

## **The bargaining model of depression**

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## **Abstract**

Minor depression—low mood often accompanied by a loss of motivation—is almost certainly an adaptation to circumstances that, in ancestral environments, imposed a fitness cost. It is, in other words, the psychic equivalent of physical pain. Major depression is characterized by additional symptoms—such as loss of interest in virtually all activities and suicidality—that have no obvious utility. The frequent association of these severe and disabling symptoms with apparently functional symptoms like sadness and low mood challenges a functional account of depression as a whole. Given that the principle cause of major unipolar depression is a significant negative life event, and that its characteristic symptom is a loss of interest in virtually all activities, it is possible that this syndrome functions somewhat like a labor strike. When powerful others are benefiting from an individual's efforts, but the individual herself is not benefiting, she can, by reducing her productivity, put her value to them at risk in order to compel their consent and assistance in renegotiating the social contract so that it will yield net fitness benefits for her. In partial support of this hypothesis, depression is associated with the receipt of considerable social benefits despite the negative reaction it causes in others.

**Keywords:** depression, bargaining, evolutionary psychology

## **Biographical sketch**

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## **The individual vs. society in the EEA**

To achieve fitness related goals, humans must rely upon one another to an exceptional degree. In ancestral human environments (the environment of evolutionary adaptedness—the EEA), an effective response to a social failure therefore often required the cooperation and consent of others. Unfortunately, inherent conflicts of interest or incomplete information regarding the relative costs and benefits of providing assistance meant that such cooperation and consent may not always have been forthcoming. Consequently, an effective strategy to compel assistance in the wake of social failures and losses would have provided substantial fitness benefits. In the first part of this article I will argue that there was a selection pressure for the evolution of a bargaining strategy in humans; in the second part, I will argue that clinical, unipolar depression—whose principle known cause is a major, negative life event, and whose characteristic symptom is a loss of interest in virtually all activities—is just such a bargaining strategy.

### ***Viscous social markets and monopoly power***

When there are many resource providers (i.e., when there is a ‘market’ instead of a monopoly), there is less need to pay a cost to influence others whose actions (or inactions) are causing opportunity costs, because one can always obtain the necessary benefits from others.<sup>1</sup> That is, the costs of these benefits are determined by the supply and demand curves of standard economic theory (if there is a market on only one side, the single seller [monopoly] or single buyer [monopsony] sets the price unilaterally).

In the EEA, however, it may frequently have been the case that there was little-to-no market at all; *all* parties often had effective monopolies on benefits that were crucial to other group members. Kin- and family-based social organization, high levels of biparental care, low population densities, ethnicity, and occasional inter-group aggression meant that switching social partners was difficult. For example, the energetic and other costs of raising human offspring were (and are) quite large relative to other primates. It would have been difficult for human mothers to raise offspring without help from the father and/or other family members, and, conversely, the fitness of the father, parents, and other family members depended critically on the mother successfully raising offspring. The father and/or family members could not easily abandon their relationship with the mother without suffering a significant fitness cost, nor could the mother abandon her relationship with the father and/or family members without also suffering a significant fitness cost (for further details, see Hagen 1999).

Similarly, political alliances between families may have often depended on an arranged marriage between a man from one family and women from the other, as is commonly seen in contemporary hunter-gatherer groups (Rodseth et al. 1991, and references therein). If so, important political relationships between families often depended critically on a son or daughter; conversely, the son or daughter’s relationship with their family depended critically on their willingness to participate in the arranged marriage.

### ***Contract enforcement***

Partners can also maintain an effective monopoly on resources they provide when they can exclude competitors or when they can easily punish defection. Both were most likely important aspects of ancestral social environments. Punishment, in particular, is increasingly recognized as

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<sup>1</sup> These benefits may include the freedom to pursue a different social strategy altogether.

an important social strategy. A number of researchers have concluded for both theoretical and empirical reasons that, at least in their original formulations, kin selection (Hamilton, 1964) and reciprocal altruism (Trivers 1971) are insufficient to explain human sociality (e.g., Boyd & Richerson 1988, 1992; see also Hammerstein this volume and McElreath et al. this volume). These researchers propose that the ability to impose various costs on defectors beyond mere defection can ensure the evolution of cooperation under a wider and more plausible range of conditions including larger groups and limited numbers of interactions. By punishing instead of ostracizing, group members can also reap cooperative benefits from an individual whose potential contributions would otherwise be lost to the group. The ability to efficiently impose costs on defectors raises the specter that individuals who are *not* benefiting from a cooperative venture could nonetheless be forced to participate despite the fitness costs they might suffer by doing so.<sup>2</sup>

In sum, the market for certain kinds of social partners in the EEA may have been anything but fluid.<sup>3</sup> Given this high degree of interdependence in foraging bands (see also Boehm 1996), individuals who were suffering losses (i.e., paying high opportunity costs) due to the current social arrangement could have bargained with other band members for more benefits by withholding the benefits they were providing to the band.

### ***Severe opportunity costs***

In the EEA, individuals' social strategies could have failed in a number of ways. Important social partners such as mates and allies could have died or severed relations, forcing one to abandon the current strategy; social strategies could have failed to realize fitness benefits, such as when efforts to increase or maintain social status failed, or when a cooperative mateship yielded a low viability infant; competitors could have blocked access to critical resources, including key social relationships; one could have been coerced by powerful others; one could have been betrayed by social partners; or one could simply have chosen the wrong strategy or executed it poorly. In many cases of social failure, individuals could have unilaterally pursued an alternative strategy, such as forming new friendships after the death of close friend. In many other cases, however—if evidence from contemporary small-scale societies is any guide—individuals required the consent and/or cooperation of group members to ameliorate the consequences of social failure. For example, if an individual were abandoned by their spouse, one strategy would have been to try and get the spouse to return. Physical threats might have worked, but they might also have been counterproductive (Figueredo et al. 2001). If the individual who experienced the loss could have convinced group members to spend political capital in securing the return of this partner or procuring another partner, chances of success would have been far greater. Unfortunately, there would often have been conflicts of interest between the individual and the group. Group members might not want to spend their political capital securing another mate for someone who had one, but lost her due to his abusive behavior, or because the group preferred using its capital to secure a mate for a higher status individual. In another example, arranged marriages are frequently made with little regard for the personal

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<sup>2</sup> The foregoing must be distinguished from simple coercion: it is often cheaper to monitor and deter defection than it is to monitor and compel investment; i.e., it may be cheaper to prevent a mother from committing infanticide than it is to make sure she nurses several times a day for six months or more.

<sup>3</sup> This is not to say that social markets were not important, just that one could not always count on the availability of a market; also, even when there was a choice of partners, the costs of switching partners were often high.

preferences of those to be married. Those betrothed to an undesirable mate often face formidable opposition from their families and other group members, however, if they resist the marriage (e.g., Shostak 1981). This opposition might be because there is a genuine conflict of interest between the parties, or because the family and group members simply have less reliable information about the relative quality of the mates (and so would not want to make costly changes for no real benefit).

In general, given that even relatively high degrees of relatedness, although important, appears insufficient to sustain cooperation in foraging bands, given the high mutual interdependence of individuals in these bands, and given that small cooperative groups of foragers only had the time and resources to achieve limited goals, conflicts between individual members and the group were inevitable, especially when one member was suffering costs that the others weren't. In such circumstances, individuals who were suffering severe costs needed a strategy to influence other group members to act in their interest when such actions could plausibly have alleviated these costs, yet there were inherent conflicts of interest, or a lack of reliable information about the extent of the costs suffered.

### ***The limits of anger and persuasion***

Influencing or deterring the actions of others is important for many animals, including humans, and a principle strategy to achieve this is to impose, or threaten to impose, costs on those individuals whose actions one wants to influence or deter (see, e.g., Clutton-Brock and Parker 1995 for theoretical models and review). In humans, this strategy is closely identified with the emotion anger, an apparent human universal (e.g., Ekman 1994) whose association with violent conflict is indisputable. The most common behavioral outcome of anger is an attempt to inflict harm on perceived transgressors, whatever form that harm might take (Fessler in press).

A key limitation of an aggressive strategy is that, in the EEA, it would have been difficult for a single individual to impose costs when one's opponent was physically more formidable, or when one was opposed by a group of individuals. If one needed to influence the behavior of a single powerful individual or a group, physical threats (especially by a woman) would rarely have been effective—even two people could almost always have overpowered one. Attempting to persuade others would have been an option, but if the individual's claims were difficult or impossible to verify, and there were conflicts of interest among the parties involved, persuasion would often have failed. Nonetheless, in the EEA conflicts between individuals and groups would have been common, and, if not resolved, would have had very negative reproductive consequences for the individual. The solution offered here is that, given the high degree of mutual dependence and the relatively high degree of relatedness among group members in the EEA compared to modern societies, one could have efficiently imposed costs on powerful others, thereby influencing them, by withholding benefits despite the apparent costs to oneself.

