Shyness, Adaptation, Human Contact

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Introduction

A number of colleagues of mine are quiet; now that does not make them shy. But a number of them are also shy. Social shyness can render navigation into new vistas in the social milieu at times burdensome. Like the larger literature, social shyness is not the same as social anxiety, though a subtype of individuals have both (see Jones, Schulkin, & Schmidt, 2014; Kagan, 1994; Schmidt & Schulkin, 1999). And having both is no fun under circumstances in which anxiety runs high. And anxiety is expensive; it takes a toll on bodily tissue, including the brain (McEwen, 1998, 2017).

But human ingenuity is central to our evolutionary ascent. We figure out how to compensate for where we are vulnerable, or at least we can. And perhaps an exaggerated behavioral inhibition might slow an impulsive response and delay it to promote more rumination and reflection. Adaptive alternatives are rooted social viability. The shy person may be forced to reflect and perhaps search for alternatives to promote social comfort.

But shyness is not one thing (Schmidt & Schulkin, 1999). There are diverse kinds of shyness, though behavioral social inhibition to unfamiliar events is a generic feature of social shyness (Kagan, 1989). Indeed, there are several subtypes of shyness. But my interest, like others, is tied to behavioral inhibition and the navigation of the social milieu (Kagan, 1989, 2002; Schmidt & Schulkin, 1999).

I have always thought since I was introduced to this phenomenon by Jerome Kagan that there probably are diverse ways in which shyness is a rather nice feature, not a detriment, and a positive attribute as I conveyed over many years to my friend and colleague Louis Schmidt. Our first book together (Schmidt & Schulkin, 1999) was on the extreme version of shyness that leads to fear, social duress, and

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debilitation. But I worried about the overselling certain features, the anxiety that pervades the anticipation of social performance, presentation, and novel events.

Shy individuals like the rest of us are rooted in the world of objects and transactions with others from birth. A primary adaptation is towards getting coherence in a social world; social cognitive dispositions predominate among other cognitive/physiological predilections essential for adaptation and coherence of action. Making sense of others is thus a core adaptation (Cacioppo, Visser, & Pickett, 2006; Kunda, 1999).

We come prepared to make sense of the objects around us—particularly conspecifics. Shy individuals are no different in this fundamental adaptation. And perhaps even better in certain capabilities. In this essay, I begin with social evolution and human social competence, social tracking, neural and social sensibilities, and finally human well-being.

Human Evolution of Social Capability

Human evolution placed social knowledge and social context at a premium. Prosocial behavior underlies the sensibility that pervades human experience resulting in significant human contact (Darwin, 1859/1958, 1872/1998). There are many ways in which to facilitate social contact, and by definition, human contact almost always has a social component.

Two features stand out about human adaptation: good enough fit of capabilities suited to social context and flexibility. Shy individuals are no different. Without the excessive pathology of the extremely debilitated individuals, shy individuals are no different than the rest of us (Jones et al,. 2014; Kagan, 1994, 2002; Schmidt & Schulkin, 1999).

Darwin, a noted shy and introverted person (Browne, 1996/2003) like many other thinkers, understood that we are social animals. What has emerged in *Homo sapiens* has been an elaboration of social contact, the expansion of individual responsibility manifested in specific types of the division of labor in the service of group safety and human viability, adaptability, and productivity. Technical expansion like modern apps to our machines expands our capabilities. Our modern era shows how these tools can aid or not social interactions. Innovative use of resources expanding one's capabilities comes through in the use of technologies. That is one form of adaptation in the social domain.

For sheer physical amelioration (e.g., touch), bodily sensibility is another primary adaptation. Perhaps, and it would not be surprising, if shy children like others seek diverse forms of social cooperative behaviors (and deceptive) to facilitate social contact, social viability. One key adaptation is simple; social grooming behaviors, comforting others (Cheney & Seyfarth, 1990, 2007). This can lead to social cooperative behaviors; but it is no panacea, and it might not.

