The influence of live-vs. video-model presentation on the early acquisition of a new complex coordination

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Abstract

Background: Demonstration is a widely used method in sports teaching and coaching, based on the assumption that it is more beneficial than verbal instructions or trial-and-error methods for skill acquisition. Although in teaching/coaching situations, the demonstration is usually carried out in front of the learners, in a research context, it is most often presented via a video. However, a direct comparison between these two types of model has rarely been undertaken in a motor context.

Purpose: In this study, we aimed to compare the effectiveness of the observation of a live- and a video-model for the early acquisition of a complex judo movement.

Research Design: Participants observed either a live- or a video-model executing the task. After observation, they practiced for three minutes taking five trials and then performed it for analysis. This procedure was repeated three times. The form and technique of each participant's execution were evaluated using a technical score.

Main results: The results indicated a significant improvement in the task execution by the end of the practice session. However, this improvement occurred only for the video model group between the second and third block of practice.

Conclusions: The video demonstration seems more effective than the live one for the early acquisition of a completely new complex coordination. This may be due to the simplification of the visual information in the former condition because of its two-dimensionality. This simplification may allow the observer to identify the more key elements that would guide him/her for the subsequent performance of the task

Key words: Observational learning; video-model; live-model; judo; skill acquisition

Summary

Demonstration is a widely used method in sports teaching and coaching, based on the assumption that it is more beneficial than verbal instructions or trial-and-error methods for skill acquisition. While in teaching or coaching situations, the demonstration is usually carried out directly in front of the learners, in a research context, it is presented via a video most of the time. Thus comparing the effectiveness of these two types of demonstrations is important from a theoretical viewpoint and even more so from a practical one. In this study, we have shown that video demonstration was more effective than a live one for the early acquisition of a completely new complex judo skill. This may be due to the simplification of the visual information in the former situation because of its two-dimensionality, allowing the learner to identify key elements that would guide him/her for the subsequent performance of the task. Thus, the video demonstration can be an effective tool for the acquisition of a complex skill and should be used more while teaching/coaching.

The influence of live versus video model presentation on the early acquisition of a complex judo movement

Demonstration is a widely used method in sports teaching and coaching, based on the assumption that it is more beneficial than verbal instructions or trial-and-error methods for skill acquisition. Such is the case from an empirical point of view, but different scientific research has also investigated its effectiveness. Since the early work on the subject (Sheffield 1961; Bandura 1969; Caroll and Bandura 1985), it has been recognized that observation plays a role on motor skill learning through, at least, some cognitive mediation. In fact, for Sheffield (1961), observation allows the learner to form a cognitive blueprint of the action that can be used subsequently to initiate and eventually correct the movement. Bandura (1969; 1986) completed Sheffield’s idea in his social learning theory proposing four underlying cognitive processes: attention, memory, motor production and motivation.

Since these early works, a large number of studies have addressed the question of the effectiveness of observational learning. However, most of these studies use simplistic laboratory tasks sometimes far from real life or sports activities (Landers and Landers 1973; Mc Cullagh and Caird 1990; Blandin, Lhuisset, and Proteau 1999; Blandin and Proteau 2000; Badets and Blandin 2005; Boutin et al. 2010; Gruetzmacher et al. 2011; Al-Abood et al. 2001; see Blandin 2002 for a review). Thus, the transferability of their findings to daily living tasks and to sport skills can be questioned (see Williams 1993 and Mc Cullagh, Weiss, and Ross 1989 for similar criticism), especially when demonstration is widely used in sports teaching and training. Several authors (Mc Cullagh, Weiss, and Ross 1989; Williams, Davids, and Williams 1999) have stressed the need to investigate the effectiveness of observational learning in a sport context through more complex motor skills realised in more ecological settings. These authors also underlined that in order to investigate the learning of a complex sport skill through observation, the difference of the performance outcome pre/post exposure is not sufficient, but changes in behaviour (including coordination, form, technical changes) should also be assessed. Thus, in this study, we have examined the effect of observation on the acquisition of a complex judo skill in novice young adults. To fulfil the above mentioned requirements, learning was assessed through the subjective evaluation of the form and technique of a specific judo movement (see Cadopi, Chatillon, and Baldy 1995; Ille and Cadopi 1995; Weeks and Anderson 2000 for similar procedure).

