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Title: Accuracy of activPAL self-attachment methods

Running Head: Self-attaching the activPAL

ABSTRACT

This study examined the accuracy of self-attachment of the activPAL activity monitor. A convenience sample of 50 participants self-attached the monitor after being presented with written material only (WMO) and then written and video instructions (WV); and completed a questionnaire regarding the acceptability of the instructional methods. Participants positioned the monitor lower than the instructed position on the thigh (WMO -5.15 ± 2.75cm, WV -4.16 ± 2.15cm; p=0.008 difference) and approximately two cm lateral from the thigh midline (WMO 1.90 ± 0.92cm; WV 2.08 ± 1.24cm). The orientation of the device was positioned correctly along the midline (within <1 degree of vertical). Acceptability was high for both instructional methods although preference was shown for the WV instruction. In conclusion, participants consistently self-attached the activPAL close to the intended placement with either instructional method. The addition of video instruction produced a slightly more accurate attachment and was preferred by the participants.

Keywords: Sedentary behavior, sitting, measurement, instructional materials

INTRODUCTION

There is a growing body of evidence that too much sitting is a health risk for adults (Owen, Salmon, Koohsari, Turrell, & Giles-Corti, 2014; Tremblay, Colley, Saunders, Healy, & Owen, 2010). Although much of this evidence has been derived from self-report measures of sedentary time, with the associated susceptibility to error and bias (Atkin et al., 2012; Webb & Bain, 2011), objective measurement tools, such as accelerometers, are increasingly being incorporated into population-based studies (Wijndaele et al., 2015). Most of the objective monitor data collected to date classifies sedentary time spent at low acceleration recorded at the device wear locations of the hip, waist, or wrist (Wijndaele et al., 2015). However, sedentary behavior is defined by both a low energy expenditure (≤1.5 metabolic equivalents), and a sitting or reclining posture (Sedentary Behaviour Research Network, 2012). With its ability to accurately distinguish sitting/lying and upright postures (Bassett et al., 2014), the activPAL activity monitor is being increasingly used in free-living studies to examine time spent sitting/lying as a measure of sedentary behaviour (Dunstan et al., 2013; Healy, Winkler, Owen, Anuradha, & Dunstan, 2015).

The activPAL is a small, lightweight monitor worn on the thigh. As indicated in a recent review (Edwardson et al., 2016), in studies of adults, researchers have mostly followed the manufacturer-recommended practices for continuous wear protocols (i.e., waterproofing then attachment with a medical dressing) or for overnight-removal protocols (i.e., attachment with the easily removable PAL Stickies). Some researchers use pouches to attach the device (Ridgers et al., 2012; Stanton, Guertler, Duncan, & Vandelanotte, 2014). Participants need to re-attach the monitors themselves when the devices fall off or are removed — at least daily in overnight-removal protocols (Edwardson et al., 2016). Yet, researchers have exclusively used a face-to-face approach to initially attach the activPAL at the first study assessment and have mostly used face-to-face fittings for the initial attachment at repeat assessments (Edwardson et al., 2016). Allowing participants to also initially attach the activPAL themselves has the potential to reduce research costs. Firstly, research staff time could be reduced by adopting a mail-out distribution approach, such as has been used for other accelerometers in large-scale studies (Eakin et al., 2010; Lee & Shiroma, 2014; Plotnikoff et al., 2013). To yield an overall cost saving however, the self-attachment method would need to ensure correct initial attachment and promote adequate compliance with wear time so as not to affect the amount of valid data retrieved (Matthews, Hagstromer, Pober, & Bowles, 2012; Trost, McIver, & Pate, 2005). Otherwise, administrative costs of research staff following up participants would be incurred (Matthews et al., 2012). A mail-out self-attachment approach could also have non-financial advantages, such as improved reach, representativeness and equity by facilitating the inclusion of participants from geographically dispersed locations in research.

Determining where participants self-attach their activPAL monitors is a necessary step in establishing whether output from studies using a self-attachment protocol are likely to achieve the level of accuracy we would expect based on validation studies derived from monitors that have been carefully attached by trained staff (Grant, Ryan, Tigbe, & Granat, 2006). The accurate distinction the activPAL achieves between sitting/reclining versus upright posture relies on the device angles indicating particular thigh angles. As such, classification accuracy is affected to some degree by the orientation and rotation of the device, and possibly by the location on the thigh, since the thigh is curved.

