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What Is an Intelligence?

I HAVE now set the stage for an introduction of the intelligences. My review of earlier studies of intelligence and cognition has suggested the existence of a number of different intellectual strengths, or competences, each of which may have its own developmental history. The review of recent work in neurobiology has again suggested the presence of areas in the brain that correspond, at least roughly, to certain forms of cognition; and these same studies imply a neural organization that proves hospitable to the notion of different modes of information processing. At least in the fields of psychology and neurobiology, the *Zeitgeist* appears primed for the identification of several human intellectual competences.

But science can never proceed completely inductively. We might conduct every conceivable psychological test and experiment, or ferret out all the neuroanatomical wiring that we desired, and still not have identified the sought after human intelligences. We confront here a question not of the certainty of knowledge but, rather, of how knowledge is attained at all. It is necessary to advance a hypothesis, or a theory, and then to test it. Only as the theory's strengths—and limitations—become known will the plausibility of the original postulation become evident.

Nor does science ever yield a completely correct and final answer. There is progress and regress, fit and lack of fit, but never the discovery of the Rosetta stone, the single key to a set of interlocking issues. This has been true at the most sophisticated levels of physics and

chemistry. It is all the more true—one might say, it is all too true—in the social and behavioral sciences.

And so it becomes necessary to say, once and for all, that there is not, and there can never be, a single irrefutable and universally accepted list of human intelligences. There will never be a master list of three, seven, or three hundred intelligences which can be endorsed by all investigators. We may come closer to this goal if we stick to only one level of analysis (say, neurophysiology) or one goal (say, prediction of success at a technical university); but if we are striving for a decisive theory of the range of human intelligence, we can expect never to complete our search.

Why, then, proceed along this precarious path at all? Because there is a need for a better classification of human intellectual competences than we have now; because there is much recent evidence emerging from scientific research, cross-cultural observations, and educational study which stands in need of review and organization; and perhaps above all, because it seems within our grasp to come up with a list of intellectual strengths which will prove useful for a wide range of researchers and practitioners and will enable them (and *us*) to communicate more effectively about this curiously seductive entity called the intellect. In other words, the synthesis that we seek can never be all things for all people, but it holds promise of providing some things for many interested parties.

Before moving on to the intellectual competences themselves, we must consider two topics. First of all, what are the prerequisites for an intelligence: that is, what are the general desiderata to which a set of intellectual skills ought to conform before that set is worth consideration in the master list of intellectual competences? Second, what are the actual criteria by which we can judge whether a candidate competence, which has passed the "first cut" ought to be invited to join our charmed circle of intelligences? As part and parcel of the list of criteria, it is also important to indicate those factors that suggest we are on the wrong track: that a skill that had appeared as a possible intellectual competence does not qualify; or that a skill that seems very important is being missed by our approach.

Prerequisites of an Intelligence

To my mind, a human intellectual competence must entail a set of skills of problem solving—enabling the individual *to resolve genuine problems or difficulties* that he or she encounters and, when appropriate, to create

an effective product—and must also entail the potential for *finding or creating problems*—thereby laying the groundwork for the acquisition of new knowledge. These prerequisites represent my effort to focus on those intellectual strengths that prove of some importance within a cultural context. At the same time, I recognize that the ideal of what is valued will differ markedly, sometimes even radically, across human cultures, within the creation of new products or posing of new questions being of relatively little importance in some settings.

The prerequisites are a way of ensuring that a human intelligence must be genuinely useful and important, at least in certain cultural settings. This criterion alone may disqualify certain capacities that, on other grounds, would meet the criteria that I am about to set. For instance, the ability to recognize faces is a capacity that seems to be relatively autonomous and to be represented in a specific area of the human nervous system. Moreover, it exhibits its own developmental history. And yet, to my knowledge, while severe difficulties in recognizing faces might pose embarrassment for some individuals, this ability does not seem highly valued by cultures. Nor are there ready opportunities for problem finding in the domain of face recognition. Acute use of sensory systems is another obvious candidate for a human intelligence. And when it comes to keen gustatory or olfactory senses, these abilities have little special value across cultures. (I concede that people more involved than I in the culinary life might disagree with this assessment!)

