Using a Constant Time Delay Procedure to Teach Aquatic Play Skills to Children with Autism

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Abstract: Effects of a constant time delay procedure on aquatic play skills of children with autism was investigated. A single subject multiple probe model across behaviors with probe conditions was used. Participants were four boys, 7-9 years old. Data were collected over a 10-week period using the single opportunity method as an intervention. Results revealed that all subjects increased their correct target skills significantly during intervention. In addition, subjects maintained their successful play skills during first, second and forth week of maintenance phases. Results showed that constant time delay was an effective way of increasing and maintaining aquatic play skills of children with autism.

Children first learn vocabulary words about their parents, other people who are very close to them, food and drinks they like, and social words such as “Hi” and “Bye.” Later, children’s vocabulary mainly consists of games and activities that they like to do in a game context (Pieterse & Treloar, 1989). Smith (2001) defines the game as “Something that happens voluntarily, often spontaneously, offering the child internal reinforcements and rewards.” (p.2). The role and importance of playing games does more than just contribute to the child’s vocabulary, it also is an activity that provides an interaction with other people and objects.

Children learn verbal and nonverbal communication skills during their game experience because playing games provides an opportunity for children to express themselves during the game, such as requesting and refusing the things that they would like to do or not (Coyne, Nyberg, & Vandenburg, 1999; Maurice, Green, & Luce, 1996; Smith, 2001).

In addition, game activities provide an ideal and natural interactive environment for parents and teachers to contribute to children’s language skills with plenty of motivation and opportunities (Pieterse & Treloar, 1989).

Autism is a lifelong developmental disability that causes delays in verbal and nonverbal communication and social interaction as well as exhibition of ritualistic and compulsive behaviors (Loovis & Ersing, 1979). Children with autism have severe communication, language, and social interaction problems compared to their nondisabled peers. Therefore, teaching games is an essential need to develop vital social skills of children with autism (Maurice, Green, & Fox, 2001; Leaf & McEaching, 1999).

Autistic children have several stereotypical motor behaviors (e.g. swinging their bodies backward and forward, playing with their fingers, moving their head in a circular motion and jumping). These behaviors cause communication and learning problems for children with autism. However, it is possible to reduce these behaviors via teaching physical activity and games (Leaf & McEaching, 1999; Smith, 2001). Sherrill (1986) states that some of these stereotypical behaviors can be used to teach skills similar in behavior such as swimming (e.g., swinging their bodies backward and forward, moving arms up and down).

Although past research showed that children with autism have normal motor develop-
ment patterns, a recent study found that autistic children have very low performance in motor skills. Therefore, it is recommended that autistic children be encouraged to participate in games and other physical activities for motor skill development (Smith, 2001).

There are several studies that showed the possibility of teaching individuals with autism or moderate to severe intellectual disabilities play skills such as playing darts (Schleien, Kiernan, & Wehman, 1981), pinball (Hill, Wehman, & Horst, 1982), frisbee (Horst, Wehman, Hill, & Bailey, 1981), and bowling (Halle, Gabler-Halle, & Bemben, 1989). Also, Cameron and Capello (1983) taught specific sport skills to individuals with autism or severe intellectual disabilities. Moreover, several research studies reported that children with autism have enjoyed swimming activities, and play skills in the water promoted many learning opportunities during training and post training periods (Campion, 1985; Killian, Menna, & Arena, 1984).

Constant time delay is an effective method in teaching children with severe mental disabilities (Schuster, Gast, Wolery, & Guiltinan, 1988; Stevens & Schuster, 1987; Tekin & Kırcaali-Iftar, 2001; Wolery, Ault, & Doyle, 1992). In several studies, constant time delay was utilized to teach play skills such as playing darts, pool, pin knocking, hotshot basketball, golf, and frisbee to children with autism or intellectual disabilities (Tekin, et al., 2001). Constant time delay was also used to teach lifetime sport skills to adolescents with severe to profound intellectual disabilities (Zhang, Gast, Horvat, & Datillo, 1995), playing UNO, croquet, and horse shoe to adolescents or young adult with moderate to severe intellectual disabilities (Wall & Gast, 1997). Acquisition and maintenance data for these studies revealed that constant time delay was effective in teaching leisure skills to subjects with developmental disabilities.

