ranging from mechanical devices, such as pendulum clocks (Huygens, 1673/1986; Pikovsky, Rosenblum, & Kurths, 2001), to living organisms, such as fireflies that flicker (Hanson, 1978). Human movement systems are no exception, and previous researchers have shown that movements of two or more individuals (Richardson, Marsh, & Schmidt, 2005; Schmidt & O'Brien, 1997) or movements of a single individual and an environmental rhythm (Buekers, Bogaerts, Swinnen, & Helsen, 2000; Repp & Penel, 2004; Schmidt, Richardson, Arsenault, & Galantucci, 2007) can become unintentionally synchronous. Unintentional coordination is not inevitable, however. It will occur only when the coupling that links the movements is strong enough to overcome any differences in the natural period or tempo of the movements (von Holst, 1939/1973). For a given coupling strength, unintentional coordination will occur only within a specific range of period differences. The range of period differences reflects the systems' period basin of entrainment (Strogatz, 1994). Our aim in the present study was to identify the basin for unintentional visual coordination.

Previous researchers have shown how the same coupled-oscillator dynamic governs human rhythmic visual coordination and rhythmic interlimb coordination within a person (Kelso, 1995; Schmidt & O'Brien, 1997; Schmidt & Turvey, 1994; Wimmers, Beek, & van Wieringen, 1992). The dynamic constrains stable patterns of coordination to two stable modes of behavior: in-phase and antiphase. In-phase coordination occurs when the movements of two oscillators have a 0° constant phase relation. In-phase coordination is more stable than antiphase coordination, which occurs when the two oscillators are moving with a 180° constant phase relation. When the movements of the two oscillators are perfectly phase locked at either 0° or 180°, the coordination is said to be absolute. That behavior most frequently occurs when an individual intentionally synchronizes his or her movements with another individual's (Schmidt, Bienvenu, Fitzpatrick, & Amazeen, 1998; Schmidt & Turvey, 1994; Temprado & Laurent, 2004) or an environmental rhythm (Buekers et al., 2000; Repp & Penel, 2004; Russell & Sternad, 2001; Wilson, Collins, & Bingham, 2005; Wimmers et al., 1992). In contrast, unintentional coordination

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typically manifests as relative or intermittent coordination (i.e., movements are attracted to 0° and 180° but are not phase locked). The movements wander in and out of phase (Kelso, 1995; von Holst, 1939/1973). The strength of the coupling that links the movements cooperatively (referred to as the *magnet effect*) in relation to the tendency for the movements to maintain their intrinsic or natural period determines both absolute and relative coordination. The inclination of movements to remain at their natural period is referred to as the *maintenance tendency* (Gallistel, 1980; von Holst). Absolute coordination results when the coupling strength (or magnet effect) is much greater than the movement's maintenance tendency, whereas relative coordination results when the coupling strength is equal to or slightly less than the movement's maintenance tendency. If the coupling strength is much less than the maintenance tendency, then no coordination occurs.

Researchers who have investigated the emergence of unintentional interpersonal coordination (Richardson et al., 2005; Schmidt & O'Brien, 1997) have shown how synchrony may not always occur between visually coupled individuals because they produce movements at notably different natural periods. In a recent investigation into the role of visual information in unintentional interpersonal coordination (Richardson et al.), pairs of individuals performed the following two tasks simultaneously: (a) They identified as many differences as possible in two cartoon faces, and (b) they swung handheld pendulums at a natural self-selected period. For half of the trials, the cartoon faces that were attached to each participant's pendulum provided visual information about each other's movements. For the remaining trials, the cartoon faces, which were attached to a stand positioned in the direction opposite to each partner's view, provided no visual information about the other's movements. An analysis of the distribution of relative phase angles formed between the two oscillating pendulums revealed that relative coordination occurred when visual information was available and did not occur in its absence. The authors determined the presence of coordination by observing an increase in the amount of time that two individuals' pendulums moved in 0° (in-phase) and 180° (antiphase) phase relations. Although, on average, most pairs exhibited a greater-than-chance level of unintentional coordination, a closer inspection of the data revealed that they did not always do so. Some pairs exhibited a great amount of unintentional coordination, whereas others exhibited a small amount, equal to that of chance-level coordination.

