Affiliative bonding as a dynamical process: A view from ethology

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Abstract: Depue & Morrone-Strupinsky's (D&M-S's) implicit assumption appears to be that affiliative bonding is either strengthened or maintained with time; however, it is more realistic that it can also be weakened or destroyed by conflictive interpersonal interactions. Without specifying the mechanisms by which antagonistic stimuli deteriorate affiliative bonding, the model is incapable of accounting for the dynamics associated with this complex phenomenon.

The argument concerns the theoretical conceptualization of affiliative bonding. Depue & Morrone-Strupinsky (D&M-S) define affiliative bonding in the context of psychometric studies, where the high-order trait of affiliation represents an independent dimension in multidimensional personality space. From there, they delineate the core behavioral-motivational processes underlying this trait, around which their neurobiological model is constructed. A critical view from ethology – which takes a bottom-up, behavior-based approach for studying animal social interactions – is that such top-down approaches may overlook many of the behavioral dynamics underlying affiliative relationships in human and nonhuman primate societies. The ethological approach has a theoretical advantage in conceptualizing affiliation, because definitions of personality traits should ideally be based on explicit behaviors in the scientific study of personality (Itoh 2002).

Observations readily illustrate the complexity of the behavioral dynamics associated with affiliative bonding. *Ame futte ji katamaru* is a Japanese idiom that literally means "After a rainfall, the ground gets firm," and although it may at first seem counterintuitive, it truthfully illustrates the natural phenomenon of soil-hardening that occurs after water in the soil evaporates. This phrase is often used to refer to the apparently paradoxical tightening of interpersonal bonds that can occur after successful postconflict reconciliation. It suggests the possibly constructive role of conflictive events in strengthening social relationships and supports the view that affiliative bonding involves complex dynamics evolving around intricate interpersonal interactions (Vallacher et al. 2002). Cycles of aggression and postconflict reconciliation constitute an integral part of affiliative bonding, and are also found in nonhuman primates (de Waal 2000). Matrilineal kin in rhesus monkeys, for example, show greater frequencies of both affiliative and antagonistic interactions than is found between unrelated individuals (Bernstein et al. 1993). Aggressions between closely related individuals are often quickly followed by reconciliatory behaviors in many species of nonhuman primates (Aureli 1997).

These observations indicate that behavioral expressions of affiliative bonding involve complicated interindividual interactions marked by both affiliative and nonaffiliative episodes. The authors' model of the core behavioral processes that underlie the affiliation trait (target article, Fig. 3) falls short, however, of depicting the dynamics involved. In their scheme, affiliative bonding is strengthened and maintained through appetitive and consummatory phases of processing affiliative rewards, and hence it is a nondecreasing function of time (Fig. 1a). By contrast, and according to a more dynamical view, it can also get weakened, theoretically at least, in the course of time because of conflictive interactions (Fig. 1b).

From this perspective, one crucial component missing from D&M-S's model is a negative input mechanism. In addition to the mechanisms by which affiliative rewards increase affiliation (labeled as "activation" in the target article, Fig. 3), mechanisms by which antagonistic stimuli deteriorate affiliation would also need