According to the manual, the activPAL will function correctly if placed in an upright position "anywhere on the front of the thigh" (PAL Technologies Ltd, 2010). However, high-quality data for research may entail stricter requirements. As to what constitutes "upright", based on correspondence with PAL technologies, the rotation of the monitor away from the midline should be no more than 10 degrees either direction (M.H. Granat, personal communication, May 2015). Placement as close as possible to the midline is desirable as the curved surface of the thigh means placements further from the midline increasingly become more like the side than the front of the thigh. Vertical positioning along the midline may be unimportant, with a laboratory validation study demonstrating good inter-device reliability across higher and lower placements of the activPAL along the midline (Grant et al., 2006). Nonetheless, it is prudent to still consider this issue as reliability has only been established for sitting and standing postures during which all of the thigh is respectively horizontal and vertical. Inter-device reliability along the midline has not been tested for other postures with more variable thigh angles that tend to be poorly classified, such as sitting perched forwards (Steeves et al., 2015) and other non-standard positions (Davies, Reilly, & Paton, 2012).

To our knowledge, accuracy of placement of the activPAL device attached by trained staff or by participants has not been reported to date; nor has the impact of various instructional methods on the accuracy of monitor placement. This study aimed to assess and compare, using two instructional methods, how accurately adult participants self-attached the activPAL activity monitor relative to the position indicated in the device's user manual. Placement error was considered separately for orientation/rotation, position on front versus side of thigh, and vertical positioning along the midline. A secondary aim was to examine the acceptability of the methods in terms of satisfaction with the content of both the written and video instructions.

METHOD

Study design

This study evaluated the accuracy and acceptability of two instructional methods to self-attach the activPAL activity monitor: written material only (WMO), and written and video material (WV). Data were collected mid-March to the end of April 2015, and were analysed in April-May 2015. The study was given ethical approval from The University of Queensland Behavioral & Social Sciences Ethical Review Committee, and all participants provided written, informed consent. The instructional methods were developed in consultation with three researchers at the Cancer Prevention Research Centre, The University of Queensland, who use activPAL devices in field-based research. The materials were also presented to five adults (students at the University of Queensland) not familiar with the device, prior to the initial data collection for feedback and modification.

Participant recruitment

Participants were adults at least 18 years of age, who were recruited by convenience sampling, social media and word of mouth in Brisbane, Australia, particularly through universities and workplaces. Purposive sampling was used to recruit participants across a range of ages and gender. Participants were ineligible if they were non-ambulatory and/or did not speak English fluently. It was estimated that a sample size of 50 was sufficient to provide ≥80% power (two-tailed $p<0.05$) to detect a mean difference between WMO and WV instructions of approximately 1 cm in placement error, assuming standard deviations of 2.5cm and 2.0cm for the change between instructional conditions, for vertical and horizontal placement error, respectively. Fifty-one participants were recruited and one participant was excluded from the analysis based on the poor quality of the photographs taken.

Data collection

For each participant, data were collected in a single assessment of approximately 30 minutes duration, conducted at place convenient to the participant (their home, their workplace, or facilities at The University of Queensland). A single assessor conducted all assessments using the same equipment each time. The activPAL monitor (35mm x 53mm x 7mm; 15g) was covered with a nitrile sleeve and a stick figure was drawn on the front to indicate the correct orientation in which to wear the monitor (i.e., head up, feet down), as per standard practice in field based studies (Edwardson et al., 2016).

The order of WMO and WV instructions could not be randomised. All participants first undertook self-attachment of the activPAL following the written instructions (WMO). Written instructions were given (Supplementary data 1), along with the necessary equipment (adhesive patch, alcohol swab, activPAL monitor) for the participant to self-attach the activPAL monitor on the right leg. To minimise learning effects, after the WMO instruction, the right leg was covered and no feedback was given to the participants about the accuracy of their device placement. Then, an instructional video plus the same equipment was provided, so that all participants could self-attach the monitor to the left leg having received both written and video instructions. The video instruction can be seen at: https://www.youtube.com/watch?v=CHCCX2GW3DM. In both sets of instructions, the intended midline and vertical placement of the monitor was described to participants as ‘one third of the way down, on the midline, between the hip and knee’ and is derived from the description in the activPAL manual (PAL Technologies Ltd, 2010).

