Persistent Cough in an Adolescent*

CASE

Jessica, a 14-year-old girl with a history of asthma, went to her pediatrician’s office because of a persistent cough. She had been coughing for at least 3 months with occasional cough-free periods of less than a few days. The cough was nonproductive and was not accompanied by fever, rhinorrhea, or facial or chest pain. Jessica and her mother observed that the cough increased with exercise and typically was not present during sleep. She has used two metered-dose inhalers—albuterol and cromolyn—without any change in the cough pattern.

For the past 5 years, Jessica has had mild asthma responsive to albuterol. She enjoys running on the cross-country team, soccer, and dancing. She is an average student and denies any change in academic performance. She has never been hospitalized or had an emergency department visit for asthma or pneumonia. There has been no recent travel or exposure to a person with a chronic productive cough, tobacco smoke, or a live-in pet. Jessica lives with her mother and younger sister in a 10-year-old, carpeted apartment without any evidence of mold or recent renovation.

In the process of taking the history, the pediatrician noticed that Jessica coughed intermittently, with two or three coughs during each episode. At times, the cough was harsh; at other times, it was a quiet cough, as if she were clearing her throat. She was cooperative, without overt anxiety or respiratory distress. After a complete physical examination with normal findings, the pediatrician interviewed Jessica and her mother alone.

Jessica’s parents had been divorced for the past 6 years. She lived with her mother but visited her father, and his new family with two young children, every weekend. She spoke about this arrangement comfortably and said that she loved her father and her mother alone.

Jessica’s parents have been divorced 6 years. During weekend visits to her father’s new family, she experiences a feeling of discomfort in response to “tension. . . and arguing when the kids are around.”

Although the information about Jessica in the case scenario is sparse, it is a reasonable amount of data to obtain from an initial visit to a pediatrician. Subsequent office visits focused on discovering the cause for the chronic cough while simultaneously trying other therapeutic interventions. It was only after the failure of those treatments and the reassessment of the psychosocial history that her pediatrician considered a conversion reaction.

Dr. Gordon Harper, an Associate Professor of Psychiatry at Harvard Medical School, begins the discussion. Dr. Harper completed residencies in both pediatrics and psychiatry, as well as training in psychoanalysis. He has been an active medical educator for more than two decades, past director of inpatient psychiatry at Boston Children’s Hospital, and is currently medical director of Child and Adolescent Services, Massachusetts Department of Mental Health. Dr. Jane Chen recently completed her pediatric res-


PEDIATRICS (ISSN 0031 4005). Copyright © 2001 by the American Academy of Pediatrics and Lippincott Williams & Wilkins.
The possibility, will strike patient (and parent) as mean-
feelings”), in advance of the patient’s (or parent’s) attribution (“I think you’re having trouble with your theory is ultimately “right,” the pediatrician must 
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not lead with it. Offering the patient a psychological 
attribution (“I think you’re having trouble with your feelings”), in advance of the patient’s (or parent’s) indicating that she is actively entertaining such a possibility, will strike patient (and parent) as mean-

REFERENCES

clinicians are increasingly entertaining the possibility of 
and OCD in children formerly thought to have 
ly “functional” disorders, those conditions 
whose biological mediation we have not yet under-
stood.

Unconscious psychological processes (i.e., patho-
genic processes in which unrecognized meanings of 
events or feelings play a part) have, since the time of 
Freud, been implicated in the origin of conversion 
symptoms. “Conversion” expresses the idea that 
psychological conflicts are “converted” into somatic 
symptoms. Conversion is the only category in the 
DSM-IV, otherwise rigorously nonontological, in 
which a causal mechanism is specified.3 Jessica shows one of the classic features of conversion, la 
be indifferent: she does not seem to be troubled by 
her symptom. Such apparent indifference suggests 
that the symptom has “solved” an intrapsychic 
conflict that would otherwise be causing distress. Clar-
ification of such conflict is sometimes associated with 
dramatic relief of the symptom. But even if such a 
theory is ultimately “right,” the pediatrician must 
not lead with it. Offering the patient a psychological 
attribution (“I think you’re having trouble with your feelings”), in advance of the patient’s (or parent’s) indicating that she is actively entertaining such a possibility, will strike patient (and parent) as mean-

To explore conscious psychological processes, the 
pediatrician will ask what the symptom means to 
Jessica. What does she think is going on (explanatory 
model)?2 Does she think she has an infection? Some-
thing difficult to talk about, like a sexually transmitted disease? Has she known or heard of anyone with 
such a cough (looking for possible identification, not 
for infectious source)? Has she noticed anything 
about the variability of the cough? The case protocol 
lets the pediatrician hear the patient’s concerns in 
expressing Jessica’s voice: she does not like tension 
or adults arguing. The pediatrician can ask, Who 
argues? Who is tense? Do they know it bothers her? 
How does Jessica feel about asserting her wish for 
less fighting?