We are also a vulnerable species; our ontogeny is long and labored and greatly dependent on others. We look to others to gain that important ladder into the social

milieu. The long dependency on others is a fundamental feature of our species. The social knowledge we gather in ontogeny represents a critical part of our armament for gaining a foothold in the larger social world, a world in which recognizing others' intentions (e.g., Jaspers, 1913/1997; Kagan, 1984; Schmidt & Poole, 2018; Tomasello, Kruger, & Ratner, 1993) and gathering practical knowledge are critical. In other words, we come into life prepared to interpret our surroundings as defined by the social milieu, and the degree to which we succeed in this task determines to a great extent our success in coping, achieving, and thriving. The fact that we come prepared to recognize others and learn from their experiences is thus a fundamental social behavioral adaptation.

We know that socially shy children get a foothold in the larger world; they learn from others and learn well and with the same distribution of capabilities. And there seems no developmental delays in most of these capabilities in shy individuals so essential for long-term viability.

Some common themes in our cognitive development, particularly that of social development, in Table 1 (adapted from Tomasello et al., 1993), are depicted in the following.

Exaggerated Social Shyness: Some Biology

Of course, in shy children for which the social anxiety interacts with breakdown in capability, the results are not good, both in the short term and in the long run (Raglan, Schmidt, & Schulkin, 2017). And shy children have this burden, or perhaps not.

Shy children tend to secrete, for instance, less cortisol as they grow in maturity. They start with a tendency of an exaggerated cortisol response (Kagan, Resnick, & Snidman, 1988; Schmidt et al., 1997; Schmidt, Fox, Schulkin, & Gold, 1999; Schmidt, Fox, Sternberg, et al., 1999). Cortisol is the major adrenal steroid vital for

Table 1 Some developmental capabilities

Infancy: Understanding others as intentional
1. Following attention and behavior of others: Social referencing, attention following, imitation of acts on objects
2. Directing attention and behavior of others: Imperative gestures, declarative gestures
3. Symbolic play with objects: Playing with "intentionality" of object
Early childhood: Language
1. Linguistic symbols and predication: Intersubjective representations
2. Event categories: Events and participants in one schema
3. Narratives: Series of interrelated events with some constant participants
Childhood: Multiple perspectives and representational redescriptions
1. Theory of mind: Seeing situation both as it is and as other believe it to be
2. Concrete operations: Seeing events or object in two ways simultaneously
3. Representational redescription: Seeing own behavior/cognition from "outside" perspective

the organization of action and energy resources. But as shy children develop, they tend to display less cortisol secretion (Beaton et al., 2006, 2008; Schmidt, Fox, & Hamer, 2007; Tang et al., 2015). Over time, perhaps, one adaptation is to under secrete cortisol (Raglan et al., 2017). Hypersecretion of cortisol and inability to reduce its circulation is detrimental to bodily tissue (McEwen, 1998, 2017). Of course, it is all about cephalic/bodily regulation, turning on physiological/behavioral capabilities in suitable contexts and turning them off. Extreme version of shyness is a vulnerability. The issue is adaptation in the face of adverse conditions.

More generally, one adaptive role of cortisol in the maintenance of bodily tissue and in the organization of action in response to novel or unfamiliar events. One feature that can be difficult for shy, social wary events, people etc. And we come prepared often to be wary of novel events, that might be dangerous, disruptive, potentially debilitating (Kagan, 1994, 2002; Rozin, 1976, 1998). One cognitive adaptation is to make the unfamiliar familiar; we flavor the unfamiliar with the familiar (Rozin, 1976). Moreover, inhibited and shy children are more likely to demonstrate exaggerated responses to unfamiliar events (Kagan, 1989; Schmidt et al., 1997; Schwartz, Wright, Shin, Kagan, & Rauch, 2003) that can be predictive into early adulthood (Schwartz et al., 2003).

In other words, it also might be the case that shy individuals feel this extra burden to form contact, and adaptation is an enhanced capability. Perhaps those individuals less likely to be socially anxious are those seeking contact (Gunnar, 1998; Gunnar, Mangelsdorf, Larson, & Hertsgaard, 1989). Indeed, socially fearful individuals can ameliorate some of the internal discomfort by seeking bodily/social contact with others. And the ability to regulate cortisol secretion is present early on in the development (Gunnar & Quevedo, 2007; Schmidt & Schulkin, 1999).