To determine whether those between-pair differences resulted from large discrepancies between the pairs' individual movement periods, we reanalyzed the Richardson et al. (2005) data by examining visual entrainment strength, as measured by cross-spectral coherence, as a function of the difference between the natural (self-selected) period of each participant in a pair. Cross-spectral coherence indexes the degree of coordination between two time series on a scale from 0 to 1. A coherence of 1 reflects *perfect correlation* of the movements (perfect phase entrainment) and 0 reflects *no correlation* (no phase entrainment). Figure 1 reveals that when we plotted coherence as a function of the difference in the self-selected periods of participants in a pair (i.e., we calculated the differences in the natural periods of participants in a pair from their comfort mode, no visual information, control trials), the magnitude of unintentional entrainment decreased as the differences in the two participants' self-selected periods increased. Both linear and second-order polynomial regression analyses revealed a negative relationship between period difference and unintentional entrainment, with $R^2 = .56$, $F(1, 16) = 20.65$, $p < .01$ ($y = -5.45x + .89$), and $R^2 = .59$, $F(2, 15) = 10.85$, $p < .01$ ($y = -29.38x^2 - 10.96x + 1.06$), respectively.

Clearly, the results of our reanalysis of the data of Richardson et al. (2005) suggest that unintentional entrainment in visually guided tasks becomes less likely with increases in period differences. Given that movements of a handheld pendulum can also become unintentionally entrained with a visually oscillating stimulus (Schmidt et al., 2007), one would also expect period difference to significantly constrain unintentional visual–environmental coordination. To test that notion and uncover the period basin of unintentional visual–environmental entrainment, we adapted the environmental coordination paradigm that Schmidt et al. developed in which individuals swing a wrist-pendulum at a self-selected period (participants are told they are performing a motor distractor task) while simultaneously reading aloud letters that flash on a visually oscillating stimulus that is projected on a large screen (see Figure 2A). The advantage of that environmental coordination paradigm is that it allowed us to directly manipulate the period of the visually oscillating stimulus with respect to the participant's natural period of movement and thus precisely control the range of period differences that the participant experienced.

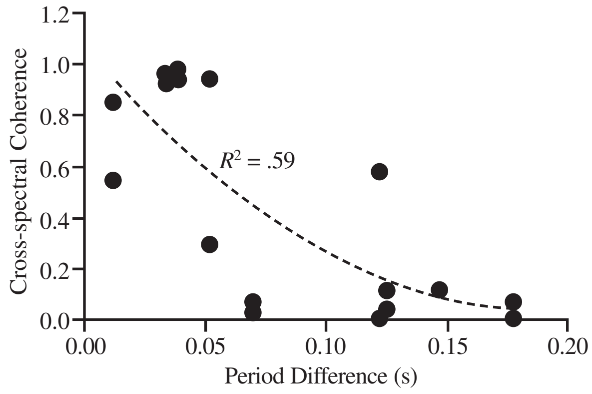

FIGURE 1. A reanalysis of the Richardson et al. (2005) data revealed that as the absolute period difference between individuals in a pair increased (the authors calculated the data from the no-visual-information trials), the strength of entrainment (indexed by cross-spectral coherence) decreased.

