

The Effect of Augmented Feedback on the Hit Accuracy of Foil Fencers

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ABSTRACT

The study aims to investigate the effect of augmented feedback on the hit accuracy of foil fencers. A total of 10 fencing players, juniors and cadets registered at the Jordan Fencing Federation were divided into control and experimental groups during an 11-day fencing training camp held at the Jordan fencing federation from January 17th – 27th 2021. The camp consisted of 66 hours of training, equivalent to 30 regular training days. The 'Fencing Scouting Sheet / Foil' instrument was developed to assess the players performance; divided into 'Touches scored', 'Touches received', 'Touches scored out of target' and 'Touches received out of target'. Each player engaged in 20 bouts, totalling 100 bouts for each group; each bout was meticulously scouted and assessed by the coach, and the overall data of each group member was calculated. Coaches provided the experimental group with the proper augmented feedback according to each player's performance, both individually and in group settings; before, during, or after the bouts. The study results revealed that the experimental group surpassed the control group by 37.4 % in 'Touches scored', while trailing behind by 36.7%, 59.3% and 19.3% in 'Touches received', 'Touches scored out of target' and 'Touches received out of target' respectively. We encourage future studies to adopt and further investigate the developed scouting sheet to enrich the quality of training sessions and enhance players' performance.

Keywords: fencing; sport; feedback; coaching; teaching; scouting sheet

INTRODUCTION

'Feedback' is a generic term that describes information individuals receive regarding their performance of a motor skill either during or after performance (Magill & Anderson, 2013). It has been always considered as the most pivotal element for learning, except for practice itself (Bilodeau,

1966). This term applies to both forms of performance-related information: inherent or intrinsic feedback and augmented or extrinsic feedback. The inherent feedback (intrinsic) holds significant value as it is a natural consequence of an action and does not rely on external sources. Conversely, augmented feedback (extrinsic) is provided to the performers externally complementing the task-intrinsic feedback loop (Petancevski et al., 2022).

Knowledge of results (KR) and knowledge of performance (KP) are two distinct categories of augmented feedback, as categorized by Schmidt et al., (2018). KR entails externally provided information regarding the outcome of a skill attempt. It might be delivered by a person or by an external device. KP, on the other hand, involves information regarding the specific movement characteristics that led to the performance outcome. It can be presented verbally and nonverbally such as video replay, computer software, and biofeedback devices; such sensory feedback informs the person about the movement characteristics associated with the outcome of an action (Magill & Anderson, 2013).

Augmented feedback provides players with essential information about their skill level and performance, actively contributing to skill-learning process and the achievement of their skill goals (Magill & Anderson, 2013). Players would effectively assess their performance accuracy and fulfil their skill goal easier and quicker than without such augmented information (Wulf et al., 2010). Moreover, the comparing of their performance to a performance goal fuels their passion to perform better, achieve and accomplish their goals (Alhirsan et al., 2021).

Both Kim et al. (2019) and Tsai & Jwo (2015) have demonstrated a positive effect of augmented feedback on performance during the acquisition phase, thereby promoting skill learning. Kim et al. (2019) observed significant improvement of performance level of those who received AF compared to those who did not receive any AF while learning a key-pressing task. Similarly, Tsai and Jwo (2015) reported enhanced performance during the acquisition phase in favor of the manual force grasp task group receiving AF. Consistently, Burtner et al., (2014) and Goodwin & Goggin, (2018) supported the notion that Augmented feedback significantly enhances performance in the acquisition phase in relation to the number of trials and attempts executed during the learning process.

Performance improvement in the presence of AF is evident regardless of age group. Goodwin & Goggin (2018) studied older adults, Cuppone et al. (2016) investigated the adults, and Burtner et al. (2014) examined the children's groups. Furthermore, when considering the skill level of the players, Krause et al. (2014) found that both novice and expert golf players benefit from augmented feedback during the acquisition phase of the learning process, although their performance may differ in the retention phase (Magill & Anderson, 2013). Similarly, augmented feedback improved athletes' skill acquisition across various types of skills they are performing. Lim et al. (2015) indicated improvement in serial skills of taekwondo, Burtner et al. (2014) found improvement in arm discrete movements, and (Goodwin & Goggin, 2018) demonstrated improvement in continuous balance movements.

