Lexical and Goal Inference Making in a Cooperative Story Mapping for Students with Autism Spectrum Disorders and their Peers

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〈Abstract〉

Three elementary school students with autism spectrum disorders (ASDs) and their peers in cooperative learning groups participated in lexical and goal inference making in a cooperative story mapping intervention. A multiple-baseline design across participants was implemented to assess the intervention effect on reading comprehension skills of students with ASDs. Generalization of learned skills and social validity of the participants were also examined. Students with ASDs as well as peers increased their reading comprehension scores, especially on inferential questions. This study contributes to the existing literature on effective reading instruction strategies for students with ASDs in an inclusive educational setting.

Keywords: reading comprehension, inference making, cooperative learning group, autism spectrum disorders

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Students with autism spectrum disorders (ASDs) are reported to have good reading accuracy skills commensurate to their intellectual level as well as general language skills. Such relatively good text-decoding skills of students with ASDs, however, contrast their limited skills in reading comprehension, in particular, of narrative texts (Huemer & Mann, 2010; Minshew et al., 1994; Nation et al., 2006; Wahlberg & Magliano, 2004). Jones et al. (2009) tested the intelligent quotient (IQ) and literacy/mathematical abilities of adolescents with ASDs and found discrepantly poor reading comprehension as the most pervasive profile in their academic achievement. Similarly, Wei et al. (2015) reported that children with ASDs remarkably lost ground in their comprehension skills over time compared to other academic achievements.

Reading comprehension considers as an ongoing process in which readers interact with a text to different degrees (Snow, 2002) to construct meaning from text (Hanon & Daneman, 2001). As students with ASDs have deficits in communication and social interactions and show a unique cognitive processing style, reading for understanding is especially challenging for them (Randi, Newman, & Grigorenko, 2010). As more students with ASDs have been integrated in an inclusive educational setting to ensure their access to the general education curriculum (White et al., 2007), their unusual and diverse academic profile appears to challenge educators in meeting needs of students with ASDs and their peers. Responding to such challenges in educating students with ASDs in an inclusive educational setting, this study investigated effective reading comprehension strategies that benefit students with ASDs as well as their peers.

1. Inferencing Deficits in Students with ASDs

Students with poor reading comprehension skills are more likely to have poor inference making skills. More specific, poor inference making ability appears to cause text comprehension difficulties (Cain & Oakhill, 1999; Cain et al., 2001). It is no surprise that students with ASDs have difficulties in inference making, considering their poor reading comprehension profile. Inferencing is frequently commented on as an area of difficulty for students with ASDs, although there are a limited number of studies in this area. They show significant deficits in making inferences and processing of metaphoric expressions compared to their peers (Minshew et al., 1994; Norbury & Bishop, 2002).

For instance, high functioning individuals with ASDs were found to have impairment in inferring a character's mental state when comprehending stories (Happe, 1994; Jolliffe & Baron-Cohen, 1999).

However, Happe and Frith (2006) argued that the problem was not their inability to infer mental states, but rather a difficulty attributing a mental state that was appropriate to the story text. In other words, their limited inference making ability is due to their tendency to focus on details or individual words, making it difficult for them to understand text at the global level. Inability to "see the big picture" of students with ASDs has been demonstrated in Frith & Snowling's studies (1983, 1986), in which individuals with ASDs failed to use preceding-sentence context to determine the pronunciation of homographs. Thus, this reading intervention study employed inference making techniques with an emphasis on helping students with ASDs comprehend the given text at the global level.

2. Inference Making Training for Students with ASDs

Inference is cognitive process connecting information from different sources (Loukusa & Moilanen, 2009). There are two different stages of the inference making process where difficulties might arise: (a) *incorrect premise recall* in which a student fails to retrieve the relevant information and (b) *integration failures* in which a student fails to integrate the relevant pieces of information (Cain & Oakhill, 1999; Cain et al., 2001; Oakhill & Yuill, 1986, 1988, 1991). Students with low reading comprehension often fail to recall the information that needs to be integrated to generate inference as well as experience integration failures, compared to those with high reading comprehension. Thus, this study employed lexical inference training to help students sensitize to the types of inferences they should make and goal inference training to enhance integrating relevant information process when students making inferences.

1) Lexical inference training

Yuill and Oakhill (1988) and McGee and Johnson (2003) used lexical inference training for their inference training intervention. In lexical inference activity, the students were instructed how to look for clue words that would help them understand the text and what shorts of inference could be made from certain words. For example, from "Johnny was told to be quiet because other people were reading books" students can infer a location and, possibly, traits of Johnny clued by "to be quiet" and "reading books." Question-generation is another technique to promote inference making (McGee & Johnson, 2003; Whalon & Hanline, 2008; Yuill & Oakhill, 1988) by identifying the

elements of the story (i.e., setting, characters, event, problem, and solution). Students were trained to generate questions such as "Where did Arthur have his pet business?" "Who is helping Arthur write his story?" "Why is Arthur not sleeping well?" or "What did Mr. Ratburn do to help Arthur solve his problem?" (Whalon & Hanline, 2008). Such lexical inference or question-generation techniques associated with story elements were demonstrated to be effective in helping students to retrieve the relevant textual premise to make appropriate inferences.

