Preventing Errors in Clinical Practice: A Call for Self-Awareness

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ABSTRACT

While ascribing medical errors primarily to systems factors can free clinicians from individual blame, there are elements of medical errors that can and should be attributed to individual factors. These factors are related less commonly to lack of knowledge and skill than to the inability to apply the clinician’s abilities to situations under certain circumstances. In concert with efforts to improve health care systems, refining physicians’ emotional and cognitive capacities might also prevent many errors. In general, physicians have the sensation of making a mistake because of the interference of emotional elements. We propose a so-called rational-emotive model that emphasizes 2 factors in error causation: (1) difficulty in reframing the first hypothesis that goes to the physician’s mind in an automatic way, and (2) premature closure of the clinical act to avoid confronting inconsistencies, low-level decision rules, and emotions. We propose a teaching strategy based on developing the physician’s insight and self-awareness to detect the inappropriate use of low-level decision rules, as well as detecting the factors that limit a physician’s capacity to tolerate the tension of uncertainty and ambiguity. Emotional self-awareness and self-regulation of attention can be consciously cultivated as habits to help physicians function better in clinical situations.


INTRODUCTION

The discussion of clinical errors has shifted from being an almost taboo matter to being a major focus of decision theory, epidemiology, health services research, and quality assurance policy. A systemic perspective on clinical errors proposes that behind each error there is often a chain of circumstances involving multiple actors within the organization as a whole. The current tendency is to displace individual guilt to a more institutional perspective. The positive consequence is that physicians can examine their own errors without activating feelings of blame, which usually paralyze the individual’s and the team’s capacity to correct the error and prevent future ones. This systemic perspective, however, should not reduce the degree to which physicians should be held accountable to be vigilant and engage in self-monitoring. Some evidence indicates that errors often result not from a lack of knowledge but from the mindless application of unexamined habits and the interference of unexamined emotions.

METHODS

Case 1. A 47-year-old man with abdominal pain and decreased urination was seen in the emergency department of a well-respected hospital. The board-certified and experienced physician taking a cursory history assumed that the decreased urinary flow was due to dehydration, even though he was aware that the patient had recently had bladder surgery for localized carcinoma and just had a Foley catheter removed. The patient was signed
out to another physician at the end of the shift. When intravenous hydration did not result in improvement, the new physician increased the rate of the intravenous infusion. Only the next day, when seen by another resident, did the situation seem obvious: a new catheter was inserted with relief of the pain and a yield of 1.5 L of urine. By then, the patient had developed a fever, and the urine appeared to be infected.

Whereas it is clear that some errors may have been made in the hand-offs of care, lack of individual vigilance and inability to think about the concrete situation in a new way contributed to poor care. To a certain degree, each physician’s competence in this situation depended on the ability to avoid routine and to tune clinical abilities to deal with the situation. We use the terms tune or calibrate in the same way one might use them when referring to tuning a musical instrument or calibrating a glucometer.11 Self-awareness is the process whereby the physician self-calibrates to produce the desired effect: an effective communication process, or an accurate physical examination.11,12 The cognitive and emotional processes that physicians use to increase self-awareness in the moment during everyday medical practice, however, have not been described in depth until recently.

We present this article as a preliminary step to answer the question of whether training in self-awareness can prevent clinical errors.13 To that end, we explore a rational-emotive model of clinical error prevention, building on our own clinical, teaching, and research experience,12,14-16 and develop some educational strategies that can help to prevent clinical errors by increasing access to the thoughts and feelings that guide clinical actions. We hope to build on the literature that describes the cognitive structure of medical knowledge17-19 to bring attention to the influence of emotions and self-calibration in daily practice. Briefly, the model involves strategies for recognizing situations that increase the risk of errors (which often involve denial, fatigue, or distraction), attending to previously unexamined decision rules that are being applied to the situation, seeking opportunities for engaging in reframing to revise an understanding of the clinical situation, and promoting a habit of self-questioning during clinical work.

The Rational-Emotive Model

Physicians tend to reason tacitly to the extent of consciously perceiving only the tip of the iceberg of their own thinking processes. Beneath the surface there are quasi-automatic mental operations that are often useful mental shortcuts; however, sometimes these same shortcuts can play tricks on reasoning skills. In the case above, decreased urination is often associated with dehydration, but clearly it is not the only explanation. Failure to examine the reasoning process led to perpetuation of an error.

Figure 1 represents the rational-emotive model of the clinical act. This model takes into account the division of the encounter into 2 phases: the exploratory phase and the resolution phase.20 In the exploratory phase, the physician experiences the need to know how to resolve the patient’s problem as quickly as possible to reduce the psychological tension the physician experiences. Observe how the model works based on the following example:

**Case 2.** A physician evaluates a child with high fever, headache, and confusion at 4:00 AM after an exhausting shift. The physician activates the decision rules: “Headache and fever with confusion, rule out nuchal rigidity.” While looking for the Kernig sign, however, an image of what will happen if this sign were to be positive is projected, which, in turn, would mean performing a lumbar puncture. At this point, the physician automatically and unconsciously lowers the sensitivity of the Kernig sign; if the sign is not clearly positive, the physician will consider it nega-
The challenge situation is perceived as the confluence of (1) the demand encountered by the physician (in this case, a child with fever, headache, and confusion); and (2) the environment in which this demand is made (a fatigued physician at 4:00 AM in the emergency department). The physician then creates a frame for the situation, ie, an understanding of what he or she must do during the visit. In our case, this frame could well be as follows: "This patient has headache and fever with confusion, so I have to make sure the patient does not have a serious infection." This frame is automatically associated to an early hypothesis: viral infection, meningitis, pneumonia, etc. The exploratory phase includes maneuvers of observation, listening, questioning, and physical examination to support or refute the early hypothesis. The resolution phase includes arriving at an understanding of the diagnosis and therapeutic plan and then closure.

When the data obtained by the physician do not confirm the early hypotheses, or new data require adding to or modifying these early hypotheses, the physician engages in type 1 reframing to arrive at a more accurate understanding of the situation. In this example, type 1 reframing would have occurred had the physician found a high fever with cognitive impairment not explained by a viral infection. Type 2 reframing occurs when it is necessary not only to adjust the hypotheses but to rethink the whole clinical situation. This situation can occur at the initiative of the patient ("I think you're wrong, Doctor, I'm not depressed") or as the result of new data (eg, the unexpected finding of lymphadenopathy and splenomegaly during a routine physical examination). Type 2 reframing requires more effort than type 1 reframing, because it disrupts the time allotment and fatigue management that the physician had planned.

The case above gives us also the opportunity to analyze the role of somatic markers and emotional satisfaction as regulators of decision making. Our argument is based on the notion that physicians do not act as rationally as they believe they do, and that emotional satisfaction often comes into play.21 Before making a decision, for example, at some level physicians weigh the satisfaction that each option is likely to produce by imagining the result of an action before doing it. This exercise leads physicians to weigh different options based on the projected image, which might be at odds with a rational analysis of the outcome.22 Damasio’s somatic marker hypothesis23,24 goes one step further: Before making a decision, physicians evoke images and emotions for each of the options in play—they project themselves into the imagined situation and feel as if they were there. In subsequent similar situations, that as-if feeling, which Damasio calls a somatic marker, comes forward automatically, without the effort of imagining, facilitating decision making.

Cognitive Activation and Errors

In Figure 2 we explain the concept of critical tension. When physicians are facing the challenge to make a diagnosis to solve a patient’s problem, they experience a degree of emotional tension. This tension is more extreme when the situation is atypical or ambiguous, or when the patient is perceived as demanding. In addition, all physicians have good and bad days. An important hypothesis of our model is that the days are good partially by virtue of the physician’s ability to tolerate the emotional tension of not knowing. A bad day precipitates the premature closing of the encounter or other strategies to decrease the emotional discomfort. Table 1 lists factors that interfere with professional performance partially as a result of lower tolerance of critical tension.

Case 3. Dr. X is tired at the end of his work shift. He attends a 64-year-old patient complaining of chest pain. Diagnosing musculoskeletal chest pain, he prescribes an analgesic. Shortly thereafter a colleague asks his opinion about another patient the colleague is “not sure about.” Dr. X. overcomes his fatigue and carries out a complete interview, physical examination, and electrocardiogram in the presence of his colleague.

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**Figure 2. Clinical tension.**

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Trigger resolution consists of saying to oneself: “Stop asking or exploring the patient, I know the diagnosis or what to do.” Sometimes the physician needs more time to achieve a diagnosis, but the tension of not knowing what to do is so important that the physician achieves critical tension, and the resolution trigger is activated. At this point the physician can accept as a good diagnosis an early hypothesis that does not fit well with the case.
and a junior trainee. Once home, Dr. X asks himself whether the first patient did not also deserve these same tests and why he treated the 2 cases differently.

This case illustrates the concept of the level of cognitive activation. This activation level can depend upon attitude. Fatigue, perceptions of urgency or danger to the patient, or even physicians' perceptions that they might lose professional prestige, among other factors, can raise levels of cognitive activation.23 In this example, in the solitude of the first visit, the physician could permit himself to be minimally activated and allow himself to be beaten by fatigue. In the second visit, during which the physician had to demonstrate his skill in front of his colleague and was forewarned by the inner dialog (“I’m not sure about this patient”), the physician's activation level increased. If the physician were able to learn from this situation, he could conclude, “When I’m tired, I might imagine that I am presenting a case to a respected colleague to avoid a premature closure.”

Unlike a computer, a human being self-regulates the amount and type of attention paid to the environment and manages the energy this effort requires.26 The preceding examples show a lack of regulation on the part of both physicians. A human being can function in a spectrum that ranges from very low arousal, almost bordering somnolence, to a state of hyperexcitation, with associated feelings ranging from pleasure to frank discomfort. Apter’s reversal theory27 describes how a change in the intensity of a stimulus can change the quality of an emotion, going from a state of enjoyment to a state of displeasure, or from cooperative emotions to emotions of competition. For example, a patient asking the same question 2 or more times can change a physician’s reaction from interest to irritation.

Apter's theory also predicts that physicians have an ideal cognitive activation zone (Figure 3) to open a library of decision rules in which are stored the memories of similar clinical experiences that mark their presentation at a certain moment. He conceptualizes 2 axes: arousal and pleasure. Along the axis of arousal, for instance, the physician can be affected by physical fatigue, boredom, or anxiety. Along the axis of pleasure, for example, if the physician is flooded by emotions of irritation or hostility, the physician will be tempted to shorten the encounter. To close the clinical encounter, however, the physician always needs a cognitive alibi, such as, “this patient exaggerates his or her symptoms,” or “he or she has the same thing I diagnosed last week.”

### Table 1. Some Restrictive Factors Interfering With Professional Performance

<table>
<thead>
<tr>
<th>Excessive or Lack of Emotional Arousal</th>
<th>Excessive or Lack of Hedonic Tone</th>
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<tbody>
<tr>
<td>Fatigue</td>
<td>Patient hostility (especially when indirectly expressed)</td>
</tr>
<tr>
<td>Poor clinical skills</td>
<td>The professional's feelings of rejection or hostility toward the patient (especially when unrecognized)</td>
</tr>
<tr>
<td>Transient cognitive problems, (for example, sleep disturbances, alcohol consumption, etc)</td>
<td>The clinician has a somatic discomfort</td>
</tr>
<tr>
<td>Lack of motivation</td>
<td>Creating more work if a certain hypothesis is confirmed</td>
</tr>
<tr>
<td>Urgency to finish</td>
<td></td>
</tr>
<tr>
<td>Overwhelming clinical workload, &quot;excessive workload&quot;</td>
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</table>

Figure 3. Apter’s model of emotional reversal theory.

The optimum work zone avoids extreme values in arousal and hedonic (pleasure) tone. Extreme positions make cognitive processes difficult.

Low-Level Decisions Rules as a Strategy to Close the Encounter

**Case 4.** A 52-year-old woman complaining of colicky lower abdominal hypogastric pain who reports a history of nephrolithiasis. The physical examination showed no tenderness anywhere but in the hypogastrium. A quick urinalysis showed no hematuria. The physi-
A physician diagnosed renal colic. A few hours later the patient returned and was found to have ovarian torsion.

In this case the physician formulated a simple preliminary hypothesis, “She is having a recurrence of her renal colic,” and applied a basic decision rule looking for colicky pain, hematuria, and costovertebral tenderness. Finding only the first item, the physician ignored the disconfirming data because, “If it’s not renal colic, I can’t imagine what it could be, so...it must be!” Perhaps the physician believed that admitting uncertainty would be humiliating in front of colleagues, or perhaps the effort to consider other possibilities would make the physician more irritable or unsure of the diagnosis.

In the above example, the physician’s internal dialogue might be articulated as, “In a patient with colicky lumbar pain and a history of renal colic, I can diagnose nephrolithiasis and proceed to give her analgesics.” It is not uncommon for such simple solutions to the diagnosis of renal colic to be acquired during medical school. Should the solution emerge solely as a way to justify a premature closure of the encounter, however, this otherwise seemingly useful shortcut might lead to a higher rate of error, perhaps 1 clinical error in 25 patients (these rates are merely conjectures). Despite being an experienced doctor, the physician was unable to counterbalance some of the factors that are synthesized in Table 1. Maybe, at a certain point, the physician believed that the clinical performance was suboptimal and activated a cognitive alibi, such as “the most common is the most frequent,” “I can assume this risk,” or “this patient exaggerates her symptoms.” This cognitive alibi allows the physician to resolve the situation with less effort; at the same time it puts the physician at risk of making avoidable and inappropriate errors considering a high level of competence in other circumstances. This tendency can be counteracted by acquiring and reinforcing habits of mind and behavior described below. Other cognitive alibis and how to substitute for more appropriate thoughts are summarized in Table 2.

