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Effects of Augmented Feedback on Cardiopulmonary Resuscitation Skill Acquisition: Concurrent Versus Terminal

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ABSTRACT

Purpose: While various approaches, methods, and devices have been employed to foster maximum learning of CPR skills, researchers have suggested external feedback as a crucial source for the improvement of these skills. **Purpose:** The purpose of this study was to determine the effects of augmented concurrent (AC) and augmented terminal knowledge of results (AT-KR) on cardiopulmonary resuscitation (CPR) skill acquisition. **Method:** A sample of 76 second-year university students participated in the study. All study participants, who were determined to be eligible, completed a total of four hours of CPR training (two hours a week). Immediately after the training, the pre-test (ten sets of CPR) was administered to determine the participants' baseline CPR skill level. Participants were then assigned into three groups, one control and two experimental groups (AC and AT-KR), according to their sex and baseline CPR skill level. Participants in the AC group received a simultaneous visual feedback during CPR practice; participants in the AT-KR group received a printed report of their performance after they completed the CPR practice; and students in the control group received no feedback related to their CPR performance. Upon completion, effects of the feedback were measured to show CPR performance improvement at post-test relative to the pre-test. **Findings:** Students in the AC and AT-KR group performed better in some ventilation and compression skills than the students in the control group. **Implications for Research and Practice:** Usage of advanced technical feedback devices are recommended to enhance CPR skill acquisition.

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Introduction

Cardiac arrest, sudden and unexpected cessation of effective cardiac functions, is one of the most dangerous, life-threatening conditions in the world (George, 2013; Deo & Albert, 2012). Approximately three million cardiac arrests occur annually throughout the world and survival rate of the victims is less than 1% (Josephson & Wellens, 2004). Among the several actions that should be taken during cardiac arrest conditions, the first and, the most crucial is cardiopulmonary resuscitation (CPR), which consists of the use of 30 chest compressions and 2 ventilations (30:2 CPR). CPR is used to provide oxygen to the body and circulatory support and to prevent cardiac arrest victims from brain damage and death (Tucker, Larson, Idris, & Curtis, 1994; Wenzel, Idris, Banner, Fuerst, & Tucker, 1994).

The majority of cardiac arrests occur at home or in public places and the incidents are fatal if not treated immediately (O'Rourke, 2005; Wellens, Gorgels, & Munter, 2003). Correspondingly, considering the time from cardiac arrest to arrival of emergency personnel to the scene, administration of CPR by someone at the site of the incident is mandatory to save the life of the victim. For this reason, increasing the number of people who are well equipped to provide effective CPR has been one of the most important lifesaving public health priorities (Nolan et al., 2010). Research has proven that timely and effective intervention within three to four minutes in cardiac arrest conditions improves the survival rate of the victim up to 50% (Nolan et al., 2010; Terence et al., 2000). However, despite all educational efforts to enhance the quantity and quality of resuscitation skills in society, studies have reported inadequate CPR performance in trainees even immediately after training (Brennan & Braslow, 1995; 1998). Several reasons (insufficient practice time, lack of corrective feedback, poor assessment, ineffective instructors, and teaching styles) have been proposed in the literature for this poor CPR performance (Brennan & Braslow, 1995; 1998; Chamberlain & Hazinski, 2003; Kaye et al., 1991; Parnell & Larsen, 2007; Tekelioglu, Cakici, Tansu, Hayrioglu, & Buyukyilmaz, 2010).

A great deal of research has been conducted to facilitate and ensure maximum learning in CPR training courses. These studies have concentrated on the effectiveness of a variety of approaches, methods, tools, and devices (Roppolo, Wigginton, & Pepe, 2009; Yeung, Meeks, Edelson, Gao, Soar, & Perkins, 2009). Although research evidence has suggested that these attempts, to some extent, have facilitated the acquisition and retention of CPR skill and knowledge, CPR is composed of a complex combination of skills and steps that should be carefully followed during cardiac arrest conditions to enhance survival of victims, and there is still need for improvement (Chamberlain & Hazinski, 2003; Sutton, Nadkarni, & Abella, 2012). The range of CPR skills is complex and includes nine perceptive-motor skills: multimember coordination, control accuracy, response orientation, reaction time, arm movement speed, agility, manual dexterity, arm-hand steadiness, and wrist-finger speed. CPR also requires a high level of eight physical proficiencies: static strength, dynamic strength, trunk muscle strength, extent flexibility, dynamic flexibility, gross body coordination, general body balance, and stamina. It requires physical fitness, especially when applied for long periods of time (Baubin et al., 1996;

Lucia et al., 1999; Miyadahira, 2001; Pierce, Eastman, McGowan, & Legnola, 1992; Trowbridge, Parekh, Ricard, Potts, Patrickson, & Cason, 2009).

Efficacy of CPR performance decreases significantly by the time involved and by performers who are unaware of this decrease and their true level of performance during application (Hightower, Thomas, Stone, Dunn, & March, 1995; Ochoa, Ramalle-Gomara, Lisa, & Saralequi, 1998; Ock, Kim, Chung, & Kim, 2011). This is mostly because of the difficulty of interpreting whether one's own performance is correct (Barrow & Brown, 1988). At this point, an external source of feedback from a variety of sources, such as a device or an instructor, is of vital importance in informing the performer about the efficacy of his/her performance (Young, Schmidt, & Lee, 2001). Otherwise, the performer will generally not be aware that he/she is performing inaccurately. Like other skills, improvement of CPR is influenced by and depends on a deeper understanding of performance information offered to performers to improve their skills. This information related to the performance of a skill during or after the performance is referred to as "feedback" (Magill, 2004; Schmidt & Wrisberg, 2000; Schmidt & Lee, 2011).