### **Bargaining**

As a consequence of viscous social markets, enforcement of social contracts, and conflicts of interest, there was a strong selection pressure among humans to evolve bargaining strategies to compel modification or renegotiation of social contracts, thereby ameliorating the costs of social failures. As a strategy of social influence, bargaining can only work when all parties have a near monopoly on crucial benefits—otherwise, disaffected parties could simply choose to cooperate with someone else, and the 'price' of social benefits would then be set by the market. Stating the requirements for bargaining explicitly: in an ongoing cooperative venture, bargaining to establish

a new social contract is necessary when 1) at least one participant is not benefiting from the current social contract, 2) others are benefiting from the social contract (i.e., there are conflicts of interest), and 3) participants have a monopoly or near monopoly on the benefits they provide (see Kennan & Wilson, 1993, for a review). When one has a monopoly on critical benefits, withholding these benefits, even at a cost to oneself, will impose significant costs on others.

I will argue below that the costly symptoms of depression have a function, and that function is to efficiently impose costs on other group members by withholding benefits despite the apparent costs to oneself. On this view, depression is an (unconscious) social manipulation strategy that is triggered when an individual perceives that they are suffering costs that can only be ameliorated by the actions of fellow group members (Hagen 1996, 1999, 2002; MacKey and Immerman 2000; Watson and Andrews 2002). Much as striking workers are withholding benefits in order to impose costs on management, hopefully inducing them to raise wages, a depressed individual may be strategically reducing her productivity in order to impose costs on fellow group members, hopefully inducing them to act in ways more beneficial to her. To paraphrase Clausewitz, depression is the continuation of personal politics by other means.

### ***Private information and credible signaling: the function of delay***

Even when one individual is not profiting from a cooperative venture but others are, bargaining for more than ‘one round’ is usually not necessary if the valuation of the venture by participants and their discount factors are common knowledge. The discount factor,  $\delta$ , is the fraction of cooperative benefits still available after each round of bargaining, and is thus a measure of the costs of delay due to multiple rounds of bargaining. Kennan and Wilson (1993) argue that quick agreements are usually possible in most models of bargaining where valuations and discount factors are common knowledge. Informally, if each participant knows what the other participants know, each will come to the same conclusions about how any sequence of bargaining rounds will proceed; each participant will also come to the same conclusions about the ‘optimal’ outcome for other participants, and so this outcome can be offered in the first round. For example, in a simple game of alternating offers by a buyer and seller, if  $0 < \delta < 1$ , then the maximum benefit decreases as  $\delta^t$ , where  $t$  = the number of rounds, so the seller must make an offer just sufficiently generous such that the buyer cannot do better by waiting another round—when delay is costly, each party has an incentive to minimize the number of rounds of bargaining in order to maximize benefits. It can be shown that if the seller makes the first offer, she will offer a price that gives her  $1/(1+\delta)$  of the benefits, which the buyer accepts immediately (Rubinstein, 1982). In general, most equilibria in bargaining games where there is no private information involve no delay (although there are exceptions; see Kennan and Wilson, 1993 for examples).

If, on the other hand, the participants in a cooperative venture do not know how other participants value the potential benefits or the costs they will suffer from delays, it will be impossible for all participants to reach the same conclusion about the ‘optimal’ agreement. If participants could credibly signal to other participants their true valuations and discount factors, then an agreement could be reached. Kennan and Wilson (1993) argue that the willingness of participants to suffer the costs of multiple rounds of bargaining (due to discount factors less than one), coupled with the sizes of the offers made each round, represents credible information about valuations and discount factors—longer delays signal lower valuations (because the more valuable the potential benefits from the current venture are to a participant, the less she can afford to delay). Once each participant acquires a relative level of certainty about the other

participants' private valuation and discount factors by observing their willingness to incur delays, the bargaining game becomes equivalent to one where valuations and discount factors are public knowledge, and an agreement can be quickly reached.

## **Depression is still a mystery**

After more than a century of inquiry, unipolar depression remains a profound scientific mystery. Like people working on a large and difficult jigsaw puzzle, researchers in genetics, biochemistry, cognitive psychology, social psychology, and psychodynamics have pieced together detailed accounts of depression from their various theoretical vantage points, but these disparate views have yet to be integrated into a single, coherent whole. Just as an unfinished puzzle often reveals itself in parts that give little clue of the final picture, depression is well understood in aspects, yet no one can answer the question, *What, ultimately, is depression?* Social relationships are clearly implicated in both its onset and remission, and psychotherapy has been shown to be about as effective in reducing depressive symptoms as the latest antidepressants (e.g., U.S. Department of Health and Human Services 1993). These indisputable facets of depression must be reconciled with the equally significant genetic and biochemical correlates. As the editor of a recent volume on depression concluded, "Despite a great deal of thorough research there is no agreement concerning etiology, symptomatology, and treatment methods (Wolman 1990)." The editor's choice of terminology reflects what is perhaps the single point of agreement among depression researchers: major depression is a pathology.

With no consensus on causes, symptoms, or treatment, little-to-no evidence that depression in general is caused by infections, toxins, or physical injury to the brain, excellent evidence that depression is caused by social circumstances that would have occurred repeatedly in EEA (often dangerous social circumstances in which a genuine cognitive impairment would have been disastrous) and given that, unlike many sufferers of brain injuries, most sufferers of depression experience a full remission of symptoms, one wonders why there is such conviction that depression is a mental illness? Several extraordinarily unpleasant experiences such as physical pain and nausea are in fact adaptations designed to prevent the sufferer from further harm. Given that accelerating advances in psychopharmacology promise to offer rapid, reliable relief to all, or almost all, of the multitudes who suffer an episode of depression, there is an urgent need to determine whether depression is functional or dysfunctional. If depression is functional, then treating its painful symptoms without also treating the underlying cause to which they are an adaptive response poses serious ethical problems indeed.

### ***What we do know (in a nutshell)***

The symptoms of a DSM-IV major depressive episode (what will here be referred to as major or unipolar depression) are given in column 1 of table 1 (APA 1994). (Bipolar depression will not be discussed.) The diagnostic criteria for a major depressive episode are that an individual experiences either symptom one or symptom two, and at least four of the remaining seven symptoms nearly every day for a period of not less than two weeks. Presumably because 'low mood' by itself is widely viewed as 'normal', *minor* depression is not considered a distinct clinical entity in DSM-IV; it is, however, frequently defined on an ad hoc basis for research purposes as consisting of symptom one and/or two of major depression, and perhaps one or two of symptoms 3-9 (often with no minimum time period). The ICD-10 criteria for depression (the WHO equivalent of DSM-IV) are quite similar to the DSM-IV criteria, except that ICD-10 grades episodes as mild, moderate, or severe depending on the number and severity of

symptoms. Both the DSM and ICD recognize that in typical depressive episodes the individual usually suffers from depressed or sad mood, loss of interest and enjoyment, and reduced energy and diminished activity. The correlated suite of emotions and behaviors characterizing depression has been observed in virtually all human societies (Patel 2001).<sup>4</sup>

<b>Symptoms of a Major Depressive Episode (DSM-IV)</b>	<b>Hypothesized functions according to the bargaining model</b>
1. <b>Sad or depressed affect</b>	Information to the sufferer that the current social strategy or circumstance is imposing a net fitness cost.
2. <b>Marked loss of interest in virtually all activities</b>	a) reduce investment in the costly strategy. b) reduce investment in oneself & others.
3. <b>Significant weight loss or gain</b>	Loss: Reduce investment in oneself. (Gain: store resources for tough times ahead?)
4. <b>Hypersomnia or insomnia</b>	Hypersomnia: Reduce productivity (Insomnia: allocate additional cognitive resources towards finding a profitable resolution to the current crisis).
5. <b>Psychomotor retardation or agitation</b>	Retardation: Reduce productivity. (Agitation: comorbid anxiety? Conflicts with social partners are often dangerous.)
6. <b>Fatigue or loss of energy</b>	Reduce productivity.
7. <b>Feelings of worthlessness or guilt</b>	Worthlessness: contributions undervalued by others. Guilt: imposing costs on others by defecting from social contracts.
8. <b>Diminished ability to think or concentrate</b>	Reduce productivity (and divert cognitive resources to renegotiating the current venture or towards finding more profitable alternatives).
9. <b>Recurrent thoughts of death</b>	Threaten to put future productivity at risk.

Table 1: Symptoms of a Major Depressive Episode according to DSM-IV. Symptoms in bold have a possible function listed to the right.

Worldwide, it is estimated that 5.8% of men and 9.5% of women will experience a depressive episode in a 12-month period, although rates can vary widely by country (WHO 2001); estimates from the US National Comorbidity Survey indicate that 17% of the population suffers from a major depressive episode at some point in their lifetimes.

Anxiety and depression frequently occur together (i.e., have high comorbidity). Schatzberg et al. (1990), for example, reported that 58% of their patients with a current diagnosis of major depressive disorder had a history of an anxiety disorder and 49% met current criteria for anxiety disorder. Similarly, the US National Comorbidity Survey found that 58% of individuals with a lifetime episode of major depression also met criteria for anxiety disorder (Kessler et al. 1996).

<sup>4</sup> Although, e.g., Asians may be more willing to report somatic symptoms relative to cognitive or affective symptoms, it appears that they are just as likely to experience cognitive and affective symptoms as are Westerners; similarly, somatic symptoms are the most commonly reported by Westerners as well (Patel 2001).