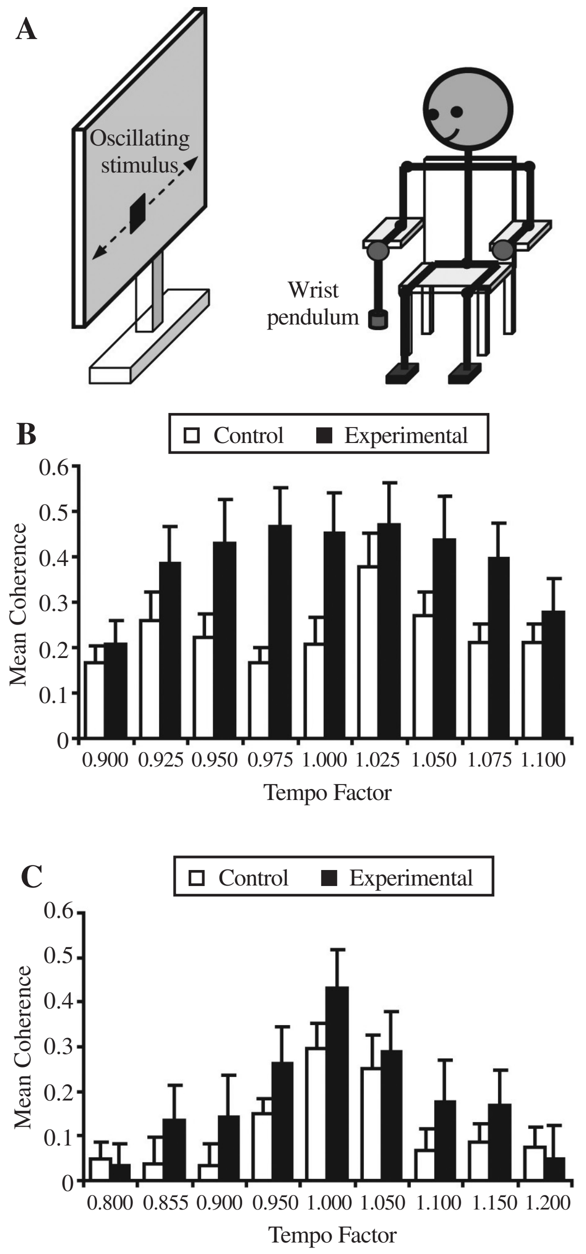

FIGURE 2. (**A**) Experimental setup that Schmidt et al. (2007) used to study unintentional environmental entrainment. Cross-spectral coherence values and standard error bars for (**B**) the nine tempo factors used in Experiment 1 and (**C**) the nine tempo factors used in Experiment 2.

EXPERIMENT 1

Method

Participants

Sixteen undergraduates at the University of Connecticut volunteered to participate for partial fulfillment of a course requirement. All procedures were approved by the University's Institutional Review Board.

Procedure

Individuals swung a handheld pendulum about the right wrist joint (radial-ulnar abduction–adduction) parallel to the sagittal plane. We constructed the pendulum from an aluminum rod measuring 45.75 cm in length; it had a 12.75-cm rubber handle. A 150-g mass attached to the base of the rod resulted in a pendulum with an eigenperiod of 1.10 s. To ensure that any coordination exhibited would be unintentional, we informed participants that the experiment was a dual-task experiment. Participants' first task consisted of reading aloud letters that appeared on an oscillating red square as quickly as possible, whereas their second task consisted of swinging a handheld pendulum at their own preferred comfort mode tempo. We recorded participants' movements by using a Biometrics DataLINK 800 acquisition system and an electrogoniometer (Biometrics, Gwent, England) that was attached to the metacarpophalangeal joint of the middle finger of the participants' right hand and extended approximately 12 cm beyond the right wrist joint. Participants sat in a chair with a right-sided forearm rest. We positioned the chair 1.6 m away from and parallel to a 1.5-m × 1.8-m projection screen (see Figure 2A). We used the screen to display both the oscillating stimulus (the 4-cm × 4-cm red square) and a set of randomly generated letters that appeared on the stimulus every 2 s plus a random offset between 0 and 0.999 s. We used a Dell Dimension 800, Pentium 4 computer to generate the display and record the movement data from the DataLINK 800 system. We used an NEC MT 850 projector, mounted to the ceiling 2.46 m from the screen, to project the visual display.