### Implications of the Model

The 2 practical implications of the model we propose are that excellent physicians (1) use their capacity for insight to detect when they are at risk for cognitive distortion, premature closure, or use of low-level decision rules, and (2) detect moments when it is necessary to reframe the visit. So, as part of basic clinical training, a physician should assimilate as habits the following cognitive, emotional, and behavioral skills.

First, there are tools to help physicians learn to detect states of low cognitive activation or emotional saturation, which lead to not giving importance to (or even rejecting) the demands or complaints of patients. For example, we invite physicians to detect physical and psychological signs of fatigue (such as deterioration in handwriting, tremor, headache, forgetfulness, irritability, and inattentiveness), enhancing a better control over the environment and a systems-wide strategy of intelligent time assignment.

Second, physician training can focus on learning to reframe with minimal effort, although doing so might entail a delay in the resolution of the clinical task. Teaching methods should subject the student to a series of simulated situations in which he or she must detect whether the need to reframe an early hypothesis exists. This proposal goes

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**Table 2. Low-Level and High-Level Decision Rules**

<table>
<thead>
<tr>
<th>Low-Level Decision Rules</th>
<th>High-Level Decision Rules</th>
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<tbody>
<tr>
<td>Learned in basic stages of apprenticeship</td>
<td>Learned from experience</td>
</tr>
<tr>
<td>Errors experienced not incorporated</td>
<td>Errors experienced incorporated</td>
</tr>
<tr>
<td>Tacit knowledge not reconsidered</td>
<td>Tacit knowledge conscientiously revisited</td>
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also learn in a more general way, however, by detecting more tentative diagnosis of renal colic. A physician can with typical pain but without hematuria will receive a self-questioning. We believe there are 2 ways to learn the example of colicky abdominal pain, future patients from errors. The situation-specific strategy consists in always form my own impressions.

“Am I persisting in my first decision because of tiredness or self-esteem?” are acquiring a general skill, which we call reframing training that can be applied to both emotions and cognitions.

Table 3. Examples of Low-Level vs High-Level Schemata

<table>
<thead>
<tr>
<th>Low-Level Schemata</th>
<th>High-Level Schemata</th>
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<tbody>
<tr>
<td>I’ve got it! As soon as the patient told me, I knew what</td>
<td>I should look beyond early hypotheses.</td>
</tr>
<tr>
<td>he had.</td>
<td></td>
</tr>
<tr>
<td>If the patient is satisfied with the diagnosis of another</td>
<td>I should always form my own criteria.</td>
</tr>
<tr>
<td>physician, why should I bother to find out more data?</td>
<td></td>
</tr>
<tr>
<td>When in doubt, choose the simplest or most convenient</td>
<td>When in doubt, assume the worst hypothesis.</td>
</tr>
<tr>
<td>hypothesis. Complains a lot? He doesn’t have anything!</td>
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</table>

Habitual use of 2 or 3 questions from Table 4 can become routine quality-control points. The questions should reflect the individual characteristics and needs of each physician. Often, the physician is aware that some type of habit of self-questioning is already in use, in which case, his or her performance must simply be optimized.

Third, the physician should work on subjectivity, specifically on intuitive clinical impressions. In this sense, we teach to distinguish between intuitive (or analogical) thinking and criterion-based (or categorical) thinking. The general impression of serious illness when a patient is pale and has lost weight is of the first type, while prescribing a radiological study for all patients with unexplained cough of more than 1 month of evolution is of the second type. The skill of the physician often depends on the skill in switching from one type of thinking to the other, recognizing the limits of both and knowing up to which point analogical and categorical thinking can complement each other. We have developed a series of techniques to bring the physician closer to this learning process.

CONCLUSION

The rational-emotive model of the clinical act helps physicians become aware of their early hypotheses and how they frame the clinical encounter. It proposes

Table 4. Habits of Self-Questioning: Reflective Questions

<table>
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<th>Reflective Questions</th>
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<tr>
<td>How might my previous experience affect my actions with this patient?</td>
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<tr>
<td>What am I assuming about this patient that might not be true?</td>
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<tr>
<td>What surprised me about this patient? How did I respond?</td>
</tr>
<tr>
<td>What interfered with my ability to observe, be attentive, or be respectful with this</td>
</tr>
<tr>
<td>patient?</td>
</tr>
<tr>
<td>How could I be more present with and available to this patient?</td>
</tr>
<tr>
<td>Were there any points at which I wanted to end the visit prematurely?</td>
</tr>
<tr>
<td>If there were relevant data that I ignored, what might they be?</td>
</tr>
<tr>
<td>What would a trusted peer say about the way I managed this situation?</td>
</tr>
<tr>
<td>Were there any points at which I felt judgmental about the patient — in a positive or</td>
</tr>
<tr>
<td>negative way?</td>
</tr>
</tbody>
</table>
creating habits, especially the habit of reframing. It also invites an application of cognitive and emotional strategies to correct avoidance behavior, which would otherwise lead to precipitous closing of the clinical encounter. We advocate the need to teach future physicians not only the use of hard technologies but also the use of the technology derived from their own emotional and cognitive capacities.

To read or post commentaries in response to this article, see it online at http://www.annfammed.org/cgi/content/full/2/4/310.

Key words: Medical errors; decision making/education; professional practice; risk management; medical mistakes; quality of health care; self-awareness; clinical reasoning

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References

Communicating Evidence for Participatory Decision Making

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Brian S. Alper, MD, MSPH
Timothy E. Quill, MD

Physicians should create collaborative partnerships with patients (and families) in which clinical decisions are made using the best available evidence, consistent with patients' values, goals, and capabilities. However, this ideal is rarely achieved. Physicians typically spend less than 1 minute out of a 20-minute visit discussing treatment and planning. Informed decision making occurs in only 9% of outpatient office visits, and physicians ask patients if they have questions in less than half. Although patients generally want more information about their illnesses, they recall only a fraction of the information physicians transmit.

Communicating evidence to patients has practical, relational, and ethical goals. Informed patients are more likely to participate actively in their care, make wiser decisions, come to a common understanding with their physicians, and adhere more fully to treatment, however, currently there are no evidence-based guidelines for discussing clinical evidence with patients in the process of making medical decisions.

Objective To identify ways to communicate evidence that improve patient understanding, involvement in decisions, and outcomes.

Data Sources and Study Selection Systematic review of MEDLINE for the period 1966-2003 and review of reference lists of retrieved articles to identify original research dealing with communication between clinicians and patients and directly addressing methods of presenting clinical evidence to patients.

Data Extraction Two investigators and a research assistant screened 367 abstracts and 2 investigators reviewed 51 full-text articles, yielding 8 potentially relevant articles.

Data Synthesis Methods for communicating clinical evidence to patients include nonquantitative general terms, numerical translation of clinical evidence, graphical representations, and decision aids. Focus-group data suggest presenting options and/or equipoise before asking patients about preferred decision-making roles or formats for presenting details. Relative risk reductions may be misleading; absolute risk is preferred. Order of information presented and time-frame of outcomes can bias patient understanding. Limited evidence supports use of human stick figure graphics or faces for single probabilities and vertical bar graphs for comparative information. Less-educated and older patients preferred proportions to percentages and did not appreciate confidence intervals. Studies of decision aids rarely addressed patient-physician communication directly. No studies addressed clinical outcomes of discussions of clinical evidence.

Conclusions There is a paucity of evidence to guide how physicians can most effectively share clinical evidence with patients facing decisions; however, basing our recommendations largely on related studies and expert opinion, we describe means of accomplishing 5 communication tasks to address in framing and communicating clinical evidence: understanding the patient's (and family members') experience and expectations; building partnership; providing evidence, including a balanced discussion of uncertainties; presenting recommendations informed by clinical judgment and patient preferences; and checking for understanding and agreement. JAMA. 2004;291:2359-2366 www.jama.com

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Box 1. Proposed Communication Skills for Discussing Evidence With Patients

Ability to communicate complex information using non-technical language
Tailoring the amount and pace of information to the patient’s needs and preferences
Drawing diagrams to aid comprehension
Considering the values of the patient while weighing choices
Explanation of the probability and risk for each option
Facilitative skills to encourage patient involvement
Evaluation of Internet information that patients might bring with them
Creating an environment in which patients feel comfortable asking questions
Giving patients time to think in the information
Declaration of equipoise when present
Checking patient understanding
Negotiation

*Adapted with permission.10

...necity of practitioners and patients and proposed evidence-based consultation skills for discussing evidence and treatment choices with patients (BOX 1). Although participants emphasized the importance of conveying probabilities and risks to patients and suggested the use of diagrams, they did not propose specific methods.

Using published evidence to guide clinical decisions has its perils.11 It is difficult to reconcile evidence based on populations with care directed toward individuals having unique needs, concerns, and expectations. Quantitative estimates of probability of given outcomes can be difficult to establish prospectively. The values ascribed to relevant outcomes are often subjective8 and depend on factors that may be intangible but personally significant (e.g., a death with dignity), context-depen-

dent factors (e.g., risk of pregnancy), and the perspective of the decision maker (e.g., physician, patient, or social institution such as Medicare).12 Presenting evidence to patients on intermediate outcomes such as “response rate” rather than morbidity and mortality may lead patients to believe that they will feel better or live longer when, in fact, the intermediate outcome measure (e.g., shrinkage of the tumor demonstrated by computed tomography scan) may only be one marker of disease activity and meaningless in terms of mortality or functional status. The “utility” of each given outcome is notoriously value laden.13 Utilities are not universal but rather emerge through dialogue.14 Formal decision analysis may use patients’ values to guide recommendations but is not a method for informing patients about evidence.15

While the skills in recognizing clinical questions that might drive a search of the medical literature16 (sometimes by eliciting the patient’s view of the problem16,17) and formulating a researchable question have been described,18 the communication skills required to conduct the important dialogues with patients have not, and are not routinely covered during training in evidence-based medicine. In this article, we explore how physicians can translate findings from a literature search to the clinical encounter in a way that enhances patient understanding and participation in their care. We frame those communication skills within the context of participatory decision making; they also apply to other situations, such as informing patients about prognosis. In order to generate recommendations, we conducted a systematic search of the published literature.

METHODS AND RESULTS

Using MEDLINE to search articles from the period 1966 to 2003, we conducted a systematic review of articles that (1) reported original research, (2) dealt with communication between clinicians and patients, and (3) directly addressed methods of presenting clinical evidence to patients (details of the search strategy are available from the authors on request). Two investigators and a research assistant screened 367 abstracts and 2 investigators reviewed 51 full-text articles, yielding 2 articles that clearly met criteria18,20,5 others10,21,23 were considered “marginal.” Reference lists of these and other articles, and searches of authors’ names, yielded no additional references. One recent, not-yet-indexed additional reference was sent to us by an astute librarian.24 The focus-group studies19,21,23 that proposed skills for communicating evidence were discussed above.

Chao et al20 used hypothetical scenarios presented to preclinical medical students to examine 4 methods of presenting survival benefits on chemotherapy decisions. Students’ responses confirmed prior studies,25,26 that suggested that presenting information using relative risk reduction (e.g., “This treatment will improve your chances of recovery by 50%”) may be misleading by exaggerating the significance of a positive effect, especially if the absolute benefits are small or if the effects of the intervention are realized in the distant future. Absolute survival benefits or numbers needed to treat were difficult for patients to interpret; combinations of methods led to confusion. In contrast, students were able to interpret absolute risk reductions clearly and without confusion. However, the study cannot be generalized to patients having less medical sophistication.

Mazur and Merz20 presented volunteers with a series of survival curves comparing 2 hypothetical treatments and noted that the order of presentation of the graphs influenced subsequent decision making, especially in less-educated and older patients.

Schapira et al10 conducted focus groups composed of women aged 40 to 65 years to compare different types of graphic displays for presenting evidence. They suggested graphics using human stick figures or faces for single probabilities and vertical bar graphs for comparative information between 2 options. Stick figures or faces were judged...
easier to identify with, more understandable, and less “clinical” than graphs. However, patients sometimes interpreted the stick figures as representing higher risk; this was true especially among less-educated patients. Schapira et al also suggested using lower denominators (eg, 1 stick figure out of 10 rather than 10 out of 10) for stick-figure graphics. Graphs with vertical bars were preferred to those with horizontal bars. Shapiro et al did not study pie charts.

Describing proportions (eg, “One in 10 women will get breast cancer”) was considered more “people-oriented” than was describing probability (eg, “You have a 10% chance of getting breast cancer”), which was considered more mathematical and more difficult to understand by less-educated patients. However, proportions were more likely to lead patients to attribute risk to others; they assumed that they belonged to the healthy group.

Less-educated women felt that confidence intervals were “wishy-washy,” whereas better-educated women preferred the expression of uncertainty. Women younger than 50 years preferred 10-year risk time frames, whereas women aged 50 years or older preferred estimates of lifetime risk. The generalizability of these findings is unclear. Also, graphs may require in-person explanations to help patients interpret them correctly.

Decision aids are interactive products that use computer or workbook formats to present information, options, and guidance through a decision process. Some present evidence, but most simply elicit values without explicit discussion of research findings. None of 87 studies of decision aids in a 2001 Cochrane review directly addressed patient-physician communication, although they did report presumed results of improved communication, such as improved patient knowledge, satisfaction, and patient involvement in decision making.

The impact of the decision aid on actual decisions or clinical outcomes is mixed, and it remains unclear whether the effect is due to empowerment, provision of information, or enhanced patient-physician communication triggered by the use of a decision aid. We found only 2 studies, both investigating the same decision tool, which addressed—albeit indirectly—communication between physicians and patients. These studies suggested that more time may be required for postintervention visits and that decision aids can facilitate discussions with family members.