2) Goal inference making training

In Jolliffe and Baron-Cohen's study (1999), when participants were asked to justify the character statements, the readers with ASDs made their justifications based on the character statements rather than knowledge gained by reading the prior text. In order to comprehend the character's actions throughout a narrative, readers should be able to infer the connections between goals of characters and other elements of a story. Such connection between character's goals and elements of the story may help readers to activate the appropriate knowledge. In order words, goal inference making helps readers to glue events together to make a coherent story (Lynch & van den Broek, 2007), which may be effective at the stage of integrating relevant information pieces. Since students with ASDs have a unique cognitive processing style that tends to focus on local information, rather than looking at a big picture (Randi et al., 2010), this goal inference making training will help them integrate collected clues related to story elements at the global level.

3. Cooperative Story Mapping

Cooperative story mapping is a reading comprehension intervention combined with the use of a story map and cooperative learning procedures to create an activity in which all students are actively engaged in analyzing and discussing stories (Mathes, Fuchs, & Fuchs, 1997). Story mapping is one instructional strategy that can improve students reading comprehension in that a story map is a visual framework, typically presented in the form of a graphic organizer, to facilitate the acquisition of the story structure and story elements (Reutzel, 1985). Cooperative learning has been suggested for effective comprehension instruction for general population as well as students with ASDs (Chiang & Lin, 2007; Randi et al., 2010; Whalon, Al Otaiba, & Delano, 2009), by motivating students to work together while providing them an opportunity to elaborate their understanding of the learning

materials (Slavin, 1996). Especially, an interdependent group contingency and structured peer interaction are strong moderators for positive student outcomes (Ginsburg-Block, Rohrbeck, & Fantuzzo, 2006; Rohbreck et al., 2003).

Since both lexical and goal inference making involve story elements, cooperative story mapping activity may be effective to help students with ASDs share their interpretations of stories while extending their own understanding (Mathes et al., 1997). Thus, this study employed a lexical and goal inference making training in a cooperative story mapping for students with ASDs and their peers as reading comprehension intervention.

4. Social Validity

The present study was implemented as a supplemental educational service in order to examine the effect of inference making training on reading comprehension skills. Thus, participants' reception of the intervention plays a crucial part in sustaining the intervention. It is likely that students' perceptions of how worthwhile and enjoyable an intervention is might influence its implementation (Elliott & Von Brock Treuting, 1991). This study evaluated social validity through the participants' changes in Self-evaluation in Reading, adopted from Marsh, Smith, & Banes (1983).

5. Purpose of This Study

The current study aimed to examine whether a lexical and goal inference making training in a cooperative story mapping might improve reading comprehension skills of students with ASDs and their peers. The participants' self-evaluation on reading was examined to evaluate social validity of the study.

Ⅰ. METHOD

1. Design

This study was part of after-school reading intervention program where both reading performance and behavior changes of participants were examined. In this study, multiple-baseline across students

with ASDs was implemented to demonstrate a functional relationship between inference making training in a cooperative story mapping and their reading scores. A social validity was examined through participants reporting their self-evaluation on reading before and after the intervention. Three cooperative learning groups composed of one student with ASDs and two peers each had 50-minutes sessions twice a week for 12 weeks. One instructor was assigned to each cooperative learning group to implement inference making intervention in cooperative story mapping intervention. All the sessions with three cooperative learning groups were audio recorded for the fidelity check.

2. Participants

Three elementary students with ASDs and six peers participated in the study. Inclusion criteria for a target student with ASDs were as follows: First, students were diagnosed with autism by a district evaluation team with expertise in autism and exhibited characteristics of autism according to the 4th edition of the Diagnostic and Statistical Manual of Mental Disorders (DSM-IV-TR; American Psychiatric Association, 2000). Second, they had to demonstrate a significant intellectual ability-achievement discrepancy, i.e., one standard deviation between standard scores on the reading of the Wechsler Individual Achievement Test-Second Edition (WIAT-II; Wechsler, 2002) and the full scale IQ of the Wechsler Intelligent Scale for Children-Fourth Edition (WISC-IV; Wechsler, 2003). Last, students with ASDs were integrated in general education setting during part of the school day. The reading subtests of both the WISC-IV and WIAT-II were administered to three target students with ASDs. They all demonstrated the significant discrepancy between intellectual ability and achievement in reading. <Table 1> presents the results of the WISC-IV and WIAT-II along with other demographic information of the three target students with ASDs.

