Dynamics of social coordination

The synchronization of internal states in close relationships

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Close relationships are described in terms of the temporal coordination of behavior based on the similarity of partners' internal states (e.g., moods, personality traits). Coupled nonlinear dynamical systems (logistic equations) were used to model the emergence, maintenance, and disruption of coordination in such relationships. For each system (partner), there was a control parameter corresponding to an internal state and a dynamical variable corresponding to behavior. Computer simulations investigated how the temporal coordination of behavior in a relationship reflects the similarity of partners' control parameters and the strength of coupling (mutual influence between partners). Several types of coordination were observed, with in-phase synchronization occurring for strong coupling and similarity in internal states. In a variation of the model, each system could adjust its own control parameter to synchronize its dynamics with that of the other system. Simulation results provide insight into several topics in the study of close relations and group dynamics.

Keywords: close relationships, coordination, synchronization, dynamical systems, logistic equations, control parameters, dynamical variables, mutual influence, internal states

Interpersonal relations are established through the coordination of people's thoughts, moods, and actions. Coordination is necessary for any type of sustained relationship, from those defined in purely instrumental terms to those defined in terms of romance and commitment. Lay people clearly recognize the importance of coordination to their relations with one another. Two individuals with a positive relationship are commonly described as "being on the same wavelength" or "resonating with one another," whereas individuals in problematic relationships are said to "be out of synch with each other." Yet despite the

Interaction Studies 6:1 (2005), **35–52**.
ISSN 1572–0373 / E-ISSN 1572–0381

centrality of coordination in people's implicit psychology of relationships, this construct has received surprisingly little attention in scientific psychology. Our aim in this article is to document the role of coordination in close relationships and to present a dynamical model, implemented in computer simulations, that illustrates how this dynamic component develops in interpersonal contexts.

The importance of coordination to social relations has not been entirely lost on social scientists. The prevalent approach, however, has been to conceptualize interactions and relationships with respect to global variables that characterize the interaction or relationship as a whole. The interactions of dyads and groups, for example, are often investigated in terms of dimensions such as cooperation versus competition, compatibility of motives and goals, and the structure of norms and roles (e.g., Biddle & Thomas, 1966; Dawes, 1980; Levine & Moreland, 1998; Berkowitz & Walster, 1976; Wish, Deutsch, & Kaplan, 1976). Some approaches emphasize the temporal aspects of social interaction, but the focus is typically restricted to the development of strategies for achieving personal or shared goals (e.g., Axelrod, 1984; Messick & Liebrand, 1995; Thibaut & Kelley, 1959).

Social coordination takes on a different meaning when viewed from the perspective of dynamical systems. In this account, two (or more) people are coordinated to the extent that the actions, thoughts, and feelings of one person are related over time to the actions, thoughts, and feelings of the other person or persons (cf. Nowak & Vallacher, 1998; Vallacher, Read, & Nowak, 2002). With this in mind, we suggest that the concepts and methods used to characterize temporal coordination in physical systems may be relevant to coordination in interpersonal systems. In particular, we argue that coupled nonlinear dynamical systems capture the essence of the temporal coordination of individual dynamics in relationships. We employ coupled logistic equations — the simplest dynamical systems capable of chaotic behavior — to study the temporal aspects of coordination. Our focus is how coordination changes as a function of the strength of influence between individuals, and of the degree of similarity of their respective internal states.

The coordination of behavior and internal states

The most basic form of social coordination is the synchronization of motor behavior. This phenomenon has been examined in the context of movement coordination (e.g., Beek & Hopkins, 1992; Schmidt, Beek, Treffner, & Turvey, 1991; Turvey, 1990), with most research focusing on the synchronization of the leg movements of two people. In this approach, one person is asked to swing his or her legs in time to a metronome and the other person tries to match those movements. Two forms of coordination are typically observed: in-phase synchronization (people swinging their legs in unison) and anti-phase synchronization (people swinging their legs with the same frequency but in the opposite direction). Sometimes the individuals are instructed to synchronize out-of-phase and up to a certain frequency they are able to do so. Beyond a critical tempo, however, the individuals can no longer synchronize in this manner and switch to in-phase synchronization. Hysteresis, which is a sign of non-linear dynamical systems, is also commonly observed in this line of research (cf. Kelso, 1995). Thus, when the tempo decreases, at some value the individuals are able to reestablish anti-phase coordination, but this tempo is significantly lower than the point at which they originally started to coordinate in-phase.

