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

Léna. Lhuisset^{1,2} and Eric Margnes¹

1- Univ Pau, EA 4445 – Laboratoire Activité Physique Performance et Santé, Zone Bastillac Sud, 65 000 Tarbes, France

2 –INSERM, ERI 27, Caen, France

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Correspondence concerning this article should be addressed to

Léna Lhuisset, Département STAPS, Université de Pau et des Pays de l'Adour, Zone Bastillac Sud, 65000 Tarbes, France.

E-mail : lena.lhuisset@univ-pau.fr ;

Phone: +33 651 317 863 ; Fax: +33 562 566 110

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

1 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.

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1   **The influence of live versus video model presentation on the early acquisition of a**
2   **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; Carroll 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

1 also underlined that in order to investigate the learning of a complex sport skill through
2 observation, the difference of the performance outcome pre/post exposure is not
3 sufficient, but changes in behaviour (including coordination, form, technical changes)
4 should also be assessed. Thus, in this study, we have examined the effect of observation
5 on the acquisition of a complex judo skill in novice young adults. To fulfil the above
6 mentioned requirements, learning was assessed through the subjective evaluation of the
7 form and technique of a specific judo movement (see Cadopi, Chatillon, and Baldy
8 1995; Ille and Cadopi 1995; Weeks and Anderson 2000 for similar procedure).

9   In the sport context, demonstration is widely used and represents, most of the
10 time, the first exposure to the task. In fact, prior to practice, sport teachers or coaches
11 often demonstrate the task, with or without verbal instructions, and then ask their
12 students or athletes to reproduce it. According to Scully and Newell's (1985) visual
13 perception perspective, the observation of a model allows the observer to pick-up the
14 relative motion of the model to create a reference that will constrain the reproduction of
15 the movement during the following practice. This reference conveys information about
16 the general form of the movement as well as the relative motion of the different
17 segments. Since Newell (1985) proposed that learning goes from the establishment of a
18 coordination pattern to a control phase, finally leading to the emergence of skilled
19 behaviour, this suggests an important role of demonstration during the early stage of
20 learning, while the influence of the model should decrease during the refinement phase
21 of learning (see Feltz 1982 for a similar proposition). In fact, recent works have shown
22 that, after observing a model realising a soccer chipping task (Horn et al. 2005) or a
23 reversed baseball throw (Horn et al. 2007), participants observing a video model
24 changed their relative motion to approximate the coordination of the model exclusively
25 between the pre-test and the first three acquisition trials. Such movement pattern

1 modifications did not occur for the non-model control group neither in the early, nor in
2 the late acquisition phases (Horn et al. 2007). Thus, the observation of a model provides
3 information about the movement pattern (at least the relative motion of the different
4 segments) which the observer seems to use during his first practice trials. This is why,
5 in this study, we focused exclusively on the early stage of skill acquisition.

6 In most of the observational learning studies, demonstrations are presented via a
7 video (Blandin, Lhuisset, and Proteau 1999; Horn et al. 2007; Horn, Williams, and Scott
8 2002; Horn et al. 2005; Hodges et al. 2005; Hayes et al. 2006; Giroud and Debu 2004),
9 mostly to control the variability of the repeated demonstrations. This is based on the
10 assumption that this type of presentation is equivalent to the direct observation of a
11 model present in front of the observer (hereafter called a live-model). Moreover, only a
12 few studies used a live- model (Lafont 2002; Winnykamen and Lafont 1990; Kapiotis
13 and Theodorakou 2006). Since in teaching and coaching contexts, demonstration is
14 almost exclusively done by the instructor directly in front of the learner, it seems
15 important to compare the effectiveness of such a live-model to a video-model, and this
16 is for two main reasons. Firstly, to question the transferability of results obtained by
17 research using video-models (Blandin, Lhuisset, and Proteau 1999; Horn et al. 2007;
18 Horn, Williams, and Scott 2002; Horn et al. 2005; Hodges et al. 2005; Hayes et al.
19 2006; Giroud and Debu 2004) into a training and coaching context. Secondly, to
20 determine the most effective mode of model presentation in such real live activities. In
21 fact, even though one has the same model undertaking the same task in the same way,
22 either live or on a video, the information presented to the observer is slightly different.
23 In the live condition, the observer has access to a three-dimensional view of the model,
24 while in the video condition, the information is only two-dimensional since the
25 stereoscopic parallax is eliminated. Thus, the information conveyed by a live-model is

