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# Critical Review:

## Dynamic vs static stimuli: Effectiveness in emotion recognition for individuals with Autism Spectrum Disorder

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This critical review examines the effectiveness of dynamic and static stimuli in emotion recognition for individuals with Autism Spectrum Disorder (ASD). A literature search yielded eight case-control nonrandomized clinical trials. Overall results of these studies indicate that there is no significant difference between the use of static and dynamic stimuli in emotion recognition. Clinical implications and recommendations for future research are discussed.

### *Introduction*

Autism Spectrum Disorder (ASD) is a condition that results in a range of deficits including cognitive, behavioral, language and pragmatic difficulties. Individuals with ASD often demonstrate difficulties recognizing emotions from facial expressions (Harms, Martin & Wallace, 2010) which can have a negative impact on their social interactions. Impaired emotion recognition may be attributed in part to the different facial scanning mechanisms employed by individuals with ASD. Eye tracking studies have shown that individuals with ASD spend less time looking at the core facial features (eyes, mouth and nose) compared to normal controls (Pelphrey, Sasson, Reznick, Paul, Goldman and Piven, 2002).

The majority of studies conducted on facial expression recognition in individuals with ASD utilized static rather than dynamic stimuli (Gepner, 2001). Many authors have argued that dynamic stimuli provide a more accurate and ecologically valid measure of facial expression recognition compared to static stimuli because facial expressions encountered in everyday life are inherently dynamic (Johnston, Enticott, Mayes, Hoy, Herring and Fitzgerald, 2010; Klin, Jones, Schultz, Volkmar and Cohen, 2002; Moore, 2001).

There is evidence to support that both typical adults and individuals with intellectual disability demonstrate improved emotion recognition when dynamic stimuli are used compared to static stimuli (Harwood, Hall and Shinkfield, 1999). This critical review evaluates the current evidence regarding the impact of dynamic stimuli on emotion recognition in individuals with ASD.

### *Objectives*

The primary objective of this critical review is to determine whether dynamic stimuli results in greater accuracy in emotion recognition for individuals with ASD relative to static stimuli.

### *Methods*

Search Strategy
Computerized databases including Cochrane Library, EMBASE, MedLine, ProQuest, PsycINFO, PubMed and SCOPUS were searched using the following strategy: [(Autism) OR (Autism Spectrum Disorder) OR (ASD) OR (Asperger) OR (Pervasive Developmental Disorder) OR (PDD)] AND [(facial emotion recognition) OR (facial expression)].

Selection Criteria
Inclusion criteria included only those studies directly comparing the use of static and dynamic stimuli in emotion recognition among individuals with ASD.

Data Collection
The literature search yielded eight case-control non-randomized clinical trials.

### *Results*

Although randomized clinical trials provide the highest level of evidence, this type of study was not possible for the research question addressed in this critical review. This was due to the requirement that one group contain only individuals with ASD and the other group contain only individuals without ASD. Therefore, the highest level of evidence that could be obtained was a nonrandomized clinical trial. All eight studies reviewed are nonrandomized clinical trials.

**Back, Ropar and Mitchell (2007)** compared facial expression recognition of fully dynamic, partially dynamic and static stimuli in 18 individuals (10-14 yrs) with ASD (Autism: 11; Asperger's syndrome: 7) and 18 age, gender, and full scale IQ-matched controls (typically developing: 13; developmental delay: 5). Participants selected emotions for eight facial expressions from a list of four options. An appropriate three-way ANOVA indicated that judgments of individuals with ASD and the controls did not differ in accuracy between the static and dynamic conditions.

The methods employed in this study were well described and contained extensive validation of stimuli on typically developing individuals prior to their use in the study. Participants in the ASD group were selected based on well-defined criteria. The authors stated that the control group did not contain any autistic features; however they did not explain how this was assessed. This study provides highly suggestive evidence that there is no difference between the use of dynamic and static stimuli in emotion recognition.

**Enticott, Kennedy, Johnston, Rinehart, Tonge, Taffe and Fitzgerald (2013)** examined the recognition of six basic emotions (anger, disgust, fear, happy, sad and surprise) using static and dynamic stimuli in 36 adolescents and adults with high functioning ASD (M age=25 years; SD=8.83) and 36 typically developing controls matched for gender and age. Participants identified emotions corresponding to static and dynamic stimuli from six written options in a forced choice task. Appropriate regression analysis revealed that both the controls and individuals with ASD achieved higher accuracy for identifying anger when dynamic stimuli were used. The individuals with ASD achieved lower accuracy for identifying sadness when static stimuli were used. All other effects involving motion were not significant.

