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Ilina Singh [a] & Kelly J. Kelleher [b]
[a] BIOS Centre, London School of Economics and Political Science,
[b] Centre for Innovation in Pediatric Practice, Nationwide Children's Hospital,

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Target Article

Neuroenhancement in Young People: Proposal for Research, Policy, and Clinical Management

Ilina Singh, BIOS Centre, London School of Economics and Political Science
Kelly J. Kelleher, Centre for Innovation in Pediatric Practice, Nationwide Children's Hospital

Psychotropic neuroenhancement by young people under 18 is growing, and is certain to increase further with the availability of effective drugs and increasing tolerance for neuroenhancement practices. Use of these agents by young people for purposes of enhancement has social and ethical implications that require scrutiny and analysis. It is particularly important that these analyses do not simply translate normative judgments on adult neuroenhancement practices or intentions to young people. In this article, we outline the key social and ethical concerns raised by the use of stimulant drugs for neuroenhancement in young people and make specific research, practice, and policy recommendations. We also suggest a rationale for clinical management of psychotropic drug neuroenhancers for young people, attending closely to the necessary boundaries on such practice asserted by organizational and clinical factors, as well as by potential ethical conflicts.

Keywords: child and adolescent psychiatry, neuroenhancement, neuroethics, Ritalin, stimulant drugs

In recent years various neurotechnologies that promise to enhance human cognitive and behavioral functioning have come on the market. Some of these, such as transcranial magnetic stimulation, deep brain stimulation, and brain exercise regimes are of questionable benefit to those desiring neuroenhancement at this time. However, there is increasing evidence that certain psychotropic drugs do have enhancement applications in several cognitive-behavioral areas: memory (Izquierdo et al. 2008; Elliott et al. 1996), performance anxiety (Hartley et al. 1983), attention (Petrzack et al. 2006), cognitive flexibility or problem solving (Silver 2004), and alertness (Caldwell et al. 2004).

It is clear from a number of reports that neuroenhancement is actively practiced by adults and by young people in North America, Europe, and the United Kingdom (Schermer et al. 2009; Greely et al. 2009). Informal polls and newspaper reports suggest that alongside growing evidence of neuroenhancement practices, there is also increased public tolerance of neuroenhancement using psychotropic drugs—at least among educated middle-class respondents (Maher 2008; Tysone 2007). doi:10.1073/pnas.0810650105 We think the current level of use of stimulants for purposes of enhancement among young people[1] (which is almost certainly underreported) will also increase, not least because the use of psychotropic neuroenhancing agents will likely become normal in future generations.

From an ethical perspective, psychotropic neuroenhancers are not substantively different from non-drug strategies widely used (especially among the U.S. educated socioeconomic classes) by parents and young people themselves to enhance cognition and performance. A range of non-drug strategies are in use, including vitamins and "natural" therapies that claim to enhance focus, attention, and memory; early music learning and listening, including the use of "baby Mozart" to enhance the intelligence of babies while still in the womb; a variety of tutoring strategies to improve performance on standardized tests and the like; "brain exercise" regimes that claim to increase the size of certain brain regions associated with cognitive and behavioral performance; and so on.

Similarly, caffeine and related dietary stimulants available without prescription act as attentional and neuroenhancement agents. Caffeine has been shown to enhance attention and manual dexterity in normal prepubertal children as compared to placebo (Bernstein et al. 1994);

Address correspondence to Ilina Singh, Wellcome Trust University Lecturer in Bioethics and Society, London School of Economics and Political Science, Houghton Street, London WC2A 2AE, United Kingdom. E-mail: i.a.singh@lse.ac.uk

1. We use the term "young people" throughout this article to refer to persons under 18 years of age. Given our own emphasis on the importance of recognizing the developmental status of children and adolescents, this term is not entirely satisfactory. However, specifying developmental stages in this discussion would be premature because we have no age-related thresholds to guide the use of neuroenhancers.

however, this randomized control study involved only 21 subjects. Caffeine is also efficacious as an enhancer for competition weightlifting among older adolescents and young men (Beck et al. 2006).

While these interventions do not engender the same automatic, visceral reactions as psychotropic drug interventions in children, it is only the delivery of neuroenhancement that differs; the motivation to enhance children's functioning is substantively the same. We believe the acceptance of drug delivery techniques will normalize, as more and more people choose to take these drugs. At that point, several advantages of drug delivered neuroenhancement—ease of use, quick results, and the perception of greater efficacy than other interventions—will likely outweigh the intuition that it is wrong to psychotropically enhance young people's cognition and performance (Chatterjee 2006).

Use of these agents by young people for purposes of enhancement has social and ethical implications that require scrutiny and analysis. It is particularly important that these analyses do not simply translate normative judgments on adult enhancement practices or intentions to young people. Young people are most likely more vulnerable to many intended and unintended effects of psychotropic drugs as compared to adults (Vitiello 1998). There is strong evidence that young animals are more vulnerable to the effects of psychotropic drugs than adult animals, although no specific data on stimulants exist (Borella 1997; Mazer 1997; Hill 1984; Rosengarten 1979; Haldelman 1983). For some time now, there has been a call out for more studies on the impact of psychotropic drugs on the developing brain in humans (Vitiello 1998). Existing fetal studies suggest increased teratogenicity and perinatal behavioral abnormalities after exposure in utero for the developing brain (Omtzigt 1992; Rosa 1991; Cohen 1994; Shou 1976). In a rare study of the longitudinal effects of psychotropic drugs on children, administration of phenobarbital was associated with prolonged and persistent decrements in cognitive function that have not been observed for adults (Farwell 1990).

Young people also rely on proxies for their care; therefore, the barriers to use of neuroenhancers should be higher than those for adults. Harms and benefits specific to young people—of particular neuroenhancers, as well as of performance enhancement itself—must be made explicit in order to inform relevant policy and practice. Barriers should be age-appropriate; that is, they should take into account the developmental and cognitive status of the child, as well as the decision-making capacities of young people at different ages. Where not enough is known to establish valid, evidence-based barriers to use of neuroenhancers for young people, further research will need to be undertaken, although sufficient research to ensure safety of the developing child will require time and investment of resources.

