PERCEIVING FACIAL AND VOCAL EXPRESSIONS OF EMOTIONS IN INDIVIDUALS WITH DOWN'S SYNDROME

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Abstract: Down's Syndrome(DS) constitute an ideal population for analyzing the development of emotional expression from the first months of life, due to the fact that this chromosomal alteration is identifiable from birth and results in well-known difficulties of cognitive development and in basic learning processes. Aim was to identify the extent to which visual, auditory and auditory-visual cues influence emotional perceptions in children with DS in comparison to their typically developing (TD) counterparts. Participants included children with Down's syndrome with borderline intelligence and typically developing mental age matched. Participants were instructed to identify emotions of happiness, anger, surprise, sadness, fear, cry and neutral face through three different modes. Overall emotional perception ability of DS is poorer than TD peers through all modes. Auditory and visual modality combined gave best score for emotional perception in DS. From the present study it can be concluded that these children need the context of a whole face and with auditory cues to help them recognise features.

Keywords: down syndrome, emotion perception, cognition

Introduction

Faces are rich conduits of emotions. Human faces are source of information mediating emotional and linguistic communication as well as social interactions. Geenbaum & Yirmiya (1999) reported that corticolimbic system is involved in the emotional development during first year of life. Izard (1991) stated that emotions are regulated & controlled by sub cortical network of neurons. These networks have specific circuit for each emotion & these networks are responsible for universality of certain facial expressions and their communicative function. Some of this face processing system presents at birth but others networks, synapses and circuits continue to develop through adult levels (Carey, 1992). Facial emotion processing is a complex task that involves a distributed neural system. For example, superior temporal sulcus (STS) is responsible for detecting facial movements associated with eye gaze, speech, and emotional expression and intention, (Winston JS et al.; 2002). A region in the ventral-occipital cortex is implicated in face detection, categorization and identity recognition (George N et al; 1999, Hoffman EA, Haxby JV; 2000). The faces, especially fearful faces generate response from amygdala (Young et al.; 1996). Developmental condition such as williams' syndrome, down syndrome are associated with anomalous face processing (Golijeh Golarai et. al, 2006) so this condition may helpful and provide or add evidence in the existing literature in order to understand neural mechanisms of face processing.

According to Down's syndrome Association, 2014, for every 1,000 babies born, one will have Down's syndrome (DS). Every year between 23,000 and 29,000 children are born in India with Down syndrome, which is the highest in the world (Deccan Herald, 2014). There has been a remarkable increment reported in the life expectancy for these individuals now exceeding 50

years, attributable mainly to a more interventionist therapeutic approach (Mastroiacovo et al, 1992). The most direct consequence of the lifespan lengthening of persons with DS is the increased number of affected adults in the population, with several implications to achieve a better quality of life. Not many studies can be traced in literature that has attempted to study emotion recognition in individuals with developmental disorders. The study of developmental disorders serves to illuminate the constraints under which normal development occurs (Karmiloff-Smith, 1998).

DS infants is an ideal population for analyzing the development of emotional expression from the first months of life, due to the fact that chromosomal alteration is identifiable from birth and results in well-known difficulties of cognitive development and in basic learning processes. The chromosomal alteration is heterogeneous in terms of phenotype, constituting an interesting natural model for the study of emotional development (Cicchetti & Beeghly, 1990). Many neuro-imaging studies showed the slower and restricted cortical development from birth in infants with DS which results in difficulties in the basic processes of learning and memory, and particularly in language development and the conventional expression of emotions (Marotta & Vicari, 1997). Specifically, the study of facial expression exchanges during early social interaction is of enormous importance for analyzing the role of emotion in psychological development. Majority of studies developed on these lines are not sufficiently conclusive, as they are basically limited to a description of the morphological configuration of infantile facial expression. In order to develop the salutary measures it would be necessary to study the emotional perception in different modalities and find out the comparative analysis to synthesize the best restorative approach. Thus, studying children with DS appears to be an ideal restorative approach in emotional perception manifold with different modalities. Need of the present study is based upon the high frequency of occurrence of DS among school age population and the dearth of Indian research studies reflecting modality bound emotional perception in DS. The findings of the present study may guide in development of therapeutic approaches that utilizes emotional perception for building newer linguistic blocks in DS and enable a more practical tool for communication in the population.