In-phase coordination is the easiest form to achieve and maintain. Indeed, this may become the only form that can be sustained as coordination becomes more difficult (e.g., as the tempo of behavior is increased). This restriction on coordination possibilities may generalize to social situations. Under high stress (e.g., a panic situation), for example, it may prove impossible for people to coordinate their behavior in any form other than in-phase. In a crowded theater that suddenly bursts into flames, the occupants are unable to take turns in exiting through the doors, even though this is the only form of coordination that would make evacuation possible. Similarly, two people engaged in conversation may find it impossible to take turns speaking if the level of emotionality reaches a critical point.

Coordination of overt behavior is certainly important in interpersonal relations, but of greater interest from a psychological perspective is the coordination of people's internal states (cf. Nowak, Vallacher, & Zochowski, 2002; Tickle-Degnen & Rosenthal, 1987). Internal states cover a wide ground, from those that are highly variable, such as mood or arousal, to those that reflect fairly enduring properties of a person, such as personality traits, values, goals, and temperament. Achieving coordination with respect to such psychological features as opposed to physical movements is especially important in close relationships. Empathy, perspective taking, and emotional compatibility capture necessary components of a relationship in which the partners are on the same wavelength. Indeed, people are often motivated to adjust their own internal state to match that of their interaction partners, presumably in service of facilitating smooth interaction. Research has shown that people sometimes prepare for social interaction by changing their internal state to match the anticipated state of the interaction partner, even if this means toning down a positive mood in favor of a more subdued mood (e.g., Erber, Wegner, & Thierrault, 1996). Accordingly, we propose a formal model that depicts the emergence of synchronization of both overt behavior and internal states in social relationships. We present the results of computer simulations that test key assumptions in the model regarding the development of synchronization between two people as they develop a progressively closer relationship.

Humans as nonlinear dynamical systems

A dynamical system is a set of interconnected elements that undergo change by virtue of their mutual influences. This means that even in the absence of external influences, a dynamical system may display a pattern of change in some system-level property that reflects the mutual adjustment of elements at each moment in time. Recent research in several areas of science has shown that very simple rules of interaction among system elements can produce highly complex dynamics on the system level if the interactions are nonlinear in nature. Nonlinearity means that the effects of changes in one element — represented as a variable — are not reflected in a proportional manner in other elements (variables). Non-linearity also means that the relations among variables usually depend on the values of other variables in the system, and thus are interactive rather than additive in nature (cf. Nowak & Lewenstein, 1994). In more formal terms, a dynamical system is composed of a set of *dynamical variables* (x) that change in time, and one or more *control parameters* (r) that play a critical role in influencing the dynamical variables.

Humans can be viewed as dynamical systems in the sense that they display change over time in the absence of external influence. There clearly is no shortage of variables capable of promoting constant change in people's thoughts, emotions, and actions. Any element of human experience, after all, can be analyzed with respect to myriad potential genetic, hormonal, familial, dispositional, and cultural factors. The abundance of potential interactions among these variables, meanwhile, suggests that humans can be profitably viewed as nonlinear systems. In recognition of the dynamic, complex, and non-linear nature of human experience, recent years have witnessed the ascendance of the dynamical perspective in personality and social psychology (e.g., Nowak

& Vallacher, 1998; Vallacher & Nowak, 1994, 1997; Vallacher, Read, & Nowak, 2002).[1]

