

work on motivation- and emotion-specific neuropeptides leading the way to future human trials (Panksepp & Harro 2004). But what are the best animal models?

With the amount of evolutionary diversification that exists, one must select model systems carefully (Panksepp et al. 1992; 2002), and D&M-S wisely prioritized primate data over rodent data. Dogs are also an excellent species (Panksepp et al. 1978). Certainly lab rats are not optimal for understanding separation-distress arising from severing *specific* social bonds. These excellent “test-tube” creatures thrive when housed alone in sterile environments, perhaps because their separation-distress systems are vestigial (Panksepp 2003). *Selective* opioid regulation of social distress is well documented in many species (Panksepp 1998), but is dubious in rats (Winslow & Insel 1991a). Perhaps because of this, they are excellent species for studying the affiliative energies of play and low-dose opioid facilitation of social interactions (Panksepp & Bishop 1981; Panksepp et al. 1985).

As D&M-S recognize, the use of selected neurochemical systems to discuss processes as complex as affiliation needs to be advanced with the proviso that they only approximate the complexity of the underlying causal issues. If we try to extrapolate general neurochemical principles to excessively fine-circuit and synaptic levels, we may be encouraging a radical reductionism that is wrong (Bennett & Hacker 2003). Obviously, social attachments and affiliations are fully “embodied” within brain, body, and environment.

Important fusion points between levels of analysis must not be construed as explanations. But, as this target article exemplifies, meaningful visions of the larger picture cannot deny nor should they shy away from investigations at finer layers of explanation. Continued attempts to stitch neuroscience details from animal studies into coherent, *testable* hypotheses at more molar, human levels are vital intellectual initiatives, as long as we recognize that the emergent neuropsychology of human beings lies at the root of our social dilemmas, not merely the biochemical mechanisms that underlie the electrical properties of subsets of neurons in limited brain regions.

Ultimately, affiliation is an *emergent property* of being a mammal. Attachment does not simply exist in the brain, but in brains’ interrelations with bodies and environments. Analysis of neurochemistries of brain/mind states that correlate in some way with affiliation is a most reasonable empirical way to proceed, especially if we carefully strip away erroneous philosophical assumptions, as well as potentially irrelevant fine details. If we do that well, translations between levels can be advanced at a more rapid pace than was evident during the 20th century. Evidence for brain opioids in the regulation of social affect has been definitive for a while (Panksepp et al. 1980), and connections to human brain imaging are impressive (Zubieta et al. 2003).

Attempts to link such animal work to human concerns are essential for progress on major societal problems. For example, opiate addiction may often reflect the desire of individuals to diminish depression and chronic mental distress – to feel socially whole again (Panksepp 1981). We already have safe medications, such as the mixed opioid agonist-antagonist buprenorphine, invaluable in narcotic detoxification, which could be used to study and to treat such emotional imbalances clinically (Bodkin et al. 1995). There is a linkage between opioids and affiliative tendencies in all mammals. New approaches at the human level (e.g., Davis et al. 2003; Panksepp & Harro 2004), as exemplified by the contribution by D&M-S, are needed to round out this “too hot to handle”¹ scientific saga. However, as more and more investigators try their hand at such bridge building, it is important to cultivate the most appropriate level of analysis, and to recognize that even velvet-gloved reductionism needs to affirm emergent, holistic models that do no injustice to complex, sociobiological phenomena.

NOTE

1. When first submitted as an empirically based hypothesis for publication in the mid 1970s, our seminal brain-opioid mediation of social affect data were rejected for publication despite two positive reviews. The

then managing editor of *Science* advised JP by phone of his reason for not publishing – the hypothesis needed to be extensively replicated because otherwise it was “too hot to handle.” As of a month ago, that is no longer the case (Moles et al. 2004).

Impaired hedonic capacity in major depressive disorder: Impact on affiliative behaviors

Diego A. Pizzagalli and Christen M. Deveney

Department of Psychology, Harvard University, Cambridge, MA 02138.

dap@wjh.harvard.edu deveney@wjh.harvard.edu

<http://www.wjh.harvard.edu/~daplab/>

Abstract: Research on the neurobiology and psychosocial features of Major Depressive Disorder has the ability to extend our understanding of affiliative behavior. In depression, decreased hedonic capacity and hypoactivity in dopaminergic and prefrontal circuitries may decrease the ability to experience affiliative relationships as rewarding. We suggest that neurobiological research on depression can provide a test case for theoretical models of affiliation.

