

Original Article

Perceived usefulness of mirrored video self-modeling in the development of bilateral competence in elite team-sports

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ABSTRACT

The use of video technology in perfecting athletic training has many benefits on performance. The aim of this study was to determine: (1) athletes' perception of the importance of bilateral skills in sports; (2) the prevalence of use of video feedback in individual skill development; and (3) athletes' attitude toward "mirrored" video self-modelling in four sports. A total of 20 elite athletes, from four popular team sports, were interviewed regarding the three issues using semi-structured interviews. The qualitative results indicate that bilateral skills are differently appreciated in the four team sports. They are perceived as the most important by soccer players, followed by basketball- and handball players and least important by the water polo players. These findings are in full synchrony with athletes' attitudes toward using mirrored video self-modelling. It emerges that the use of technology for developing bilateral skills, with the aim to improve sport performance, is currently sport specific and matches the actual worldwide ranking of the sports' popularity. **Key words:** BILATERAL SKILLS, LATERALITY, MIRROR, SELF-MODELING, SPORTS, VIDEO.

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INTRODUCTION

There is a high demand for the reduction of bilateral skill asymmetry in many team sports (Grouios, 2004; Stöckel & Carey, 2016). For example, soccer experts agree that the importance of bilateral competence (two-footedness) is of paramount importance (Carey et al., 2001). It is proven advantage if a soccer player can control the ball, pass, or shoot with either foot. The actions of strikers are more unpredictable, the available angle for shots becomes wider if they can use both legs similarly. Two-footedness enables midfield and defensive players to move the ball around faster, leaving opponents in uncertainty (Carey et al., 2001). In addition, two-footed players can be deployed in more positions within the team. As a consequence, the value of two-footed ability manifests in a substantial salary premium enjoyed by the 'two-footed' players (Bryson, Frick, & Simmons, 2012). Similarly, the capability of handling the ball equally well on both sides of the body makes a difference in basketball as well; a video analysis of basketball games of professional, semi-professional, and amateur players demonstrated that professional players use their non-dominant hand more often and more efficiently than amateur players (Stöckel & Weigelt, 2012).

Laterality research indicates that extensive bilateral training can modify lateral preference and performance (Teixeira & Okazaki, 2007). An emphasis on non-preferred foot training can reduce the asymmetry of young soccer players' soccer specific capability (e.g. Cobalchini & Silva, 2008; Haaland & Hoff, 2003; Teixeira, Silva, & Carvalho, 2003). Certain parallels can be drawn between the athletes' efforts in improving their non-dominant side performance and the affected limb training in neurorehabilitation. For example, *mirror visual feedback* can promote motor recovery. In mirror visual feedback, a mirror is placed along the midsagittal plane of the patient so that he/she could see the reflection of his/her intact limb superimposed over the contralateral limb (Ramachandran, 2005). The method was first used to treat phantom pain of amputees. As the patient moves his/her intact limb he/she can see the illusion of the moving amputated limb. This visual feedback can alleviate phantom pain in some of the patients (Ramachandran, 2005). A systematic review of the literature suggests that the method has been applied to improve upper limb function in stroke rehabilitation with considerable success (Deconinck et al., 2014).

Action observation plays an obvious role in motor learning, especially in sports (Carroll & Bandura, 1982). Taken the previously reviewed results, mirror visual feedback might support the training of non-preferred side skills, however in a modified version. Because a mirror cannot be placed in close proximity of practicing athletes, mirror reversed video footage may be a substitute. Such mirrored videos horizontally flip the footage, thus right handed movements appear as left handed. With the advent of user friendly video cameras, video editing software solutions, and smart devices, the utilization of mirrored videos are simple. The application of mirrored videos is a version of *video self-modelling* (VSM). Video self-modelling refers to the observation of videos of oneself engaged in only adaptive behaviour (Dowrick & Dove, 1980). The videos applied in VSM are either selected, showing only successful actions, or edited in order to show the person performing the desired skill. Systematic reviews and meta-analyses suggest that VSM can be successfully used in a variety of academic and behaviour skills (Bellini & Akullian, 2007; Buggley & Ogle, 2012; Hitchcock, Dowrick, & Prater, 2003). The results regarding sport movements are more mixed (Clark & Ste-Marie, 2007; Law & Ste-Marie, 2005; Winfrey & Weeks, 1993; Zetou, Kourtesis, Getsiou, Michalopoulou, & Kioumourtzoglou, 2008), and to the best of our knowledge, no meta-analysis or systematic review has been conducted yet in this area.