There are two main types of feedback: intrinsic and extrinsic or augmented. Intrinsic feedback refers to sensory information that arises from the performance itself, while augmented feedback refers to movement-related information provided by external sources (Schmidt & Wrisberg, 2000; Young et al., 2001). Each of these two feedback types are further divided into two sub-categories based on the time at which the feedback is given: concurrent (feedback provided during the performance) and terminal (feedback provided after the performance) (Sage, 1984; Schmidt & Wrisberg, 2000; Young et al., 2001). Lastly, terminal feedback is also divided into two categories: knowledge of results (KR) and knowledge of performance (KP). KR includes information about the achievement of the performance in terms of the intended environmental goal; KP, on the other hand, contains information regarding movement pattern after performance (Magill, 2004; Sage, 1984; Schmidt & Lee, 2011; Young et al., 2001). The current study focuses primarily on two types of feedback: augmented concurrent (AC) and augmented terminal (AT-KR).

Many studies have been conducted to determine whether different types of feedback are effective in skill learning (Sarac, 2006; Couper & Finn, 2013; Zapletal et al., 2013). These studies have reported mixed results of necessity and effectiveness of feedback as essential, inessential, enhancing, and hindering the skill acquisition (Magill, 2004). However, it has long been suggested that feedback from devices or instructors is crucial and inevitable for CPR skill acquisition and retention (Soar et al., 2010; Terzioglu et al., 2013). For this reason, there is a need for further studies exploring the effects of different types of feedback, specifically on CPR skill acquisition. In addition to the influence of feedback on CPR performance, studies have found evidence of an interaction between the responder's sex and the CPR quality (Hong, Park, Lee, Baek, & Shin, 2012; Peberdy, Silver, & Ornato, 2009; Tomlinson, Nysaether, Kramer-Johansen, Steen, & Dorph, 2007). There are, however, several inconsistencies among the findings of these studies. While several studies showed that males performed better than females in CPR skill performance (Ashton, McCluskey, Gwinnutt, & Keenan, 2002; McDonald, Heggie, Jones, Thorne, & Hulme, 2012; Meissner, Kloppe, & Hanefeld, 2012; Sayee & McCluskey, 2012), other studies found no difference between males and females in CPR quality (Ochoa et al., 1998). It is still unclear whether sex of the rescuer significantly affects CPR performance. Since improvement in CPR skills is directly related to survival of cardiac arrest patients, the aim of this study is to determine the effectiveness of augmented concurrent (AC) and augmented terminal KR (AT-KR) feedback and the effects of performers' sex on CPR skill acquisition.

Method

Research Design

The current study was designed to investigate the effects of two different types of augmented feedback, AC and AT-KR, on CPR ventilation and compression skills of male and female university students. This study employed a 2 (Sex: male and female) x 3 (Groups: control, AC and AT-KR) X 2 (Time: pre-test and post). Repeated measures mixed factorial ANOVA design, with Sex and Groups as between-subjects factor and Time as a repeated measure factor. The dependent variables in the study were mean scores of the 9 ventilation skills (average ventilation volume, average number of ventilations per minute, minute ventilation volume, total number of ventilations, number of correct ventilations, percent of correct ventilations, number of too many ventilations, number of too few ventilations, and number of too fast ventilations) and 11 compression skills (average compression depth, average number of compressions per minute, average compression rate, total number of compressions, number of correct compressions, percent of correct compressions, number of too deep compressions, number of too shallow compressions, number of wrong hand positions, number of too low hand positions and number of incomplete releases) of CPR that served as pre-test and post-test measures.

Research Sample

The eligible participants for this study were eighty second-year university students of different academic disciplines enrolled at the Mersin University during the 2012 and 2013 fall semesters. All were enrolled in "First Aid (FA)," an elective course provided by the School of Physical Education and Sports. A non-probability, convenience-sampling method was used to select participants. Although 80 students initially volunteered to participate in the study, a total of 76 students` CPR performance scores were taken into consideration. One of the students was excluded from the study for having previous training in FA and CPR. Accordingly, the number of eligible participants declined to 79 at the beginning of the study. In addition to this, three students, who did not attend the FA classes regularly, were excluded from the study. However, these students remained actively enrolled in FA from the beginning to end of the course. Regular class attendance in the FA course was mandatory, but participation in the study was voluntary. Ultimately, the study sample consisted of 28 males (36.84%) and 48 females (63.16%). The participants` ages ranged from 18-24 years, with a mean age of 21.33±1.44 years. The mean age for males was 22.00±1.33 and for females was 20.94±1.36. The potential participating students were identified and informed about the research. A signed consent form was obtained from students who were willing to participate in the research, and they were asked about their age, sex, and previous CPR training experience.

Course Description

The FA course was a one semester (14 weeks) instructor-led course involving two hours of class time per week. Although the course covered topics, such as circulatory emergencies, respiratory emergencies, soft tissue injuries, and burns, this study only included the topic of CPR. The CPR section of the FA course lasted for two weeks (two hours a week), and the content followed the 2010 guidelines of the European Resuscitation Council (Nolan et al., 2010). These standards involved application of 30 chest compressions by trained or untrained rescuers at the rate of at least 100 compressions per minute and to a depth of at least 5 cm, allowing full chest recoil and minimized interruptions between each chest compression. In addition, for trained rescuers, guidelines suggest that following 30 chest compressions, two ventilations with a tidal volume of 500-600 ml and one-second duration be performed. The certified instructor of the FA course had taught this particular topic for 12 years.

Research Instrument and Procedure

Eighty students organized into three groups (classes), each of which had the same materials and circumstances in which to learn. Each group had four hours (two hours a week) of theoretical training and practical information related to CPR ventilation and compression skills as well as hands-on practice on a Resusci Anne Basic Torso CPR Manikin (Image 1). These three groups were not treatment groups (control, AC, and AT-KR), limited in size (Group 1= 26, Group 2= 27 Group 3= 27), and formed only for the purpose of instruction in FA. The participants, instructor, and researcher as well, were aware of the purpose of the study but were blind to the treatment delivered to each participant before and during the instruction. Accordingly, this grouping process helped reduce researcher bias.