During the first 4 of the 40 trials, the letters appeared on a stationary red square (visual stimulus). The initial 4 trials enabled us to capture each participant's preferred comfort mode period ($M = 1.08$ s, $SD = 0.04$ s). Previous researchers have demonstrated that the period of oscillation that each individual produces differs slightly from the natural (eigen) period of the pendulum alone because of individual dynamical differences (e.g., stiffness of the wrist joint) and differs from other individuals' limb–pendulum systems (de Rugy, Salesse, Oullier, & Temprado, 2006; Russell, de Rugy, & Sternad, 2004; Schmidt & Turvey, 1992). In 18 experimental trials, letters appeared on a red square that oscillated horizontally across the screen with an amplitude of 86 cm and a visual angle of 72°. The square moved at nine different factors of the participant's preferred comfort mode period (0.900, 0.925, 0.950, 0.975, 1.000, 1.025, 1.050, 1.075, 1.100), which corresponded to a range of ±10% of each participant's preferred period of oscillation. In our reanalysis of the Richardson et al. (2005) data at period differences around ±0.13 s, which corresponds to ±11.5% of participants' preferred comfort mode period ($M = 1.14$ s), coherence values dropped to 0 (see Figure 1). We hypothesized that the basin of entrainment for unintentional person–environment coupling might coincide with a similar range, and we accordingly chose tempo factors for the present study. We anticipated that the range and scale of gradation would capture the entire basin of entrainment. In 18 control trials, the letters appeared on the red square. The square remained stationary, whereas a sinusoidal stimulus invisible to participants oscillated horizontally across the screen at each of the aforementioned factors of the participants' preferred period. The unseen stimulus allowed us to calculate the amount of chance-level coordination between the two oscillators. Each trial lasted 35 s, and we sampled the movements at a rate of 50 Hz. We discarded the first 5 s of each trial to eliminate any transient behavior, leaving a total of 1,750 samples per trial. We randomized and counterbalanced the 36 control and experimental trials across participants. We made Greenhouse–Geisser adjustments for violations of sphericity as necessary in the analyses.

Results

For each trial, we used the average of the cross-spectral coherence calculated at the peak frequencies of the wrist and stimulus time series to measure the degree of coordination between movements of the wrist and movements of the oscillating stimulus (Richardson et al., 2005; Schmidt & O'Brien, 1997; Schmidt et al., 2007). A coherence of 1 reflects perfect coordination, and a coherence of 0 reflects no coordination. A 2 × 9 (Condition × Tempo Factor) repeated measures analysis of variance (ANOVA) on the coherence values revealed a greater amount of coordination for experimental trials (visible oscillating stimulus) than for control trials (invisible oscillating stimulus), $F(1, 15) = 14.71$, $p < .01$, indicating a greater-than-chance level of entrainment between the participant's limb movements and the oscillating visual stimulus. Although Figure 2B shows how the amount of coherence decreased as period difference increased for both control and experimental trials, there was no significant effect for tempo factor, $F(2.40, 36.05) = 1.83$, $p > .05$, and no significant interaction between condition and tempo factor, $F(8, 120) = 1.22$, $p > .05$. Those findings suggest that the range of tempo factors we used was too circumscribed to enable us to capture the period basin of entrainment and that we needed a larger range of period differences to uncover the period basin of entrainment for unintentional visual coordination. To better assess our hypothesis that increases in period difference lead to decreases in entrainment, we conducted a second experiment.

EXPERIMENT 2

Method

Participants

Fifteen undergraduates from the University of Connecticut participated in Experiment 2 for partial fulfillment of a course requirement. None of them had participated in Experiment 1. The University's Institutional Review Board approved all procedures.

Procedure

We used the same paradigm and equipment in Experiment 2 as in Experiment 1 but with an extended range of tempo factors and larger step intervals. The tempo factors were 0.800, 0.850, 0.900, 0.950, 1.000, 1.050, 1.100, 1.150, and 1.200. Those correspond to a range of ±20% of each participant's preferred period of oscillation. Again, the first 4 of the 40 trials served as preliminary trials that enabled us to determine the participants' preferred comfort mode tempo ($M = 1.06$ s, $SD = 0.04$ s). Of the remaining 36 trials, 18 were control trials and 18 were experimental trials.