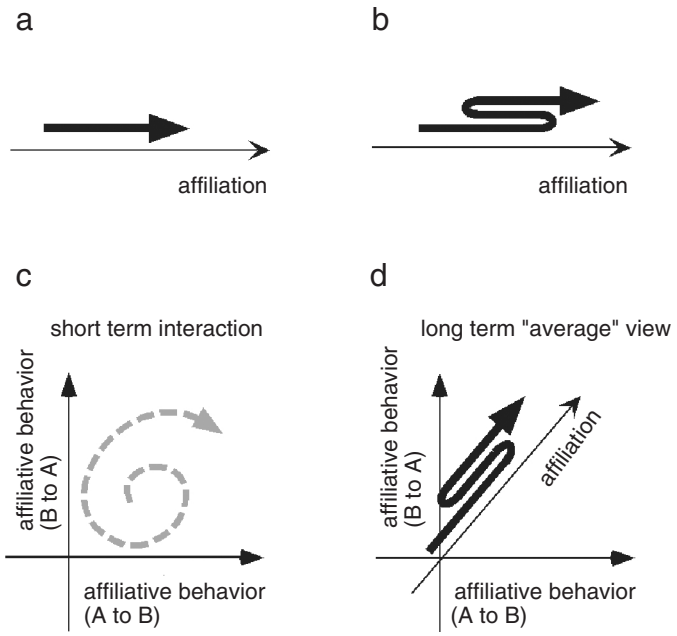

Figure 1 (Itoh & Izumi). Different conceptualizations of affiliative bonding. Affiliative bonding is a nondecreasing function of time in Depue & Morrone-Strupinsky's model (a), but it can also get weakened by conflictive interactions, according to a more dynamical view (b). In a behavior-based, dynamical formalization of affiliative bonding, short-term temporal dynamics associated with the affiliative quality/quantity of behaviors between two individuals map onto a two-dimensional "affiliation space" as a trajectory (c), and the temporal average of these short-term interactions represents the long-term affiliative bonding between those individuals.

to be modeled explicitly so that they can work as counteracting elements in the dynamics to "deactivate" affiliation. Moreover, yet another dimension of complexity is added by considering that affiliative bonding is, by definition, a relational property of not one but all individuals involved in the interaction. The significance of this notion is appreciated, for example, by recognizing that personality combinations can be important to affiliation. The difficulties that an individual undergoes in establishing an affiliative relationship with a particular individual do not necessarily indicate that he/she will have such a difficulty with another person.

To account for these points, the following conceptualization of affiliative bonding is suggested, in which an affiliative relationship between two individuals (A and B) is expressed in a two-dimensional "affiliation space," as depicted in Figures 1c and 1d. The axes represent the affiliative quality/quantity of their behaviors directed at each other. Short-term temporal dynamics in their affiliative relations map onto this plane as a trajectory (Fig. 1c). Long-term mutual affiliation between two individuals can be considered as the overall tendency of the trajectory in Figure 1c to stay in the first quadrant at some distance from the origin, close to the 45-degree diagonal line. In this formulation, the affiliation trait is defined as the long-term "average" of the short-term behavioral interactions (Fig. 1d). This definition of affiliative bonding has the virtue of being dynamical, relational, and behavior-based. It is extendable to n dimensions, $n \geq 2$, if necessary.

How the short-term trajectory moves about in this two-dimensional space can be modeled, in dynamical systems theory (e.g., Strogatz 1994), by a set of equations

$$A(n+1) - A(n) = f(A(n), B(n))$$
$$B(n+1) - B(n) = g(A(n), B(n))$$

where $A(n)$ = affiliative/antagonistic behavior of A against B at

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their nth interaction, and $B(n)$ = affiliative/antagonistic behavior of B against A at their nth interaction.

Positive and negative values of A (or B) represent affiliative and antagonistic behaviors, respectively. These equations formalize the idea that temporal changes in affiliative quality/quantity of behaviors are dependent on the previous behaviors of both individuals involved. Functions f and g define the affiliative styles of A and B, respectively. Gottman et al. (2002) modeled marital relationships using this framework. An educational example of how love affairs between a man and a woman can be caricatured was presented by Strogatz (1994). The dynamical systems approach to studying social interactions and interpersonal bonds is receiving growing attention in human personality psychology (Vallacher et al. 2002).

The current conceptualization of affiliative bonding is quite different from that underlying D&M-S's neurobiological model. The utilization of personality inventory techniques for defining personality traits tends to average out temporal dynamics in behaviors, and therefore the top-down method for delineating core behavioral processes is not always justified. Another potential source for discrepancy is that the authors' model construction relied heavily on rodent data. Behavioral expressions of affiliative bonding may be more straightforward in rodents than in primates. The use of inventories and animal models under the strategic framework of the target article's Figure 2 is a legitimate approach in studying the neurobiology of personality traits (Itoh 2002). Nonetheless, inasmuch as the ultimate goal is to understand the affiliation trait as expressed in human behavior, it would eventually become necessary for the model to adapt to a conceptual framework in which affiliative bonding is regarded as a temporally dynamic, social phenomenon. In this admittedly daunting exploration, the neurobiological study of affiliative bonding would benefit from an incorporation of the behavior-based view of ethology and mathematical tools in dynamical systems theory.

Opioid bliss as the felt hedonic core of mammalian prosociality – and of consummatory pleasure more generally?