In this article, we outline the key social and ethical concerns raised by the use of stimulant drugs for neuroenhancement in young people and make specific research, practice, and policy recommendations. We use the case of stimulant drugs as a template to construct a rationale for clinical management of neuroenhancers for young people, attending closely to the necessary boundaries on such practice asserted by organizational and clinical factors, as well as by potential ethical conflicts.

NEUROENHANCEMENT

The neuroethics literature provides an extended discussion and debate over the term "neuroenhancement" that we cannot explicate here (e.g., Juengst 1998; Parens 1998; Daniels 2000; Sabin and Daniels 1994). For the purposes of this article, we define neuroenhancement as the use of neurotechnologies (e.g., stimulant drugs) to improve cognitive and/or behavioral functioning and performance where cognitive and/or behavioral functioning is not judged to be impaired. Enhancement is sometimes differentiated from treatment; in reality, however, distinctions between treatment and enhancement of human cognitive and behavioral functioning are often continuous rather than categorical (Daniels 2000; Wolpe 2002). In the clinical context, a better distinction between treatment and enhancement takes into account the level of contextual impairment caused by behaviors and/or cognitive functioning. Where cognitive and/or behavioral functioning is not impaired at clinically significant levels in a particular context, the motivation for use of neurotechnologies can be considered neuroenhancement.

LITERATURE ON PSYCHOTROPIC DRUG USE AND ENHANCEMENT IN YOUNG PEOPLE

The dramatic increase in the number and types of psychotropic drugs over the past two decades provides a number of potential products for neuroenhancement among young people and adolescents. Four types of pharmacologic neuroenhancements are described in the literature. Anxiolytic agents like the benzodiazepines, beta-blockers, and newer antidepressants are employed for high levels of performance anxiety for public speaking, sports performance, and musical performances. Although anecdotal evidence supports their use, cognitive behavioral therapy may be more effective in the long term than medications in adults (Stein and Stein 2008). No treatment trials of medications for performance improvement generally or performance anxiety specifically among young people or adolescents have been published.

Even fewer data are available on the potential for enhancement with new memory drugs developed originally for patients afflicted with Alzheimer's disease. Drugs that affect the cholinergic and dopaminergic pathways in the brain appear to temporarily improve memory for these patients. The possibility of enhancement of memory in healthy subjects using such drugs is still unclear. In a recent study, the drug donepezil was shown to improve memory in healthy elderly subjects, as compared to placebo, but improvements were limited to semantic encoding processes (Fitzgerald et al. 2008). Studies with pilots have shown donepezil to have beneficial effects on retention of training in complex flight simulator tasks; however, donepezil may be no more effective than performance-enhancing doses of nicotine (Yesavage et al. 2002; Mumenthaler

et al. 2003). Other studies have failed to demonstrate any memory-enhancing effects of donepezil in healthy volunteers (Nathan et al. 2001).

Despite this mixed picture for current memory enhancers, there still are considerable medical and economic incentives to developing memory-enhancing drugs (Cheshire 2006). These drug discovery efforts will be driven by the desire to find treatments for serious, debilitating medical conditions; they will not be driven by the enhancement market. However, the need for effective treatments for conditions like dementia and Alzheimer's disease, and the existence of active governmental and private research programs around memory and memory enhancement, increase the likelihood that successful "dual-use" drugs will appear on the market in the near future. Memory-enhancing drugs have clear applications in the enhancement of young people's academic performance, and it is highly probable that they will eventually be used for this purpose.

At present, however, the only pharmaceutical agents in widespread use as neuroenhancers are the stimulant medications, including methylphenidate (e.g., Ritalin) and dexamphetamine compounds (e.g., Adderall). In a medical context, stimulants are the most commonly prescribed psychotropic drugs for young people, followed distantly by antidepressants (Safer et al. 2003). Stimulants are almost always prescribed to young people for a diagnosis of attention deficit/hyperactivity disorder (ADHD). However, stimulants have been shown to improve focus and attention in young people without a psychiatric diagnosis as well as in young people with ADHD (Rapoport et al. 1980). Moreover, diagnoses of ADHD are fraught with questions of consistency, rigor, and validity (Singh 2008). Consequently, there is widespread suspicion that the simultaneous increases in ADHD diagnoses and in stimulant drug prescriptions reflect in part an increasing use of stimulants to enhance young people's performance, rather than to treat a clearly diagnosed disorder. This is not a uniquely American preoccupation; in fact, recent studies suggest that the rising trends in stimulant drug prescriptions to U.S. young people may be attenuating both among the usually treated school-aged young people and in the preschool population (Zuvekas et al. 2006; Scheffler et al. 2007). Growth trends in other countries, on the other hand, suggest significant increases in stimulant drug usage, with global spending on stimulant medications increasing ninefold among OECD Organization for Economic Cooperation and Development (OECD) countries between 1993 and 2003 (Scheffler et al. 2007).

Since the introduction of psychotropic drug treatments for ADHD more than 50 years ago, pediatric stimulant medications have been used as appetite suppressants, sleep suppressants, and study aids throughout the United States. Still, estimates of nonprescription use of stimulants were below 0.5% until 1995 across the age range from high school to adults. However, since the mid-1990s, these numbers have increased, with 2.5% of U.S. high school students, college students, and young adults consistently reporting nonprescription use of stimulants. In grades 10–12, a larger proportion of students (4.1%) acknowledge nonprescription use, with boys reporting greater nonprescription use than girls (Teter et al. 2005). College students have the highest rates, with 5.7% admitting nonprescription use (Arria et al. 2008) in one study, while another study reported 34% of students admitting use at a southeastern university (DeSantis, 2008). In the latter study, students reported easy access and a widespread acceptance of stimulant use for academic focus and wakefulness.