In picking up Jessica’s own complaints, we move 
to the social dimension. Although much of the liter-
ature on conversion focuses on intrapsychic pro-
cesses, all physicians who have dealt with epidemic 
hysteria (mass sociogenic illness) know that social 
context shapes these symptoms and often offers the 
arena in which interventions, including behavioral 
therapies, effect relief.6,7 Jessica has come to the pe-
diatrician’s office with her mother; her father and 
stepmother are also mentioned. They should be in-
terviewed. What about context? Does the cough vary 
with place (school, home, mother’s or father’s place) 
or situation (open conflict, smothered conflict)?

Keeping possible factors at all of these levels in 
mind, the pediatrician can develop a management 
plan that explores one or several of these. Hospital-
ization is indicated only for the most afflicted who 
fail to respond to other treatment.8,9 With whichever 
interventions one begins, the plan should have a time 
line, including a date fixed in advance at which, if no 
change has occurred, all parties agree that a referral to a child psychiatrist will be made.

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Psychogenic cough is often described as a barking or honking cough that is persistent, interferes with normal activities, and is without an organic etiology. It is described most commonly in children and adolescents. The cough may remit during sleep or during pleasurable activities. Children initially may have a preceding respiratory infection with a cough which then persists. Treatment generally is more favorable in pediatric than in adult populations. Behavior modification and either resolution or management of psychological stressors is the focus of treatment.

The pattern of a psychogenic cough in children and adolescents often has features consistent with a conversion disorder. The DSM-IV describes the essential features of conversion disorder as symptoms affecting voluntary motor or sensory function that suggest a general medical condition with associated psychological factors. These stressors are often elicited on the basis of observations that the initiation or exacerbation of the symptom is preceded by psychological conflicts. Symptoms are distressful to the individual with some impairment in functioning; they are not intentionally produced or feigned as in malingering. Other medical and psychiatric conditions are excluded.

The term conversion derived from the hypothesis that the individual’s somatic symptom represents a symbolic resolution of an unconscious psychological conflict, reducing anxiety and serving to keep the conflict out of conscious awareness. Symptoms of a conversion disorder are variable and may include persistent cough, paroxysmal sneezing, sighing dyspnea, hoarseness, paralysis, aphony, difficulty swallowing, urinary retention, loss of touch or pain sensation, visual complaints, deafness, hallucinations, or seizures. The diagnosis should be made only after an appropriate medical investigation.

Psychosocial factors may be associated with the onset or exacerbation of symptoms. Patients may show “la belle indifférence” or a relative lack of concern about the symptoms, whereas in some teenagers, symptoms may be described with elaborate and exaggerated detail. A personality disorder may be associated with a conversion disorder, especially the histrionic or the passive-dependent types. Patients with conversion disorder are often suggestible, and symptoms may be modified on external cues that may be used in treatment.

Conversion disorder is more common in rural populations, in those having a lower socioeconomic status, and in individuals less knowledgeable about medical and psychological concepts. Conversion symptoms in children tend to be limited to gait problems or seizures. It is diagnosed more commonly in women, and the prevalence is reported to be 11 to 300 per 100,000 people in the adult populations. The prevalence in childhood is unknown, and in children, there may not be an overrepresentation of females.

The typical onset is in late childhood to early adulthood and generally with a sudden presentation. Generally, there is a better prognosis for children than for adults and in presentations of more recent onset, although in all groups, recurrences are common. Because these patients are very suggestible, it is important that there is a unified approach of the medical team. Patients should be told that there is treatment, and that through behavior therapy they can exert voluntary control over their symptoms. They should be offered psychosocial evaluation in a nontreating manner to facilitate acceptance of the diagnosis, such as being told that the illness is not “all in their head” and that these symptoms often occur on a subconscious level. Evidence-based studies do not support a specific behavioral therapy. Occasionally, asking the patient to repeat to themselves on a daily basis that they will not have any spells or symptoms may improve the condition. Specific treatments for psychogenic cough reported in the literature include teaching the patient to mouth-breathe (others suggest preventing mouth-breathing) and wrapping bed sheets tightly around the chest. Bronchoscopy, when associated with the patient’s misunderstanding that the procedure was performed for therapeutic reasons, has also been reported to resolve chronic cough.