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Abstract: Depue & Morrone-Strupinsky's (D&M-S's) language suggests that, unlike Kent Berridge, they may allow that the activity of a largely subcortical system, which is presumably often introspectively and cognitively inaccessible, constitutes affectively felt experience even when so. Such experience would then be phenomenally conscious without being reflexively conscious or cognitively access-conscious, to use distinctions formulated by the philosopher Ned Block.

Depue & Morrone-Strupinsky (D&M-S), in dissecting the personality trait extraversion into independent traits of agency and affiliation, which are in their view based in distinct but interacting core processes and neural systems, also distinguish two different kinds of experience based in these systems. They come close to identifying the affective core of the experience or feeling of social and sexual consummatory reward with the activity of a μ-opioid-receptor-dependent affective process. But they also seem to distinguish from this the "emotional experience" that "is the subjective expression of [afffiliative consummatory] reward and physiological quiescence processes" (sect. 5), which quiescence, in their next paragraph (sect. 6), belongs to the experience of reward, as well. Perhaps their implicit view is that, besides cognitively noticed and reportable experience (such as figures in human subjects' "subjective" reports in affective vocabulary), less cognitively accessible inner episodes also are experienced.

The possibility that consciousness conceived of phenomenally, or as it feels, is dissociable from consciousness conceived of in any cognitive or functional manner, has been more discussed and defended by philosophers (e.g., Block 1995; 1997; 2002) than by the affective scientists, such as Berridge, cited by D&M-S. For Berridge (1999; 2004), it seems that any process science can study, not by self-report but only otherwise, counts as purely objective. But to some philosophers this may seem to run together method or way of knowing with the nature of what we wish thereby to know, and thus to bury substantive questions, such as whether, in the speechless infant or rat whose μ-opioid activity or smile we observe, pleasure is experienced.

Berridge originally distinguished "liking" from more motivational processes by observing the contrasting and recognizably hedonic facial expressions of rats responding to sweet and bitter things. However, he has also argued that, since the same motor responses can also be observed in forebrain-ablated rats and anencephalic human infants, the core affective processes thus expressed are not always felt. Presumably, it is supposed to be intuitively obvious that in such cases there is no one at home. But this may be too cortically or cognitively chauvinistic, if not in these, then in other cognitively unnoticed cases, perhaps including cases of that opioid bliss which is our own. Or perhaps the truth lies somewhere in between, with brain activity that would itself be unfelt, nevertheless sometimes entering essentially (and not only by way of its upstairs effects) into conscious feeling, as seems to be Antonio Damasio's view (1999; 2003).

How largely the affective social warmth that goes with physiological quiescence and behavioral calm in mammals differs from what we experience when basking in the sun – or from what a lizard does when doing the same – remains to be seen. That so much of the archaic structure and function of opioid signaling and response have been conserved suggests that something of felt affect may be conserved as well. Perhaps such conservatism of structure–function linkage is mere accident, a founder effect locked into place in our lineage for only brute historical reasons. But if some opioid functions, affects, and structures are linked by deeper necessities, then such evolutionary conservatism may be more interestingly explained.

To start seeking the general functions and affects that opioid systems may be especially suited to serve, we need not talk to lizards. We can seek to extend D&M-S's synthesis to our own less social and sexual consummations and also consider the human variations found between men and women as well as those presented by autistic brains, which may derive the very same opioid bliss from contemplating things, mathematical structures, or scientific theories as more social brains get mainly from interacting with more fickle friends. Perhaps we will find even more general accounts of what kinds of feeling, function, and structure naturally go together. Then we may be able to tell how much non-socially mediated opioid bliss has in common with the social kind – and perhaps even why things are so.

Is all affiliation the same? Facilitation or complementarity?

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Abstract: The authors regard opiates as the primary neural substrate for social attachment, and peptide hormones as subsidiary. One may instead conclude from their evidence that oxytocin, vasopressin, and opiates play complementary roles in attachment. Oxytocin and vasopressin relate to different aspects of emotional experience, and opiates to quiescence from long-term attachment. This is related to intimacy versus affiliation.

Depue & Morrone-Strupinsky (D&M-S) are to be commended for making order out of the intricate web of brain areas, neuro-