Practical Consideration of the Support Function for Analyzing the Behavioral Factors of People Suffering from Autism Spectrum Disorder in a Video Annotation System

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Abstract: A case conferences wherein several teachers analyze an ASD person have been adopted in ASD intervention programs to analyze ASD person's behavior. However, inexperienced teachers may have a tendency to focus not on the causal behavior factors but on the surfaced behavior when analyzing videos in a case conference. Therefore, we designed a computer-based video annotation system for supporting case conferences to increase inexperienced teachers' awareness of behavior factors. In this paper, we reported the results of the trial use of a prototype system. The results suggested that the prototype system is effective for enabling inexperienced teachers to pay attention to behavior factors.

Keywords: Balloon type video annotation, Behavior Analysis, Autism Spectrum Disorder (ASD), Analyzing Skill Acquisition of inexperienced teacher

1. Introduction

This study focuses on those children who are diagnosed with low-functioning autism spectrum disorder (ASD). ASD is a neural development disorder characterized by impaired social interaction and communication, which are listed on the diagnostic criteria of both the DSM-IV [1] and ICD-10 [2]. Problem behavior, such as self-injury, includes movements that injure or can injure the person, such as skin picking, hand biting, and head banging, are almost caused by these characteristics of ASD [3]. It is sometimes compared to an iceberg: the tip of the iceberg represents the overt behaviors (the result), whereas the submerged portion represents the underlying differences and impairments (the factor) [4]. The same was also said in Applied Behavior Analysis (ABA), which is the science wherein the tactics derived from the principles of behavior are applied systematically to improve socially significant behavior, and experimentation is used to identify the variables responsible for behavior change [5, 6]. Therefore, a teacher who instructs ASD person must observe his/her overt behavior and acquire the skills to analyze the causes. However, they cannot afford to analyze the cause of behavior because of the amount of work like responding to problem behavior in class.

Accordingly, case conferences wherein several teachers analyze an ASD person have been adopted in ASD intervention programs. The discussion among teachers enables objective analysis. More recently, case conferences have increasingly started using videos to view the behaviors of ASD people. By using videos, teachers can analyze the behavior precisely even when their memory of the behaviors of the ASD people is unclear. On the other hand, inexperienced teachers may have a tendency to focus not on the causal factors but on the

result when analyzing videos in a case conference. For example, if a ASD person injures himself/herself, the experienced teacher assumes that the self-injury was caused by the stress of the unpredictable situation, and creates a work schedule. In contrast, the inexperienced teacher assumes that the self-injury is just a risk behavior because it is difficult for him/her to analyze the causal factors of the problem behavior from the video. Thus, it is necessary to develop a supporting function for analyzing behavior factors in video case conferences.

In the present study, we designed a computer-based video annotation system for supporting case conferences to increase inexperienced teachers' awareness of behavior factors. Before the system design, we focused on that behavior factors are present in the intentions of the ASD person, such as a demand or a refusal, because of the communication difficulties and developed a prototype system which is based on the following two hypotheses (Fig. 1). One is that the inexperienced teacher can become aware of behavior factors through the activity of expressing the intention of the target child by a balloon-type video annotation. (Henceforth, the balloon-type video annotation in this paper will simply be referred to as video annotation.) Another is inexperienced teachers can judge the propriety of their own analysis through comparison with the balloon-type video annotation which an experienced teacher inserts.