The simplest dynamical system capable of complex behavior is the logistic equation or map (Feigenbaum, 1978). The logistic map involves repeated iteration, which means that the output value of the dynamical variable (x) at one step (n) is used as the input value at the next step ($n+1$). The current value of the dynamical variable (which varies between 0 and 1), in other words, depends on the variable's previous value — that is, $x_{n+1} = f(x_n)$. This dependency is represented in two opposing ways. First, the higher the previous value, the higher the current value; specifically, x_{n+1} equals x_n multiplied by the value of r. Second, the higher the previous value, the lower the current value; specifically, x_{n+1} equals $(1-x_n)$ multiplied by the value of r. The combined effect of these competing tendencies is expressed as $x_{n+1} = rx_n(1-x_n)$. Depending on the value of r, the logistic equation may display qualitatively different patterns of behavior (pattern of changes in x), including the convergence on a single value, oscillatory (periodic) changes between two or more values, and very complex patterns of behavior resembling randomness (i.e., deterministic chaos).

The logistic equation provides a useful way of conceptualizing human dynamics (cf. Nowak & Vallacher, 1998; Nowak, Vallacher, & Zochowski, 2002). In this approach, the dynamical variable (x) represents a person's behavior, and changes in x represent variations in the intensity of the behavior. The control parameter, r, corresponds to internal states (e.g., moods, values, traits) that shape the person's pattern of behavior (changes in x over time). The notion of opposing forces represented in the logistic equation captures the idea of conflict, which has proven to be a key concept in many psychological theories. In the approach-avoid situation (Miller, 1944), for example, movement toward a goal increases both approach and avoid tendencies. The work on achievement motivation (e.g., Atkinson, 1964), in turn, has identified two concerns, the desire for success and the fear of failure, that combine in different ways to produce resultant motivation. Research on the dynamics of suppression, meanwhile, suggests that attempts at action or thought suppression activate an ironic process that works at cross-purposes with the attempted suppression (cf. Wegner, 1994). The assumption that conflicting forces or tendencies are central to human dynamics, in fact, represents a common theme in most issues of psychological interest (e.g., impulse vs. self-control, autonomy vs. social identity, short-term vs. long-term self-interest, egoism vs. altruism).

Social interaction as the coupling of nonlinear dynamical systems

If an individual is conceptualized as a dynamical system, then social interaction can be investigated as the coupling or synchronization of two (or more) dynamical systems. Accordingly, we employed coupled logistic equations, an approach which has successfully modeled the synchronization of physical systems (e.g., Shinbrot, 1994), to model the synchronization of people in social interaction. The basic idea is that when the value of the dynamical variable (x) for one equation depends not only on its previous value but also to some degree on the value of x for the other equation, the two equations tend to synchronize in their behavior over time. This idea has straightforward application to human interaction. Quite simply, the behavior of each partner depends not only on his or her preceding behavior but also on the preceding behavior of the other person. Formally, such influence is introduced by the assumption that the behavior of each partner in the next moment in time depends to a certain degree on the behavior of the other partner at the preceding moment in time. The coupling is done in a simple way, according to the following equations:

$$x_1(t+1) = \frac{r_1 x_1(t)(1 - x_1(t)) + \alpha r_2 x_2(t)(1 - x_2(t))}{1+\alpha} \quad [1]$$

$$x_2(t+1) = \frac{r_2 x_2(t)(1 - x_2(t)) + \alpha r_1 x_1(t)(1 - x_1(t))}{1+\alpha} \quad [2]$$

To the value of the dynamical variable representing one's own behavior (x_1), one adds a fraction, denoted by α *(alpha)*, of the value of the dynamical variable representing the behavior of the partner (x_2). The size of this fraction (*alpha*) corresponds to the strength of coupling and reflects the mutual influence or interdependency of the partners. When the fraction is 0, there is no coupling on the behavior level, whereas a value of 1.0 corresponds to the situation where one's own behavior is determined equally by one's preceding behavior and the preceding behavior of the partner. Intermediate values of *alpha* correspond to intermediate values of coupling.