Mirrored video self-modelling can be perceived as an extension of the mirror visual feedback that might be useful in cases when a mirror is inapplicable (in therapy or sports). Despite the importance of non-preferred side skills in many sports (e.g. Carey et al., 2001; Petro & Szabo, 2016; Stöckel & Weigelt, 2012), the efficacy of mirror visual feedback, and the availability of mirrored video self-modelling, the method has received little

attention. We are aware of three published papers testing the method of which one is ours (Petro & Bárdos, 2014; Steel, Adams, Coulson, Canning, & Hawtin, 2013; Steel & Ellem, 2016). These studies, in spite of different methodology, have revealed promising results that merit further investigations. The assessment of the efficacy and the appropriate application of the mirrored VSM in sports require a large number of participants, since many aspects of the method may be varied in the elaboration of the method. In addition, the athletes' high level of inner motivation and attention is required for observational learning, which determine the method's effectiveness (Bandura, 1969). Furthermore, the opinion and cooperation between sport professionals and athletes has ample importance in the refinement of the method.

The aim of the study

The aims of the current study were to assess and compare training characteristics among four team-sports: (1) the perceived importance of bilateral skills; (2) the current use / practice of video feedback for individual skill development; and (3) elite athletes' attitude toward using mirrored video self-modelling. We selected four popular Olympic team sports in which bilateral skills are likely to be important: soccer, basketball, handball, and water polo (listed in order of global popularity; Biggest Global Sports, 2017)).

METHOD

Participants

Twenty (former or present) elite athletes and/or managers (ex elite athletes) from four team sports participated in our study. The participants' mean age was 48 years (SD=11). We recruited interviewees with relevant experience to obtain the most appropriate picture of each sport (see Table 1 for details). Snowball method was applied in our recruitment. The research plan has been approved by the Faculty of Education and Psychology research ethics board.

Table 1. The participants' experiences.

Code	Age	Gender	Achievements as a player	Achievements as a manager
Water polo				
W1	65	male	Olympic gold medallist, world and European champion	women's national team
W2	71	male	Olympic silver medallist, world and European champion	
W3	40	male	Three times Olympic gold medallist, world champion, 6 times national champion, hall of fame member	
W4	43	male	Olympic gold medallist, world championship silver medallist, 2 times European champion, 4 times national champion	
W5	45	female	World and European champion, 6 times national champion	
Handball				

H1	35	female	15 years in first division, national cup winner, reached the quarter-final of European Champions League	
H2	63	male	13 years in first division, 20 times in national team	Women's national team: European championship gold medallist, Olympic silver medallist, world championship silver medallist. Men's national team: world championship silver medallist, several national and international trophies in clubs as well
H3	31	female	15 years in first division European Handball Federation (EHF) cup winner	
H4	47	male	6 times in a national team; 16 years in the first division	for 5 years in first division
H5	58	male	6 years in first division	2 times EHF Champions League winner, co-manager of the women's national team
Basketball				
B1	37	male	Four times national champion, 98 times in the national team	
B2	47	male	Five times national champion, 88 times in the national team	
B3	49	female	Three times winner of the European championship, 2 times in the all-star team of the competition, 4 times national champion, member of hall of fame, 223 times in the national team	
B4	36	male	16 years in the first division, 90 times in the national team	
B5	49	female	19 years in the first division, 145 times in the national team, member of hall of fame	
Soccer				
S1	48	male	12 years in the first division	U-16 national team
S2	39	male	four years in the first division	U-16-U-21 national teams, 1. and 2. division teams
S3	58	male	in 3. division teams	1. division youth teams

S4	49	male	Eight years in the first division	national youth teams
S5	47	male	12 years in the first division, 3 times in the national team, National Cup winner	

Measures

Semi structured interviews were conducted; each respondent was asked about three topics: a) the importance of bilateral skills, b) the use of individual video feedback, and c) the attitude toward mirrored video self-modelling.