Other than the choice of graphic formats, the literature review gave few detailed suggestions about how physicians can effectively incorporate clinical evidence into routine medical encounters and no empirical support for those suggestions. None of the articles addressed whether the method of presenting clinical evidence to patients or discussing it with them affects clinical outcomes. The following sections build on our review by considering possible methods for communicating evidence to guide clinical decisions, drawing on the general communication literature when available.

**PRESENTING EVIDENCE**

**Clinical Example**

Consider a patient who has been successfully treated for major depression with antidepressants and now, after 12 months of treatment, wonders if the antidepressants should be continued or discontinued. A systematic review of 31 randomized trials comparing antidepressant continuation with discontinuation concluded that continuing antidepressants reduced the risk of relapse within the next 12 months. The average risk of relapse across trials was 18% with active treatment and 41% with placebo (number needed to treat, 4.3). Stated conversely, 59% of patients treated with placebo did not experience relapse. These data come from aggregated studies; individual risks of relapse depend on factors such as genetic predisposition and the number, severity, and length of prior depressive episodes. The literature and clinical experience suggest 4 ways of presenting these research findings: description of benefits and harms in general conceptual terms, numerical translation of clinical evidence, graphical representation of quantitative data, and decision-aid programs.

Describing benefits and harms in general conceptual terms is considered appropriate in settings in which scientific precision might obscure lay understanding. Although we found no relevant research in medical settings, in experimental settings verbal and numerical probabilities led to equal estimates of the likelihood of a precise binary event (eg, winning/not winning a lottery). For a patient who is not numerically oriented, the physician might say something like, “Continuing this medicine makes it less likely that the depression will return, but many people can stop the medicine and not have a recurrence.” Further discussion depends on patients’ understanding of the evidence (eg, “Does this mean that the depression will come back if I stop the medicine?”) or values (eg, “I hate being on medication, so I would really like to try stopping”). If the patient asks, “How much will it reduce my chances of relapse?” the clinician can use a more quantitative approach. However, there is tremendous variation in the interpretations of some, but not all, expressions of probability. For example, the word “rare” was interpreted as a 24% probability (SD, 30.5%) by patients and 5% (SD, 6%) by physicians, whereas “frequent” was interpreted similarly by physicians and patients. These kinds of miscommunications are even more likely when physicians and patients are not of the same race, ethnicity, or socioeconomic status.

Numerical translation of clinical evidence generally provides a description of the “average” patient. However, no patient is an average patient. Individualized numerical translation of clinical evidence requires estimating each patient’s risk of relapse, comparing it with that estimated for the research study sample, and extrapolating the clinical evidence to the individual patient. Although few stud-

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Box 2. Steps for Discussing Evidence With Patients, and Examples of What Physicians Might Say

Step 1: Understand the Patient’s Experience and Expectations

“What were you hoping for in this visit today?”
“I just want to make sure that I’ve touched on all of the important issues.”
“Would you like to invite your [partner] in to discuss this together?”
“Have you known anyone with [your diagnosis]? What was their experience like?”
“If not, then “What have you heard, or what were you expecting?”
“You have said that quality of life is more important than quantity, but in this case does that still seem to make sense?”

Step 2: Build Partnerships

“You might feel uneasy, as this can be a difficult decision. I think I understand your concerns and questions. Now I would like to help you understand the issues involved from my perspective so that we can make this decision together.”

Step 3: Provide Evidence, Including Uncertainties

“While there has been a lot of research about this question, the answer is not entirely clear. Let me explain my view of the dilemma.”
“While we used to always treat ear infections with an antibiotic, research shows that in cases with fewer than 2 days of pain, the antibiotic is usually not necessary and may cause more problems than it helps. Six out of 10 ear infections resolve spontaneously within 24 hours.”
“Even though the evidence is divided on this issue, I think that we can still make a reasonable decision.”

Step 4: Present Recommendations

“We could try a tricyclic antidepressant that may help your pain, even though the evidence is not in as to how well it works.”
“I think that you should hold off antibiotics for now, but you can call me if you don’t get better and we can reconsider.”
“I’m going to suggest a medication that could help strengthen your bones but that could also worsen your heartburn if you are not careful. I think that [ . . .] would be the best course of action.”

Step 5: Check for Understanding and Agreement

“Does that make sense to you?”
“Could you tell me how you understand the treatment choices I’ve presented to you for your [disease]?”
“Do you see things differently?”

Considerations in Presenting Evidence to Patients

Generally, a “relationship-centered” approach not only provides opportunities for information transfer but also enhances the patient’s ability to participate in care. Relationship-centered care differs from paternalism (in which the physician has all of the relevant information and sole decision-making responsibility) and from a radical “independent choice” model (in which clinicians simply present “the facts” without making a recommendation and place sole responsibility for the decision on the patient). The consumer movement, physicians’ fears of lawsuits, and a genuine desire not to influence patients all promote informed choice. But patients and families should not be deprived of the clinician’s prudent judgments grounded in the knowledge of the patient, his or her family, the illness, and the relevant medical literature. Clinicians should not merely tolerate input from the patients but should implement relationship-centered care that includes active encouragement and coaching to help patients be involved in medical dialogue and decisions.

Describing evidence to patients and their families depends on the characteristics of the evidence (type of mea-
sure used, consistency of findings, magnitude of effect), characteristics of the patient (cognitive capacity, desire for information, attention to detail, mathematical and scientific understanding), role of family members in the patient's care (primary decision maker, influential, or uninvolved), and characteristics of the physician (orientation toward evidence, communication style).

Presenting evidence may be more straightforward in cases in which there is high-quality evidence of improved outcomes and relatively low risk (e.g., use of angiotensin-converting enzyme inhibitors for patients with heart failure), the patient is identified as the primary decision maker, the patient's values are known, and his or her expectations are concordant with the physician's. In such cases, it may be expedient to inform the patient about the diagnosis and treatment, anticipate common questions, and assist in implementation of the treatment plan without the need for detailed discussions of evidence unless the patient requests it. Even then, thorough patient adherence might be enhanced by providing data and ensuring understanding.

Communicating evidence is most appropriate when the clinical issue is deemed important by either the clinician or the patient, when the evidence is ambiguous or the outcomes uncertain, and when the evidence is clear but interpretations made by the patient and/or the family differ substantially from the physician's. There may be widely discrepant views about the importance of a clinical issue. For example, using antibiotics to treat an otherwise healthy patient's upper respiratory tract infection is ineffective and potentially harmful. Therefore, a request for antibiotics may be driven by unvoiced fears—for example, perhaps a relative had had a life-threatening pneumonia that started with similar symptoms. For that reason, a quick but routine inquiry about patients' fears, ideas, and expectations in all visits should precede discussions of medical evidence.

No single approach will work with all patients, even in similar clinical situations. For example, a study of women at risk of familial breast cancer found no consensus regarding how they wanted their clinicians to explain their personal risk. Some wanted numbers, whereas others preferred words. Those wanting numbers varied among preferences for percentages, proportions, or (rarely) odds. Thus, clinicians need a variety of techniques to communicate evidence about diagnosis, treatment, risk, and prognosis, as well as several ways of verifying that the information has been understood.

Interpretations of medical evidence are always matters of subjectivity and values. For example, a patient with asymptomatic human immunodeficiency virus infection may understand the evidence that early initiation of antiretroviral treatment can delay symptoms related to the infection. However, this fact should be interpreted in the context of the patient's values; the patient might decide that early treatment does not warrant the inconvenience, potential adverse effects, and possible future viral resistance.

Family members of patients are often involved in health care decisions, whether or not they are present during the clinical encounter. Patients from some cultures tend to entrust the primary responsibility for medical information and decisions to family members. But there may be conflicts of values among family members; in one study of a decision-analysis program for prostate cancer screening, men preferred a no-screening approach, whereas their wives favored screening to a greater degree and also expressed less concern about the impact of impotence and incontinence on quality of life than did their husbands. Thus, the clinician should simultaneously welcome family input and be vigilant about maintaining the patient's primacy in the decision-making process. Patients' desire to have family members involved in health care may not be explicit, so it is useful to ask whenever there is a major decision about a potentially worrisome illness.

RECOMMENDATIONS FOR PRACTICE

Because of the paucity of evidence in our review, we also used related literature and clinical experience to guide our recommendations. Evidence from the general communication skills literature suggests that actively listening, providing information in small "digestible" amounts, and pausing to check for patient understanding will likely improve understanding and may shorten visit times by eliminating transfer of information that the patient neither needs nor wants. When the patient is distressed, delaying discussions of evidence until the patient is more receptive can reduce misunderstandings. Situations such as initiation of antihypertensive medication are usually not urgent, and the increased patient commitment gained by judicious delay may improve concordance to a mutually agreed-upon plan. Time spent thinking and talking with family members can help in the interpretation and presentation of complex information and raise additional questions that are important to the patient.

Once options have been presented to the patient, detailed discussions may follow; we propose a 5-step process that is informed by the needs and perspectives of the patient as well as by the physician's expertise (Box 3). The model recognizes that decision making is only partially a rational process; it also includes elements of trust, confidence, and values.

**Step 1: Understand the Patient's (and Family Members') Experience and Expectations**

The scope and importance of the issue should be understood from the patient's standpoint as well as the physician's. Even if the clinician has inquired about the patient's perspective earlier in the visit, it is helpful to delineate the patient's specific needs, fears, expectations, and context specific to this issue. Also, this is the time to invite family members to participate when appropriate.
Box 3. A Hypothetical 2-Minute Discussion That Incorporates Clinical Evidence

Physician: It sounds like you've done well on the antidepressant but don't know whether it's worth continuing. Is that right?
Patient: Yes.
Physician: This is a difficult choice, and the answer is not quite clear. Most people do well even if they don't take an antidepressant medication. But, research shows that quite a few people will have a relapse. And, if you take the medication, you're less likely to have another episode of depression in the next 5 years. Patient: Well, what would you do?
Physician: This is not an easy choice, so I think that different people would make different decisions. But first, let me make sure that you understand the issue. Patient: Well, I think I understand, but how certain is it that the depression will come back? The pills are okay, but I really don't want to be on them for the rest of my life—they do affect my sex life a bit.
Physician: Do you want statistics?
Patient: Okay—let's try.
Physician: There have been several research studies, and it seems, overall, that of 10 patients with depression who stop the medicine, 4 will have a recurrence within the next year, while 6 will remain healthy. If they continued the medication, only 2 out of the 10 would have a recurrence. Are you following me?
Patient: What's the choice then? I really don't want to feel that way again!
Physician: You've hit the nail on the head. You first said you did not want to take medication forever, and now you are telling me that you clearly don't want to have a relapse. And that is the choice we should make together.
Patient: I understand now. I guess the million-dollar question is whether I'm going to be in the healthy group or the depressed group. Is there any way to tell?
Physician: That's a good question—the problem is, we really don't know. But we know that depression runs in your family, so your risk for relapse might be somewhat higher than what is reported in the research. So, a lot of physicians would suggest that you continue, and I guess that I would agree, as long as the side effects are tolerable. And, if not, there are other medications. And we can talk again in 6 to 12 months to see if it makes sense to continue.
Patient: Got it. I'll probably do it. I'm going to need to think about this for a while.
Physician: Is there anything that we've discussed that you don't understand?
Patient: Not really. I just need time to think.
Physician: Should we talk again next month? Maybe continue the medication until then?
Patient: Okay, sounds reasonable.

Step 2: Build Partnership

Relationship-building activities include the expression of empathy (e.g., “You might feel uneasy”), acknowledgment of the complexity or difficulty of the issue, an expression of mutual understanding (e.g., “I think I understand...”), increasing patient/family involvement (e.g., “I would like to help you understand”), and fostering partnership (e.g., “We need to make this decision together”). This approach builds trust and facilitates transfer of important information.44,45,47

Step 3: Provide Evidence, Including a Balanced Discussion of Uncertainties

Generally, patients want more information from their physicians than they receive.60 Since some patients may not know the appropriate questions or may be hesitant to ask, physicians should anticipate critical unasked questions and suggest discussing them. Presenting clinical uncertainty in simple lay terms can be challenging. Avoiding discussions about uncertainty might preclude a patient's full understanding of a critical decision. Overemphasizing uncertainty can also be problematic, as some patients will lose confidence.34,41-45

Balance is achieved by explaining the limitations of what is known while maintaining confidence that this represents the imperfections of medical science rather than lack of competence of the practitioner.61 It is at this phase that the clinician should determine the appropriate format for presenting evidence—for example, general descriptions, numbers, educated guesses, graphics, or decision aids. Patients may have already found information that they may or may not spontaneously discuss with the clinician.

Step 4: Present Recommendations

Recommendations should only occur after the clinician has integrated clinical evidence with the patient's values. Some decisions, especially when the evidence is uncertain or mixed, may represent true equipoise—ie, the physician may not have a specific recommendation—in which case the physician should present options dispassionately. For other situations, in which the evidence about benefits or harms is clearer, the physician may have recommendations for how to best meet the patient's goals. If so, the physician should inform the patient which course of action is recommended and explain how that recommendation is generated clearly from the patient's goals and the evidence. The physician then has the burden of differentiating evidence-based recommendations from those generated from personal experience or bias (eg, religious or financial concerns; desire for convenience).

Step 5: Check for Understanding and Agreement

Sometimes simply asking “Does that make sense to you?” may be adequate, and a positive response can indicate that you can continue with your recommendations and planning. In complex situations (such as the choice between cancer chemotherapy regimens) it is helpful to ask the patient to summarize what he or she understands and the
rationale for the choice made. If the patient appears not to understand, seems to agree but appears apprehensive, or actively disagrees, that is an invitation to go back to exploring the patient's values, ideas, and expectations, or to provide detailed information. Sometimes patients and families feel comfortable enough to try out a treatment while reserving full agreement with the plan.