Fencing is a competitive sport. It encompasses of three disciplines: foil, épée, and sabre. The goal of all fencers is to hit the target without being hit. For every hit action, a fencer needs to know when to hit, where to hit, and how to hit. All hitting actions should be conducted accurately and precisely when the opponent is distracted, hesitant, and incapable, (Smith, 2007). Knowing the fact that coaches commonly use both KR and KP in the learning process due to their significant positive effect on performance in the acquisition phase (Lauber & Keller, 2012; Tsai & Jwo, 2015). Yet, Sharma et al., (2016) argued that the results of KP have a more significant impact on performance than the KR.

The objective of the study

Hit accuracy stands as a crucial factor determining success in fencing bouts, where the ability to hit the target effectively while evading opposing hits is paramount. In this study we aim to investigate the effect of augmented feedback on the hit accuracy of foil fencers.

The significance of the study

The anticipated effect of augmented feedback on the efficacy of skill performance, coupled with the lack of prior studies exploring the effectiveness of the augmented feedback on the hit accuracy in fencing sport, and the necessity to develop the inherent feedback tool, that might help to improve the accuracy of the hit and enhance the coaching/training experience.

METHOD

Participants

A total of 10 fencing junior and cadet players registered at the Jordan Fencing Federation voluntarily participated in this study. Their average fencing experience was 6-11 years. They participated in an 11-day fencing training camp held at the Jordan fencing federation from January 17th – 27th 2021. The players were distributed homogeneously into a control and an experimental group based on their fencing experience, with five players in each group. Before the training camp, they were all committed to their regular training program, four days/week, three hours/day. They had played in different levels of both national and international championships.

Instrument

The 'Fencing Scouting Sheet / Foil' instrument

To investigate the effect of augmented feedback on the hit accuracy in foil attacks, we needed an instrument to scout the hits in every game for each sample player. A comprehensive revision of related and most recent literature concerning sports and fencing, in particular, took place. Yet, no scouting or analysing sheets of the hits during fencing practice or competition' games was available. Therefore, an urgent need for a scouting sheet evolved. Fencing coaches and instructors were consulted to develop the sheet, and the first draft of the scouting sheet, the scouting sheet targeted the eight target areas (sixte, tierce, quarte, prime, octave, seconde, septime and quinte) in addition to the back. The draft was reviewed, assessed, and tested by several field experts to provide evidence of content representation, relevance and technical quality. Their feedback and comments on the sheets' clarity, accuracy, and construction were taken into consideration. The draft was refined accordingly. The second version of the sheet was content validated and field-tested by fencing coaching, then modified according to their comments. Lastly, a third version of the sheet was developed, field-tested, and content validated. The scouting sheet was then distributed for reliability field testing. It was tested on random five subjects outside the study sample by two different coaches; their scouting sheet analysis reflected a high level of reliability (over 0.90%).

The scouting sheet had two main parts; the first part consisted of the players' names, ages, fencing experiences, gender, dominant arm and game score. The second part consisted of two tables; the first table was for the touches scored against other fencers, while the second table was for the touches received from other fencers. Each table included the four main target areas (sixte, quarte, octave and septime) and the back target; the instrument is shown in Appendix 1.

Procedures

This study was conducted during an 11-day fencing training camp held at the Jordan fencing federation from January 17th – 27th 2021. The total training hours of the camp were 66 hours, equivalent to regular 30-training days.

Experiment protocol

The participants were distributed randomly into the experimental and control groups, with five players in each group. Both groups participated in the training camp effectively for 11 days. The experimental protocol interference was conducted during the technical and tactical phase of the training sessions, followed by the implementation during the friendly bouts in the same session. Each player within the experimental and control group competed in 20 bouts. The bout was scouted and calculated by the coach using the developed scouting sheet (Appendix 1). Each group played 100 bouts in total.