Parallel to these findings, research has shown that constant time delay is an effective instructional procedure in teaching students with autism (Alig-Cybriwsky & Schuster 1990; Ault, Wolery, Gast, Doyle, & Elizenstat, 1988; Browder, Morris, & Snell, 1981; Kleinert & Gast, 1982; McIlvane, Withstandley, & Stoddard, 1984; Schoen & Sivil 1989; Schuster et al., 1988; Stevens & Schuster, 1987; Tekin et al., 2001).

Although there have been studies about effects of constant time delay procedures on different disabilities in the literature, there was no research on the effects of constant time delay procedures on aquatic play skills of children with autism. Therefore, the purpose of the current investigation was to examine effectiveness of constant time delay procedures on aquatic kangaroo, cycling, and snake play skills of children with autism. Also, maintenance and generalization effects of the procedure were assessed.

**Method**

**Participants**

Four boys with autism, 7-9 year old, participated. Five prerequisite conditions were established for participants before the study: 1) Ability to response to visual and audio stimuli for at least 7-10 minutes, 2) Ability to imitate gross muscle skills, 3) Have regular restroom habits, 4) Have no open wound on the body, and 5) Ability to get into water at waist level. All participants met these criteria.

Ömer was a 9 year old boy with autism. He participated in an early special education program when he was 4-5 years old. In addition, he had an individual special education service four times a week when he was 6 years old. At the time of the study he was a mainstream student at a public school. Ömer had reading, writing, and simple mathematical skills. However, he had difficulty in social interaction, communication and language skills. Ömer did not have any experience or systematic intervention with errorless teaching in constant time delay procedure.

Ali was the twin brother of Ömer. He also participated in an early special education program when he was 4-5 years old. He also is mainstream student at a public school, and he had reading, writing, and simple mathematical skills. Moreover, he had the same problems as his brother, and he did not get any prior systematic intervention with errorless teaching in constant time delay procedure.

Yener was a 9 year old boy with autism. He participated in an early special education program when he was 3-5 years old. In addition, he had an individual special education service twice a week when he was 6 year old. At the
time of the study, he had been a mainstream student at a public school for two years. Yener had reading, writing, and all simple mathematical skills. However, similar to other participants he had problems in social interaction, communication, and language skills. Yener did not have any systematic intervention with errorless teaching in constant time delay procedure prior to study.

Can was a 7 year old boy with autism. He was a mainstream student in a preschool program for 4 years. He received a special education service 5 times a week after 3 years old. In addition, Can had learned the concepts of color, shapes, and the numbers between 1 and 9. Like the other subjects, Can had problems in social interaction, communication and language skills. Can did not get any systematic intervention with errorless teaching in constant time delay procedure.

Trainers

The intervention phase was applied by four researchers. All researchers had degrees in education and prior research experience in special education.

Settings

All instructional, probe, maintenance and generalization sessions occurred at the Anadolu University indoor swimming pool. The swimming pool was divided into two parts with a rope. At the beginning, all students participated in fun water activities with instructors on the right side of the pool. Each student then was transferred individually to the left side of the pool for instruction and intervention. In addition, all sessions occurred in a one-to-one format for 10 weeks, three times a week, between 7:30 am and 8:30 am. There was also a writing board at the swimming pool.

Materials

There was not any special equipment used during the study. However, a video recorder, video tapes, data collection forms, a writing board and pencil were used to collect data. Social reinforcements were used for motivational purposes (e.g. free time game activities).