Additional resources may be useful for improving understanding and recall; these include carefully selected Web sites, printed handouts, handwritten instructions, review with nurses, audio recordings of the visit, and follow-up appointments.

Clinicians who have the flexibility to use different approaches can more easily adapt to the different ways in which people learn or process information. Finally, clinicians should be open to reconsidering medical decisions; many medical decisions are at least partially reversible. By leaving the door open for future discussions there is the possibility of responding to changing patient needs.

**COMMENT**

We have proposed methods of helping patients and their families make use of results of medical research to reach decisions that incorporate evidence and patients' values. The ingredients for effective use of evidence include understanding the patient's preferred style, informed flexibility in presenting the information to accommodate the patient's needs, a visit that is characterized by dialogue rather than lecturing, and an active partnership in which the patient is encouraged and coached to take a more active role in the consultation. Paradoxically, although relationship-centered consultations in which there is shared understanding and participatory decision making are associated with better outcomes, there is little evidence to guide many of our other recommendations. Further research will help define optimal ways of incorporating evidence into clinical conversations.

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Character cannot be developed in ease and quiet. Only through experience of trial and suffering can the soul be strengthened, ambition inspired, and success achieved.

—Helen Keller (1880-1968)
TOWARD AN INTERPERSONAL NEUROBIOLOGY
OF THE DEVELOPING MIND:
ATTACHMENT RELATIONSHIPS, “MINDSIGHT,”
AND NEURAL INTEGRATION

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ABSTRACT: This article reviews findings from a wide range of scientific disciplines in exploring the idea that the mind develops at the interface between human relationships and the unfolding structure and function of the brain. Recent discoveries from a number of independent fields, including those of developmental psychology and cognitive neuroscience, can be synthesized into an integrated framework for understanding how the brain gives rise to mental processes and is directly shaped by interpersonal experiences. This “interpersonal neurobiology” (Siegel, 1999) presents an integrated view of how human development occurs within a social world in transaction with the functions of the brain that give rise to the mind. This framework suggests some basic principles for conceptualizing the essential experiential ingredients that may facilitate the development of the mind, emotional well-being, and psychological resilience during early childhood and perhaps throughout the lifespan. At the core of these processes is a fundamental mechanism of integration which can be seen at a variety of levels, from the interpersonal to the neurological. Integration may be conceptualized as the basic process that secure attachments facilitate in promoting psychological well-being. This article will summarize these concepts and offer some ideas about their implications for practice and future investigations.
Résumé: Cet article passe en revue des conclusions d’une grande gamme de disciplines scientifiques en explorant l’idée selon laquelle l’esprit se développe à l’interface entre les relations humaines et la structure et la fonction en développement du cerveau. Les découvertes récentes dans un certain nombre de domaines indépendants, y compris ceux de la psychologie du développement et de la neuroscience cognitive, peuvent être synthétisées en une structure intégrée pour la compréhension de la manière dont le cerveau fait naître des processus mentaux et est directement formé par des expériences de communication. Cette "neurobiologie communicative" (Siegel, 1999) présente une vue intégrée de la façon dont le développement humain se produit au sein d’un monde social en transaction avec les fonctions du cerveau qui font naître l’esprit. Cette structure propose quelques principes de base pour la conceptualisation des ingrédients d’expérience essentiels qui peuvent faciliter le développement de l’esprit, le bien-être émotionnel, et le ressort psychologique durant la petite enfance et peut-être durant la vie entière. Au cœur de ces processus se trouve un mécanisme fondamental d’intégration qu’on peut observer à plusieurs niveaux, du niveau communicatif au niveau neurobiologique. L’intégration peut être conceptualisée comme un processus de base que les attaches solidés facilitent en promouvant le bien-être psychologique. Cet article résumera ces concepts et offrira quelques idées sur leurs implications pratiques et des recherches à venir.

The infant is born into the world genetically programmed to connect with caregivers who will become "attachment figures" in the child's life (Cassidy & Shaver, 1999). These attachments can be formed to the mother, to the father, and to other individuals who are intimately involved in providing care for the growing child. Attachment is considered a basic, in-born, biologically adaptive "motivational system" that drives the infant to create a few, selective attachments in his life. These attachments provide a relationship in which the infant will: (1) seek proximity to the attachment figure; (2) have a sense of a safe haven—in which when he is upset the attachment figure will soothe his distress; and (3) develop an "internal working model of a secure base"—an internal schema of the self with the other: self-with-attachment-figure—that will provide him with a security enabling him to explore the world, have a sense of well-being, and to soothe himself in times of distress in the future (Bowlby, 1969).

Though the attachment system is "hard-wired" in the brain, the experiences that an infant has will directly shape the organization of that system. Experience involves the activation of neurons in the brain that respond to the sensory events from the external world—or to the internally generated images created by the brain itself (such as our experience of recalling times from the past) (Gazzaniga, 1995; Kandel & Schwartz, 1992). Neurons are the basic cells of the brain. They are long cells that contain a central nucleus and sending and receiving extensions that connect with other neurons. The basic mechanism of neural function is this: the equivalent of a flow of electrical activity (called an "action potential") passes down the long "axon" or neural length to its end where it functionally connects with other neurons at a "synapse." The electrical impulse causes the release of a neurotransmitter (a chemical) that flows across the small synaptic space to activate (or inhibit) the receiving neuron. That receiving neuron, if activated by the release of enough neurotransmitter, sends its electrical signal down its long length to release neurotransmitters at its own synaptic connections. The key issues are these: each neuron connects to an average of 10,000 other neurons! There are about 100 billion neurons, with over 2 million miles in their collective length. In addition, there are thought to be an incredible range of possible "on-off" firing patterns within this complex, spider web-like net of neural connections—estimated to be about ten times ten one million times. The fact that our brains can be organized in their functioning is quite an accomplishment!

The processes of the mind are thought to emanate from the activity of the brain (Mesulam, 1998). When particular circuits in the brain (interconnected neurons, groups of neurons, and clusters of groups of neurons that form specific pathways and systems of the brain) are activated, various mental processes are created. The brain creates a "neural map" or "neural net profile"—a specific pattern of neural firing in particular regions—that serves to create a "mental image," such as a sensory image, or the linguistic representation of a concept or object. The term "representation" is sometimes used to refer to a neural map or to a mental image that serves as a symbol for something. At this point in the history of science, we do not yet know exactly how the brain "map" creates the mind "image" (Damasio, 1999). Cognitive neuroscientists generally agree, however, that it is the pattern of firing in the map—the particular clusters of neurons activated in a specific pattern—that, somehow, creates the experience of mind.

The entity we call the mind can be understood in the simplest terms as patterns in the flow of energy and information (Siegel, 1999). As we will see, energy and information can flow within one brain, or between brains. In this manner, the ways in which energy and information flow within an individual or between two individuals helps create the experience of mind. There is an exciting convergence of findings from the neurosciences and from the developmental "behavioral" sciences that allow us to see a unity of knowledge, or consilience (Wilson,
1998), on a deeper plane than each individual field of study alone can portray. Though our scientific studies and our words may emphasize a focus on either brain or mind, the reality appears to be that the processes of the mind emanate from the structure and function of the brain. The brain itself is an integral part of the central nervous system, which is fundamentally interwoven within the whole body. Thus, though we may speak of the mind as emanating from the neurophysiological processes of the brain, this statement is an abbreviated way of referring to the flow of energy and information within the brain as a fundamental part of the functioning of the body as a whole. The patterns in the flow of energy and information, the essence of the mind, are a product of both bodily (neurophysiological) processes and interpersonal interactions.

Another important general point is this: although we focus on particular regions and circuits of the brain, the fact is that the brain is a complex set of integrated systems that tend to function together. The mind is created from the whole brain. “Integration”—the ways in which functionally distinct components come to be clustered into a functional whole—may be a fundamental way in which the nervous system functions. As we will see, when certain suboptimal attachment experiences occur, the mind of the child may not come to function as a well integrated system. We will explore the important interpersonal elements of communication that help to foster, or to hinder, the development of such neural integration. In a text entitled *The Developing Mind* (Siegel, 1999), I have proposed that integration is a core process essential for mental well-being within the individual and the family, and perhaps fundamental for the healthy functioning of a nurturing community.

**DO ATTACHMENT RELATIONSHIPS INFLUENCE BRAIN DEVELOPMENT?**

We now know that both genetically encoded information and neural activation itself can result in the activation of genes that leads to the creation of the proteins necessary to shape the structure of the brain (Kandel, 1998; Nelson & Bloom, 1997). Experience involves the activation of neurons. In this manner, experience shapes the function of neural activity in the moment, and can potentially shape the continually changing structure of the brain throughout the lifespan. Recent findings from neuroscience in fact suggest that the brain remains plastic, or open to continuing influences from the environment, throughout life (Barbas, 1995; Benes, 1998). This plasticity may involve not only the creation of new synaptic connections among neurons, but also the growth of new neurons across the lifespan. The capacity for attachment classifications to change beyond the early years of life may be related to this ability of the brain to continue to grow in response to experiences across our life times.

A public debate within the popular media erupted in the United States at the end of the 1990s over how important the first years of life, or parents in general, are in children’s development. The media has focused on a few books written to discount the impact of early experience—or any parenting experience—in helping to shape children’s minds (Brewer, 1999; Harris, 1998). In general, these publications make these claims by dismissing the major contribution of attachment research to understanding the important part caregivers play in children’s lives, especially in the early years. Arguments used to diminish the importance of attachment findings include the possible role of genetics in determining the outcome of attachment studies and the finding that if attachment status can change then these studies do not demonstrate a “critical” period that is irreversible. With a quick dismissal on these grounds, these authors urge the reader to consider the important role of genetics, peers, or later years of development. As discussed below and in detail in *The Developing Mind*, attachment researchers have indeed not yet carried out the important direct procedures to clarify the role of genetics
in determining the attachment patterns. Given the fact that most parents in these studies are genetically related to their offspring, it is wise to be cautious about inferring causal attributions rather than statistically significant associations from present studies. A number of indirect analyses, however, suggest that attachment classifications are determined primarily by relationship experiences and not by genetic inheritance. Several findings point to the experiential role of relationships, rather than that of genetic information, in determining attachment status. In brief, these findings include the following: (1) the child’s attachment classification is independently correlated to each parent and is related to that parent’s Adult Attachment Interview (AAI) findings (discussed below). In other words, one child can have two attachment patterns that are each specific to a given parent and correlate with a feature of that parent; (2) the child’s temperament, thought to have a genetic underpinning, does not predict the child’s attachment pattern; (3) the individual factors in adults that have been found to have a high degree of genetic influence, including intelligence, memory, and personality test scores such as those of the MMPI, have not been found to correlate with the AAI findings. This finding, plus recent studies that suggest that the AAI is a measure of the child’s attachment experiences, support an experiential origin for the AAI findings; and (4) the AAI findings of a pregnant woman and her husband can independently predict the child’s attachment pattern some 18 months later, suggesting that the AAI is not a measure of the parent’s response to parenting that particular child. Attachment relationships are important in the unfolding of the emotional and social development of the child during the early years of life. Development is an ongoing process, and so close, emotionally involving relationships may continue to influence us throughout the lifespan. As we will see, the importance of the first years may be that the brain structures that mediate social and emotional functioning begin to develop during this time in a manner that appears to be dependent upon interpersonal experience. Although at this point in attachment research there is little direct evidence from neurobiological studies in humans of the impact of relationships on brain function, there is a great deal of consilience (Wilson, 1998) across a number of fields, including those studying attachment, child development, cognitive neuroscience, complex systems, developmental psychopathology, neurology, and psycholinguistics. This convergence of findings from a range of independent fields of research suggests a direction in which academicians may understand how the findings in their own work may relate to those from other disciplines. For clinicians, educators, and policymakers, this interdisciplinary view offers a broad perspective on how to understand the role of science in understanding the profound importance of an interpersonal focus on the subjective experience of developing children. The argument that we do not have “enough direct neuroscience” to state that attachment relationships shape the developing brain evades the essential findings of cognitive neuroscience that experience in general shapes neuronal function and brain architecture (Milner, Squire, & Kandel, 1998). Furthermore, the patterns of development of children with distinct attachment classifications suggests that the minds of these individuals are functioning in quite distinct manners. For example, the paucity of autobiographical recall in the avoidantly attached children and their parents with Dismissing Adult Attachment findings support the notion that certain aspects of their minds are functioning in a unique manner (Siegel, 1999). As cognitive neuroscience findings enable us to better understand the neural processes involved in autobiographical recollection, we can begin to hypothesize the mechanisms by which the avoidantly attached children and their parents with a Dismissing state of mind with respect to attachment may have distinct neurobiological functions subsuming these distinctions. Future research is necessary to confirm these proposals stemming from this convergence of findings. This process of analysis is, in fact, the manner by which science advances (Wilson, 1998). Those who help
children develop should be aware of the nature of our knowledge, the limitations, and practical implications of our current science, and the potential directions for future investigations.

There is a genetically driven overproduction of neurons prior to birth and of synapses during the first three years of life. This finding is relevant for practitioners because it means that the brain appears to have a built-in mechanism to create the neurobiological foundation of the developing mind. As the child grows, this neural substrate will serve as the structure from which basic experiences will “carve out” the neural connections governing basic processes such as perception and motor activity. This early form of brain development, called by some neuroscientists an “experience-expectant” process (Greenough & Black, 1992), functions by way of the genetically encoded synapse formation that requires a minimal amount of “species-expectable” environmental stimulation, such as exposure to light or sound. The “pruning” or selective elimination of the genetically produced excess in connections shapes development. Disuse (“use-it-or-lose it”) or toxic conditions, such as with excessive stress (as in child abuse), can lead to the elimination of existing synapses. The important point is that some neurobiologists point out that circuits must be only minimally stimulated to maintain the neurons and their interconnections.