This paper describes the components of the prototype system and the results of the system's trial use in a school for special support education. Section 2 discusses the existing studies related to this topic. Section 3 describes the components of the system. Section 4 reports the examination procedure. Section 5 provides details of the examination results and discusses the findings.
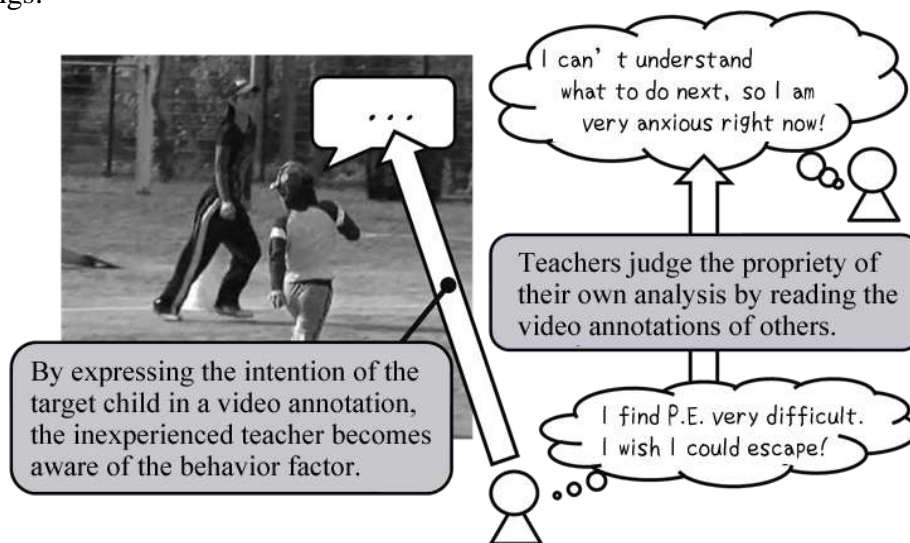

Fig. 1 Concept of our method

2. Related Work

Analysis of human behavior can be traced back hundreds of years [7]. More recently, such analysis has utilized technologies such as videos or computers. As these technologies emerged, teachers were able to analyze human behavior objectively and quickly refer back to actual events, rather than rely exclusively on notes and memory [8]. With the advancement in technology, new techniques for analyzing children in special education have emerged. From the perspective of prompting the reflection of inexperienced teachers, video annotation technology is useful for case conferences on behavior analysis.

Today, many studies have addressed computer-based annotation systems for videoconferencing. Schroeter, Hunter, & Kosovic [9] developed Vannotea, a collaborative video annotation system to describe, store, and share video annotations. Bargeron, Gupta, Grudin, & Sanocki [10] discussed design considerations in the construction of the collaborative video annotation system called Microsoft Research Annotation System (MRAS). Colasante [11] developed the integration of a media annotation tool (MAT) and explored the learning and assessment activities of an undergraduate teaching course (physical education). Yamamoto & Nagao [12] developed a web-based video annotation system named iVAS (intelligent Video Annotation Server) whose users can associate any video content on the internet with various annotations. However, these systems do not target behavior analysis.

Ogawa, Ogawa, Kakegawa, Ishida, & Morihiro [13] proposed the VISCO (Video Sharing System for Supporting COllaborative lesson improvement), which visualizes the correspondence between the problem scene and a related scene on video and reports the educational practice for inexperienced teachers. Gotoh & Nishihara [14] proposed teacher training using a web-based annotation system, which involves teaching practice students to allow teachers to develop their own teaching cognition, views on physical education, and views on students. These studies targeted collaborative lesson improvements and produced results for inexperienced teachers' training. However, they did not target special needs education. In the case of special education, it is not necessary to display the problem scene and related scene in the video. Therefore, the existing systems are difficult to apply in the special needs education context.

Nagamori, Ando, Nagasawa, Songmuang, & Ueno [15] developed a data base system for special needs education cases in order to store and share children's problem behavior, which are recorded by webcams in the classroom. This study reported that teachers could clearly describe children's behaviors in electronic educational records using the video webcam recordings even when their memory was unclear. Halipern, Karahalios, Halle, DeThorne, & Coletto [16] proposed Annotation for ASD Analysis (A^3), a coding guideline for ASD analysis that quantitatively assesses a set of dependent variables identified through the digital video annotation process. These studies made it easy for teachers and scholars to analyze the problem behaviors of ASD person However, they did not focus on improving the awareness of inexperienced teachers. Inexperienced teachers may tend to insert video annotations for overt behavior or the method of instruction and disregard the causal factors of an ASD person's problem behavior. We conducted an ex-ante evaluation for inexperienced teachers using a video annotation system. As a result, there were hardly any annotations in the video.

Consequently, we aim to develop a video annotation system that enhances the inexperienced teachers' awareness of behavior factors.