The present study aims to identify the extent to which visual, auditory and auditory -visual cues influence emotional perceptions in children with DS in comparison to their typically developing counterparts.

Methodology:

Emotion perception was examined by having the participants identify happiness, anger, surprise, sadness, fear, cry and no emotion or neutral face. The emotional content was placed upon the same neutral sentence. The stimuli were presented in auditory, visual, and combined auditory–visual modes.

Participants: 35 children with Down's Syndrome (28 male, 7 female; age range 8;3–14;4 years old, M=11;3) with borderline intelligence, 35 typically developing mental age matched children (27 male, 18 female; age range 5;2–9;2, M=7;2), participated in the current study. Exclusion criteria included: secondary neurological disorders (e.g. epilepsy, dementia), difficulties with vision (including poor acuity and lack of correction) or hearing (history of ear discharge or any reported hearing impairment).

Material:

Task 1: Facial Emotional labeling (FEL)

Stimuli consisted of a set of 6-photographs of human "emotional" faces standardized and cross-validated on non-patients. These photographs were presented on a screen for approximately 10 s each, with an inter stimulus interval of 10 s. The projector screen was located 6 ft from the subject. Participants were asked to look at each projected slide carefully and then describe how the person in the photo seems to be feeling.

Task 2: Voice emotion recognition test (VERT) without visual feedback

Subjects were presented with a sentence "/je/ /kja/ /hæ/" (what is this?). The sentence was recorded in a female voice in such a manner as to convey one of the six basic emotions: happiness, sadness, anger, crying, surprise, and in neutral tone of voice. Each of the six sentences was presented in randomized order with an inter-stimulus interval of 7s. Participants were asked to identify the emotion expressed in voice sample. Response time (RT) was obtained for each stimulus.

Task 3: Voice emotion recognition test (VERT) with visual feedback

Participants were allowed to see faces of the speaker along with auditory cues, conveying emotions. Stimuli and procedure were similar as in task 2 except for the visual cues in task 3.

Stimuli presentation followed randomized sequencing for tasks 2 and 3.

The data were analyzed using ANOVA (version 3.0). The mean correct percentages for emotions were calculated across items for the participant analysis (F1) and across participants for the by-item analysis (F2).

Result:

Results of the present study can be explained under the following subheadings:

1. Performance of TDC and DS on FEL

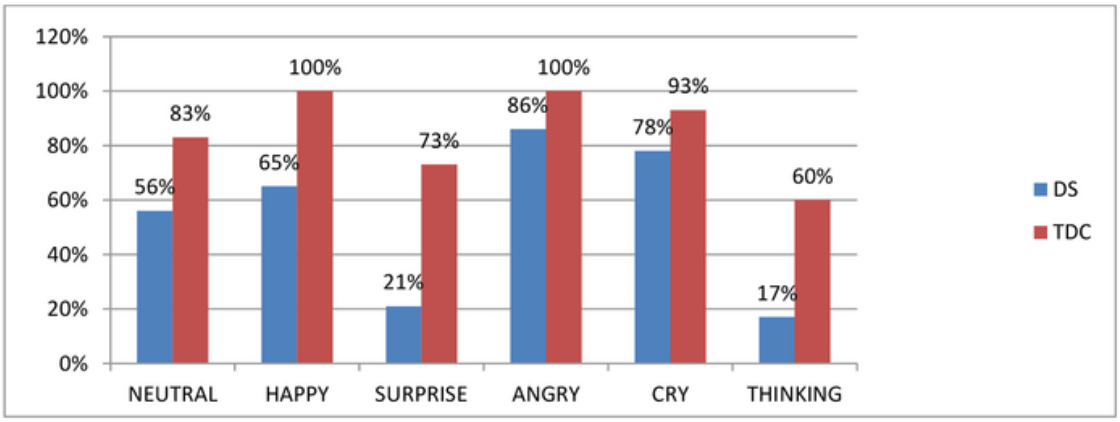
2. Performance of TDC and DS on VERT (without visual feedback)
3. Performance of TDC and DS on VERT (with visual feedback)
4. Overall performance of TDC and DS over combined effect of FEL, VERT (without visual feedback) and VERT (with visual feedback).