Nonmedical use of stimulant drugs occurs in student populations outside America as well. A recent survey of more than 2000 students in the Netherlands indicated that 2.4% of students between ages 12 and 18 had used psychotropic drugs for nonmedical purposes in the past year. Fifty percent of these students said they had used Ritalin (for unspecified purposes). The authors of the report noted that use of Ritalin was probably underreported (http://www.moedigemoeders.nl/index.php?module=news&cat_id=21&year=2008&item_id=6741). A poll taken among 1500 students in Belgium suggested that 3% used stimulants as neuroenhancers (Ravelingien et al. 2009). Indeed, while the evidence is at present mainly anecdotal, the use of stimulants as neuroenhancers appears to be a growing trend among university students around the world. There is less evidence available for usage trends among high school age students (adolescents), and the majority of research to date has been conducted with young people in the United States.

Where are students getting their stimulants? Researchers and journalists report that university chat sites and listservs are filled with offers of drugs like Ritalin and Adderall; the drugs are often shared freely by those who have obtained a prescription (Talbot 2009; Scott Vrecko personal communication). Indeed, approximately one-fifth of all children, adolescents, and young adults prescribed ADHD medications report giving, selling, or being forced to hand over their medications to other students (Poulin 2001). However, most children and adolescents use their stimulant medications appropriately. Those with comorbid conduct disorder or substance abuse diagnoses are particularly likely to sell or to distribute their stimulant medications to other young students (Wilens et al. 2006).

It is clear that we need to build a more substantive and more methodologically consistent research base on young people's neuroenhancement practices and targets. Indeed, at the moment, precise estimates of the prevalence of neuroenhancement, using stimulant medications, are almost impossible to come by. This is in part a methodological problem. For example, in the current literature, most studies have limited methods of identifying nonprescription use of stimulants, and do not distinguish between recreational use and attempts at enhancement (Teter et al. 2005). In an analysis by Wilens (2008), a majority of 21 studies reviewed did not discriminate between stimulant use for euphoria or mood alteration and stimulant use for academic purposes, such as to help with studying or to improve test performance. Moreover, almost all (19/21) empirical studies published

on neuroenhancement with stimulants were student surveys of either high school or college students.

The few studies that inquire about specific reasons for nonprescription use of stimulants note that the most common reasons for nonprescription use of stimulants endorsed by student survey respondents include enhancing alertness and improving studying. An early study found that among students engaging in nonprescription use at college, 65.2% used stimulants to help with concentration, 59.8% to help studying, and 47.5% to increase alertness. Other motives included getting high (31.0%) and experimentation (29.9%). Nearly every illicit user (95.3%) reported oral administration, and 38.1% reported snorting prescription stimulants (Low and Gendaszek 2002).

As many authors note, both the general use of stimulants as neuroenhancers and the specific enhancement practices involving stimulants could be underreported due to social desirability bias. Furthermore, it is notable that we know very little about the demographic distribution of young people using stimulants for neuroenhancement. Research with university students provides data on enhancement practices within well-resourced, largely middle-class educational settings. Whether, how, and why neuroenhancers are used by young people beyond these settings needs further research. It is likely that neuroenhancement is desirable for different reasons in different social contexts, and that the emphasis on improved academic performance as a key target of neuroenhancement is at least in part an artifact of sampling university students in research studies.

ETHICAL CONSIDERATIONS AND RESEARCH AND POLICY RECOMMENDATIONS

Our still limited understanding of neuroenhancement practices suggests an urgent need for innovative, in-depth social and ethical research in this area—research that goes beyond polling university students. In addition, the current level of knowledge about neuroenhancement practises among young people provides insufficient ground for a prospective analysis of social and ethical harms and benefits of neuroenhancement practices among young people. We therefore need a proxy ground on which to conduct this analysis, in order to enable a constructive vision for managing these practices.

In the following section we use existing analyses of stimulant drug treatment of ADHD in young people to identify and evaluate the relevant social and ethical harms and benefits of stimulant drug use in young people for purposes of enhancement. We recognize that the case of young people taking stimulant medication for a diagnosis of ADHD is an imperfect model for the case of young people taking stimulants for purposes of enhancement. However, we use the case of young people with ADHD because this group provides a wealth of evidence about the individual, social, ethical and policy implications of stimulant drug use in young people. We extend this evidence base to the case of enhancement in order to set an agenda for policy, practice, and further research around pediatric neuroenhancement.

Our recommendations are, in most cases, conservative, possibly to the point of being overly cautious. However, in the absence of evidence for safety of stimulant use in young people for purposes of enhancement, and in the presence of good evidence that coercive social influences can drive uptake of neuroenhancers in young people, we believe that caution is prudent, for now.

Ethical Harms and Benefits of Neuroenhancement for Young People

Concerns About the Individual

1. Safety and physical effects of stimulant drugs

A primary ethical consideration for young people taking stimulant drugs is safety. Stimulant drugs have a long history of use in pediatrics and child psychiatry, and there is good anecdotal information about safety and side effects. However, systematic longitudinal safety data is lacking. Long-term impact of stimulant drug use on the human brain is largely unknown (Vitiello 1998); moreover, there are likely to be different implications of treatment use of methylphenidate and enhancement use of methylphenidate for the developing brain. This is because dosing practices for these two different uses of the drug will likely differ, with enhancement doses focused on short-term events and treatment emphasizing ongoing use over long periods; in addition, preexisting structural and functional variations in the brains of those diagnosed with a clinical disorder as compared to undiagnosed persons may mediate the impact of methylphenidate on the developing human brain. Chronic administration of stimulants in young animals does appear to have lasting bio-behavioral effects in adult animal brains (Martins et al. 2006). These effects have been variously interpreted, however. For example, stimulant use in adolescence is associated with biochemical modifications in brain reward-related circuits in adult rats, which may account for the positive effect of increased capacity for self-control in adulthood (Grund et al. 2006; Adriani et al. 2007). On the other hand, a recent study found that the structural and biochemical changes in reward-related areas associated with methylphenidate use in mice overlapped with changes associated with cocaine use (Kim et al. 2009). These findings led the director of the U.S. National Institute for Drug Abuse to express concern that "nonmedical" use of methylphenidate could lead to addiction (http://www.medicalnewstoday.com/articles/137454.php). In addition to the lack of clarity regarding the total risks of stimulant drug use for the developing brain, it is also unclear how relevant findings from animal models are for the complex developmental processes of human brain development.

