Autism and the Closure Response: A Discussion of Brain Evolution and Future Treatments

One ostensible drawback of Darwin’s theory of natural selection is that it focuses almost exclusively on the interaction between organisms and the environment. That is clearly an important aspect of evolution, particularly in a biological sense, since all creatures must adapt to the climate, terrain, food resources and the competition arising within its ecology.

Yet there is another side to evolution, which is perhaps more in the domain of physics than biology; specifically that all organisms are also systems that can only remain functional and intact through internal biochemical, intra-cellular and intercellular regulatory configurations and interactions. The second law of thermodynamics mandates that all system will ultimately be prone to entropy, but also that the duration of their existence depends in large part on the capacity of their sub-parts to operate in integrative, complementary fashion so that each organ system and each component of singular organ systems are in sync. In simple terms, the organism must have an effective noise-reducing capacity, i.e. a functional means of assuring that messages sent between brain and heart, brain and lungs, hormones and various muscles and bones are not blurred – irrespective of what’s going on in the outside world.

In a sense the dichotomy between the biology and physics of natural selection can be described as a duality involving trait vs. behavioral evolution. Traits have to with skin color, size, musculature, anatomy and other features. Behavior has to do with both external and internal interactions and reactions. Both are equally important. For example having large canines and a strong bite capacity enables hyenas to be proficient hunters. But using the muscles of the jaw to focus the bite on specific anatomical targets of prey requires that several internal systems work together in fluid manner.

The internal component of behavior is of course anchored by memory. Drawing once again on the hyena analogy; while having well coordinated, large canines and jaw muscles would make possible a successful kill, the lack of a pre-set strategy regarding when and whom to prey on as well as how to coordinate the behaviors of the pack would turn the hunt into a trial and error process. Such a blank slate strategy would not favor survival.

*Feed-forward/Feedback*

Memory is by definition an internal neural representation of events. It operates not just by mere recall but by a gauge function, whereby it provides an anticipatory (feed-
forward) trace or outcome-template to a responder to guide its behavior toward the correct anticipated outcome. In other words, to an extent, the organism has to “know” what it’s supposed to do beforehand in order to enact a successful response. (Manan, Zaslayer et al 2003)

The first prerequisite in that process is synchrony among neural circuits so as to make those internal traces discernible (Mahas, Monto et al 2010). Thus one crucial internal adaptation in the evolutionary process had to be synchrony – the capacity for the neuronal rhythms in one system to augment, but not overlap or interfere with others in setting gauges, thereby making possible memory itself.

That synchronizing mechanism was quintessentially important with regard to human brain evolution. With a mass of 1500 centimeters and some 25 billion neural connections the brain of Homo sapiens absolutely requires an inter-coordinated, noise reducing, stimulus and response selection mechanism to function. In a sense, despite our penchant for homo-hubris, a massive brain can be both strength and a weakness, depending on its internal fluidity – or, in other words its noise-reducing, encoding capacity.

Language in the broadest sense
There are several ways by which to utilize an encoding process as a noise-reducer. Two of the most prominent are parsing and closure. Parsing is nothing more than a discriminatory mechanism by which the neurons differentiate between and among inputs. Differing colors, names of people, scientific taxonomies, emotional labels etc are examples of this. Whether it be a toddler pointing at a specific object and calling out its name or a scientist applying different labels to the Specific and General Theories of Relativity, parsing is one of the primary functions of language. It is both external and internal (Luria & Vinogradova 1959) and it narrows down the focus and enables humans to think categorically. Some aspects of that have been beneficial (for example in the domains of math, science, literature and religion). Others have been problematic – as seen in bigotry, the promulgation of false beliefs, and propaganda. The benefits of parsing are two fold. It not only facilitates the categorical organization of knowledge. It also reduces noise in the central nervous system by preventing diffuse pan-arousal that typically accompanies confusion and psycho-physiological upheaval, (Berlyne, 1960). In that sense the internal-physiological and the external-epistemological coincide. They depend on one another, and are in fact two sides of the same coin.

