such a proliferation of adaptationist hypotheses is that clinicians are skeptical of the validity and utility of Darwinian psychiatry and believe that the preferred activities of evolutionary psychiatrists are storytelling and the invention of outlandish explanations to elucidate the selection pressures that forged psychopathological traits (Dubrovsky 2002; McCrone 2003).

Keller & Miller (K&M) argue "against those evolutionary thinkers who assume that adaptive forces are the only possible explanations for common, heritable polymorphisms such as mental disorders" (sect. 8, para. 1) and suggest that the apparent evolutionary paradox of the existence of mental disorders can be resolved by recognizing the enormous mutational target size of human behaviors. K&M convincingly demonstrate that the application of the evolutionary theory to psychopathology should not necessarily consist in finding hidden adaptive benefits for each psychiatric syndrome. They should be commended because, in doing so, they avoid the risk of throwing out the baby with the bath water. K&M acknowledge that "the search for possible adaptive functions of mental disorder symptoms . . . is an important counterbalance to the prevailing assumption that subjective distress equals biological disorder" (sect. 8, para. 2). This is a crucial point because, if adaptationism is the Achilles' heel of Darwinian psychiatry, medicalization is the original sin of past and present psychiatry.

During the past two decades, psychiatric epidemiological studies have contributed a rapidly growing body of empirical knowledge on the prevalence data for mental disorders. Two large community surveys conducted in the United States – the National Institute of Mental Health Epidemiologic Catchment Area Program (ECA) and the National Comorbidity Survey (NCS) – showed overall 1-year mental and addictive disorder prevalence rates approaching 30% and lifetime rates approaching 50%. This means that, according to current diagnostic criteria, one out of every two persons will suffer from a mental disorder during his or her lifetime. These implausibly high prevalence rates have led to concerns about the validity of the current methods of psychiatric diagnosis and have reinvigorated the debate about the concept and definition of mental disorder (Troisi & McGuire 2002). According to many, the most basic problem with current criteria of psychiatric diagnosis is that they fail to distinguish mental disorders from "problems in living," that is, the vast array of problematic but nondisordered human conditions that reflect "the aches and pains of normal life" (Chodoff 2002, p. 627).

In psychiatry, the medicalization of the human condition is a long-standing problem. In the past, cultural prejudices and political aims were the major causes of the social construction of mental illness, as, for example, in the (in)famous case of drapetomania (the "mental disease" causing black slaves to run away) (Cohen 1981). In the last few years, the social construction of mental illness has partly been replaced by the corporate construction of psychiatric disorder. Pharmaceutical companies are actively involved in sponsoring the diagnostic definition of new diseases and promoting them to both prescribers and consumers (Moynihan et al. 2002). It seems that some new behavior is medicalized every day. The recent psychiatric literature has witnessed the conversion of sexual desire into an "addiction" complete with support groups, and excessive fear of social interaction into a mental disorder treatable with medication. One study (Laumann et al. 1999) has coined the term *female sexual dysfunction* to refer to sexual difficulties such as lack of desire for sex, anxiety about sexual performance, and problems with lubrication that are present in 43% of American women aged 18–59, even though leading sex researchers have argued that these difficulties may reflect healthy and functional responses in women faced with stress, fatigue, or threatening patterns of behavior from their partners (Bancroft 2002).

The necessity of avoiding medicalization of human behavior is not simply an intellectual exercise. The concept of disease acts not only to describe and explain, but also to enjoin to action. For this reason, labeling a psychological or behavioral condition as sick may have serious individual and social consequences. At the individual level, inappropriate medicalization carries the dangers of self-reproach, social stigma, inappropriate treatment decisions, and iatrogenic illness. At the social level, the resources invested in diagnosing and treating healthy people are likely to be diverted away from preventing and treating individuals with real diseases. Since a major contribution of evolutionary theory is the insight that individual differences are core biological features of any animal species, including *Homo sapiens*, the application of the concept of adaptive behavioral polymorphisms to psychopathology can be a powerful antidote against the normative attitude of mainstream psychiatry and its growing tendency to medicalize human diversity (Troisi 2005).

