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Determining the Efficacy of Dyad Practice Components (Observation-Dialogue) in Learning How to Open and Close Shooting Gun G-3

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ABSTRACT

The aim of this study is to determine the effectiveness of observation and dialogue in dyad practice in order to learn the opening and closing skill for shooting gun G-3. For this purpose, 80 volunteer participants with no previous experience about G-3 shooting gun were randomly selected in four training groups (observation/dialogue, observation/ no dialogue, no observation/dialogue, no observation/no dialogue). In the acquisition phase, participants tried to practice the skill for 10 times. In all phases of the study, the participants' performance criterion was the time spent for opening and closing the shooting gun G-3. Retention tests were conducted one day, one week, 2 weeks, 3 weeks and one month after the acquisition phase. Two-way ANOVA and Bonferroni post hoc tests were used ($p<0.05$) for analyzing data. Results showed that the observation factor was significant in all remind tests which may be due to the activation of mirror neurons, motivation and sense of positive competition. The dialogue factor became significant from the second week onwards. The lapse of a relatively long period of time from the initial training might have distinguished the role of cognitive factors in learning this skill.

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INTRODUCTION

Motor learning studies are generally concerned with factors that enhance motor skills learning, such as the type of instructions or feedback, practice order of different tasks and observational learning or mental practice. That is researchers have primarily focused on variables that can promote motor skill retention. In optimal practice condition, training programs should be both effective and efficient. A training program is efficient when it increases skill learning and is effective when it decreases the costs such as energy, time and money associated with training sessions. Dyad practice is a form of exercise, which is done in pairs to achieve a common goal. Do practice in pair, compared to individual exercise, lead to a better learning? Shebilske *et al* have concluded that dyad practice leads to a better learning compared with individual practice. Reviewing motor learning literature clearly demonstrates that learning with someone else can adjust and regulate the performance. In this project, in frequent attempts, individuals tried physical training of the skills and observing their training partner's performance. So at the end of acquisition phase, they carry out a skill in half of the required time. So, dyad practice sessions are more efficient. Despite reducing costs, potential benefits of dyad practice is getting the benefit of talking about the performance strategies with partner. It is accepted that physical training is not the only way of learning a new motor skill but observing another individual who is doing the skill facilitates the learning of a widespread domain of tasks. Bandura argues that observing a model leads to reflecting the relevant task. Afterwards, whenever the individual needs to carry out the task, he/she applies the reflection to opt, plan and response. Moreover, reflection plays a standard reference role for diagnosing and correcting faults. There is not a severe difference among those mechanisms which are obtained through observation and those obtained via physical training. Thus, it has been suggested that observational learning and learning through practice may be achieved via similar cognitive processes. In behavioral level researches show, the variable which affects learning through physical practice, similarly affects observational learning. Indeed, a training program which is experienced through observation and the available relevant sensory information provides similar learning

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outcomes for the observers. There are two outstanding perspectives in observational learning; the first one is Bandura's social cognitive theory which indicates that during observation the observer symbolically encrypts skill's information. Then, he/she can apply the encrypted information to guide the performed actions. According to this theory, "patterning" is the usage of display as a means of data transfer and is about how to implement the skill. And it would be effective when follows four sub-processes; *Attention, Retention, Rehabilitation* and *Motivation*. Scully and Newel have a different approach; they argue that the visual system directly receives constant motor information about the relationship between different parts of the body, and it is capable of distinguishing special motor characteristics from displaying the motion. There are different methods like live patterning; "*master* or *novice model*", video patterning; "*film* and *photographs*" and sometimes computerized patterning, *animation*, in order to help the learner in acquiring each of observational learning processes which result in consolidation of existing information in a memory representation. Observing a master model leads to perception of information related to unchanging motion patterns and imitation of display strategies. Also, observing a novice model instead of encouraging the person to mimic the performance observed involves the observer in a more active way in problem solving. Findings indicate that live patterning; either master or novice, in laboratory or field conditions can be effective for learning motor skills (Heyes, 2010).