The augmented feedback intervention occurred during the training camp (sessions) and at the beginning of each bout. Coaches provided the experimental group players with the proper augmented feedback, consisting of KP and KR based on each player's performance. Individually or in groups before, during, or after the bouts. The coach would approach the players as follows;

- Direct them towards the importance of the accuracy of the hit.
- Instruct them verbally on the proper technique they should adapt to achieve their goal.
- Use the sniper rifle approach to deliver accurate verbal instructions at the appropriate time.
- Inspires them to use cue words or self-talk to encourage encoding of the hit accuracy.
- Address each player individually and give him the proper knowledge and feedback on his performance in a calm, positive, and assertive tone.
- Tries to minimise the psychological stress factors affecting the players' tasks and calm them down, ensuring they are adequately motivated.
- He seeks to minimise the time between his augmented feedback and the bout.

Upon successful completion of the fencing training camp, each player in the experimental and control groups played four games in their group, with the same opponents as the pre-bouts phase. All their games were scouted by their coaches using the scouting sheet.

Statistical analysis

Statistical analysis was conducted using the Statistical Package for Social Sciences (SPSS), version 25. Participants of both groups did not adhere to normality. Therefore, a non-parametric test, the Mann-Whitney U test, was used to compare the median of all the study's independent variables for both the control and experimental groups.

RESULTS

To fulfil the aim of the study, we will present the descriptive data and the differences in the touches scored, touches received, touches scored out of target, and touches received out of target scouted during the bouts for both the control and experimental groups as follows;

1. Touches scored (TS)

Descriptive data is shown in Table 1, and between – groups differences/ Mann- Whitney U are shown in Table 2.

Table 1. Number of Touches scored by the experimental and control group.

Player	Touches scored (TS)											
	Sixte		Quarte		Octave		Septime		Back target		Total	
	Cont.	Exp.	Cont.	Exp.	Cont.	Exp.	Cont.	Exp.	Cont.	Exp.	Cont.	Exp.
1	21	30	13	11	27	14	-	11	-	8	61	74
2	14	31	22	41	19	24	-	-	-	6	55	102
3	34	24	20	31	11	31	-	-	-	3	65	89
4	33	29	14	16	14	30	-	-	-	-	61	75
5	26	26	22	28	15	25	-	-	-	-	63	79
Total											305	419

Table 2. Between-groups differences/ Mann- Whitney U for Touches scored

	Control Group (N=5)		Experimental group (N=5)		u	Z value	P value
	Mean rank (MD)	Sum of ranks	Mean rank (MD)	Sum of Ranks			
Touches scored (TS)	3.9 (61)	19.50	7.1 (79)	35.50	4.5	-1.681	.093

*P < 0.05

Although the Mann-Whitney test indicated no significant differences in the ‘Touches scored’ between the control and experimental group, the difference between the touches scored was relatively large.

2. ‘Touches received’ (TR)

Descriptive data is shown in Table 3, while between–group differences/ Mann- Whitney U are shown in Table 4.

Table 3. Number of Touches scored by the experimental and control group

Player	Touches scored (TS)											
	Sixte		Quarte		Octave		Septime		Back target		Total	
	Cont.	Exp.	Cont.	Exp.	Cont.	Exp.	Cont.	Exp.	Cont.	Exp.	Cont.	Exp.
1	21	30	13	11	27	14	-	11	-	8	61	74
2	14	31	22	41	19	24	-	-	-	6	55	102
3	34	24	20	31	11	31	-	-	-	3	65	89
4	33	29	14	16	14	30	-	-	-	-	61	75
5	26	26	22	28	15	25	-	-	-	-	63	79
Total											305	419

Table 4. Between-group differences/ Mann- Whitney U for Touches scored

	Control Group (N=5)		Experimental group (N=5)		u	Z value	P value
	Mean rank (MD)	Sum of ranks	Mean rank (MD)	Sum of Ranks			
Touches scored (TS)	3.9 (61)	19.50	7.1 (79)	35.50	4.5	-1.681	.093

*P < 0.05

The Mann-Whitney test indicated the ‘Touches received’ were significantly lower for the experimental group (Md = 54, n =5), than the control group (Md = 77, n = 5) than $U = .000, z = -2.611, p = .009$ with a large effect size $r = .83$.

3. ‘Touches scored out of target’

Descriptive data is shown in Table 5, and between – groups differences/ Mann- Whitney U are shown in Table 6.