Image 1. Laerdal Resusci® Anne CPR Training Manikin

During hands-on practice, students were observed and were provided feedback by the instructor when necessary. One week after four hours of training, the pre-test was applied and all students were required to perform ten sets of CPR (1 set= 30 chest compressions, 2 breaths). The 2010 European Resuscitation Guidelines include recommendations to change rescuers about every 2 minutes to prevent adverse effects of rescuer fatigue and maintain chest compression quality during CPR (Nolan et al., 2010). The required ten sets of CPR were chosen according to the above theoretical framework. A Laerdal Resusci Anne SkillReporter ® manikin was used in order to collect pre-test data on nine ventilation and 11 compression skills, which were described in the "Research Design" section. Although the manikin had real-time feedback and debriefing features, it was only used to record data (Image 2).

Image 2. Laerdal Resusci Anne SkillReporter CPR Manikin and SkillReporter Device

During the pretest, students did receive any feedback from the instructor or from the manikin. Each participant administered ten sets of CPR individually in a laboratory environment, which totally isolated a person from external distractions. Pre-test scores and sex of the participants were then used to randomize and assign participants anonymously into three intervention groups: control, AC, and AT-KR. It was ensured that male and female students with higher and lower CPR performance scores were equally distributed across the three groups. Twenty-five participants were placed in the control group (n_{male}= 9, n_{female} = 16), 27 students in the AC group (n_{male}= 10, n_{female} = 17), and 24 students in the AT-KR group (n_{male}= 9, n_{female} = 15). Four weeks after the pre-test, all students in the three groups were required to perform ten sets of CPR for a post-test, which was administered in the same manner. Before administering the post-test, each student in the AC group did ten sets of CPR trials on a Laerdal Resusci Anne Manikin by using its real-time visual feedback features. These features included moving light bars for dynamic and simultaneous feedback of CPR ventilation and compression performance, such as ventilation volumes, compression depths, wrong hand positions, and stomach distension. Light bars included yellow, green, and red colors. Yellow lights activated when the inflation volume and compression depth were insufficient; the green light was activated when the inflation volume and compression depth were sufficient; and the red light activated when the inflation volume and compression depth were excessive. In addition, too fast inflations and wrong hand positions were also indicated by lights on the manikin's torso. These light indicators, which were observed by performers, on correct and incorrect CPR ventilation and compression skill performance during ten sets of CPR practice, were expected to be used as instant and objective feedback for students who were in the AC group. Students were given a five-minute recovery period after ten sets of CPR and were informed about additional time allocation for recovery, but none of the students used extra time other than the standard five-minute recovery time. Throughout the recovery period, no verbal communication occurred between student and researcher regarding the CPR performance.

At the end of this five-minute recovery period, students in the AC group were required to perform ten sets of CPR as a post-test. Students in AT-KR group were also given ten sets of CPR trial and a five-minute recovery period within the post-test. However, the real-time visual feedback features were not provided to students in the AT-KR group. They were given a printed report of their CPR ventilation and compression skill performance during the ten sets of CPR trial. This report was provided by Laerdal Resusci Anne SkillReporter ® and contributed a statistical data of ventilation and compression parameters that were given in Image 2. Because the report is in English, the data was translated into Turkish and was explained verbally by the researcher to the students. Students also analyzed their correct and incorrect attempts related to ventilation and compression performance by using this printed report. The verbal explanations given by the researcher did not include any different information from the printed report. Students in the control group were similarly given ten sets of CPR and a five-minute recovery, but did not receive any additional feedback. They completed the post-test performing ten sets of CPR. Figure 1 provides an overview of the procedures used in the current study.