In the sport context, demonstration is widely used and represents, most of the time, the first exposure to the task. In fact, prior to practice, sport teachers or coaches often demonstrate the task, with or without verbal instructions, and then ask their students or athletes to reproduce it. According to Scully and Newell's (1985) visual perception perspective, the observation of a model allows the observer to pick-up the relative motion of the model to create a reference that will constrain the reproduction of the movement during the following practice. This reference conveys information about the general form of the movement as well as the relative motion of the different segments. Since Newell (1985) proposed that learning goes from the establishment of a coordination pattern to a control phase, finally leading to the emergence of skilled behaviour, this suggests an important role of demonstration during the early stage of learning, while the influence of the model should decrease during the refinement phase of learning (see Feltz 1982 for a similar proposition). In fact, recent works have shown that, after observing a model realising a soccer chipping task (Horn et al. 2005) or a reversed baseball throw (Horn et al. 2007), participants observing a video model changed their relative motion to approximate the coordination of the model exclusively between the pre-test and the first three acquisition trials. Such movement pattern modifications did not occur for the non-model control group neither in the early, nor in the late acquisition phases (Horn et al. 2007). Thus, the observation of a model provides information about the movement pattern (at least the relative motion of the different segments) which the observer seems to use during his first practice trials. This is why, in this study, we focused exclusively on the early stage of skill acquisition.

In most of the observational learning studies, demonstrations are presented via a video (Blandin, Lhuisset, and Proteau 1999; Horn et al. 2007; Horn, Williams, and Scott 2002; Horn et al. 2005; Hodges et al. 2005; Hayes et al. 2006; Giroud and Debu 2004), mostly to control the variability of the repeated demonstrations. This is based on the assumption that this type of presentation is equivalent to the direct observation of a model present in front of the observer (hereafter called a live-model). Moreover, only a few studies used a live- model (Lafont 2002; Winnykamen and Lafont 1990; Kampiotis and Theodorakou 2006). Since in teaching and coaching contexts, demonstration is almost exclusively done by the instructor directly in front of the learner, it seems important to compare the effectiveness of such a live-model to a video-model, and this is for two main reasons. Firstly, to question the transferability of results obtained by research using video-models (Blandin, Lhuisset, and Proteau 1999; Horn et al. 2007; Horn, Williams, and Scott 2002; Horn et al. 2005; Hodges et al. 2005; Hayes et al. 2006; Giroud and Debu 2004) into a training and coaching context. Secondly, to determine the most effective mode of model presentation in such real live activities. In fact, even though one has the same model undertaking the same task in the same way, either live or on a video, the information presented to the observer is slightly different. In the live condition, the observer has access to a three-dimensional view of the model, while in the video condition, the information is only two-dimensional since the stereoscopic parallax is eliminated. Thus, the information conveyed by a live-model is richer than the one displayed by a video-model since the latter condition has the effect of flattening the scene, reducing or eliminating the perception of depth. Even though comparisons of the effectiveness between different types of model presentations have been largely tested (Hayes et al. 2007; Horn, Williams, and Scott 2002; Horn et al. 2005; Kampiotis and Theodorakou 2006; Blandin 2002), to our knowledge, only a few studies have directly examined whether video models are as effective as live ones (Feltz, Landers, and Reader 1979; Bandura and Mischel 1965; Bandura, Ross, and Ross 1963). Feltz et al. (1979) were the only ones to examine this question in a motor skill learning context. After observing either a video-model or a live-model, their participants performed equally on a springboard-diving task. However, their task was fear-provoking since it concerned a back dive from a 1m board, and thus the results might not apply to a general context (i.e. less fear-provoking tasks). Furthermore, Newell and Walter (1981) and Runeson (1984) proposed that when a model contains too much information, it could make it ineffective for the observer to isolate the pertinent parameters of the movement. This prediction has been tested by comparing the visual search pattern during the observation of either a video-model or a simplified light-point model (i.e. a reconstitution of the model derived from the registered position of 18 markers placed at the model’s joint centres) for a soccer chipping task (Horn, Williams, and Scott 2002). These authors showed that participants observing the light-point model used more refined visual searches than the ones observing a real video model (see Hodges et al. 2007 for a review). In fact, this latter situation seemed to contain more distracting structural information inducing a greater amount of viewing time to less informative areas of the display such as the head and face, irrelevant to the task, while the first one encouraged participants to direct their gaze to more strategic and relevant locations (i.e. lower body and more central points allowing a synthetic search strategy, Ripoll 1991). Thus, the visual search strategies seem to be more selective when the information available to the observer is simplified. Following this line, the pertinent information should be more accessible during the observation of a video-model as compared to a live-model since, as explained earlier, the information is only two dimensional in the former condition. That would suggest a superiority of a video-model for movement acquisition.