Performance of TDC and DS on FEL

DS faced more difficulty in labeling facial emotions as compared to TDC for the given stimuli. Their mean scores are as in Table 1:

EMOTIONS	NEUTRAL	HAPPY	SURPRISE	ANGER	CRY	THINKING
MEAN OF DS	0.56	0.65	0.21	0.86	0.78	0.17
MEAN OF TDC	0.83	1.00	0.73	1.00	0.93	0.60
P-VALUE	0.03	0.00026	0.00009	0.04	0.11	0.001

Table 1: Performance of TDC and DS on *FEL* task



Graph 1: Facial Recognition % on *FEL* task

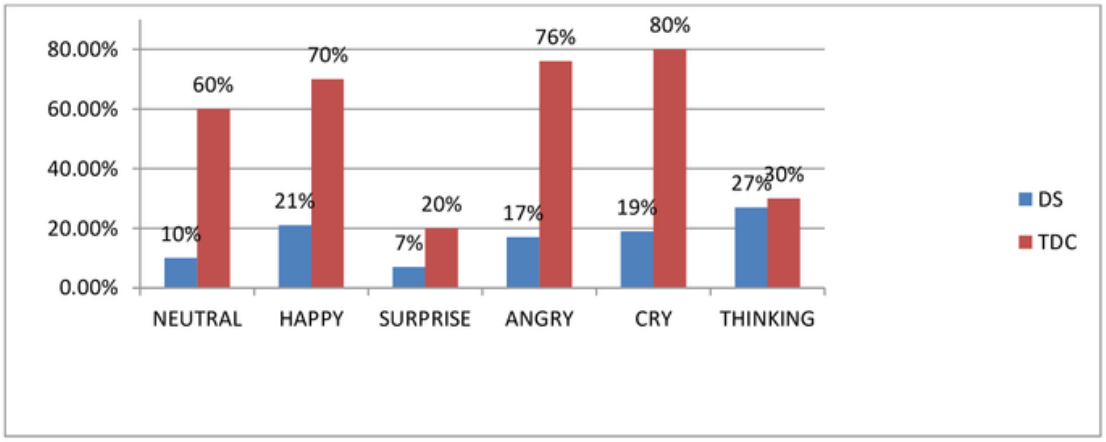
Performance of TDC and DS on VERT (without visual feedback)

On comparative analysis, DS performed poorer than TDC for all the emotions.

EMOTIONS	NEUTRAL	HAPPY	SURPRISE	ANGER	CRY	THINKING
MEAN OF DS	0.1	0.21	0.07	0.17	0.19	0.27
MEAN OF TDC	0.6	0.7	0.2	0.76	0.8	0.3

P-Value	0.0003	0.0002	0.09	0.06	0.01	0.05

Table 2: Performance of TDC and DS for different emotion on VERT (without visual feedback)



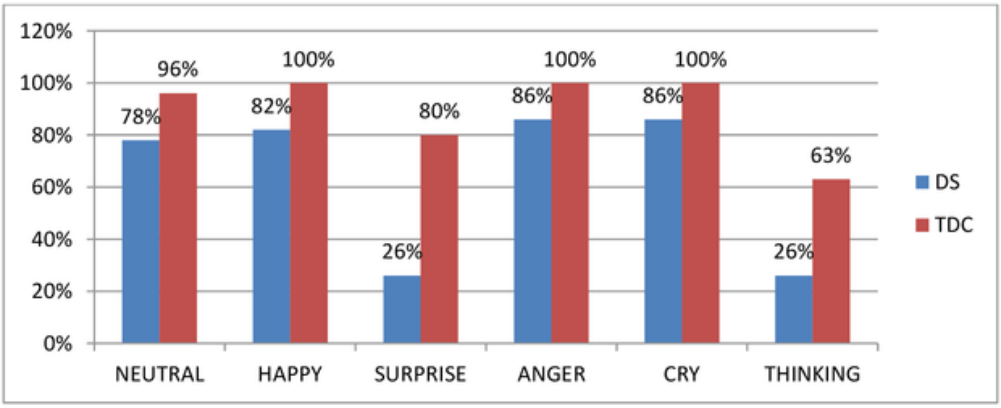
Graph 2: Facial perception % on VERT (without visual feedback)