Women are about twice as likely to suffer from a major depressive episode as men, a finding that, cross-culturally, is quite robust (e.g., Ustun and Sartorius 1995); matching men and women by social role variables like employment, marriage status, and number of children *within* cultures appears to reduce the female bias by about 50% (Maier et al. 1999); the remaining bias has yet to be explained.

Depression is also strongly correlated with suicidal ideation (thoughts of killing oneself), suicide attempts, and completed suicides. Depression is the most common mental disorder leading to suicide, although substance abuse and schizophrenia are also major contributors (WHO 2001).

Finally, numerous studies have found a significant impact of depression on mortality rates, suggesting that either depression itself, or the poor self-care caused by its symptoms, or both, might have an important negative impact on health; unfortunately, most of these studies did not sufficiently control for important associated health risks like smoking and alcohol use. As a recent systematic review of the mortality of depression concluded (Wulsin et al. 1999):

The existing body of studies, so rich with mixed findings and so lean in the numbers of well-controlled comparable studies, suggests a substantial effect of depression on mortality in some populations, but to estimate the true size and the source of this effect (whether it is a direct result of the pathophysiology of depression or the indirect result of poor self-care) will require more rigorous study.

Any theoretical explanation of depression must account for low mood and loss of interest in virtually all activities, a significant reduction in productivity, suicidality, a possible negative impact on health, a 2:1 female bias, a relatively high annual prevalence rate of around 10%, the substantial evidence that depression is closely associated with chronic activation of the hypothalamic-pituitary-adrenal axis (e.g. Nemeroff 1996)—which prepares the body for fight-or-flight—and the fact that the most significant known cause is a major, negative life event. More on each of these below.

## **Problems with previous adaptationist hypotheses for depression**

Whether major depression is functional or dysfunctional can only be evaluated by comparing specific hypotheses regarding an evolved function vs. specific hypotheses regarding the dysfunction of cognitive and affective systems that putatively result in depression. Unfortunately, widely cited adaptationist hypotheses for depression either specifically exclude major depression, are theoretically implausible, or are inconsistent with what is known about depression.

The most theoretically coherent and empirically supported hypothesis for minor depression is the “psychological pain” hypothesis (Alexander 1986; Hagen 1999; Nesse 1991; Suarez and Gallup 1985; Thornhill & Thornhill, 1989; Tooby & Cosmides, 1990; Watson and Andrews 2002). Whereas physical pain functions to inform individuals that they have suffered a physical injury—motivating them to cease activities which would exacerbate this injury, as well as to avoid similar future situations which would also likely result in such an injury—psychological pain informs individuals that their current social strategy or circumstance is imposing a fitness cost, motivating them to cease activities which would exacerbate this cost, as well as to avoid similar future situations which would also likely result in a fitness cost. Such circumstances include, e.g., the death of children and relatives, loss of status, loss of a mate, etc. It is well

established that negative life events are an important cause of depression (e.g., Kendler et al. 1993).

Similarly, the ‘social competition’ or ‘social yielding’ hypothesis proposes that depression is an adaptation to force the loser of a social conflict involving status or rank to 1) stop competing with the winner, 2) accept the fact that s/he has lost, and 3) to signal submission, thereby avoiding further conflict with the winner (Price 1967; Price et al. 1994). The ‘yielding’ hypothesis obviously has much in common with the ‘psychic pain’ hypothesis, and is probably best considered an important, special case of the latter—loss of a social competition is certainly a prime example of a social circumstance that imposes a fitness cost, and the pain of depression could quite plausibly motivate losers to cease competing, thus avoiding the costs of continuing a futile competition. The yielding hypothesis cannot be a complete explanation for even minor depression, however, because loss of a social competition is not the only cause of minor depression—having a baby with temperament problems (Beck 1996a) is but one well-documented cause of depression that does not involve losing a status competition. Further, the behaviors exhibited by chimpanzees (our closest relatives, with a social organization similar to ours) and other primates who have lost a status competition do not resemble major depression (see the appendix for a detailed description of one such event).

Neither the yielding hypothesis nor the psychic pain hypothesis adequately accounts for major depression, and recent comments by proponents of these theories suggest that they may not be intended to. Proponents of the yielding hypothesis see severe and prolonged depression as maladaptive (a major depressive episode can typically persist for months). Similarly, Nesse (1999) suggests that “Sadness is almost certainly adaptive, but depression may arise from dysregulated sadness or from an entirely separate mechanism.” It is worthwhile, nonetheless, to explicate why the yielding and psychic pain hypotheses *cannot* account for major depression. A pronounced and sustained loss of interest and enjoyment in virtually all activities, loss of energy and diminished activity are core features of major depression. Some psychic pain theorists (Tooby and Cosmides 1990; 2000; Nesse 2000) have cogently argued that, in the face of a major social failure, one *should* take pause. Immediately pursuing another social strategy without first evaluating the recent failure would likely only lead to another, costly failure. A distinction must be made, however, between a short-term reluctance to pursue one’s social strategies, which often would have been wise in such circumstances, and long-term reduced self-care, which rarely would have been wise in any circumstances. Not only does depression have a significant, long-term negative impact on productivity, there is, as noted above, legitimate concern that the lack of self care that accompanies depression may cause increased mortality, even in populations with ready access to resources and sophisticated medical care. Except when faced with an immediate threat, individuals should never stop eating, bathing, and grooming; individuals who did so in the EEA would have found that their health deteriorated rapidly, hindering them from adequately responding to future social opportunities.

Suicidality is also a very common symptom of major depression, yet there is no reason that an individual who has suffered a severe fitness cost should contemplate imposing additional costs on herself—especially the ultimate cost of death! The same goes for the yielding hypothesis. Status hierarchies are beneficial for all members of the group—it is beneficial for an individual who has lost a status competition to accept low rank in order to avoid of the costs of conflicts that he is very likely to lose. That is the essence of the yielding hypothesis. Again, why should such an individual consider killing himself?

Energy conservation is another commonly proposed function for depression (e.g., A. Beck 1996). Although energy conservation was certainly an important reproductive problem in the EEA, depression does not show evidence of having been well designed by natural selection to solve it. Depression has some features that would reduce energy consumption such as psychomotor retardation, but it has many features that have nothing to do with energy conservation, such as the intensely negative emotions that are the hallmark of depression. Neither fatigue nor sleep, two recognized energy conserving adaptations, are associated with such afflictive emotions. Similarly, why would depression often be associated with loss of appetite? If it were an adaptation to resource-poor conditions, the opposite should always be the case. Why would depression be associated with insomnia, intense social rumination, or psychomotor agitation, which increase energy consumption? Why would it often be associated with feelings of guilt or anxiety? In sum, the symptoms of depression would have added nothing to, and would often have subtracted much from, the efficacy of fatigue and sleep as energy conserving adaptations.

A common and reasonably compelling hypothesis is that depression is an evolved signal of social need (Lewis 1934; Henderson 1974). Many human emotions are closely associated with facial expressions and other types of signaling such as laughing and crying. Could the symptoms of depression, including suicide threats, simply be costly, and therefore credible signals of need? However theoretically attractive this hypothesis, it is not supported by the evidence. Research has clearly shown that individuals who are neither kin nor social partners of depressed individuals react negatively to people who are depressed or exhibit symptoms of depression, precisely opposite the desired reaction if depression were merely a generic signal of social need (see Segrin & Dillard, 1992, for a meta-analysis of the literature on the robust relationship between depression and consequent negative reaction by others).<sup>5</sup>

In general, the symptoms of major depression seem designed to *prevent* the acquisition of benefits. A marked loss of interest in *virtually all* activities, significant weight loss, psychomotor disturbances, fatigue or loss of energy, and suicidal ideation would all have impeded ancestral humans from engaging in critical, beneficial activities, such as food gathering and consumption, buffering food shortages, personal hygiene, avoiding environmental hazards, information gathering, helping relatives and friends, etc. The challenge for an evolutionary account of depression is to reconcile the close association of plausibly functional symptoms like sadness and loss of interest in some activities with seemingly dysfunctional and costly symptoms like psychomotor disturbances and suicidality. As shown above, there are circumstances where it would have been beneficial to deliberately withhold benefits despite the apparent costs to oneself. It appears that such circumstances cause depression.

## **Unipolar depression as a bargaining strategy**

### ***Social costs<sup>6</sup> and other causes of depression***

An enormous number of studies have shown that adverse life events are a potent cause of depression (see, e.g., Kendler et al. 1995, Mazure et al. 2000, and references therein). Kendler et al.'s (1993) etiologic model of depression among female twins captures the essentials as well as

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<sup>5</sup> Note that, despite the negative feelings engendered by depression, actual rejection would have been difficult for most group members in the EEA if the depressed person had a monopoly on benefits they provided to the group.