The researcher took several photographs of each thigh using a camera (Canon 1100D) supported by a tripod. The crease of the thigh, top of the patella and the midline were identified and marked by the researcher. A measuring scale (ruler) was then taped next to the activPAL in order to set the scale. After the assessment the participant completed a selfadministered online questionnaire regarding the acceptability of the instructional methods. This questionnaire was also used to capture demographic characteristics.

Measures

Placement accuracy was measured from the photographs, using a Java image processing program available from the US National Institutes of Health (ImageJ: http://imagej.nih.gov/ij/index.html) that enables distances, in millimetres, to be calculated from the image pixels (Ferreira & Rasband, 2012). The midline was marked between the top of the patella and the crease of the thigh and the distance between these points was taken as the thigh length. Actual placement was measured as distance outward from the midline (horizontally) and distance along the midline upward from the patella (vertically). The correct placements were taken as zero cm from the midline and two-thirds of the thigh length upward from the patella (vertically). Placement error was measured as actual minus intended placement, with positive values representing placement that is too high (vertically) or too far outward (horizontally). To minimise errors, all measures were taken from the corners rather than the middle of the activPAL (the lower left and right corners when measuring vertically, the outermost upper and lower corners when measuring horizontally) with the average of the two measures used. Measures were corrected by half of the height or width of the activPAL as appropriate to indicate the position of the middle of the monitor. Absolute error was also examined, such that higher values represent greater error in either direction.

The extent to which the monitor was positioned in the correct orientation was measured first as the basic orientation (correct, upside down, rotated right, rotated left). Then, for those with the monitor in the correct basic orientation, the rotation of the monitor in either direction, relative to its correct placement (i.e., aligned with the midline) was estimated, as depicted in Figure 1. The hypotenuse was taken as the activPAL width (3.5 cm) and the opposite side was taken as the absolute height difference in placement above the knee between the two bottom corners of the activPAL. The rotation angle (θ) was calculated as the inverse sine function of the opposite/hypotenuse ratio, then was expressed in degrees.

INSERT FIGURE 1 ABOUT HERE

The questionnaire included Likert scale questions on acceptability, ranging from 1 (very poor) to 10 (very good), specifically how easy the instructional methods were to read/understand, the length of the material and whether they were sufficiently descriptive. This questionnaire also included demographic characteristics (age, gender, first language, highest education level completed, occupation, employment status, height, and weight). Body mass index (BMI) was calculated and dichotomised as normal weight/underweight (< 25 kg/m^2) and overweight/obese (≥25 kg/m^2) (World Health Organisation, 2000).

Statistical analysis

Data analyses was performed in SPSS version 22.0 (IBM Corporation). All analyses were limited to the 50 participants with useable photographic data. The demographic characteristics of the sample were reported as n (%) or means and standard deviations (M±SD). Placement error (rotation, horizontal and vertical) was summarised (M±SD, Minimum, Maximum) along with 95% Limits of agreement (M ± 1.96 x SD) and absolute placement error (M±SD). Placement error was compared between the two instructional conditions using paired t-tests. Nonparametric tests (Wilcoxon signed ranks test) and medians were reported for rotation angles. All differences are described relative to WMO. As the pooled results may not apply to all types of participants in the sample, differences in placement error by participant characteristics (age group, gender, education, BMI category, occupation, language) were examined, using a mixed model. The study was not powered *a priori* to examine these differences. Statistical significance was set at $p<0.05$ (two-tailed).

RESULTS

Table 1 shows the characteristics of the 50 included participants. Participants were aged 19 to 72 years, most (82%) had a completed post-school qualification and were either in full time employment (42%) or studying (36%). The average BMI of the sample was 23.8 ±2.7 kg/m^2, with 38% categorised as overweight/obese.