Modeling the synchronization of behavior

When the control parameters of each system have the same value, the dependence between their respective dynamical variables causes the systems to synchronize completely, so that the temporal changes in x_1 and x_2 become identical (e.g., Kaneko, 1984). Of course, the respective control parameters of two individuals are rarely (if ever) identical, nor do all relationships display the same degree of mutual influence or interdependence. Our first set of simulations, then, investigated how the coordination of dynamical variables (corresponding to individuals' behavior) depends on the similarity of control parameters (corresponding to individuals' internal states) and the strength of coupling (corresponding to the strength of influence between individuals).

For each simulation, we started from a random value of the dynamical variables for each person, drawn from a uniform distribution that varied from 0 to 1. The control parameter for one system (corresponding to one partner) was held constant at a value of 3.67, which corresponds to low levels of chaotic behavior. We systematically varied the value of the control parameter for the other partner between values of 3.6 and 4.0, which corresponds to the highest value of the chaotic regime. We let the two systems run for 300 steps, so that each system had a chance to come close to its pattern of intrinsic dynamics (i.e., pattern of changes in x) and both systems had a chance to synchronize. For the next 500 simulation steps, we recorded the values of the dynamical variables for each system and measured the degree of synchronization (i.e., the difference between the dynamical variables).

The primary results were straightforward and in line with the intuitions expressed earlier. The degree of synchronization tended to increase both with increases in *alpha* and with increasing similarity in r. This suggests that interdependence and similarity in internal states can compensate for one another in achieving or maintaining a particular level of synchronization in people's behavior. Thus, two people can achieve a high degree of synchronization despite relatively weak mutual influence if their respective internal states are similar. By the same token, if the partners have different internal states, high mutual influence (e.g., constant monitoring, communication, mutual reinforcement) is necessary to maintain the same level of synchronization.

The simulation results also revealed less straightforward, but quite interesting effects for coordination as a result of variation in *alpha*. For very high values of *alpha*, the predominant mode of coordination was in-phase synchronization and what varied was the strength of the behavior matching. For low values of *alpha*, however, different modes of coordination were observed. In addition to in-phase synchronization, the coupled systems displayed anti-phase synchronization (analogous to complementarity or turn-taking in behavior), independence in behavior, and other complex forms of coordination. This suggests that a richer repertoire of modes of coordination is available when mutual influence is relatively weak. There was also a tendency under relatively weak coupling for the systems to stabilize each other, so that each system behaved in a more regular (e.g., less chaotic) manner than it would have without the weak influence (cf. Ott, Grebogi, & York, 1990). With respect to close relationships, these results suggest that for strong mutual influence and control (e.g., constant monitoring and control), the behavior of one partner largely tends to mirror the behavior of the other partner. For relatively weak mutual and control, in contrast, interpersonal coordination can take more complex and less obvious forms. Because coordination in this case may reflect a complex, non-linear pattern, observers may find it difficult to note or understand the ways in which the behaviors of the partners are synchronized.

Taken together, these results suggest that the mutual influence commonly associated with close relationships (cf. Thibaut & Kelley, 1959) may be a mixed blessing. To be sure, if two people are highly dissimilar in their internal states, they may nonetheless achieve a fair degree of coordination by directly influencing one another's behavior. This scenario, though, creates the potential for instability in the relationship. As soon as the influence is curtailed, the dynamics of the two people will immediately diverge. On the other hand, a high degree of similarity in the setting of control parameters preserves synchronization for a considerable period of time when mutual influence is broken. Even if the partners' behaviors do not synchronize in time, the overall form of their respective dynamics will remain similar, so that reestablishing coordination at a later time will be relatively easy. In couples characterized by similarity of internal states, then, relatively little influence or communication is needed to maintain coordination and thus preserve the relationship. Couples characterized by weak similarity of internal parameters, on the other hand, may be able to maintain their behavioral coordination, but only through strong and sustained attempts at mutual influence. Such couples thus have a heightened risk for a breakdown in coordination. To prevent this from occurring, they may engage in events together that induce a common mood and also bring about coordination on a behavioral level. Events that are affectively positive (e.g., dancing, sexual relations) can clearly have this effect, but in principle so can negatively toned events, such as a heated argument or witnessing a tragic event.