1) Emily
Emily was an African-American female fourth grader who was fully mainstreamed in a general education class. Emily was referred due to her limited comprehension skills. Her standard score on the WIAT-II Reading was 83 points (grade equivalent 2.5), 26 points lower than her WISC-IV Full Scale IQ (FSIQ) 109. In classroom, Emily struggled with 3rd grade-level reading materials and was often unable to complete her assignments on time, so she frequently stayed after school to complete her classroom assignments. Her classroom teacher and speech therapist reported that Emily was

〈Table 1〉 Testing Scores and Demographic Information of Three Target Students with ASD

Target students with ASD		Emily	Aiden	Jackson
Gender		Female	Male	Male
Ethnicity		African-American	Hispanic	African-American
Age		9	11	10
Grade		4th	5th	5th
% of time in an Inclusive setting		100	36	36
WISC-IV	Full scale	109	66	86
	Verbal comprehension	132	50	87
	Perceptual reasoning	92	82	90
	Working memory	97	52	91
	Processing speed	103	109	88
WIAT-II	Reading composite	83	40	50
	Word reading	77	41	45
	Pseudoword decoding	90	55	66
	Reading comprehension	89	56	61

Note. WISC-IV= Wechsler Intelligence Scale for Children-Fourth Edition; *WIAT-II* = Wechsler Individual Achievement Test-Second Edition.

observed to be more passively responding to her peers when interacting with peers. Lack of eye contacts with the classroom teacher, constructive peer interactions, and seeking for help were observed during classroom instruction. She was often observed to be alone during recess and lunch.

2) Aiden

Aiden was a Hispanic fifth grader in a special education class for students with ASDs. Aiden was planning to attend a fully inclusive middle school after summer. Aiden scored 41 on WIAT-II Reading, 26 points lower than his WISC FSIQ 66. Aiden's reading performances in the classroom were below the first grade level. Aiden's classroom teacher stated that although Aiden was able to read the first grade-level reading materials, he did not demonstrate an understanding of the story or words he read. According to his speech therapist, Aiden required maximum-level of cueing and verbal models to use more than one-two word phrases when communicating wants and needs and

sharing ideas. This limited his ability to fully get his messages across people. He also spoke in a remarkably low tone which made him difficult to be understood. When a teacher asked him questions regarding the given topic, Aiden's responses were mainly nodding with a smile. The teacher had to rephrase open-ended questions with close-ended ones to elicit "Yes" or "No" responses from Aiden. Aiden rarely interacted with his classmates during classroom instruction despite peer-interaction-promoted his seating arrangements.

3) Jackson

Jackson was an African-American fifth grader in a special education class for student with ASDs. Jackson's standard score on the WIAT-II Reading was 50 (grade equivalent 1.9), 36 points lower than his WISC-IV FSIQ 86. According to his classroom teacher's report, Jackson was able to read simple stories at the second grade level and respond to the questions. His speech therapist stated that Jackson participated in activities and engaged in conversation when they were elicited. He exhibited difficulty identifying and producing appropriate responses during social situations. This impacted his ability to communicate functionally during class discussions, oral presentations and when asking and answering questions.

4) Peers

Six peers who participated in the study attended the same school with the target students with ASDs. They were all fourth graders and recommended to participate in the study due to their limited comprehension performances in the state tests. Six peers were administered the WIAT-II by the first author for grouping purpose, and their scores and other demographic information are presented in <Table 2>.

3. Instructors

Two classroom teachers and one teacher assistant from the participants' school provided the instruction to participants. The instructors had at least three years of classroom teaching experience for students with reading difficulties in special education. None of them was the participants' classroom teacher during the period of the study.

⟨Table 2⟩ WIAT-II Scores and Demographic Information of Peers

Peers	Gender	Ethnicity	IEP	Word reading	Pesudoword decoding	Reading comprehension	Reading composite
Peer 1	Female	Hispanic	No	99	87	120	99
Peer 2	Female	Hispanic	No	102	105	93	97
Peer 3	Female	African-American	Yes SLD	98	87	91	85
Peer 4	Female	African-American	No	80	80	95	82
Peer 5	Female	White	No	79	76	79	75
Peer 6	Male	Hispanic	Yes SLD	83	69	86	82

Note. *WIAT-II* = Wechsler Individual Achievement Test-Second Edition; SLD=specific learning disability.

4. Setting

Three classrooms at the participants' school were used for the study. Based on the WIAT-II scores of the participants, one target student with ASDs and two peers each, three heterogeneous cooperative learning groups were formed. Sessions were held twice a week for 12 weeks. Each session lasted 50 minutes, including 10 minutes' comprehension assessment. Each group was provided with a 5-minute interval timer; the instructor and the students could monitor the group working-pace. All the sessions were recorded with a digital voice recorder for the instructor's fidelity check.

5. Instructional Materials

1) Inference awareness worksheets

In the intervention and maintenance conditions, students were provided with an inference awareness worksheet, which was adopted from an inference making workbook (Spector, 2006). Students worked on making inferences from provided clues, by inferring place, time, agent, feeling, and so on.

2) Reading materials

In each probe, the students were provided with one narrative story. The stories were adopted

from the publicly released state tests, and their reading levels were determined through the Flesch-Kincaid readability test using Microsoft Word 2000 program. In order to maintain consistent reading level during the study, lengthy easy stories and short difficult stories were evenly distributed. The average number of words was 486 and average grade level of reading was 3.4.