<sup>6</sup> Strictly speaking, these should be conceptualized as 'strategic' costs—costs that result from a failed strategy even when the failure is due to events beyond one's control, such as the death of an important relative or social ally.

any. In a longitudinal study of 680 female-female twin pairs, Kendler et al. found that the strongest predictors of a major depressive episode were, in descending order (1) recent stressful life events, (2) genetic factors, (3) previous history of major depressive disorder, and (4) neuroticism. Their full, nine-variable model explained 50.1% of the variance in liability to depression (see also Kendler et al. 2002). For illustration, the four adverse life events which predicted onset of major depression in women with an odds ratio of  $> 10$  in a study by Kendler et al. (1995) were: death of a close relative, assault, serious marital problems, and divorce/breakup. Cross-culturally, rates of adverse life events strongly co-vary with depression case rates (figure 1).

### Correlation between adverse events and depression, cross culturally

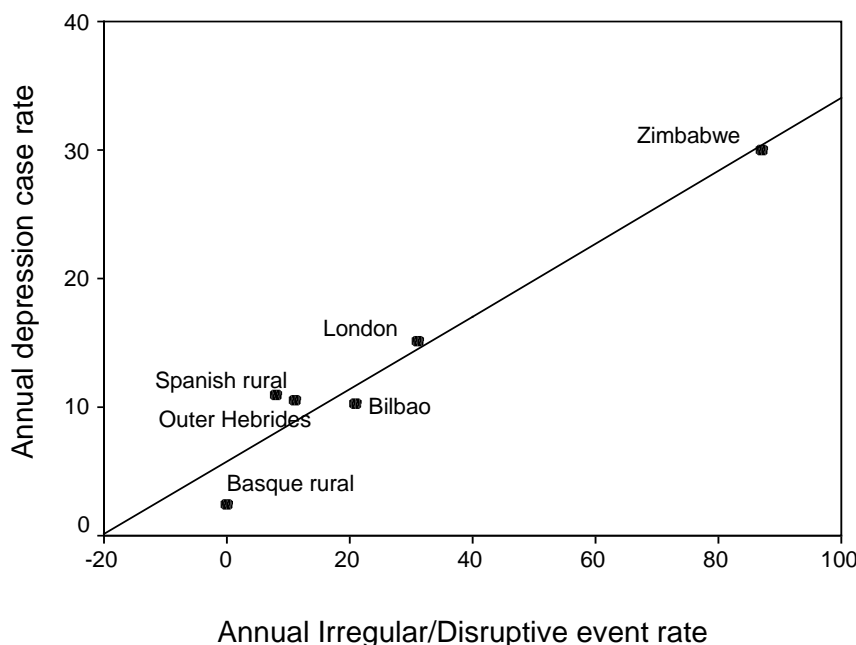


Figure 1: Yearly rate of irregular or disruptive severe events per 100 women in six populations vs. prevalence of caseness of depression in the same year (after Brown 1998).

Decades of research have shown that postpartum depression (PPD) is similar, if not identical, to depression in general (e.g., Whiffen and Gotlib 1993). It can therefore be used as a model for depression (PPD has a number of methodological advantages in the study of depression; for example, it is easy to identify a population—pregnant women—who will be experiencing a stressful and potentially costly life event—birth—at a predictable point in time). Parental investment theory (e.g., Trivers 1972, Clutton-Brock 1991) makes clear that human mothers should not automatically invest in offspring, but rather should weigh the decision carefully based on infant viability, levels of social support, access to resources, negative consequences for their other children, etc. There is compelling, indeed overwhelming, evidence that lack of social support is associated with PPD, and substantial evidence that problems with the pregnancy, delivery, or infant, lack of resources, and concern about their ability to care for their other children are also closely associated with PPD. Further, longitudinal studies show that perceived

levels of social support and prepartum measures of infant viability among non-depressed women predict PPD, consistent with the view that these may in fact be etiological factors (see Hagen 1999 for a review of this evidence). Mothers are suffering fitness costs from the childrearing endeavor, the first precondition for bargaining, and these costs appear to cause PPD.

### ***Social constraints: viscous social markets and monopoly power***

A key prediction of the bargaining model is that depression should be associated, not simply with social costs, but, in addition, with circumstances where individuals cannot act unilaterally to ameliorate these costs. There is considerable evidence that this is the case. A perceived lack of control over events—variously termed external locus-of-control (e.g., Levenson, 1974; Rotter, 1966), helplessness or hopelessness (Seligman, 1975; Abramson et al., 1989), or entrapment (see Brown 1998 and Harris 2001 for reviews and discussion)—has long been associated with depression. In these models of depression, the perception that important outcomes are not under one's control are postulated to cause depression. 'Locus of control' is one theoretical construct which attempts to operationalize the notion of control. Internal locus of control refers to an individual's belief that important outcomes are largely under his or her control, whereas external locus of control reflects a belief that outcomes are not under one's control. Under the helplessness/locus-of-control hypothesis, depression should be caused by an external locus of control orientation with respect to important outcomes. Similar to an external locus of control orientation, hopelessness is defined as an "expectation that highly desired outcomes will not occur or that highly aversive outcomes will occur coupled with an expectation that no response in one's repertoire will change the likelihood of occurrence of these outcomes (Abramson et al., 1989)."

In a meta-analysis of 97 (!) studies, Benassi et al. (1988) found that locus of control orientation and degree of depression were significantly related, that the relation was moderately strong, and that it was consistent across studies. Greater externality (i.e., events are not under one's control) was associated with greater depression. In a follow-up meta-analysis designed to control for possible confounds, Presson and Benassi (1996) found that higher degrees of belief in a lack of internality, powerful others, and chance were each associated with higher levels of depression. Under the bargaining model, depression is a strategy to *redress* the causes of helplessness/hopelessness/lack-of-control/entrapment, and that is why depression is expected to be associated with them. In the EEA, even seemingly irredeemable losses like abandonment by, or death of, a spouse could often have been readily addressed by powerful individuals in one's social group.

Studies of postpartum depression also support the contention that constraints on unilateral action are associated with depression, and that these constraints are real, and not simply the result of depression-biased cognition. In Western societies, where most of the PPD studies have been conducted, mothers who are suffering costs like lack of social support cannot defect without facing severe social penalties. Child neglect and infanticide are both illegal, and mothers who commit either are subject to harsh punishments including incarceration. In many non-Western societies, however, when parenting costs are high and benefits low, mothers can defect from childrearing with little cost: cross-culturally, both child neglect and infanticide are common under these circumstances (Daly & Wilson 1984). When mothers' reproductive decisions are socially constrained in the face of high costs, bargaining is a plausible response given that mothers themselves are monopoly suppliers of childcare benefits.

Hagen (in press) tested whether PPD was in fact associated with such social constraints on decision-making. Mothers with a new baby were asked how much an abortion for personal

reasons would have damaged their relationship. For mothers in general, there was no correlation between a social constraint on abortion and their PPD levels, nor should there have been. A social constraint on abortion is inconsequential for mothers who *want* the new child. The depression scores of mothers with unwanted or unplanned pregnancies, however, significantly positively correlated with their perception that having an abortion would damage their relationship with their spouse (there was, however, an interesting non-linearity—see Hagen in press). Because mothers' perceptions could have been biased by their depression levels, fathers were also asked to report how much damage a personal abortion would have done to their relationships with their wives. Fathers' perceptions of damage also correlated with mothers' depression levels, suggesting that actual, and not merely perceived, social constraints on reproductive decision-making are associated with depression.

Men's reproductive decisions are also constrained. Men, but not women, can substantially increase their reproductive success by mating with multiple partners. The opportunity cost of socially imposed monogamy is therefore predicted to be much higher for men, especially during the postpartum period when their nursing wives are infertile, encumbered with a new infant, and therefore significantly hindered from finding other mates. This cost, however, will only be borne by men who have additional mating opportunities. Hagen (in press) found exactly this. Men with more sexual opportunities were more depressed postpartum, but women with more sexual opportunities were not. About one half the effect for men was found to be due to relationship problems, but one half was due simply to sexual opportunities.

### ***Conflicts of interest and private information in the EEA***

In the bargaining model, social costs and monopoly power (i.e., the inability of parties to act unilaterally) are necessary, but not sufficient, to cause major depression. There must also be a conflict of interest between the monopoly suppliers and the individual, a conflict that can arise, in part, from private information (if there were no conflict, monopoly suppliers would simply provide the needed benefits). Note that this conflict need not be overt, nor even consciously recognized by those involved. Although the evidence presented above that entrapment, powerlessness, etc. are implicated in depression certainly suggests a conflict, there is also considerable direct evidence that social conflict is involved as well. In a meta-analysis of 48 studies, Finch et al. (1999) found that social negativity had a significant correlation with depression in the expected direction, and the results of longitudinal studies suggest a *causal* influence of negative social interactions on subsequent depression (e.g., Finch & Zautra 1992; Vinokur & van Ryn 1993); depression may, in turn, exacerbate social negativity (e.g., Coyne 1976). A follow-up study by Finch et al. (1999) suggests that Interference/Hindrances, Anger, and Insensitivity are the three aspects of social negativity that are most salient as predictors of depression. The first seems particularly relevant to the bargaining model. Not unexpectedly, each of these constructs was highly correlated with the others.