The purpose of the present study was to investigate the effect of observation on the early acquisition of a complex judo skill in novice young adults. The main question of interest concerned the influence of a live-model in comparison to a video-model. In fact, such direct comparison has rarely been made in a motor context (Feltz, Landers, and Reader 1979)even though it presents an interest for teaching and coaching. The task chosen was a “kubi nage”, which is a real judo technique suited for beginners. Since it is an ecological complex task, learning was assessed through the evaluation of the form and the technique of the movement execution (Mc Cullagh, Weiss, and Ross 1989; Williams, Davids, and Williams 1999). As suggested by Feltz et al. (1979) as well as by the results of different studies using either the live-model (Kampiotis and Theodorakou 2006; Hayes et al. 2007; Horn, Williams, and Scott 2002; Horn et al. 2005; Horn et al. 2007; Lafont 2002; Winnykamen and Lafont 1990) or the video-model (Hayes et al. 2007; Horn, Williams, and Scott 2002; Horn et al. 2005; Horn et al. 2007) for the acquisition of complex ecological tasks, both types of model should lead to a significant improvement in learning the task. Thus, we can expect a main effect of the repetition. However, on the basis of Horn el al.’s results (2002) indicating a better intake of pertinent visual information when the access to relative motion is facilitated (i.e. point light model in their study), we hypothesised that there should be an advantage for the observation of a video-model as compared to a live-model. Such should be the case because of the simplification of the available information in the former condition (i.e. two-dimensional information only). This would be testified by a significant interaction between the type of model and the repetition.

A secondary question of interest concerned the amount of observation and practice needed to induce modifications in behaviour. Since after observation most of these transformations seem to occur during the first three practice trials (Horn et al. 2005; Horn et al. 2007), we were exclusively interested in the early acquisition of the skill. Furthermore, we hypothesised a significant improvement between the first and second blocks of observation followed by practice, while further observation should not lead to major improvements in movement execution.

Method

Participants

Twenty-four participants (four women and 20 men) aged from 18 to 21 years old (M_{age} = 18.91 years, *SD* = 0.77 years), took part in the study. They were first year students in a Sport and Physical Education Department and were all Caucasians. Participants were informed of the general purpose of the study (investigating the effectiveness of different pedagogical teaching methods) and gave their written consent. The experiment took place during the fifth lesson of a judo course. Students who had attended any judo lesson prior to this course were excluded from the study. All participants were complete novices to the task since they had had only three lessons learning judo on the ground and one lesson learning how to fall. At the end of the fourth lesson, the voluntary novice participants were quasi-randomly assigned to one of two experimental groups (the randomization was done by gender to balance the female /

male ratio): (a) Silent Demonstration by a live-model (live group, n=12, 2 females and 10 males), (b) Silent Demonstration by a video-model (video group, n=12, 2 females and 10 males). This study has been approved by the local Ethics Committee.

Task and procedure

Task.

The task consisted of a judo technique suited for beginners. It was a variation of “kubi nage” (see figure 1). As it is the case in judo, the task needed a pair of performers: one actor, “tori” (the one who makes the other one fall) and one partner (the opponent in a real duel), semi passive, “uke” (the one who falls).

Insert Figure 1 approximately here

The aim of this movement, for “tori”, is to unbalance the opponent (partner in this situation) and to throw him/her on the ground by rolling him/her around the hip. This technique can be divided into three phases: (a) “tsukuri” which consists of detecting a change in balance of “uke” that he/she can use to pull him/her in the direction of his/her choice and thus trigger a loss of balance. This phase will be here-after called the break of balance phase; (b) “kuzushi” which corresponds to the application of the technique itself. It consists of a rotation on the upper body to load “uke” on the hip and back. This phase will be called the placement phase; and finally (c) “kake” which corresponds to the final projection of “uke” to the ground. This will be called the projection phase.