3. Components of the prototype system

The prototype system is a client-server system. The client side is developed by Microsoft Visual Studio 2010 and is able to operate in Windows VISTA/7. Figure 2 shows the prototype system interface. It is composed of a video part and annotation list part. Video annotations can be inserted by using the interface, which appears when the user clicks on the video, as shown in Figure 2. The annotations are then shown in the annotation list part. In order to distinguish the users, the video annotations of each user appear in different colors. Additionally, users can jump from one video annotation to another by clicking an item in the annotation list.
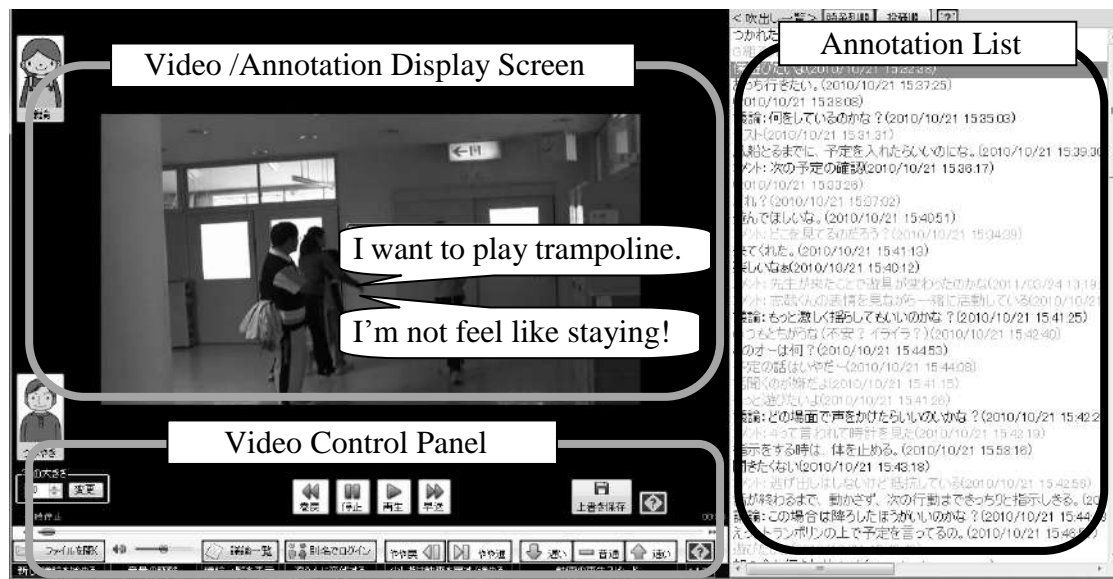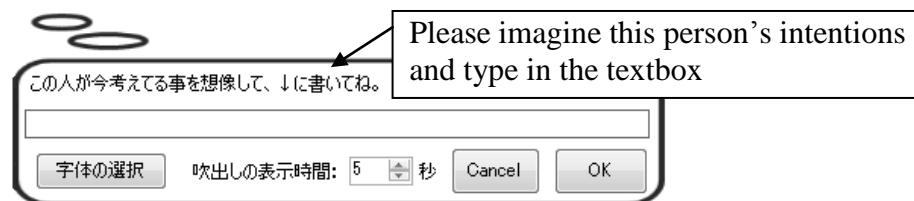
Fig. 2 Interface of the prototype system

Fig. 3 Interface for inserting the balloon-type video annotation

4. Experiment Method

4.1 Target video

The target child was 10 years old, male, diagnosed with ASD, and enrolled in a school for special education. His vocabulary was limited, and his method of communication was to use non-verbal instrumental gestures. Although the teacher had instructed the target student to participate in the class many times before the experiment, there were many video scenes that showed the target child running around or not participating in the class.

We video-recorded the target child for one day of school and edited the video. The video was 40 minutes long and composed of a morning assembly, an arithmetic lesson, and a Physical education (P.E.) lesson wherein the target child exhibited problem behavior rather frequently.