INSERT TABLE 1 ABOUT HERE

Under both WMO (50 attachments) and WV (50 attachments) instructional conditions, 49 attachments were in the right orientation and one was upside down, with both upside down attachments performed by the same participant. Of the 49 participants who attached the monitor in the correct orientation, the rotation angles ranged from 0 to 6.7 degrees with WMO instructions (median = 2.3 degrees) and from 0 to 8.5 degrees with WV instructions (median = 2.8 degrees) and were not significantly different between the instructional conditions (p=0.754). The horizontal placement deviated significantly from the midline with both WMO and WV instructions (both p<0.001), with participants on average placing the monitor approximately two cm outwards from the midline (i.e., laterally) (Table 2). The degree of placement error did not vary significantly or by a large amount depending on the instructions given (mean difference = -0.19 cm, 95% CI: -0.48, 0.09 cm, p=0.172). For both instructional methods, the monitor was placed significantly lower on the thigh than the instructed placement location, by approximately 4–5 cm (p<0.001) (Table 2). The placement was approximately one centimetre closer to the intended location with WV instructions than with WMO (p=0.008).

INSERT TABLE 2 ABOUT HERE

INSERT TABLE 3 ABOUT HERE

Table 3 shows the differences in absolute placement error by age, gender, education, occupation, native language and weight status. Placement error in both instructional conditions varied significantly only by gender, and only in terms of vertical error. Women showed significantly less vertical placement error on average than men, both with written instructions only (-1.72 cm, 95% CI: -3.23, -0.21 cm, p=0.026) and after video instruction (-1.56 cm, 95% CI: -2.65, -0.47 cm, p=0.006). Most of the non-significant differences in horizontal placement error were also small, with confidence intervals containing differences of <1cm. By contrast, for vertical placement error, sizeable differences (≥1cm) were not unlikely based on the confidence intervals. Here, differences of ≥1cm were observed between age groups and occupational categories prior to video instruction. The direction of the results for vertical placement error in both instructional conditions tended to show more placement error for those who were aged 40 years and older, employed in office-based occupational categories (professional/managerial, white collar/administrative), native English speakers, and not university educated, relative to their respective counterparts.

Preference for instruction methods and acceptability of materials

Most participants (44/50, 88%) reported fully reading the written material; the only participant in the sample who attached both monitors upside down reported not fully reading the instructions. All participants stated that they did not need further support after being presented with the video and written materials and nearly all participants (47/50, 94%) indicated they preferred having both instructions to having only the written materials.

Table 4 describes the satisfaction scores with the written instructions and video demonstration. The materials were mostly satisfactory in terms of clarity, length and level of detail, particularly the video, for which mean scores on all satisfaction scales were greater than nine out of a possible 10 (Table 4). Very few (n=2, 4%) participants indicated the video should have been more elaborate. Seven participants (14%) wanted more information in the written instructions. Those who provided suggestions for additional written information (n=23, 46%) wanted a more detailed step-by-step description or pictures of how to measure a third of the thigh and how to find the top of the thigh and the midline. Two participants, both aged over 65 years, wanted more instruction on how to peel off the backing tape. Suggestions for changes to the video by seven participants (14%) concerned how to measure a third of the leg and the midline, and wanting more time between the attachment steps. In reporting whether they preferred the video or written materials, 44 (88%) participants chose the video stating it was easier to get a visual demonstration on how to measure a third of the thigh and on how to handle the tape, and it gave less room for misunderstanding. Those who preferred the written instructions to the video (n=6, 12%) reported the reasons for their preference being that this format was quicker, short and concise, and they could attach the monitor at their own pace.

INSERT TABLE 4 ABOUT HERE

DISCUSSION

This study was the first to evaluate how adults self-attach the activPAL activity monitor under two instructional methods: written instructions alone and written instructions followed by a video demonstration. The findings indicated that most participants self-attached the monitor on the thigh in the correct orientation, and broadly "on the front of the thigh" as required for correct functioning, but typically slightly further down and outward from the position recommended by the manufacturer. Acceptability was high for both instructional materials. Most participants preferred written and video instructions rather than written instructions alone and no participants reported requiring any form of instruction in addition to the written and video materials.