Experimental design.

After a warm up session of 20 minutes, participants were divided according to the group they belonged to. The practice hall was divided in two by an opaque curtain. On one side of the curtain the experiment took place while on the other side, the remaining participants did some exercises on the ground. The live-model group participated first, and once the experiment was completed for all participants of this group, they exchanged place with the video-model group. In each group, participants were paired to execute the task. Each would take turns to alternatively play the role of “tori” and “uke”. For both groups the procedure was similar. Participants observed the demonstration three times from each side (right and left profiles). Then, they practiced for about three minutes during which they were instructed to undertake five repetitions each. At the end of this practice, they performed the task, once as “tori” and once as “uke”. This performance was filmed for further analysis. Even though participants performed both roles, it was made clear that the performance of interest (the only one analysed) was as “tori” (“uke” was instructed to allow the action of “tori”, which meant: no anticipation of “tori’s” action, no resistance and no refusal of fall). Thus, one block of practice was constituted by three demonstrations followed by five practice trials followed by one performance trial for analysis. It was repeated three times to evaluate the progression (see Giroud and Debu 2004 for similar design). No feedback and no knowledge of results were delivered throughout the experiment. To avoid mutual influence, each duo was filmed one by one while the other participants were waiting, facing the other side of the room. Thus, at no time could participants see the performance of the others, except their partner while they played the role of “uke”, and one can easily understand that this was not the best position to analyse the other’s performance.

Model.

The model was the same for both groups. It was the course teacher, a judo expert, black belt, fourth dan, BEES[1] 2^{cd} degree. His judo level insured regularity during the demonstrations. He was assisted in his demonstrations by another expert playing “uke”. According to the group, the demonstration was either performed directly in front of the participants (live group) or displayed on a video (video group). For both groups, the demonstration was silent, which means that no technical comment was provided at any moment.

For the observation of the model (either live or video), participants were seated on chairs, facing the demonstration. They were assigned to a certain place that they would use for the three blocks of observation and were instructed to stay still during the whole observation. For the live-model observation, they were seated three metres away from the model, all on the same side. For the video-model observation, they were seated one metre away from a television screen (120 cm x 80 cm) with the middle of the screen located at eye level. The model was filmed during the live observations, from the same perspective as the live observers (same angle, distance of three metres) in such a way that the full body of the judo experts could be seen during the whole demonstration.

Measures and analyses

As described earlier, “kubi-nage” technique can be divided into three phases. For each of which some execution criteria have been identified: three for the break of balance and the placement phases and four for the projection phase (see table 1 for details). Each of these criteria could be considered as absent, imperfectly executed or correctly executed, which corresponded to a respective score of 0, 1 or 2.

Insert Table 1 approximately here

Thus, for each performance of each participant one has been able to calculate a technical score for each phase as well as a global technical score. The technical analyses have been done by two judo experts (black belt, second dan, BEES[1] 1st degree) who independently watched the videos and attributed a score to each criterion. They could watch the videos as many times as they wanted and use slow motion as well as freeze frames. They were blind to the group of participants. To insure the reliability of the rating, the inter-rater reliability was assessed through an interclass correlation (Shrout and Fleiss 1979; see also Suen 1988 for a discussion on the application of the different reliability indices). The results of this correlation showed that there was no significant differences between raters' quotation [ICC coefficient = 0.9818; $F(1, 216) = 0.0553$]. In fact, there were very few differences between raters, and when it was the case, they watched the concerned performance together and found a common agreement on the score to allocate.

As multivariate analysis is less likely to lead to experimentwise Type 1 error when multiple repeated measures are used (Leary and Altmaier 1980; Huberty and Morris 1989), a 2 Groups (video-model vs. live model) x 3 Blocks (block 1, 2 and 3) MANOVA with repeated measurement on the last factor was chosen to statistically analyse the scores from the three different phases. Such was possible because the different scores represented different aspects of the same movement and were moderately correlated between each others (correlations went from 0.31 to 0.73). Univariate analyses (ANOVAs) were used in post-hoc analysis where appropriate, to provide details of which variable contributed to the significance. In addition, the global score was submitted to a 2 Groups (video-model vs. live model) x 3 Blocks (block 1, 2 and 3) ANOVA with repeated measurement on the last factor. As repeated measurements were present, the Greenhouse-Geisser correction was applied when the epsilon value was smaller than 1 (Greenhouse and Geisser 1959; see also Winer 1971). Because the correction did not modify the outcome of the analyses, we report the data using the original degrees of freedom. All significant main effects and interactions were further delineated using the Newman-Keuls technique. Statistical significance was set at $p < 0.05$. Partial eta square (η_p^2) are the effect sizes and will be reported for all significant effects (Cohen 1988).

