The framework for disturbed affective consciousness in autism

Neha Khetrapal
Centre for Behavioural and Cognitive Sciences, University of Allahabad, Allahabad, India

Abstract: The current article explores the implication of the interaction of emotion and consciousness for autism. The framework that is proposed for the disorder explains that the compromised functional integrity of the amygdala is the root cause of disturbed affective consciousness. Amygdala, with its connections to various cortical and subcortical regions, helps detect a fearful facial expression at the attentional periphery and make it the focus of attention and awareness for enhanced processing. The conscious life of autistics with respect to affective objects can thus be very different from that of normal people, which leads them to perceive the world differently. They process fearful stimuli the way normal controls perceive common objects by activating areas responsible for feature based analysis rather than the amygdala and other connected areas. Conscious perception of such stimuli is important for appropriate development of emotion concepts, something that autistics lack, thus leading to impairment in the awareness of one’s own emotions especially within the negative spectrum with a prominent position for fearful stimuli. Thus the interaction of emotion with consciousness is ripe for investigation and can help to throw light on the mental life of autistics.

Keywords: emotion, amygdala, visual awareness, fear processing

Introduction
It has recently been argued that consciousness and emotion interact with each other tremendously (Tsuchiya and Adolphs 2007). As the emotional processes interact with consciousness, such an interaction can have implications for cognitive and psychiatric disorders where the emotional processes have been found to be not normal.

According to Tsuchiya and Adolphs (2007), consciousness encompasses two components: the level of a state of consciousness such as wakefulness, coma, and dreamless sleep, and its content, that is, whatever a person is conscious of at a particular point in time (e.g., the color of a house). The contents of conscious experience can be analyzed into their phenomenal aspect. The focus of the current paper will be on the contents of consciousness, assuming the state of wakefulness, and in this case the contents will refer to emotional facial expression since humans rely heavily on facial expressions when communicating emotional states to others.

The aim of the current article is to show what implications such an interaction can have for the disorder of autism. Initially the interplay between consciousness and emotions will be described before applying the description of the interplay to illuminate the disturbed affective consciousness in the disorder. For simplicity, the review will focus on fear processing. Moreover, findings from studies, including samples of autistic as well as Asperger syndrome subjects, will be discussed in this paper.

It is important to keep in mind that only a framework for disturbed affective consciousness will be proposed. A framework is not a detailed hypothesis but is a suggested viewpoint for a particular scientific problem suggesting various hypotheses. A good framework sounds reasonably plausible given a particular set of scientific
data. It is unlikely to be correct in all its details and contains
unstated though unrecognized assumptions but this is
unavoidable due to the inherent nature of frameworks (Crick
and Koch 2007).

A model of interaction between emotion and consciousness
The perception of some stimuli in the environment is impor-
tant for adaptive behavior; eg, an emotional face. Adaptive
behavior requires that processing of some important stimuli
such as an emotional face takes place independently of aware-
ness and attention so that attention could be guided towards
these stimuli which ultimately receive enhanced processing
due to their saliency even while falling outside the focus of
attention. Hence, emotional faces conveying threat signals
enjoy such privileged status (Vuilleumier 2002).