1 richer than the one displayed by a video-model since the latter condition has the effect
2 of flattening the scene, reducing or eliminating the perception of depth. Even though
3 comparisons of the effectiveness between different types of model presentations have
4 been largely tested (Hayes et al. 2007; Horn, Williams, and Scott 2002; Horn et al.
5 2005; Kampiotis and Theodorakou 2006; Blandin 2002), to our knowledge, only a few
6 studies have directly examined whether video models are as effective as live ones
7 (Feltz, Landers, and Reader 1979; Bandura and Mischel 1965; Bandura, Ross, and Ross
8 1963). Feltz et al. (1979) were the only ones to examine this question in a motor skill
9 learning context. After observing either a video-model or a live-model, their participants
10 performed equally on a springboard-diving task. However, their task was fear-
11 provoking since it concerned a back dive from a 1m board, and thus the results might
12 not apply to a general context (i.e. less fear-provoking tasks). Furthermore, Newell and
13 Walter (1981) and Runeson (1984) proposed that when a model contains too much
14 information, it could make it ineffective for the observer to isolate the pertinent
15 parameters of the movement. This prediction has been tested by comparing the visual
16 search pattern during the observation of either a video-model or a simplified light-point
17 model (i.e. a reconstitution of the model derived from the registered position of 18
18 markers placed at the model's joint centres) for a soccer chipping task (Horn, Williams,
19 and Scott 2002). These authors showed that participants observing the light-point model
20 used more refined visual searches than the ones observing a real video model (see
21 Hodges et al. 2007 for a review). In fact, this latter situation seemed to contain more
22 distracting structural information inducing a greater amount of viewing time to less
23 informative areas of the display such as the head and face, irrelevant to the task, while
24 the first one encouraged participants to direct their gaze to more strategic and relevant
25 locations (i.e. lower body and more central points allowing a synthetic search strategy,

1 Ripoll 1991). Thus, the visual search strategies seem to be more selective when the
2 information available to the observer is simplified. Following this line, the pertinent
3 information should be more accessible during the observation of a video-model as
4 compared to a live-model since, as explained earlier, the information is only two
5 dimensional in the former condition. That would suggest a superiority of a video-model
6 for movement acquisition.

7   The purpose of the present study was to investigate the effect of observation on
8 the early acquisition of a complex judo skill in novice young adults. The main question
9 of interest concerned the influence of a live-model in comparison to a video-model. In
10 fact, such direct comparison has rarely been made in a motor context (Feltz, Landers,
11 and Reader 1979) even though it presents an interest for teaching and coaching. The task
12 chosen was a “kubi nage”, which is a real judo technique suited for beginners. Since it
13 is an ecological complex task, learning was assessed through the evaluation of the form
14 and the technique of the movement execution (Mc Cullagh, Weiss, and Ross 1989;
15 Williams, Davids, and Williams 1999). As suggested by Feltz et al. (1979) as well as by
16 the results of different studies using either the live-model (Kampiotis and Theodorakou
17 2006; Hayes et al. 2007; Horn, Williams, and Scott 2002; Horn et al. 2005; Horn et al.
18 2007; Lafont 2002; Winnykamen and Lafont 1990) or the video-model (Hayes et al.
19 2007; Horn, Williams, and Scott 2002; Horn et al. 2005; Horn et al. 2007) for the
20 acquisition of complex ecological tasks, both types of model should lead to a significant
21 improvement in learning the task. Thus, we can expect a main effect of the repetition.
22 However, on the basis of Horn et al.’s results (2002) indicating a better intake of
23 pertinent visual information when the access to relative motion is facilitated (i.e. point
24 light model in their study), we hypothesised that there should be an advantage for the
25 observation of a video-model as compared to a live-model. Such should be the case

1 because of the simplification of the available information in the former condition (i.e.
2 two-dimensional information only). This would be testified by a significant interaction
3 between the type of model and the repetition.

4 A secondary question of interest concerned the amount of observation and
5 practice needed to induce modifications in behaviour. Since after observation most of
6 these transformations seem to occur during the first three practice trials (Horn et al.
7 2005; Horn et al. 2007), we were exclusively interested in the early acquisition of the
8 skill. Furthermore, we hypothesised a significant improvement between the first and
9 second blocks of observation followed by practice, while further observation should not
10 lead to major improvements in movement execution.