Table 5. Number of Touches scored out of target by the experimental and control group

Player	Touches scored out of target											
	Sixte		Quarte		Octave		Septime		Back target		Total	
	Cont.	Exp.	Cont.	Exp.	Cont.	Exp.	Cont.	Exp.	Cont.	Exp.	Cont.	Exp.
1	42	12	34	11	36	17	-	-	-	-	112	40
2	30	14	38	15	35	15	-	-	-	-	103	44
3	39	15	41	13	26	12	-	-	-	-	106	40
4	37	24	32	10	31	11	-	-	-	-	100	45
5	33	15	31	14	34	13	-	-	-	-	98	42
Total											519	211

Table 6. Between-groups differences/ Mann- Whitney U for Touches scored out of target

	Control Group (N=5)		Experimental group (N=5)		u	Z value	P value
	Mean rank	Sum of	Mean rank	Sum of			
	(MD)	Ranks	(MD)	Ranks			
Touches scored out of target	8 (103)	40.00	3 (42)	15.00	.000	-2.619	.009*

*P < 0.05

The Mann-Whitney test indicated the ‘Touches scored out of target’ were significantly lower for the experimental group (Md = 42, n = 5) than the control group (Md = 103, n = 5), $U = .000, z = -2.619, p = .009$ with a large effect size $r = .83$.

4. ‘Touches received out of target’

Descriptive data is shown in Table 7, and between–group differences/ Mann- Whitney U are shown in Table 8.

Table 7. Number of Touches received out of target by the experimental and control group

Player	Touches received out of target											
	Sixte		Quarte		Octave		Septime		Back target		Total	
	Cont.	Exp.	Cont.	Exp.	Cont.	Exp.	Cont.	Exp.	Cont.	Exp.	Cont.	Exp.
1	30	31	37	27	26	33	-	-	-	-	93	91
2	44	32	38	21	27	20	-	-	-	-	109	73
3	34	29	32	22	32	16	-	-	-	-	98	67
4	36	26	21	30	41	23	-	-	-	-	98	79
5	37	28	29	32	33	31	-	-	-	-	99	91
Total											497	401

Table 8. Between-groups differences/ Mann- Whitney U for Touches received out of target

	Control Group (N=5)		Experimental group (N=5)		u	Z value	P value
	Mean rank (MD)	Sum of Ranks	Mean rank (MD)	Sum of Ranks			
Touches received out of target	8 (98)	40.00	3 (79)	15.00	.000	-2.627	.009*

*P < 0.05

The Mann-Whitney test indicated the ‘Touches received out of target’ were significantly lower for the experimental group (Md = 79, n = 5) than the control group (Md = 98, n = 5), U = .000, z = -2.627, p = .009 with a large effect size r = .83.

DISCUSSION

A foil player would gain the priority by starting an attack, parrying or evading his opponent’s attack, establishing a ‘point-in-line’ by extending his arm with his sword pointing at his opponent’s target area, or making a counter-attack against a compound attack before the opponent’s last action.

‘Touches scored’ reflects touches awarded to the fencer who had the priority (right of way). The ‘Touches scored’ of the experimental group were 37.4 % higher than the control group. This result may be attributed to the feedback instructions given to the experimental group fencers by their coach (Magill & Anderson, 2013; Wulf et al., 2010). These instructions directed the players to execute a good hit on the opponent’s target while maintaining the priority of the hit. A player should be fully aware of the opponent’s quick response to his attack. Still, if the opponent succeeded in gaining the priority, the player should win it back. Also, to score a hit, a player should focus on his hand and foot timing in conjunction with his opponent’s timing, maintain the correct distance from his opponent, and sustain the proper decision. Moreover, the players were directed to the importance of the accuracy of the hit. The AF improved the performance in the acquisition phase during the learning process (Goodwin & Goggin, 2018; Burtner et al., 2014).

Using the sniper rifle approach, the coach was able to verbally instruct the players of the experimental group on the proper technique before and during the bouts to score. He Inspired them to use cue words or self-talk to encourage encoding of the hit accuracy. Most importantly, utilising the Fencing scouting sheet for foil bouts assisted in describing the experimental group fencers’ strengths and weaknesses, based on which general and specific feedback was given to the players during or after the bouts. According to Alharisan et al. (2021), augmented feedback may motivate the player to accomplish his goal; in our case, the score sheet could assist the player in comparing his performance with the ultimate performance.