Overall, participants in both groups were identified using well-established inclusion and exclusion criteria. Limitations of participant selection included the reliance on self-reports to confirm the absence of psychiatric and neurological disorders. As acknowledged by the authors, the stimuli may have minimized the differences between conditions. In particular, the dynamic stimuli ended with a static facial expression that remained onscreen until participants made a decision and the dynamic stimuli were created using morphed static stimuli. This study provides mildly suggestive evidence that there is no significant difference between the use of dynamic and static stimuli in emotion recognition.

**Gepner, Deruelle and Grynfeltt (2001)** studied the effect of dynamic facial expressions on children with ASD's ability to recognize four basic emotions (joy, surprise, sadness and disgust) in 13 children with ASD (M age=69.38 months; SD=11) and 13 controls matched for gender and developmental level. The participants matched still, dynamic and strobe emotional facial expressions to their corresponding photographic equivalent by selecting from an array of four photographs (1 match, 3 foils). A series of t-tests revealed that children with ASD performed slightly lower than controls in all three conditions and that there was no significant difference in their performance when static or dynamic stimuli were judged.
One inherent limitation of the procedures in this study was that judgments were made by selecting a static photograph in all conditions. Therefore, even the strobe and dynamic conditions had a static element. In addition, the authors acknowledge that the still images may have contained small movements. Therefore, the static images may have contained a dynamic element. One limitation of the statistical analysis was that a series of t-tests were used rather than a single omnibus ANOVA without providing justification. A series of t-tests increases the risk of a type 1 (false positive) error. This study provides mildly suggestive evidence that there is no difference between dynamic and static stimuli in emotion recognition.

**Tardif, Laine, Rodriguez and Gepner (2007)** conducted a study that replicated and expanded on the Gepner et al (2001) study. In a forced choice task involving matching expressions to a photograph, judgments were made about emotional facial expressions according to 2 variables, only the first of which is relevant to the present review: 1) static and varying degrees of dynamic (very slow, slow and normal speed); 2) silent and audio. Participants included 12 children with ASD (M age= 10;5 ; SD= 2;6) and two age-matched typically developing control groups additionally matched for either verbal mental age or nonverbal mental age. Appropriate ANOVA revealed the following results: 1) children with ASD performed significantly poorer than their matched control groups on all conditions; 2) children with ASD were significantly better at facial emotion recognition in the slow condition; 3) children with moderate to severe ASD performed significantly better in the slow and/or very slow condition compared to children with mild ASD.

The selection criteria used in this study were well-established and described. The procedures were limited by matching all stimuli (static and dynamic) to a photograph, which is static. This study provides moderately suggestive evidence that there is a significant difference between the use of dynamic and static stimuli in emotion recognition.

**Katsyri, Saalasti, Tiippana, von Wendt and Sams (2008)** studied the recognition of four basic emotions (anger, disgust, fear and happiness) in twenty adults with Asperger syndrome (M age= 32 years; SD=10) and twenty age and gender matched controls. Two variables were examined, only the first of which is relevant to the present review: 1) static and dynamic; 2) unfiltered and low-pass filtered images (2 levels). Appropriate mixed design ANOVA revealed no significant difference between the use of static and dynamic stimuli in emotion recognition for individuals with Asperger syndrome and for controls.

Participants in both groups were identified using well-established inclusion and exclusion criteria. One limitation of the methods was that the dynamic stimuli ended with a static image. This study provides highly suggestive evidence that there is no significant difference between the use of dynamic and static stimuli in emotion recognition.

**Speer, Cook, McMahon and Clark (2007)** examined the gaze fixation duration of 12 children and adolescents with ASD (M age=13.6 years, SD=2.7) and 12 gender, chronological age and verbal intelligence matched controls. Six facial regions (eyes, mouth, body, other facial features, object, and off) were examined according to two variables: 1) isolated and social; 2) static and dynamic. Appropriate ANOVA and planned contrasts revealed that for the social-dynamic condition participants with ASD spent a significantly shorter duration looking at the eyes and a marginally longer duration looking at the body compared to the control group. All other comparisons were non-significant.

Participants in both groups were selected using well-established inclusion and exclusion criteria. The analysis was strengthened by a high inter-rater and test-retest reliability for coding eye gaze fixation duration in the dynamic condition. However, a limitation was that inter-rater and test-retest reliability were not reported for the static condition. This study provides mildly suggestive evidence that there is a significant difference in the eye gaze strategy used by individuals with ASD when viewing emotional dynamic and static stimuli.