Results

The MANOVA revealed a significant multivariate interaction between group and block, Wilks' $\lambda = 0.46$, $F(6, 17) = 3.36$, $p = 0.022$, $\eta_p^2 = 0.54$. This interaction is illustrated in figure 2. Given the significance of the overall test, the univariate effects were examined. They revealed that the group x block interaction was significant for the placement phase, $F(2, 44) = 3.42$, $p = 0.04$, $\eta_p^2 = 0.13$ as well as for the projection phase, $F(2, 44) = 3.37$, $p = 0.04$, $\eta_p^2 = 0.13$ while it was not the case for the break of balance phase, $F(2, 44) = 2.01$, $p = 0.15$. The performances of both groups for the various phases are indicated in table 2. Post-hoc analyses indicated that during the placement phase, while both groups had equivalent scores during the first and second blocks ($p = 0.34$ and 0.75 respectively), they differed significantly during the third block ($p = 0.005$) since only the video-model group significantly improved its performance between the second and third block ($p = 0.019$, see figure 2). Finally, during the projection phase, the video-model group tended to improve from the second to the third block ($p = 0.071$) while no improvement was evidenced for the live-model group (see figure 2).

Insert Table 2 approximately here

Taken together, these results indicated that overall, only the video-model group improved from the second to the third block. This was confirmed by a significant interaction between group and block, $F(2, 44) = 6.41$ ($p = 0.003$), $\eta_p^2 = 0.23$ revealed by the ANOVA realised on the global score (see figure 2). Furthermore, the breakdown of this interaction indicated that this differential improvement resulted in significantly higher scores for the video-group during the third block ($p = 0.007$), while the scores were equivalent for both groups during the first two blocks ($p = 0.26$ and $p = 0.31$ for respectively block 1 and 2).

Insert Figure 2 approximately here

Discussion

The aim of this study was to determine the influence of two different types of demonstrations on the early acquisition of a complex judo movement. The main question of interest concerned the comparison of the effectiveness of a video demonstration and a demonstration completed by a model directly present in front of the participants. Even though we expected significant improvement in behaviour for both types of models (Feltz, Landers, and Reader 1979), we hypothesised a superiority of the video demonstration (Horn, Williams, and Scott 2002; Horn et al. 2005).

The results indicated an improvement in the technical execution of the movement after three blocks of observation followed by practice. However, this improvement was significant only for the participants who observed the model via a video. This improvement for the video-model group is in line with previous studies showing a learning effect when using video models (Blandin, Lhuisset, and Proteau 1999; Horn et al. 2007; Horn, Williams, and Scott 2002; Horn et al. 2005; Hodges et al. 2005; Hayes et al. 2006; Giroud and Debu 2004; Cross et al. 2009; Weeks and Anderson 2000). Furthermore, the superiority of the video-model group after observation followed by practice is in accordance with our hypothesis and with the results obtained by Horn et al. (2002; 2005). These authors found evidence for more pertinent visual searches during the observation of a new soccer-chipping task when the model was simplified to light-points located at the major joints and linked by sticks, than when it was a regular person presented on a video. In the former situation, the visual information was less rich and concerned exclusively the movement of the segments. It allowed participants to gaze at more relevant positions and to be less distracted by less relevant ones. Thus, the fact that, in our study, observing the model on a video led to improvement in the execution of the task while observing it directly did not, indicates that the observers were able to identify the key elements necessary for its subsequent execution (Blandin, Lhuisset, and Proteau 1999) on the video condition only. That could be explained by the facilitation of the visual information intake because, in this condition, the visual information was only two-dimensional and was thus simplified as compared to the live condition where the visual information was three-dimensional and therefore, more complex and more difficult to select and process. In fact, differences between both types of model presentations concerned essentially the dimensional factor of the visual information since the model doing the demonstration live (live-model group) was filmed and then, these demonstrations were presented to the video-model group. This allowed us to control any master effect phenomenon as well as variability issues concerning the demonstration. Thus, the differences obtained between the groups can not be related to differences in the demonstration per se, but rather to its presentation. On the subject of the demonstration presentation, another difference can be identified. It concerns the size of what was seen by the observer, since the size, on the screen, of the presented model was smaller than it actually was live (even though the television screen was of a decent size: 120cm x 80cm, and the participants were seated only one metre away, as compared to three metres from the model for the live-model group). However, this size differences should make the information intake more difficult for the video-model group and thus can not explain the superiority of this group at the end of the protocol.