Because changing the social contract of a group can be a difficult and costly affair, most group members will resist such a change without clear evidence that it is necessary (Watson and Andrews 2002). If an individual believes that she is incurring fitness costs from the current social arrangement, she must convince her social partners that this is the case before they will agree to change. That is, the individual has credible information that she is suffering a cost, but the other group members do not; thus, the individual must credibly communicate private information to others. Because this is a novel aspect of the bargaining model, there is no evidence (yet) that private information is associated with depression. It is very likely, however, that individuals often had private information about their costs and benefits in important

cooperative ventures. Childrearing provides a nice example. The mother, having carried the child for the last nine months, may have considerable information about its health that is unavailable to either the father or other family members, or she may have information about her own health that necessitates changing her levels of investment. Newborns of depressed mothers, for example, were rated by objective, trained observers as having poorer ‘state organization’ than newborns of non-depressed mothers, an assessment reflected in the ratings of the mothers themselves (Hart et al. 1999).<sup>7</sup>

The father, on the other hand, may have private information about other mating opportunities, or about the probability that children of other men are in fact his (thus reducing the relative value of the current offspring), or about changes in availability of food and other resources. Furthermore, information about offspring health, levels of social support, and mating opportunities can change dramatically over the course of pregnancy, so that any prior ‘agreements’ about investment in the new offspring may have to be renegotiated.

### ***Withholding benefits and the costs of delay***

Withholding benefits until better terms are forthcoming (asserting monopoly power) is the essential feature of any bargaining strategy, and is one of the central functions of depression proposed here. In addition, the willingness of a depressed individual to delay investment in a cooperative venture is a credible signal to her social partners that the endeavor is unprofitable (Watson & Andrews 2002). Conversely, the degree of reluctance of other participants to increase the benefits they are providing is an equally credible signal of *their* true valuation of the venture—the longer they are willing to delay, the less they value the venture. It is important to note that depression is not simply a costly and therefore honest signal of social need (*a la* Spence 1974; Zahavi 1975). First, in the classic theory of costly signaling, the recipient of the signal does not incur a cost, only the sender (ignoring the relatively small costs of signal detection). This is not the case for the theory of bargaining with private information and costly delays nor is it the case with depression: in both cases the recipients of the signal may incur substantial costs; this is, in fact, a principle objective of the strategy.

Second, although it is widely assumed that costs guarantee the honesty of a signal, it is not the costs of a signal *per se* but rather that inherent aspects of the signal necessarily distinguish between individuals in different states. Here, the sender—the depressed person—may incur little or no fitness cost when sending a credible signal. Consider, for example, the extreme case of a worker who is paid nothing, but whose boss profits handsomely from her labor. Because she has no wages to lose, it costs her nothing to go on strike, but it costs her boss plenty. Her willingness to delay working indefinitely is a credible (but not costly) signal of her low valuation of her current salary. Similarly, there would have been little fitness difference between an indissoluble marriage to an infertile mate, and a complete cessation of all activities, including feeding and self care. The ‘message’ of depression is that, for the sufferer, there is little difference in the fitness benefits obtained from investing heavily in her current social strategy, or investing little. Depression is a credible signal because individuals who are profiting from their social strategies cannot afford the delay required to send it. Depression is a relatively low-cost and therefore ‘sendable’ signal only to those whose social circumstances are imposing significant opportunity costs.

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<sup>7</sup> Assessments were conducted within 48 hours of birth. It is possible, of course, that mothers’ depression during pregnancy may have caused their babies to have poorer state organization (a measure of emotional lability), or that both are correlated with a third variable.

Consistent with the bargaining model, a loss of interest in virtually all activities is a prominent symptom of major depression. In addition to the psychic suffering it causes, depression also has a very significant, negative impact on productivity. Worldwide, it is the leading cause of disability as measured by YLDs, and the fourth leading contributor to the global burden of disease (DALYs) in 2000.<sup>8</sup> Depression is the second most significant cause of DALYs in the age category 15-44 years for both sexes combined (WHO 2001). In a RAND study of 11,242 outpatients at three US sites, Wells et al. (1989) found that the poor functioning uniquely associated with depressive symptoms (with or without depressive disorder) was comparable to, or worse than, that uniquely associated with eight major, chronic medical conditions. For example, the unique association of days in bed with depressive symptoms was significantly greater than the comparable association with hypertension, diabetes, and arthritis.<sup>9</sup>

In the postpartum model, mothers with PPD should 1) experience a loss of interest in the infant, and 2) actually reduce their investment in the infant. Loss of interest in the infant is indeed a very prominent symptom of PPD (APA, 1994; Beck, 1996b; Campbell et al., 1992). Not only do mothers with PPD often lose interest in their child, they frequently have thoughts of harming it (Jennings et al., 1999). “Negative emotions while with the baby” are significantly correlated with PPD (Affonso & Arizmendi, 1986), as are “negative or detached feelings for the baby” (Kumar & Robson, 1984). Mothers with PPD also decrease their investment in their newborns. Beck’s meta-analysis (1995) of 19 studies on the effects of PPD on mother-infant interactions indicates that PPD has a moderate to large negative effect on maternal-infant interaction. In these studies, observers who are blind to the mothers’ depression status rate her interaction with her infant. Mothers with PPD are observed to have significantly less warmth, delight, positive regard, sensitivity, activity, contented facial expressions, imitative behaviors, contingent responses, and game-playing on the one hand, and significantly increased disengagement, negative affect, flatness of affect, irritation, tenseness, annoyance, and intrusiveness towards the infant on the other.

In addition to exhibiting more negative emotions and fewer positive emotions towards their infants, mothers with PPD are less responsive and less sensitive to infant cues, have a less successful maternal role attainment, and have infants that are less securely attached (Beck 1995; see also Hagen 1999 and references therein). Mothers with PPD unequivocally reduce their investment in the new offspring along virtually every dimension at the same time that they appear to have reached a negative assessment of the benefits of the cooperative childrearing venture.

Given the time-sensitive nature of most human cooperative activities like foraging, territorial defense, and parenting, the withholding of benefits documented above would, in the EEA, have certainly imposed on others the costs of delay required by the bargaining model. Even if an individual did not receive increased investment as a consequence of bargaining, she would have credibly signaled her low valuation of this cooperative venture to her social partners, and would

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<sup>8</sup> “DALYs for a disease are the sum of the years of life lost due to premature mortality (YLL) in the population and the years lost due to disability (YLD) for incident cases of the health condition. One DALY can be thought of as one lost year of ‘healthy’ life.” (WHO 2001)

<sup>9</sup> Depression is also associated with serious physical illness. For example, there is a well-documented elevated risk of acute coronary syndromes in persons with major depression, which may be caused by the increased platelet reactivity/aggregability that has been observed in depressed patients (because these increase the risk of intra-arterial thrombus formation—i.e., clotting) (e.g., Lederbogen et al. 2001; Shimbo et al. 2002; and references therein). An obvious interpretation of these findings is that, in the EEA, a social threat of the type hypothesized to cause depression frequently resulted in physical injury; thus, the blood clotting system is on ‘high alert’.



have received credible information from her social partners regarding their valuation of the venture; this information would have been of considerable utility for her future strategic decision-making.

### ***Depression in the ethnographic record***

What little evidence exists suggests that, in small-scale, kin-based societies, depression occurs for the reasons predicted by the bargaining model, and has the predicted effects on the group. Among the tropical forest Papua New Guinean Kaluli, for example, emotions in general, and depression in particular, must be understood for the roles they play in the system of reciprocity upon which Kalulian society is based (Schieffelin 1985). Emotions like grief and anger are appeals or demands to redress losses. If grief is an appeal to satisfy a 'legitimate' claim, depression is an appeal to satisfy an 'illegitimate' claim. Scheffelin argues that depression should "arise in circumstances where an individual was placed unwillingly into a long-term life situation in which his or her assertive moves were regularly rebuffed or frustrated and in which there were no socially acceptable grounds for expressing anger or feeling owed." Thus, according to both Schieffelin and the bargaining model, grief should occur when there is a loss but little conflict between the individual and powerful others, and depression should occur when there is loss (more accurately, an opportunity cost) but a significant conflict between the individual and powerful others.

A careful study of an indigenous Quechuan malady, *pena*, that closely resembles depression (Tousignant and Maldonado 1989), also illustrates the impact of depressive symptoms on others in a small, kin-based society. Like major depression, severe cases of *pena* are characterized by a lack of concern for personal hygiene, loss of appetite often resulting in serious weight loss and dehydration, sleep disturbances, an inability to enjoy life, and a wish to die. Also like major depression, *pena* is invariably associated with some kind of loss. Tousignant and Maldonado argue that *pena* functions to restore the balance of reciprocity upset by the loss, and that "restitution of some form or another is the goal of the emotional strategy." The impact of *pena* on the community closely matches the predictions of the bargaining model:

[L]ong periods of sadness in a woman will attract the attention of kin. They will investigate with whom the fault lies, usually suspecting the husband, and see in what way the situation can be corrected. In case of failure, the eldest adults of the community will get involved and, if discussions fail, more stringent admonitions and punishments, even flogging, may be applied. As was pointed out by McKee [unpublished ms], guilt is not the core element of punishment. The goal of the intervention is not to make the abuser ashamed but to facilitate reparation. (Tousignant and Maldonado 1989)

Both Schieffelin and Tousignant & Maldonado argue that the meaning and social consequences of depression among the Kaluli and the Quechua can only be understood in the context of the central organizing principle of these societies: reciprocity. Given the ubiquitous importance of reciprocity in contemporary hunter-gatherer and horticultural groups, depression may well have had the same meaning and social consequences among ancestral human foragers.

