An Attempt to Conduct Eye-Tracking Measurements During Video Viewing in Children with Intellectual Disabilities : To Obtain Educationally Useful Information

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Abstract: Fifteen students in the elementary school division of a special needs school for children with severe intellectual disabilities and autistic tendencies watched a video lasting approximately three and a half minutes, and their eye tracking was measured during this time. The video content included scenes where humans and patterned designs were displayed simultaneously, one image was visually emphasized among multiple images, and a teacher spoke to the viewers through the screen. As a result, all 15 students completed the test without any issues, and it was possible to analyze their eye movements. Additionally, individual differences in attention toward human, patterns, and symbols were identified, and strategies such as pointing or circling objects to make them stand out were found to effectively increase attention in the children participated in this study. These findings are expected to provide valuable insights for educational methods, material creation, and selection in schools for children with relatively severe intellectual disabilities.

Keywords: eye-tracking, children with intellectual disabilities, human or patterns, education

Introduction

1. Difficulty in Educating Children with Intellectual Disabilities

Intellectual disability is a condition characterized by a delay in intellectual development that requires continuous support in daily and social life. The DSM-5-TR includes it in the neurodevelopmental disorders group, defining it as a state where the individual's IQ is generally below 70 and an adaptive impairment is recognized. Furthermore, the more severe the intellectual disability, the higher the comorbidity with autism spectrum disorder (ASD), and the severity of ASD also tends to be greater.[1), 2)] In

Japanese special needs schools for children with intellectual disabilities, students who enter at an earlier age generally have a higher degree of intellectual disability, and it can be said that many of the children who enter from the elementary school level have a certain degree of autistic spectrum disorder tendencies.

The Ministry of Education, Culture, Sports, Science and Technology points out that characteristics of education for children with intellectual disabilities include the tendency for knowledge to be fragmented and the difficulty they have applying it to real life and solving problems. There are also indications of challenges in teaching specific subjects such as science education [3] and English education [4], issues with curriculum development [5], and the potential for long-term support and increased costs if effective interventions are not provided [6]. While the necessity of creating individualized education plans and implementing inclusive education has been noted in the education of children with intellectual disabilities [7], the difficulty of providing instruction that accounts for individual characteristics has also been reported [8]. It is easy to imagine that for children entering the elementary school section of special needs schools, the strong frequency and severity of co-occurring autistic traits−such as restricted interests, fixations, sensory peculiarities, and a lack of verbal and non-verbal interpersonal responses—can easily contribute to the difficulty of instruction.

2. What is eye tracking research?

Eye tracking research has a history of over 100 years, as exemplified by Huey's eye tracking research on reading[9]. Eye movements tend to reflect attention, interest, and focus in a nonverbal manner, and Yarbus pointed out the importance of understanding cognitive processes based on “what is being seen.” [10] Since then, advancements in eye movement analysis and infrared-based analysis of pupil and corneal light reflection have further driven research in eye tracking across various fields, including psychology, neuroscience, medicine, and marketing [11]. In the field of special education for children with disabilities, Toki has suggested that eye tracking analysis during reading may be useful for diagnosing and evaluating dyslexia[12]. Notably, there have been reports on applied research for early diagnosis and support of children with autism[13] and studies analyzing attention and interest in children with multiple disabilities[14]. These findings suggest that eye-tracking could serve as a useful tool for educational support for children with severe intellectual disabilities or autism spectrum tendencies, who often have limited verbal explanations or responses regarding their attention and interests. However, research using eye-tracking devices to obtain information useful for school education among elementary school groups in special needs schools—which include children with severe intellectual disabilities who frequently co-occur with classic autism—remains extremely scarce. Additionally, one study has been reported on a group of children with severe intellectual disabilities whose average age was junior high-school level; however, this study was limited to examining gaze attention to sticks, underlines, and sounds.[15]

3. Purpose of this study

The purpose of this study is to present image content to elementary-age special needs school students with intellectual disabilities who often have relatively severe intellectual disabilities and autistic tendencies, measure their gaze while viewing the content, and examine how their gaze tendencies can be utilized for educational support. The specific objective is to present several video clips to the group and examine whether they serve as a convenient means for determining the object each individual is looking at—a piece of information crucial for special education. While this is difficult to discern through teacher observation alone, it is useful information for incorporating into lessons and other educational activities. Note that this study does not analyze the relationship between the children's individual biological or psychological characteristics and their individual gaze measurement results.

