A Study of the Relationship between Social Communication Skills and Sensitivity to Paralanguage

Jun N. Yoshimoto

***Abstract*—Sixty office workers at a temporary employment agency were surveyed for their Autism-Spectrum Quotient (AQ) and Sensitivity to Paralanguage (SP) scores. The SP measure contains 12 questions and requires participants to guess the nature of the social relationship between two people based on a 30-second acoustic sample of their dialogue. Paralanguage was selected for investigation in this study rather than nonverbal aspects of communication because people with autism spectrum disorder (ASD) tendencies — who tend to avoid looking at the face of the interlocutor — still use paralanguage effectively. Social communication skills (SCS) were defined as the sum of scores from the AQ subscales "Social skills" and "Communication", and participants were categorized into either high or low SCS groups. Five participants had AQ scores of 26 or more, including one participant with an AQ score of 36. The five high AQ scorers were all male and all in the low SCS group. The low SCS group had a mean SP score that was 0.47 points higher than the high SCS group. The results indicate that people with poor SCS were more effective in guessing the social relationship between the two parties based on paralanguage than those with high SCS. There are two possible explanations for this finding. The first is that the SP test favors people with ASD tendencies in the low SCS group. The second is that the high SCS group may typically rely on senses other than hearing when making social judgments. In future, the reasons for our finding may be clarified by creating a "sensitivity to nonverbal cues" measurement that uses only visual information.**

***Index Terms*—Autism spectrum disorder, autism- spectrum quotient, communication skills, sensitivity to paralanguage, social skills.**

I. Introduction

There are many individuals in schools and workplaces who appear to be typically developing (TD) but have tendencies associated with autism spectrum disorder (ASD) [1]-[7]. Such individuals are often denied specialized support because they are considered TD. However, people with ASD may benefit from assistance as they are likely to experience problems in their social lives. For example, efforts to support preschoolers with ASD have recently been implemented and successful in Japan [8].

To obtain a better understanding of people in this group, scores on the Autism-Spectrum Quotient (AQ) [1] and Sensitivity to Paralanguage (SP) [9] were examined and analyzed for 60 healthy workers at one workplace in Japan.

Even individuals with ASD who tend not to make eye contact with their interaction partners are thought to actively use paralanguage (loudness of voice, pauses, and intonations). The AQ consists of five subscales, two related to social aspects ("Communication" and "Social Skills"), and three that refer to behavioral characteristics of an individual ("Attention to Detail", "Attention Switching", and "Imagination"). Genetic factors are also involved in ASD. For example, it has been shown that parents of children diagnosed with ASD score more highly on AQ subscales for "Communication" and "Social Skills" than parents with TD children [10].

The author hypothesized that some office workers with ASD tendencies would have difficulty detecting the social relationship between two people based on their paralanguage. This hypothesis appeared straightforward, especially considering the tendency of individuals with ASD to have poor social and communication skills.

Thus, it was logical to expect that those with poor social skills and communication scores would also perform poorly on the SP scale. However, it is also possible that people with ASD tendencies rely on auditory rather than visual cues because they often avoid eye contact in social situations [11-13]. People with ASD who work in society may have higher auditory-derived social guessing abilities than other people. The reason for targeting the general workplace in this study was to investigate the abilities of people with ASD who work in society and use social skills, rather than people with ASD tendencies who are less well-connected to society.

II. Methodology

A. AQ Score

The Autism-Spectrum Quotient (AQ) was developed [1] in response to the need for a brief self-administered instrument to determine an individual's position on the autism spectrum continuum. It consists of 50 questions and includes five subscales ("Social Skills", "Attention Switching", "Attention to Detail", "Communication", and "Imagination"). Each subscale has 10 questions, and a total score in the range 0–50. The higher the score, the more likely the person is to have ASD tendencies. A score of 32 or more indicates "clinically significant levels of autistic traits".

B. SP Score

Audio clips were prepared by the author and his research group [9]. After potential participants had agreed to have their conversation recorded for research purposes, their dialogue was recorded for evaluation. The participants recorded in the audio clips were all Japanese speakers. The recorded acoustic data were cut, edited, and given filter effects using "Gold Wave" (version 5.67). Twelve audio

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J. N. Yoshimoto is with the Universal Communication Center, the National Institute of Information and Communications Technology, Kyoto 6190289 Japan (e-mail: jny@nict.go.jp).