Results and Discussion

A 2 × 9 (Condition × Tempo Factor) repeated measures ANOVA on the cross-spectral coherence values revealed a significant condition effect, $F(1, 14) = 8.29$, $p < .05$. Participants became unintentionally entrained to the visual stimulus at greater-than-chance levels during the experimental trials. There was also a significant effect of tempo factor, $F(3.59, 48.85) = 5.07$, $p < .01$. More unintentional entrainment occurred for stimulus tempos closer to the participant's natural period of movement. Although unintentional entrainment appeared to be greater for the experimental trials when the stimulus oscillated at tempo factors ranging from 0.850 to 1.150 (see Figure 2C) and then decreased to chance levels for tempo factors outside that range, we did not find a significant interaction between condition and tempo factor, $F(3.72, 52.02) = 1.06$, $p > .05$. Coherence values that we obtained for tempo factors common to both experiments (e.g., 0.900, 0.950, 1.00, 1.050, and 1.10) were different. The differences appeared to have arisen from individual differences between participants from Experiments 1 and 2 and from an overall decrease in entrainment strength that arose out of the extended range of tempo factors. Consistent with the findings of Experiment 1, coherence values for the control trials (invisibly oscillating stimulus) systematically decreased as the period difference between the two oscillators increased, although participants were unable to see the invisibly oscillating square. That finding is consistent with previous research results (Schmidt et al., 2007) and highlights one weakness of cross-spectral coherence analysis: The more similar the periods of the oscillators, the more correlation between them, even if they are not entrained. That problem suggests that researchers should also use a second measure of coordination.

Another way to measure the coordination that occurs between two oscillators is by analyzing the distribution of relative phase angles that emerge between them. In addition to enabling researchers to determine whether unintentional coordination occurred, identifying the distribution of relative phase enables them to establish whether the coordination was constrained to the patterns of entrainment that a coupled oscillator dynamic predicts. To obtain that distribution, we calculated the continuous time series of relative phase for both the wrist and the oscillating stimulus, and we recorded the percentage of time that participants spent in each of nine relative phase regions (0°–180°, in 20° increments; for more details, see Schmidt & O'Brien, 1997). The coupled oscillator dynamic model predicts that individuals will concentrate the time they spend near the attractor locations of 0° and 180° (Haken, Kelso, & Bunz, 1985), and a finding of such a concentration suggests that relative or intermittent coordination occurred. An equal distribution of time that participants spend across all relative phase regions suggests the absence of coordination (Kelso & Ding, 1994; Richardson et al., 2005; Schmidt & O'Brien, 1997). We submitted the amount of time that participants spent in each of the regions for both the control and experimental conditions of Experiment 1 to a 2 × 9 × 9 (Condition × Tempo Factor × Phase Region) repeated measures ANOVA. The analysis revealed significant effects of condition, $F(1, 15) = 8.31$, $p < .01$, and phase region, $F(2.21, 33.09) = 5.19$, $p < .01$, and an interaction between condition and phase region, $F(2.56, 38.41) = 3.91$, $p < .05$, indicating that the amount of time that participants spent in the nine different phase regions differed between control and experimental trials. During the experimental trials in particular, participants spent a greater amount of time near 0° and 180°, signifying that relative coordination had occurred. During the control trials, they spent an equal amount of time at each of the nine different phase regions, indicating the absence of coordination (see Figures 3A–3E). An interaction also occurred between tempo factor and phase region, $F(64, 960) = 1.46$, $p < .05$, revealing that the amount of coordination that emerged significantly depended on the tempo factors that we used. The amounts of time that participants spent near 0° and 180° increased particularly when the absolute period difference was smaller (see