Cortisol is the molecule of energy metabolism; excitement like social anxiety can be expensive; the issue is always about regulation of the internal milieu; and cortisol secretion is part of the internal milieu. Cortisol is elevated in energetic children and socially withdrawn and fearful children in response or anticipation of social presentation: one out of excitement under some conditions and the other social anxiety and social judgment (Gunnar, 1998; Gunnar et al., 1989; Schmidt et al., 1997; Schmidt, Fox, Schulkin, et al., 1999; Schmidt, Fox, Sternberg, et al., 1999). The adaptive side for one is to ameliorate anxiety/fear through social amelioration, while for the other, to not exhaust capability. The adaptive route is many sided; flexibility through rumination may be one side of a shy individual.

And perhaps this rumination preparation keys into other capabilities in the adjustment they make up the social milieu (Schmdit & Schulkin, unpublished manuscript). Moreover, what is distinctive about us, although our species is not alone, is the degree to which we share and participate towards common ends; shared intentions linked to the considerations of others is one of our most important cognitive adaptations (Kagan, 1994; Tomasello et al., 1993). We look at others; it is not surprising that vision, shared visual space, and recognition that we are both looking at the same objects would come to be important cognitive resources (Tomasello, 1999). But it is not simply a cognitive detached event; it is affectively rich, reassuring, and rewarding. The motivation to form meaningful contacts is essential for

development and for life. Shy individuals reach others; too basic to us for this subset of individuals not have this capability. The issues are the varied ways in which this can be accomplished (Tomasello, 2014).

Perhaps, one nice feature of shyness is introversion. It is one feature associated with shyness for some individuals. The expansion of rumination (or not) may lead to reflective equilibrium (Rawls, 1971), solution seeking adaptation that enhances human meaning, social contact, and social solidarity. Shy individuals may be in a better position for such contact. Indeed, one interesting recent hypothesis (Schmidt & Poole, 2018; Schmidt, Fox, Schulkin, et al., 1999; Schmidt, Fox, Sternberg, et al., 1999) suggests that delayed maturation of frontal cortical expression may underlie two things: (1) on the one hand, emotional tension in approach avoidance computational assessment of events (Schmidt & Schulkin, 2000), greater conflict, and more inhibition in adjusting and adapting to the social milieu, but (2) on the other hand, possibly a plus side, namely, a more varied adaptive skills, greater rumination and greater pedagogic possibility, alternative strategies. One reflects proximate evolution, the other more ultimate impacts of social shyness.

Predictive Capability and Social Tracking

Shy individuals track social events. Such tracking pervades our expectations. Diverse cognitive adaptations, including our ability to predict the behaviors of others (Dennett, 1987), are a function of the fact that we tag our fellow humans in terms of their beliefs and desires. This, of course, is a higher order cognitive function. And we use that adaptation to, in part, predict what other human beings do in our social world, as well as their intentions (Dennett, 1987; Premack & Premack, 1995; Tomasello et al., 1993, Tomasello 2014).

A cognitive resource is this ability to track others by what we think they desire and believe. Of course, we track many behaviors that are simpler, for instance, what someone is looking at; joining eye contact on a common object, rooted together in a coordinated fashion, is at the heart of pedagogy. We learn from one another and manipulate one another and predict behaviors by what the focus is on, where the eyes are rotating towards, both externally and literally telling us something about beliefs and desires (Premack & Premack, 1995; Tomasello, 2014).

We come prepared with an arsenal of cognitive adaptations rooted in social discourse and commerce with one another and the construction of objects that we use, our tools. And our evolution is knotted to social groups working in unison across diverse terrains. Key abilities include discerning the wants and the desires of others (a core feature of our adaptations), along with cognitive adaptations such as recognizing the kinds of objects that are useful or affordable (Gibson, 1979) and avoidable (Rozin, 1976), coupled with a wide array of inhibitory capacities that contribute to social cooperative behaviors. Shy individuals are no different (Tsui, LeHat, & Schmidt, 2017).