4.2 Participants

The participants in the present study comprised four inexperienced teachers and one experienced teacher. Table 1 shows the data of participants. All the inexperienced teachers had been worried regarding how they should cope with the target child's problem behavior. Although case conferences had been held several times and the experienced teacher had advised the inexperienced teachers regarding how they should handle the target child, there was no improvement in the target child's behavior.

Table 1 Participant data

Name	Sex	Experience level	Years of experience in school for special support education	Years of experience in school
Participant A	Male	Inexperienced	1	1
Participant B	Female	Inexperienced	2	7
Participant C	Female	Inexperienced	3	3
Participant D	Male	Inexperienced	2	23
Participant M	Female	Experienced	11	37

4.3 Procedure

[first case conference (Date: October 21, 2010)]

(1) Insertion of the video annotation (1.5 hours): The participants inserted video annotations using a personal computer (PC), which had been prepared individually and installed in the prototype system. In this step, participants were not able to view each others' video annotations.

(2) Sharing the video annotation (0.5 hour): The participants accessed the server-side system and shared their video annotations.

(3) Discussion (1 hour): The inexperienced teachers discussed the target child. The content of the discussion was recorded with their consent.

[second case conference (Date: November 9, 2010)]

(4) Practice report (1 hour): The inexperienced teachers discussed changes in the behavior of the target child. The content of the discussion was recorded with their consent.

(5) Questionnaire survey: We distributed a questionnaire survey, which used a four-grade evaluation system, to the inexperienced teachers (possible responses to the questionnaire survey items were "4: I strongly think so," "3: I think so," "2: I don't think so," and "1: I don't think so at all").

[third case conference (Date: December 20, 2010)]

(6) Personal interview survey (1 hour): We interviewed all participants regarding the changes in the behavior of the target child.

5. Results and Consideration

The participants inserted a total of 116 video annotations. Table 2 shows the results of the questionnaire survey. In this section, we analyzed the results of the study using the video annotation, recorded discussions, and questionnaire survey.

5.1 Awareness of behavior factors

First, *Questions 1* and *2* in the questionnaire survey suggested that every inexperienced teacher was able to consider the behavior factors. Many video annotations described behavior factors concretely, for example, "When will it start?" (the factor of the child moving his hand up and down in front of his face repeatedly or stamping his feet violently) and "Hula hoop is too difficult!" (the factor of the child running frantically in the gym). Subsequently, a change was suggested in the inexperienced teachers' analysis methods of the target child. It was assumed that as a result of the case discussion, the inexperienced teachers became actively aware of the behavior factors, and the number of the problem behaviors was clearly reduced. Every participant recognized the improvement in the

Table 2 Results of the questionnaire survey

Item	A	B	C	D	Ave.
Awareness of the causal factors of the student's behavior					
Question 1: Did you consider the participant more than usual when inserting a video annotation?	4	4	4	3	3.75
Question 2: Did you consider the reason for the occurrence of the behavior?	4	4	4	3	3.75
Question 3: Did the use of the system facilitate the analysis of the child's ideas?	4	4	4	3	3.75
Awareness of others from the annotation					
Question 4: Were other peoples' annotations helpful to you?	4	4	4	4	4.0
Question 5: Did the other peoples' annotations help you to make a discovery?	4	4	3	3	3.5
Utility of the method					
Question 6: Do you want to use the system again?	4	4	4	3	3.75
Question 7: Was the improvement more effective than that obtained by using the usual case conferences?	4	4	4	3	3.75
Question 8: Was the improvement more effective than that obtained by using video case conferences?	4	4	4	3	3.75
Effect on teaching					
Question 9: After the case conference, were you able to incorporate the results of the discussion into your instruction?	4	4	4	3	3.75
Question 10: Did you revise the goals or content of instruction for the target child?	3	3	3	2	2.75
Question 11: Did you revise the time schedule for the target child?	4	3	3	3	3.25
Question 12: Did you reduce the number of times of verbal communication for the target child?	4	3	3	1	2.75
Question 13: Did you change your approach of talking to the target child?	3	3	3	4	3.25
Question 14: Did you change the manner in which you supported the target child?	3	4	4	4	3.75
Question 15: Did you change your own movements toward the target child?	4	4	4	4	4.0

problem behavior; although a large number of instances of problem behavior appeared in the video that was used in the first case conference, only a few problem behaviors emerged in the video that was taken on October 22, 2010 (the second day of the first case conference). This improvement was also noted in the third case discussion.