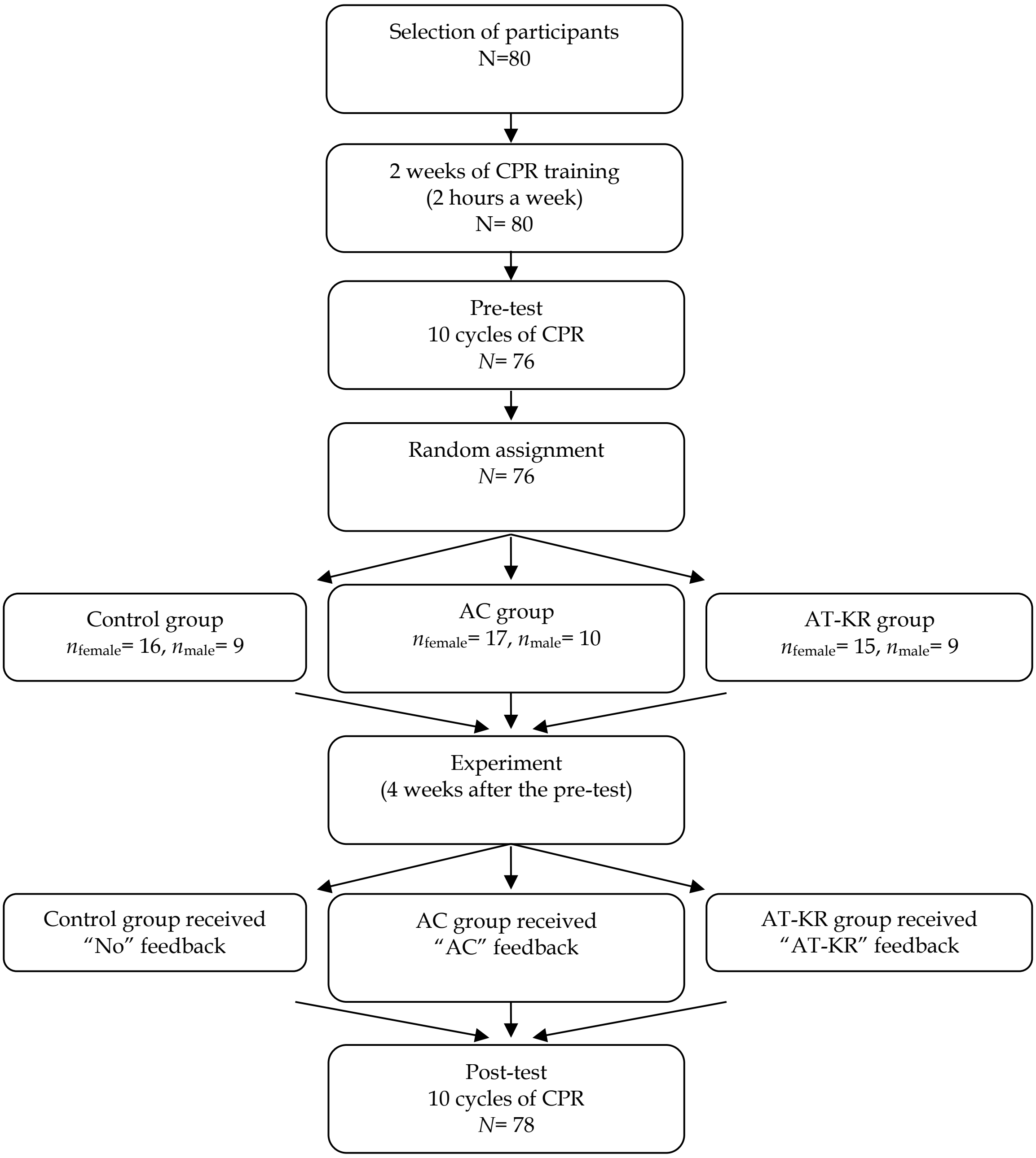

Figure 1. Flow diagram of the experimental design and procedures

Data Analysis

For two different types of augmented feedback (AC and AT-KR), mean CPR ventilation and compression data were analyzed using a three-way mixed factorial analysis of variance (ANOVA) including one within the subjects factor (Time) and two between subjects factors (Sex and Groups). The mean CPR ventilation and compression skill performance scores were dependent variables. All the analysis was performed using IBM SPSS Statistics Software, version 21. The data was interpreted for significant three-way interactions, two-way interactions, and main effects. A simple main-effects analysis was executed to analyze interaction effects. Main effects have not been interpreted in the presence of interaction effects. All differences reported are significant at the 0.05 level.

Results

Results Related to Ventilation Skill Acquisition

A Sex (male, female) x Treatment (control, AC, AT-KR) x Time (pre-, post-) mixed-factorial (2 x 3 x 2) ANOVA was conducted to examine the effectiveness of two different types of augmented feedback (AC, AT-KR) on the acquisition of CPR ventilation skills among university students. The normality assumptions in this study were satisfied for continuous variables. The analysis of results and means and standard deviations for ventilation skill performance are provided in Table 1. The mean percentage of correct ventilations on pre-test across three groups was poor; Control: M_{Male}= 8.67±11.02, M_{Female}= 11.56±19.02; AC: M_{Male}= 8.60±14.63, M_{Female}= 18.12±24.12; AT-KR: M_{Male}= 22.89±36.04, M_{Female}= 13.33±25.36. In addition, results demonstrated that Sex x Treatment x Time three-way interactions; Sex x Treatment two- way interactions; Sex x Time two- way interactions; and Sex main effects were not significant for any of the nine ventilation skills at p>.05. These results suggest that ventilation skill performance of male and female participants in control, AC feedback, and AT-KR feedback groups were comparable in pre-test and post-test.

However, results of the analysis showed that there was a significant interaction effect between Treatment and Time on average ventilation volume [F(1, 70)= 3.97, p= .02, *partial* η^2= .10], average number of ventilations per minute [F(1, 70)= 5.48, p= .01, *partial* η^2= .14], number of correct ventilations [F(1, 70)= 25.13, p= .00, *partial* η^2= .42], percent of correct ventilations [F(1, 70)= 12.91, p= .00, *partial* η^2= .27], number of too much ventilations [F(1, 70)= 7.82, p= .00, *partial* η^2= .18], number of too little ventilations [F(1, 70)= 7.55, p= .00, *partial* η^2= .18], and number of too fast ventilations [F(1, 70)= 8.56, p= .00, *partial* η^2= .20]. Simple main effects analysis conducted on the significant interactions revealed that students in control, AC, and AT-KR feedback groups performed comparable ventilation skills in the pre-test, but after getting feedback in the post-test, students in the AC and AT-KR feedback group performed better than the students in the control group on average number of ventilations per minute, number of correct ventilations, percent of correct ventilations, and number of too fast ventilations, p<.05. The mean percentage of correct ventilations by male and female in the pre-test and post-test are shown in Table 1.

Table 1
Change in Ventilation Skill Performance as a Function of AC and AT-KR Feedback

		Control Group				AC Group				AT-KR Group			
		Pre-test		Post-test		Pre-test		Post-test		Pre-test		Post-test	
		M	*(SD)*	*M*	*(SD)*	*M*	*(SD)*	*M*	*(SD)*	*M*	*(SD)*	*M*	*(SD)*
Average volume [f]	Male	465.6	(236.0)	644.4	(334.7)	985.0	(494.3)	631.0	(66.7)	762.2	(511.2)	672.2	(86.4)
	Female	634.4	(526.6)	725.6	(438.1)	801.2	(437.5)	682.9	(199.3)	718.7	(524.3)	676.0	(118.2
Average # per min[c,f]	Male	3.4	2.4)	3.9	(1.7)	3.8	(1.8)	4.3	(0.7)	2.3	(1.9)	4.3	(1.1)
	Female	2.6	(2.3)	2.9	(1.7)	2.9	(1.9)	4.2	(1.0)	2.1	(1.9)	4.4	(0.7)
Minute volume	Male	1923.3	(1409.5)	2671.1	(1078.9)	4158.0	(2439.8)	2710.0	(479.7)	2387.8	(2279.9)	2848.9	(572.2)
	Female	2296.3	(2229.4)	2581.9	(1747.6)	2765.9	(2207.6)	2824.7	(952.7)	2300.0	(2437.0)	2970.0	(680.0)
Total number [c]	Male	14.0	(8.0)	16.8	(6.8)	15.6	(6.9)	20.2	(1.6)	13.4	(9.4)	20.4	(1.4)
	Female	12.0	(9.9)	15.3	(8.6)	15.0	(8.3)	20.1	(1.3)	10.9	(8.9)	19.8	(2.1)
Number correct [b,c,f]	Male	1.6	(2.1)	4.6	(4.5)	1.4	(2.1)	12.2	(4.9)	2.8	(4.6)	13.9	(2.5)
	Female	2.2	(3.7)	3.1	(5.4)	2.8	(4.1)	14.7	(5.7)	1.4	(1.6)	13.2	(5.6)
Percent correct [b,c,f]	Male	8.7	(11.0)	24.2	(22.5)	8.6	(14.6)	60.3	(23.5)	22.9	(36.0)	68.2	(14.5)