**Falkmer, Bjallmark, Larsson and Falkmer (2011)** examined the number and duration of eye gaze fixations on the eyes, mouth and other facial features in 15 adults with Asperger syndrome (M age= 26.5 years; SD=9.6) and 15 age and sex matched controls while viewing static (no emotion and emotion) and interactive dynamic stimuli. The interactive dynamic condition involved a dialogue between the researcher and participant. Appropriate t-tests and Wilcoxon's signed rank tests revealed that all but one participant with Asperger syndrome and the entire control group used similar eye gaze fixations and durations in both the static and interactive dynamic condition.

Participants in both groups were identified using well-defined inclusion and exclusion criteria. The methods were not well-defined and contained the following limitations: 1) did not state the emotions that were examined 2) did not describe instructions provided to participants. This study provides mildly suggestive evidence that there is no significant difference in the eye gaze strategy used by individuals with ASD when viewing emotional dynamic and static stimuli.

**Uono, Sato and Toichi (2010)** examined whether facial expressions for two emotions (fearful and happy) would be perceived as more emotionally exaggerated in dynamic stimuli relative to static stimuli in 13 individuals with PDD (M age=19 years) and 13 chronological age and sex matched controls. Appropriate ANOVA revealed that individuals with PDD and controls judged the dynamic stimuli to be statistically more emotionally exaggerated compared to static stimuli.

Well-established inclusion and exclusion criteria were implemented for participants in the PDD group but not for the control group. Limitations of this study include: 1) inability to generalize findings as only two emotions were examined and 2) the authors did not interpret the importance of perceiving dynamic stimuli as being more emotionally exaggerated in emotion recognition. This study provides mildly suggestive evidence that individuals with PDD perceive dynamic stimuli as more emotionally exaggerated compared to static stimuli.

## ***Discussion***

The results of this critical review provide moderately suggestive evidence that individuals with ASD perform with similar accuracy in emotion recognition for both static and dynamic stimuli. However, one limitation of this finding is the scarcity of literature investigating the accuracy of emotion recognition. Only five of the eight studies in this review directly examined the accuracy of emotion recognition using static and dynamic stimuli. Three of these five studies concluded that there was no significant difference between the use of static and dynamic stimuli in emotion recognition. Enticott et al (2013) suggested that the accuracy of emotion recognition varied depending on the emotion, with anger being more easily recognized in dynamic stimuli and sadness more easily recognized in static stimuli. Tardif et al (2007) found that the speed of the dynamic condition was important in emotion recognition, with individuals with ASD demonstrating increased accuracy with slow dynamic stimuli. These results indicate that both the emotion being examined and the speed of the dynamic display have an impact on emotion recognition.

Two of the eight studies included in this review examined the eye gaze pattern of individuals with ASD when viewing emotional static and dynamic stimuli.

Speer et al (2008) reported that when viewing social dynamic stimuli, individuals with ASD tend to spend less time looking at the eyes and more looking at the body compared to controls. This finding is significant because it suggests that individuals with ASD employ different visual strategies when viewing dynamic stimuli compared to static stimuli. In the five studies examining the accuracy of emotion recognition, only the face was provided in the stimuli. Considering Speer et al's findings, different results may have been obtained if a full body view was used in these studies rather than only a facial view. Contrary to the results of Speer et al, Falkmer et al (2011) found that individuals with ASD employ similar visual strategies when viewing static and interactive dynamic stimuli. The authors therefore suggest that findings from eye gaze studies using static stimuli can be generalized to everyday dynamic situations. Given the mixed results of these studies, it is difficult to conclude whether individuals with ASD use different visual strategies when viewing static stimuli such as a picture versus dynamic stimuli such as a social interaction. Further research is required to determine the impact of visual strategies on emotion recognition.

Lastly, one study in this review conducted by Uono et al (2010) demonstrated that individuals with ASD perceive dynamic stimuli to be more emotionally exaggerated. However, the authors do not interpret the significance of this finding in terms of emotion recognition in individuals with ASD.

Several limitations inherent in all eight of these studies must be considered when interpreting the results. One limitation was the small sample size. This limitation is difficult to avoid due to difficulty in finding research participants fitting the criteria of having a diagnosis of ASD. A second limitation was the diverse age range and level of functioning of the participants. This diversity makes it difficult to interpret whether or not age and severity of the ASD have an impact on whether static or dynamic stimuli are better for emotion recognition. These limitations in addition to the limitations stated previously for each individual study should be taken into account when drawing a conclusion with regards to the reliability of the results.