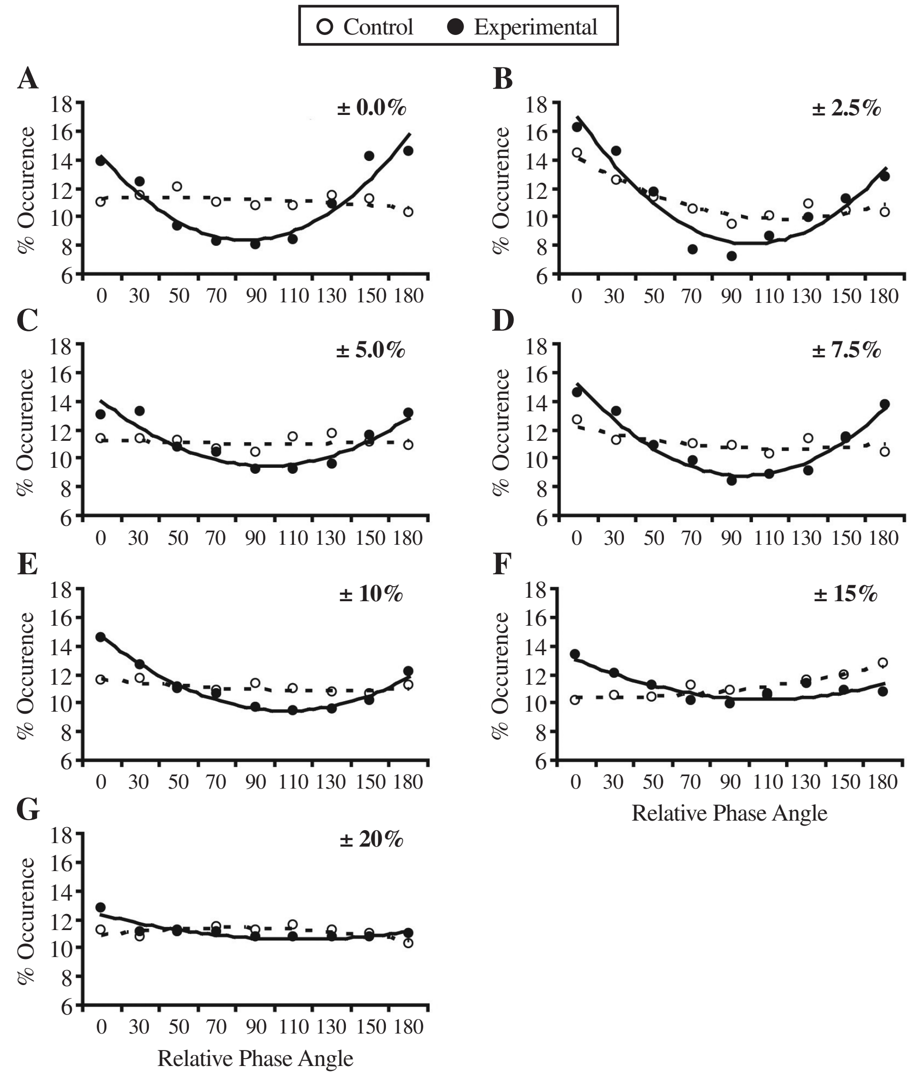

FIGURE 3. Distributions of relative phase regions for control and experimental trials plotted as a function of the averaged absolute tempo factor differences in Experiments 1 and 2: (**A**) 1.00, (**B**) 0.975 and 1.025, (**C**) 0.95 and 1.05, (**D**) 0.925 and 1.075, (**E**) 0.90 and 1.10, (**F**) 0.85 and 1.15, and (**G**) 0.80 and 1.20. For simplicity, the distributions reported in (**A**), (**C**), and (**E**) are the average of the distributions collected in Experiments 1 and 2.

Figures 3A–3D). Although during the experimental trials, there appeared to be increases in the amount of time that participants spent near 0° and 180° for tempo factors within ±0.075 (see Figures 3A–3D), the three-way interaction was not significant, $F(64, 960) = 0.76$, $p > .05$. Moreover, we found no significant effect of tempo factor, $F(8, 120) = 1.38$, $p > .05$, and no significant Condition × Tempo Factor interaction, $F(8, 120) = 0.86$, $p > .05$.