Method

1. Subjects

Fifteen elementary school students enrolled in a special needs school. All of them have relatively severe intellectual disabilities and autistic tendencies. To use confidential information from our examinations of eye tracking analyses, we obtained written consent from 15 elementary school students and their parents, as required under the Japanese Privacy Protection Law. We received permission from the Research Ethics Committee of the Faculty of Education at Ehime University(approval no. R6-12). The risks and harms associated with this test are extremely low, but it was also stated that should circumstances arise making it difficult to continue the test, it would be stopped immediately.

2. Equipment

Gazefinder NP-100 manufactured by JVC Kenwood Corporation. This device uses infrared rays to detect and analyze the pupils and corneas of test subjects and records their gaze positions on a monitor screen. In addition to implementing the standard social development assessment system “Look Look,” it is also capable of displaying still images and videos imported from external sources.

3. Measurement Method

Subjects were seated in front of the Gazefinder installed in a quiet private room and instructed to view two types of video content. The content was as follows.

A) Social Development Assessment Tool “Look Look”

This is a video content approximately two minutes long that is standardly implemented in the Gazefinder. The video includes scenes such as the following.

・People and patterned images appear simultaneously on the left and right sides of the screen.

・A woman's face looking at the camera is displayed on the screen.

・Pointillist drawings in the shape of people appear simultaneously on the left and right sides of the screen and move their bodies in time with the song. One is an upright image, and the other is an inverted image.

・A person points at one of several objects.

B) Original video content

This is an original video content created by the authors, approximately 90 seconds in length. The video includes the following content.

・The author is on the right side of the screen, and a stick figure is performing the same gymnastic movements on the left side.

・Initially, a video showing eight dogs appears.

1) The voice “Look Look” is heard simultaneously with the appearance of a pointing mark, indicating one dog.

2) A red circle appears around one dog. No voice is heard.

3) The voice says “Look Look” and a pointing mark appears, pointing to one dog.

4) The voice says “Look Look” and a red circle appears around one dog, and at the same time, a pointing mark appears, pointing to the same dog.

・ A video showing a pencil on the right and an eraser on the left.

1) The voice says, “Look at the pencil,” and at the same time, a finger pointing at the pencil appears.

2) The voice says, “Look Look,” and at the same time, a finger pointing at the pencil appears.

3) The voice says, “Look Look,” and three seconds later, a finger pointing at the pencil appears.

4) At the same time as the voice saying “Look at the pencil,” a finger pointing at the eraser appears.

・ A video of a male teacher looking directly at the camera and calling out. Behind him is a whiteboard with a picture of a fish on the left and words on the right. After a while, the teacher says, “Look at me.”

Regarding the content of the original video, it was created in consultation with four highly specialized teachers from the special needs school where the research took place, based on matters they wished to include but were not covered in “Look Look.”

4. Analysis Methods

A) Analysis of “Look Look”

For each subject, patterns were identified for the following four tendencies.

1) Whether they focused on the eyes or the mouth

2) Whether they focused on the upright image or the inverted image

3) Whether they focused on the person or the pattern

4) Whether they focused on the pointing finger

B) Analysis of original video content

1) Whether they focused on the person or the stick figure

2) Changes before and after the teacher's verbal cue

3) Whether they focused on the pencil when it was pointed at

4) When the pointing and verbal cue were contradictory

5) The effect of circling the dog with a red circle

6) The effect of pointing at the dog

The method for identifying the above was first decided by consensus between the two authors, and then the results were confirmed by three researchers not involved in the study to ensure their validity.