Cephalic expansion set the stage for technological creations, expanding our sensory systems. Seeing by magnifying became an evolving theme as our capacities were extended, and we turned from managing nature towards understanding nature—tool use, which was critical for this development. The Internet is an outlet, an expansion, and a modern tool for social contact, and it provides one venue for shy individuals to interact. It is perhaps less threatening in some contexts (Schmidt & Poole, 2018).

One result is social contact and a context for cooperative behaviors. And social cooperative behaviors (Dewey, 1925/1989; Greene, Sommerville, Nystrom, Darley, & Cohen, 2001; Greene, Nystrom, Engell, Darley, & Cohen, 2004; Moll & Schulkin, 2009; Moreno, 1995; Tomasello et al., 1993), in addition to an evolutionary arms race of cognitive capabilities, lie at our evolutionary base. Many core capabilities are depicted, such as numerical, spatial, and theory of mind (predicting behaviors on the basis of their beliefs and desires), which are well-known ingredients of the human mind and to some extent other primates (Premack & Premack, 1995). But when the issue turns to social events, young children early on outdistance our closest primate relatives (Tomasello et al., 1993).

The cognitive architecture is linked to making sense of our work. It is reflected in quite different kinds of events important to adaptation. Diverse cognitive systems are involved in the organization of action (Gallistel, 1992; von Holst & von St. Paul, 1963). Cognitive systems were, in part, selected to organize actions that underlie perception (Lakoff & Johnson, 1999; Schulkin, 2000); cognitive systems are not divorced from action but endemic to it.

But these ideas are not in a vacuum; they are in a context that is bodily in nature, struggling to learn something, persevering to acquire something such as knowledge as a contact sport with others, getting linked to others, enjoying the solitude of one's self enclosure amidst the safety of others, or, despite others, forming boundaries of protective parlance. Cognitive adaptation is in the doing of things for coherence of action in complex social environments (e.g., Barrett, Henzi, & Dunbar, 2003; Dewey, 1925/1989; Lakoff & Johnson, 1999; Schulkin, 2003) and for diverse cognitive adaptations to ecological conditions and social communicative functions (Barton et al., 2003; Dunbar, 1992).

Core cognitive architecture is mostly about kinds of objects (Lakoff & Johnson, 1999). As social animals, we are oriented towards diverse expressions of our conspecifics that root us in the social world (Hinde, 1970; Humphrey, 1976; Jolly, 1966), for example, a world of acceptance and rejection and of approach and avoidance towards one another and towards social and ecological objects rich with significance and meaning (Cheney & Seyfarth, 1990, 2007; Schneirla, 1959).

The social world is full of signals of cognitive/behavioral significance (Tinbergen, 1951/1969) that serve as an orientation in the organization of action. And it is the adjudication of the complexity of the social terrain that sets the conditions of approach/avoidance behavioral options (Schneirla, 1959) for which there are different in the neocortical laterality in shy/fearful children (Schmidt, Fox, Schulkin, et al., 1999; Schmidt, Fox, Sternberg, et al. 1999). People with greater right frontal activity exhibit an increased reactivity to negative stimuli, demonstrated as behav-

ioral inhibition and vigilant attention—a withdrawal response. Greater left frontal activity is associated with greater positive affect and greater behavioral activation and goal approach behaviors—an approach response (Schmidt, Fox, Schulkin, et al., 1999; Schmidt, Fox, Sternberg, et al. 1999).

A broad-based set of findings in non-primates has been the link between social complexity and larger brain size (Byrne & Corp, 2004). The metabolic investment of larger brained animals is expensive; neural tissue is a high-energy organ; brains expand while other tissues do not, or at least not to the same degree. Interesting correlations have been suggested between neocortical size and social cognitive skills—Machiavellian skills (Byrne & Corp, 2004; Byrne & Bates, 2007; Whiten, 1991, 1997). Detection and deception amidst cooperation and social prediction is a common occurrence that utilizes diverse cognitive systems (Byrne & Bates, 2007).