### *Conclusion*

Further research is required regarding the use of static and dynamic stimuli in emotion recognition for individuals with ASD given the scarcity and limitations of the current literature. Although the current evidence suggests that individuals with ASD perform with similar accuracy when identifying emotions in static and dynamic stimuli, there is a lack of research regarding the generalizability of this skill. This is an important consideration because children with ASD often have difficulty generalizing newly learned skills to the natural environment (Whalen, 2009). Even though individuals with ASD perform similarly for both static and dynamic stimuli, use of dynamic stimuli may result in greater generalizability because the facial expressions encountered in everyday life are dynamic. Future research should focus on the generalizability of emotion recognition using static and dynamic stimuli. Secondly, the five studies that examined the accuracy of emotion recognition included stimuli only facial stimuli. Findings from Speer et al suggest that individuals with ASD spend more time looking at the body than at the eyes when viewing dynamic stimuli. Considering this finding, individuals with ASD may perform differently on an emotion recognition task using static and dynamic stimuli that include full body stimuli. Future research should therefore include using static and dynamic stimuli that show an entire body view rather than just a facial view.

### *Clinical Implications*

The findings of this critical review provide moderately suggestive evidence that there is no significant difference in the use of static and dynamic stimuli in emotion recognition for individuals with ASD. Given the inconclusiveness of these findings and the need for further research, it is recommended that clinicians not change their practice based on the current evidence.

### *References*

Back, E., Ropar, D., & Mitchell, P. (2007). Do the eyes have it? Inferring mental states from animated faces in autism. *Child Development, 78*, 397 – 411.

Enticott, P.G., Kennedy, H.A., Johnston, P.J., Rinehart, N.J., Tonge, B.J., Taffe, J.R., & Fitzgerald, P.B. (2013). Emotion recognition of static and dynamic faces in autism spectrum disorder. *Cognition and emotion*, 1 – 9.

Falkmer, M. Bjallmark, A., Larsson, M., & Falkmer, T. (2011). The influences of static and interactive dynamic facial stimuli on visual strategies in persons with Asperger syndrome. *Research in Autism Spectrum Disorders, 5,* 935– 940.

Gepner, B., Deruelle, C., & Grynfeltt, S. (2001). Motion and emotion: A novel approach to the study of face processing by young autistic children. *Journal of Autism and Developmental Disorders, 31*, 37 – 45.

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Harms, M.B., Martin, A., & Wallace, G.L. (2010). Facial emotion recognition in autism spectrum disorders: A review of behavioural and neuroimaging studies. *Neuropsychology Review, 20*, 290 – 322.

Harwood, N., Hall, L.J., & Shinkfield, A.J. (1999). Recognition of facial emotional expressions from moving and static displays by individuals with mental retardation. *American Journal on Mental Retardation, 104*, 270 – 278.

Johnston, P.J., Enticott, P.G., Mayes, A.K., Hoy, K.E., Herring, S.E., & Fitzgerald, P.B. (2010). Symptom correlates of static and dynamic facial affect processing in schizophrenia: Evidence of a double dissociation? *Schizophrenia Bulletin*, 36, 680 – 687.

Katsyri, J., Saalasti, S., Tippana, K., von Wendt, L., & Sams, M. (2008). Impaired recognition of facial emotions from low – spatial frequencies in Asperger syndrome. *Neuropsychologia,46*, 1888 – 1897.

Klin, A., Jones, W., Schultz, R., Volkmar F., & Cohen, D. (2002). Visual fixation patterns during viewing of naturalistic social situations as predictors of social competence in individuals with autism. *Archives of General Psychiatry, 59*, 809 – 816.

Moore, D.G. (2001). Reassessing emotion recognition performance in people with mental retardation: A review. *American Journal on Mental Retardation, 106*, 481 – 502.

Pelphrey, K.A., Sasson, N.J., Reznick, J.S., Paul, G., Goldman, B.D. & Piven, J. (2002). Visual scanning of faces in Autism. Journal of Autism and Developmental Disorders, 32, 249 – 261)

Speer, L.L., Cook, A.E., McMahon, W.M., & Clark, E. (2007). Face processing in children with autism: Effects of stimulus contents and type. *Autism, 11*, 265 – 277.

Tardif, C., Laine, F., Rodriguez, M., & Gepner, B. (2007). Slowing down presentation of facial movements and vocal sounds enhances facial expression recognition and induces facial vocal imitation in children with autism. *Journal of Autism and Developmental Disorders, 37*, 1469 – 1484.

Uono, S., Sato, W., & Toichi, M. (2010). Brief report: Representational momentum for dynamic facial expressions in pervasive developmental disorder. *Journal of Autism and Developmental Disorders, 40*, 371 – 377.

Whalen, C. (2009). *Real life, real progress for children with autism spectrum disorders: Strategies for successful generalization in natural environments*. Baltimore, MD: Paul H. Brooks Publishing Co.