The conceptualization of depression in some larger-scale traditional societies is also quite similar to the bargaining model. The Bengali illness concept *mathar golmal* (disturbance of the head), which appears to include depression, is an example. It is caused by "shock" such as the death of a loved one, business or career failures, or rejection by a lover (Bhattacharyya 1981:153).

[T]hese emotional states all seem to point to frustration as a key cause. This frustration may be economic (money worries), academic (failure in exams), career (lack of advancement), or emotional (unrequited love). As several respondents have noted, being unable to obtain what is deeply desired is the source of frustration. The most extreme example of such frustration and the one most frequently cited is [intense grief] where the death of a loved one prevents the fulfillment of one's desires. Thus, the primary attribute of "shock" is an emotional response to an intensely frustrating situation. The gratification of desires is prevented because of some obstacle which makes the desired outcome beyond one's control, thus rendering one's own efforts totally ineffectual. (*ibid*:201)

Consistent with the bargaining model, informants believe that the affliction "can be cured if the desires of the individual are met." Examples include obtaining a spouse or securing the return of a boyfriend (*ibid*:203).

### **Suicidality**

A suicide *threat* is a threat to impose substantial costs on group members, and can therefore be viewed as a means to cheaply and efficiently signal a large social group that they may soon suffer costs imposed by a suicide attempt. A suicide *attempt* is an attempt to influence other group members by imposing costs on them and, as such, is simply an extreme form of the bargaining strategy described above (Brown 1986; Giddens 1964; Watson & Andrews 2002). Suicide attempts also underwrite the credibility of suicide threats. A suicidal signaling/bargaining strategy could evolve if it involved warning others beforehand and allowed them to respond to the suicidal person's needs, and it resulted in death with much less than 100% certainty. Under these circumstances, the average benefits received over many generations by genes coding for this strategy could exceed the average costs suffered by those genes when suicide attempts succeeded.<sup>10</sup> In depression-related suicidality, individuals commonly warn others of their intentions, and frequently choose unreliable methods (Kreitman 1977; Stengel 1974).

Although suicidality can occur without depression, depression is the most common mental disorder leading to suicide. It is estimated that about 60% of people who commit suicide have had a mood disorder (e.g., major depression, bipolar disorder, dysthymia; NIMH 2000).<sup>11</sup> Conversely, the depressed are at significantly increased risk for suicide: one study found that approximately 4% of those treated for depression as inpatients will commit suicide vs. 2.2% in mixed inpatient/outpatient populations treated for depression vs. less than 0.5% for those with a non-depression illness (Bostwick and Pankratz 2000). By comparison, averaging across the 53 countries for which complete data is available, the age-standardized suicide rate for 1996 in the population at large was .015% (WHO 2001).<sup>12</sup>

It is difficult to estimate the prevalence of suicidal thoughts and suicide attempts, but the prevalence is much higher than that for completed suicides. Using stringent and objective criteria such as suicide attempt-related hospitalizations, there are approximately 8-25 suicide attempts per completed suicides (NIMH 2000; Platt et al. 1992). A population study found the prevalence of suicidal ideation in the prior two weeks to be 2.6%; it also found that major

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<sup>10</sup> It may have been adaptive for very elderly or infirm individuals who were burdening their close kin to kill themselves reliably and without warning (deCatanzaro 1981). This does not account, however, for the large number of healthy, productive people who attempt suicide; healthy individuals who are imposing a fitness cost on their family should simply leave the group.

<sup>11</sup> Younger persons who kill themselves often have a substance abuse disorder in addition to being depressed (NIMH 2000).

<sup>12</sup> Approximately four times as many men (.024%) as women (.068%) commit suicide, a bias that is probably due to men choosing more lethal methods (WHO 2001).

depression was by far the major risk factor for suicidal ideation (Goldney et al. 2002). A nine country study (Weissmann et al. 1999) that relied instead on self-report measures found a lifetime prevalence of 10-18% for suicidal ideation and 3-5% for suicidal attempts.<sup>13</sup> Using the latter figures, the ratio of attempts to completions is on the order of several hundred.

Because of low mortality for other reasons, suicide is among the three leading causes of death among young people 15-34 years of age (WHO 2001). Across numerous studies, five psychological constructs have consistently been associated with suicide: impulsivity/aggression, depression, anxiety, hopelessness, and self-consciousness/social disengagement (Conner et al. 2001), most of which are obviously consistent with the bargaining model.

Previous research suggests that both clinicians (Bancroft et al., 1979; Hawton et al., 1982) and families (James and Hawton 1985) tend to attribute suicide attempts to manipulative motives, consistent with the bargaining model. Although studies of adolescents' stated reasons for suicide indicate that few mention a manipulative motive (e.g., only 18% did so in a study by Boergers et al. 1998), numerous data from small, kin-based societies confirm that suicide threats are used by individuals for exactly the political purposes proposed here. Giddens' 1964 article on the cross-cultural sociology of suicide is worth quoting at length:

An example [of suicide as part of a wider social system of punishment and sanction in some societies] was given by Malinowski, in what has been recently described as 'the best-known suicide in the ethnographic literature.' [Bohannon 1960, p. 4] This was the case of a youth who committed suicide after he had been publicly accused of incest. This action, says Malinowski, served to expiate his crime. The suicide, by means of his act, 'declares that he has been badly treated' [Malinowski 1949, p. 97]; the probability that a wronged or humiliated individual would kill himself serves as 'a permanent damper on any violence of language or behavior, or any deviation from custom or tradition, which might hurt or offend another.' [Malinowski 1949, p. 98] Suicide thus functions to facilitate social order; suicide, or the possibility of suicide, serves as a sanction in situations of controversy or dispute. A similar conclusion is reached by Berndt in a recent discussion of suicide [Berndt 1962, pp. 201ff.]. Jefferys has collected together a number of examples of what he calls 'revenge' suicide: in these examples, again, suicide functions as a form of social sanction against those towards whom the individual has a grievance [Jefferys 1952, pp. 118-122]. Such suicide usually has ritualized elements in it—the suicide method, for example, is often standardized.

Attempted suicide and verbal threats of suicide, can also be seen in some societies to be part of a recognized social pattern. In Tikopia, for example, according to Firth, the suicidal threat is recognized as an appropriate response in certain types of situations. Verbal suicide threats are used as a form of social pressure in the judicial process. The announcement of intention to commit suicide draws public attention to the individual who believes himself wronged, and provides an indictment of the wrongdoer [Firth 1951, p. 74]. A similar mechanism involving 'a threat of suicide dramatically announced' operates, according to Honigman, among the Kashka Indians [Honigman 1963, p. 279]. In Ovimbundu, in central Angola, suicide threats are similarly used to put pressure on others in disputes; the suicidal threat is also recognized as an important form of social sanction among the Fulani [Edwards 1962, pp. 128-45; Hopen 1958, pp. 76f.]. Other examples are not hard to find. In all of these cases, suicide threats are part of a defined social pattern relating to the settlement of disputes.

Attempted suicide, of course, often simply represents a suicide which fails through technical reasons. But this is by no means always the case. Malinowski, for example, notes that, in the Trobriands, there are two 'serious' methods used in suicide—these virtually always produce death; there is also a 'milder' method, from which the individual usually recovers. The 'milder' method is usually the one used in matrimonial quarrels and other relatively minor disputes [Malinowski 1949, p. 94]. Among the Kuma of New Guinea, suicide attempts are 'expected' of women when they are contractually married. The suicide attempt is always by drowning. The attempt only occasionally results in the death of the individual. The suicide attempt is an accepted method of protest against the relatives who have brought about the undesired match. [Reay 1959, pp. 178-181] Fortune describes various cases of attempted suicide in Dobu.

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<sup>13</sup> There was little sex difference in suicidal ideation rates but a female bias in attempt rates.

Here attempted suicide is mainly associated with marital disputes. The suicide attempt is typically made in the spouse's village, and serves as a means of registering protest, in front of relatives, against the conduct of the spouse [Fortune 1932, pp. 91-93]. Gorer remarks upon similar instances among the Lepchas of the Southern Himalaya. An individual who believes himself wronged may attempt to commit suicide; this serves both to affirm his own innocence in the matter in question, and as a public indictment of the transgressor. The individual attempts suicide, but the attempt is made 'in such situations that he is bound to be saved.' [Gorer 1938, pp. 269ff.]

In all of these examples, the suicidal act is a recognized type of social mechanism, an accepted method of bringing pressure to bear upon others.