Some adverse effects are known to exist among young people taking stimulants for treatment of ADHD. Common side effects of stimulant drugs in young people include appetite suppression and insomnia (Jensen 2007). Extended use of stimulants may have a small effect on young people's growth (Jensen 2007) and exacerbate preexisting heart

conditions. Recent studies also suggest that young people taking stimulant drugs for ADHD may be at greater risk for substance abuse and delinquent behaviors, although it is not possible to know whether diagnosis and/or drug treatment are causal factors in these outcomes (Jensen et al. 2007).

Abuse potential. A minority of young people are using stimulants without a prescription and/or diverting stimulants, but it is currently impossible to know the extent to which diversion of stimulant drugs occurs for enhancement purposes. Abuse potential of stimulants is a serious safety concern in both the treatment and the enhancement case; however, it can be avoided if a young person is only prescribed the stimulants with low potential for abuse.

Multiple use of neuroenhancers. In the future it is likely that stimulant drugs will not be the only psychotropic neuroenhancers available to young people. Simultaneous use of multiple neuroenhancers may lead to physical and developmental harms as these drugs interact with each other in unknown ways.

There are related concerns about the safety of dosing practices for enhancement. The available safety data are derived from studies of young people taking stimulant drugs as treatment for ADHD. Stimulant drug dosing practices for purposes of enhancement are likely to be substantially different from treatment practices for ADHD. For enhancement purposes, stimulants will be used for specific, short-term events that will probably not occur on a daily basis, such as major tests. Indeed, until more is known about safety implications, daily use of stimulants for enhancement purposes should be actively discouraged, as there is likely to be little benefit, and possible harm. Short-term use will protect a child from the physiological and neurological uncertainties of long-term, daily use, although it is possible that even short-term use will, over an extended period, also have an impact.

Recommendations related to physical safety of stimulants for neuroenhancement in young people

- Only stimulants with low abuse potential should be prescribed for enhancement purposes in young people.
- Until more is known about safety implications, enhancement should be limited to short-term or individual events rather than long-term use.
- Young people should not be prescribed simultaneous use of psychotropic enhancers in the absence of evidence that simultaneous prescription is safe and efficacious.
- Health care systems and pharmacies should institute systems to monitor the quantity and location of requests for neuroenhancers to avoid abuse and monitor total dosage.

Research recommendations related to safety

- More research is needed to understand the impact of stimulant drugs on the developing brain, when stimulants are used for enhancement purposes. This research should include investigation of both short-term and long-term effects in young people at varying stages of development and consider different patterns of administration and dosing that may be more common for enhancement prescriptions.
- More research is needed to identify likely patterns of neuroenhancement requests from parents and young people and to understand their preferences in considering neuroenhancement timing, dosing, and motivation.

2. Consent

Neuroenhancement in young people raises at least two relevant ethical concerns about stimulant drugs and consent: a young person's right to assent and to dissent to treatment; and a young person's capacity to participate in treatment decisions. In treatment cases, parents or a legal guardian are empowered to make medical decisions on behalf of the child until the child is the age of majority. Should parents/caregivers have the right to override a young person's dissent to using psychotropic drugs for purposes of enhancement? Equally important, should a young person's request for neuroenhancers ever be granted without the parents/caregivers' consent?

Consent and capacity issues require systematic ethical deliberation and resolution in the form of ethical practice guidelines for neuroenhancement in young people. Deliberation needs to take into account evidence of young people's capacity to participate in treatment decisions. Young people have the capacity to understand their medical conditions, and are competent to judge treatment decisions from quite a young age (Alderson 1993; Kuther 2003; Miller et al. 2004). However, decisions around neuroenhancement involving long-term risks may be particularly challenging at some stages of development because they involve calculation of future risk–benefit ratios.

Decision-making competence is clearly age related in young people, and if young people's assent is to be taken into account in neuroenhancement practices, then appropriate assessments of the young person's capacity and competence will need to accompany assent procedures. We do not believe that such assessment requires a separate test; rather, it should occur as part of an interview between the young person and the person who is in a position of providing legal access to neuroenhancers.

Another key dimension of the deliberative process should be evaluation of ethical practice guidelines in analogous enhancement cases, such as cosmetic surgery or use of growth hormones in young people. Such evaluation should judge the relevance of existing cases for the neuroenhancement case, and should also assess whether drug-induced neuroenhancement in young people is an exceptional case that presents a set of unique ethical problems and therefore requires distinctive ethical practice guidelines.

Recommendations related to consent in young people's use of stimulants for neuroenhancement

- Both parents' consent and young people's assent to neuroenhancement with stimulants or other psychotropic drugs should be mandatory.

- Assessment of capacity and competence should accompany child consent proceedings for neuroenhancement. These should be assessed as part of an interview between the young person and the person providing legal access to neuroenhancers.

Research recommendations related to consent

- Further research is needed in order to identify decision aids to help young people better understand the risk and benefits of neuroenhancers
- Further research is needed to inform the creation of noncoercive, age-appropriate, standardized child consent procedures. Research should examine the specific content to be presented as well as the best modalities for presentation.
- Further research is needed to assess whether neuroenhancement in young people using stimulants presents an exceptional case that requires a unique set of ethical practice guidelines.