Other abilities that are certainly central in human intercourse also do not qualify. For instance, the abilities used by a scientist, a religious leader, or a politician are of great importance. Yet, because these cultural roles can (by hypothesis) be broken down into collections of particular intellectual competences, they do not themselves qualify as intelligences. From the opposite end of analysis, many skills tested for perennially by psychologists—ranging from recall of nonsense syllables to production of unusual associations—fail to qualify, for they emerge as the contrivances of an experimenter rather than as skills valued by a culture.

There have, of course, been many efforts to nominate and detail essential intelligences, ranging from the medieval trivium and quadrivium to the psychologist Larry Gross's list of five modes of communication (lexical, social-gestural, iconic, logico-mathematical, and musical), the philosopher Paul Hirst's list of seven forms of knowledge (mathematics, physical sciences, interpersonal understanding, religion, literature and the fine arts, morals, and philosophy). On an *a priori* basis, there is nothing wrong with these classifications; and, indeed,

they may prove critical for certain purposes. The very difficulty with these lists, however, is that they are *a priori*—an effort by a reflective individual (or a culture) to devise meaningful distinctions among types of knowledge. What I am calling for here are sets of intelligences which meet certain biological and psychological specifications. In the end, the search for an empirically grounded set of faculties may fail; and then we may have to rely once more on *a priori* schemes, such as Hirst's. But the effort should be made to find a firmer foundation for our favorite faculties.

I do not insist that the list of intelligences presented here be exhaustive. I would be astonished if it were. Yet, at the same time, there is something awry about a list that leaves glaring and obvious gaps, or one that fails to generate the vast majority of roles and skills valued by human cultures. Thus, a prerequisite for a theory of multiple intelligences, as a whole, is that it captures a reasonably complete gamut of the kinds of abilities valued by human cultures. We must account for the skills of a shaman and a psychoanalyst as well as of a yogi and a saint.

Criteria of an Intelligence

So much, then, for the prerequisites of this undertaking and onward to criteria, or "signs." Here, I outline those considerations that have weighed most heavily in the present effort, those desiderata on which I have come to rely in an effort to nominate a set of intelligences which seems general and genuinely useful. The very use of the word *signs* signals that this undertaking must be provisional: I do not include something merely because it exhibits one or two of the signs, nor do I exclude a candidate intelligence just because it fails to qualify on each and every account. Rather, the effort is to sample as widely as possible among the various criteria and to include within the ranks of the chosen intelligences those candidates that fare the best. Following the suggestive model of the computer scientist Oliver Selfridge, we might think of these signs as a group of demons, each of which will holler when an intelligence resonates with that demon's "demand characteristics." When enough demons holler, an intelligence is included; when enough of them withhold approbation, the intelligence is, if regrettably, banished from consideration.

Ultimately, it would certainly be desirable to have an algorithm for the selection of an intelligence, such that any trained researcher could determine whether a candidate intelligence met the appropriate criteria. At present, however, it must be admitted that the selection (or rejection) of a candidate intelligence is reminiscent more of an artistic judgment than of a scientific assessment. Borrowing a concept from statistics, one might think of the procedure as a kind of "subjective" factor analysis. Where my procedure does take a scientific turn is in the making public of the grounds for the judgment, so that other investigators can review the evidence and draw their own conclusions.

Here then, in unordered fashion, are the eight "signs" of an intelligence:

POTENTIAL ISOLATION BY BRAIN DAMAGE

To the extent that a particular faculty can be destroyed, or *spared* in isolation, as a result of brain damage, its relative autonomy from other human faculties seems likely. In what follows I rely to a considerable degree on evidence from neuropsychology and, in particular, on that highly revealing experiment in nature—a lesion to a specific area of the brain. The consequences of such brain injury may well constitute the single most instructive line of evidence regarding those distinctive abilities or computations that lie at the core of a human intelligence.