Finally, our results differed from Feltz et al.'s (1979) study which did not provide evidence for any superiority for either type of demonstration (video vs. live). This might be partly explained by the task differences, as they used a back dive which can be qualified as a high-avoidance or a fear-provoking task. That was not the case in our study since all our participants had learnt how to fall in judo prior to the exposure to the task. However, such differences are more likely related to the outcome measurements. In fact, in Feltz et al.'s (1979) study, the performance was marked as ”correct” or “incorrect” while in our study, a more qualitative score was used concerning a variety of criteria thought to be pertinent to the execution of the gesture. Thus, we had a more sensitive tool to assess the changes in behaviour and it revealed more subtle differences than was the case in the previous Feltz et al. study.

Furthermore, if one analyses more precisely what has been acquired by the video-model group, then one can notice that the behaviour improvement was due to a better placement under the opponent's body and to a better projection of his/her body. The initial interaction with the opponent which consists in breaking his/her balance did not improve. Such was probably the case because the last two phases (placement and projection) concern the execution of the technique itself while the initial one (break of balance) is related to its preparation and requires taking information not only on the main actor, but also on the opponent's behaviour to be able to adjust to it. This information intake is probably possible only on subsequent stages of learning (Fitts 1964) and improvement might occur on later trials.

A secondary question of interest concerned the amount of observation followed by practice needed to induce behavioural change. We expected most of these changes to occur between the first and second block of observation (Horn et al. 2005; Horn et al. 2007). Significant improvement in performance occurred only after the third block of observation and practice for the video-model group. Even though this can be considered as early changes (that corresponds to a total of only nine observations and 15 practice trials), this is in contrast to previous studies by Horn et al. (Horn, Williams, and Scott 2002; Horn et al. 2007; Horn et al. 2005) where improvements occurred earlier after fewer observations of the model. The fact that the changes occurred later in the present study could be related to the nature of the tasks employed. The soccer chip kick used by Horn et al. (2002; 2007; 2005) and the backhand baseball pitch used by Horn et al. (2002; 2007; 2005) are variants of skills usually experienced in childhood, leading to rich motor schemas being acquired for those types of actions (Schmidt 1975; Schmidt and Lee 2011; Sherwood and Lee 2003). Thus, the observation of variations of previously learned actions could have made it easier to identify and pick-up the relevant key elements of the action. In contrast, the judo skill was less likely to have been previously experienced in any form by the learners. This would make it more difficult for relevant key elements to be identified and picked up in earlier observations. This may also explain the absence of significant improvement for the live-model group which might have needed even more observations to be able to modify significantly their behaviour.

In conclusion, we have demonstrated that a fast behavioural change for the acquisition of a completely new complex coordination (i.e. a complex judo skill in this particular study) through observation interspersed with physical practice is possible. Moreover, it appears that the observation of a video model seems more effective than the observation of a live model for the early acquisition of such a skill. This suggests that video demonstrations should be used more while teaching and coaching, although it is a live demonstration that is usually implemented. We suggested that the superiority of the video demonstration is linked to the simplification of the visual information available through a video display (two dimensional information only) that allows the observer to more easily identify the key elements for the subsequent execution of the task. In fact, this less rich visual environment probably helps him/her to take into account the relevant information and to be less distracted by non relevant information. To test this explanatory hypothesis, the visual search strategies should be explored with an eye movement registration system in a subsequent study.

Finally, one of the limitations of this study is that it focussed only on the early acquisition processes. One can hypothesise that with repeated demonstrations and further practice, participants observing a life model could also depict the key elements of the task and reach a similar level of performance in the long term. Such questions should also be addressed in a subsequent study.

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Footnotes

[1] BEES = French teaching and coaching diploma

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Table 1. Execution criteria for each of the three phases of the “kubi-nage” technique.