Performance of TDC and DS on VERT (with visual feedback)

DS performed poorer than TDC for all emotions.

EMOTIONS	NEUTRAL	HAPPY	SURPRISE	ANGER	CRY	THINKING
DS (mean)	0.78	0.82	0.26	0.90	0.80	0.26
TDC (mean)	0.96	1.00	0.80	1.00	1.00	0.63
p-value	0.03	0.01	0.0003	0.1	0.04	0.006

Table 3: Performance of TDC and DS for different emotions on VERT (with visual feedback)



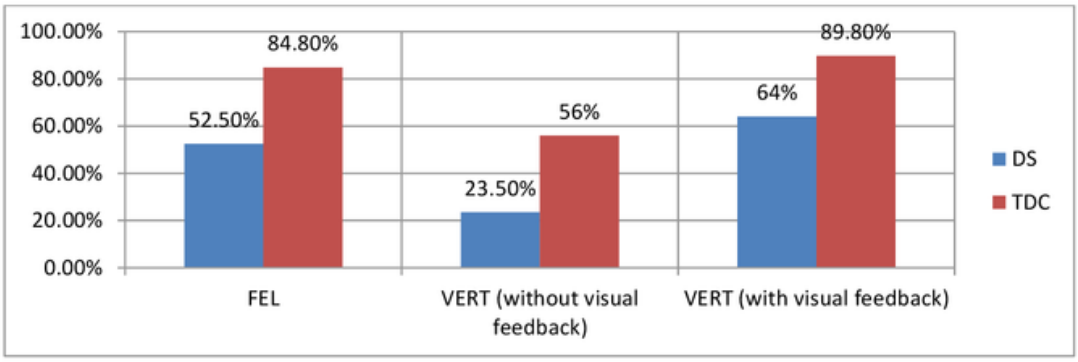
Graph 3: Facial perception % on VERT (with visual feedback)

Overall performance of TDC and DS over combined effect of FEL, VERT (without visual feedback) and VERT (with visual feedback) and VERT (with visual feedback)

On comparative analysis between DS and TDC over combined effect of FEL, VERT (without visual feedback) and VERT (with visual feedback) DS (mean=0.48) performed poorer than TDC (mean=0.77).

EMOTIONS	FEL	VERT (without visual feedback)	VERT(with visual feedback)
DS (mean)	0.52	0.23	0.64
TDC (mean)	0.84	0.56	0.89

Table 4: Mean Scores of DS and TDC on different tasks



Graph 4: Facial perception % TDC vs. DS on all three stimuli

This gave a clear implication that VERT with visual feedback served the best cue for the children with DS to perceive the emotions. The facial processing majorly improved when stimulus presented with a combination of visual and auditory feedback (Graph 4).

Discussion:

Young infants rapidly develop face recognition abilities, learning to detect gaze direction, facial gestures, and expressions of emotion within the first year of life. Indeed, research suggests that newborns preferentially orient toward face-like stimuli (e.g., Johnson et al., 1991), recognizing certain properties of faces from birth and distinguishing internal features by around the middle of the first year (Haan, 2001). The development of emotion recognition can be disrupted either by atypical experience, such as early visual deprivation, or by atypical developmental constraints present in some developmental disorders (e.g. Down's syndrome). In the case of DS, the stereotypical perception is that children with DS are highly sociable and have good 'people' skills (Down 1866; Hines & Bennett 1996; Gilmore et al. 2003a; Fidler et al. 2008).This has led to a widely held assumption that their social understanding is relatively intact. In many respects, development at these early stages was found to be very similar to typical development in terms of the sequence in which early abilities unfolded (Cicchetti & Beeghly 1990). However, there was also evidence of subtle differences in how children with Down's syndrome attend to the social world around them, differences which might well impact on the development of later, more complex, socio-cognitive abilities such as emotion recognition, theory of mind and empathy.