The phenomenon of mirror neurons, for the first time, was discovered by Italian scientists in the University of Parma. When a monkey performs an action itself (e.g. it picks up a raisin by its finger) or when it passively sees a similar action by another monkey or a human being, these neurons are activated. Hayes (2005) says that these neurons indicate how an animal's brain decodes another animal's behavior. Therefore doing that behavior at the same time or later becomes easier. Researchers initially discovered these neurons in parietal cortex and pre-motor of monkeys (Kilner *et al*, 2009). But evidence suggests that a similar system exists in the human's brain (Rizzolatti, Fogassi and Gallese, 2001). The results of various studies also show that the position of neurons in the human brain overlaps with the monkeys' brain. Ferrari, Rozzi and Fogassi (2005) in their research about mirror neurons concluded that there is a specific type of cell in motor cortex of a monkey's brain called neurons related to tools (e.g. tongs or wood) which are activated when the monkey performs an action or observes what another monkey or human does. In such circumstances, the activity of these neurons is more intense than when the operation is done by hand or mouth. Evidence suggests that such a mirror system also exists in human's brain (Gazzola and Keysers, 2009). The first research on existence of mirror neuron in humans was carried out by Heyes (2010). It was observed that when people see the other person's action, in addition to mirror neurons, the frequency of movement potentials, in the muscles of the same part of the body of the spectator, who is viewing another person significantly increases; just like the man himself is doing the observed action.

As stated previously, dyad practice is a kind of exercise that two people work simultaneously to achieve common goals. In this regard Shea, Wulf & Whitacre (2009) showed that dyad practice compared with individual training can facilitate motor learning and increase the performance efficiency (because two participants can be trained at a time). Thus, when workouts are scheduled in groups of two or more, expenses will be divided among groups and training costs reduce for each participant (Granados and Wulf, 2007). In recent years several studies have been conducted on dyad practices (in which two persons do exercise together), concluding that observation in dyad practice is highly effective that can, in turn, significantly promote motor learning. Dyad practice can facilitate education quality, particularly if observation and practice (physical) take place at the same time. Shea *et al* indicated in their study that observational learning provides unique opportunities for data processing activities, which are not possible in physical training of skills. When the most cognitive resources are required for physical performance of the task, observer can be aware of different aspects of adjusting patterns or of evaluating the various effects of strategies during a new, difficult or impossible skill.

Furthermore, training with a partner and sharing learning strategies, beside the learning progression, may increase the learner's sense of responsibility to engage in learning processes. Shea *et al* argue that observation gives the trainee a unique chance to extract important information or to access the effectiveness of strategies. Social learning theory suggests that paired training can have advantages in learning sophisticated skills. Even if the learners are beginner and make mistakes during training process, they may avoid repeating their faults by observing each other while practicing. Wulf and Granados (2007) went one step beyond and studied the effect of observation and dialogue separately on dyad practice in the task of certain arrangement for glasses. 24 hours after training they ran retention test on participants. In this test, that group which benefited from observation factor had a better learning than the other groups who were unable to see each other during training. This study was chosen because the author wanted to identify the effect of observation and dialogue in, relatively complex motor skills of opening and closing the shooting gun G-3. If the effectiveness of observation and dialogue are to be approved, the causes must also be stated. Therefore, in this study, the researcher tries to answer this question what is the proportion of each variable, namely observation and dialogue, in skill training to open and close the shooting gun G-3? And, whether lapse of time affects their efficiency or not?

Participants:

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80 volunteer participants, with no previous experience about shooting gun G-3were randomly selected in four training groups (observation/dialogue; observation/no dialogue; no observation/dialogue; no observation/no dialogue).

MATERIAL AND METHODS

Opening and closing shooting gun G-3 was the task of this study. In order to make the training procedures similar, one educational film was used for all groups. The task consisted of two phases: first was opening the gun (opening bipods, butt stock, springs, knob, movable tools, tube, flame-cap, bush) and the second phase was closing the gun (bush, flame-cap, tube, knob, movable tools, springs, butt stock, bipods).