3. Identity and moral self-understandings (identity, agency, autonomy, and responsibility)

ADHD treatment prescriptions for stimulant drugs have raised strong concerns about potential threats to a young person's personal identity, agency, and responsibility because of the alterations in motivation, attention, interaction with others, and performance for those young people taking them. There is little empirical evidence to support or deny that stimulants threaten these moral self-understandings, although the existing research suggests that normative ethical judgments of stimulant drug treatments may have little relevance to parents' and young people's actual moral experiences (Singh 2005; 2007). Moreover, existing ethical analyses pay insufficient attention to how a young person's developmental status mediates the impact of stimulant drug treatment on personal identity and moral self-understandings. Some ethicists have suggested that stimulants threaten young people's right to "self-creation," notions of personal responsibility, and the experience of an "authentic" (unmedicated) self (Presidents Council on Bioethics 2003; Fukuyama 2003; Sandel 2007). However, research among young people with ADHD suggests that there are benefits to stimulant drug use. To the extent that notions of personal authenticity are affected by stimulant drug medication, the impact is more positive rather than more negative, at least until adolescence. Young people with ADHD who take stimulant medication tend to feel that they have increased agency in determining the outcome of their immediate actions and also in forging their life trajectories (Singh 2007; Singh et al. 2008).

It is the case that stimulant drug treatment may complicate a young person's ability to develop an appropriate conception of personal responsibility for behavior. Some studies suggest that when young people are on stimulant medication, there is a higher likelihood that they and adult caregivers will attribute positive behaviors to medication, whereas when young children are in an unmedicated state, positive behaviors are more likely to be attributed to effort (Johnston et al. 2000; Amirkahn 1982). In some cases, young people's attributions may be strategic: Qualitative interviews with young people suggest that they do use stimulants to explain positive and negative performance or behaviors, but young people also admit to using explanations like "I didn't take my pill" as an excuse for poor performance or behavior (Singh et al. 2008).

There is also a concern about stigma and labeling associated with taking stimulant medication. Yet again, the benefits of drug use may outweigh the harms: Bullying appears to be worse around ADHD-type behaviors than it is around drug treatment, and these behaviors are often ameliorated with stimulant medication (Singh et al. in press).

Better understanding of the qualitative impact of stimulant drug treatment on young people's personal identity, notions of responsibility, and other moral self-understandings will emerge with more empirical research among young people themselves. However, it is unclear how relevant studies of young people with a psychiatric diagnosis are for the enhancement case. It is likely that relevance will depend on the characteristics of the young person seeking enhancement. In one study, for example, college students who reported using stimulants for neuroenhancement purposes were more likely to have undetected or previously unreported symptoms of ADHD (Wilens 2008). In this case, use of stimulants could be considered self-medication rather than neuroenhancement. A thorough assessment of the impact of enhancement on young people's personal identity and moral self-understandings will therefore need to engage with variation at the level of the individual even while attempting to discover general benefits and harms.

Recommendations related to identity and moral self-understandings in the use of stimulants for neuroenhancement in young people

- Prescribers of stimulant drugs for purposes of enhancement should assess the young person's self-perceptions and moral self-understandings and should track changes in these during the time that the young person is using neuroenhancers. This assessment could employ a widely used standardized measure such as the Harter Self-Perception questionnaire.
- Prescribers of stimulant drugs for purposes of enhancement should use standard diagnostic tools to assess whether the young person does in fact meet clinical criteria for a diagnosis of ADHD, in which case the young person should be managed as a clinical case.

Research recommendations related to identity and self-understandings

- Further research with young people at varying ages is needed to understand the motivations and goals of parents and young people for neuroenhancement for young people.

- Further research with young people is needed to build an evidence base for ethical harms and benefits specific to the enhancement case in relation to identity and moral self-understandings.
- Research undertaken should involve young people themselves, be developmentally informed, and incorporate hypotheses about the influence of demographic factors on outcomes.
- Research is needed to assess the sensitivity to change over time for tools such as the Harter Self-Perception questionnaire and the best methods for administering such surveys in routine practice settings.

Social Factors in Neuroenhancement Among Young People

1. Parents/caregivers and family context

Coercion and community. Parents have received a good deal of social and ethical scrutiny in relation to stimulant drug treatment for young people. Parents can be driven by performance pressures or personal parenting goals to produce highly successful young people, at the expense of the young person's physical or mental health. Oh the other hand, undermotivated, chaotic, or under-resourced parents may be using stimulant drugs as a "child management" tool; as a result, improvement of parenting practices and/or amelioration of conditions within the family context that could be exacerbating young people's problematic behaviors may be neglected. Individual parenting goals can also be shaped or exacerbated by social ideologies; for example, cultural notions of "good mothering" place a burden on mothers in consumer-driven Western societies to access and exploit all available resources to ensure a young person's success (Malacrida 2004). These factors can have a coercive influence and can drive uptake of stimulant drug treatments for young people (Singh 2004). Discussions around the influence of parental values and motivations in the area of cosmetic surgery for young people similarly emphasize the need to recognize and evaluate the extent to which parents' interests are promoted by cosmetic interventions (Opel and Wilfond 2009).

The extent to which parents and young people are vulnerable to social influences in the stimulant drug case varies with demographic and environmental factors. Overall, stimulant drug usage among young people in the United States is unevenly distributed across neighborhoods, school districts, and geographic regions; prescription rates vary by race/ethnicity, religion, gender, and socioeconomic status (Olfson et al. 2003; Angold et al. 2000). These demographic factors probably interact with parent/family factors to produce more harmful or more beneficial outcomes for young people. Studies investigating stimulant use for enhancement purposes among young people suggest that some of the same demographic influences affect outcomes: In the enhancement case, stimulant use is related to environmental factors such as region of the country, competitiveness of the school, and number of students at a school being treated for ADHD (Olfson et al. 2003).

Parenting factors can create a coercive context for young people around performance-enhancing drugs. However, if neuroenhancers come to be considered a valuable resource for young people's learning and success, then it is possible that demographic factors associated with lower stimulant drug use (such as race/ethnicity) could come to be interpreted as restrictive rather than protective.