In Greek mythology, Scylla and Charybdis were two immortal and irresistible monsters who beset the narrow waters of the Strait of Messina, destroying ships as they attempted to navigate through. The two sides of the strait were within an arrow's range of each other, so close that sailors attempting to avoid Charybdis would pass too close to Scylla, and vice versa. The phrase *between Scylla and Charybdis* has come to mean being in a state where one is between two dangers and moving away from one will cause you to be in danger from the other. The Scylla and Charybdis of Darwinian psychiatry are adaptationism and medicalization. To be integrated into mainstream psychiatry without leaving behind its original contribution, Darwinian psychiatry will have to navigate through these equally misleading alternatives.

Population genetical musings on suicidal behavior as a common, harmful, heritable mental disorder[1]

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Abstract: Suicidal behavior is an interesting blank space in Keller & Miller's (K&M's) population genetical account on explaining the existence and persistence of common, harmful, heritable mental disorders. I argue that suicidal behavior is yet another of these disorders. It may well be consistent with all three evolutionary models considered by K&M.

First of all, I congratulate the authors, Keller & Miller (K&M), for their population genetical analysis, concerning the existence and persistence of common, harmful, heritable mental disorders; it is an outstanding contribution that without doubt will have a marked impact on the research fields addressed. One interesting omission (or avoidance) in the target article, however, is suicidal behavior. Only in their opening paragraph do the authors mention that "many people with schizophrenia kill themselves" (sect. 1, para. 1). Otherwise, the text is silent on this theme. This commentary addresses this blank space. In order to stimulate further inquiry along these lines, I briefly discuss whether suicidal behavior fits into the three population genetical scenarios evaluated by K&M for mental disorders in general. For simplicity, the focus is on completed suicide.

Is suicidal behavior a "common, harmful, heritable mental disorder," as defined by K&M? I think the answer is yes. Suicide is relatively common: Across many societies, it is the tenth-or-so leading cause of death (Mann 2003), with a lifetime mortality of around 0.5% in the general population (Bostwick & Pankratz 2000). Suicide is harmful: It ends the suicide victim's physical existence, as well as any chance for future reproductive success, and in most situations adversely impacts on the victim's

https://doi.org/10.1017/S0140525X06419099 Published online by Cambridge University Press

relatives. Risk factors for suicide are heritable: multiple lines of evidence – family, twin, and adoption studies (Baldessarini & Hennen 2004; Brent & Mann 2005); molecular genetical studies (Li & He 2006), supplemented by suggestive findings from geographical studies (Marušič 2005; Voracek & Formann 2004; Voracek et al. 2003) – converge to this conclusion (Bondy et al. 2006). And, finally, suicidal behavior may well be a distinct mental disorder: It is increasingly regarded as an independent, possibly dimensional, nosological entity (Leboyer et al. 2005). This emerging view is based mainly on genetic evidence that its transmission is noticeably independent of the transmission of the risk for mental disorders. Like these, suicides also run in families, but not necessarily in the same families; or, if so, they may take a different path through the pedigree (Brent & Mann 2005). Whereas alcohol-related, schizophrenia-spectrum, and mood disorders (particularly, depression) constitute major risk factors for suicide and frequently are ascertained among suicide cases, the vast majority (up to 80%–90%) of people affected by these disorders do not commit suicide (this is even valid for suicide attempt as a risk factor for subsequent suicide).

In what follows, I argue that the current suicidological knowledge appears consistent with all three evolutionary models considered by K&M, not just with the one they opine to be the most plausible (i.e., the mutational selection model). I commence with this one: polygenic mutation-selection balance. According to this model, among others, a multitude of susceptibility alleles for suicidal behavior should be expected, all of them having small effect sizes and many of them being population specific, thus resulting in slow gene-hunting progress, characterized by frequent replication failures. All of this is indeed true with respect to the search for genetic risk factors for suicide. No major "suicide genes" have been found, polymorphisms of suspected vulnerability genes account for small effects only and show population differences, and nonreplications are frequent in this area (Bondy et al. 2006). The serotonergic system has been strongly implicated in the neurobiology of both depression and suicide. Thus, past research has almost exclusively focused on this system's genetic bases (i.e., on the serotonin transporter gene, the genes for the various types of serotonin receptors, the monoamine oxidase A gene, and the two tryptophan hydroxylase genes). Because of this theoretically and clinically well-founded candidate-gene approach, genome scans have not been conducted in this area until quite recently, and the evidence from a first major genome scan (Cheng et al. 2006) was disenchanting: Several significant and suggestive linkage signals were found for suicidal behavior in a large pedigree sample of patients with bipolar disorder, but none of these linkage findings overlapped with any of the gene loci of the aforementioned serotonergic system constituents. This is expected under the polygenic mutation-selection balance scenario of mental disorders, and in this respect the evidence for genetic risk factors for suicide is consistent with this model.