Phases	Criteria	Technical score
Break of balance phase	1. pull on the left arm of “uke” towards oneself	0, 1 or 2
	2. rotation of the shoulder	0, 1 or 2
	3. placement of the right arm on “uke’s” back.	0, 1 or 2
		On 6 points
Placement phase	1. completion of the rotation of the body (to turn one’s back to “uke”)	0, 1 or 2
	2. spreading of the legs (for better balance)	0, 1 or 2
	3. contact kept with “uke’s” body on the thigh	0, 1 or 2
		On 6 points
Projection phase	1. liberation of “uke’s” body with the right arm	0, 1 or 2
	2. direction of the projection of “uke”	0, 1 or 2
	3. quality of the balance (necessity to keep “uke’s” sleeve in hand during the projection to stay balanced)	0, 1 or 2
	4. continuity of the projection movement (dynamic projection)	0, 1 or 2
		On 8 points
Global		On 20 points

Table 2. Details of the technical scores for each phase as a function of group and block of practice. Mean (±*standard deviation*).

	Break of balance phase (on 6 points)			Placement phase (on 6 points)			Projection phase (on 8 points)		
	Block 1	Block 2	Block 3	Block 1	Block 2	Block 3	Block 1	Block 2	Block 3
Video-model group	3.7 (±*1.2*)	3.6 (±*1.5*)	4.8 (±*1.2*)	3.9 (±*1.2*)	3.2[a] (±*1.5*)	4.4 [ab] (±*1.3*)	4.4 (±*1.6*)	4 (±*1.6*)	5.2 (±*1.5*)
Live-model group	2.9 (±*1.3*)	3.2 (±*1.3*)	3.2 (±*1.4*)	3.7 (±*1.5*)	3.91 (±*1.5*)	3.5[b] (±*1.2*)	3.7 (±*1.3*)	4.7 (±*1.9*)	4.6 (±*1.4*)

[a]significant difference from block 2 to block 3

[b]significant difference between groups

Figure captions

Figure 1. Illustration of the Kubi Nage technique. The adaptation we used concerned the position of the right arm of “tori”: instead of having to place his/her arm above the shoulder and around the neck of “uke”, he/she was required to place it on the back of his/her partner. This adaptation has been done to ease the execution of the task as well as for safety reasons.

Figure 2. Evolution of the technical scores across the three blocks of observation followed by practice for the video-model group (on the left) and the live-model group (on the right)

Figure 1

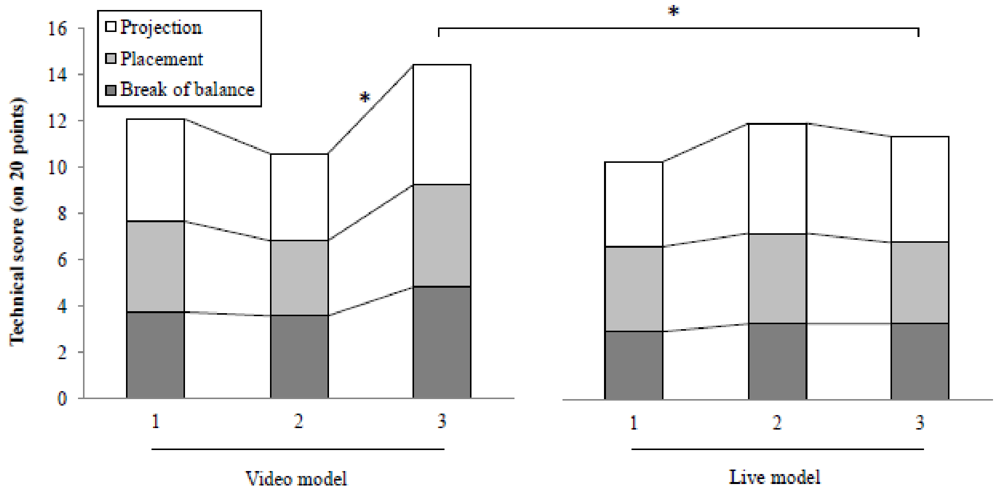
Projection
Placement
Break of balance
Technical score (on 20 points)
16
14
12
10
8
6
4
2
0
*
*
1
2
3
Video model
1
2
3
Live model

Figure 2