In a recent review of children with pseudo-seizures who received a diagnosis of conversion disorder, secondary psychiatric diagnoses were common, as well as severe psychosocial stressors. Thirty-two percent had a history of sexual abuse, which should be further addressed in the evaluation of a child or adolescent with a conversion disorder. Other medical conditions may precede or coexist with the presenting symptom, such as in Jessica, who had a history of reactive airway disease.

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Web Site Discussion

Two participants in the cyberspace discussion of the case on the Developmental and Behavioral Pediatrics web site* provided thoughtful commentaries that complement those of Drs. Harper and Chen:

Dr. Daniel P. Kohen, a behavioral and developmental pediatrician from the University of Minnesota, wrote:

This is a very interesting and not terribly unusual situation. I have seen many young adolescents with this kind of history, some with a known history of asthma as an antecedent, and others with a history of pneumonia or bronchitis which was treated successfully but in which the cough lingered, as in Jessica’s situation. The pattern of the cough then changes in character somewhat, particularly when careful observation elicits the description we hear from the pediatrician at the end of the case, i.e., “that Jessica coughed intermittently with two or three coughs during each episode. At times, the cough was harsh; at other times, it was a quiet cough, as if she were clearing her throat.” Jessica’s case seems to be quite consistent with a diagnosis of so-called “habit cough,” “psychogenic habit cough,” or “cough tic.” While I don’t know that the precise pathophysiology has been worked out, it has been clear that these cases have all been responsive to self-regulation training, i.e., training the patient in relaxation and mental imagery/self-hypnosis, with or without the use of biofeedback. (see Gay M, Blager F, Bartsch K, Emery CF, Rosenstiel-Gross AK, Spears J: Psychogenic habit cough: Review and case reports. J Clin Psychiatry 48:483–486, 1987; Olness K, Kohen DP. Hypnosis and Hypnotherapy with Children, 3rd ed. New York, NY, Guilford Press, 1996, pp 154–155; and Laurence Sugarman, M.D., “Imaginative Medicine”—a videotape that demonstrates self-regulation techniques in primary care office practice for a variety of common conditions, including habit cough. For information about this videotape, contact Laurence I. Sugarman, M.D., General & Behavioral Pediatrics, 2223 Clinton Avenue South, Rochester, NY 14618-2632, tel: 716-271-0860, fax: 716-271-1383.) Jessica’s life is certainly a “set-up” for conversion disorder. However, the fact that she has initiated talking about socioemotional stressors (“I don’t like adults [at my father’s home]arguing when kids are around.”) would argue against a conversion disorder, since there is at least in part a conscious expression of difficult feelings, whereas in conversion disorder, physical symptoms develop precisely because the difficult feelings are not easily accessible or amenable to conscious expression, and the patient therefore develops a physical symptom. While this diagnosis is a judgment call and ought to be considered, I would argue more strongly for a diagnosis of “habit cough” and formal training in self-management as noted above. Unlike a diagnosis of conversion disorder, which often by its very nature suggests the need for long-term psychotherapy, most patients with a habit cough experience relief of their symptoms rather quickly in response to varying types of self-regulation therapy. These approaches make use of the clinician’s understanding of pulmonary physiology; in particular, consideration of the distinction between cough-variant asthma which is often worse at night and patients with a psychogenic habit cough, most of whom, like Jessica, sleep through the night without coughing. Self-regulation and suggestion interventions emphasize development of mind-body techniques to focus on development of a sense of mastery over and disappearance of the symptom.

In addition to a behavioral approach to her habit cough, Jessica deserves an opportunity to explore her ambivalent and apparently unresolved feelings regarding the current visitation arrangements, the tension she describes between adults in her life (dad and stepmom), and her role in each family. She might also benefit from a personal insight into her thoughts and feelings about the divorce, as they evolved over the past 6 years.