Modeling the synchronization of internal states

In principle, modeling the direct coordination of control parameters is fairly straightforward. All one needs to assume is that on each simulation step, the values of each person's control parameter drifts somewhat in the direction of the value of the partner's control parameter. The rate of this drift and the size of the initial discrepancy between the values of the respective control parameters determine how quickly the control parameters begin to converge. This mechanism assumes, however, that both partners can directly observe or estimate the settings of one another's control parameters. Direct observation of the internal states of an interaction partner may be difficult, or even impossible in some cases. Indeed, considerable effort is typically devoted to communicating or inferring one another's dispositional qualities and other internal states (cf. Jones & Davis, 1965; Kunda, 1999; Nisbett & Ross, 1980; Wegner & Vallacher, 1977). Even with the multiplicity of cognitive means available to people, the precise nature of a person's momentary state or relevant chronic disposition may be impossible to determine.

Lacking insight or clear inferences into one another's internal states, interaction partners may nonetheless achieve similarity in these states by means of behavioral coordination. Various lines of social psychological research are relevant to this idea. Research on the facial feedback hypothesis, for example, has shown that when people are induced to mechanically adopt a specific facial configuration linked to a particular affective state (e.g., disgust), they tend also to adopt the corresponding state (e.g., Strack, Martin, & Stepper, 1988). The matching of internal states to overt behavior is enhanced for behavior that is interpersonal in nature. Research has shown that even role-playing, in which a person follows a scripted set of actions *vis a vis* another person, commonly produces noteworthy changes in attitudes and values on the part of the role player to match his or her overt actions (cf. Zimbardo, 1970).

We implemented this mechanism in our model by allowing each system to modify the value of its own control parameter in order to match the other system's pattern of behavior. The exact value of the partner's control parameter is invisible to the person. Each person, however, remembers the partner's most recent set of behaviors (i.e., the most recent values of x), as well as his or her own most recent behaviors. The person compares the partner's pattern with his or her own, and adjusts his or her own control parameter until the respective behavior patterns match (cf. Zochowski &Liebovitch, 1997). If the partner's observed behavior pattern is more complex (e.g., more chaotic) than the person's own