Screening Procedure for Target Behaviors

The main purpose of this study was to teach aquatic play skills for children with autism and one of the future plans was to collect data on Halliwick’s method of swimming rotation skills (Martin, 1981). Therefore, aquatic play skills of kangaroo, snake, and cycling were randomly selected from this method. The study was designed as a multiple probe model to implicate target behaviors efficiently. However, target behaviors must be selected according to two important characteristics: 1) Target behaviors functionally should be similar to each other; and 2) Target behaviors should be independent from each other (Alberto & Troutman, 1990). At this point, all of these selected behaviors are functionally similar gross motor tasks that can be taught easily via constant time delay method. Besides, these behaviors are independent from each other so learning a kangaroo aquatic play skill does not have a negative effect on the other target skills. Selected target behaviors are functionally independent from each other in the study.

Tasks

The task analyses were developed by all authors by performing the skills. Later, three of the authors got together and reviewed the task analyses by performing these skills again. Some modifications and revisions were done. These task analyses are presented in Table 1.

Experimental Design

Constant time delay is an errorless teaching procedure in which the stimulus control is transferred from a given stimulus condition (e.g. teacher) to other stimulus conditions (e.g. target stimulus). This is a promising alternative for instructing individuals with developmental disabilities because the instructor presents a target stimulus, waits the specific fixed amount of delay interval, and finally presents the controlling prompt. This prompt is then faded by systematically inserting a fixed amount of time between presenting the target stimulus and providing a controlling prompt that will ensure the student does the task correctly (Tekin et al., 2001; Wolery et al., 1992).
Constant time delay is an effective instructional procedure because it reduces the probability of the learner making mistakes. Especially, 0 s constant time delay is a good way of eliminating the number of mistakes made by learner. This procedure also provides reinforcement to the learner, and it could be a more fun and positive experience for both the learner and teacher (Tekin et al., 2001).

**Experimental Procedures**

A 1 to 1 instructional format was use during all experimental sessions. There were probe, probe, maintenance, and generalization sessions in the study. Teacher and participants were face to face in all sessions, and all participants were ready in the pool before the start of the study. A probe condition was implemented before the training of each target behavior, and after the criterion was reached in training of that target behavior for a minimum of three probe sessions.

**Probes Conditions**

Probe sessions occurred prior to training each target behavior and after the criterion were met in that target behavior. Each probe condition had a minimum of three consistent probe sessions. A single opportunity procedure was used during probe sessions. The teacher presented the task direction and recorded the subject’s response to steps of the task analysis. When the subject initiated an incorrect response, performed an incorrect response or no response, he was interrupted by the teacher and the subject’s response was recorded as a minus (−) and the rest of the steps in the task analysis were recorded as incorrect. When a subject performed a correct step he got a plus (+) (Brown & Snell, 2000). For example, the trainer took his/her place in the pool and said, “Osman, are you ready to perform kangaroo movement in the water?” to get attention of subject. Once an affirmative verbal or physical response was received, the trainer delivered the task direction, “Do the kangaroo movement in the water.” Then the trainer waited 4 s for the subject to initiate a response. Subject was reinforced with a descriptive verbal phrase when he initiated the correct steps in 4 s and kept it 15 s. Incorrect responses were defined as not initiating a step in 4 s, initiating but not completing in 15 s, and initiating an incorrect step of the task analysis is not considered. In addition, if the first response was incorrect then the rest of steps in the task analysis were recorded as incorrect (Wolery et al., 1992).

**Constant Time Delay Instructional Conditions**

Aquatic play skills were taught by using a 4 s constant time delay procedure. Two types of delay intervals were used: 0 s and 4 s delay intervals. During 0 s trials the trainer secured subject’s attention and said, “Osman are you ready to perform kangaroo motion in the water?” Then the trainer said, “Osman do the kangaroo motion”, then presented the controlling prompt immediately and said, “Osman turn your direction to me now.” The controlling prompt was determined according to the performance and characteristics of each subject and target behavior individually. The 4 s delay, trials were implemented in the

### Table 1

**Task Analyses for Making an aquatic kangaroo, cycling, and snake play skills**

<table>
<thead>
<tr>
<th>Skills</th>
<th>Steps in the task analyses</th>
</tr>
</thead>
</table>
| Kangaroo | 1. Participant and trainer face to each other  
2. Participant and trainer hold each other hands  
3. Participant jumps like a kangaroo inside of the pool with assistance of trainer |
| Cycling  | 1. Participant turns his back to trainer  
2. Trainer holds the participant from his waist and raise him in the water  
3. Participant moves his legs forward like pedaling a bicycle |
| Snake   | 1. Trainer turns his back to participant  
2. Participant holds from trainer’s waist with his fingers  
3. Participant follows trainer 20 meters within the water holding him from waist |
same way as 0 s delay except the trainer waited 4 s before providing the subjects a controlling prompt.