3) Story map

During the intervention and maintenance phases, each group was provided with a story map that could be posted on the wall. All the students also had their own copy. The story map had five story elements such as setting, characters, events, problem, and solution. Additional components were added to the story map to help students to make goal inference: "Want" component for each character and "Lesson" component for the whole story (See Appendix A).

6. Procedures

This study had the baseline, intervention, and maintenance phases. Besides three phases, students had generalization probes between the intervention and maintenance phases and after the maintenance phase.

1) Baseline

Once the target student with ASDs and two peers were ready to start a session, the instructor passed out a story paper to each student. The instructor read a story aloud while the students read it along. Then, the instructor passed out a comprehension quiz to each student and provided verbal directions:

"Now, you are going to answer the questions. Do not worry about spelling. If you are unsure of an answer for one question, just pass to the next one. Just try your best. If you have any questions, please ask me. You have 10 minutes to complete it."

The instructor placed a timer where the students could see. Once the timer went off, the instructor collected the answered quizzes from the students. A single baseline probe lasted approximately 15-20 minutes. Since each tutoring session lasted 50 minutes long, two or three baseline probes were conducted depending on the group's reading pace. The baseline phase lasted until the target student's scores on comprehension quizzes got stable and did not show any sign of

visually remarkable increases. Length of baseline phase ranged from 3 to 5 probes staggered across three target student with ASDs.

2) Intervention: Lexical and goal inference making in a cooperative story mapping

Once the baseline phase was established, lexical and goal inference making trainings in cooperative story mapping activities were implemented. Each intervention session had three major activities: inference awareness, cooperative story mapping, and comprehension quiz. The intervention phase lasted until the group completed the cooperative story mapping activity with 100% accuracy with the instructor's prompts.

(1) Inference awareness activity

Students were guided to make lexical inferences such as location, time, agent and etc., by given clues on short passages in an inference awareness worksheet.

(2) Cooperative story mapping

Structured peer interaction and interdependent group contingency were employed during cooperative story mapping activity. Students were assigned to a facilitator, writer, or monitor and written scripts were provided to them. The group earned one point every five minute if they were all on the task and collaborating, which was recorded on the group point chart by the instructor. During the first four sessions, the instructor modeled and guided the group how to perform assigned roles while comprehending two social stories on which three students made a reading club and read stories as a cooperative learning group. Starting the fifth session, students with the assigned roles started taking a charge of story reading and cooperative story mapping activity following the scripted *Cooperative Learning Group Role Chart*. After shared reading, the group worked on the story element as a group. For goal inference making, the instructor guided the group to make goal inference regarding what each character wanted or needed. The instructor referred to the *Cooperative Learning Group Role Chart* whenever the group was not making progress as a group. The cooperative story mapping activity lasted approximately 30 minutes.

(3) Comprehension quiz

Same as the baseline phase, the instructor collected the story map worksheet and passed out

comprehension quiz paper to students. The students had 10 minutes to independently complete the test.

3) Maintenance

The maintenance phase had the same activities as the intervention phase: inference awareness, cooperative story mapping, and comprehension quiz. During cooperative story mapping activity, the instructor's role was decreased to the minimal level, only by providing prompts if necessary. The students implemented cooperative story mapping activity by playing the assigned roles written on the *Cooperative Learning Group Role Chart*. The group point system was continuously employed throughout the sessions.

4) Generalization probes

Generalization probes were employed to evaluate the extent to which inference making training in a cooperative story mapping was carried out to students' performance in reading comprehension. All the participants had generalization probes between intervention and maintenance phases. Additional generalization probes were implemented after the maintenance phase was over. The procedures in the generalization probes were consistent as those in the baseline phase. The instructor passed out a story to the students and pre-read the story with the students. Then, the students independently took a comprehension quiz for the given 10 minutes.

7. Dependent Measure and Social Validity

1) Scores on comprehension quizzes

Participants' reading comprehension skills were measured by 10-minute comprehension in paper-and-pencil quizzes. The comprehension quiz consisted of 10 open-ended questions that were modified from O'Connor & Klein (2004). The sequence of questions included four "who, what, where, when" questions that required students to recall factual information explicitly stated in the passage, three "why or how" questions that required students to make inferences about information not explicitly stated in the passage, three synthesizing questions including generating title for the story, identifying the main idea of the story and free retelling. The participants independently took a comprehension quiz for the given story in the baseline, intervention and maintenance probes as well as

generalization probes. Factual questions 6 points and inferential questions 15 points, thus a total of 21 points were the possible scores on each quiz. Each participant's scores were categorized into total scores, factual scores, and inferential scores for further analysis. The first author graded the participants' quizzes and a graduate student checked the scores for 25% of the graded comprehension quizzes.