THE EXISTENCE OF IDIOTS SAVANTS, PRODIGIES, AND OTHER EXCEPTIONAL INDIVIDUALS

Second only to brain damage in its persuasiveness is the discovery of an individual who exhibits a highly uneven profile of abilities and deficits. In the case of the prodigy, we encounter an individual who is extremely precocious in one (or, occasionally, more than one) area of human competence. In the case of the *idiot savant* (and other retarded or exceptional individuals, including autistic children), we behold the unique sparing of one particular human ability against a background of mediocre or highly retarded human performances in other domains. Once again, the existence of these populations allows us to observe the human intelligence in relative—even splendid—isolation. To the extent that the condition of the prodigy or the *idiot savant* can be linked to genetic factors, or (through various kinds of non-invasive investigative methods) to specific neural regions, the claim upon a specific intelligence is enhanced. At the same time, the selective absence of an intel-

lectual skill—as may characterize autistic children or youngsters with learning disabilities—provides a confirmation-by-negation of a certain intelligence.

AN IDENTIFIABLE CORE OPERATION OR SET OF OPERATIONS

Central to my notion of an intelligence is the existence of *one or more* basic information-processing operations or mechanisms, which can deal with specific kinds of input. One might go so far as to define a human intelligence as a neural mechanism or computational system which is genetically programmed to be activated or "triggered" by certain kinds of internally or externally presented information. Examples would include sensitivity to pitch relations as one core of musical intelligence, or the ability to imitate movement by others as one core of bodily intelligence.

Given this definition, it becomes crucial to be able to identify these core operations, to locate their neural substrate, and to prove that these "cores" are indeed separate. Simulation on a computer is one promising way of establishing that a core operation exists and can in fact give rise to various intellectual performances. Identification of core operations is at this point still largely a matter of guesswork, but it is no less important on that account. Correlatively, resistance to the detection of core operations is a clue that something is amiss: one may be encountering an amalgam which calls for decomposition in terms of its own constituent intelligences.

A DISTINCTIVE DEVELOPMENTAL HISTORY, ALONG WITH A DEFINABLE SET OF EXPERT "END-STATE" PERFORMANCES

An intelligence should have an identifiable developmental history, through which normal as well as gifted individuals pass in the course of ontogeny. To be sure, the intelligence will not develop in isolation, except in an unusual person; and so it becomes necessary to focus on those roles or situations where the intelligence occupies a central place. In addition, it should prove possible to identify disparate levels of expertise in the development of an intelligence, ranging from the universal beginnings through which every novice passes, to exceedingly high levels of competence, which may be visible only in individuals with unusual talent and/or special forms of training. There may well be distinct critical periods in the developmental history, as well as identifiable milestones, linked either to training or to physical

maturation. Identification of the developmental history of the intelligence, and analysis of its susceptibility to modification and training, is of the highest import for educational practitioners.

AN EVOLUTIONARY HISTORY AND EVOLUTIONARY PLAUSIBILITY

All species display areas of intelligence (and ignorance), and human beings are no exception. The roots of our current intelligences reach back millions of years in the history of the species. A specific intelligence becomes more plausible to the extent that one can locate its evolutionary antecedents, including capacities (like bird song or primate social organization) that are shared with other organisms; one must also be on the lookout for specific computational abilities which appear to operate in isolation in other species but have become yoked with one another in human beings. (For example, discrete aspects of musical intelligence may well appear in several species but are only joined in human beings.) Periods of rapid growth in human prehistory, mutations that may have conferred special advantages upon a given population, as well as evolutionary paths that did not flourish, are all grist for a student of multiple intelligences. Yet it must be stressed that this is an area where sheer speculation is especially tempting, and firm facts especially elusive.

SUPPORT FROM EXPERIMENTAL PSYCHOLOGICAL TASKS

Many paradigms favored in experimental psychology illuminate the operation of candidate intelligences. Using the methods of the cognitive psychologist, one can, for example, study details of linguistic or spatial processing with exemplary specificity. The relative autonomy of an intelligence can also be investigated. Especially suggestive are studies of tasks that interfere (or fail to interfere) with one another; tasks that transfer (and those that do not) across different contexts; and the identification of forms of memory, attention, or perception that may be peculiar to one kind of input. Such experimental tests can provide convincing support for the claim that particular abilities are (or are not) manifestations of the same intelligences. To the extent that various specific computational mechanisms—or procedural systems—work together smoothly, experimental psychology can also help demonstrate the ways in which modular or domain-specific abilities may interact in the execution of complex tasks.