The determination of whether gaze was directed toward a target was decided through consensus between the two authors. This approach was taken because situations such as “glancing briefly” or “gaze moving back and forth between

targets" could be judged qualitatively by humans, but it was difficult to provide quantitative evidence for them. The authors' judgment results were verified for validity by three researchers not involved in this study.

Results

1. Eye contact rate

Eye tracking was conducted on 15 people, and all of them successfully completed the calibration and finished the experiment without experiencing any discomfort during the examination. Table 1 shows the results of the "eye contact rate," which is the percentage of time during the eye tracking period that the subject's gaze was on the screen.

Table 1 Eye contact rate (%)

ID	Look Look	original video
1	19.7	28.0
2	88.0	77.4
3	88.2	4.3
4	89.5	86.0
5	70.3	72.3
6	19.7	13.6
7	73.9	41.8
8	82.6	70.9
9	55.6	49.3
10	88.6	88.1
11	48.9	0.0
12	84.8	76.0
13	83.6	63.1
14	98.6	91.7
15	86.9	87.2

There were significant differences in gaze contact rates. While the original video for ID11 could not be analyzed for gaze targets within the frame because the subject was not looking at the screen at all, gaze detection was still possible in several other cases with low gaze contact rates.

2. Analysis results of "Look Look"

Table 2 shows the eye tracking results for each subject during the implementation of "Look Look."

Table 2 Eye tracking analysis results for "Look Look"

ID	Facial parts	Upright or Inverted	Human or Pattern	Focusing on pointing
1	Mouth	inversion	human	(-)
2	Eyes	upright	pattern	(+)
3	Eyes	upright	human	(-)
4	Mouth	upright	pattern	(-)
5	Eyes	upright	pattern	(-)
6	Eyes	inversion	human	(-)
7	Eyes	upright	pattern	(+)
8	Eyes	upright	human	(+)
9	Eyes	upright	human	(+)
10	Eyes	upright	human	(-)
11	Eyes	upright	pattern	(-)

12	Mouth	upright	pattern	(+)
13	Eyes	inversion	human	(-)
14	Mouth	upright	human	(+)
15	Eyes	upright	human	(-)

Regarding the parts of the face that attracted attention, 11 people focused on the eyes and 4 people focused on the mouth, with the eyes receiving more attention. Regarding upright and inverted animations, 12 people focused on the upright animation and 3 people focused on the inverted animation, with the upright animation receiving more attention. When comparing human and patterns, 9 people focused on human and 6 people focused on patterns, with human receiving more attention. Regarding pointing at objects, 6 people focused on the pointed object and 9 people did not, with more people not focusing on the object.

3. Analysis results of the original video

The results of the eye-tracking analysis of the original video are shown in Table 3.

Table 3 Eye tracking analysis results for original video

ID	human or stick	Teacher's call	pointing effect	pointing or voice	Encircling	pointing effect
1	(-)	(-)→(+)	(-)	voice	(+)	(+)
2	stick	(+)→(+)	(+)	voice	(+)	(+)
3	(-)	inside→(+)	(+)	(-)	(-)	(+)
4	equivalent	(+)→(+)	(+)	wondering	(+)	(+)
5	equivalent	(+)→(+)	(+)	pointing	(+)	(+)
6	stick	(+)→(+)	(+)	(-)	(+)	(+)
7	stick	(+)→(+)	(+)	pointing	(+)	(+)
8	human	(+)→(+)	(+/-)	voice	(+)	(+)
9	stick	(-)→notices*1	(+)	pointing	(+)	(+)
10	equivalent	(+)→(+)	(+)	pointing	(+)	(+)
11	(-)	(-)	(-)	(-)	(-)	(-)
12	stick	(+)→(-)	(+/-)	voice	(+)	(+)
13	stick	(+)→(+)	(+/-)	voice	(+)	(+)
14	stick	notices→(+)	(+/-)	pointing	(+)	(+)
15	equivalent	inside*2→(+)	(+)	voice	(+)	(+)

*1: On-screen notices *2: Inside the screen but excluding the teacher and notices

First, ID 11 had 0% view acquisition of the original video, so eye movements could not be

measured.