There were six types of subject responses during instructional sessions: correct response; anticipations, errors, nonwait, wait, and no response. Correct waits were defined as completing a step of the task analysis correctly within 15 s after the prompt. Anticipations were defined as initiating a step of the task analysis before the prompt and completing the response correctly within 15 s. There were three types of nonwait errors: initiating a step of the task analysis before the prompt but performing it correctly as a topographical error, initiating a step of the task analysis before the prompt but not completing it within 15 s duration as a duration error, performing a different step of task analysis as a sequence error. Wait errors were completing the response incorrectly or completing the response within 15 s of the prompting. No response was not initiating a response within 4 s of the prompt. All types of correct responses, correct anticipations, and correct waits resulted in descriptive verbal praise. Finally, all incorrect responses were ignored and the task direction for the next step was provided.

Maintenance and Generalization Sessions

Maintenance sessions were conducted one, two, and four weeks after the final full probe condition. Maintenance sessions were conducted in an identical manner to probe sessions except reinforcement was thinned during maintenance.

Generalization across persons was examined by a pre-post test design. These sessions occurred before training and at the end of teaching for each targeted leisure skill. Generalization sessions were conducted exactly the same but with another trainer.

Reliability

Inter-observer agreement data was collected during at least 35% of all experimental sessions. Inter-observer reliability was calculated by using a point-by-point method with a formula of the number of agreements divided by the number of agreements plus disagreements multiplied by 100 (Tawney & Gast, 1984).

Mean percent of the inter-observer agreement for Can during probe conditions was 88% (67% to 100%); during instruction was 92% (84% to 100%), 100% for kangaroo, 92% for snake, 84% for cycling; during maintenance was 100%; and during generalization was 100%.

Mean percent of inter-observer agreement for Yener during probe conditions was 100%; during instruction was 92% (84% to 100%), 84% for kangaroo, 92% for snake, 100% for cycling; during maintenance was 100%; and during generalization was 100%.

Mean percent of inter-observer agreement for Ali during probe conditions was 97% (84% to 100%); during instruction was 96% (84% to 100%), 84% for kangaroo, 100 % for snake, 100% for cycling; during maintenance was 100%; and during generalization was 100%.

Mean percent of inter-observer agreement for Ömer during probe conditions was 100%; during instruction was 100%, 100% for kangaroo, 100% for snake, 100% for cycling; during maintenance was 100%; and during generalization was 100%.

Independent variable reliability (procedural reliability) was calculated by dividing the number of teacher behaviors observed by the number of teacher behaviors planned and multiplied by 100 (Billingsley, White, & Munson, 1980). The following teacher behaviors were observed for procedural reliability during training session: (a) having the materials ready, (b) securing the subject’s attention, (c) delivering the task direction, (d) delivering the controlling prompt in time (if appropriate), (e) waiting for the response interval, (f) delivering the correct behavioral consequences, and (g) waiting for the inter-trial interval. The same steps were observed during probe, maintenance, and generalization sessions except delivering the controlling prompts in time.

Procedural reliability measures resulted in an overall percent of 100% during probe conditions for the first teacher with Can. Procedural reliability measures resulted in an overall percentage of 95% (86% to 100%) during instruction with Can. The teacher implemented maintenance and generalization sessions with 100% accuracy with Can.

Procedural reliability measures resulted in an overall percent of 97% (84% to 100%)
during probe conditions for the second teacher with Yener. Procedural reliability measures resulted in an overall percentage of 93% (86% to 100%) during instruction with Yener. The teacher implemented maintenance and generalization sessions with 100% accuracy with Yener.