The target article provides a comprehensive description of trait affiliation and commendably integrates a broad series of literatures including animal, neurobiological, personality, and psychosocial. Depue & Morrone-Strupinsky (D&M-S) argue that the ability to experience affiliative reward is essential to the development and maintenance of affiliative bonds. Literature in which the reward capacity of an organism is manipulated is used to highlight the relationship among decreased reward capacity, decreased incentive motivated behavior, and decreased reward from affiliative interactions. However, as the authors note, much of the model is based on animal data. In this commentary, we suggest that Major Depressive Disorder (MDD) provides a fruitful extension of this model of affiliative behavior because this population constitutes a naturally occurring group of individuals with decreased capacity to experience pleasure (anhedonia), a cardinal symptom and trait marker of vulnerability to MDD (American Psychiatric Association 1994; Meehl 1975). Specifically, we comment on neurobiological correlates of anhedonia in MDD and the interpersonal deficits exhibited by this population. Finally, we discuss specific affiliative relationships between infants and depressed mothers, “the prototypic affiliative bonding condition” (target article, sect. 4.1). Research on such naturally occurring populations of decreased reward capacity has the potential to provide converging evidence for and extension of this model of affiliation through the development of testable hypotheses.

Several lines of evidence point to a decreased hedonic capacity in MDD. First, MDD has been associated with decreased responsiveness to positive cues (Sloan et al. 2001) and reward (Henriques & Davidson 2000; Hughes et al. 1985), as well as with dopaminergic hypoactivity, the neurotransmitter most implicated in reward (Wise & Rombre 1989). Individuals with MDD exhibited abnormal response to a dopaminergic probe (Tremblay et al. 2002), increased striatal binding of the D2 antagonist IBZM (Shah et al. 1997), and increased dopamine transporter (Laasonen-Balk et al. 1999), putative markers of down-regulated dopamine activity. Second, the distributed neural network reviewed in the target article, governing hedonic processing, formation of affiliative memories, and the emergence of appetitive behavior, is dysfunctional in MDD (Davidson et al. 2002). Whereas abnormalities in the amygdala and hippocampus may lead to dysfunctions in stimulus-reward association and contextual learning for affiliative stimuli, respectively, dysfunctions within different prefrontal cortical (PFC) regions may underlie difficulty in anticipating, evaluating, and experiencing reward in MDD. The subgenual PFC, in particular, has been implicated in reward responsivity because of its rich innervation with dopamine from the ventral tegmental area (Gaspar et al.

1989). Notably, individuals with MDD exhibit hypoactivity in the subgenual PFC (Drevets et al. 1997), and one study related this hypoactivity to melancholic depression, a subtype of MDD characterized by anhedonia (Pizzagalli et al. 2004). A second PFC region implicated in reward processing is the orbitofrontal cortex (OFC), which is critically involved in reinforcer evaluation and learning of stimulus-incentive associations. Interestingly, decreased medial OFC volume and decreased glial and neuron density have been reported in MDD (Bremner et al. 2002; Lacerda et al. 2004; Rajkowska et al. 1999). OFC dysfunction may be a marker for vulnerability to MDD because it is present in response to sad mood provocation in currently depressed and remitted individuals as well as in those individuals who later relapsed (Bremner et al. 1997; Liotti et al. 2002). Considered within the model presented in the target article, these findings suggest that the disruption in affiliative reward capacity and memory formation should lead to affiliative behavior difficulties in individuals with MDD.

Indeed, research suggests that individuals with MDD exhibit decreased attention to positive facial expressions, decreased social competency scores, impaired social problem-solving skills, and fewer positive interactions in intimate relationships (Fisher-Beckfield & McFall 1982; Gotlib & Asarnow 1979; Lewinsohn et al. 1980; Suslow et al. 2001; Zlotnick et al. 2000). Early theories of MDD considered low rates of response-contingent positive reinforcement to play a central role in the causation and perpetuation of depression (Lewinsohn 1974). However, the precise ties between interpersonal deficits and the ability to experience affiliative reward remain largely uninvestigated.

Growing evidence indicating impaired affiliative relationships between depressed mothers and their infants (Field 1995) provides further insight regarding trait affiliation. Depressed mothers demonstrate less physical and eye contact with their infants, display more negative and fewer positive facial expressions, exhibit less positive affect, use fewer positive affiliative behaviors, exhibit more behaviors unrelated to an infant's actions, and spend less time talking with their infants than do non-depressed mothers (Field 1995; Field et al. 1990).