A contrasting process, sometimes called “experience-dependent” development, occurs by way of the establishment of new neural connections induced by experience. Experience, therefore, can alter brain structure by leading to either the maintenance and strengthening of existing synapses, or by the experience-driven creation of new synaptic connections. Many authors do not even make this distinction between experience-expectant and experience-dependent growth, focusing instead on the basic mechanisms of neural development that shape synaptic formation and function. The end result is similar for these experience-influenced processes: neural connections are maintained, strengthened or created. The generally held belief in neural science is that the patterns of neuronal connections determine the ways in which the brain functions and the mind is created. Because experiences with others early in life are so important for human development, I have earlier stated that “Human connections create the neural connections from which the mind emerges” (Siegel, 1999). It is in this manner that interpersonal experiences directly shape the genetically driven unfolding of the human brain.

These distinctions between “expectant” and “dependent” processes are in the midst of being clarified by researchers. I point them out here for two reasons. One is that there is no need to bombard infants or young children (or possibly anyone) with excessive sensory stimulation in hopes of “building better brains.” This is an unfortunate misinterpretation of the neurobiological literature—that somehow “more is better.” It just is not so. Parents and other caregivers can “relax” and stop worrying about providing huge amounts of sensory bombardment for their children. This synaptic overproduction during the early years of life has been proposed to allow for a likelihood that the brain will develop properly within the “average” environment that will supply the necessary minimal amount of sensory stimulation to maintain necessary portions of this genetically created and highly dense synaptic circuitry. More importantly than excessive sensory stimulation in the early years of development, however, are the patterns of interaction between child and caregiver. Attachment research suggests that collaborative interpersonal interaction, not excessive sensory stimulation, can be seen as the key to healthy development. Recent independent findings in neurobiology give us some possible explanations for why this may be true, but these studies are not necessary for us to know about these essential elements of development. Neurobiology can help us know how to pursue further research questions to deepen our understanding of the developmental mechanisms underlying these findings from attachment studies.

Because of the ongoing creation of synapses in response to experience and the early excessive growth of new synapses, which eventually become pruned to adult levels by the end
of puberty, it is clear that development may occur over a prolonged period of time. Whether
development occurs from the elimination of the excess in synapses, or in the creation of new
ones based on experience, interaction with the environment can provide children (and adults)
with developmental impetus for years to come. The recent findings from neuroscience that the
adult brain remains “plastic”—or open to changes in response to experience—throughout the
lifespan in no way decreases the importance of the first years of life in establishing patterns of
neuronal growth that subsume very important functions. Development is about the creation of
specific circuits, not merely the overall amount of synapses in the brain. The ways in which
the circuits regulating emotional and social functioning develop may be profoundly influenced
by interpersonal experience beginning early in life. Recent explorations of the convergence of
neurobiological findings in experimental animals and in humans with findings from attachment
research, (as I summarize in The Developing Mind and also as discussed in the work of Allan
Schore noted in the references) have suggested, in fact, that patterns of interpersonal com-
munication may have a powerful effect on the how neural circuits grow and develop within
the brain in the early years.

There are circuits that are responsible for emotional and social functioning (not just per-
ception and motor action) that come “on-line” during the first years of life. While this period
may not be the “last chance” for ongoing development in these areas, it is a time when basic
circuitry is being established for the first time. Books that discount the importance of the early
years, or of attachment in general, fail to examine what we know about the development and
the possible neurobiological foundations of emotional and social processes. The orbitofrontal
region, which is central for a number of processes such as emotion regulation, empathy, and
autobiographical memory, may have an experience-influenced development that depends upon
the nature of interpersonal communication during the early years of life. Interactions with “older
people,” with attachment figures, are essential during this time to create the contingent, col-
laborative communication necessary for the proper emotional and social development of the
child. It is not a matter of overwhelming “enrichment” or excessive sensory stimulation that is
needed during this time, but one of attunement between adult and child. This collaborative,
attuned communication establishes patterns of interaction by which the caregiver can regulate
the child’s positive and negative emotional states. These emotion-regulating interactions
are required for the experientially influenced maturation of the infant’s developing emotional and
social brain.

BRAIN DEVELOPMENT AND MEMORY

During the early years of life, the basic circuits of the brain are developing which will be
primarily responsible for a number of important mental processes involving emotion, memory,
behavior, and interpersonal relationships (Schore, 1994, 1996, 1997). These processes include
the generation and regulation of emotion, the capacity for “response flexibility” or mindful,
reflective behavior (Siegel, 1999), the autobiographical sense of self and the construction of a
“self-narrative,” the capacity to understand and care about the minds of others, and the ability
to engage in interpersonal communication. Independent studies in attachment suggest that pat-
terns of interaction between caregiver and child have an important impact on the development
of these mental processes (Cassidy & Shaver, 1999; Toth, Cicchetti, Macfie, & Emde, 1997).

Development shapes the brain by altering the strength of the synaptic connections within
the brain. These alterations can take a number of forms: (1) synapses formed from primarily
genetically encoded information can be strengthened, weakened, or eliminated (pruned); (2)
new synapses can be formed in response to experience; (3) temporary increases in the linkages
among neurons can occur in the case of short-term or working memory; (4) the laying down
of myelin (a sheath around more mature neuronal fibers) functionally enhances the neural connectivity by increasing the speed of conduction of the electrical "action potential" down the axon length; and (5) regardless of the origin of the synapse, genetic information, toxic substances, and stressful or absent experiences can lead to the elimination of synapses.

Memory is the way in which past experience is encoded in the brain and shapes present and future functioning (McClelland, 1998; Milner, Squire, & Kandel, 1998). The processes of memory and those of development in fact are closely aligned. For the first year of life, the infant has available an "implicit" form of memory that includes emotional, behavioral, perceptual, and perhaps bodily (somatosensory) forms of memory. Implicit memory also includes the generalizations of repeated experiences, called "mental models" or schema (Johnson-Laird, 1983). The way that the brain readiness itself for retrieval of certain memories in response to specific cues is also a part of implicit memory and is called "priming" (Schacter & Buckner, 1998). When implicit memories are activated, they do not have an internal sensation that something is being recalled. They merely influence our emotions, behaviors, or perceptions directly, in the here and now, without our awareness of their connection to some experience from the past.

By the middle of the second year, children begin to develop a second form of memory, "explicit" memory (Bauer, 1996). Explicit memory includes two major forms: factual (semantic) and autobiographical ("episodic") (Tulving, Kapur, Craik, Moscovitch, & Houle, 1994). For both types of explicit memory, recollection is associated with an internal sensation of "I am recalling something now." For the later developing autobiographical memory, there is also a sense of the self at a time in the past.

As we can see, infants will only have implicit forms of recollection available to them. In this manner, the shaping of their minds in the earliest months of life will never be explicitly available to them as they grow. This is the normal, universal finding of "childhood amnesia" and is thought to be due to the genetically determined timing of the unfolding of brain structures needed for explicit memory (Nelson & Carver, 1998). In particular, the maturation of the hippocampus in the medial temporal lobe does not occur until after the first birthday, and is thought to be essential for explicit encoding (Bremner & Narayan, 1998). Later on, the front part of the frontal regions of the neocortex (the upper part of the brain)—an area called the prefrontal cortex—will mature enough to allow for the beginning of autobiographical recall.

One of the important messages of these findings is that although we may never recall "explicitly" what happened to us as infants, the experiences we had with our caregivers have a powerful and lasting impact on our implicit processes. These experiences, as we have seen, involve our emotions, our behaviors, our perceptions, and our mental models of the world of others and of ourselves. Implicit memories encode our earliest forms of learning about the world. Implicit memories directly shape our here-and-now experiences without clues to their origins from past events. Attachment research, combined with the independent findings from our modern studies of genetics and developmental neurobiology, suggests that specific kinds of communication within emotionally connected relationships appear to offer the most important experiential world in which the child’s mind can develop. This perhaps is best seen in ways of understanding the development of the self.

THE DEVELOPMENT OF "SELF" AND HUMAN RELATIONSHIPS

When we think about psychological development, about the developing mind, it is helpful to think about what the "psyche" actually is. There is an entity called the psyche or the mind that is as real as the brain, the heart, or the lungs, although it cannot be seen directly with or without the aid of microscopes or other tools of modern technology. One definition of the psyche is:
"1. the human soul; 2. the intellect; 3. psychiatry — the mind considered as a subjectively perceived, functional entity, based ultimately upon physical processes but with complex processes of its own: it governs the total organism and its interaction with the environment" (Webster’s, 1996). Within this definition, we can see the central importance of understanding the psyche, the soul, the intellect, and the mind in understanding human development.

A number of authors have offered various views of how the sense of self can be understood. The psychiatrist and infant researcher Daniel Stern, for example, has examined the ways in which the self develops from within interpersonal relationships during the first few years of life (Stern, 1985). Antonio Damasio, a neurologist, has examined the neurological structures that subsume the manifestations of various aspects of consciousness at the root of three very different forms of self (Damasio, 1999). In my own work (Siegel, 1999), I have examined an “interpersonal neurobiology” of the sense of self as it emerges from the various layers of neural integration and forms of memory. Because the conceptualization of self is so fundamental to the notion of development, I will explore these and other perspectives in depth, and offer a new view of the connection of the sense of self to the mental/physical representation of self-with-other at the root of neural integration and developmental processes.

Stern (1985) has suggested that the self develops within stages during the first years of life. Each domain of self experience begins at a certain age but then continues to play an important role throughout the lifespan. From birth to two months, the infant’s “emerging self” begins in which the body takes in sensory data and the infant has the sense of emerging organization of the world as directly experienced. From twotothree months to seven to nine months, the infant has the onset of a sense of a “core self,” one in which the infant’s sense of agency (the center of will), coherence (sensations of the body), affectivity (emotionality), and continuity (the sense of self across time in the form of memory) are all central features. From nine months to around 18 months, the “subjective self” emerges in which there is a sense of self and self-with-other that involves the shared attention, intention, and emotion between caregiver and child. By the second birthday, the “verbal self” has begun in which words begin to be shared between self and other. Beyond this period, a “narrative self” emerges in which autobiographical narratives play a major role in defining the self (Wolf, 1990).

Damasio (1999) has suggested that various neurological studies (of normal and diseased brains) can be examined to reveal three forms of “self” and two forms of consciousness. Within deep structures in the brain that represent sensory information from the outside world (perceptions) and from the body (via the somatosensory system) is created a “proto-self.” This can be seen as a direct experience of the brain with the outer and bodily worlds. These representational processes can be called “first-order” neural maps. Within higher circuits in the brain are the neural processes that create a “second-order” map of the proto-self as it is changed by its interaction with the world/body. In other words, these higher brain regions are able to have a neural map of the proto-self before interaction and then a proto-self just following interaction with the world/body. This second-order map is in essence a neural symbol of change: it compares the proto-self before and after the interaction. This process of change defines the “core self.” The ability of the brain to focus attention on the “object” that produced the change in the proto-self that created the core self—whether it is something in the world (a physical object), something in the body proper, or an image in the mind itself—creates the heightened sense of awareness Damasio calls “core consciousness.” Core consciousness is a “here-and-now” experience of focused attention that is fundamentally a measure of how the proto-self is changed by interaction with an “object” in the internal or external world.

Damasio goes on to point out that a third, “higher” grouping of neural structures is essential for what he has called, “extended consciousness.” Extended consciousness can be thought to involve “third-order” neural maps—neural representations of the changes in the core self over ...
time. (These are maps of the changes in the changes of the self in interaction with objects).
Such a process allows for the brain to create a "autobiographical self" that records the history of the individual, compares it to present experience, and prepares for the future.

Other scientists have also discussed various conceptualizations of consciousness and the neural structures that subsume their function. For example, Gerald Edelman (1992) has described a primary form of consciousness that is in the "prison of the present" and a "higher form" of consciousness that depends upon language for its functioning in order to liberate the self from that "prison" in creating a sense of past and future. Ernst Tulving and colleagues (Tulving et al 1994; Wheeler, Stuss, & Tulving, 1997) have described a form of "autonoetic consciousness" that permits the self to create the experience of "mental time travel" that links past, present, and future. Within this framework there is also a sense of a "noetic consciousness," a knowing of facts without a sense of self. In many of these frameworks, consciousness is described as involving at least two distinct processes that include a "here-and-now" form of awareness that is distinct from a "past-present-future" integrating process of consciousness.

One can draw on a number of these perspectives in examining how interpersonal experiences may shape the higher, extended, autonoetic forms of consciousness. The neural substrate that allows for the sense of self that "emerges" early in life, the foundations for the emerging or proto-self, is likely to be determined in large part by genetic and constitutional features. In neurologically normal individuals there is likely a fairly similar basic mechanism involved in the creation of an emerging proto-self experience. This sense of self is rooted in the direct experience of the brain as it interacts with its environment: the external world, the body proper, and the mind itself (the neural flow of energy and information within the brain). Neurologically impaired individuals may differ significantly in the manner in which this emerging proto-self is organized and thus how the subsequent and more elaborated senses of self (core, subjective, verbal, narrative or the core and autobiographical selves) come to be formed.

Many of these views converge upon the notion, paralleled by studies of implicit memory, that the brain creates a "here-and-now" experience of self. This core ability of "living in the moment" may also have a large degree of genetically determined neural structure to it. However, as Damasio points out, one view of this core self is that it is the neural mapping of the individual’s changing in response to interaction with an "object" in the external or internal world. In this manner, the core self may indeed be subject to huge degrees of impact by the environment. For example, if the environment is one of trauma and stress, the core self will be impacted to a great degree. The sense of agency, coherence, affectivity, and even continuity (memory) of the self in interaction with others will be severely impaired in cases, for example, of familial child abuse (Siegel, 1995, 1996). For these reasons, the deepest sense of self awareness, of core consciousness, may be profoundly influenced by early experiences in infancy even before explicit, autobiographical memory is available.