Table 1 Continue

	Female	11.6	(19.0)	17.8	(28.1)	18.1	(24.1)	72.0	(27.7)	13.3	(25.4)	65.7	(26.2)
Too much c,f	Male	0.2	(0.7)	2.7	(5.7)	11.6	(8.7)	2.0	(3.5)	9.2	(10.1)	2.2	(3.6)
	Female	6.5	(8.5)	7.8	(9.0)	7.6	(8.8)	1.6	(3.6)	8.1	(8.0)	3.1	(4.7)
Too little f	Male	5.1	(7.6)	1.2	(2.1)	0.6	(1.6)	2.3	(1.8)	0.2	(0.7)	1.7	(1.9)
	Female	2.1	(4.9)	0.6	(0.9)	1.1	(1.9)	1.2	(1.3)	1.3	(1.4)	1.8	(2.0)
Too fast c,f	Male	7.3	(9.1)	9.0	(7.8)	11.4	(8.1)	4.7	(4.2)	9.6	(8.7)	2.9	(1.8)
	Female	5.5	(8.1)	8.9	(8.8)	10.0	(7.8)	3.6	(4.5)	5.9	(7.3)	3.3	(5.2)

[b] Treatment main effect
[c] Time main effect
[d] Sex x Treatment interaction effect
[e] Sex x Time interaction effect
[f] Treatment x Time interaction effect
[g] Sex x Treatment x Time interaction effect

Results Related to Compression Skill Acquisition

A 2 x 3 x 2 mixed-factorial ANOVA was also conducted to examine the effectiveness of AC and AT-KR on the acquisition of CPR compression skills among university students. Results obtained from the analysis are shown in Table 2. Similar to ventilation skill performance, the mean percentage of correct compressions on pre-test across three groups was poor: Control: M_{Male}= 1.33±2.83, M_{Female}= 0.13±0.34; AC: M_{Male}= 19.70±32.56, M_{Female}= 0.24±0.66; AT-KR: M_{Male}= 10.33±24.96, M_{Female}= 10.33±20.42. Additionally, the only Sex x Treatment x Time three-way interactions were found on average compression depth, [$F(2, 70)= 6.52$, $p= .00$, *partial* $\eta^2= .16$]. Simple main effects of Treatment and Time showed that the average depth of chest compressions were different between all three treatment groups in pre- and post-tests, $p<.05$; however, compared to the control group, participants in the AC and AT-KR feedback group improved their average compression depth after receiving feedback in post-test, p<.05. Additionally, simple main effects of Sex and Time revealed that, ignoring the influence of other variables, average depth of compressions of male and female participants were different on the pre-test, $p>.05$, and improved from pre- to post-test, $p<.05$. Results of the analysis also showed a significant interaction between Treatment and Time on students' performance of the number of correct compressions [$F(2, 70)= 47.92$, $p= .00$, *partial* $\eta^2= .58$], percent of correct compressions [$F(2, 70)= 39.97$, $p= .00$, *partial* $\eta^2= .53$], the number of too shallow compressions [$F(2, 70)= 22.47$, $p= .00$, *partial* $\eta^2= .39$], the number of wrong hand positions [$F(2, 70)= 3.22$, $p= .05$, *partial* $\eta^2= .08$], the number of too low hand positions [$F(2, 70)= 3.99$, $p= .02$, *partial* $\eta^2= .10$], and the number of incomplete releases [$F(2, 70)= 5.29$, $p= .01$, *partial* $\eta^2= .13$]. Simple main effects analysis showed that students in control, AC and AT-KR feedback groups performed similarly in the pretest, $p>.05$, but students in AC and AT-KR feedback groups improved their performance on number of correct compressions, percent of correct compressions, number of too shallow compressions and the number of wrong hand positions after having feedback in post-test, $p<.05$. The mean percentage of correct chest compressions by male and female in pre-test and post-test are shown in Table 2.