Children, shy children included (Kagan, 1994), are oriented within the first few months of life to form social contact through the visual system, to track events in a manner of joint attention (Kagan, 1994, 2002). These events are like social glue, facilitating future transactions with one another and determining social adaptation. The social roots of our diverse cognitive capabilities are pervasive (e.g., Humphrey, 1976; Vygotsky, 1934/1979). Shy children may have exaggerated responses under some conditions to facial and other bodily responses (Tang et al., 2015), but this can be ameliorated. The developmental trajectories are not frozen at the core in most individuals and over time cognitive/behavioral serve to ameliorate. And that is a core factor in our evolutionary capabilities.

The demands of our long postnatal period are essential for pedagogy (Premack and Premack, 1995), during which sets of core cognitive capabilities are expressed (Perner, 1991). One core feature is the ability to determine whether an object is alive or not, or intentional or not, or animated or not. Most, if not all, end organ systems have computational capabilities (e.g., kidney functions) in the maintenance of the internal milieu; but for our purposes, in this context, we are talking about the integration of information from the external world, translated into coherent adaptative functions. This later suggestion of a developmental lag to compensate for greater conflict in navigating may be an advantage over viability later in life.

Cognitive categories figure in our recognition of social and live objects (Tomasello 2014). There is much unresolved debate with regard to the range, innateness, and developmental expression of these capabilities. What is not debated is the fact that they are anchored to our social milieu, getting oriented to others, to the ecological and social surroundings. Shy children figure out ways to do this, and this enhanced capability may be an expanded capability over time.

Early on the social capability is clear in our species. The orientation of the child to a physical domain of objects, and this can appear quite similar on some tasks to the common chimpanzee or orangutan in the first few years in development (Herman, Call, Hernadez-Lioreda, Hare, & Tomasello, 2007); when given problems concerning objects in space, quantities, or drawing inferences in very young humans, chimpanzees and orangutans look similar. What becomes quite evident early on in ontogeny is the link to the vastness of the social world in which the neonate is trying to get a foothold for action (Tomasello, 1999, 2014).

Shy individuals do this quite well, and perhaps the greater conflict in development might serve over time (Schmidt & Poole, 2018). Survival depends upon social capability; viability demands social competence, which entails getting others to participate in the life blood of human activity, from the small to the large. Shyness can be a feature of behavioral inhibition (Kagan, 1994, 2002) which under some conditions might enhance cautiousness in social and unfamiliar contexts and which can be adaptive or not.

The issue for long-term viability is social intelligence. And shy children are not different here. Social intelligence, particularly in primates, is importantly knotted to reproductive success (e.g., Silk, 2007); the alliances formed by mammalian females in a number of species, for instance, are vital for this (e.g., baboons (Silk, 2007)). A premium is set on cognitive evolution, an expression of diverse cognitive/behavioral adaptations coupled with cephalic expansion (Byrne and Corp, 2004; Byrne and Bates, 2007; Whiten, 1997). Behavioral inhibition and social shyness certainly as a single factor probably do not impact this core evolutionary feature. Social collations are essential for survival in our species.

Diverse factors underlie the link between corticalization of function and both social and ecological factors in primate life, life span, group size, terrain adaptation (detection of predation, approach behaviors, foraging behaviors, etc. While shyness as a feature can change over the lifetime of an individual, group size is probably not a factor. And group size is linked to neocortex expansion in hominoids, as is longevity, as depicted subsequently. The pressure on coming into touch with others, creating alliances, and tracking lineages no doubt required more cortical mass (Barton et al., 2003; Byrne & Corp, 2004; Cheney & Seyfarth, 1990, 2007; Dunbar & Shultz, 2007).

Evolution and Adaptation: Neural/Social Sensibilities

We search for the stable amidst the precarious (Darwin, 1859/1958; Dewey, 1925/1989). The search requires diverse cephalic and cultural resources and results in punctuated and gradual cultural epicenters; the human condition remains more precarious, our weapons much more dangerous, and the level of potential destruction much greater. The precarious shifts towards the more stable by cephalic adaptation. Core needs are always a common function satisfied by food, water, sensual contact, sport, explorations, etc. The diverse motivations that underlie these needs are quite broad—as we are broad in potential for expression (e.g., Hofer, 1973; Keverne, 2004; Kagan, 1989). Shy individuals initiate diverse forms of social contact and ameliorate the internal milieu (Gunnar & Quevedo, 2007).