2) Social Validity

Students' self-evaluation on reading was asked as part of subjective evaluation before and after the study. The questionnaire of students' self-evaluation on reading was adopted from *The Self-description Questionnaire* developed by Marsh and colleagues (1983), whose coefficient alphas for the seven dimensions range from .80 to .92. The students responded to each item either with "Like Me" or "Unlike Me" on 10 questions. When the student's response on the item reflected positive self in reading, 1 point was given and when reflecting negative self in reading, 0 point was given. Higher points reflected the student's higher self-evaluation on reading.
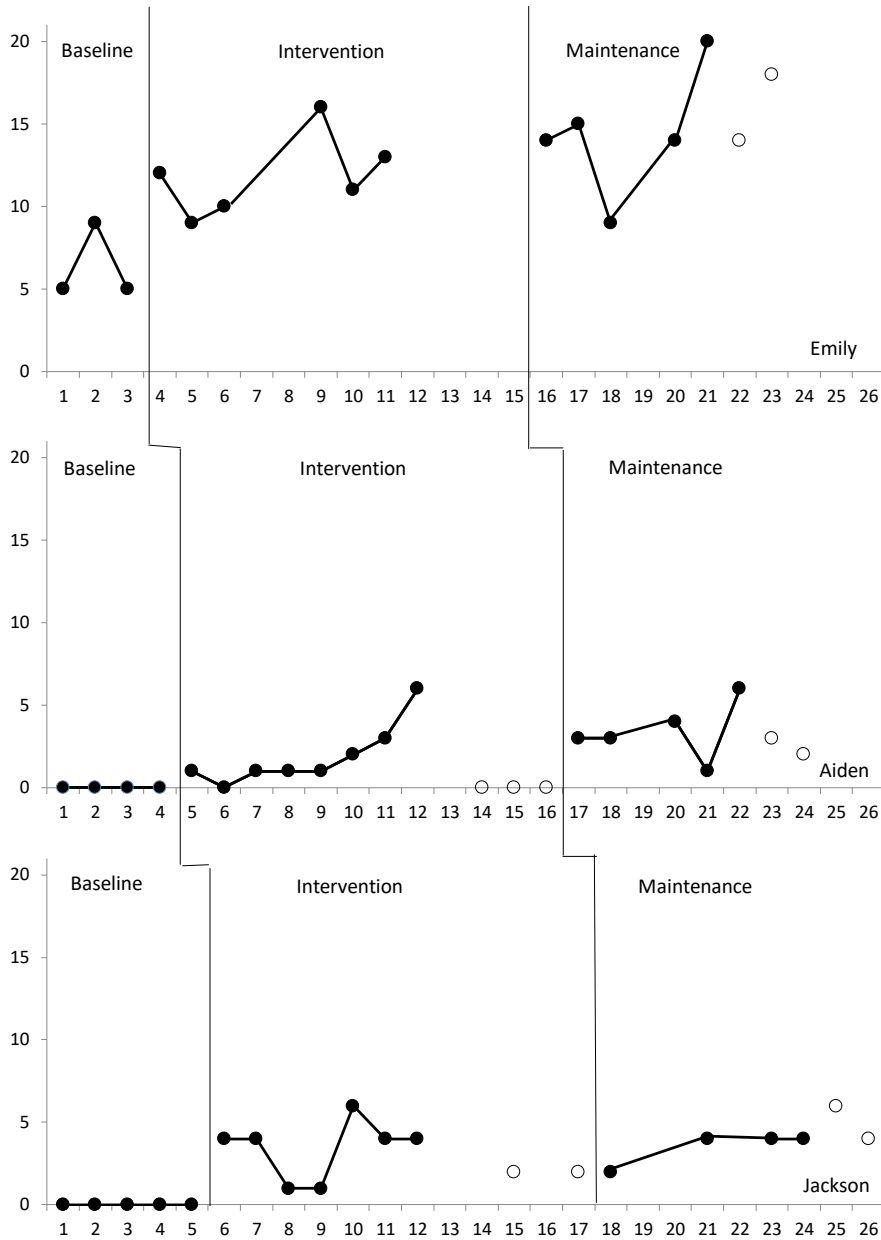
8. Treatment Fidelity

Instructors' adherence to the procedure of each session was evaluated for their treatment fidelity. Three instructors followed all the procedures written in the manual, according to audio files recorded in each session. Thirty percent of audio files of all the baseline, intervention, maintenance conditions and evaluation probes were randomly selected for the fidelity check. All three instructors adhered to the procedure 100% of time.

Ⅱ. Results

1. Reading Comprehension Skills of Student with ASDs

<Figure 1> deficits scores on comprehension quizzes in which three target student with ASDs, i.e., Emily, Aiden, and Jackson, demonstrated their comprehension skills in the baseline, intervention, maintenance probes as well as generalization probes. The ordinates show the scores on comprehension

quizzes in which the target students with ASDs obtained and the abscissas show the consecutive probes. The results show that three target student with ASDs demonstrated increase on comprehension quizzes after intervention.