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clips of about 30-seconds each were extracted. For example, Fig. 1 is one of the sample dialogues from an audio clip. The clip presents a sample of typical natural dialogue, where one speaker (the waveform at the bottom) talks about a particular topic, while the other (top waveform) demonstrates back-channeling. This type of waveform information suggests a natural dialogue. However, the voices were filtered to sound extremely muffled, although the timing of speech, volume, and inflection were the same as before processing. Thus, the samples appeared like ordinary dialogue waveforms – with the sentence meaning removed. The muffled voices of the two speakers were completely separated into left and right channels, as shown in Fig. 1, and by using headphones during the evaluation. This meant that participants did not have to worry about who was speaking.

Six audio clips comprised conversations between pairs meeting for the first time, and the other six clips were dialogues between best friend pairs. Both groups did not act but were authentic real friends or a pair of people who had never met before. To create an index that would allow people to guess the relationship between two people based on prosody and paralanguage rather than the context of the conversation, audio editing software was used to remove the phonetic information.

To obtain the SP score, participants were asked to listen to every dialogue clip and guess whether the speakers were best friends or meeting for the first time. They were awarded one point if the relationship guess was correct, and zero points if it was not. Thus, an SP score from 0 to 12 points was obtained in approximately 6 minutes of survey time.

C. Participants

Thirty males with a mean age of 29.0 years (SD: 6.57 years) and 30 females with a mean age of 33.9 (SD: 2.73) years participated in this study. All participants were working for one temporary employment agency in Japan and had Japanese as their mother tongue. The scales were administered to all participants using a laptop PC with headphones. Assessment took place on an individual basis in a quiet private room. The Japanese version of the AQ [2] was used, and 12 recorded audio clips of Japanese dyads in conversation were used for the SP.

III. Results

There were no missing data and thus, all the scores obtained were used in the analysis.

Social communication skills (SCS) were defined as the sum of scores from the AQ subscales "Social skills" and "Communication", and participants were categorized into either high or low SCS groups. SCS scores of 4 or less were defined as the high SCS group, while an SCS score of 5 or more defined the low SCS group.

Five participants (16.7% of all participants) had an AQ score of 26 or higher, including one participant with an AQ score of 36. The cut-off value of 32 or higher was taken as the clinical threshold (1.67% in this case). The five highest AQ scorers were all males and all fell in the low SCS group.

The mean AQ and SCS scores of the high SCS group were 13.0 (SD: 2.84) and 2.00 (SD: 1.22), respectively. Scores for the low SCS group were 21.4 (4.35) and 8.53 (3.07) respectively.

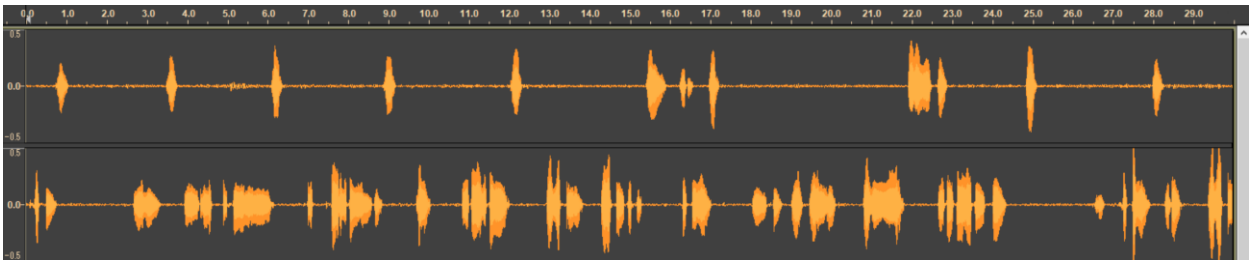

Fig. 1. Filtered dialogue wave data sample.

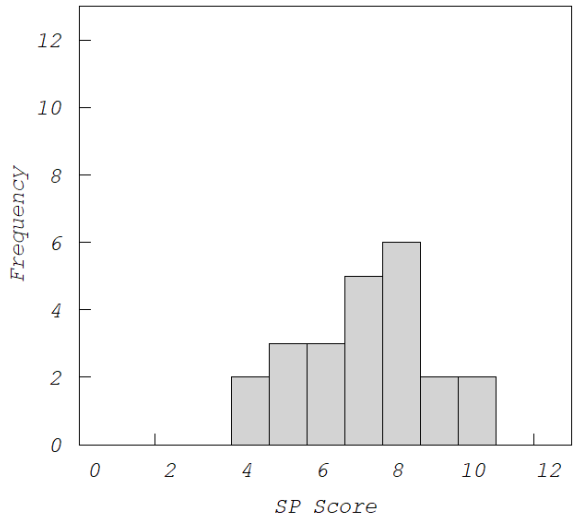

Fig. 2. Histogram of the high SCS group (n=24).