In individual items, the focus of attention for “people and stick figures” was on “people” for only one person, excluding the three who could not be measured, while “stick figures” were focused on by seven people and ‘equal’ by four people, indicating that there was more attention on “stick figures.”

In terms of changes before and after the teacher's prompt, nine participants were already looking at the teacher before the prompt, but one participant who was looking outside the screen after the prompt began focusing on the teacher, and one participant began focusing on the display inside the screen. Additionally, two participants who were looking at objects other than those inside the screen began focusing on the teacher after the prompt. On the other hand, one participant shifted their gaze from the teacher to outside the screen after the prompt.

In the video where the pencil was pointed at, nine people clearly focused on the pencil, and four people showed some degree of attention. In the video where the pencil was pointed at and the voice indicated the eraser, five people focused on the pencil and six people focused on the eraser, excluding the three people who could not be measured. One person shifted their gaze back and forth between the two.

When the dog was circled in red, 11 out of 13 participants focused on it, and when the finger was pointed, 12 out of 13 participants focused on it. It was not determined that attention increased further when all three elements—the circle, the pointing finger, and the verbal cue—were combined.

Discussion

1. Conducting the examination

This study uses eye tracking to identify the objects that children with intellectual disabilities, who have difficulty explaining their interests and actual circumstances, focus on, and to examine how the results can be utilized in education.

First, it was a major achievement that all of the children in the elementary school department of a Japanese special needs school for children with intellectual disabilities, who have relatively severe intellectual disabilities, were able to complete the examination without any particular problems. Severe intellectual disabilities not only make it difficult to understand the significance of the test but also tend to exacerbate autistic traits, leading to more limited interests and stronger resistance to new stimuli or unfamiliar sensations. Therefore, identifying a method that can be easily applied to such children is meaningful. In a previous study conducted with 51 children with intellectual disabilities, 13 children could not be measured successfully. While the reasons for this were not examined, it is not difficult to imagine that difficulties stemming from their disabilities were involved. In our current study, factors such as the short duration of approximately 5 to 6 minutes total, the use of a quiet private room, and the administration by a familiar teacher may have contributed to a sense of security.

The gaze acquisition rate was 19.7–98.6% for “Look Look” and 0–91.7% for the original video, showing significant individual variation, but all data except for the 0% gaze acquisition rate for

ID 11 in the original video were analyzable. There was no need to maintain eye contact at all times, and the fact that this method did not involve attaching electrodes to the face to track eye movements, as in previous eye-tracking techniques, likely contributed to reduced discomfort. The device used, “Gazefinder,” had previously been applied to measuring social development in infants and toddlers and assessing autism tendencies[16], and is a device that can be easily adapted to cases where cooperation is difficult to obtain.

2. Considerations based on the results of “Look Look”

The video content that comes standard with the Gazefinder device was developed for the purpose of early detection of autistic tendencies[17]. Therefore, although this study was conducted on school-age children, we expected that it would reveal the focus of a child's attention that cannot be ascertained through teacher observation by targeting a group of children with strong autistic tendencies, namely, elementary school students at special needs schools in Japan.

In “Look Look,” there are several pieces of content that show people's faces. While one of the main characteristics of children with autism is that they have little interest in people, there are reports that they tend to focus more on the mouth than the eyes when looking at facial features[18] . Some reports point to abnormalities in the control of visual attention as the reason for this[19] , and there is also a theory that the more severe the autistic tendencies, the stronger the tendency to look at the mouth[20]. In this study, 11 out of 15 participants tended to focus on the eyes, while 4 tended to focus on the mouth. While the differences compared to typically developing children of the same age have not been examined, identifying this personal reaction tendency is a significant finding.

In a video showing movements similar to dancing to music, an upright image was displayed on the left side of the screen and an inverted image on the right side, and the focus of attention was analyzed. The results showed that 12 out of 15 participants primarily focused on the upright image, while only 3 focused on the inverted image. Previous studies have reported that children with autism have lower recognition of upright faces[21), 22), 23)]. Although the stimulus video in this study featured a human figure in an upright position rather than facial features, the fact that most children focused on the upright figure suggests that, compared to an “inverted face,” a “simple human outline” may not evoke negative feelings and that its simplicity may have contributed to the higher level of attention. Of course, the results of the three children who focused on the inverted figure are also important from the perspective of understanding individual characteristics. In this study, no comparison was made between individual characteristics such as the strength of autistic tendencies and the results, which remains a future challenge.