The outcomes for the current study suggest that though children with DS recognised the emotions but their performance was significantly low for all three tasks used for emotion perception than their mental age matched TDC. Emotion perception was best through VERT (with visual feedback) for both the groups however, children with DS performed significantly poorer than TDC in addition to a shortfall in surprise and anger. The lowest achievement is through VERT (without visual feedback) by both the groups also surprise and thinking were underperformed greatly. Amid of all emotions 'surprise' was perceived poorer consistently in all three tasks by the children with Down syndrome. Similar to one study finding (Jennifer G. Wishart and T. K. Pitcairn, 2000), children with DS were equally proficient at recognizing unfamiliar faces when expression was varied but significantly poorer at recognizing expression overall, with a specific deficit in perceiving surprise and fear. These findings were further supported by Katie Williams, Jennifer G. Wishart, Tom K. Pitcairn, and Diane S. Willis (2005) revealing that emotion recognition ability in the DS group was significantly poorer than in the typically developing group overall, particularly for fearful expressions.

Contrary to the study findings by Connie Kasari, Stephanny F. N. Freeman, and Margaret A. Hughes (2001) in which the results indicate that young children with DS perform similarly to typical controls matched on mental ages of approximately 3 years. However, by developmental age of 4 years, children with DS performed worse than both MA-matched typical children and children with non-DS types of mental retardation.

Differences in these early interpersonal responses (e.g. emotion recognition) may also influence language development, which in turn plays a central role in the development of successful interpersonal functioning at later ages. There are still many gaps in our knowledge of social cognition in DS and explanations for socio-cognitive difficulties at the neurological, cognitive

and environmental level all need to be considered. Unraveling these different contributory factors presents a considerable challenge. DS exhibit unique patterns of behavior. A better understanding of these differences in DS and in other distinctive syndromes is essential to building more complete theories of typical and atypical development (Karmiloff-Smith et al., 2004 & Karmiloff-Smith, 2009). The important socio-cognitive tool for interacting and learning from others is social referencing; the ability to use emotional cues from others in interpreting shared contexts. Social referencing studies with young children focus on the extent to which they use their parent's affective reaction to a situation to guide their own response.

Summary and conclusion:

Findings indicate that children with DS may make fewer and shorter social referencing looks than typically developing children, with their own responses often incongruent with the parent's affective reaction (Knieps et al. 1994; Kasari et al. 1995). This suggests that even in the early years, children with DS may have difficulties in emotion recognition and/or in making use of this information to guide their own behavior. Thus, bearing in mind the enormous importance of the expressive components of emotion for human communication throughout the life cycle, the relevance of encouraging the study about the life of children with DS is obvious. This is particularly true if we consider that, given the limits imposed by deficits of, for example, language, our perspective on DS is somehow enriched and hereby, modified by attending to cognitive aspects, among which facial expression plays a fundamental role. In sum, for significant progress to be made in this field, theorists need to become more engaged in explaining the distinctive socio- cognitive profile of children with DS and how this is expressed in their behaviour at different ages. Correspondingly, in the field of DS, the need is to engage more with theoretical advances being made in the study of typical socio-cognitive development thereby eradicating the discrepancies appearing in language development. Harnessing new technologies and innovative paradigm will help in improving the social life of individuals with DS.

Nevertheless, spontaneous facial expression and the process of emotional development, particularly in terms of the nature of the stimuli that provoke the appearance of these emotional expressions at each stage of development, is found to be comparable to that of typically developing infants, at least during the first year of life (Cicchetti & Sroufe, 1976; Emde & Brown, 1978).

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