Brown's (1986) detailed analysis of suicide among the Aguaruna, a group of hunter-horticulturalists who live in the rugged uplands of the Amazon in northern Peru, similarly reveals that the social etiology of suicides among this group are precisely those predicted by the bargaining model—suicide is used by the individual to impose costs on group members with whom he or she has a conflict:

Some segments of Aguaruna society—specifically, women and young men *who are unable to organise collective responses to conflict*—use solitary acts of violence directed against the self to express anger and grief, as well as to punish social antagonists. (emphasis added)

### **Sex bias**

Cross-culturally, there is a robust 2:1 female bias in depression rates (e.g., Ustun and Sartorius 1995). Although the differing social roles of men and women explain part of this bias, they do not appear to explain all of the bias (e.g., Maier et al. 1999). Under the bargaining model, women are expected to have higher rates of depression because 1) it was more often a better strategy for them, and 2) they had more conflicts with powerful others (cf. Wenegret 1995; see also Watson and Andrews 2002, and MacKey and Immerman 2000). Women should have a lower threshold for, and higher rates of, depression than men because, in the EEA:

1. Patrilocality<sup>14</sup> meant that females, more often than males, were living with non-kin, and thus were more likely to have conflicts with the group (e.g., Rodseth et al. 1991; see also Hess and Hagen n.d.).
2. Physical aggression was a less effective strategy for females in intersexual conflict.
3. Female reproductive capacity was a scarce resource, so females were, more than males, victims of social manipulation by powerful others.
4. Most females could put scarce reproductive and childcare investment capacities at risk, whereas only some males had, e.g., valuable hunting or military benefits to put at risk (i.e., there was less variability in female reproductive value relative to male reproductive value).

### **Biochemistry**

The monoamine hypothesis of depression proposes that the physiological basis for depression is a deficiency of central noradrenergic and/or serotonergic systems, and that rectifying such deficiencies with an antidepressant would reduce or eliminate depression. Consistent with this hypothesis, the symptoms of depression can be alleviated by agents that, via several mechanisms, increase synaptic concentrations of monoamines like serotonin and norepinephrine. This hypothesis has a number of problems, however, including the fact that it usually takes weeks or months of antidepressant treatment before depressive symptoms lift, even

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<sup>14</sup> Males live with kin, females transfer—the modal pattern for humans.

though antidepressants increase availability of the target neurotransmitters immediately. The hypothesis also fails to explain why depletion of serotonin does not cause depression in nondepressed subjects, nor does it exacerbate symptoms in depressed subjects (see Bell et al. 2001 for review). In addition, not all drugs which enhance serotonergic or noradrenergic transmission effectively treat depression. These and other deficiencies of the monoamine hypothesis are widely recognized, although it has by no means been abandoned (see Hirschfeld 2000 for a review).

According to the bargaining model, individuals should experience depression when they have potential conflicts with powerful others and cannot act unilaterally. Such circumstances would obviously induce long term stress. Hundreds of studies have demonstrated increased levels of the stress hormone cortisol in depressed patients, and there is rapidly accumulating evidence that chronic activation of the hypothalamic-pituitary-adrenal axis, the hormonal system that regulates the 'fight-or-flight' (i.e., stress) response, is a proximate cause of depression. Pariante and Miller (2001) summarize these findings in their review of the role of glucocorticoid receptors and stress hormones in major depression:

Hyperactivity of the hypothalamic–pituitary–adrenal (HPA) axis in patients with major depression is one of the most consistent findings in biological psychiatry. Specifically, patients with major depression have been shown to exhibit increased concentrations of [the stress hormone] cortisol in plasma, urine, and cerebrospinal fluid (CSF); an exaggerated cortisol response to adrenocorticotrophic hormone (ACTH); and an enlargement of both the pituitary and the adrenal glands (Gold et al 1988; Holsboer and Barden 1996; Nemeroff 1996; Owens and Nemeroff 1993). These HPA axis alterations are believed to be secondary to hypersecretion of corticotropin-releasing hormone (CRH), which has behavioral effects in animals that are similar to those seen in depressed patients, including alterations in activity, appetite, and sleep (Owens and Nemeroff 1993).

Elevated levels of stress hormones among depressives were recognized even before antidepressants were discovered, but these changes were seen as epiphenomena of the stressful experience of depression. A vast amount of evidence has since accumulated that altered stress hormone secretions in depression are *not* epiphenomenal, but are causally involved in its development and course. Further, there is evidence that traditional antidepressants may function by effecting changes in corticosteroid receptors, and thus in the HPA axis, changes which then lead to clinical recovery (see Holsboer 2000 and Pariante and Miller 2001 for reviews). In sum, considerable biochemical evidence on depression is consistent with the bargaining model.<sup>15</sup>

### ***Other etiological factors and findings***

Three factors that are important in the etiology of depression—genetic background, prior episodes of depression, and personality—do not clearly support the bargaining model, yet they are not inconsistent with it either. That there is a significant heritable component to unipolar depression is perhaps the strongest evidence against it being an adaptation.<sup>16</sup> However, just as there could be heritable differences in thresholds for physical pain (which clearly *is* an

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<sup>15</sup> Of course, all biomedical researchers investigating depression assume that differences in biochemistry between depressed and non-depressed individuals reflect pathology. This appears, however, to be little more than an assumption.

<sup>16</sup> Although studies consistently find that individual environmental factors play the largest role in the development of unipolar depression, various twin studies have found modest degrees of heritability, ranging from approximately .30-.50; there is also some evidence that depression might be more heritable in women than men (see e.g., Bierut et al. 1999 and references therein).

adaptation), there could be heritable differences in depression thresholds, or heritable differences in the likelihood of experiencing depressogenic events. Kendler and colleagues (Kendler et al. 1995; Kendler and Karkowski-Shuman 1997) found just this: a significant fraction of the heritable component of depression consists of heritable differences in the sensitivity to the environmental stimuli that trigger depression, and heritable differences in the likelihood of selecting oneself into environments that cause depression. That is, the genetic effects, at least in part, act on the environmental pathways to depression (see also Kendler et al. 2002).

Prior episodes of depression appear to be, in and of themselves, a cause of current episodes. Evidence is accumulating that there is a 'kindling' effect: with each depressive episode, the association between stressful life events and a depressive episode decreases. Thus, although early episodes are strongly correlated with stressful life events, later episodes onset with little apparent provocation (Kendler et al. 2000, 2001). This effect was strongest for those at low genetic risk; those at high genetic risk appear to be 'prekindled' for depression. The kindling effect is probably responsible for the widespread clinical observation that many cases of depression are not obviously related to life stressors. One possible functional interpretation of this effect is that defensive strategies become increasingly 'hair-triggered'. Much as the immune system becomes sensitized to specific antigens in order to respond with maximum speed and efficiency when it encounters them again, so, too, may social defense strategies like depression become sensitized to social circumstances that are likely to reoccur and require a rapid response. In fact, given that some costly social circumstances may be predictable, it is possible that in these cases depression could trigger preemptively in order to minimize costs. It is also possible that the kindling effect is simply a byproduct of the neurological changes that are associated with chronic stress.

Vulnerability factors like having a 'neurotic' personality also account for some of the variability in depression, and are good predictors of future episodes. Although the origins of such personality factors are still obscure, they may be based on genetic background, experiences during childhood, and long term exposure to particular social circumstances (e.g., Goldberg 2001). Given that an anxious disposition is a central feature of neuroticism (neuroticism is perhaps the vulnerability factor most reliably associated with depression) it is reasonable that 'high-n' individuals believe themselves to be facing, or vulnerable to, social threats. If so, then neuroticism, whatever its origins, is understandably a 'risk factor' for depression under the bargaining model.

A number of differences in cognitive performance between depressed and non-depressed individuals, typically involving memory, attention, and executive functions, have been well established (for a brief review, see, e.g., Austin et al. 2001). These differences are widely interpreted as 'deficits' indicative of an underlying neurological pathology. If depression is an adaptation, a number of cognitive differences along with their associated neuronal differences would also be expected between depressed and non-depressed individuals. The mere fact of differences is not, in and of itself, evidence that depression is a pathology, and it is possible that the documented differences are in fact related to adaptive functions of depression. Specific models of pathology will have to be tested both against functional models and against each other in order to determine the best interpretation of these and the other data on depression.

### ***Does depression cause positive changes, at least some of the time?***

Depression's too often deadly impact is well recognized. Critical to the bargaining hypothesis, however, is evidence that depression can also improve one's social environment (or

would have in the EEA). Just as management would react negatively to a worker strike, but still be forced to provide benefits, depression should cause negative reactions in others, yet still elicit benefits from them. If depression were simply an illness, in contrast, it should elicit both sympathy and benefits. The substantial evidence that depression causes negative reactions in others (Segrin and Dillard 1992) implies that most people do not seem to interpret depression as an illness. But, despite the negative reaction it causes, does depression nonetheless elicit benefits? For much of the last century in the West, researchers have viewed depression as an illness, so studies investigating its power to work deep, and ultimately positive, changes in the lives of those afflicted have been few-to-none. Accounts of depression's transformative capabilities can not infrequently be found, however, in the penetrating autobiographies of those who have known the 'black dog', like Jeffery Smith's *Where the Roots Reach for Water*.