In videos where people and patterned images appear simultaneously on the screen, we measured which of the two participants tended to focus on. The results showed that 9 out of 15 participants focused on the people, while 6 focused on the patterned images. Several studies have reported that children with autism tend to

be more interested in patterned images than in people[24]. There are also reports indicating that individuals with autism tend to focus on geometric patterns, repetitive images, or moving stimuli that involve repetition or cycles[25), 26)]. In a sense, this is a fundamental characteristic of autism that appears at the diagnostic criteria level. Eye-tracking is a method that allows direct confirmation of cognitive characteristics without requiring the individual to provide explanations, and the results can be utilized in educational materials and explanatory documents during special education classes.

It is well known that children with autism spectrum disorder (ASD) have difficulty focusing their attention on objects pointed to by others compared to typically developing children [27]. In an analysis of whether participants focused on the object being pointed to, 6 out of 15 participants focused on it, while 9 could not be determined to be focusing. This result was lower than the authors' expectations and showed a lower tendency than the original video described below. The pointing in this video involves a relatively small image of a person pointing their finger. The fact that the pointing is small and inconspicuous, and that it is a real person, may make it harder to focus on than larger symbols. In educational settings for children with intellectual disabilities, it may not be possible to capture their attention as much as teachers expect during explanations. The “Look, look!” video contains content reported to attract the attention of children with autism, but the reactions of the children in this study did not necessarily align with those reports. It is important to consider how to utilize these findings effectively when sharing them with teachers engaged in daily educational practice to apply them to actual instruction.

3. Considerations based on the results of the original video

In this study, we created an original video to measure the characteristics of gaze toward objects that include elements not reflected in “Look Look.” The video is only 90 seconds long to avoid motivational decline in children with severe intellectual disabilities and young children. Each specific video was created based on topics that teachers at Special School A wanted to investigate based on their daily teaching experiences, so they are significant in terms of educational practice.

The video “Which exercise video do children focus on more: real people or stick figures?” was created with the intention of exploring effective presentation methods for teaching exercise and dance in the classroom. As a result, eye trackings were measured in 12 out of 15 children, and only one of those 12 children focused on the real people. The remaining 11 children included 7 who focused on the stick figures and 4 who focused equally on both the real people and the stick figures. While it is challenging to explain the reasons behind their focus, factors such as stick figures being simpler with only necessary structures, a tendency to avoid autistic individuals, and the novelty of stick figures may be involved. This result suggests that teachers should not only demonstrate movements as models but also use symbolic visuals or objects to present movements. Of course, individual

differences in the results can also be utilized as valuable information. In practical teaching situations, these findings may provide useful information when considering instructional methods for physical education skills or dance choreography.

In a video in which a teacher appeared on the screen and said, “Look this way” after a short while, the children showed a high level of attention even before the teacher spoke, and their attention increased further when the teacher spoke. There are reports that children with autism respond less to verbal cues than typically developing children [28]. However, in cases such as this one, where the teacher appeared prominently in a small classroom setting and gave simple instructions, the children at least paid close attention, demonstrating the usefulness of this approach in the classroom.

The video showing a pencil and an eraser was created without emphasizing the pencil in particular. However, pointing at the pencil had the effect of increasing attention. This was more effective than pointing with the phrase “Look, look,” suggesting that a tool such as a finger-shaped pointer may be useful. Additionally, in a slightly mischievous video where the pointing gesture for the pencil and the verbal cue for the eraser occur simultaneously, the level of attention varied among individuals. While we did not analyze the relationship with individual characteristics in this study, the results may be influenced by factors such as language comprehension ability or personal preferences.