I agree with the observations of other participants in this discussion that Jessica’s cough could be a tic, a sign of a tic disorder. Though this would not be my first choice, it would be prudent to obtain a complete family history for evidence of tic or Tourette syndrome in family members, as well as evidence of any other tic behaviors that Jessica may have experienced previously.

Robert D. Wells, Ph.D., a clinical child and adolescent psychologist at the Valley Children’s Hospital in Fresno, California, commented:

When I am considering a conversion disorder diagnosis, I have found it helpful to use the following IM HELPFUL criteria:

Idiopathic: This may be true with Jessica as no cause is yet discovered.

Model of symptom: Jessica could be her own model due to her asthma.

Historic: The history does not reveal whether she has histrionic features.

Emphasized family relationships: The history does not reveal this process.

Life event: Jessica may have recent stressors from postdivorce conflict.

Primary gain: It is unclear how this symptom is alleviating an unconscious conflict.

La belle indifference: Is she concerned about her symptom?

Exaggerated need for attention and affection: It is not clear from the history, but it is a possible contributing factor.

Secondary gain: Is the symptom helping her gain reinforcement?

Somatically focused family: Excessive and persistent attention to physical and mental symptoms is not mentioned in the history.

Dr. Martin T. Stein

Adolescence is a vulnerable time for the development of a psychosomatic condition. It is a predictable moment in development when excessive attention to body sensations occurs with rapid physical and emotional changes. Approximately 20% of adolescents worry about their health “all the time,” whereas only 15% “never give their health a thought.” Prazar provides definitions and examples of five psychosomatic disorders in adolescents (Table 1). Although some of the specific categories of conditions are different from those proposed by the discussants (as well as variations of the categories found in the DSM-IV), I have found this framework to be useful in understanding patients with physical symptoms that cannot be explained by biomedical findings and that are associated with psychosocial factors (Table 1).

The discussants considered the possibility of a tic disorder as an explanation for Jessica’s persistent cough. A transient tic disorder (lasting longer than 4 weeks and less then 1 year) is consistent with Jessica’s history of a 3-month duration. Tourette syndrome (TS) is a consideration only if we hypothesize that this case may be the first stage of the disorder. TS is defined as severe multiple motor tics of at least 1 year’s duration with less than a 3-month remission. Vocal tics are associated with motor tics in children and adolescents with TS, but not necessarily contemporaneously. A knowledge that tics, in some cases, are a genetic disorder should encourage the pursuit of a complete family history. The gene for TS seems to be autosomal dominant with a high variability for...
TABLE 1. Categories of Psychosomatic Disorders

<table>
<thead>
<tr>
<th>Disorder</th>
<th>Definition</th>
<th>Examples</th>
</tr>
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<tbody>
<tr>
<td>Conversion reactions</td>
<td>Presence of a physical symptom that unconsciously communicates unpleasant emotions; the patient displays little or no anxiety associated with the symptoms; physical findings are inconsistent with physiological concepts</td>
<td>Some cases of limb paralysis and blindness, recurrent headache, recurrent abdominal pain</td>
</tr>
<tr>
<td>Psychophysiological symptoms</td>
<td>Presence of a physical symptom that is precipitated by activation of biological systems (autonomic nervous system and/or neuroendocrine system); the symptom is organic in origin and is associated with unpleasant feelings with which the patient can easily identify; physical findings are consistent with organic illness</td>
<td>Some cases of diarrhea and palpitations; exacerbation of inflammatory bowel disease, asthma, and peptic ulcer disease</td>
</tr>
<tr>
<td>Hypochondriasis</td>
<td>Presence of a physical symptom that is associated with extreme concern by the patient; the patient is preoccupied with physical disease; physical findings do not substantiate organic illness</td>
<td>Some cases of recurrent headaches, recurrent abdominal pain, diffuse pain</td>
</tr>
<tr>
<td>Malingering</td>
<td>Display of a physical symptom that the patient creates consciously to avoid unpleasant situations, physical findings often corroborate factitious illness</td>
<td>Some cases of skin infections, recurrent headache, and recurrent abdominal pain; self-administration of excess medication</td>
</tr>
<tr>
<td>Somatic delusions</td>
<td>A symptom of psychosis; other signs of thought disorder are present; physical symptoms are bizarre and not substantiated by physical findings</td>
<td>Patients complaining of their heart shriveling up, or patients complaining of something wrong the blood flowing through their body</td>
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expression.