11

12 **Method**

13 **Participants**

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

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

4 **Task and procedure**

5 **Task.**

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

10

11

Insert Figure 1 approximately here

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

22 **Experimental design.**

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

25   **Model.**

1   The model was the same for both groups. It was the course teacher, a judo expert,
2   black belt, fourth dan, BEES¹ 2^{cd} degree. His judo level insured regularity during the
3   demonstrations. He was assisted in his demonstrations by another expert playing “uke”.
4   According to the group, the demonstration was either performed directly in front of the
5   participants (live group) or displayed on a video (video group). For both groups, the
6   demonstration was silent, which means that no technical comment was provided at any
7   moment.

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

17   **Measures and analyses**

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

23

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Insert Table 1 approximately here

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2 Thus, for each performance of each participant one has been able to calculate a
3 technical score for each phase as well as a global technical score. The technical analyses
4 have been done by two judo experts (black belt, second dan, BEES¹ 1st degree) who
5 independently watched the videos and attributed a score to each criterion. They could
6 watch the videos as many times as they wanted and use slow motion as well as freeze
7 frames. They were blind to the group of participants. To insure the reliability of the
8 rating, the inter-rater reliability was assessed through an interclass correlation (Shrout
9 and Fleiss 1979; see also Suen 1988 for a discussion on the application of the different
10 reliability indices). The results of this correlation showed that there was no significant
11 differences between raters' quotation [ICC coefficient = 0.9818; $F(1, 216) = 0.0553$]. In
12 fact, there were very few differences between raters, and when it was the case, they
13 watched the concerned performance together and found a common agreement on the
14 score to allocate.

15 As multivariate analysis is less likely to lead to experimentwise Type 1 error
16 when multiple repeated measures are used (Leary and Altmaier 1980; Huberty and
17 Morris 1989), a 2 Groups (video-model vs. live model) x 3 Blocks (block 1, 2 and 3)
18 MANOVA with repeated measurement on the last factor was chosen to statistically
19 analyse the scores from the three different phases. Such was possible because the
20 different scores represented different aspects of the same movement and were
21 moderately correlated between each others (correlations went from 0.31 to 0.73).
22 Univariate analyses (ANOVAs) were used in post-hoc analysis where appropriate, to
23 provide details of which variable contributed to the significance. In addition, the global
24 score was submitted to a 2 Groups (video-model vs. live model) x 3 Blocks (block 1, 2
25 and 3) ANOVA with repeated measurement on the last factor. As repeated

1 measurements were present, the Greenhouse-Geisser correction was applied when the
2 epsilon value was smaller than 1 (Greenhouse and Geisser 1959; see also Winer 1971).
3 Because the correction did not modify the outcome of the analyses, we report the data
4 using the original degrees of freedom. All significant main effects and interactions were
5 further delineated using the Newman-Keuls technique. Statistical significance was set at
6 $p < 0.05$. Partial eta square (η_p^2) are the effect sizes and will be reported for all
7 significant effects (Cohen 1988).

8

9 Results

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

1 -----

2 Insert Table 2 approximately here

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

12 -----

13 Insert Figure 2 approximately here

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15

16 Discussion

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

1 The results indicated an improvement in the technical execution of the movement after
2 three blocks of observation followed by practice. However, this improvement was
3 significant only for the participants who observed the model via a video. This
4 improvement for the video-model group is in line with previous studies showing a
5 learning effect when using video models (Blandin, Lhuisset, and Proteau 1999; Horn et
6 al. 2007; Horn, Williams, and Scott 2002; Horn et al. 2005; Hodges et al. 2005; Hayes
7 et al. 2006; Giroud and Debu 2004; Cross et al. 2009; Weeks and Anderson 2000).
8 Furthermore, the superiority of the video-model group after observation followed by
9 practice is in accordance with our hypothesis and with the results obtained by Horn et
10 al. (2002; 2005). These authors found evidence for more pertinent visual searches
11 during the observation of a new soccer-chipping task when the model was simplified to
12 light-points located at the major joints and linked by sticks, than when it was a regular
13 person presented on a video. In the former situation, the visual information was less rich
14 and concerned exclusively the movement of the segments. It allowed participants to
15 gaze at more relevant positions and to be less distracted by less relevant ones. Thus, the
16 fact that, in our study, observing the model on a video led to improvement in the
17 execution of the task while observing it directly did not, indicates that the observers
18 were able to identify the key elements necessary for its subsequent execution (Blandin,
19 Lhuisset, and Proteau 1999) on the video condition only. That could be explained by the
20 facilitation of the visual information intake because, in this condition, the visual
21 information was only two-dimensional and was thus simplified as compared to the live
22 condition where the visual information was three-dimensional and therefore, more
23 complex and more difficult to select and process. In fact, differences between both types
24 of model presentations concerned essentially the dimensional factor of the visual
25 information since the model doing the demonstration live (live-model group) was