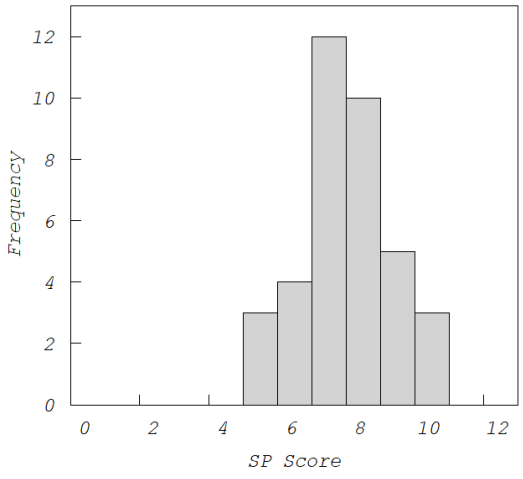

Fig. 3. Histogram of the low SCS group (n=36).

The score range for SP was 0–12 points, and the participants in this study scored between 4 and 10 points. One participant with an AQ score of 35 had the highest SP score of 10. Figs. 2 and 3 show the distribution of SP scores for both groups.

The mean SP scores for the high SCS (n=24) and low SCS (n=36) groups were 7.04 (SD: 1.72) and 7.51 (SD: 1.33) points, respectively. The high SCS group included 45.8% males, and the low SCS group comprised 54.3% males. The low SCS group had a mean SP score that was 0.47 points higher than the high SCS group.

The Shapiro-Wilk test was applied to determine whether the data were normally distributed and the significance level was accepted as p<0.05 in the analyses. The high SCS group showed a normal distribution (p=0.3096). In contrast, data for the low SCS group were not normally distributed (p=0.0381).

IV. Conclusion

The results of this study were contrary to the author's expectations. There are two possible causes for the discrepancy. The first is that the SP test was more favorable to those with higher ASD tendencies. Some people with ASD have secondary sensory sensitivities [14]. For example, people with hyperacusis may have found the SP measurement easier than people with normal hearing. The second is that adults generally place more importance on visual cues than auditory cues [15]. Thus, SCS may often be judged by senses other than hearing (e.g., visual information such as facial expressions and eye contact).

In future, this problem could be addressed by using a measure of nonverbal sensitivity based only on visual information, such as *the Diagnostic Analysis of Nonverbal Accuracy* [16], [17].

The author has already started using a method to evaluate nonverbal sensitivity using only visual information, namely black and white photographs that have been published and studied [18]. For example, one photograph depicts a man and a woman, and the task is to determine whether they are a couple or strangers. Answering that question requires judgment based on their social distance, facial expressions, gestures, the directions of their gaze, and where their hands are placed. These are skills that people are not formally taught, but rather learn in society. Answering correctly is not straightforward and requires careful judgment, similar to SP. The author believes that this task may be more difficult for people with ASD who have low frequency eye contact, than for TD individuals.

Nonetheless, the difference in SP scores and distributions between high and low SCS were slight, and this study may have only measured fluctuations in the error range. For a more accurate conclusion, more participants may be needed.

The genesis of this study was the unusually accurate auditory social skill of one person with a high AQ score (AQ score of 35). This person was not involved in the present study but is an active member of society. In this study, one participant with a high AQ score also received the highest SP score of all participants. It will be difficult to conduct a large-scale experiment with individuals with ASD and accurate auditory social skills because of their limited numbers in society. However, a comparative experiment involving this group would likely yield valuable insights.

Conflict of Interest

The author declares no conflict of interest.

Author Contributions

Etsuo Mizukami conceived and performed the experiments and contributed to the research and development of the SP score. JY conceived and performed experiments, contributed to the research and development of the SP score, processed the experimental data, performed the analysis, and wrote the manuscript. The author approved the final version.

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References

[1] S. Baron-Cohen, S. Wheelwright, R. Skinner, J. Martin, and E. Clubley, "The autism-spectrum quotient (AQ): evidence from Asperger syndrome/high-functioning autism, males and females, scientists and mathematicians," *Journal of Autism and Developmental Disorders*, vol. 31, no. 1, pp. 5-17, February 2001.

[2] A. Wakabayashi, Y. Tojo, S. Baron-Cohen, and S. Wheelwright, "The Autism-Spectrum Quotient (AQ) Japanese version: Evidence from high-functioning clinical group and normal adults," *The Japanese Journal of Psychology*, vol. 75, no. 1, pp. 78-84, April 2004.