Distributive justice. If neuroenhancement in young people is to become a common social practice—which is likely—the uneven demographic distribution of stimulant drug use raises distributive justice and access concerns. If they meet the rigorous parameters that will ensure minimum risk and maximum benefit, all young people ought to have equal access to existing resources to improve themselves and their performance, just as there should be equal access to existing resources to address neural and behavioral impairments.

Equal access to performance-enhancing resources will in turn raise an additional concern about the implications of a society in which young people learn that they must continually strive to go beyond their natural capacities, using all available technological means of neuroenhancement. Widespread neuroenhancement may also come to constrain concepts of "the normal" and lead to lower tolerance of cognitive and other notable differences and disabilities. This may lead to psychological and emotional conflicts in young people and parents as they struggle to get ahead in a world in which the upper limits of performance are ever-receding due to psychopharmacological or other neuro-innovations. Young people and/or their parents may come to feel that they need to try one enhancement innovation after another in search of optimized performance.

Recommendations related to parent/caregivers and family context in stimulant use for enhancement in young people

- All young people and families who meet criteria for eligibility ought to have equal access to stimulant drugs to enhance performance.
- Parents' vulnerability to social coercion should be assessed via interview and found to be appropriate before neuroenhancement of the young person is allowed.
- The impact of parent factors on the decision to pursue neuroenhancement for the child should be assessed via interview with parents and the young person and found to be appropriate before neuroenhancement of the young person is allowed.

Research recommendations related to parents/caregivers

- The impact of parenting factors and family context on young people's behavior should continue to be a key dimension of research on child development and should be

integrated with neuroscience studies on child behavior and well-being.
- Further research is needed to identify the demographic contexts in which young people and parents/caregivers are most vulnerable to socially based coercive influences. These influences can unfairly encourage or limit use of stimulants for enhancement purposes. Once identified, programs to educate and protect young people and parents/caregivers within these contexts should be developed.
- Research should investigate the utility of a brief "waiting period" following an educational program, for families seeking neuroenhancers.
- Further research is necessary to ascertain the qualitative impacts on young people of a society in which use of psychotropic agents to enhance abilities is normal.

2. Schools and schooling context

Schools and schooling practices have also been scrutinized in relation to stimulant drug treatment of young people. Schools can assist in protecting young people from ethical harms, and increase the benefits of enhancement for young people, or they can exacerbate the harms. For example, schools are often the site where abuse and diversion of stimulant drugs occur, and some schools monitor this as part of drug abuse prevention programs.

Coercion. There are claims that schools can exert pressure on families to pursue stimulant drug treatment for a child, such that some U.S. states have passed legislation that makes it illegal for schools to accuse parents of educational neglect for refusing stimulant drug treatment for their child. (http://www.cchr.org/press_room/press_releases/Over_500_Parents_Say_Schools_Coerced_Them_to_Administer_Psychiatric_Drugs_to_Children.html; http://www.edwatch.org). While some of these legal moves against schools have been spearheaded by entities with active biases against the use of stimulant drugs, such as the Church of Scientology, the great majority of research evidence indicates that long-term use of stimulants does not improve overall academic achievement (Molina et al. 2009). This suggests that teachers may be using stimulants, because of their known association with improved classroom behavior, as a means of classroom management, rather than as a means of improving an individual child's chances of academic success. Teachers are often the first professionals to suggest to parents that a child would benefit from stimulant treatment (Sax and Kautz 2003). Many teachers receive training on how to recognize symptoms of psychiatric disorders that will benefit from psychotropic drug treatment, but it is not clear that these trainings involve a discussion of ethical issues such as coercion. Indeed, in several U.S. states teachers are now legally prohibited from discussing stimulant treatment with families (http://www.ablechild.org/slegislation.htm).

Overall, it is unclear whether the enhancement case of stimulant use raises unique or new ethical concerns in terms of schools. The concerns outlined earlier about use of stimulants by young people are relevant to both the treatment and the enhancement case. Moreover, in both cases there may be more subtle coercive factors operating to influence teachers' encouragement of stimulant use, such as the school's investment in its performance on national standardized tests, or university entrance statistics, results that have resource and incentive implications.

Recommendations related to schools in the use of stimulants for purposes of neuroenhancement in young people

- Schools should be prevented from coercion of young people or families into adopting stimulants for enhancement purposes. Similarly, schools should monitor medication use for enhancement with the same procedures and policies employed for other medical uses of stimulants.
- Schools should institute formal mechanisms through which teachers can raise concerns about the physical or emotional consequences of enhancement practices in the case of a particular young person.
- Teachers should receive ethical training as part of educational courses on stimulant drug use and other neuroenhancers.
- Teachers' and school administrators' incentives should not be so disproportionate that they motivate these adults to encourage large-scale use of neuroenhancement among young people.
- Teachers and schools should cooperate in efforts to prevent abuse of stimulant drugs by young people.

Research recommendations related to schools

- Further research is necessary to understand how use of stimulants for neuroenhancement impacts short- or long-term academic achievement or individual academic motivation. This research should be designed to take into account variations in demographic factors such as age, gender and race/ethnicity, and baseline cognitive functioning.
- Further research is necessary to understand whether the case of stimulants for neuroenhancement in young people represents a qualitatively different set of ethical concerns beyond safety as compared to the cases of widely used non-drug neuroenhancement practices adopted by parents and schools, such as tutoring, music lessons, and early language education.

3. Pharmaceutical Industry

The pharmaceutical industry presents a major ethical concern because of its history of unethical practices related to marketing and testing of drugs. The industry is potentially a beneficiary of neuroenhancement of young people, as neuroenhancement practices in young people increase the consumer base for psychotropic drugs, as well as increasing

demand for a particular drug because of its "dual-use" (treatment and enhancement) applications.