The mild and transient forms of tics seen in many relatives suggest the existence of both protective and risk factors. As pointed out by Dr. Harper, ongoing research into the immune-regulated association between Group A β-hemolytic streptococcal infection and movement disorders suggests a potential infectious etiology for tic disorders (and obsessive-compulsive disorder) among children and adolescents. Although I have never observed a tic in any of the pandas at the San Diego Zoo, this condition has taken on the name pediatric autoimmune neuropsychiatric disorders associated with streptococcal infections (PANDAS). At present, preliminary studies on the use of prophylactic antibiotics in children with tic disorders has not been proven to be beneficial in the alleviation of symptoms.

History repeats itself, even when we consider the tremendous advances in twentieth-century medicine. In 1895, Sigmund Freud wrote about a variety of physical symptoms (especially motor symptoms and often with an onset in adolescence) that he classified as “hysterical phenomena,” a precursor to the origin of conversion symptoms. Freud wrote that “we found, at first to our greatest surprise, that the individual hysterical symptoms immediately disappeared without returning if we succeeded in thoroughly awakening the memories of the causal process with its accompanying affect, and if the patient circumstantially discussed the process in the most detailed manner and gave verbal expression to the affect.”

Dr. Kohen’s recommendation to use to mental imagery and teach patients self-hypnosis, while not directly focusing on “awakening the memories,” taps into unconscious psychological processes mentioned by Dr. Harper, in which “unrecognized meanings of events or feelings play a part” in the origin of conversion symptoms. Counseling in contemporary pediatric practice is consistent with Freud’s suggestion that “the patient . . . gave verbal expression to the affect.” The progress made in the past century since Freud’s observations is reflected in the expanded paradigm available to clinicians when faced with a persistent and unexplained symptom—a consideration of factors that may be neurophysiological (e.g., PANDAS), psychological (either unconscious or experiential), and social.

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Authority of the Brain

In our postmodern society, the brain has become the ultimate scientific authority. Over the past decade, neuroscientists have learned an enormous amount about the growth and functioning of the brain. Most of this research, however, has been done on animals: rats, cats, and primates. New knowledge has been obtained in three main areas: synaptogenesis, critical periods, and the effects of enriched environments. These advances reflect new technologies that make it possible to obtain accurate counts of brain cells, to measure brain activity, and to identify those areas of the brain responsible for many mental functions. Much of this information has now been popularized in the media and has created a whole new enterprise zone of infant stimulation products.

Before reviewing and evaluating some of these products, it might be helpful to briefly summarize some of our new knowledge about brain growth and activity. First, when discussing synaptogenesis, it is important to note that at birth the infant has far fewer synapses than does the adult. During the first few years of life, however, synapses proliferate exponentially with the result that the brain of infants and young children is host to vastly more synapses than is the adult brain. This early explosion of synapses is followed by a period of synaptic pruning that is largely regulated by experience. As a result of this selective thinning, the adult brain has fewer synaptic connections than does that of the child. It is, however, the pattern of connections rather than their number which makes the adult brain so much more capable than the brain of the infant. With respect to critical periods, there are age windows during which certain types of stimuli seem to be essential for normal brain development. The age at which these windows open varies with different functions and abilities. To illustrate this point, consider that the critical period for the attainment of some visual skills, such as tracking and shape discrimination, occurs during the first year of life. On the other hand, the window for higher-level functions, such as planning and foresight, does not seem to open until adolescence. Finally, animal studies suggest that an environment rich in sensory stimulation and full of opportunities for motor activity is more conducive to brain growth than is an environment which lacks these possibilities.

Although these findings are suggestive, neuroscientists are cautious about extrapolating from these animal studies to human brains and human behavior. Several responsible, balanced books for the lay public such as Magic Trees of the Mind, Teaching With the Brain in Mind, and The Growth of the Mind detail these precautions. Unfortunately, others writing for parents have not shown similar restraint, particularly those advocating or selling infant stimulation practices or products. Popular magazine articles such as Fertile Minds and How To Build a Baby’s Brain, Internet articles such as Building a Better Baby Brain, national television programs such as Building Brains: The Sooner the Better and Your Child’s Brain, and computer programs such as Baby Wow, Jumpstart Baby, and Future Bright offer interpretations that go far beyond what the data warrant.