The amygdala plays a very important role in fear pro-
cessing. It receives highly processed information not only
from the visual cortical pathways but also crude information
through a direct subcortical pathway via the thalamus involv-
ing the retinocollicular and the pulvinar projections. The
direct pathway provides fast signals about any potential threat
in the environment such as a fearful face, which bypasses the
slow and fine analysis of the visual cortex. Amygdala also has
direct connections with the fusiform cortex and sends projec-
tions back to orbitofrontal, visual, and the medial prefrontal
cortex, anterior cingulate gyrus, basal forebrain nuclei, and
striatum. These projections enable the amygdala to influence
perceptual and motor processes in response to a threat cue
(Vuilleumier 2002). This arrangement of connections can
help bring the threatening face into the focus of awareness
and attention after it was detected at the attentional periphery.
In support of this claim, brain imaging studies have demon-
strated that visual cortical regions show enhanced activation
in response to emotional stimuli (Kosslyn et al 1996). The
magnitude of this enhanced activation in the visual cortex
is correlated with the activation of the amygdala in response
to these same stimuli (Morris et al 1998a). Vuilleumier and
colleagues (2004) provided further support for the claim
that the amygdala mediates enhanced responses in visual
cortical regions for emotional stimuli. They presented fearful
and neutral faces to normal control subjects, patients with
damage to the hippocampus only, and patients with damage
to the hippocampus and amygdala. Enhanced activation was
observed in visual cortical regions for fear versus neutral
faces in normal control and patients with damage confined
to the hippocampus. Patients with damage to the amygdala
did not show any significant activation for fearful versus
neutral faces in the visual cortex, which supports the role
the amygdala plays in mediating transient changes in visual
cortical processing in response to emotional stimuli.

Another set of results obtained by Pascual-Leone and
Walsh (2001) supports the role of amygdala in bringing the
fearful face detected at the periphery of attention to the focus
of attentional and conscious processing. They show that
conscious experience depends as much on the lower anatomical
regions as on the higher ones but the lower processing
anatomical regions participate at a later point in time. Thus
areas like the early visual cortices and the amygdala and other
structures engaged very early in processing contribute to con-
scious experience but can be compared with activity driven
by feedback from higher regions during a later iteration of
processing when the activity is driven by the stimulus.

Disorder of autism
Autism is a psychiatric syndrome characterized by impair-
ments in social interaction, communication, and restricted
and repetitive behaviors and interests (Salmond et al 2003).
Amygdala has been found to play a role in the neurobiology
of autism (Baron-Cohen et al 2000). Ashwin and colleagues
(2006) gathered evidence to show that compared with normal
adults who activated areas of the social brain like the amygd-
ala while viewing fearful faces implying automatic emo-
tional appraisal of biologically relevant stimuli, the autistic
individuals showed activations in the areas responsible for
the processing of conscious and feature-based analysis of social
and emotional stimuli. A similar conclusion was reached by
Wang and colleagues (2004) based on the neuroimaging data
that they obtained from children and adolescents. Further the
control individuals in Ashwin and colleagues’ (2006) study
also showed activations in the amygdala and other areas of
the social brain similar to those which were responsible for
face processing, in response to various intensities of fearful
stimuli implying that the amygdala modulates activity in
other brain areas to facilitate the processing of biologically
relevant stimuli as compared with the autistics. The findings
show that the amygdala deficits may have effects on other
parts of the brain too.

Therefore the conscious life of autistics with respect to
affective objects can be very different from that of normal
people, which means that the environment might look dif-
ferent to different people due to their conscious awareness of
various affective objects. It is very important to note again
that objects having affective value can increase activations in
both the amygdala and the central visual cortex (Pessoa et al
2003) because of the extensive connections of the amygdala
with the ventral visual cortex. Consistent with the role of amygdala in visual conscious awareness of such objects, Pessoa and colleagues (2006) have shown that objective awareness of fearful faces at short presentation times is related to the co-activation of the amygdala and the fusiform gyrus (a portion of the ventral visual stream). Vuilleumier and colleagues (2002) have consistently shown that people with amygdala lesions show decreased activations in the fusiform gyrus in response to affective objects.

Conscious perception of emotions is very important for various mental processes. For instance, it has been shown by Honk and Schutter (2007) that the conscious perception of emotional faces serve as socially corrective signals that act to curtail misbehavior on the part of the perceiver. Conscious perception of emotional expressions is also important for the development of appropriate emotion concepts and autistics lack such a concept due to their inability to perceive such emotional signals in others, which thus leads to impairment in the awareness of one’s own emotions especially within the negative spectrum with a prominent position for fear (Rieffe et al. 2007).