Ethical concerns within clinical and other research trials. The pharmaceutical industry sponsors the majority of clinical trials for new psychotropic drugs, often in conjunction with university clinics, whose researchers (and sometimes their clinics) receive financial incentives for their participation in trials. This raises a substantial conflict of interest for researchers in terms of the objectivity of their research and their ability to publish problematic findings from the trials. The pharmaceutical company typically owns all the data resulting from clinical trials and has in the past suppressed negative safety data in psychotropic drug trials with young people (Kendall and McGoey 2007). The Food and Drug Administration (FDA) is providing incentives to drug companies to include a pediatric arm in their trials for psychotropic drugs, due to lack of evidence of safety and efficacy of these drugs in the pediatric population (http://www.fda.gov/Cder/pediatric/index.htm). However, there is at present no concurrent encouragement to include ethical analysis around young people's participation in these trials. This creates a lost opportunity to gather valuable research evidence on the ethical dimensions of participation in paediatric psychotropic drug trials and on young people's experiences of these drugs.

There is a general need for more research on psychotropic drug safety and efficacy in young people, because many psychotropic drugs are currently used off-label in young people. Research evidence for efficacy and safety of psychotropic drugs used for purposes of neuroenhancement in young people is also critical. Because of the lack of substantive empirical understanding of the social and ethical risks and benefits of neuroenhancement for young people, trials that evaluate a drug's capacity to enhance functioning in healthy young people should include ethical research and analysis on normative concerns such as informed consent and risk assessment, and on issues such as young people's understanding of neuroenhancement, their motivations for participation in research, and the perceived acceptability and impacts of psychotropic drugs and other means of neuroenhancement.

In addition, because clinical trials for drug efficacy and safety in relation to neuroenhancement would have a significantly different agenda from existing clinical trial protocols (which are aimed at treatment of an existing disorder or disease), there should be systematic ethical oversight of at least the first wave of such trials. Exactly what such oversight would entail needs further discussion, but we think it would include at minimum attention to the following concerns: whether the origin of funding (e.g., from the pharmaceutical industry, or not) affects findings from studies; researchers' motivations for participation in such research; the progress of trials and potential ethical risks to participants at different stages; and communication of study outcomes to the public.

Recommendations related to clinical trials involving psychotropic drugs for purposes of neuroenhancement in young people

- Clinical trials involving psychotropic drugs for purposes of neuroenhancement in young people should whenever possible be conducted without researcher financial conflicts of interest and without pharmaceutical industry control of publications and data.
- Government and private funds should be raised for neuroenhancement research with young people, to ensure the availability of non-industry research comparisons. Lower cost study designs should be considered to ensure non-industry comparisons are possible.
- Ethical research and analysis should be included in clinical and other research trials on psychotropic neuroenhancers in young people.
- Ethical oversight should accompany the first wave of clinical trials on neuroenhancement involving young people.
- Information given to families entering research on psychotropic drug neuroenhancement in young people should be age appropriate and studies should be undertaken to ensure that consent (by parents) and assent (by young people) is fully informed.

Stimulant drug advertising and implicit coercion. Advertising is a primary social means of increasing desire for various kinds of individual enhancement, and stimulant drug advertising is no exception. Direct-to-consumer (DTC) advertising is prohibited in all countries except the United States and New Zealand. However, consumers anywhere can access drug-company sites on the Internet, where information about the drug is frequently conflated with advertising for the drug. Research suggests that the general public has poor skills in "media literacy"—or the capacity to critically assess both the overt and the covert messages in advertisements and other media information (Livingstone et al. 2005). At the same time, advertising of psychotropic drugs direct to consumers in the United States is linked to physicians' prescribing practices: When patients ask for antidepressants by name, having seen the drug advertised, they are more likely to receive a prescription for that drug from their doctor (Kravitz et al. 2005).

Most consumers are not aware of the dialectic between the advertised product promise and their own desires; nor are they aware of the extent to which individual motivations to pursue products for personal enhancement might be socially conditioned, in part through advertising. This lack of critical consumer awareness means that advertising neuroenhancers to the public could operate coercively to manipulate and/or to create desire for neuroenhancement. This is especially true for young people, whose vulnerability to advertising of controlled substances is notable (Saffer 2002).

If psychotropic neuroenhancement for young people becomes a common social practice, then the pharmaceutical industry is likely to initiate advertising campaigns that

target young people as potential consumers of psychotropic enhancers. Such advertisements are likely to "sell" a highly appealing lifestyle and personal identity to young people as part of the effort to sell drugs. For the reasons just articulated , advertisements that appeal directly to young people in this way should be prohibited.[2]

Recommendations related to advertising of stimulant drugs for purposes of neuroenhancement in young people

- In those countries where DTC advertising is legal, advertisements for neuroenhancers that target young people as consumers should be prohibited.
- DTC advertising for neuroenhancement in young people must not be allowed in media to which young people are likely to have regular access (e.g., Internet, television, radio, and young people's magazines).

OVERSIGHT OF YOUNG PEOPLE'S NEUROENHANCEMENT IN PRIMARY CARE

As neuroenhancement in young people becomes an increasingly common practice, it is necessary to consider how best to protect young people from ethical and physical risks of stimulant drugs, and to maximize the benefits. We believe it is imperative to locate a relevant site where young people's use of enhancement technologies can be safely, objectively, and ethically evaluated and managed. In this section, we propose that this site should be the primary care clinic.

Primary care clinicians prescribe the majority of stimulants for ADHD treatment, and as the professionals with greatest access to these controlled substances, it is likely that families interested in neuroenhancement will approach them (Preen 2008; Goldman 1998). Because of strong relationships, primary care clinicians are well situated to assist families and young people consider neuroenhancing agents where appropriate (Hickson 1983; Heneghan 2004). Clinicians are highly trusted by parents and young people, especially for advice on sensitive topics; moreover, primary care clinicians often have long-standing relationships (Freeman and Richards 1990; Baker and Streatfield 1995) with their patients and families that engender trust and insight into family and child dynamics. They may be involved in the care of multiple family members, and because of their embedding in the community (Etz et al. 2008), primary care clinicians are often aware of other resources for the family and the child, as well as of local expectations that may be encouraging neuroenhancement.