Support from Psychometric Findings

Outcomes of psychological experiments provide one source of information relevant to intelligences; the outcomes of standard tests (like I.Q. tests) provide another clue. While the tradition of intelligence testing has not emerged as the hero of my earlier discussion, it is clearly relevant to my pursuit here. To the extent that the tasks that purportedly assess one intelligence correlate highly with one another, and less highly with those that purportedly assess other intelligences, my formulation enhances its credibility. To the extent that psychometric results prove unfriendly to my proposed constellation of intelligences, there is cause for concern. It must be noted, however, that intelligence tests do not always test what they are claimed to test. Thus many tasks actually involve the use of more than their targeted ability, while many other tasks can be solved using a variety of means (for example, certain analogies or matrices may be completed by exploiting linguistic, logical, and/or spatial capacities). Also, the stress on paper-and-pencil methods often precludes the proper test of certain abilities, especially those involving active manipulation of the environment or interaction with other individuals. Hence, interpretation of psychometric findings is not always a straightforward matter.

Susceptibility to Encoding in a Symbol System

Much of human representation and communication of knowledge takes place via symbol systems—culturally contrived systems of meaning which capture important forms of information. Language, picturing, mathematics are but three of the symbol systems that have become important the world over for human survival and human productivity. In my view, one of the features that makes a raw computational capacity useful (and exploitable) by human beings is its susceptibility to marshaling by a cultural symbol system. Viewed from an opposite perspective, symbol systems may have evolved *just in those cases* where there exists a computational capacity ripe for harnessing by the culture. While it may be possible for an intelligence to proceed without its own special symbol system, or without some other culturally devised arena, a primary characteristic of human intelligence may well be its "natural" gravitation toward embodiment in a symbolic system.

These, then, are criteria by which a candidate intelligence can be judged. They will be drawn on repeatedly, as appropriate, in each of

the substantive chapters that follows. It is germane here to remark on certain considerations that might cause one to rule out an otherwise plausible candidate intelligence.

Delimiting the Concept of an Intelligence

One group of candidate intelligences includes those that are dictated by common parlance. It may seem, for example, that the *capacity to process auditory sequences* is a strong candidate for an intelligence; indeed, many experimentalists and psychometrians have nominated this capacity. However, studies of the effects of brain damage have repeatedly documented that musical and linguistic strings are processed in different ways and can be compromised by different lesions. Thus, despite the surface appeal of such a skill, it seems preferable not to regard it as a separate intelligence. Other abilities frequently commented upon in specific individuals—for example, remarkable common sense or intuition—might seem to exhibit such signs as "prodigiousness." In this case, however, the categorization seems insufficiently examined. More careful analysis reveals discrete forms of intuition, common sense, or shrewdness in various intellectual domains; intuition in social matters predicts little about intuition in the mechanical or musical realm. Again, a superficially appealing candidate does not qualify.

It is, of course, possible that our list of intelligences is adequate as a baseline of core intellectual abilities, but that certain more general abilities may override, or otherwise regulate, the core intelligences. Among candidates that have frequently been mentioned are a "sense of self," which derives from one's peculiar blend of intelligences; an "executive capacity," which deploys specific intelligences for specific ends; and a synthesizing ability, which draws together conclusions residing in several specific intellectual domains. Beyond challenge, these are important phenomena, which demand to be considered, if not explained. Such discussion, however, is a task best left until later when, having introduced the specific intelligences, I initiate a critique of my own in chapter 11. On the other hand, the question of how specific intelligences come to be linked, supplemented, or balanced to carry out more complex, culturally relevant tasks, is one of the utmost importance, to which I shall devote attention at several points in this book.

Once one has set forth the criteria or signs most crucial for the identification of an intelligence, it is important to state as well what intelligences are *not*. To begin with, intelligences are not equivalent to sensory systems. In no case is an intelligence completely dependent upon a single sensory system, nor has any sensory system been immortalized as an intelligence. The intelligences are by their very nature capable of realization (at least, in part) through more than one sensory system.