⟨Figure 1⟩ Scores on comprehension quizzes by target students with ASD

1) Baseline

During the baseline phase, in which the participants were expected to comprehend a given story and take a quiz, scores on comprehension quizzes remained at a low level for all three target student with ASDs. For instance, Emily's scores were below 10, out of possible 21 points, in all the baseline probes (range = 5-9, M = 6 points) and both Aiden and Jackson showed flat low performance by scoring 0 points on the quizzes.

2) Intervention

During the intervention phase, each target student with ASDs was grouped with two peers and inference making intervention in a cooperative story mapping was implemented under the instructor's guidance. Emily's group started an intervention session as her scores during the baseline phase did not increase. Once the intervention started, Emily's scores increased to average 11.8 points (range = 9-16). Aiden's group started the intervention phase right after Emily demonstrated scores increase on the comprehension quiz. Aiden's scores immediately rose in the first intervention probe and consistently continued to increase after the third intervention probe (range = 0-6, M = 1.9 points). Once Aiden showed a positive change in his scores, the third group of Jackson started the intervention phase. Immediately after the start of intervention, Jackson exhibited scores increases on comprehension quizzes (range = 1-6, M = 3.4 points).

3) Mid generalization probes

Once the target student with ASDs demonstrated scores increases on comprehension quizzes consecutively more than three probes in the intervention phase and the participants were able to complete cooperative story mapping activities at 100% accuracy with the instructor's prompt, generalization probes were conducted. Emily was absent during her group's mid generalization probes, due to her arm injury. Aiden's scores in generalization did not change from the baseline's scores, by marking all 0 points. Jackson's scores increased (M = 2 points) from the baseline probes (M = 0 points).

4) Maintenance

After the participants had mid generalization probes, the maintenance phase started. The

instructors minimized their prompts and the participants took charge of cooperative story mapping activities. During the maintenance phase, scores on comprehension quizzes continuously increased for all the target students with ASDs. Emily continued to demonstrate improved comprehension skills in the maintenance probes (range = 9-20, M = 14.4 points). Both Aiden and Jackson, exhibited higher scores, respectively M = 3.4 points, M = 3.5 points, than the baseline and intervention phases.
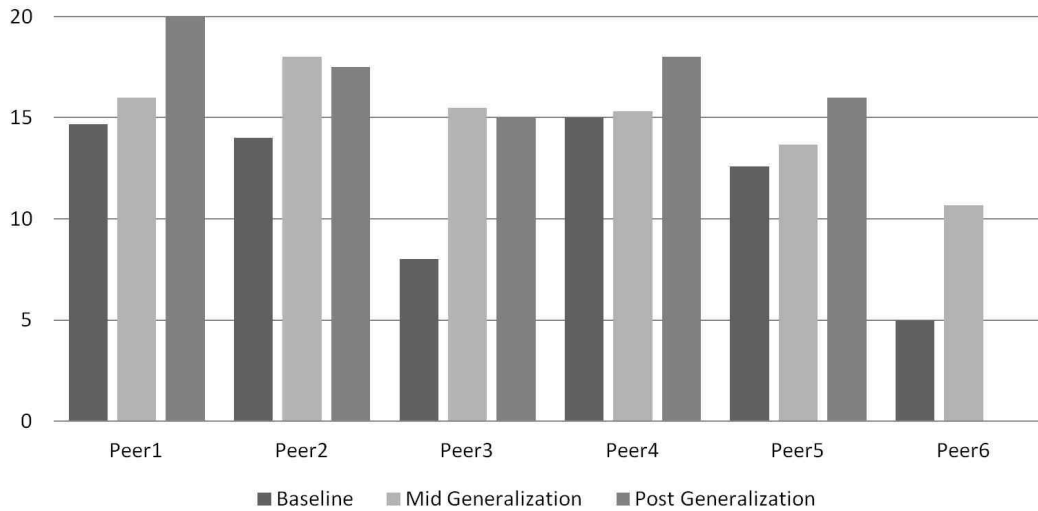
5) Post evaluation probes

Post evaluation probes were conducted after the maintenance phase and the procedure was same as the baseline and mid evaluation phases. All three target students with ASDs demonstrated the effect of inference making training in a cooperative story mapping on their reading performances, by increasing their scores on comprehension quizzes. Although Emily did not have mid generalization probes, her scores in the post generalization evaluation probes demonstrated that her reading comprehension skills improved from the baseline phase, by jumping to average 16 points from average 6 points. Aiden who showed no change in the mid generalization probes also demonstrated increased reading comprehension skills, by scoring average 2.5 points. Likewise, Jackson increased his scores to average 5 points from average 2 points.