Conclusions
This paper provides a new framework which explains that the conscious life related to fear perception can be very different for people with autism, and causes a different perception of the world from the normal controls. Thus this area is ripe for investigation and will help better understanding of the mental life of autistics. The root cause of their problem lies at the compromised functional integrity of the amygdala, which plays a major role in visual awareness by bringing objects holding affective (eg, fear) value, detected at the attentional periphery to the focus of attention and awareness, due to its connections with various parts of the ventral visual stream and the prefrontal areas and the subcortical areas.

Some autistic symptoms might be related to the way emotions, especially fearful expressions, are perceived by the autistics. It has been shown that they perceive and process fearful expressions the way other general objects are processed by normal individuals by activating areas responsible for conscious and feature-based analysis of social and emotional stimuli, which implies that the significance of such stimuli for them is equivalent to other common objects, and thus leads to the deficits seen in the disorder.

Since conscious perception of such faces is important, it is quite likely that autistics consequently suffer from an inappropriate development of emotion concepts, which leads to impairment in the awareness of one’s own emotions, especially within the negative spectrum with a prominent position for fear.

References
Ashwin C, Baron-Cohen S, Wheelwright S, et al. 2006. Differential activation of the amygdala and the ‘social-brain’ during fearful face-processing in the Asperger syndrome. *Neuropsychologia*, 45:2–14.
Baron-Cohen S, Ring HA, Bullmore ET, et al. 2000. The amygdala theory of autism. *Neurosci Biobehav Rev*, 24:355–64.
Crick F, Koch C. 2007. Neurobiological framework for consciousness. In: Velman M, Schneider S (eds). The Blackwell Companion to Consciousness. New York: Wiley Blackwell Publishing Limited.
Honk JV, Schutter JLG. 2007. Testosterone reduces conscious detection of signals serving social correction. *Psychol Sci*, 8:663–7.
Kosslyn SM, Shin LM, Thompson WL, et al. 1996. Neural effects of visualizing and perceiving aversive stimuli: a PET investigation. *Neuroreport*, 7:1569–76.
Morris JS, Friston KJ, Buchel C, et al. 1998a. A neuromodulatory role for the human amygdala in processing emotional facial expressions. *Brain*, 121:47–7.
Pascual-Leone A, Walsh V. 2001. Fast backprojections from the motion to the primary visual area necessary for visual awareness. *Science*, 292:510–12.
Pessoa L, Japee S, Sturman D, et al. 2006. Target visibility and visual awareness modulate amygdala responses to fearful faces. *Cerebral Cortex*, 16:366–75.
Pessoa L, Kastner S, Ungerleider LG. 2003. Neuroimaging studies of attention: From modulation of sensory processing and top-down control. *J Neurosci*, 23:3990–8.
Rieffe C, Terwogt MM, Kotronopoulou K. 2007. Awareness of single and multiple emotions in high-functioning children with autism. *J Autism Dev Disord*, 37:455–65.
Salmond CH, Haan MD, Friston KJ, et al. 2003. Investigating individual differences in brain abnormalities in autism. *Philos Trans R Soc Lond B Biol Sci*, 358:405–13.
Tsuchiya N, Adolphs R. 2007. Emotion and consciousness. *Trend Cogn Sci*, 11:58–67.
Vuilleumier P, Richardson MP, Armony JL, et al. 2004. Distant influences of amygdala lesion on visual cortical activation during emotional face processing. *Nature Neurosci*, 7:1271–8.
Vuilleumier P. 2002. Facial expression and selective attention. *Curr Opin Psychiatry*, 15:291–300.
Vuilleumier P, Richardson MP, Armony JL, et al. 2002. Distant influences of amygdala lesion on visual cortical activation during emotional face processing. *Nature Neurosci*, 11:1271–8.
Wang AT, Dapretto M, Hariiri AR, et al. 2004. Neural correlates of facial affect processing in children and adolescents with autism spectrum disorder. *J Am Acad Child Adolesc Psychiatry*, 43:481–90.