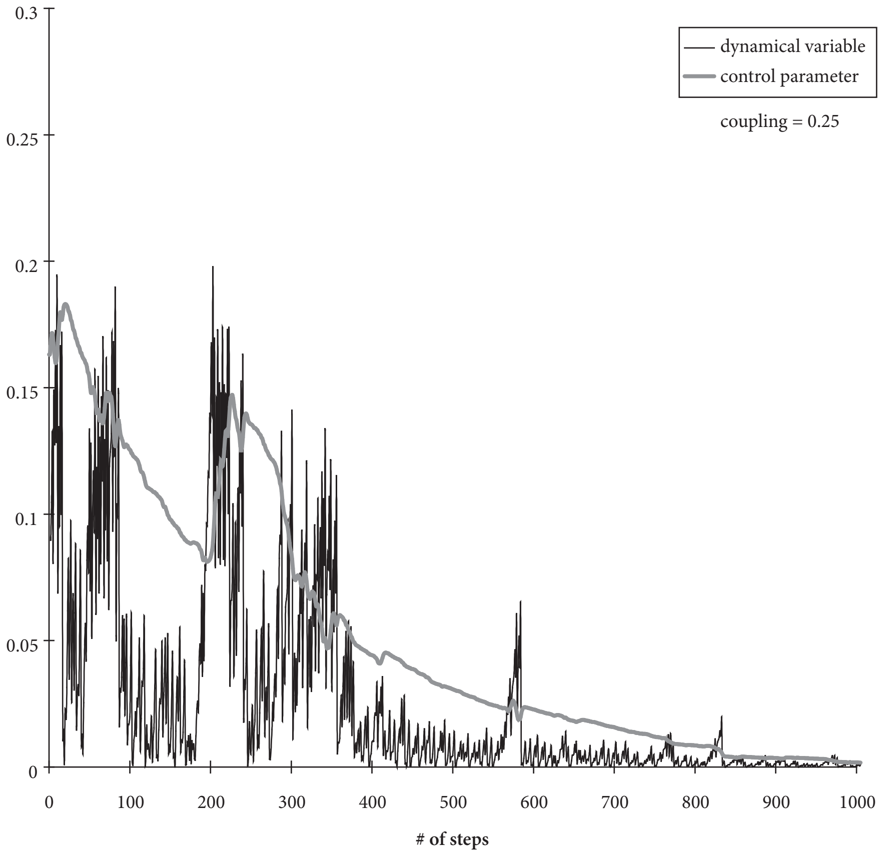

Figure 1. Development of synchronization under relatively weak coupling (mutual influence)

behavior pattern, he or she adjusts (increases) the value of his or her own control parameter until similarity in their respective behavior patterns is achieved. On the other hand, if the partner's behavior is less complex than the person's own behavior, the person decreases slightly the value of his or her own control parameter. Each person, in effect, can discover the internal state of the other person by monitoring and matching the dynamics of the other person's behavior.

In Figure 1, we show how the internal states of two systems become progressively similar in accordance with this scenario. This simulation was run for relatively weak coupling (*alpha* = .25). The *x*-axis corresponds to time in simulation steps, and the *y*-axis portrays the value of the difference between the two systems in their respective control parameters (thick gray line) and in their dynamical variables (thin black line). The figure shows that over time, the two

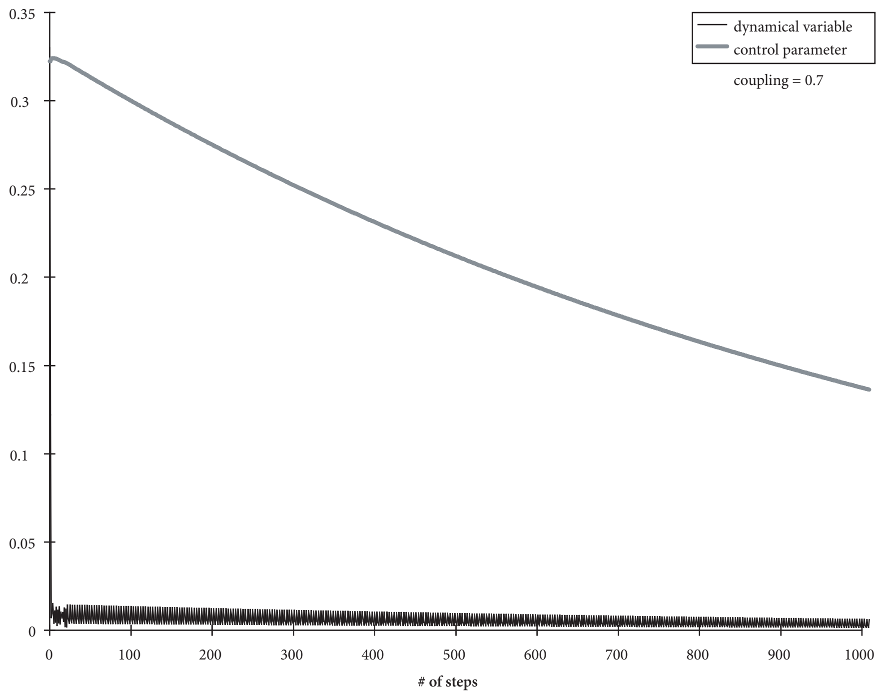

Figure 2. Development of synchronization under relatively strong coupling (mutual influence)

systems become similar in the values of their control parameters and perfectly synchronized in their behavior. This suggests that attempting behavioral synchronization under weak levels of mutual control over one another's behavior facilitates the matching of one another's internal state.