This neurological view of the creation of a core self experience may also help us to understand the profound importance of collaborative, contingent communication in the development of the infant, and perhaps normal functioning throughout the lifespan. Secure attachments are created within such a mutually resonant form of interpersonal communication. We can propose that the alignment of states of mind inherent in contingent communication enables the core self of each member of an interacting dyad to have a sense of "fullness": as the proto-self is changed in response to interaction with another, the contingency of the transaction within collaborative relationships enables the ever evolving core self to have a sense of coherence. Such coherence is defined by the fundamental manner in which the responses of the "other," of the "object" in the world, are directly contingent to the signals given off by the pre-change proto-self. The subsequent collaborative changes in the proto-self create a core self-experience that is coherent and inherently defined as connected to another person. In this fundamental
neural manner, interpersonal connections can be seen to create the self. When these interpersonal connections are contingent, the self becomes integrated and coherent.

One aspect of the self is that of autonoesis, or "self-knowledge," as revealed in autobiographical narratives. Attachment research has established that one of the most powerful predictors of an infant’s attachment to the parent is the parent’s autobiographical narrative coherence (Hesse, 1999). Narrative coherence can be examined by determining the free and flexible flow of information as individuals tell the story of their lives, beginning with the memories they recall of their earliest experiences. The research instrument utilized to assess this coherence is the Adult Attachment Interview (see Hesse, 1999; Main, 1995). The Interview is a narrative review by the parent of her recollections of her earliest relationship experiences with her own parents. One can view such autobiographical accounts as revealing the capacity of the mind to achieve a certain amount of integration of functioning. Such a process can be called "coherent autonoesis." This integration appears to allow the individual to have an internal sense of connection to the past, to live fully and mindfully in the present, and to prepare for the future as informed by the past and the present. In this manner, coherent autonoesis allows for the fluid flow of past, present, and future. Such fluid and flexible reflections on the past, present, and future are the hallmark of coherent autobiographical narratives.

But why should such a coherent self-reflective process of the parent be associated with the child’s security of attachment? This question has been one of the essential issues in attachment research that I have tried to address in The Developing Mind (Siegel, 1999). In the next section, I will offer some possible links between the internal processes of autonoesis and the interpersonal connections of parent-child relationships.

ATTACHMENT AND THE DEVELOPING MIND

Longitudinal attachment studies have found that securely attached children appear to have a number of positive outcomes in their development (Cassidy & Shaver, 1999). These include enhanced emotional flexibility, social functioning, and cognitive abilities. Some studies suggest that security of attachment conveys a form of resilience in the face of future adversity. In contrast, a number of studies suggest that the various forms of insecurity of attachment can be associated with emotional rigidity, difficulty in social relationships, impairments in attention, difficulty in understanding the minds of others, and risk in the face of stressful situations. Suboptimal attachment experiences may predispose a child to psychological vulnerability in part by altering the brain’s neuroendocrine response to stress (Liu et al., 1997; Rosenblum, Coplan, Freidman, Basoff, Gorman, & Andrews, 1994).

One form of insecurity of attachment, called "disorganized/disoriented," has been associated with marked impairments in the emotional, social, and cognitive domains. Individuals with this form of attachment have also been demonstrated to have a predisposition toward the clinical condition of dissociation in which the capacity to function in an organized, coherent manner is at times impaired (Carlson, 1998; Lasti, 1992; Main & Morgan, 1996; Ogawa, Streuf, Weinfeld, Carlson, & Egeland, 1997). Recent studies have also found that youths with a history of disorganized attachments are at great risk of expressing hostility with their peers and have the potential for interpersonal violence as they mature (Lyons-Ruth, Alpern, Repacholi, 1993; Lyons-Ruth & Jacobwitz, 1999). This disorganized form of attachment has been proposed to be associated with the caregiver’s frightened, frightening, or disoriented behavior with the child (Main & Hesse, 1990). The parents of these children often have an Adult Attachment Interview finding of “unresolved trauma or grief” that appears as a disorientation in their narrative account of their own childhoods (Hesse, 1999). What this implies is that the lack of resolution of trauma or loss in a parent can lead to parental behaviors that create
“paradoxical,” unsolvable, and problematic situations for the child. The attachment figure is intended to be the source of joy, connection, and emotional soothing. Instead, the experience of the child who develops a disorganized attachment is such that the caregiver is actually the source of alarm, fear, and terror, so the child cannot turn to the attachment figure to be soothed (Main & Hesse, 1990).

This finding provides important insights into the nature of the transmission of trauma across the generations. Helping such individuals resolve their traumatic experiences and losses may be an important therapeutic intervention in attempting to alter the course of devastation that such transgenerational trauma can create.

These and numerous other findings suggest that the patterns of communication between caregiver and infant provide a foundation for the developing mind of the child. What are the essential ingredients of secure attachments, then, and how can we understand their importance in the developing child’s life?

We can summarize several basic elements of interpersonal relationships that are likely to foster emotional well-being and psychological resilience. Although derived from research studies in attachment, these ideas may also be useful for understanding the impact of close, interpersonal relationships of all sorts throughout the lifespan.

Parents are usually the primary attachment figures for a child. For a variety of reasons, in many families there may be a decreased availability of parents to care for their young children during the working hours. This situation requires that we address the basic needs of the young child to have the opportunity to develop secure attachments with caring, consistent, and reflective adults in addition to her own parents. Fortunately, the infant’s mind appears to be quite capable of creating a secure attachment to a selective few adults besides the parents. Grandparents and other relatives, daycare providers, nannies, and other individuals who are “caregivers” for a child may all play important roles as attachment figures. Understanding a child’s individual needs and style of communicating, taking joy in the child, and being able to soothe the child when he is in distress, are each basic components of the child’s relationship with the attachment figure. The following are five basic elements of how caregivers can foster a secure attachment in the children under their care.

1. **Collaboration.** Secure relationships are based on collaborative, contingent communication. The signals sent by each member of an attuned dyad (a pair of individuals) are directly responsive in quality and timing with each other. These attuned communications often have their foundation in the nonverbal signals that are shared between two individuals. Eye contact, facial expression, tone of voice, bodily gestures and timing and intensity of response are all fundamental aspects of nonverbal signals. The sharing of nonverbal signals creates a joining of two minds at a basic level of “primary” emotions. As discussed later in this article, these primary emotions can be seen as the “music of the mind,” and thus the sharing of these nonverbal signals, the sharing of the primary states of mind of each person, creates a resonant connection that often may have a sense of emerging vitality. Each person may come to “feel felt” by the other. Some adults may find such joining experiences exhilarating and easy to create; others may find them uncomfortable or unfamiliar, and be unable to participate in such an intimate “connecting” experience. Children need such joining experiences because they provide the emotional nourishment that developing minds require. Relationships that are “connecting” and allow for collaboration appear to offer children a wealth of interpersonal closeness that supports the development of many domains, including social, emotional, and cognitive functioning. Such collaboration may be essential in the creation of a coherent core and autobiographical sense of self.
2. **Reflective Dialogue.** Secure attachment relationships may involve the verbal sharing of a focus on the internal experience of each member of the dyad. Attachment figures recognize the signals sent by the child, attempt to make sense of them in their own minds, and then communicate to the child in such a manner that creates “meaning” for the child in the shared dialogue about the mental states of the child and of the caregiver. Internal experience, or “states of mind,” can involve emotions, perceptions, thoughts, intentions, memories, ideas, beliefs, and attitudes. By directly focusing on these aspects of mental life, the adult can create a sense that subjective experience is both important and can be communicated and shared. In this manner, the “mind” itself becomes a central focus of sharing in the discussions between two minds. Such a meaning-making process coupled with collaborative, reciprocal communication allows the child to develop “mindsight”: the capacity of the mind to create the representation of the mind of others, and of the self (Siegel, 1999).

3. **Repair.** When attuned communication is disrupted, as it inevitably will be, repair of the rupture is an important part of reestablishing the connection within the dyad. Repair is healing. Repair is also important in helping to teach the child that life is filled with inevitable moments of misunderstandings and missed connections that can be identified and connection created again. Such interactive repair allows the child to make sense of periods of painful disconnection and create a sense of meaning out of the understanding of one’s own and another’s mind. An adult’s pride may at times inhibit repair and leave the child isolated in what may be a shameful state of disconnection. Intense uncomfortable emotional states in the child or parent may lead to a disconnection in collaborative communication. Prolonged disconnection, especially if combined with hostility and humiliation, can have significant negative effects on a child’s developing senses of self. Providing repair of the inevitable disconnections of attuned communication can occur naturally in a setting where parents and other attachment figures generally provide consistent, predictable, reflective, intentional, and mindful caregiving.

4. **Coherent Narratives.** The connection of the past, present, and future is one of the central processes of the mind in the creation of the autobiographical form of self-awareness. An adult without a coherent autonoetic process may be at risk of providing interactive experiences for a child that produce various forms of insecure attachment. In essence, adults with a flexible capacity to integrate their experiences across time appear to also be able to provide integrating interpersonal communication with their children. In addition, adults can teach children about the world of the self and of others by joining with them in the coconstruction of stories about life events. These stories focus on activities as well as the mental life of the characters. In so doing, the adult is both collaborating in the construction of reality for the child, as well as giving her the very tools she needs to make sense of the internal and external worlds in which we all live.

5. **Emotional Communication.** Attachment figures can amplify and share in the positive, joyful experience of living. These heightened moments of sharing a sense of vitality are important in creating the foundation for a positive attitude toward the self and others. Equally important is the attachment figure’s ability to remain connected to the child during moments of uncomfortable emotion. Thus, negative emotional states can be shared as the adult then helps the child to reduce these states and soothe his distress. Helping a child learn that he will not be emotionally abandoned during these moments and that he can learn to understand and soothe his painful emotional state is an important role for the attachment figure to play. Adults also need to be sensitive to a child’s cycling needs for direct connection and for solitude. Awareness and respect for these
changing needs for connection are a part of emotionally attuned communication. These interactive forms of emotional communication may be at the core of how interpersonal relationships help to shape the ongoing emotional and social development of the child’s growing mind.

EMOTION

Emotional communication is at the heart of attachment. But what exactly is emotion? It may be surprising that both clinicians and academicians often have quite varied responses to this question. Exploring the nature of emotion as a fundamental process both of the individual and of interpersonal communication may help deepen our view of an “interpersonal neurobiology” of the developing mind. Researchers have examined a number of ways to view emotion. For example, emotion can be conceptualized as an integrating process in the mind with many dimensions (Ciompi, 1991). Some scientists argue that emotions are everywhere in the processes of the mind, while others support very specific circuits in the brain that mediate emotion (see LeDoux, 1996). In general, emotion is considered to be a central process that interconnects many aspects of mental functioning. This perspective is expressed by Kenneth Dodge: “... all information processing is emotional, in that emotion is the energy that drives, organizes, amplifies, and attenuates cognitive activity and in turn is the experience and expression of this activity” (Dodge, 1991, p. 159).

What are these processes, these emotions, and how can we “see” them at work? The study of emotion suggests that nonverbal behavior is a primary mode in which emotion is communicated. Facial expression, eye gaze, tone of voice, bodily gestures, and the timing and intensity of response each are fundamental to emotional messages (Ekman, 1992). But what exactly is emotion? We can know when others are upset and “emotional,” but what does this really mean? Attempting to clearly define the process of emotion and its regulation can yield some helpful ways of understanding the mind, how the mind arises from the processes of the brain, and how one mind interacts with other minds within human relationships. Examining the fundamental ways in which emotion is an integrative process can enable us to see how central emotion is in both intraindividual mental processes and in interpersonal communication.

As Damasio notes:

It would not be possible to discuss the integrative aspects of brain function without considering the operations that arise in large-scale neural systems; and it would be unreasonable not to single out emotion among the critical integrative components arising in that level. Yet, throughout the twentieth century, the integrated brain and mind have often been discussed with hardly any acknowledgment that emotion does exist, let alone that it is an important function and that understanding its neural underpinnings is of great advantage. (Damasio, 1998, p. 83)

It is for this reason that we need to expand the area of “affective neuroscience” if we are to meaningfully explore the neurobiological basis of interpersonal relationships, subjective experience, and the developing mind. In essence, we need to build on the “objective” approaches of science to provide the foundation for understanding why interpersonal relationships (such as attachment) that focus on the importance of the “subjective” experience of each individual are most likely to promote emotional well-being and psychological resilience. At the core of these mental phenomena is the process of integration.

Attachment relationships differ across the various categories in the ways in which states
of mind and emotional communication are shared between parent and child (Siegel, 1999). Distinct patterns of emotional communication characterize each of the differing attachment classifications. The emotional processes of the more mature adult mind can be used by the child to regulate her own internal state. From the beginning of life, "self-regulation" is actually determined in part by an interactive "dyadic" process of mutual coregulation (Feldman, Greenbaum, & Yirmiya, 1999; Hofer, 1994; Sroufe, 1996). A child uses the state of mind of the parent to help organize her own mental processes. This alignment of states of mind permits the child to regulate her own state by direct connection with that of her parent. The processes of affect attunement and social referencing reveal the fundamental way in which nonverbal communication is the medium in which states are aligned. What do these nonverbal signals actually represent?