What evolved in our species are long-term social bonds, plasticity of expression, and corticalization of function. And as our cortical visual functions increased dramatically, standing up and looking and forming eye contact began as an evolutionary expansion in many primates. Human social contact, representation of objects, and

use of objects are core cognitive capacities; technology is an extension of ourselves, expanding what we explore.

In addition, regions of the amygdala essential for social attachment and avoidance also demonstrate significant changes in us: for instance, enlargement of the lateral amygdala which is closely tied to neocortical function (Aggleton, 1992/2000; Emery, 2000; LeDoux, 2015; Swanson, 2011/2015). The largest nuclear region is the basal lateral region. In one comparative study of apes and humans (e.g., human, chimpanzee, bonobo, gorilla, orangutan, gibbon), investigators found that the size of the lateral division of the amygdala expands quite a bit in *Homo sapiens* compared to the expansion in other primates (Barton, Aggleton, & Grenyer, 2003).

Since our evolutionary ascent is knotted to our social ability, in addition to tool making and the onset of linguistic competences. This is coupled with a long gestational period (Gould, 2002) and the massive amount of learning that takes place early in ontogeny with a long lactational period and long period of dependency. In addition, there is also a link between our longevity and the evolution of our problem-solving capabilities; our species had a greater opportunity to solve problems over time (e.g., Kaplan & Robson, 2002) and longer more varied for shy individuals to develop alternative strategies of adaptation and adjudication. Of course, that is empirical and we need to know that.

The degree of cognitive competence and social gesture, bipedal organization communicative engagement, diverse tool use, and pedagogy are clearly linked to an expansion of the range of social contact (Dunbar, 1992). For example, the more grooming-related behavioral responses, reconciliation, and social contact, the greater the degree of neocortical expansion, which may be particularly pronounced in females, in whom social contact is obviously linked to reproduction (Jolly, 1966).

The important point in our evolution is the combination of not just deception, but trust and cooperation as important cognitive and regulatory adaptations (Barrett & Henzi, 2005; Byrne & Bates, 2007). Of course, trust and cooperation can enhance the use of deception. Competition is often overstated at the expense of cooperation; we readily cooperate to the benefit of our short- and long-term interests. With corticalization of function came an enhanced capacity to regulate the diverse competing social interests that interact with various motivational systems.

A social brain is distributed across a wide array of neural structures and functions (Barton et al., 2003; Dunbar & Shultz, 2007; Frith & Wolpert, 2003; Greene et al., 2001, 2004; Moll et al., 2006; Moll & Schulkin, 2009) devoted to negotiating complex social interactions. And social attachment is a primary adaptation; evolved sets of neural systems are designed to facilitate social contact. Distinct sets of neurons in diverse regions of the cortex are active when one performs an action and when one watches others do so; this is pristinely shown in studies in macaques (Perrett & Emery, 1994; Rolls, 1999). That does not mean that there is no overlap in neurons that fire to mirroring others and in performing the action (Decety & Jackson 2006); it is just so that we come prepared to respond to others.

Prosocial sensitivity allows humans to quickly apprehend the moral implications in a social situation depending on context, agency, and consequences of one's choices. These sentiments are intrinsically linked to daily social interactions, and

there are several regions in the brain which provide a context for social flexibility. One virtue moral is in "deciding together" (Moreno, 1995). Recognizing the intentions of others is a critical feature in prosocial behaviors. This cognitive capacity begins early in ontogeny and is tied in to visual sensibility (Premack & Premack, 1995; Tomasello et al., 1993).

Recognizing the intentions is knotted to a broad array of cephalic tissue that underlies perspective taking and human social judgment (Adolphs, 1999; Moll et al., 2006). Individuals who are excessively inhibited demonstrate increased reactivity to fearful faces and social events (Tang et al., 2015). Behaviorally inhibited children demonstrate increased vigilance and uncertainty as well as heightened reactivity to novelty, which are accompanied by an increased amygdala response (Schwartz et al., 2003). This region of the brain, in addition to the hippocampus, habituates less in individuals with inhibited temperamental features (Blackford, Allen, Cowan, & Avery, 2013).