In contrast to the current lack of objective evidence for long-term benefits, there is solid evidence that depression elicits short-term benefits. Before presenting the evidence for benefits like increased investment in joint ventures, problem solving and increased willingness to consider alternative social arrangements that are obvious predictions of the bargaining model, the rational for an additional benefit—reduced risk of punishment—will be developed. Unilateral defection from a cooperative contract, as occurs in the bargaining model, invites punishment for cheating (e.g., Axelrod & Dion, 1988). Cheaters—the targets of punishment—are those who take benefits without giving benefits in return. If those choosing a bargaining strategy could convince others that, despite not providing benefits, they were not taking benefits either, they might be able to avoid punishment, at least in the short term. The behavioral 'shutdown' that characterizes major depression effectively prevents individuals not only from providing benefits, but from taking or making use of benefits provided by others. It is important to have a thorough behavioral shutdown. Theoretical treatments of punishment and the evolution of cooperation make clear that error rates can be a critical parameter (e.g., Boyd & Richerson 1992). If group members mistakenly perceive that an individual is taking benefits but not reciprocating, they can impose devastating costs that negate the benefits of cooperating in the first place. A marked loss of interest in virtually all activities can significantly decrease the odds that the depressed individual will be perceived by anyone to be taking benefits.

A number of behavioral studies have demonstrated that although depression in one family member prompts negative feelings from other family members, it nonetheless appears to *deter* their aggressive behavior and to *cause* an increase in their tendency to offer solutions to problems in a positive or neutral tone and an increase in their solicitous behavior (e.g., caring statements), consistent with the bargaining model.<sup>17</sup> In the short term, depression has also been shown to elicit help and support from non-family members (i.e., roommates) in naturally occurring as well as laboratory situations, although longer term studies indicate high levels of hostility and a progressive decline in social contact and satisfaction with the depressed person. See Sheeber et al. (2001) for a review of this literature. Behavioral studies thus confirm that depression causes an increase in provisioning of social benefits and a decrease in aggressive responses, as predicted.

Similarly, the spouses of individuals experiencing PPD should report increasing their investment in parenting, and in fact they do. Depression scores for one spouse were positively correlated with reports of increasing investment in childcare by the other spouse (see Hagen in press for details). This is consistent with the study of Boath, et al. (1998), who found that family

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<sup>17</sup> Oddly, such responses seem to be viewed negatively by researchers in this field because they are seen as 'facilitating' or 'reinforcing' depressive behavior.

members of women with PPD report that they are more attentive to the mother's needs as a consequence of her depression, and that they have assumed many of her responsibilities. They also report that their increased investment is a considerable burden and that arguments are common, suggesting conflict and negotiation over who should do what. This result was also consistent with the finding by Campbell et al. (1992) that high levels of help from spouses and better interactions with infants were the only variables associated with remission of PPD.

In a review of the psychosocial literature on depression, Harris (2001) discusses the 'fresh start' experiences which may play a causal role in remission:

Even more thought-provoking was the investigation of the 'meaning' of those fresh start experiences which, more often than not, preceded depressive remission [Brown et al. 1988; Brown et al. 1992; Leenstra et al. 1995; Oldehinkel et al. 2000]. Although all these data were collected retrospectively, the time order between these and remission, and the high proportion of such events which were independent of the subject's agency, lent plausibility to this being the effect of the environment on pathology. It seemed fresh starts were the mirror image of those producing the generalised hopelessness of Beck's depressive cognitive triad [Beck 1967]. They either involved events like starting a new job after months unemployed, starting a course after years as a housewife, establishing a regular relationship with a new boy friend/girl friend after many months single, or the reduction of a severe difficulty, usually with interpersonal relationships, housing or finance. They seemed to embody the promise of new hope against a background of deprivation. It was notable that even for women who continued to experience difficulties of a depressogenic severity in one life domain such as marriage, a fresh start in another life domain – starting an access course – often seemed to tip the balance and set them on course for remission.

It is not yet apparent whether depression symptoms themselves play a role in enabling 'fresh starts', but this is, of course, precisely the proposed function of depression. It is therefore encouraging that 'fresh starts' are closely associated with the remission of depression, and may even cause it.

## **Conclusion**

Although effective in many circumstances, aggression and persuasion are poorly suited to resolve genuine conflicts between an individual and powerful others. Given the high degree of interdependence in ancestral social groups, such conflicts would have been common, especially when most group members' social strategies were yielding benefits, but one individual's social strategies were not. If the individual had a monopoly, or near monopoly, on the benefits she was providing to the group, she could put these benefits at risk, forcing group members to bargain over the terms of the social contract.

Depression—whose principle cause is a negative life event, and whose characteristic symptom is a loss of interest in virtually all activities—may be such a bargaining strategy. The following facts about depression also support the bargaining hypothesis:

1. Depression is associated with social conflict.
2. People with depression often feel 'trapped' or blocked by powerful others, and that they have little control over their destiny.
3. Depression causes an objective reduction in productivity.
4. Studies in Western populations indicate that depressive symptoms, despite causing negative reactions suggestive of conflict, elicit a surprising number of benefits, including a decrease in aggressive behavior by family members towards the depressed person, an increase in family members' offers of problem solving advice



- and concern, an increase in childcare by one's spouse, and an increase in support and help by non-family members in both real and laboratory settings.
5. Depression in at least some small-scale, kin-based societies occurs for the reasons, and has exactly the positive political effects, predicted by the bargaining model. Indeed, given the high degree of interdependence and reliance on reciprocity in these societies, it is difficult to imagine that depressive symptoms would not have such effects.
  6. Suicidality in many small-scale, kin-based societies occurs for the reasons, and has exactly the positive political effects, predicted by the bargaining model.
  7. Numerous biochemical investigations indicate that depression may be caused, not by neurotransmitter deficits *per se*, but by chronic stress.
  8. The 2:1 female bias in depression rates has a natural interpretation under the bargaining model.
  9. Fresh-start experiences and increased social support are frequently associated with, and appear to cause, remission of depression.

The hypothesis that depression is an adaptation designed to detect the opportunity costs of cooperative ventures and to subsequently bargain for increased benefits is supported by much of what is known about depression, but finer grained longitudinal studies will be required to adequately determine if depression can, in fact, cause meaningful and ultimately beneficial changes in social circumstances, or could have in the EEA. If so, then non-Western models of depression such as the Quechuan *pena* are largely correct, whereas the Western illness model is largely incorrect.

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## **Appendix: Loss of a status competition among male chimpanzees**

The following describes the sequences of events leading to a loss of dominance by a male chimpanzee in a zoo population. Two groups had recently been merged. Contrary to the yielding hypothesis, there is little evidence of behavior resembling major depression in the male who loses the competition. Rather, a series of fights closely followed by affiliative and grooming behaviors commence over a period of months until the formerly dominant male finally gives visible and audible signs of formal submission (Seres et al. 2001):

[T]he older of the two adult males, Phineas, lost his dominance over Amos, his son. Phineas had gained dominance during the first dyadic introduction over Amos on the 17th of September, 1993, which dominance he maintained until the 5th of January, 1994, when he first showed submissive pant-grunts to Amos. Phineas has been the beta male in the group since. The first observed sign of the takeover was a dispute involving the dominant female, Ericka. Ericka used to live in Phineas' group (group A) at YMS, in which she was the dominant female. As reflected in received pant-grunting and performed display behavior, Ericka also became the dominant female, without contest, over all other females in the newly assembled group and maintains this rank currently. From the beginning, this female seemed to prefer the younger adult male, Amos. In the group context, Phineas three times attacked and tried to overpower the physically stronger (i.e., heavier) but socially less experienced Amos.

On the first of these occasions, November 4th, Phineas attacked Amos, when the latter tried to sexually mount Ericka. Ericka exhibited maximum anogenital swelling, and had solicited Amos for copulation. Phineas knocked Amos over, and Ericka also turned against Amos. She provided only vocal support to Phineas, however. Amos counterattacked and bit Phineas, causing a bleeding wound on his rear. The two males did not reconcile for at least 3 hours.

The second time, a day later, Phineas viciously attacked Amos for the very same reason, but Amos again proved stronger. He pinned Phineas to the ground, slightly biting him on his back and rear. Both males were slightly bleeding, but none of their wounds were serious. Phineas did not give up and attacked, but only hit Amos repeatedly, until he was visibly exhausted. Some females, including Ericka, barked against Phineas. Ericka then approached Amos and inspected his wounds, kissed him, and groomed him. The females ignored Phineas. Less than 30 minutes later, Amos initiated reconciliation with his opponent, walking up to him on the climber, and the two males embraced, after which Phineas vigorously groomed Amos. They engaged in mutual grooming for a long time, while they repeatedly panted to each other. The two males avoided confrontation and both were relaxed for the next 17 days. They engaged in mutual grooming on numerous occasions, and affiliative interactions were on the rise.

On November 22nd, however, Phineas attacked Amos for a third time, again in a dispute over females. Other than placing a few bites on each other, nothing serious happened, and grooming followed again. No further fights between them were observed, although Phineas had a new puncture wound on his left palm on January 3rd. This was probably his last injury caused by Amos. On January 5th, Phineas began to bow and pant-grunt to Amos, a visible and audible sign of formal submission.... Not a single, not even a minor physical fight has been observed between them in the first 5 years of colony establishment.

Avoidance may be another important post-conflict strategy for primates, especially those in wild (as opposed to captive) populations (Sommer et al. 2002).