Table 2

Change in Compression Skill Performance as a Function of AC and AT-KR Feedback

		Control Group				AC Group				AT-KR Group			
		Pre-test		Post-test		Pre-test		Post-test		Pre-test		Post-test	
		M	*(SD)*	*M*	*(SD)*	*M*	*(SD)*	*M*	*(SD)*	*M*	*(SD)*	*M*	*(SD)*
Average depth [a,b,c,e,f,g]	Male	35.1	(7.6)	35.2	(9.2)	45.8	(10.0)	52.2	(8.7)	44.9	(9.3)	55.1	(2.6)
	Femaleee	33.7	(6.8)	38.0	(8.2)	32.9	(6.8)	51.7	(3.5)	44.2	(5.9)	50.5	(4.6)
Average # per min.	Male	79.1	(11.6)	78.9	(9.4)	72.2	(13.5)	70.5	(10.6)	69.1	(18.3)	75.2	(11.9)
	Female	75.4	(13.7)	70.0	(13.9)	70.3	(11.9)	72.8	(11.6)	70.5	(16.3)	74.8	(9.4)
Average compression rate	Male	119.2	(19.1)	119.6	(17.2)	120.5	(15.4)	112.4	(16.4)	124.4	(22.9)	134.7	(14.5)
	Female	120.4	(19.5)	113.3	(20.0)	115.9	(26.9)	119.9	(24.1)	124.9	(14.9)	129.3	(20.2)
Total number [d]	Male	302.3	(21.1)	305.0	(11.2)	285.1	(58.3)	297.0	(19.0)	307.2	(16.0)	329.9	(46.3)
	Female	308.5	(22.6)	306.3	(18.4)	302.1	(11.6)	313.4	(18.1)	308.2	(20.5)	305.0	(28.0)
Number correct [b,c,f]	Male	4.2	(8.9)	3.8	(10.2)	43.4	(65.5)	215.0	(89.5)	30.3	(70.0)	230.3	(58.4)
	Female	0.6	(1.6)	13.1	(25.9)	1.0	(2.5)	189.4	(72.6)	31.8	(61.9)	197.4	(91.0)
Percent correct [b,c,f]	Male	1.3	(2.8)	1.0	(3.0)	19.7	(32.6)	72.2	(30.2)	10.3	(25.0)	70.7	(19.9)
	Female	0.1	(0.3)	4.2	(8.3)	0.2	(0.7)	59.8	(22.4)	10.3	(20.4)	64.5	(29.3)
Too shallow [a,b,c,f]	Male	268.2	(70.5)	270.4	(86.9)	178.8	(141.0)	48.6	(91.4)	197.7	(139.4)	21.3	(18.7)
	Female	292.1	(56.1)	273.7	(60.6)	293.8	(26.2)	75.7	(71.5)	228.7	(94.1)	94.1	(95.4)

Table 2 Continue

Wrong hand position [c,f]	Male	103.0	(83.6)	69.8	(92.2)	142.9	(106.6)	42.0	(51.2)	136.9	(111.6)	78.6	(72.4)
	Female	180.4	(90.9)	134.4	(109.8)	169.8	(97.6)	62.2	(50.5)	176.3	(108.4)	27.9	(26.5)
Hand position too low [b,c,f]	Male	8.7	(13.3)	20.4	(61.0)	14.8	(35.7)	3.9	(7.1)	75.1	(99.8)	6.2	(11.4)
	Female	4.6	(11.6)	0.3	(1.0)	15.1	(61.8)	0.4	(1.5)	28.7	(75.2)	4.6	(14.8)
Incomplete release [f]	Male	7.4	(21.2)	14.7	(44.0)	0.2	(0.4)	5.5	(13.0)	34.8	(75.0)	7.2	(19.8)
	Female	0.1	(0.5)	0.0	(0.0)	0.1	(0.3)	0.5	(1.1)	6.5	(24.8)	0.1	(0.5)

[a] Sex main effect
[b] Treatment main effect
[c] Time main effect
[d] Sex x Treatment interaction effect
[e] Sex x Time interaction effect
[f] Treatment x Time interaction effect
[g] Sex x Treatment x Time interaction effect

Discussion and Conclusion

The findings of this study were consistent with the previous research in finding a poor CPR performance and skill acquisition among university students following resuscitation training. This may be explained by the fact that instructor led training alone, due to various reasons reported in the literature, is partially effective in acquisition of such complicated lifesaving skills (Braslow et al., 1997; Brennan & Braslow, 1995; 1998). Direct observation with the naked eye, continuous evaluation of each element of CPR, and giving objective feedback about right, wrong, good, or bad aspects of CPR skills during and/or after the performance may not be easy for instructors. However, adequate, objective, and timely feedback is essential for performers to correct their errors during and/or after the performance. Various alternative ways and devices, which will decrease the instructor's role in providing feedback, were recommended by experts and researchers to deliver CPR knowledge and skills effectively (Yeung et al., 2009; Soar et al., 2010).

In addition, this study provided evidence that provision of the AC and AT-KR feedback were effective in improvement of some compression and ventilation skills of CPR. Consistent with the current study findings regarding positive effects of AC and AT-KR feedback on CPR skill acquisition, other studies on the effectiveness of various types of feedback have also reported improved CPR performance (Buleon et al., 2013; Cason, Trowbridge, Baxley, & Ricard, 2011; Spooner, Fallaha, Kocierz, Smith, Smith, & Perkins, 2007). Surprisingly, the two types of feedback had no effect on the students' performance of ventilation volume. The most recent resuscitation guidelines recommend a tidal volume of 500-600 ml and breathing over about one second, rising chest wall, and avoiding rapid and forceful breaths, as a simple way to deliver acceptable tidal volume during adult CPR (Nolan et al., 2010). Students' average ventilation volume in the current study was excessive, but not more than 700 ml. This result may be explained by the fact that even with different types of feedback provided, the exact amount of ventilation volume is very hard for someone to measure and apply during CPR. The number of too fast ventilations, on the other hand, decreased in AC and AT-KR feedback group. This finding suggests that, unlike the amount of ventilation, feedback may be effective in preventing too quick ventilation delivery during CPR. In accordance with these results, previous studies have demonstrated a problem of poor ventilation during CPR and they have suggested various types of feedback could effectively be used to solve this problem (Wenzel, Lehmkuhl, Kubilis, Idris, & Pichlmayr, 1997; Wik, Myklebust, Auestad, & Steen, 2005; Wik, Myklebust, Auestad, & Steen, 2002; Wik, Thowsen, & Steen, 2001). In addition to the positive effects of AC and AT-KR on the number and percent of correct chest compressions, these two types of feedback also improved the number of too shallow chest compressions and wrong hand positions during CPR. In relation to the performance of participants in the control group, it is possible to suggest that these improvements might be due to the two different types of feedback provided to participants. Many studies reported the problem of shallow (< 38 mm) chest compressions and incorrect hand placement by laypeople, even by healthcare professionals, following CPR training (Grzeskowiak, Bartkowska-Sniatkowska, Rosada-Kurasinska, & Pulinska, 2008; Russo et al., 2011; Skorning et al., 2010; Wiese, Wilke, Bahr, & Graf, 2008; Woollard et al., 2012; Wyss et al., 2010). In addition, there have been a number of studies that revealed the effectiveness of different feedback approaches (e.g. video self-instruction, real-time audiovisual feedback, and augmented feedback) over the traditional means of instructor feedback (Braslow et al., 1997; Hostler et al., 2011; Sarac, 2006; Todd et al., 1998; Zapletal et al., 2013).