Infants of depressed mothers also exhibit reward-related behavioral and neurobiological abnormalities when compared to infants of non-depressed mothers. For example, they demonstrate more negative and fewer positive facial expressions, fewer vocalizations, less positive affect, and more withdrawal behavior than do the offspring of non-depressed mothers (Field 1995). They also exhibit lower urinary dopamine levels than infants of control mothers (Diego et al. 2004). Moreover, general PFC hypoactivity and EEG asymmetry patterns similar to those in adult clinical populations have been observed among infants of depressed mothers (Dawson et al. 1997a; 1997b; 1999; 2003). Decreased left PFC activity was associated with decreased engagement and contingent responding, less approach behavior, and less affection by the infant (Dawson et al. 1999).

This unique literature is consistent with the idea that impaired reward capacity among mothers with depression may lead to abnormal affiliative interactions with their children and possibly reward-related neurobiological abnormalities in the offspring. Because important affiliative bonds are established between mother and infant within the first few days following birth (see sect. 7.3 of the target article), examining populations in which the mother's capacity to experience pleasure is reduced, as may occur during postpartum MDD, and the subsequent effect on mother-infant relationships could provide critical insight into mechanisms subserving affiliative relationships, including why individuals may experience different levels of affiliative reward capacity. In particular, the pattern of neurobiological abnormalities and the corresponding affiliative behaviors exhibited by individuals with MDD may identify potential "sources of individual differences that occur within the functioning of the network of neural structures and variables associated with the trait" (target article, sect. 7), thereby addressing a major challenge to neurobehavioral models of affiliation.

ACKNOWLEDGMENT

Preparation of this article was partially supported by NIMH Research Grant R01MH68376 to Diego A. Pizzagalli.

Is the construct for human affiliation too narrow?

Nancy Nyquist Potter

Department of Philosophy, University of Louisville, Louisville, KY 40292.
Nancy.Potter@louisville.edu

Abstract: The construct for affiliation in Depue & Morrone-Strupinsky's (D&M-S's) study is restricted to the interpersonal domain. This restriction is not found in other disciplines. It may be necessary in early stages of trait research. But the construct will need to be expanded to speak to the more complex, second-order affiliations of which humans are capable.

The science of affiliation makes significant and exciting headway in this target article. Love, affection, and attachment have been shown to be crucial to the well-being and survival of individuals and groups in the animal kingdom (Cassidy & Shaver 1999; Harlow 1958; Harlow & Zimmerman 1996; Karen 1994), but until now a substantive model has not been presented that explains, from a neurobiological perspective, how affiliation as a personality trait develops.

Depue & Morrone-Strupinsky (D&M-S) rightly observe that an analysis of the construct of affiliation is crucial to their study, because how affiliation is understood determines which direction researchers will take in positing and studying core processes (sect. 1). They state that "affiliation is clearly interpersonal in nature" (sect. 2) and define affiliation as "enjoying and valuing close interpersonal bonds and being warm and affectionate" (sect. 2). Within the parameters of this construct, the model has much to offer. The scope, though, may be too narrow to explain much of human social behavior.

As the authors say, core behavioral-motivational processes promote not only parent-infant bonds and mate pairs but, "more generally," bonds "between individuals to promote formation of social groups that are necessary for tasks critical to survival" (sect. 4, para. 1). They state that "activation of the underlying processes leads in varying degrees to behaviors associated with *intimate social engagement*" (sect. 5, emphasis in original). In the context of the authors' definition of affiliation, one can understand intimacy as a relation between individuals, families, and loved ones. But intimate social engagement for humans is not only, or necessarily, directly interpersonal, and objects of affiliation are not just other humans. As the etymology of the word indicates, "affiliation" comes from the Latin language and refers to adoption. Other disciplines use the term "affiliation" to apply to a broad range of entities. People affiliate with (adopt) religious values and moral norms (cf. Taris & Semin 1997). People affiliate with sports teams even though they don't know the players personally. Depending on a group's cosmology, members may affiliate with rocks and trees, as many First Nations people do, believing rocks and trees to have spirits just as humans do. We affiliate with (adopt) bodies of knowledge. Consider Western science's affiliation with the medical model and traditional cultures' affiliation with healers, rituals, and folk medicine. And we affiliate with ideologies and ideals. It would probably mischaracterize some of these affiliations to say they evoke warmth and affection as interpersonal relationships can, but nearly all the things humans affiliate with include strong positive bonding emotions. Applying the construct of affiliation to the political level, one notices that an incentive-encoded affiliative memory network would be abstract and symbolic, as the bonding network would include not only individuals and groups but also ideas such as freedom, equality, and rights. People become committed to these abstract ideals, they bond with them, and they work to protect them. They become passionate