1 filmed and then, these demonstrations were presented to the video-model group. This
2 allowed us to control any master effect phenomenon as well as variability issues
3 concerning the demonstration. Thus, the differences obtained between the groups can
4 not be related to differences in the demonstration per se, but rather to its presentation.
5 On the subject of the demonstration presentation, another difference can be identified. It
6 concerns the size of what was seen by the observer, since the size, on the screen, of the
7 presented model was smaller than it actually was live (even though the television screen
8 was of a decent size: 120cm x 80cm, and the participants were seated only one metre
9 away, as compared to three metres from the model for the live-model group). However,
10 this size differences should make the information intake more difficult for the video-
11 model group and thus can not explain the superiority of this group at the end of the
12 protocol.

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

24 Furthermore, if one analyses more precisely what has been acquired by the video-model
25 group, then one can notice that the behaviour improvement was due to a better

1 placement under the opponent's body and to a better projection of his/her body. The
2 initial interaction with the opponent which consists in breaking his/her balance did not
3 improve. Such was probably the case because the last two phases (placement and
4 projection) concern the execution of the technique itself while the initial one (break of
5 balance) is related to its preparation and requires taking information not only on the
6 main actor, but also on the opponent's behaviour to be able to adjust to it. This
7 information intake is probably possible only on subsequent stages of learning (Fitts
8 1964) and improvement might occur on later trials.

9   A secondary question of interest concerned the amount of observation followed
10 by practice needed to induce behavioural change. We expected most of these changes to
11 occur between the first and second block of observation (Horn et al. 2005; Horn et al.
12 2007). Significant improvement in performance occurred only after the third block of
13 observation and practice for the video-model group. Even though this can be considered
14 as early changes (that corresponds to a total of only nine observations and 15 practice
15 trials), this is in contrast to previous studies by Horn et al. (Horn, Williams, and Scott
16 2002; Horn et al. 2007; Horn et al. 2005) where improvements occurred earlier after
17 fewer observations of the model. The fact that the changes occurred later in the present
18 study could be related to the nature of the tasks employed. The soccer chip kick used by
19 Horn et al. (2002; 2007; 2005) and the backhand baseball pitch used by Horn et al.
20 (2002; 2007; 2005) are variants of skills usually experienced in childhood, leading to
21 rich motor schemas being acquired for those types of actions (Schmidt 1975; Schmidt
22 and Lee 2011; Sherwood and Lee 2003). Thus, the observation of variations of
23 previously learned actions could have made it easier to identify and pick-up the relevant
24 key elements of the action. In contrast, the judo skill was less likely to have been
25 previously experienced in any form by the learners. This would make it more difficult

1 for relevant key elements to be identified and picked up in earlier observations. This
2 may also explain the absence of significant improvement for the live-model group
3 which might have needed even more observations to be able to modify significantly
4 their behaviour.

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

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

24

1

1 Footnotes

2 ¹ BEES = French teaching and coaching diploma

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1

- 1 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	
	3. placement of the right arm on “uke’s” back.	0, 1 or 2
		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”	
	3. quality of the balance (necessity to keep “uke’s” sleeve in hand during the projection to stay balanced)	0, 1 or 2 0, 1 or 2
	4. continuity of the projection movement (dynamic projection)	0, 1 or 2
		On 8 points
Global		On 20 points

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4

- 1 Table 2. Details of the technical scores for each phase as a function of group and block
- 2 of practice. Mean ($\pm$ standard deviation).

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

3 ^asignificant difference from block 2 to block 3

4 ^bsignificant difference between groups

5

6

7

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)

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Figure 1

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Figure 2