One way of answering this question is by viewing emotion as the fundamental process that regulates the flow of energy and information. In this manner, I have proposed (1999) that a "primary" emotional process occurs that includes initial orientation, appraisal, and arousal. Subsequent elaborative mechanisms lead to differentiated emotional states (such as the categorical emotions of sadness, joy, anger, fear). Within this framework, the flow of energy is directed within a primary emotional process that leads to characteristic profiles of energy activation. These profiles can be seen externally as what Stern (1985) has termed, "vitality affects" and can be experienced internally parallel to what Damasio (1999) has called "background" emotions. These reflections of primary emotional states are the shared focus within "affective attunements." By directing the flow of energy and information processing within the brain, primary emotions reflect a core process that interconnects processes within one mind, as well as connecting those of one mind to those of another.

This integrative and interpersonal view of emotion is one perspective on emotion and brain functioning. Within the field of neuroscience, there is actually a heated debate about the nature of emotion in the brain. For example, for many decades there was an accepted viewpoint that emotions emanated from a part of the brain called the limbic system. Research paradigms attempted to carefully define the boundaries and specific functions of this system but often were unable to identify its functional limits (LeDoux, 1996). The essential point here is that emotion is not limited to some specifically designed circuits of the brain that were once thought to be the center of emotion. Instead, these same "limbic" regions appear to have wide ranging effects on most aspects of brain function and mental processes. Emotion is perhaps better seen as an integrative process throughout the brain, rather than some element limited to a particular area. The limbic regions, however, are specialized to carry out the appraisal of meaning or value of stimuli. They are also dominant for the information processing system that carries out social cognition, including face recognition, affiliation, and theory of mind (the view that another person has a subjective experience of mind) (Barbas, 1995; Baron-Cohen, 1995; Baron-Cohen & Ring, 1994; Davidson, 1992; Haxby et al., 1996; Panksepp, 1982; Rolls, 1995; Ross et al., 1994; Tucker, 1992; Watt, 1998). In this manner, we can see a convergence between social processing and the creation of meaning within emotional processing.

Emotion involves complex layers of processes that are in transaction with the environment. Emotions are both regulated and perform regulatory functions. This view describes both the omnipresent nature of emotion and the way in which the distinction sometimes made between cognition and emotion, thoughts and feelings, is artificial, and can potentially impair our efforts to understand mental processes.

Emotion involves complex layers of processes that are in transaction with the environment. These transactions involve cognitive processes (such as appraisal or the evaluation of meaning) and physical changes (such as endocrine, autonomic, and physiological). As Alan Sroufe has
described, emotions involve “a subjective reaction to a salient event, characterized by physiological, experiential, and overt behavioral change” (Sroufe, 1996, p. 15). A similar view suggests that emotion can be seen as involving neurobiological, experiential, and expressive components (Izard & Kohak, 1991).

Emotions represent a dynamic process in which they are created within the socially influenced value appraising processes of the brain. Emotion is integrative in that it is a process that connects other processes to each other. By viewing emotion as central to the regulation of energy and information flow in the brain, we can see that emotion plays a central role in creating and regulating mental life. In this manner our understanding of the distinct ways in which emotion is experienced and is communicated among individuals can shed light on how the mind develops and functions within the social context of human relationships.

INTERPERSONAL COMMUNICATION AND THE DEVELOPMENT OF MINDSIGHT

The mind of the child appears to develop a core manner in which the mental states of other individuals become represented within the neural functioning of the brain (Stone, Baron-Cohen, & Knight, 1998). In the child’s early life, emotional interactions with attachment figures appear to be of primary importance in shaping the core (here-and-now) and autobiographical (past-present-future) senses of self. We can see such interactive effects in the central ways in which the brain creates neural maps of the self as influenced by the “object.” These neural maps are the essence of how the brain constructs its specific experiences of reality.

One form of neural map is the way in which the brain creates images of other minds. I have used the term “mindsight” to refer to this representational process. In essence, this is the capacity of one mind to “perceive” or create representations of the mind of oneself or of another (Aitken & Trevarthen, 1997). The basic elements of mind that are “seen” can include thoughts, feelings, perceptions, beliefs, attitudes, intentions, and memories. Such a complex capacity develops throughout childhood, and can become continually more enriched throughout the lifespan. Other authors have described similar processes using terms such as mentalizing, reflective function, theory of mind, and social cognition (Fonagy & Target, 1997). In some neurologically impaired individuals, the capacity for mindsight may be disturbed, such as in children with the disorder of autism (Baron-Cohen, 1995). In some cases of intrusive parenting, children also have been shown to have diminished mentalizing abilities (Fonagy & Target, 1997). This suggests that the capacity for mindsight develops from within the intact neurological structures of an individual who experiences a certain degree of collaborative, nonintrusive attachments.

In exploring the fundamental neural substrate for the elements that allow the brain to create maps of other minds, it has been helpful to examine the nature of the early interpersonal communication and the neurobiology of the largest systems of the brain, the left and right hemispheres, and how they may each develop and come to function in an integrated manner (Springer & Deutsch, 1993). From the embryonic period onward, there is a significant asymmetry in the nervous system. The “higher” functions of the brain, those of more complex and abstract thinking, are directly shaped by the motivational forces of the “lower” areas of the same side of the brain (Trevarthen, 1996; Tucker, Luna, & Pribram, 1995). The left and right sides of the entire brain appear to be driven by different “streams” of processing or neural circuits that create distinct flows of information that drive subsequent information processing in particular directions.

The left and right sides of the brain are anatomically isolated except for connections made directly through bands of neural tissue called the corpus callosum and the anterior commissures.
(Trevarthen, 1990) that develop during the first decade of life. Indirect passage of information may occur at other sites, including an area called the cerebellum. Of note is that early child abuse has been shown to impair the development of the corpus callosum, as well as leading to a diminished development of the brain as a whole (DeBellis et al., 1999a, 1999b). Severe stress is toxic for the growing brain.

In general, a wide array of studies in humans suggest that the isolated functions of the left and right hemispheres may be “integrated” under normal conditions in creating the mind. The complex capacity for mindsight, for example, appears to require the integration of aspects of both right and left hemisphere functioning (Stone et al., 1998). Thus, we normally experience a blending of right and left functions. However, the anatomical separateness of these two hemispheres also permits for functional isolation under certain conditions. Such isolation of function between, or within, hemispheres may produce a “nonintegrated” functioning and the impairment of certain intricate mental processes. Dissociation may be one clinical syndrome that reflects this mental disassociation of processes (Siegel, 1996).

The right hemisphere is involved in more self-soothing actions in the infant, has a more integrated mapping of the “somatosensory system” (the representation of the body in the brain), directly regulates bodily processes, is involved in affective expression and perception, specializes in the processing of perceptual images, mediates autobiographical recollection, and processes information in a “holistic” manner. The capacity for mindsight may depend, in large part, on the integration of a number of these bodily, emotional, and social information processing circuits that reside predominantly in the right side of the brain and how they become interconnected with those of the left hemisphere.

The left side of the brain is involved in more exploratory actions in the infant, has very little integrated representation or regulation of the body, and is not very good at reading the nonverbal expressions of emotions of others. The left side of the brain has a primarily linguistic processing mode, and processes information using “syllogistic reasoning”—looking for cause–effect relationships in a linear, logical fashion. The left hemisphere is said to have an “interpreter” function, attempting to use the limited bits of information at its disposal to assess true/false distinctions and determine causal relationships within linear, logical, narrative descriptions.

In this manner, one can see that some attachment figures provide children with “nonintegrated” communications that serve to impair the movement of the child toward integration of his or her own experience. One view is that certain parents may isolate their verbal output from their emotional facial and tone of voice expressions (Beebee & Lachman, 1994). I have proposed a way to understand how these nonintegrated attachment experiences impact upon the growing brain of the child (Siegel, 1999). The right hemisphere is the dominant side of the brain during the first few years of the infant’s life (Chiron, Jambaque, Naibbot, Loumes, Syrota, & Dulac, 1997). “Dominance” means that the right hemisphere is both growing more rapidly and is more active (Thatcher, 1997). In fact, areas of the right hemisphere within the prefrontal cortex (the orbitofrontal region, just behind and above the orbits of the eyes) that regulate bodily function and emotionally attuned communication appear to be actively developing during this period (Schore, 1994, 1996). Thus, the ways in which the caregiver comes to communicate with the infant during these crucial early years may help shape the right hemisphere’s capacity for self-regulation, self-other relationships, an autobiographical sense of self, and the basic elements of the capacity for mindsight. These can all be seen as complex functions that depend upon various dimensions of neural integration.

Recent work also suggests that the prefrontal regions of the brain may also be a part of the integrated circuitry that permits social and moral behavior (Anderson, Bechara, Damasio, Tranel, & Damasio, 1999; Dolan, 1999). In these reported cases of early neurological damage
to this important area of the brain, individuals were found to have marked impairments in both their capacity to understand basic social information and to behave in socially and morally meaningful ways. What we do not yet know is exactly how certain early adverse experiences in a child’s life may negatively shape the development of the complex circuitry, including that of the prefrontal regions, that has been proposed to permit social and moral behaviors. Neuroscience is just beginning to discover the details about a possible neurological origin of “conscience.” Our work in attachment will benefit from these independent findings in examining how secure relationships may promote moral development through the impact of interpersonal relationships on neural structures.

What we do know from the independent field of studies in child development is that certain attachment experiences appear to promote socially adaptive, morally responsible behaviors in children. One way of thinking about these secure attachments is that they involve the basic elements discussed earlier, and have as their foundation the ability of the adult to create a collaborative form of communication with the child. But how can a logical, word-oriented adult communicate with a primarily right-hemisphere dominant nonverbal infant to help with the earliest stages of the development of these important functions? The nonverbal interactions of caregiver and infant can be proposed to be the most important elements that help to create a secure attachment between the infant and the caregiver at the beginning of life. As the child grows, as discussed above, reflective dialogues that help create meaning and interpret the complex world of human minds for the child are extremely important. Such reflective, meaning-making dialogues require, we can propose, an integrated right and left hemisphere in both caregiver and child. But adults often live in a logical world filled with word-dominated thoughts. These left-hemisphere processes are often far from the more subtle, nonverbal experiences that the adult needs to be able to share with the infant. In essence, the infant’s brain needs to “feel felt” by the caregiver. Such a feeling of connection, in fact, may be extremely important for each of us in our relationships throughout the lifespan. Collaborative communication is far more than the sharing of linguistic packets of verbally understood words.

At the neurological level, such a nonverbal, emotional sharing involves the output of the right hemisphere of each member of the interacting pair. As the right hemisphere both sends and receives these signals, the opportunity is created for a “resonance” of the minds of each of the individuals. At this nonverbal, core self-level, the interaction of self with other becomes mapped in the brain in a manner that literally, neurologically, creates the mind of the other. In Stern and in Damasio’s terms, we can propose that the emerging proto-self takes in the signals from the caregiver and maps the changes in the proto-self in response to these nonverbal signals. These signals are “the object” that produces the changes in the proto-self, and thus, are themselves woven directly into the construction of the core self. The core self is the second-order neural mapping of the changed proto-self as core consciousness focuses attention on the “object”—the caregiver’s face, eye gaze, tone of voice, and gestures.

We can propose that within the child’s brain is created a multisensory image of the emerging caregiver’s nonverbal signals. These nonverbal signals reveal the primary emotional states of the individual’s mind. These primary emotions, the music of the mind, are the most direct way in which the nonverbal, subjective state of one’s current mental processing can be externally expressed to another person. Such primary emotions are the profiles of activation, the flows of energy and nonverbal information, that reveal the primary essence of one’s mind. It is in this manner that emotionally attuned communication, the resonant sharing of nonverbal signals, allows for the child to “feel felt” and to create a secure attachment with that connecting adult. It is the sharing of these nonverbal expressions of primary emotions that allows for the most direct connection of one mind to another. Within such attuned, collaborative experiences the securely attached child’s core self is then able to reflect a coherence between the self and
the “other.” This defining focus of the self as a “self-with-attuned-other” is, I believe, the developmental origins of our natural capacity for caring about and feeling connected to others in the world.

The heart of the emotional transactions with the growing child can be described as being the sharing and amplification of positive emotional states, and the sharing and reduction of negative states. These repeated and reliable emotional transactions allow a child to feel connected in the world. It is also these communications that allow a child to initially rely on the caregiver for help in regulating her own emotions, and then later to develop a more autonomous form of flexible self-regulation. In this manner attuned emotional communication within secure attachments leads to a healthy and flexible capacity for self-regulation.

COMPLEXITY, COHERENT NARRATIVES, AND NEURAL INTEGRATION

To understand the links among interpersonal communication, personal narratives, and self-regulation, it is helpful to examine the experience of mind from the perspective of complex systems. The application of “complexity theory” or the “nonlinear dynamics of complex systems” to the human mind has been useful in understanding the processes of development and of human experience (Cicchetti & Rogosch, 1997b; Fogel, Lyra, & Valsiner, 1997; Globus & Arapia, 1993; Lewis, 1995, 1997; Robertson & Combs, 1995; Thelen, 1989). Complexity theory examines the ways in which the flow of the states of activation of a system has self-organizational properties, movement toward maximizing complexity, and recursive, self-reinforcing processes. Application of these principles to the layers of systems, from neural circuits to interpersonal relationships, can provide useful insights into the bridges across these levels of analysis.

Development can be seen as a movement toward ever more complex states of processing over the lifespan (Thelen, 1989). In this manner, the brain as a complex system may be naturally capable of attaining states of connection within its own neural circuits that allow it to achieve greater and greater degrees of integrated functioning. Such integration—the clustering of distinct, differentiated components into a functional whole—can be seen as allowing the brain to achieve these higher states of complexity. Complexity can be viewed as a flow of states of activation that move between the extremes of sameness, order, and rigidity on one side, and variation, randomness, and chaos on the other. The flow of states between order and chaos creates the maximal complexity of a system. The key element in attaining such complexity within a system’s changing states is the combining of differentiation (component parts being distinct and well-developed in their own uniqueness) with integration (clustering into a functional whole). Making component parts identical—sameness and order of the system—may create a form of integration, but the elimination of the unique elements of differentiation actually decreases the level of complexity achievable by the system. Having component parts of a system activated in total isolation from each other—randomness and chaos of the system—may permit differentiation but lacks the integration necessary to achieve complexity.