[3] R. A. Hoekstra, M. Bartels, D. C. Cath, and D. I. Boomsma, "Factor structure, reliability and criterion validity of the autism-spectrum quotient (AQ): A study in Dutch population and patient groups," *Journal of autism and developmental disorders*, vol. 38, no. 8, pp. 1555-1566, September 2008.

[4] J. Broadbent, I. Galic, and M. A. Stokes, "Validation of autism spectrum quotient adult version in an Australian sample," *Autism Research and Treatment*, 2013.

[5] L. Lundqvist and H. Lindner, "Is the autism-spectrum quotient a valid measure of traits associated with the autism spectrum? A Rasch validation in adults with and without autism spectrum disorders," *Journal of Autism and Developmental Disorders*, vol. 47, no. 7, pp. 2080-2091, July 2017.

[6] Y. Maeda, Y. Kaneyama, and H. Sato, "Investigation on the autistic spectrum tendency of University Student: Using AQ-J-10 Japanese," *Kansai University Psychology Research Departmental Bulletin Paper*, no. 8, pp. 23-29, 2017.

[7] A. Abu-Akel, C. Allison, S. Baron-Cohen, and D. Heinke, "The distribution of autistic traits across the autism spectrum: evidence for discontinuous dimensional subpopulations underlying the autism continuum," *Molecular autism*, vol. 10, no. 24, pp. 1-13, May 2019.

[8] H. Haraguchi, H. Yamaguchi, A. Miyake, Y. Tachibana, A. Stickley, M. Horiguchi, M. Inoue, F. Noro, and Y. Kamio, "One-year outcomes of low-intensity behavioral interventions among Japanese preschoolers with autism spectrum disorders: Community-based study," *Research in Autism Spectrum Disorders*, vol. 76, 101556, August 2020.

[9] J. Yoshimoto, E. Mizukami, and Y. Naruse, "Development of a new index for sensitivity to vocal paralanguage and its evaluation," *The 32nd International Congress of Psychology*, Czech Republic, July 2021.

[10] D. V. M. Bishop, M. Maybery, A. Maley, D. Wong, W. Hill, and J. Hallmayer, "Using self-report to identify the broad phenotype in parents of children with autistic spectrum disorders: A study using the Autism-Spectrum Quotient," *Journal of Child Psychology and Psychiatry*, vol. 45, no. 8, pp. 1431–1436, November 2004.

[11] A. Senju and M. H. Johnson, "The eye contact effect: mechanisms and development," *Trends in Cognitive Sciences*, vol. 13, no. 3, pp. 127-134, February 2009.

[12] H. Akechi, T. Stein, A. Senju, Y. Kikuchi, Y. Tojo, H. Osanai, and T. Hasegawa, "Absence of preferential unconscious processing of eye contact in adolescents with autism spectrum disorder," *Autism Research*, vol. 7, no. 5, pp. 590-597, June 2014.
[13] A. R. Madipakkam, M. Rothkirch, I. Dziobek, and P. Sterzer, "Unconscious avoidance of eye contact in autism spectrum disorder," Scientific Reports, vol. 7. no. 1, 2017.
[14] T. Attwood, *Asperger's Syndrome*, London: Jessica Kingsley, 1998.
[15] B. Zupan, D. R. Babbage, and J. E. Sussman, "Modality dominance in the perception of incongruent bimodal emotion expressions," *Advances in Applied Psychology*, vol. 1, no. 1, pp. 35-46, July 2015.
[16] S. Nowicki and M. P. Duke, "Individual differences in the nonverbal communication of affect: The diagnostic Analysis of nonverbal accuracy scale," *Journal of Nonverbal Behavior*, vol. 18, no. 1, pp. 9-35, 1994.
[17] S. Nowicki, *Instructional Manual for the Receptive Tests of the Diagnostic Analysis of Nonverbal Accuracy 2*, Atlanta, GA: Peachtree, 1997.
[18] D. Archer, *How to expand your S.I.Q. (Social Intelligence Quotient)*, New York, NY: M. Evans and Company, 1980.

Jun N. Yoshimoto obtained his PhD in human informatics from Nagoya University, Nagoya 4648601 Japan in 1997.

He has served in the National Institute of Information and Communications Technology, Tokyo 1848795 Japan for over 20 years, and is currently involved in research and development of human communication technologies for conversational interaction.

Dr. Yoshimoto is a regular member of The Japanese Psychological Association.