Procedure

The first author conducted semi-structured interviews with the participants in a convenient location for the interviewees (i.e., sports facilities, workplace, café), and quiet enough for a comfortable talk. The interviews (with five people in 4 sports, totalling 20) were audio-digitally recorded and transcribed verbatim to ensure a complete and accurate record of the conversations. The answers were coded by three coders within the respective topics by a manual qualitative method (Braun & Clarke, 2006). Given the qualitative nature of the study, no quantitative statistical procedures were used. After the coding of the individual interview data, the final codes were checked and agreed upon by the three coders.

RESULTS

An abbreviated summary of the interviews is illustrated in Table 2. The gist of the answers to the three exploratory research questions are described for each participant in the four sports.

Table 2. Brief descriptions of the experts' opinion on each subject.

	The importance of bilateral skills	The use of individual video feedback	The attitude toward mirrored video self-modelling
W1	should be emphasized more	rarely, sometimes in goalkeepers' training	good idea
W2	should be emphasized more	rarely, may be useful for kids	may be good
W3	the other hand is rarely used, only for general coordination, and to warm up the legs	99% of teams do not use it	not useful
W4	rather in centre-forward position	rarely	interesting, maybe useful, motivational factor
W5	rather in centre-forward position, close range solutions	maybe occasionally in some clubs	not sure
H1	important for passing, dribbling	not in use	must be useful

H2	important for all actions, apart from long range shots	it is important in youth teams' technical training	not useful, because of lateral differences in the anatomy of the necessary joints and muscles
H3	important for all actions, apart from long range shots	rarely, may be useful for kids	must be useful
H4	important for all actions, apart from long range shots	it is getting into practice	may be useful
H5	important for all actions, apart from long range shots	he uses it	not useful
B1	important for all actions, apart from long range shots	quite rare, but it must be useful	close range shots are similar with either hand, not sure
B2	important for all actions, apart from long range shots	it is getting into practice, could be used more, must be useful	good idea, they might try it
B3	important for all actions, apart from long range shots	they highlight individual actions from team videos.	every action is somewhat different, so not sure
B4	important, but it can be compensated with other skills	must be useful, could be used more	good idea
B5	important, but it can be compensated with other skills	She used it, it is useful	must be useful
S1	Important in youth teams, on adult, professional level the non-preferred foot extra trainings depend on the player's individual demand.	has not heard of it	interesting, may be used as a motivational factor
S2	Important in youth teams, no emphasis in adulthood	very useful, used only in top clubs' youth teams	maybe useful
S3	very important	not in use, maybe for goalkeepers	good idea
S4	very important, always	some teams use it	good idea
S5	very important	not in use, but should be used in youth teams	rather top players' technique should be copied

Water polo

All water polo experts agreed that non-dominant hand actions occur occasionally, only in near-goal situations in water polo. Four of the water polo interviewees identified the centre-forward position, requiring the most non-dominant handed actions. The experts' consensus suggests that individual video feedbacks for skill development are not adopted in water polo, except for a few teams, if any. Three respondents mentioned that video could be applied more for movement acquisition. Two of the interviewees thought that mirrored video self-modelling could not be applied in water polo, as the non-dominant hand is rarely used. One participant was undecided, the remaining two experts thought positively about the method.

Handball

Long-distance shots are almost never executed with the non-preferred hand in handball. All participants thought that the use of the non-dominant hand was important in handball, though. All players in youth teams learn the basic skills bilaterally (passing, dribbling, catching the ball). Three respondents noted that pivot players are usually better with their non-preferred hand. Individual video feedback is useful in handball, as agreed by all handball experts (with some uncertainty of H4), and it is getting more popular. Two athletes, H2 and H5, were on the opinion that the mirrored video self-modelling method cannot be applied in handball. The other three participants thought positively about the mirrored video self-modelling.