Procedural reliability measures resulted in an overall percent of 99% (94% to 100%) during probe conditions for the third teacher with Ali. Procedural reliability measures resulted in an overall percent of 96% (75% to 100%) during instruction with Ali. The teacher implemented maintenance and generalization sessions with 100% accuracy with Ali.

Procedural reliability measures resulted in an overall percentage of 100% during probe conditions for the fourth teacher with Omer. Procedural reliability measures resulted in an overall percentage of 98% (86% to 100%) during instruction with Omer. The teacher implemented maintenance and generalization sessions with 100% accuracy with Omer.

**Results**

**Constant Time Delay Instructional Data**

Probe and training data for Can, Yener, Ali and Omer are shown in Figure 1 through 4 respectively. The open circles represent percent of correct responding during full probe and instructional sessions, maintenance and generalization session.

All subjects met criteria after the introduction of 4 s constant time delay. Data revealed that constant time delay was effective in teaching aquatic play skills to children with autism.

Instructional data for each subject, number of training sessions, number and percentage of training errors, and amount of training time are in Table 2. As seen in Table 2, 50 training sessions and approximately 2 hours and 5 minutes training time were required for all students to reach criterion on three aquatic play skills.

Can needed 13 training sessions to reach criterion on three aquatic play skills. A total of 29 minutes training time was required to reach criterion on all three aquatic play skills. Ali needed 12 training sessions to reach criterion on three aquatic play skills. A total of 21 minutes training time was required to reach criterion on all three aquatic play skills. Omer needed 12 training sessions to reach criterion on three aquatic play skills. A total of 24 minutes training time was required to reach criterion on all three aquatic play skills. The percent of training errors that occurred during training sessions was between 0% and 2%.

**Maintenance and Generalization Data**

Maintenance data was collected one, two, and four weeks after the instruction had stopped. Maintenance data showed that the subjects maintained the aquatic play skills taught to them at criterion level during the one, two, and four weeks after the instruction. Generalization data showed that all subjects generalized the aquatic play skills in 100%.

**Discussion**

The purpose of this study was to determine effects of a constant time delay procedure on aquatic play skills of children with autism. Additionally, generalization and follow up data was collected. Results of the study were analyzed via graphic illustrations. Results showed that all subjects increased their correct target skills a significant amount during the intervention phase. Moreover, subjects maintained their successful play skills during the first, second, and fourth weeks of generalization phases.

Literature indicates constant time delay is an effective method to teach chained tasks to individuals with disabilities in using copy and soda machines (Chadler, Schuster, & Stevens, 1993); using napkins, spoon, and cup (Collins et al., 1991); reacting positively to newly introduced people (Collins et al., 1992); applying first aid skills for small wounds, burns and bites (Gast et al., 1992) and learning kitchen skills (Griffen, Wolery, & Schuster, 1992; Hall et al., 1992). Parallel to findings in the literature, this study demonstrated that constant time delay was an effective method to teach and maintain chained tasks (e.g. kangaroo,
snake and cycling aquatic play skills) to individuals with disabilities.

According to the graphic illustration of data, it can be concluded that all participants received the same amount of sessions (e.g. 4 or 5) and all participants performed with minimal percentage of error. Considering the difficulties subjects have with attention and communication skills, this study revealed that constant time delay was an effective method to teach aquatic play skills. In addition, procedural reliability measures showed that all teachers applied constant time delay procedure consistently between 93%-100%. In the literature it is recommended that procedural reliability is minimally 80% and above 90% is

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**Figure 1.** Percent correct responses after the prompt for Can during full probe, instructional, maintenance, and generalization probe sessions. Closed circles represent correct responses during full probe, instructional, and maintenance sessions. Open circles represent correct responses during generalization sessions.
high regarded (Wolery, Bailey, & Sugai, 1988). This study showed that procedural reliability was high for teachers during the sessions. It can be concluded that all teachers efficiently applied the procedures of constant time delay to teach aquatic play skills for children with autism. Also all participants performed the aquatic skills very well in early sessions with this intervention in a limited time. Therefore, this procedure is highly recommended for further studies.