Human relationships may involve these principles of complexity. Secure attachments enable resonant interpersonal connections in that they foster the blend of differentiation of each individual with the integration of each person within collaborative, contingent forms of emotional communication. In this manner, we can see that human relationships that encourage both individual differences (differentiation), and interpersonal collaboration (integration) may nurture the most complex states. Nonlinear dynamics suggests that systems that move toward such complexity are in fact the most stable, flexibly adaptive, and capable of a wide range of “self-organizing” processes. Within secure attachments, such self-organization may be seen as the...
ultimate gift that caregivers offer to their children: to enable the self to achieve differentiation and integration in acquiring flexible and adaptive means for self-regulation. Such an ongoing process involves the internal adjustment of mental functions as well as the continual modification of interpersonal connections. This capacity to modify both the internal and the external (interpersonal) dimensions of connections may be at the heart of mental health and emotional well-being.

The linkage of secure attachment, the development of mindsight, and the integrating role of nonverbal and verbal processing can also help us to explore the possible connections between coherent autonoesis and collaborative interpersonal relationships. In a fundamental way, both are about the interconnectedness of life. Each also involves the process of neural integration. The processes of coherent self-knowledge and of collaborative interpersonal communication each appear to be mediated by the same integrating prefrontal region. This region and these processes are fundamentally involved in connecting widely distributed and differentiated functions into a coherent whole. They thus involve integration at both the intra- and interpersonal level of organization.

From the beginning of development, the brain has the capacity to differentiate its circuitry and also to integrate its functioning. This blend of differentiation and integration within the single brain also applies to the nature of the development of the child within interpersonal relationships. From the beginning, the brain is capable of — and, in fact, is hard-wired to — make connections with other brains. As we have seen, the core self evolves in the response of the emerging proto-self in interactions with objects, including others in the world. As the more complex capacity for autonoesis develops and creates an autobiographical self, these third-order neural maps are built on the second- and first-order mappings of the self in interaction with others in the world. In this fundamental way, the manner in which we come to construct our integration of past-present-future is built upon the self in interaction with other selves. This is the way in which the collaborative communication of attachment relationships directly shapes the development of the self.

The contingent, collaborative communication of secure attachments produces a coherence within the here-and-now core self as well as in the past-present-future integrating autobiographical self. In this manner, coherent interpersonal relationships produce coherent neural integration within the child that is at the root of adaptive “self-regulation.”

A parent with a flexible access to an integrating process that enables self-regulation would likely be more emotionally accessible to the range of states and signals provided by a child. Attachment research suggests that we learn different adaptive strategies early in life for communicating with other individuals. “Integration” can be proposed to be a central self-organizing mechanism that links the seemingly disparate aspects of emotion, narrative, and interpersonal relationships within the human mind. The “wholeness” of this integrative process can be described within the concept of “coherence” in which the disparate elements contribute to the flow of a system toward maximal complexity. Within this adaptive and flexible flow of states, individual components remain highly differentiated AND functionally united. Coherent narratives may reflect such an integrative process within the mind. Interpersonal integration can be seen when the mind of one person has the free flow of energy and information with another mind. Such adaptive and flexible states flow between regularity, sameness, and predictability on one side and novelty, change, and uncertainty on the other. This flow of states yields a maximal degree of complexity. Such dyadic states may be seen within securely attached children and their parents.

The structure of the narrative process itself may also reveal the central role of integration in states of mental health and emotional resilience. Within the brain, the neural integration of the processes dominant in the left hemisphere with those dominant in the right can be proposed...
to produce a “bihemispheric” coherence that enables many functions to occur. The left hemisphere functions as what has been called an “interpreter,” searching for cause–effect relationships in a linear, logical mode of cognition. The right hemisphere is thought to mediate autonoe tic consciousness and the retrieval of autobiographical memory. Also dominant on the right side are elements of the mindsight module of information processing. Coherent narratives can thus be proposed to be a product of the integration of left and right hemisphere processes: the drive to explain cause–effect relationships (left) and to understand the minds of others and of the self within autonoe tic consciousness (right). In this manner, we can propose that coherent narratives reflect the mind’s ability to integrate its processes across time and across the representational processes of both hemispheres. Could this integrative capacity have more generalized functions, enabling that same individual to then create a “coherent dyadic state”? Is this central process of the mind’s capacity for integration—both internal and interpersonal—the link between narrative and parent–child relationships? Perhaps such a capacity is at the heart of secure attachments.

We can propose that the brain is structured with an innate capacity to transcend the boundaries of the skin of its own body in integrating itself with the world, especially the world of other brains. This linkage permits mindsight and creates the capacity for compassion. Under certain situations, the neurological foundations for mindsight may be compromised and the sense of integration with others may be impaired. With some neurological conditions, such as sensory impairment, caregivers may be especially challenged to provide the kind of connecting, collaborative communication that allows the child to “feel felt,” make sense of the internal world of minds, and create the capacity for mindsight. In other situations, suboptimal caregiving may not have fostered the development of a coherent sense of a core or autobiographical self. We can view these situations as being the inadequate development of a coherent sense of another’s mind within the mind of the child. Such interactions are “incoherent,” and fail to facilitate the child’s own integrative processes. The fundamental outcome of such nonintegrative states can be seen as an impairment in self-regulation.

**UNRESOLVED STATES, DISORGANIZED ATTACHMENT, AND IMPAIRMENTS TO INTEGRATION**

One form of impaired integration and self-regulation can be seen within the minds of those individuals with unresolved trauma or grief. In this situation, we can propose, the mind has been unable to integrate various aspects of the overwhelming experiences of trauma or loss. With this unresolved condition, an adult’s mind may be vulnerable to entering “altered states” in interaction with others, especially with children. These states may be considered “lower-mode states” (Siegel, 1999) in which the functioning of the integrating prefrontal regions becomes temporarily impaired and behavioral output is driven more by the emotional states and impulses of the lower regions of the brain without the more reflective, rational processes of the higher, neocortical inputs. In this “low-road” state, the caregiver may be more likely to offer the child the frightened, frightening, or disorganizing interactions that have been proposed by Main and Hesse (1990) to be at the root of disorganized attachments.

The term “response flexibility” (Siegel, 1999) can be used to describe an important integrative process mediated by the orbitofrontal region of the prefrontal cortex. Response flexibility refers to the capacity of the brain to respond to changes in the internal or external environment with a flexibly adaptive range of behavioral or cognitive responses. A number of studies point to the central role of the orbitofrontal region in carrying out such a capacity (Mesulam, 1998; Nobre et al., 1999). One can propose that this ability requires the integrative
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Entry into such lower-mode states may produce excessive emotional reactions, inner turmoil, dread, or terror, as well as an ensuing sense of shame and humiliation. In such conditions, the individual may be prone to “infantile rage” and aggressive, intrusive, or outright violent behavior. The entry into such states directly impairs the capacity of the individual to maintain collaborative communication with others. In this way, the tendency to have an impairment in response flexibility and autonoetic consciousness within lower mode states may be at the core of how parents with unresolved trauma engage in the frightened and/or frightening behaviors that lead to disorganized attachment in their offspring. Lower-mode states do not allow for the sensitive, contingent communication that secure attachments require. This may be the core feature of the transfer of trauma and its devastating ripple effects across the generations.

Unresolved trauma or grief, as revealed in the Unresolved/Disorganized category of the Adult Attachment Interview, can thus be proposed to reveal a fundamental lack of neural integration within the adult’s brain. The process of resolution may involve the achievement of a more integrated form of functioning that makes these lower-mode states less likely to occur. During the resolution process, if such disconnected experiences do continue, we would anticipate that the adult would be more readily able to identify them and carry out the essential interactive repair that secure attachments require. As psychotherapeutic interventions promote neural integration, we can imagine that the integrative prefrontal region may become more actively involved in the global functioning of the individual. Resolution would involve the repair of impediments to flexible self-regulation and coherent autonoetic.

Lack of resolution implies a blockage in the flow of information and energy both within the mind and between minds. One example of the failure to achieve integration is in the various forms of dissociation that may accompany lack of resolution. For example, unresolved states may involve the intrusion of elements of implicit memory in the absence of an explicit memory counterpart for past traumatic experiences (Siegel, 1996). Such “disassociations” of mental processes may be at the core of clinical “dissociation” and an outcome of both trauma and earlier histories of disorganized attachments. Lack of resolution also means the blockage in the flow of energy and information between two minds: such impairment may be a central feature of disorganized attachments. In this manner, we can see that impaired internal integration may...
lead to impaired interpersonal integration.

One can see that the general approach to psychotherapy for individuals with unresolved trauma and grief would be to attempt to enhance the mind’s innate tendency to move toward integration, both within the brain and within interpersonal relationships. The caregiver’s ability to engage in attuned, collaborative communication will be greatly enhanced through the resolution process. Therapeutic improvement would be revealed as a more adaptive flexibility of the mind to respond to changes in both the external and internal worlds. An increased capacity to experience a broader range and higher intensity of emotion would emerge, with the caregiver becoming more able to connect with the child on a nonverbal, emotional level. Overall, these changes would reflect not only the freedom from a disorganized sense of self across time as revealed in intrusive shifts in states of mind during lived daily life and within autobiographical reflections, but also the enhanced capacity of the individual to achieve integration (internal and interpersonal) and thus more adaptive and flexible self-regulation.

REFLECTIONS ON INTEGRATION AND MENTAL HEALTH

The finding that the coherence of the adult’s autobiographical narrative is the most robust predictor of the child’s attachment with the parent can help us shed light on the importance of neural integration for both mental health and nurturing interpersonal relationships. Coherent narratives can be seen to reflect the ability of the “interpreting” left hemisphere to utilize the autobiographical, mentalizing, and primary emotional processes of the right hemisphere in the production of “coherent” autonoesis, or self-knowledge. The capacity to achieve such internal coherence may reveal that individual’s ability to allow for the maximal complexity to be achieved within an interhemispheric form of integration within the brain. In this manner, the spontaneous, free flow of information and energy between both of the parent’s hemispheres reflects a core process of integration that enables coherent autonoesis. Such bilateral hemispheric integration may also permit them to engage in the spontaneous dyadic communication that is the hallmark of secure attachments. Such attuned and reflective relationships rely on the spontaneous access to the representational processes of both the nonverbal and verbal hemispheres of the brain. Parents who can achieve such internal resonance—revealed within their coherent autobiographical narratives—will be more likely to nurture the development of such integrative processing through their attuned and reflective interactions with their own children.

The process of integration under normal conditions may yield states of activation that are more adaptive, flexible, and stable over time than nonintegrated, less complex states. As interpersonal experiences early in life shape the manner in which the child develops self-regulatory capacities, attachment patterns may instill characteristic modes of self-organization and interpersonal relatedness. Why would moment-to-moment interactions lead to lasting integrative tendencies within the child? The finding that neural systems have recursively reinforcing processes may help to understand this finding (van Ooyen & van Pelt, 1994). Neural circuits that achieve a certain degree of complexity in their structure and function appear to have self-reinforcing qualities that maintain this level of complex processing. The activation of specific patterns of neuronal firing not only creates mental representations, but it also influences the nature of the complexity that the neural networks are able to achieve. Thus, integrative interpersonal interactions may produce linkages among neural networks that reinforce their very nature. It is in this way that interpersonal communication may facilitate a direct effect on the organization of the complexity of neural structure.

The communication of emotion can be seen at the core of the interpersonal communication that facilitates integration and the maximizing of complexity. Such interpersonal sharing of
primary emotional states can be conceptualized as a form of “resonance” defined as the mutually influencing activity of separate elements. Resonance is an outcome of integration. As we have seen, emotion is inherently an integrative process. By linking mental processes to each other within the single mind and across two or more minds, emotion serves as the fundamental aspect of mental life that serves to “join” or “integrate” minds. The sense of vitality, authenticity, and resonance that arises with narrative coherence and within attuned dyadic relationships can create a deep sense of meaning and connection within oneself and with others. These integrative processes can be proposed to be at the core of emotional well-being and psychological resilience. The ongoing, dynamic process of integration may be fundamental to the evolving mechanisms within the life of an individual, dyad, family or community’s continual movement toward mental health.

By examining the convergent scientific findings regarding the social nature of the growing mind, we can come to the view that shared subjective experience is one of the most important aspects of human relationships and of psychological development. This perspective from an interpersonal neurobiology of the developing mind yields a scientific, objective view of the importance of subjectivity in human life.

Attachment research suggests that the mind may continue to develop in response to emotional relationships throughout the lifespan (Lichtenstein-Phelps, Belsky, & Crnic, 1998). These changes in the internal mental models of attachment may be mediated by continuing openness of the brain to change in response to experience. Thus, the possibility remains that ongoing experiences, especially those involving the basic aspects of secure attachments described earlier, may enable some individuals to acquire a more richly developed capacity for neural integration. These basic relationship components include collaborative communication, reflective dialogue, interactive repair, coherent narrativization, and emotional communication. The hope is that interpersonal experiences that involve these basic components will offer respect for the individual’s subjective experience within emotionally engaging relationships. Relationships such as those of family, friends, psychotherapy, and the collaborative environment of nurturing communities might facilitate the development of flexible self-regulation and a more integrated way of life for all ages. If we can find a way to facilitate neural integration within the minds of individuals across the lifespan, we may be able to promote a more compassionate world of human connections.

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