Following this, the personal interview survey revealed that case conferences on the behavior factors of the target child or other children were held voluntarily, and teachers used the prototype system in their spare time at work. Therefore, it was suggested that the inexperienced teachers enthusiastically conducted the analysis.

On the other hand, all the inexperienced teachers responded, "I considered the intentions of the target child. However, there were some scenes for which I could not insert a video annotation because it was difficult." For a scene wherein the target child had disobeyed Participant B's orders in spite of the factor that participant B wanted to improve the situation by having the target child do a forward roll on the mat, experienced Participant M inserted

the following video annotation of the specific behavior factor: "It is too difficult for me to understand your instruction" and "How many times I should do the forward roll?" In contrast, inexperienced Participant B centrally inserted video annotation of the abstract behavior factor: "I don't care to do it" and "it's a pain." However, Participant B derived the following conclusion: "I have depended on linguistic communication like 'Come back soon' and 'Do the forward roll.' Therefore, I should instruct by using visual information" from the experienced participant's video annotation "I can't understand what you say!" Equally, Participant B derived the following conclusion: "The factor of running around in the gym was that the target child couldn't understand what to do next or when to stop" from the experienced participant's video annotation "How many times do I do a forward roll?" Accordingly, the inexperienced teachers were able to analyze behavior factors in scenes for which only abstract video annotation had been inserted by referring to the experienced participants' annotations.

5.2 Awareness by referring to the video annotations of others

Responses to *Questions 4* and *5* suggested that all the inexperienced teachers increased their awareness by referring to other participants' video annotations. For a scene wherein Participant A had to hold the target child from behind, for example, the video annotations indicating the target child's stress included "Don't touch me from behind! (Participant B)" or "When will the teacher pull away from my body? (Participant C)" In the stage of the case conference, Participant A was not aware that the behavior factor was his holding the target child from behind, though he knew that the target child was always on the move. He gained this awareness by referring the other participants' video annotations in the first case conference; in the practice report of the second case conference, he said, "I have not had to hold the target child from behind his back and am now aware of the distance that I must maintain from the target child after the last case conference." This was a case in which differences between the teachers' analysis of himself and other participants' analysis of the behavior factor led to the achievement of awareness.

5.3 Usefulness of the method

Questions 6 to *8* suggested that the case conference that used the prototype system led to more effective instruction improvement than those that did not use it. Though every participant had held case conferences several times, they were ineffective.

It was also suggested that participants could share ways to attend to the target child by sharing insights on the behavior factors. Actually, the participants said the following in the second case conference: "He is quite a different child now. Although he remains calm, he behaved violently before the case conference" and "The participants could share the target child's intention through the case conference. Consequently, the target child's problem behavior was improved." Though we had not expected this result, it was an important factor in improving the problem behavior.

5.4 Influence on instruction

Responses to *Question 9* suggested that all the inexperienced teachers made use of the case conference's results to improve their instruction. Moreover, responses to *Questions 11* and *13* to *15* indicated that the case conferences influenced the teachers' method of building a

relationship with the target child through instruction. However, the scores of *Questions 10* and *12* were relatively low. Regarding *Question 10*, it was assumed that originally, inexperienced Participant D had a few opportunities to call the target child's attention. Regarding *Question 12*, it was supposed that the lesson improvement was not concerned with the analysis of the behavior factors.

6. Summary

In this paper, we reported the results of the trial use of a prototype system based on the hypotheses that inexperienced teachers can become aware of behavior factors by expressing the intentions of the target child through balloon-type video annotations and can judge the propriety of their own analysis by referring to video annotations inserted by experienced teachers in a school for special support education. The results suggested that the prototype system is effective for enabling inexperienced teachers to pay attention to behavior factors. In future works, we will investigate the differences among the several types of participants.

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