Intelligences should be thought of as entities at a certain level of generality, broader than highly specific computational mechanisms (like line detection) while narrower than the most general capacities, like analysis, synthesis, or a sense of self (if any of these can be shown to exist apart from combinations of specific intelligences). Yet it is in the very nature of intelligences that each operates according to its own procedures and has its own biological bases. It is thus a mistake to try to compare intelligences on all particulars; each must be thought of as its own system with its own rules. Here a biological analogy may be useful. Even though the eye, the heart, and the kidneys are all bodily organs, it is a mistake to try to compare these organs in every particular: the same restraint should be observed in the case of intelligences.

Intelligences are not to be thought of in evaluative terms. While the word *intelligence* has in our culture a positive connotation, there is no reason to think that an intelligence must necessarily be put to good purposes. In fact, one can use one's logical-mathematical, linguistic, or personal intelligences for highly nefarious purposes.

Intelligences are best thought of apart from particular programs of action. Of course, intelligences are most readily observed when they are being exploited to carry out one or another program of action. Yet the possession of an intelligence is most accurately thought of as *a potential*: an individual in possession of an intelligence can be said to have no circumstance that prevents him from using that intelligence. Whether he chooses to do so (and to what end he may put that intelligence) fall outside the purview of this book. (See notes to page 68.)

In the study of skills and abilities, it is customary to honor a distinction between *know-how* (tacit knowledge of how to execute something) and *know-that* (propositional knowledge about the actual set of procedures involved in execution). Thus, many of us know how to ride a bicycle but lack the propositional knowledge of how that behavior is carried out. In contrast, many of us have propositional knowledge about how to make a soufflé without knowing how to carry this task through to successful completion. While I hesitate to glorify this

rough-and-ready distinction, it is helpful to think of the various intelligences chiefly as *sets of know-how*—procedures for doing things. In fact, a concern with propositional knowledge about intelligences seems to be a particular option followed in some cultures, while of little or no interest in many others.

Conclusion

These remarks and cautionary notes should help to place in proper perspective the various descriptions of specific intelligences which constitute the next part of this book. Naturally, in a book reviewing a whole spectrum of intelligences, it is not possible to devote sufficient attention to any specific one. Indeed, even to treat a single intellectual competence—like language—with sufficient seriousness would require at least one lengthy volume. The most that I can hope to accomplish here is to provide a feeling for each specific intelligence; to convey something of its core operations, to suggest how it unfolds and proceeds at its highest levels, to touch upon its developmental trajectory, and to suggest something of its neurological organization. I shall rely heavily on a few central examples and knowledgeable "guides" in each area and can only offer my impression (and my hope!) that most of the pivotal points could have been equally well conveyed by many other examples or guides. Similarly, I will depend on a few key cultural "roles," each of which utilizes several intelligences but can properly be said to highlight the particular intelligence under study. Some notion of the wider data base on which I am drawing, and of the sources relevant for a fuller inquiry into each intelligence, can be gained from a study of the references for each chapter. But I am painfully aware that a convincing case for each of the candidate intelligences remains the task for other days and other volumes.

A final, crucial point before I turn to the intelligences themselves. There is a universal human temptation to give credence to a word to which we have become attached, perhaps because it has helped us to understand a situation better. As noted at the beginning of this book, *intelligence* is such a word; we use it so often that we have come to believe in its existence, as a genuine tangible, measurable entity, rather than as a convenient way of labeling some phenomena that may (but may well not) exist.

This risk of reification is grave in a work of exposition, especially in one that attempts to introduce novel scientific concepts. I, and sympathetic readers, will be likely to think—and to fall into the habit of saying—that we here behold the "linguistic intelligence," the "interpersonal intelligence," or the "spatial intelligence" at work, and that's that. But it's not. These intelligences are fictions—at most, useful fictions—for discussing processes and abilities that (like all of life) are continuous with one another; Nature brooks no sharp discontinuities of the sort proposed here. Our intelligences are being separately defined and described strictly in order to illuminate scientific issues and to tackle pressing practical problems. It is permissible to lapse into the sin of reifying *so long as we remain aware that this is what we are doing.* And so, as we turn our attention to the specific intelligences, I must repeat that they exist not as physically verifiable entities but only as potentially useful scientific constructs. Since it is language, however, that has led us to (and will continue to dip us into) this morass, it is perhaps fitting to begin the discussion of the particular intelligences by considering the unique powers of the word.