At least as importantly, primary care practices are an essential setting for decision making and information necessary for initiation and monitoring of neuroenhancing drugs (Zeiss and Carlin 2008). Child and adolescent prior and current drug treatments, drug allergies, and history of side effects, all necessary pieces of information for decision making around enhancement with stimulants, are often only available in primary care records (Wood 2008). In addition, primary care clinicians can provide less biased opinions since they are independent agents who are unlikely to benefit financially from most neuroenhancing drugs or other neuroenhancing interventions. This is often not the case for other mental health professionals (Bush 2006). In short, primary care clinicians are the cornerstone to effective assessment, initiation, and monitoring of neuroenhancing drugs in young people and adolescents.

Ethical Challenges for Primary Care Oversight of Stimulants for Purposes of Enhancement in Young People

Although primary care clinicians are the logical sites for assisting parents and young people with issues related to neuroenhancement, they are not without bias. First, primary care clinicians are influenced by parent and child demand for drugs even when the evidence for effectiveness of drugs is low or nonexistent. For example, antibiotics are still often prescribed for viral upper respiratory infections even though they are not effective for these conditions, because of parent and patient demand (Butler et al. 1998). Second, primary care clinicians may support parent- or child-requested neuroenhancing drug use in order to retain families in their practices. Volume is a critical issue for primary care reimbursement structures in most places, and the loss of families can be costly to practices (Miller and Miller 1991). Clinicians may fear losing families to other practices if they are not responsive to requests for neuroenhancing drugs. In short, there are several factors that may encourage some primary care clinicians to prescribe neuroenhancing drugs for young people and adolescents in situations where it may not be in the best interests of those patients.

Practical Challenges to Primary Care Oversight of Stimulants for Purposes of Enhancement in Young People

The bigger challenge for primary care management of neuroenhancement will be the implementation of a sound program in primary care settings for initiating such medications, monitoring outcomes and side effects, and tracking

2. If stimulants are found to be generally safe and effective over the long term for young people when used for purposes of enhancement, it is possible that there will one day be over-the-counter (OTC) formulations. Other stimulants, such as coffee and caffeine-containing energy drinks and tablets such as Red Bull and NoDoz, are freely available to young people and widely used by students in high school and in college (http://www.telegram.com/article/20090624/NEWS/906240411/1101). There are no constraints on advertising these products to young people, and if stimulant drugs such as Ritalin were to become OTC products, it is unlikely that advertising campaigns would, or should, be restricted. In the foreseeable future, however, stimulants will not have the necessary efficacy or safety profile to be OTC products, and if their use as neuroenhancers among young people requires medical oversight due to potential side effects and unknown risks, then these drugs should not be advertised to young people as though they are readily available consumer or lifestyle products.

abuses. Several specific obstacles loom large. No readily available assessment tools for measuring which young people would most benefit from neuroenhancement (and how often) are available. In addition, if patients pay cash for these medications, no system-wide records will be available to make sure such medications are not diverted for resale or abuse. Current systems for detecting excessive numbers of prescriptions for diversion rely on insurance and administrative claims records (Wysowski 2007; Pradel 2009). Following young people prescribed neuroenhancing drugs will be challenging as well, since specific outcome measures have not been developed. Side-effect monitoring will also be challenging since intermittent use for neuroenhancement may be very different from routine or daily use when employed for treatment of ADHD. At least as importantly, parents who support neuroenhancement may be reluctant to report side effects from medications they sought for their young people.

Primary care training deficiencies also impose some important barriers to neuroenhancement for young people and adolescents. Primary care clinicians report that they are less comfortable with and more poorly trained in psychiatric issues and psychotropic drugs than most other areas of medicine (Olson 2002). Use in these situations focused on neuroenhancement may present even more uncertainty. Moreover, primary care clinicians are not adequately trained in ethical issues generally. Their training in the specific ethical issues around enhancement is nonexistent. For example, the American Academy of Pediatrics (AAP) Office of Continuing Medical Education reports that it has never offered training on enhancement generally or neuroenhancement specifically (Linda Paul and Kelly Kelleher personal commentary.)

Recommendations related to primary care

- Primary care clinicians, aided by policies and education from their guild/specialty societies, should act as the primary gatekeepers for neuroenhancement among young people.
- Fiscal incentives that encourage drug prescribing to retain patients should be discouraged.

Research recommendations related to primary care

- Screening, assessment, and monitoring tools for short-term enhancement should be developed and validated.
- Primary care capacity to coordinate enhancement should be assessed and quality improvement methods developed to enhance care.
- As other drugs are developed for neuroenhancement among adults, they should be evaluated for young people and adolescents.

OUTLOOK

Despite a widespread intuition that neuroenhancement of young people ought not to be sanctioned, growing use of neuroenhancers among young people is likely inevitable. Models of ethical use of neuroenhancers by adults have been proposed (Greeley et al. 2008), as has an argument for clinical management of neuroenhancers for adults (Synofzik 2009). It is even more important to propose models that will allow oversight and management of safe, ethical use of neuroenhancers among young people. Young people are more vulnerable than adults in their decision making and possibly their susceptibility to long-term effects, and their perspectives on these issues have not been adequately considered. Equally important, there is inadequate research upon which to base specific recommendations. Because drugs are being developed more quickly than long-term studies can be conducted and because long-term developmental outcomes may be decades off, it is imperative that parents, caregivers, clinicians, schools, and pharmaceutical firms operate with the utmost caution and careful monitoring in the case of pediatric neuroenhancement. In order to bring neuroenhancement of young people into primary care, the American Academy of Pediatrics (AAP) and the American Academy of Family Practice (AAFP) must develop position statements and policies on primary care use of neuroenhancement drugs for children and adolescents. This will require careful attention to the individual and ethical harms and benefits to neuroenhancement in young people outlined in this article, as well as support for and coordination of research and monitoring programmes.

The use of stimulant drugs to enhance young people's cognitive and behavioral functioning raises significant concerns among many observers; it is our hope that the research, policy, and practice recommendations outlined here realistically contribute to minimizing the risks and maximizing the benefits of neuroenhancement in young people. ■

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