And the amygdala is critical for a variety of social behaviors, including play behavior in development (Lewis & Barton, 2006). The vulnerability for a hyperactive amygdala, long thought to contribute to behavioral inhibition towards social events in shy children (Kagan, 1989), is with some empirical support. One key neuropeptide, corticotrophin-releasing hormone or CRH (Schulkin, 2017), may be altered in amygdala function in behavioral inhibited macaques (Kalin, Shelton, & Davidson, 2000). More generally, we know that CRH, in addition to other information molecules, is altered in extreme social wariness in this primate (Erickson et al., 2005; Habib et al., 2000; Kalin et al., 2000, 2016) and probably with our species (Schulkin, 2017).

Of course, CRH interacts with diverse neurotransmitters in the regulation of social shyness. For instance, serotonin or dopamine expression and regulation is tied to adapting to the social milieu, social judgment, social approach, and avoidance and temperamental shyness (Furmark, unpublished; Schmidt et al., 2007). And changes, for instance, in the serotonin gene structure (long and short version of the 5-HTT receptor and dopamine) region has been suggested to be linked to shyness and behavioral inhibition (though the link to behavior does not account for much of the variance). The same information molecule is tied to altered frontal neocortical lateralization of function (Schmidt & Poole, 2018).

Importantly, regions of the brain rich in information molecules are tied to social assessment. In the instance of social unfairness, manipulations of 5-HTT function to influence the sense of unfairness; lower levels are reported to increase retaliation towards others; pharmacological depletion of serotonin increases responses to perceived unfairness (Moll & Schulkin, 2009).

Serotonin, like other broad neurotransmitters, underlies diverse behavioral adaptations, and deviations of normal gene function can tip the balance towards devolution depending upon the social context (Schulkin, 2017): the tone of a response as serotonin, the attentional requirements as central dopamine for response to incentives, and the organization of action. Interestingly, serotonin transporters variation is linked to amygdala function and the regulation of social fear (Hariri et al.,

2002). The enhanced conflict about approach avoidance to the social milieu may gain key access consideration over the long run for shy individuals.

Interestingly, there is some evidence that striatal dopamine and perhaps the prediction of reward may be more enhanced under some conditions for shy inhibited individuals (Guyer et al., 2006), may be perhaps to savor the reward, and may respond to enhanced incentive value.

Prediction of reward and/or incentive value is a fundamental feature of cephalic sensibilities (Berridge, 2007; Schultz, 2002). The findings that there might be greater sensitivity would be a nice adaptation and consistent with greater rumination about possibilities for shy individuals.

Conclusion

Shyness: Being Alone and Being with Others

This edited book is an important reminder of the adaptive value of social shyness, short-term conflict, and perhaps longer-term prosocial values. Reaching out to others is but one a prosocial response that we all share, even though it varies quite a bit across cultures in its expression. The life blood of humanity, after all, is our social bonds (Fromm, 1947; Humphrey, 1976) and the way we enjoy and manage our solitariness. Shy individuals are situated for just such capabilities.

Our brains are designed for social cooperative behaviors and social deception, among other forms of contact. Social contact, meaningful close relationship, is an important factor in well-being. The enhanced rumination that might facilitate some who tend to be introverted, and might be an asset as one grows older, becomes more alone. Meaningful social contact, on the other hand, is an ameliorative biological adaptation (Jaspers, 1913/1997).

Social contact is at the heart of ontogenetic development, a long-noted piece of epistemological history, differently expressed across diverse cultures. Family and group structure through meaningful contact are essential for our mental health. Supportive social contact is not an absolute prophylactic but a helpful ameliorative in combating disease and breakdown. Perhaps one feature of a delayed maturation of neocortical tissue is further room for pedagogic development (Schmidt & Poole, 2018).

We are social animals, as Aristotle noted; anticipatory mechanisms evolved with the social forms of adaptations, taking account of one another, foraging for food, building alliances of social cooperation, deception, and confrontation in group formation. Shyness might blunt some forms of emotion over the life span (Kagan, 1994, 2002; Schmidt & Poole, 2018) and enhance reflective rumination, important for human well-being. Shyness just might provide some advantage of being alone, something essential in life, along with being with others.

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