The effect of circling the dog with a red circle and the appearance of the pointing image clearly showed an improvement in attention. This was stronger than the effect of “Look, look,” which is consistent with the results of the “pencil” experiment mentioned earlier. This content was created in response to feedback from teachers at special education schools who wanted to know how effective the intuitive methods they use on a daily basis are, and it has once again demonstrated its usefulness. Since one method already captured the attention of nearly everyone, it remains to be verified whether using multiple visual limiting effects would be even more effective, making this an area for future research.

The content of this original video was created based on prior research showing that children with autism or intellectual disabilities exhibit different cognitive tendencies compared to typically developing children. These prior findings do not imply that “all children with autism or intellectual disabilities react in the opposite way to typically developing children.” While the eye-tracking method cannot definitively determine results stemming from the subject's disability characteristics, it demonstrates the potential for a simple test capable of measuring individual differences in reactions. Similar to “Look, look,” the results regarding the relationship between the presentation stimuli in the original video and the objects of attention for the children in this study could potentially provide useful information for teachers seeking to refine their material selection and clarify explanations during lessons.

Conclusions

The results of this study can be summarized as

follows.

1. In this study's eye-tracking measurements, we obtained data that was relatively usable at a high rate despite the participants being children with severe intellectual disabilities, compared to previous reports.

2. Eye tracking is a potentially useful method that may safely reflect differences in individual responses to presented materials and information—differences that are educationally important but difficult to recognize through teacher observation alone.

3. The results for the children in this study did not necessarily align with previous research on children with autism, which provided new insights for the teachers working with them.

4. It has been suggested that the use of symbolic visual images, such as stick figures, to explain in settings like physical education instruction may enhance educational effectiveness for the target children in this study.

5. Circling with a red circle or giving clear verbal instructions tended to capture the attention of the target children, and this finding may provide useful information when attempting to improve their attention to teaching materials and explanations in educational settings.

While there are still many unresolved issues, advances in technology have made it possible to apply these methods to research on education for children with intellectual disabilities, even when their cooperation is difficult to obtain. Furthermore, these methods are extremely safe and place little burden on such children, making this a promising area for future development. Going forward, it is hoped that teams consisting of teachers involved in education, experts engaged in educational research, engineering, and physiological research, and others will work together to develop methods that can be directly applied to those involved and demonstrate their actual effectiveness.

References

1) Johnny L. Matson, Mary Shoemaker (2009) Intellectual disability and its relationship to autism spectrum disorders Research In Developmental Disabilities, 30(6), 1107-1114

2) Sugiyama, T. (2007) Hattatsu Shōgai no Ima (The Current State of Developmental Disorders). Kodansha LTD

3) Canan Sola Özgüç, Atilla Cavkaytar (2015) Science Education for Students with Intellectual Disability: A Case Study. Journal of Baltic Science Education, 14(6), 804-821

4) Al-hassan Bawa, Mavis Osei (2018) English Language Education and Children with Intellectual Disabilities. International Journal of Development and Sustainability, 7, 2704-2715

5) Rendoth, T., Foggett, J., & Duncan, J. (2024). Curriculum Decision-Making for Students with Severe Intellectual Disabilities or Profound and Multiple Learning Difficulties. International Journal of Disability, Development and Education, 1–18.

6) Strnadová, I., Danker, J., Dowse, L., & Tso, M. (2023). Supporting students with disability to improve academic, social and emotional, and self-determination and life-skills outcomes: umbrella review of evidence-based practices. International Journal of Inclusive Education, 28(14), 3606–