The study has two important contributions to literature: 1) support of the literature that constant time delay was an effective method to teach chain and maintained tasks to individuals with disabilities: 2) first research attempt to
determine the effects of constant time delay procedure to teach aquatic play skills for children with autism.

Results of this study provide several recommendations for future research. First, 1 to 1 teaching arrangement and single opportunity method to teach aquatic play skills was used. This study can be replicated using group arrangements. Second, kangaroo, snake and cycling aquatic plays skills were selected from Halliwick’s swimming education program (Martin, 1981). As a result of this, all children became ready to participate and learn actual swimming skill patterns. Therefore, it is recommended to teach swimming skills to children with autism for future studies. Third, trainers reported that all children enjoyed aquatic plays skills during sessions, and chil-

Figure 3. Percent correct responses after the prompt for Ali during full probe, instructional, maintenance, and generalization probe sessions. Closed circles represent correct responses during full probe, instructional, and maintenance sessions. Open circles represent correct responses during generalization sessions.
Children improved their social and communication skills with peers compared to their out of pool behaviors. Fourth, most important, trainers observed autistic children had less stereotypical motor behaviors (e.g., swinging their bodies backward and forward, playing fingers, moving head in a circular motion and, jumping) in the water during training sessions.

Consequently, results of this study showed that constant time delay is an effective way of increasing and maintaining aquatic play skills for children with autism. Also, it can be concluded that teachers can teach many activities via aquatic play skills. However, this study has several limitations, such as the characteristics of participants, tests, and the measurements.

Figure 4. Percent correct responses after the prompt for Ömer during full probe, instructional, maintenance, and generalization probe sessions. Closed circles represent correct responses during full probe, instructional, and maintenance sessions. Open circles represent correct responses during generalization sessions.
that were applied. Therefore, further studies should address effects of constant time delay procedure on different play skills, disabilities, gender, and ages of children with autism.

References


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**TABLE 2**

Instructional data for each student through criterion

<table>
<thead>
<tr>
<th>Students</th>
<th>Behaviors</th>
<th>Of Sessions Thru Criterion</th>
<th>Errors Thru Criterion</th>
<th>Training Time Thru Criterion</th>
</tr>
</thead>
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<tr>
<td>Can</td>
<td>Snake</td>
<td>4</td>
<td>0%</td>
<td>00:09:10</td>
</tr>
<tr>
<td></td>
<td>Kangaroo</td>
<td>4</td>
<td>0%</td>
<td>00:10:34</td>
</tr>
<tr>
<td></td>
<td>Cycling</td>
<td>5</td>
<td>1%</td>
<td>00:09:47</td>
</tr>
<tr>
<td>Total</td>
<td></td>
<td>13</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Yener</td>
<td>Kangaroo</td>
<td>4</td>
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<td>00:08:22</td>
</tr>
<tr>
<td></td>
<td>Cycling</td>
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<td>2%</td>
<td>00:08:17</td>
</tr>
<tr>
<td></td>
<td>Snake</td>
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<td>0%</td>
<td>00:12:25</td>
</tr>
<tr>
<td>Total</td>
<td></td>
<td>13</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Ali</td>
<td>Cycling</td>
<td>4</td>
<td>0%</td>
<td>00:05:35</td>
</tr>
<tr>
<td></td>
<td>Snake</td>
<td>4</td>
<td>0%</td>
<td>00:07:43</td>
</tr>
<tr>
<td></td>
<td>Kangaroo</td>
<td>4</td>
<td>0%</td>
<td>00:07:55</td>
</tr>
<tr>
<td>Total</td>
<td></td>
<td>12</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Omer</td>
<td>Kangaroo</td>
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<td>0%</td>
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</tr>
<tr>
<td></td>
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<td></td>
<td>Snake</td>
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<td>0%</td>
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</tr>
<tr>
<td>Total</td>
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<td>Grand total</td>
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<td>50</td>
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