A 2 × 9 × 9 (Condition × Tempo Factor × Phase Region) repeated measures ANOVA on the amount of time that participants spent in each of the nine relative phase regions for the tempo factors of Experiment 2 revealed a significant interaction between tempo factor and phase region, $F(64, 896) = 1.48$, $p < .01$. As Figures 3A, 3C, and 3E–3G show, participants spent a greater amount of time near 0° and 180° when the period difference between their movements and that of the environmental stimulus was smaller. No main effects were evident for condition, $F(1, 14) = 0.40$, $p > .05$, tempo factor, $F(8, 112) = 0.85$, $p > .05$, or phase region, $F(2.69, 37.71) = 2.40$, $p > .05$. There were no significant interactions between condition and tempo factor, $F(8, 112) = 0.79$, $p > .05$, or between condition and phase region, $F(2.39, 33.47) = 1.40$, $p > .05$; nor was there a significant interaction between the three variables, $F(64, 896) = 0.97$, $p > .05$. Those results differ slightly from the findings of Experiment 1 in that the interaction between condition and phase region was no longer significant. We hypothesize that the greater period differences that we used in Experiment 2 (e.g., 0.800, 0.850, 1.150, and 1.200) led to a decrease in the amount of coordination at 0° and 180°, which reduced the differences between control and experimental conditions (see Figures 3F and 3G) and thereby eliminated the significant interaction.

Although we observed no interaction, for the experimental trials in which the period difference between participants' movements and those of the oscillating stimulus was small, the amount of time that participants spent at the attractor locations of 0° and 180° increased, resulting in a U-shaped parabolic distribution. As the period difference between the two oscillators increased, the concavity of the function decreased. For the control trials, equal amounts of time were spent in the nine phase regions for all period differences, indicating that no coordination occurred, and a flat line resulted. One way in which we might test that claim would be to conduct separate ANOVAs for each of the averaged absolute tempo factor differences that we used in Experiments 1 and 2 and determine whether the polynomial contrasts for the interaction of condition and phase region are significant. A significant interaction for the contrast would imply that the lines in the graph differ in terms of a quadratic effect, meaning that one line is bowed and the other is flat. For Experiment 1, the Condition × Phase Region quadratic contrasts for the averaged absolute tempo factors revealed significant differences for the ±0.000, ±0.050, and ±0.075 factors, all *p*s < .05, and a marginally significant difference for the ±0.100 factor, $p = .064$. There was no significant difference between the two lines for the ±0.025 tempo factor. However, a close inspection of the data revealed that the latter finding resulted from an increase in the amount of time that participants spent in either the in-phase (0°) or the antiphase (180°) region, but not intermittently between the two. Therefore, when we averaged together the times spent between the in-phase mode and the antiphase mode, the effect canceled out.

For Experiment 2, the Condition × Phase Region quadratic contrasts for the averaged absolute tempo factors revealed significant differences for the ±0.000 and ±0.100 factors, both *p*s < .05, but not for the ±0.050 factor. Again, a close inspection of the data revealed that that the absence of an interaction for the ±0.050 factor arose because of our averaging of times that participants spent between the in- and antiphase modes, which resulted in a flat line. There were also no significant interactions for the averaged absolute tempo factors ±0.150 and ±0.200. However, the explanation for that finding is that the difference in period between the individual's self-selected tempo and the experimenter-determined tempo was far too great for any coordination to occur.

Researchers can also test the hypothesis that as the period difference increases, the amount of time that participants spend in the attractor locations of 0° and 180° will decrease by conducting second-order polynomial regressions on the average amount of time that participants spend in each of the nine different phase regions for both control and experimental trials. The coefficients for the quadratic term of the regression equations serve as indexes of the concavity of the curve (the greater the magnitude of the coefficient, the greater the concavity of the curve). Thus, we expected that the experimental trials' coefficients (which indexed the concavity of the continuous relative phase functions) would depend on the absolute tempo factor differences and that as the difference increased, the coefficients would decrease.