6) Effect sizes

Percentage of non-overlapping data (PND) between the baseline and intervention phases were calculated to evaluate the intervention's effect size on students' scores. PND for Emily, Aiden, and Jackson was respectively, 84.6, 77.7, and 100, and overall average PND for all three students with ASDs was 87.4. Since PND scores of 70 to 90 have been considered effective (Campbell, 2004), inference making training in a cooperative story mapping was effective to improve reading comprehension scores of students with ASDs.
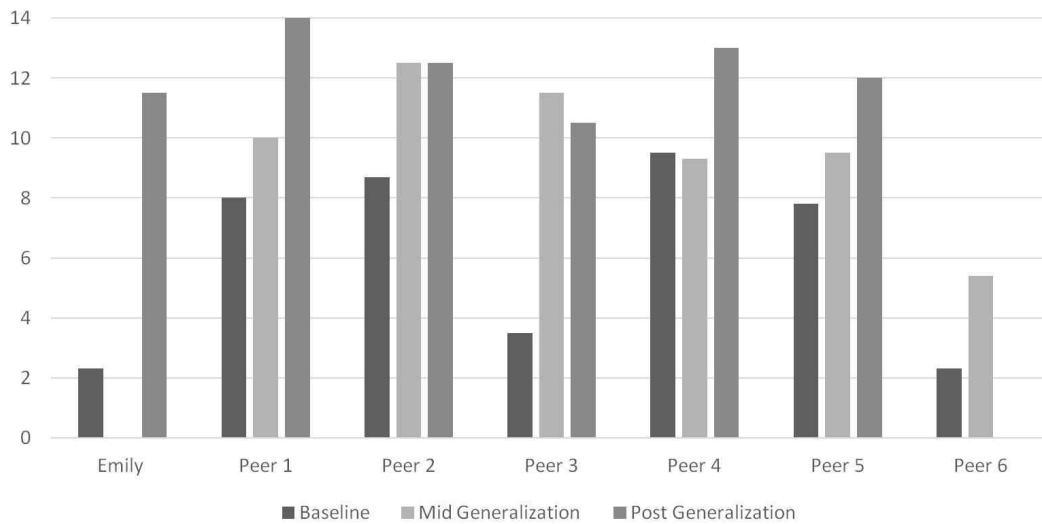
2. Reading Comprehension Skills of the Peers

The six peers demonstrated their improved reading comprehension skills by obtaining higher scores in both generalization conditions (See <Figure 2>).

〈Figure 2〉 Average scores on comprehension quizzes by the peers in the mid and post generalization probes

Note. Peer 2 and Peer 3 with a specific learning disability. Peer 6 did not participate in the post generalization probes.

〈Figure 3〉 Average scores on inferential questions in the mid and post generalization probes by Emily and peers

Note. Peer 2 and Peer 3 with a specific learning disability. Emily did not participate in the mid generalization probes. Peer 6 did not participate in the post generalization probes.

3. Inferential Skills of Participants

Comprehension quizzes (total 21 points) had two components such as factual (6 points) and inferential questions (15 points). All the participants' scores were calculated for each component along with the total scores. Since Aiden and Jackson only scored on factual questions, their scores on inferential questions were not calculated. Thus, scores on inferential questions by Emily and the peers were calculated to examine the effects of inference making training in a cooperative story mapping on the participants' inferential skills. <Figure 3> depicts average scores in both evaluation probes by Emily and the peers. Emily and all the peers increased their scores on inferential questions in generalization probes. Thus, lexical and goal inference making training in a small learning group was effective to improve the participants' inferential skills.

4. Self-Evaluation on Reading

All the participants completed the Self-evaluation on Reading questionnaires before and after the study as part of social validity evaluation. The average scores of the students with ASDs were 8 points in Pre and 9 points in Post evaluation. For peers, the average scores were 7.1 points in Pre and 8.9 points in Post evaluation. All the participants reported score increases in self-evaluation on reading after lexical and goal inference making in a cooperative mapping activity intervention.

Ⅲ. Discussion

This study developed inference making training in a cooperative story mapping activity to help students with ASDs improve their reading comprehension skills. Participant's scores on comprehension quizzes were examined in the baseline, intervention, and maintenance phases to document a functional relationship between the intervention and score changes in comprehension quizzes. All three students with ASDs empirically demonstrated the effect of inference making training in a cooperative story mapping on reading comprehension skills, by substantially increasing their scores on comprehension quizzes. Their scores continued to rise in the maintenance phase in which the instructor minimized their prompts and the students took over the sessions. Such consistent gains

were continuously kept in the generalization probes, as well. Such results in terms of overall scores on comprehension quizzes have several implications. First, despite the plethora of studies documenting improved reading comprehension performance of students with reading difficulties (Browder et al., 2006; Gajria et al., 2007), exceptionally few have demonstrated improvement in reading comprehension of students with ASDs (Chiang & Lin, 2007; Whalon et al., 2009). What is more, even fewer studies have shown gains in reading comprehension of moderate and low functioning students with ASDs (Kamps et al., 1989; Kamps et al., 1994). This study extends existing research by empirically documenting score gains in comprehension quizzes of students with ASDs at different cognitive functioning levels after inference making training in a cooperative story mapping.