Fig. 1: Shooting gun G-3 in close mode



Fig. 2: Shooting gun G-3 in open mode

Methodology:

Participants received general instructions related to the task via educational film, which was prepared in advance (master pattern). Participants were reminded that if they did wrong during the skill, they could correct their mistake and then continue their activity. Next, the relevant guidelines for each training group were separately provided.

Observation/Dialogue group: Two participants were training periodically. While a partner was doing the activity the other one was observing. The activity was followed by a 30 seconds dialogue in rest time (for example they could talk about the correct sequence of doing the skill). Then the second training partner did the activity while the first one was watching. This sequence was repeated 10 times.

Observation/ No dialogue group: The same as the first group. They periodically trained in practical and observational form. But they were not allowed to talk to each other in rest time.

In No observation/Dialogue form: participants trained in dyad, too. Not seeing each other during the practice, they were allowed to have a 30 second dialogue while resting.

No observation/ No dialogue group: Participants did practice individually and had a rest time equal to that of other groups. In addition, participants did not receive a reinforced feedback about the move time.

All the participants opened and closed shooting gun G-3 ten times in one day. After one day, one week, two weeks, three weeks and a month retention tests were carried out. The retention test was performed individually, including opening and closing of shooting gun G-3 correctly and sequentially.

Data analysis:

Using the Kolmogorov-Smirnov test, normality for the data was proved. To analyze the obtained data for each retention test, two-way ANOVA test was run. Results are presented in below table.

Table 1: Two-way ANOVA results in one-day, one-week, two-weeks, three-weeks and one-month retention tests

Probability	F value	Degree of freedom	Sum of squares	Source of Variations	Retention tests
*0.0001	104.125	1	543675.313	The observation main effect	One-day retention
0.11	2.614	1	13650.313	The dialogue main effect	
0.132	2.323	1	12127.813	Interactive effect	
*0.0001	55.321	1	627652.45	The observation main effect	One-week retention
0.728	0.121	1	1377.8	The dialogue main effect	
0.1	2.771	1	31442.45	Interactive effect	
*0.0001	201.88	1	1091379.2	The observation main effect	Two-weeks retention

*0.041	4.327	1	23392.8	The dialogue main effect	
0.1	2.777	1	15015.2	Interactive effect	
*0.0001	261.732	1	1497686.45	The observation main effect	Three-weeks retention
*0.013	6.463	1	36980	The dialogue main effect	
*0.033	4.72	1	27011.25	Interactive effect	
*0.0001	316.822	1	1969408.8	The observation main effect	One-month retention
*0.001	11.181	1	69502.05	The dialogue main effect	
*0.007	7.757	1	48216.2	Interactive effect	

P<0.05

As it can be seen, the effect of observation is significant in all retention tests. So it can be concluded that the presence of observation factor caused a significant increase in all retention tests. But the effect of dialogue factor is significant in two-weeks, three-weeks and one-month retention tests. The interactive effect of dialogue factors was significant in three-weeks and one-month retention tests and Bonferroni post hoc test for both tests is provided below along with the related charts.

Table 2: Bonferroni post hoc test relating with the interactive effect of three-week retention test

Statistical features / Groups		Differences in mean	Standard error	Significant level
Dialogue/ Observation	-6.250	23.921	1.000	Observation/ no dialogue
	-236.900	23.921	*0/0001	Dialogue/ no observation
	-316.650	23.921	*0/0001	No observation/ no dialogue
Observation/ no dialogue	-230.650	23.921	1.000	Dialogue/ no observation
	-310.400	23.921	*0/0001	No observation/ no dialogue
Dialogue/ no observation	-79.750	23.921	*0/008	No dialogue/ no observation

P<0.05

Bonferroni test results in three-week retention test indicate that those groups who took advantage of the observation factor had a better performance than those groups who didn't make use of this factor. Meanwhile, enjoying the dialogue factor leads to a better performance rather compared with those who lacked this factor.