Confusion produces an aversive feeling. Parsing overturns confusion and terminates an unpleasant feeling. In that context, knowledge-seeking is supported by a negative reinforcement process.

The second mechanism is closure. This process depends more on task termination than on labeling and semantic capabilities. While confusion-fomented aversions can be avoided by assigning names to things in the parsing process, they can also be avoided
by finding ways to terminate – or close out - the task. Closure is a central characteristic in human perception and has been shown to underlie the relief factor that drives human curiosity (Jepma, Verdenschot et al 2012) and it encompasses both perception and language.

**Beyond Verbal Language**

Whereas language is typically discussed as a symbolic, communicative function others have viewed it in a broader context – as a kind of meta-linguistic, encoding system that governs not only how people communicate within and amongst one another but how organ systems and mind inter-coordinate in maintaining homeostasis (Luria, 1973). In either case, meta-language is a short cut that operates not just through the Broca and Wernicke language centers but in many other brain centers and for that matter all systems of the body to provide synchrony and reduce noise.

**Autism and the Evolution of Language**

If language is a broad phenomenon encompassing not just interpersonal and intrapersonal interactions but also signals conveyed back and forth between brain and body then its implications for autism are rather interesting.

One question to ask is whether autism is most essentially an expressive/receptive disorder or whether it involves a broader mind-body encoding problem. In other words, can autism be described as an inability to reduce noise per se – language dysfunction being a by product of more general dyspraxia? There is evidence to support that conclusion. For example (Belmonte and Yurgelun (2003) and Belmonte (2000) have shown that lack of synchrony and selective, inhibitory perceptual capacities forces the autistic person to over and under process inputs (which would explain the stimulus aversion typical of the syndrome).

If so, then since a verbal language deficit would make parsing quite difficult the closure strategy might come to the fore as a means of controlling arousal levels and reducing internal noise. In that case one would see an obsession with task-terminating behaviors. More generally, the autistic individual would have a difficult time “enjoying” experiences (which requires some degree of task immersion) and his motivation would be predominantly relief-driven His would be an avoidant take on life fueled by aversive mind-body arousal diffusion and the need to reduce noise through various sensory, vocal and motor behaviors.

While this may sound extremely pessimistic, it should be noted that many non-autistic people not only function in a negative reinforcement context but learn to take pleasure from aversion termination. Indeed according to Freud, even the most primary of hedonistic functions (sex and hunger) are driven by a termination of uncomfortable tension levels. While Sheffield and Roby's classic research study showed drive induction can serve as a motivator (Dorman, Gaudiano 1989) tension reduction remains a viable motivator in many circumstances.
With respect to autistic behavior patterns that raises questions. For example while finger play, noise making, tearing objects and various forms of self stimulation have been variously described as para-linguistic communicative behaviors (hand movements substituting for vocalizations), sensory-orienting and priming mechanisms and inconsequential repetitive activities, they might actually provide an aversion-terminating sensation resulting from the noise reduction created by closure-driven beginning-to-end behavioral sequences.

*In Search of Solutions*

That has implications for treatment and education. In fact if it is a valid point, then the existential barrier separating instructor from autistic student would seem quite imposing. For example in setting up a behavioral or skills teaching format the instructor might ask *what rewards the student prefers* (implying that the student derives pleasure from reinforcers provided for a desired response sequence. Words like “enjoy” and “prefer” might be inherent in the teaching plan. On the other hand the autistic student might speak an entirely different language. For him there is no “prefer,” only the cold, singular question of when the task begins and ends – with emphasis on the latter. For him termination is the reward (particularly for the less verbal students. who cannot parse) and nothing inherent in the task itself is necessarily pleasurable. While the instructor might reinforce the student with comments like “Good job” or “That’s great work” the real music to the student’s ears might be more like “you’re almost finished - a little more to go - great, you’re done. No more to do.” Such closure-reinforcement comments might be encouraging because they signal not just the end of the task but also provide closure-related resolution to the asynchrony and accompanying diffuse, noisy arousal levels that are a pervasive element of autism (Iversen, 2006).