A number of important limitations need to be considered in evaluating the results. First, variables such as age, height, weight, body mass index (BMI), and even physical fitness level were not considered while evaluating results. However, several studies revealed effects of these variables on CPR performance (Krikscionaitiene et al., 2013; Ock et al., 2011). Second, the participants were required to perform ten sets of CPR. Longer periods of CPR performance could affect the results of the study. Training manikins (Resusci® Anne Basic) and evaluation manikins (Resusci Anne® SkillReporter™) were different. Compression characteristics of various manikins and feedback devices were reported as not uniform, which may then affect the CPR performance. Due to excessive usage of training manikins, the stiffness of the chest might be different compared to the evaluation manikin. Another limitation of this study was that the number of students was relatively small. However, the sample size was determined based on the number of students allowed to register for the course.

In the current study, the effects of two types of feedback on CPR skill acquisition were investigated by experimental method. The findings implied that traditional way of teaching CPR skills alone did not provide a maximum learning environment for university level learners. Skill decay was observed in all three groups of students after the instruction. In this sense, this finding is very important to be able to understand the weaknesses of and possible reasons for ineffectiveness of CPR training programs. Accordingly, policy-makers and implementers should work on eliminating barriers to provide maximum learning experiences for all learners, and they should also develop standard, structured, and well-organized training programs and refresher workshops to cope with skill decay in CPR skills.

Another important implication of this study is that participants' CPR ventilation and compression skills were increased because of receiving both AC and AT-KR feedback. Taken as a whole, regardless of the type of feedback (concurrent or terminal) participants received, their CPR skills improved significantly. As continuously pointed out in the literature, feedback was found to be an essential part of CPR skill acquisition. In addition to this, directive feedback devices, which provide information about what performers are actually doing, was found to be successful in helping participants improve their learning on components of CPR skills. These devices should be used as a part of CPR training programs to improve skills; and accordingly, to save lives of cardiac arrest patients. The results from the current study provided support for the effectiveness of two types of feedback in sustaining CPR skill acquisition; however, it also implies that additional research is necessary to investigate possible factors that affect performance improvement.

Replication of this study using larger samples is needed to determine whether similar results would be obtained with the same feedback types. While AC and AT/KR feedback were selected due to the characteristics of the feedback provider device that was used for the training, different types of feedback should also be evaluated.

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Dışsal Geribildirimin Kardiyopulmonar Resustasyon Beceri Kazanımına Etkisi: Eşzamanlı ve Nihai

Atıf:

Sarac, L. (2017). Effects of augmented feedback on cardiopulmonary resuscitation skill acquisition: Concurrent versus terminal. *Eurasian Journal of Educational Research*, 72, 83-106, DOI: 10.14689/ejer.2017.72.5

Özet

Problem Durumu: Çeşitli nedenlere bağlı olarak yaşanan kalp durması, özellikle zamanında ve yeterli müdahale yapılmadığında, insan yaşamını tehdit eden ciddi sağlık sorunlarından biri halini almaktadır. Kalp durması vakalarında, 30 kalp masajı ve 2 suni solunum içeren kardiyopulmonar resustasyon (KPR) uygulanabilecek ilk ve en önemli müdahaledir. Yaralının beyin hasarı ve ölümünü geciktirmek ya da engellemek amacı ile uygulanan KPR, yasamsal fonksiyonların sürdürülmesi için gereksinim duyulan kanın ve oksijenin hayati organlara ulaştırılmasını amaçlar. Kalp durması vakalarında çağırılan ambulansın olay yerine ulaşması zaman aldığından, olay yerinde bulunanların vakit kaybetmeden KPR uygulamasına geçmesi önemlidir. Bu yüzden toplumda KPR uygulaması konusunda bilgi ve beceri açısından donanımlı bireylerin sayısının ve uygulanacak KPR'nin niteliğini arttırılmasına yönelik eğitimler ve bilimsel araştırmalar gün geçtikçe yaygınlaşmaktadır. Ancak araştırmalar, KPR'nin nicel ve nitel özelliklerinin arttırılmasına yönelik yapılan eğitimlerin amacına ulaşmadığını ortaya koymuştur. Bu duruma neden olarak da; alıştırma için ayrılan süre ve düzeltici geribildirimin yetersiz, değerlendirmenin verimsiz, eğitmen ve öğretim yöntemlerinin etkinliğinin düşük olması gibi durumlar gösterilmiştir. Araştırmacılar tarafından özellikleri incelenerek, KPR'nin dokuz algısal-devinişsel, sekiz fiziksel yeterlik ve özellikle de uzun süre uygulandığında fiziksel uygunluk (fitnes) gerektiren karmaşık bir beceri olduğu ortaya konmuştur. Beceri öğreniminde önemi ve yeri pek çok araştırma ile ortaya koyulan geribildirimin, özellikle KPR öğreniminde eğitmen ya da geliştirilmiş araçlar tarafından sağlanan geribildirimin beceri öğrenimini arttırdığı da vurgulanmıştır. Geribildirim genel olarak içsel ve dışsal olarak gruplandırılmaktadır. İçsel geribildirim performansın kendisinden ortaya çıkan duyusal bilgi; dışsal geribildirim ise harekete yönelik dış kaynaklardan sağlanan bilgi olarak tanımlanmaktadır. Dışsal geribildirimin de çeşitleri olmakla birlikte, bu çalışmada eşzamanlı (DE) ve nihai sonuç bilgisi (DN/SB) içeren geribildirim türleri üzerinde durulmuştur. KPR becerisinin karmaşık ve fiziksel uygunluk gerektiren yapısından ötürü içsel geribildirimin tek başına yeterli olmayacağı düşünülmüş ve bu çalışma kapsamında

KPR beceri öğreniminde 2 farklı dışsal geribildirimin (DE, DN/SB) etkisi incelenmiştir.