Different results were obtained when the simulations were performed with a relatively high value of coupling (*alpha* = 0.7). Figure 2 displays the results of this simulation. Although virtually perfect coordination in behavior develops almost immediately, the control parameters of the two systems fail to converge, even after 1,000 simulation steps. This disparity occurs because strong coupling causes full synchronization of behavior, even for systems with very different values of their respective control parameters. Once their behavior is fully synchronized, the two systems do not have a clue that their control parameters are different. Hence, if the coupling were suddenly removed, the dynamics of the two systems would immediately diverge. This suggests that using very strong influence to obtain behavioral coordination is likely to hinder synchronization at a deeper level.

The results of these simulations have interesting implications for interpersonal dynamics. First of all, they suggest that there is an optimal level of influence and control over behavior in social relationships. If influence is too weak, synchronization may fail to develop at all. Very strong influence, on the other hand, is likely to prevent the development of a relationship based on mutual understanding and empathy. Highly monitored and controlled partners may fully synchronize their behavior, but they are unlikely to adopt the internal states necessary to maintain such behavior in the absence of social influence. As noted earlier, moreover, high values of coupling restrict the range of possible modes of coordination in a relationship. Too strong a coupling may therefore result in a relationship that is experienced as highly predictable and therefore boring. On balance, the most desirable degree of coupling is one that allows for effective coordination, but keeps direct influence at a relatively low level. This moderate degree of coupling allows for the internalization of common internal states in a relationship. Under such conditions, relationships may develop rich dynamics and switch between different modes of coordination. The most advantageous degree of coupling, in sum, is the minimal amount necessary to achieve synchronization.

The simulation results also shed light on a controversial and somewhat puzzling conclusion regarding the relative impact of parents and peers on personality development in children (e.g., Harris, 1995; Scarr, 1992). Although children spend far more time with their parents than with any single peer when they are very young and thus highly impressionable, considerable research suggests that children develop personality traits that are more similar to those of their peers than to those of their parents. This conclusion, though certainly controversial, is not particularly surprising in light of our model. The parent-child relationship, after all, is characterized by strong coupling, so that children have little need to internalize the settings of their parents' control parameters in order to achieve and maintain behavioral coordination with them. When parents monitor a child's behavior, praising it when it is considered appropriate and providing discipline when it is less so, they are exerting fairly constant and strong influence over what the child does. To the extent that the parents' behavior control is apparent to the child, he or she learns to act in accordance with the relevant reinforcement contingencies, expectations, rules, and so forth.

Children obviously internalize certain lessons from these experiences and thus may develop control parameters that resemble their parents'. But the need to adopt parents' internal states pales in comparison to the strategic value of matching the internal states of their peers. Unlike parents, peers are not in a position to monitor a child's behavior, let alone control it on a daily basis. Peers make for considerably less faithful interaction partners too, and the surface structure of their behavior tends to be more erratic as well. These characteristics of peer relations — relatively weak coupling, relationship instability, and potential for unpredictable behavior — all point to the practical value of learning the internal bases for peers' behavior. Beyond that, it is simply easier to resonate with the interests, moods, and thoughts of someone who is similar to oneself in age, life experiences, competencies, and power. Children certainly love and admire (and may even appreciate) their parents, but they are less likely to empathize and identify with them than they are with their peers. Synchronization with peers, in short, has all the ingredients for convergence on common control parameters, and thus may be more influential in establishing children's characteristic ways of thinking and acting.