‘Touches received’ reflects touches received by the player who was successfully attacked and hit by his opponent and did not have the priority of attack. The experimental group scored 36.7 % touches lower than the control group. This result may be attributed to the coach’s feedback instructions to the experimental group. The knowledge and feedback of the players’ performance were presented in a calm, positive, and assertive tone to each player individually and in groups. Coaches commonly use

both KR and KP in the learning process due to their significant positive effect on performance in the acquisition phase (Lauber & Keller, 2012; Tsai & Jwo, 2015). The feedback instructions focused on analysing the touches received, reviewing the fencers' weak points and vulnerable target areas where he receives touches the most, and instructing him on the best defence mechanisms used to protect these areas. Also, the feedback technique focused on minimising the psychological stress factors affecting the players' tasks and calmed them down while adequately motivated. Fencers were advised to practice good defence techniques, and to focus on their offensive attack and priority to score a hit.

'Touches scored out of target' reflects touches scored by the fencer out of the opponent's target. The experimental group achieved 59.3 % touches less than the control group. This result may be attributed to the feedback instructions given to the experimental group fencers by their coach based on the Fencing scouting sheet for foil bouts, and the relatively minimal amount of time between the augmented feedback and the bout. The coach's feedback focused on the accuracy and effectiveness of the hit, and the improvement of the decision-making process regarding the priority of the attack to avoid losing any points during the combat. The augmented feedback provided the players with the essential information of their skill level and performance (Magill & Anderson, 2013). A player assesses his performance and accuracy, fulfilling his skill goal easier and quicker than without this augmented information (Wulf et al., 2010).

'Touches received out of target' reflects touches received by the opponent out of the fencers' target, who did not have priority. The experimental group received 19.3 % touches less than the control group. This result may be attributed to the feedback instructions given to the experimental group fencers by their coach based on the Fencing scouting sheet for foil bouts. Performance level increases in the presence of AF regardless of age group (Burtner et al., 2014; Cuppone et al., 2016; Goodwin & Goggin, 2018).

Players had developed their ability to be initiative in maintaining priority, whether in attack or defence. This strategy is significant in foil fencing because the point will be counted by the player who has the priority. The feedback training allowed the players to develop their ability in leading the bout and maintaining priority even in the Touches received out of the target, and eventually assist and lead to the win. Also, when considering the skill level of the players, Krause et al. (2014) indicated that both novice and expert players benefit from the AF received at the acquisition phase of the learning process while the player automates the skill.

CONCLUSION

In conclusion, this study suggested a great benefit of the scouting sheet used to analyse the bouts, and eventually provide both coaches and players with intensive and accurate feedback, customised and tailored for each player based on his performance. This research indicated that effective feedback (KR / KP) improves the players' motor skills and performance; this is reflected in the number of hits scored and received, in and out of the target. This research could be considered as a pilot study, regarding the limited sample size. We encourage future studies to apply the developed scouting sheet, and to focus on various characteristics that feedback presents according to variables such as the sword type, age, gender, skill level, skill classification, experience, competition or training sessions.

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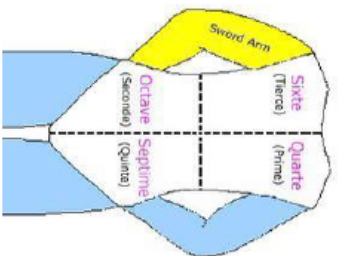
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APPENDIX 1

Fencing scouting sheet

Touches scored																
Target area	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	Total
Sixte																
Quarte																
Octave																
Septime																
Back target																
Touches received																
Target area	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	Total
Sixte																
Quarte																
Octave																
Septime																
Back target																
Touches scored out of target																
Target area	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	Total
Sixte																
Quarte																
Octave																
Septime																
Back target																
Touches received out of target																
Target area	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	Total
Sixte																
Quarte																
Octave																
Septime																
Back target																

Competition	
Fencer name	
Opponent name	
category	
Gender	
Location	



Final score	