What about the ancestral neutrality model of mental disorders? For several reasons, K&M do not give much credence, in general, to this model of neutral evolution of mental disorders. Their theoretical exception is that it could be a viable explanation for some mental disorders which show strong genotype-environment (G × E) interaction (as indicated through large cross-cultural variation in prevalence rates; recent historical changes in the rates, concurring with environmental changes; and mismatch of ancestral and modern environments). K&M mention depression as a possible candidate for this scenario. The aforementioned three characteristics also apply for patterns of suicide. More generally, it has been reasoned that G×E interaction might be common in psychopathology rather than rare (Moffitt et al. 2006). Suicide may be regarded as an analogue to late-onset disorders (i.e., the majority of suicides occur after the reproductive phase). Consequently, one sociobiological theory of suicide (de Catanzaro 1980, 1981) assumed that suicide frequently might not be highly maladaptive. Natural selection can act only on the residual reproductive potential. If this is low or nil, then there is little that natural selection can affect. Further, given the large increase in the average life span in modern environments, age-related expressions of vulnerability genes for suicidal behavior imply that they are now expressed under conditions different than those they were selected for in ancestral environments. The ancestral neutrality model might thus also have a role in explaining the persistence of suicidal behavior.

And what about the balancing-selection model? De Catanzaro (1980, 1981) noted the remarkable conformity of the social ecology of suicide to the pressures of natural selection (i.e., relations with sex, age, cohort, and fertility, and with group, health, and relationship status). He pointed out that many suicides tend to occur when the anticipated residual capacity to promote inclusive fitness is low and when staying alive could actually reduce an individual's inclusive fitness (particularly by being a burden to the kinship). This perspective of suicide appears consistent with the balancing-selection model; that is, the view that susceptibility alleles may sometimes increase (inclusive) fitness. Yet another variant of this model should also not be discounted, the logic of which unfolds as follows. Suicide is a biological anomaly: It is species general in humans, but absent in other species. It would therefore be surprising if certain higher cognitive traits, unique to humans, had no role in this unique behavior. It is difficult for natural selection to eliminate deleterious X-linked alleles (for which males are hemizygous) or antagonistically coevolved genes (Rice & Holland 1997). Early attempts to demonstrate X-linkage of intelligence (Lehrke 1997) have been met with skepticism, but it is now clear that the X chromosome harbors an excess of genes relevant for cognitive abilities (Zechner et al. 2001). Interestingly, two constituents of the serotonergic system (monoamine oxidase A receptor gene, Xp11.23; and serotonin receptor type 2C gene, Xq24) and the androgen receptor gene (Xq11–12) also reside on the X chromosome. Is this mere coincidence? Or could this imply that susceptibility alleles for suicide perhaps happened to coevolve with positively selected variants for higher cognitive abilities and with male-typed traits sensitive to testosterone? If true, this would throw new light on the robust sex difference seen in suicide prevalence (many more males than females commit suicide). I have not yet encountered this type of conjecture in the literature, but it is testable. Nineteenth-century suicide researchers were well aware of the link of higher education (a proxy for intelligence) and increased suicide risk (Morselli 1881). Using intelligence data or proxies thereof, this pattern has been replicated in recent geographical studies, both cross-nationally (Voracek 2004; 2005a) and intranationally (Voracek 2005b; 2006b; 2006d), as well as in cohort studies (Voracek 2006a; 2006c).

NOTE

1. This commentary was prepared in partial fulfillment of the author's D.M.Sc. degree requirements at the Medical University of Vienna.

High mental disorder rates are based on invalid measures: Questions about the claimed ubiquity of mutation-induced dysfunction

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Abstract: Three reservations about Keller & Miller's (K&M's) argument are explored: Serious validity problems afflict epidemiological criteria discriminating disorders from non-disorders, so high rates may be misleading. Normal variation need not be mild disorder, contrary to a

https://doi.org/10.1017/S0140525X06419099 Published online by Cambridge University Press