Caveats and conclusions

In dynamical terms, a close relationship represents the achievement and maintenance of coordination between two people. Models of coupled non-linear dynamical systems, originally developed in mathematics and the physical sciences, provide important insight into the dynamics of close relationships. We employed coupled logistic equations to model such dynamics. Coordination occurs both with respect to dynamical variables, representing overt behavior, and control parameters, representing internal states (e.g., moods, values, personality traits, attitudes). The strength of coupling (*alpha*) corresponds to mutual influence, which can represent direct communication, promises of reward or threats of punishment, or other forms of control. To simulate the coordination of internal states, we adopted a model of synchronization dynamics (Zochowski & Liebovitch, 1997; see also Nowak et al., 2002), in which a feedback loop exists such that each system changes its own control parameter to match the level of complexity in the dynamical variable of the other system.

The computer simulations revealed that coordination of internal states in a relationship facilitates the coordination of behavior. Results also revealed that difficulty in achieving behavioral coordination may be used as a guide for achieving coordination with respect to internal states. Ironically, very strong behavioral coordination resulting from strong mutual control (i.e., very high values of *alpha*) was found to hinder rather than facilitate the development of similarity in partner's internal states. A close relationship is most likely to develop and endure, in other words, if there is similarity of internal states and partners' mutual control is not too strong.

This approach is new to psychology, so caution should be exercised when generalizing the results to human relationships. At this preliminary stage, it is not clear which coordination phenomena we observed are reflective of coupled non-linear systems generally, and which are specific to the coupling of logistic equations. Although we believe the logistic equation captures important features of human systems (e.g., conflicting forces), the robustness of the results we obtained will ultimately depend on their generality across different instantiations of dynamical systems.

It is also the case that our model greatly simplifies the complexity of human behavior and people's internal (psychological) states. Overt behavior can be reduced to a single dimension (e.g., intensity) by a variety of means, but the multi-dimensionality of emotions, values, plans, and other internal states raises questions concerning the appropriateness of reducing these states to a single control parameter. Finally, certain coordination phenomena in social relations may be unique to humans, reflecting the influence of social and cultural norms, social motives and orientations, or perhaps expressing the unique biological properties of humans. Some coordination phenomena, on the other hand, may be generic to different types of coordinating systems. Although computer simulations may prove useful in discovering and illuminating the nature of the generic phenomena, empirical research with humans is critical to decide which findings may be extended to human interpersonal experience.

These caveats notwithstanding, the results of our simulations point to striking parallels between the dynamics of coupled logistic equations and the dynamics of close relationships. The finding that strong influence can compensate for differences in people's internal states, for example, corresponds with intuitions regarding control in close relationships. The computer simulations also produced results that are consistent with research demonstrating that psychological changes obtained under relatively weak influence and subtle means tends to be more enduring than are the more rapid changes obtained through excessive (rewarding and aversive) control (cf. Vallacher, Nowak, & Miller, 2003). Empirical research nonetheless is necessary before one can accept the results of the computer simulations as applicable to intimate human relationships. Computer simulations can prove useful in generating the hypotheses to be tested in such endeavors, and they can highlight those phenomena (e.g., modes of coordination and transitions between them) that are worthy of special attention. In sum, framing human interpersonal dynamics in terms of coordination phenomena prevalent in the natural world provides a bridge between psychological intuitions and the precision afforded by physical science.

Note

1. Psychological systems clearly differ from physical systems in important respects, and it is an open question whether certain unique features of human thought and action (e.g., consciousness, intentionality) can be meaningfully reframed in terms of formal properties that are common to dynamical systems in other areas of science. Because the dynamical approach has spawned a set of rigorous methods and tools, however, this question is also an empirical one. We refer the interested reader to Nowak and Vallacher (1998) for a more thorough consideration of this issue.

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The research presented in this article was presented in *Making minds: An interdisciplinary conference*, in Kloster-Irsee, Germany, January, 2004. We thank Petra Hauf, Wolfgang Prinz, and an anonymous reviewer for their insightful and constructive comments on an earlier draft of this article.