Basketball

All 5 basketball experts thought that the use of the non-dominant hand was crucial in basketball. Even close range shots for goal are required to do with either hand if a defender is nearby. Three basketball participants thought that individual video feedback is rarely used for technical training, even though all agreed that it could effectively support trainings. Two of the basketball interviewees, B1 and B3, had doubts, whether mirrored video feedback could be applied in basketball. The other three interviewees thought absolutely positively about the method.

Soccer

All soccer interviewees agreed that youth level trainings should be bilateral in all aspects (ball handling, shots, passes, dribbles) since bilateral skills are inevitable in soccer. Two respondents highlighted the importance of bilateral skills especially for those playing centrally (in defence, midfield, centre) in the team. Individual video feedback is rarely used in soccer, however three soccer participants thought that it must be helpful. Two of the soccer experts would not apply mirrored video feedback. Other two, S3 and S4, thought positively about the method. Finally, one, S5, liked the idea of comparing movements with the help of video recordings, but he would have rather made young athletes copy the world class players' shooting technique.

Summary of the interviews

The interviews have revealed that the non-preferred hand is rarely used in water polo. Handball comes next in increasing order of importance of bilateral skills. Dribbling, passing, and catching the ball is often solved with the other hand. The usage of the non-dominant hand characterizes basketball even more. Non-preferred handed close range goal scoring happens more often, and training drills target that skill. Bilateral ball handling skill is a prerequisite in professional soccer. Even long range shots at goal and passes are performed with the non-dominant limb. Video feedback for individual skill development is rarely used in the discussed sports (a few teams might use it, if any). Four basketball experts, three water polo, and three soccer experts mentioned that it can be helpful. Handball stands out somewhat in this respect. Three handball experts said that they had applied videos. Moreover, all of them thought that it should be used more widely (with the uncertainty of one handball expert). The opinions of water polo and handball experts regarding mirrored video

self-modelling were similarly mixed. Soccer and basketball interviewees were on the same or similar opinion and more optimistic whether the method could be applied in their sports.

DISCUSSION

The results indicate that bilateral skills are perceived as the most important in the following order: soccer, basketball, handball, and water polo, which parallels the order in attitude toward using mirrored video self-modelling and also parallels the world ranking order of the four sports (<http://www.biggestglobalsports.com>, 2017). The interviews showed a discrepancy between the demand of video feedback in these sports and the actual application of it. Most participants (15 out of 20) pointed out that this is a possible field of improvement since the devices for recording and displaying are widely available. Altogether 9 participants (2 from soccer, 3 from handball, 4 from water polo) mentioned central positions in a team, requiring most bilateral skills. Considering the individual differences in the propensity of training the non-preferred sided skills (Porac, 2016), and the positional differences of bilateral demand within a team, it is important to differentiate the necessity of bilateral skills.

These interviews provide preliminary evidence for the implementation of and attitudes towards the adoption of the new video technology in enhancing sport performance. Although some resistance could be detected, the overall attitudes are positive and more proven results of the method – in the near future – could further enhance athletes' openness towards engaging in mirrored video feedback as a method for development of bilateral skills.

CONCLUSION

This qualitative study identified two team sports, soccer and basketball, in which mirrored video self-modelling could be further tested and/or applied, since the bilateral skills are perceived to be important by the athletes of these sports. These two sports, however, are ranked as top sports in the world (Biggest Global Sports, 2017), indicating that pressure of performance paralleling popularity results in greater openness toward using video technology with the aim to enhance sport performance. The attitudes of elite athletes in these two sports was the most positive toward using the method. The study also revealed a current shortage or lack of individual video feedback in performance enhancement, especially in handball and water polo. Thus, a take-home message for practitioners is to consider a wider application of videos at least for skill acquisition and development of bilateral skills in team sports.

AUTHORS NOTE

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