In that context, one might expect the use of synchrony, i.e rhythm-based teaching methods to be successful, due to the fact that externally provided rhythm and synchrony serving could serve as a kind of “neural prosthetic” for the highly dyspraxic autistic individual. In that regard, some studies have shown that a rhythm teaching method can not only be effective with autism but is often used by the autistic person himself as a coping device (See 2012) Body swaying, speaking in musical tones, hand play and other measures could well be a way of creating self imposed neural synchrony - especially during high states of arousal and neural cacophony.

If noise-reducing and closure-inducing behaviors serve negative reinforcement purposes then one might expect these patterns to be resistant to extinction or redirected learning. Some research suggests that is indeed the case. For example when attempts are made to extinguish such behavior substitutions often recur in other forms. (Edelson 2010)

*Treatment Considerations*

In that context the ultimate question would revolve around future treatment possibilities. Theoretically any method that converted a rhythm deficiency within the brain and body (dyspraxia) into synchrony would go a long way toward ameliorating autistic symptoms. No single biochemical process or modality seems up to the task, though it is known that the neurotransmitter gamma-aminobutyric acid (GABA) does
play a role in modulating the activity between inhibitory and excitatory neuronal activity in the brain and has some role in orchestrating internal rhythm in the central nervous system.

Another interesting possibility could be that autistic dyspraxia is itself a secondary process dependent on a prior mechanism to utilize its parsing capacities. That “something” might a preparatory state of basal arousal strong enough to meet, cushion and diminish inputs – as a kind of filtering or shielding mechanism. Such a neural shield could hold in abeyance the impingement of inputs long enough so that neural parsing and rhythmic dispersion could then occur. This is of course speculative and the question of whether a shield, a post-input parsing deficiency (or both) are involved might be difficult to ascertain with currently available technology.

In either case autism could be viewed an overly “tender” brain capable of seeing tunnels but not horizons, making noise reduction, mind-body encoding, self awareness and linguistic ability difficult if not impossible and requiring compulsive closure-inducing behavior patterns and rhythmic behavioral compensations for perceptual and social adaptation.

Given the above assumptions, futuristic projections seem appropriate. It does not appear biochemical treatments would suffice to re-create the internal synchrony needed to ameliorate autistic symptoms. The neurochemistry in the brain is more sword than scalpel and while certain neurotransmitters target (broadly) specific brain circuits, it seems they have to be orchestrated by some para-chemical agent to work their magic. On the other hand the brain mechanism that does the orchestrating might well be neuro-computational, i.e. an algorithmic/mathematical encoding process determining which inputs go here and which go there. As a para-organic mechanism it might be subject to modification.

The superimposition of rhythmic prosthetics over brain activity – with perhaps an artificial shield device operating on the senses to stop and parse inputs might be something to look forward to as information technology (and particularly AI) developments move forward. One can hope that in the future it might be possible for mini-computers to brace and alter initial inputs, superimpose (silently – to avoid the same overload it purports to prevent) a cadence over diffuse sensory inputs and provide a synchronous umbrella over seemingly nonsensical autistic vocalizations (which might in many instances be potentially appropriate language mangled by a chunked, closure-driven, topography – in other words an overly rapid beginning-to-end expressive format which we patient, grammatical types are unable to decode).

While this might not be out of the realm of possibility, it would require a highly meticulous methodology. The first step might be to determine what signal frequencies and/or degrees of noise are typical for each autistic individual, i.e. what the sequence delays are between, say stimulus A and stimulus B, what massing (vs parsing) proportion exists as inputs are received, how quickly inputs impinge on the brain and sensory
systems and what basal arousal levels are needed to produce the shield mechanism. These would be daunting tasks for the scientist but nonetheless comprise interesting food for thought.

**FONTE:** http://www.edarticle.com/