Araştırmanın Amacı: Bu çalışmanın amacı iki farklı geribildirim türünün KPR becerileri üzerindeki etkisinin incelenmesidir.

Araştırmanın Yöntemi: Araştırma kapsamında, üniversite 2. sınıfta öğrenim gören ve İlkyardım dersini seçmeli olarak alan 80 öğrenci kolayda örnekleme yöntemi ile seçilmiş, 1 öğrenci özellikleri uygun olmadığı için örnekleme dahil edilmemiş ve 3 öğrenci de çalışmaya devam etmediği için çalışmadan çıkarılmıştır. Katılımcıların yaş aralığı 18-24 arasında iken, yaş ortalaması da 21.33±1.44'tür. Araştırmada katılımcılara 4 saatlik (haftada 2 saat) KPR eğitimi verilmiş ve eğitimden 1 hafta sonra da ön-test yapılmıştır. Ön-test, solunum ve göğüs basısının birlikte uygulandığı 10 setlik (1 set= 30 göğüs basısı + 2 nefes) KPR uygulamasını içermiştir. Ön-test sonunda katılımcılar performansları ve cinsiyetleri göz önünde bulundurularak homojen bir dağılım gösterecek biçimde amaçlı olarak kontrol, DE ve DN/SB gruplarına atanmıştır. Ön-testten 4 hafta sonra son-test kapsamında, 3 gruptaki katılımcılardan 10 setlik KPR uygulamasını tekrarlaması istenmiştir. Son-test öncesinde, DE grubundaki katılımcılar KPR maketi tarafından sağlanan görsel eşzamanlı geribildirim eşliğinde 10 set KPR uygulamışlar; DN/SB grubundaki öğrenciler yine KPR maketi tarafından sağlanan ön-test performanslarına yönelik yazılı bilgi içeren nihai geribildirim almışlar ve sonrasında 10 set KPR uygulamışlar; kontrol grubundaki öğrenciler ise herhangi bir geribildirim almadan 10 set KPR uygulamışlardır. On setlik KPR uygulaması sonrasında tüm katılımcılara 5 dakika dinlenme süresi verilmiş ve 10 setlik KPR içeren son-test uygulanmıştır.

Araştırmanın Bulguları: Cinsiyet (kadın, erkek) X Grup (kontrol, DE, DN/SB) X Test (ön-test, son-test) karışık faktöriyel ANOVA sonuçları, KPR performansının 4 saatlik KPR eğitimi sonrasında düşük düzeyde olduğunu ortaya koymuştur. Bağımlı değişkenlerden göğüs basısı performansı 9 ayrı beceri dikkate alınarak ayrı incelendiğinde ise, bazı değişkenlerde kadın ve erkekler arasında fark bulunmazken, fark yaratan bağımsız değişkenin katılımcılara sunulan geribildirim olduğu ortaya çıkmıştır. Ek olarak, kontrol grubuna kıyasla, DE ve DN/SB grubundaki öğrencilerin kurtarıcı nefes performansları bazı kurtarıcı nefes değişkenlerinde daha başarılı düzeyde bulunmuştur. Benzer şekilde 11 ayrı beceriden oluşan göğüs basısı becerilerinin bir kısmında cinsiyetin etkisi gözlenmezken, her iki geribildirim grubundaki katılımcıların performansları kontrol grubundakilere oranla daha başarılı bulunmuştur. Araştırmada ayrıca, nefes hacmi gibi bazı parametrelerde sağlanan iki farklı geribildirimin etkisinin olmadığı da ortaya konmuştur.

Araştırmanın Sonuçları ve Önerileri: KPR eğitimi sonrasında performansın istenen düzeyde olmaması literatürde desteklenen bir bulgudur. Bu çalışmadaki benzer bulgunun nedeni olarak da, KPR gibi karmaşık bir becerinin, geleneksel yöntemle ve eğitmen tarafından yönetilen eğitimle kazandırılması gösterilebilir. KPR eğitimlerinde uygulama esnasında sağlanması gereken geribildirimin, beceriyi çıplak gözle izleyen eğitmen tarafından verilmesinin olumsuz yanları araştırmalarla ortaya konmuştur. KPR eğitimlerinde eğitmen yerine, geribildirimin özel olarak geliştirilmiş

çeşitli teknolojik araçlar tarafından sağlanmasının kazanımı arttırdığı da çeşitli araştırmalarda ortaya çıkmıştır. Benzer biçimde bu çalışmada, eğitim boyunca olmasa da, yalnızca eğitim sonrasında gelişmiş teknolojik araçlarla sağlanan görsel eşzamanlı ve nihai geribildirimin performansı arttırdığı bulunmuştur. Araştırma kapsamında ortaya çıkan ve 2 farklı geribildirimin etkisinin olmadığı değişkenlerden biri nefes hacmidir. Yaşam kurtarmada etkili olması için 500-600 ml. olarak belirlenen nefes hacminin uygulayıcı tarafından belirlenmesinin zorluğundan ötürü geribildirimin etkisinin gözlenmediği düşünülmektedir. Araştırmalarda göğüs basısı uygulamasında, sağlık personeli tarafından uygulandığında bile, sıklıkla görülen problemler basının sığ uygulanması ve ellerin göğüs kafesinde yanlış yerleştirilmesi olduğu bulunmuştur. Bu araştırmada kullanılan 2 farklı geribildirimin bu iki sorunu ortadan kaldırmakta etkili olduğu görülmüştür. Sonuç olarak bu çalışmada DE ve DN/SB geribildirimlerinin KPR kurtarıcı nefes ve göğüs basısı becerisinin kazanımında etkili olduğu bulunmuştur. Buradan hareketle, KPR eğitimlerinde geribildirimleri sağlayan teknolojik araçların, geleneksel eğitmen merkezli uygulamalara alternatif olarak kullanılması önerilmektedir.

Anahtar Sözcükler: Motor öğrenme, beceri kazanımı, KPR, temel yaşam desteği, ilkyardım.