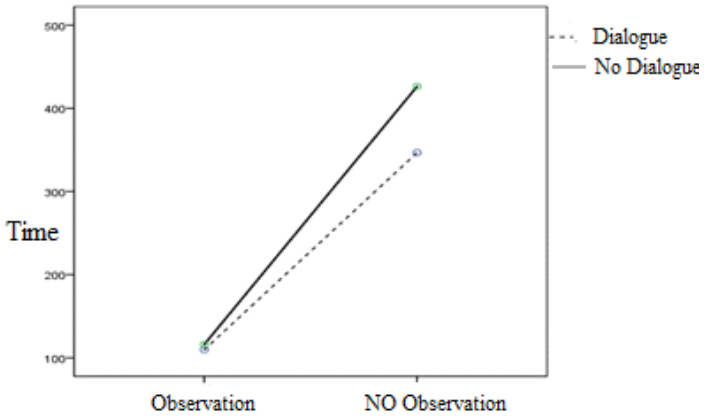


Chart. 1: Interaction effect of observation and dialogue in three-week retention test

The interaction of observation and dialogue in retention test of three-week was significant which is obvious in chart 1, so that groups that experienced the observation factor had a similar performance. And in those groups, where the observation factor is not applied, the group who enjoyed dialogue factor performed better.

Table 3: Bonferroni post hoc test relating with the interactive effect of one-month retention test

Statistical features / Groups		Differences in mean	Standard error	Significant level
Observation/dialogue group	-9.850	24.932	1.000	Observation/no dialogue
	-264.700	24.932	*0/0001	Dialogue/no observation
	-372.750	24.932	*0/0001	No observation/no dialogue
Observation/ no dialogue group	-254.850	24.932	1.000	Dialogue/no observation
	-369.900	24.932	*0/0001	No observation/no dialogue
Dialogue/ no observation group	-108.050	24.932	*0/0001	No dialogue/ no observation

P<0.05

Bonferroni test results in one-month retention test show that those groups who enjoyed the observation factor performed better than those groups who didn't make use of this factor. Meanwhile, enjoying the dialogue factor leads to a better performance compared with those who lacked this factor.

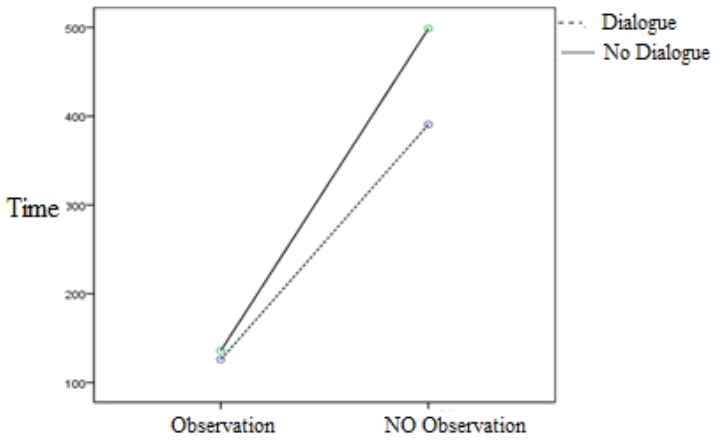


Chart. 2: Interaction effect of observation and dialogue in one-month retention test

The interaction of observation and dialogue was significant in one-month retention test. This is well understandable in the above graph, so that, groups that have experienced the observation variable have a similar function and in groups that observation factor has not been applied; those who experienced the dialogue variable enjoyed a better performance.

Discussion and conclusion:

In past several decades, the conducted studies on motor learning tried to explain how different factors affect the performance and learning of motor skills. For example, how to train (mass or scattered) (Garsia *et al*, 2009), training organizing (variable, fixed, contextual interference) (Miguel & Hall,1990), type of training (physical, observational, subjective) (Granados and Wulf, 2007) and various ways of instruction and guidance (verbal, instrumental) (Granados and Wulf, 2007) can be mentioned. This study is not an exception and it sought to find ways to better understanding of the effect of different variables, including observation and dialogue in learning of motor skills in dyad practice. Dyad practice has been shown as an effective and efficient method of learning motor skills (Wulf & Toole, 1999). Granados and Wulf carried out a research on facilitating learning through dyad practice. The purpose of their study was investigating the effects of observation and dialogue separately and any interaction between these two factors. Findings showed that groups that enjoyed the observation factor, compared with those who were unable to see each other during the training, had more effective learning. In the current study, the researcher displayed shooting gun G-3opening and closing skill through video by a skilled pattern. Then, during the training, the beginner pattern was used. In other words, in this study, the advantages of both expert and novice models are used. It seems that facilitation of learning a skill in dyad practice is due to the fact that when someone trains with another one, this leads to a motivation between them, particularly in those skills which are frustrating, delays the fatigue. Moreover it creates a positive sense of competition among them, because the purpose of performing the skill is common. Retention test results in first two weeks clearly showed that participants who enjoyed observing their partner during training demonstrated a better performance and could open and close the shooting gun G-3 in a shorter time. These findings raise the question "for what reasons, does observational learning lead to improved learning of this motor skill?" Since opening and closing skill of G-3 requires a specific sequence of chain movements and should be done in a short time, therefore, participants had two main factors; first, observing their partner which is a kind of training, and then practicing the skill itself, which causes review and recall. Indeed, observational learning provides the participant with the opportunity to consider how to perform the skill. Among advantages of the observational learning in this study was that the participants could, during the observation remember the sequence of performing, which had to be done one after another, because it was possible to forget the sequence in practice time. Another benefit of observing the beginner was also seeing the partner's faults and trying to avoid his mistakes. Thus, the participants were given the opportunity to engage in error discovery and correction. In fact, it was shown that observational learning facilitates error recognition (Black &Wright, 2000). It may also facilitate learning the correct sequence and ultimately the learning itself. In addition, the existence of mirror neurons can be mentioned, when someone performs a skill, a series of neurons, which are in parietal cortex and pre-motor part of the brain, are activated. Recent experiences show that when we see or hear someone performs a certain action, the same parts of the brain are activated when we perform that action. In fact we do not have to think about the actions of others or analyze them, but immediately make what is the purpose of others by simulation in our mind. Therefore it can

be concluded that one of the reasons that observation had a more obvious effect in retention of this skill in first and second week can be due to the these neurons.

Not having the opportunity to see errors and correcting them may be the reason why dialogue among participants had no advantage for learning. However, is assumed that some studies have realized the benefits of group discussion, although these tasks were originally cognitive (Chi, 1997; Prislin *et al*, 1996). It might seem surprising that verbal interactions with a training partner do not facilitate learning. Informal observations have shown that participants' interactions mostly involve them in reminding coach's instructions (master pattern) that are given before beginning the exercise. Especially, it seems that some of the participants have forgotten the instructions on how to open and close shooting gun G-3. In those cases, their partners give them a clue. The results also showed that groups of two people did the skill in a much shorter time. The fact that observation was useful compared to dialogue indicates that using observation is easier. Overall, the current findings suggest that the advantages of learning in dyad, including observing and talking with a partner, are better than individual practice, and it can be essentially due to observing the training partner (Shea, Wulf & Whitacre, 1999). Dialogue factor was not effective in retention tests of one-day and one-week. But after two weeks it was observed that those groups who enjoyed dialogue factor performed better than those who could not talk to each other. Thus, in these tests the interaction effect of observation and dialogue became significant. So the dialogue factor along with the observation one is not very effective, but when this factor applied alone, its impact comes to view. Since the dialogue factor has shown its effect in delayed form, it is possible that some strategies and verbal instructions that are strongly emphasized during conversation with training partner be remembered better and lead to performance improvement, compared with individual training, after two weeks of detraining. When someone is given a notification, it may remain for a long time in his mind. Also after this period, the skill may become relatively more cognitive. It is worth noting that, versus individual training, those groups who enjoyed the dialogue factor showed a better learning. Therefore, further research should be done, especially on those skills which are more cognitive like sophisticated video games etc. in which the dialogue may be effective. Nonetheless, in order to a better understand the contributions of the dialogue and observation factors in learning various skills additional tasks are needed to be studied.

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