We plotted the coefficients that we obtained from the second-order polynomial regressions for both the control and experimental trials as a function of the absolute tempo factor differences. Figure 4 shows that the best fitting line for the quadratic coefficients for the experimental trials revealed the predicted negative relationship: As the absolute tempo factor difference increased, the coefficients decreased. We expected that in the control trials, the function would not depend on the absolute tempo factors and that the functions would remain constant across all absolute differences. The close-to-horizontal best fitting line for control trials' quadratic coefficients in Figure 4 confirms that they remained constant.

GENERAL DISCUSSION

Overall, the present results indicate that participants can become unintentionally entrained to the visual stimulus when it oscillates within a limited range of their own preferred comfort mode period and that as the absolute period difference between two oscillators increases (e.g.,

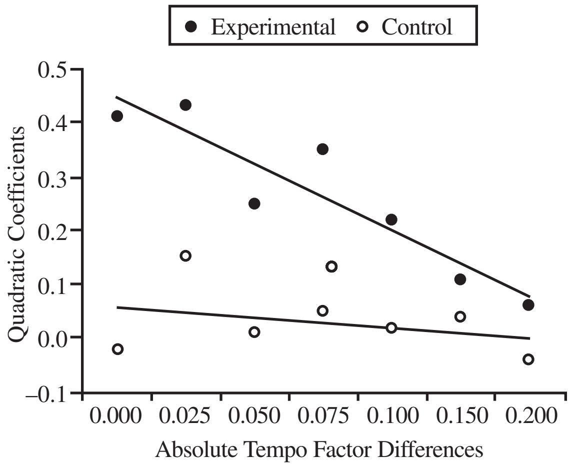

FIGURE 4. Quadratic coefficients for the control and experimental trials obtained from the quadratic regression performed on the seven different relative phase graphs (Figure 3) plotted as a function of the absolute tempo factor differences.

reaching the bounds of the period basin), the magnitude of coordination will decrease systematically. The decrease in cross-spectral coherence values and flattening of the relative phase distributions in the experimental conditions, as indexed by the quadratic regressions, revealed those coordination changes in the present experiment. It is important to appreciate that the present experimental results are consistent with the reanalysis of the Richardson et al. (2005) data in which we found that the amount of entrainment within the pairs decreased as the self-selected movement periods increased. Although it is unclear what the specific basin of entrainment would be for those types of movements, both the current experiments and the reanalysis suggest that the range is around ±10% to ±15% of the participants' preferred comfort mode period.

In conclusion, the present results support our hypothesis that the period difference between two oscillating stimuli is a significant constraint on the emergence of unintentional visual coordination. The results have important implications for predicting when unintentional coordination can occur between movements of an individual and an environmental rhythm or between movements of two interacting individuals. Future researchers can further investigate this issue by using the Richardson et al. (2005) unintentional interpersonal visual coordination paradigm with the addition of detuning by using asymmetrical pendulums, in an attempt to uncover the specific period basin of entrainment within the context of an actual interpersonal interaction. It is important to note, however, that different visual tasks and different unintentional paradigms (such as interpersonal coordination) may yield different basins of entrainment—meaning that investigators will have to use a larger range of period differences to determine at what point coordination ceases to persist. For intentional coordination, one would expect no such range for in-phase coordination, with the exception of biomechanical limits on the possible frequencies of movement. In addition, although there are task-dependent frequency limits on the production of antiphase coordination (individuals tend to transition from an antiphase pattern to an in-phase pattern at faster frequencies), that frequency range is significantly greater than the range that we observed in this study for unintentional coordination (e.g., Haken, Kelso, & Bunz, 1985; Schmidt, Carello, & Turvey, 1990; Schmidt et al., 2007) and is not known to have a lower frequency limit. Last, because we know that unintentional interpersonal coordination processes result in feelings of rapport and social connectedness (e.g., Bargh & Chartrand, 1999; Bernieri, Reznick, & Rosenthal, 1988; Bernieri & Rosenthal, 1991, Lakin & Chartrand, 2003), understanding how period difference constrains the possible occurrence of interpersonal movement entrainment should help in uncovering the degree to which social interaction can be understood as a dynamically constrained, self-organized process.

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