Second, all the peers also substantially increased their average scores on comprehension quizzes throughout the intervention and maintenance phases as well as generalization probes. Although peers' scores were not examined for the functional relationship with the intervention, such gains cannot be ignored. Especially two peers, Peer 3 and Peer 6, who were served with special education services for a specific learning disability, literally doubled their scores during the study. Thus, inference making training in a cooperative story mapping may benefit not only students with ASDs but also those with reading difficulties. Literature on reading comprehension indicates that specific reading strategies to improve reading comprehension are in need for students with comprehension difficulties (Gajria et al., 2007; Gersten et al., 2001). Inference making training in a cooperative story mapping specifically taught the participants how to employ lexical and goal inference making and how to integrate such inferences into the whole text while working as a team. At the beginning, the story maps were often incomplete, leaving problem, solution, or lesson components unfilled. However, as the sessions went by, the participants were able to complete the story map within a given time frame, filling out all the components including the last one, "the lesson learned from the story."

Third, the data exemplified in <Figure 3> are also consistent with findings in the literature documenting that inference making skills lead to comprehension skills (Cain & Oakhill, 1999; Cain et al., 2001). Emily and peers all demonstrated substantial score gains on the inferential questions. Especially Emily, Peer 3, and Peer 6, who were served with special education services showed remarkable improvements in answering inferential questions. Such results confirmed the previous studies that enhanced inferencing skills lead to better comprehension performance (Lynch & van den Broek, 2007; McGee & Johnson, 2003; Whalon & Hanline, 2008; Yuill & Oakhill, 1988). Two other target students with ASDs did not score on quizzes in the baseline phase: Their scores

increases occurred on factual questions, such as where the story took place, what the characters did, or what happened to the characters. Thus, their scores on inferential questions could not be analyzed. Jackson showed improved inference making when retelling the story, although it was not reflected in his scores in comprehension quizzes. Jackson was able to infer what each character wanted and why a major problem occurred while retelling the story.

Such results imply inference making in cooperative story mapping activities involves two different stages of inference making process. Students with low reading comprehension show limited inference skills caused by either incorrect premise recall or integration failures or both (Cain et al., 2001; Yuill & Oakhill, 1991). Both Aiden and Jackson showed their learning benefits from the intervention, by improving their scores on factual questions. On the other hand, Emily and peers were already able to correctly answer most of factual questions before the intervention. Their substantial score gains from inferential questions indicate that they may learn how to integrate their inferences in the given text. Jackson with moderate functioning autism also started showing his learning through cooperative mapping activities although such changes were not reflected in the paper-and-pencil assessment yet. The most prominent strength of this inference making in a cooperative story mapping intervention may be its applicability to heterogeneous group of students with various levels of cognitive functioning and reading ability. Since this method facilitates different stages of inference making process, students were able to demonstrate positive outcomes in comprehension regardless of their cognitive functioning or reading performance levels.

1. Limitations

This study employed scores on comprehension quizzes as only measurer for participants' reading comprehension performance. Despite positive outcomes for all participants, a traditional paper-and-pencil assessment did not seem sensitive to students' gains in comprehension. For instance, Jackson demonstrated his enhanced comprehension skills in interacting with the instructor or peers although his verbal performance was not reflected in his quiz scores. Thus, multiple measures for comprehension skills should be considered to sensitively reflect any gains in students' performance. This study employed generalization probes to measure students' growth in comprehension skills. However, generalizations over different formats of assessments or different settings were not tested. Generalization is an issue that continues to pose difficulties for professionals in the field (Hwang &

Hughes, 2000), thus it would be important for future studies to measure generalization across assessments (i.e., multiple-choice test), or setting (i.e., in classroom during the school hours).

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국문초록

자폐 아동과 또래 동료 간의 협력 이야기 도식을 통한
어휘력과 추론능력 향상을 위한 연구

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자폐학생 3명과 일반학생 9명이 3개의 협동그룹을 만들어서, 협동 story mapping활동을 통해서 문맥 그리고 목적을 추론하는 방법을 12주간 배웠다. 자폐 학생들 간의 대상자간 중다기초선설계(multiple-baseline across participants) 연구방법을 통해서 이 활동이 자폐학생들의 독해력에 미치는 효과를 측정하였다. 목표행동의 일반화와 연구의 사회적 타당성 역시 측정되었다. 발달장애학생 뿐만 아니라 일반학생들도 독해력, 특히 추론능력이 증가됨을 보여주어서 이 연구는 현재 통합교육현장에서 발달장애학생들을 위한 효과적인 독해력 증진에 관한 기존의 연구문헌에 기여를 한다.

〈주제어〉 또래중재, 자폐, 독해력, 단일피험자실험, 통합

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Appendix A

A Story Map Template

Front Page

CHARACTER1:	SETTING: Where did the story take place?
Wanted:	CHARACTER3:
CHARACTER2:	Wanted:
Wanted:	OTHER CHARACTER:

Back Page

EVENT: What did the characters do?	
PROBLEM: What was the main problem?	SOLUTION: How did the characters solve the problem?
	LESSON: What did you learn from the story?