There is some good news and some bad news associated with this heightened, brain-driven interest in infant learning and development. Many of the suggestions for infant stimulation, supposedly stemming from brain studies, were in fact arrived at on the basis of clinical experience and developmental research. For example, in a recent monograph titled Rethinking the Brain, the author argues that the following are “key findings” of recent brain research:

- Human development hinges on the interplay between nature and nurture.
- Early care and nurture have a decisive and long-lasting impact on how people develop, their ability to learn, and their capacity to regulate their emotions.
- The human brain has remarkable capacity to change, but timing is crucial.
- There are times when negative experiences or the absence of appropriate stimulation are more likely to have serious and sustained effects.
- Evidence amassed over the last decade points to the wisdom and efficacy of prevention and early intervention.

These ideas are neither new nor grounded in neuroscience. Presenting such well-entrenched developmental principles as those originating from brain studies presumably lends them more authority and makes them more persuasive. Although misleading, invoking the authority of the brain to support healthy childrearing is excusable. If it encourages parents and infant caregivers to use more developmentally appropriate childrearing practices, then no serious damage has been done, and some benefits may well accrue.

There is, however, also some bad news from this new appeal to the authority of the brain. Although Shore, like Diamond and Hopson, Jensen, and Greenspan, calls upon the authority of the brain in support of well-established practices, writers for the popular press are not bound by similar scruples. In the Time article, Nash has no hesitation in offering parents advice on the basis of our new knowledge of how rapidly the brain grows during the early years: “Loving care provides the baby’s brain with the right kind of stimulation. Neglecting a baby can produce brain wave patterns that dampen happy feelings.
Abuse can produce heightened anxiety and stress responses."

After describing how the brain progressively refines the circuits for reaching, grabbing, crawling, walking, and running, the author suggests that parents do the following:

Give babies as much freedom to explore as safety permits. Just reaching for an object helps the brain develop hand-eye coordination. As soon as children are ready for them, activities like drawing and playing the violin and piano encourage the development of fine motor skills.

How are parents to interpret these recommendations? What constitutes neglect and abuse? If you do not respond every time a baby cries, is that neglect? Are you abusing a child and causing bad brain wave patterns if you restrain the infant from engaging in a potentially dangerous activity? Likewise, how is a parent to know when a youngster is ready for drawing and playing the violin and the piano? If parents do not give their child these lessons, are they harming the brain of their offspring? Recommendations such as these are clearly irresponsible. They are too general to be helpful and yet specific enough (violin and piano lessons) to create parental anxieties. Unfortunately, this is but one example of many articles in the print media which attempt to translate brain research into childbearing practices. The results are often more confusing and stress-provoking than they are helpful.

Perhaps the most controversial derivative of the authority of brain research is the proliferation of computer programs for infants. Indeed, the fastest-growing field of software development is so-called "lapware" for infants aged 6 months to 2 years. The term "lapware" comes from the consideration that to sit the baby on their laps. If lapware were simply "lapware" for infants aged 6 months to 2 years. The growing field of software development is so-called "lapware." After describing how the brain progressively refines the circuits for reaching, grabbing, crawling, walking, and running, the author suggests that parents do the following:

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Other programs such as Jumpstart Baby and Future Bright suggest that these programs help children make discriminations, track patterns, and increase their attention spans. None of these claims have been demonstrated experimentally.

Neuroscientists are much more restrained in their interpretations of brain research. For example, Susan Fitzpatrick, a neuroscientist at the McDonnell foundation, had this to say about the rash of extrapolations from brain research to education: "Anything that people would say right now has a good chance of not being true two years from now because the understanding is so rudimentary and people are looking at things in such a simplistic way." Likewise Greenough, one of the leading researchers demonstrating the effects of enriched environments on animal brains, cautions that there is no reason to believe that there are critical periods for socially transmitted skills such as reading, mathematics, and music and that these skills can be acquired at any age. Other researchers also indicate that the emphasis on the infant brain ignores the important findings to the effect that the mature brain has the ability to change and reorganize.

My own sense, after reviewing this material, is that we should move slowly and carefully when introducing infant stimulation on the basis of the authority of the brain. Before we make that enormous leap, we need to build some bridges between the electromagnetic events of the brain and the life-sized happenings of human thought and behavior.

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Pediatrics 2001;107;959

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