3622.
7) Kauffman, James M, Hung, Li-Yu.(2009) Special education for intellectual disability: current trends and perspectives. Current Opinion in Psychiatry, 22(5), 452-456
8) Kamilla Klefbeck (2024)Implementing assessment protocols in compulsory school for students with intellectual disabilities: challenges and opportunities for teachers educating students with intellectual disabilities. International Journal for Lesson and Learning Studies, 13 (5), 76–91
9) Edmund Burke Huey (1908) The Psychology and Pedagogy of Reading. The Macmillan Company
10) Alfred L. Yarbus (1967) Eye Movements and Vision. PLENUM PRESS
11) Monika PŁUŻYCZKA (2018) The First Hundred Years: a History of Eye Tracking as a Research Method. Applied Linguistics Paper, 4(25), 101-116
12) Eugenia I. Toki (2024) Using Eye-Tracking to Assess Dyslexia: A Systematic Review of Emerging Evidence. Education Sciences 14(11), 1256
13) Thi Quynh Hoa Nguyen , Thi Kieu Chinh Nguyen , Thanh Ha Le , Thi Duyen Ngo (2025) Eye-tracking technology applications for supporting individuals with autism spectrum disorder: insights, challenges, and opportunities. Disability and Rehabilitation: Assistive Technology, 23, 1-36
14) Thalia Cavadini, Yannick Courbois, Edouard Gentaz (2025) Improving social-emotional abilities in children with profound intellectual and multiple disabilities through a person-centred eye-tracking-based training: A pilot study. Acta Psychologica, 255, 104928
15) Osumi, J. Matsumura, K. (2013) Effects of Teaching Materials on Eye Gazes to Letters in Autistic and Non-autistic Students with Intellectual Disabilities. The Japanese Journal of Developmental Psychology, 24(3) 318-325
16) Shuntaro Fukushima et.al.(2021) The feasibility of Gazefinder under 12 months of age infants. Scientific Reports, 11, 10009
17) Kenji J. Tsuchiya et.al.(2021) Diagnosing Autism Spectrum Disorder Without Expertise: A Pilot Study of 5- to 17-Year-Old Individuals Using Gazefinder. Frontiers in Neurology, 11, 603085
18) Tiffany L. Hutchins, Ashley Brien (2016) Conversational topic moderates social attention in autism spectrum disorder: Talking about emotions is like driving in a snowstorm. Research in Autism Spectrum Disorders, 26, 99-110
19) Dirk Neumann, Michael L Spezio, Joseph Piven, Ralph Adolphs (2006) Looking you in the mouth: abnormal gaze in autism resulting from impaired top-down modulation of visual attention. Social Cognitive and Affective Neuroscience, 1(3), 194-202
20) Warren Jones, Katelin Carr, Ami Katelin (2008) Absence of preferential looking to the eyes of approaching adults predicts level of social disability in 2-year-old toddlers with autism spectrum disorder Archives of General Psychiatry, 65(8), 946-954
21) Jason W Griffin et.al. (2023) Investigating the Face Inversion Effect in Autism Across Behavioral and Neural Measures of Face

Processing. JAMA Psychiatry, 80(10), 1026-1036
22) Karen Pierce, R.-A. Müller, J. Ambrose, G. Allen, E. Courchesne (2001) Face processing occurs outside the fusiform `face area' in autism: evidence from functional MRI. Brain, 124(10), 2059-2073
23) Falck-Ytter, Terje (2008) Face inversion effects in autism: a combined looking time and pupillometric study. Autism research, 1(5), 297-306
24) Karen Pierce, David Conant, Roxana Hazin, Richard Stoner, Jamie Desmond (2016) Preference for Geometric Patterns Early in Life as a Risk Factor for Autism, Arch Gen Psychiatry, 68(1), 101–109
25) Qiandong Wang et.al. (2018) Children with Autism Spectrum Disorder Prefer Looking at Repetitive Movements in a Preferential Looking Paradigm. Journal of Autism and Developmental Disorders, 48, 2821-2831
26) Yun-Ju Chen et. al. (2022) Attention patterns to non-social stimuli and associations with sensory features in autistic children. Research in Autism Spectrum Disorders, 98, 102035
27) Maite Montagut-Asunción, Sarah Crespo-Martín, Gemma Pastor-Cerezuela, Ana D'Ocon-Giménez (2022) Joint Attention and Its Relationship with Autism Risk Markers at 18 Months of Age. Children, 9(4), 556
28) Sam Perochon et.al. (2022) A scalable computational approach to assessing response to name in toddlers with autism. Journal of Child Psychology and Psychiatry, 62(9), 1120–1131