Only 2% of monitor attachments were in the wrong orientation (always inverted), and acceleration data collected upside down can be reprocessed correctly in the device software. Quality controls, such as photographic records, to identify and rectify such data would be advisable. None of the monitors that were placed upright were misaligned by the 10 degrees or more that may interfere with device functioning, based on correspondence with PAL technologies (M.H. Granat, May 2015). The usual self-attachment position was slightly too low along the midline (4–5 cm) and slightly too far outward from the midline (≈2 cm) relative to the position in the instructions. The variability in positioning shown by the 95% limits of agreement suggests that self-attachment protocols are likely to result in most participants placing their monitor somewhere between approximately the intended location and 5 cm too far outward and 10 cm too low. Further study is recommended to determine how much deviation from the manufacturer-recommended placement can be tolerated without meaningfully impacting data quality, when classifying activities (sitting/lying, standing, and stepping) across a wide range of activities performed in the wide array of postures people adopt in their everyday lives (Davies et al., 2012; Hewes, 1955), such as perching forwards or sitting cross-legged.

The accuracy of placement may depend to some extent on the study population, with significant differences between men and women in vertical placement accuracy. Some non-significant differences by age groups and occupational categories were also noted (≥1 cm difference observed) and the study was not powered *a priori* to test demographic differences. We would suggest some caution in expecting the same degree of placement accuracy we observed overall within these and any other unexamined population groups.

Providing video instructions in addition to the written materials improved placement accuracy vertically, where the amount of placement error was greatest. However, this additional instruction did not improve significantly or to a large degree the placement error in terms of device orientation and rotation (which was minimal to begin with) or distance horizontally from the midline. Though efforts were made to minimise learning effects, they may have still accounted for some of the improvement between the first attachment with WMO instructions then the subsequent WV attachment. Learning effects unlikely completely explain the findings, since the improvements though were predominantly in vertical placement only, and matched up with participant comments, such as that the video helped them use the tape to measure one third of the way down the thigh. In addition to some degree of improvement in placement accuracy, including video instructions, such as ours, which is freely available online, along with written materials was preferred by participants over written materials only.

Findings from this study suggest that self-attachment of the activPAL monitor, such as through mail-out, is a suitable approach based on the general indications regarding the position of the monitor needing to be “upright” and on the “front of the thigh”. However, in absence of clear-cut data on device placement and classification accuracy, it may be prudent to measure device placement. For example, participants could upload or email photographs, that could be used for anything from detailed examination of all placements, to a cursory check for extreme misplacement only, or even as a "referee" when other data checks indicate the output data from the device looks questionable. This issue extends beyond primary self-attachment protocols as even when initial attachment is by trained staff, participants typically reattach their own monitors when they change the dressing every day when using waking-wear or work-wear only protocols (Barreira et al., 2015; Kozey-Keadle, Libertine, Lyden, Staudenmayer, & Freedson, 2011) or in continuous wear protocols where attachment fails (Dunstan et al., 2013; Healy et al., 2015).

To our knowledge, no previous studies have assessed instructional methods to self-attach activPAL activity monitors. An instructional video about the ActiGraph activity monitor targeting children and adolescents was shown to be a sufficient method for participants to comply with the wearing protocol and obtain valid data (Thompson, Abdelsamad, Cantu, & Gillum, 2012). While the ActiGraph monitor is attached differently to the activPAL, we also found that video instruction, coupled with written instructions, was enough to achieve attachment in broadly the correct location, and was acceptable to participants. Regarding the specific instructions contained within the written materials and videos, possible areas for improvement included more details on how to find the midline and the top third of the thigh with a measuring tape provided as an aid, and instructions on using the adhesive tape (especially for older participants). Participants typically chose their midline slightly outward of its position measured standing. An instruction to find this position while standing up, prior to sitting down, before the soft tissue of the thigh expands and it is harder to find accurately could be helpful. The video was designed to be watched prior to attaching the monitors, but many participants tried attaching their monitor while watching the video, and wanted more time between each attachment step. Creating a longer video with instructions suited to this preference may work, with a shorter video available to watch prior to attaching the monitor.

A limitation of this study was recruitment through convenience sampling, which limits the generalisability of the results and compromises the external validity (Daniel, 2011). Although the sample included a diverse group in terms of age (19–72 years) and gender, the group was mostly highly educated, of professional/managerial occupation or studying, and of normal/underweight body weight. For other groups covered to a limited extent or not at all in the sample (low socioeconomic status, non-English speaking background and Aboriginal and Torres Strait Islander), the acceptability and cultural appropriateness of the materials, and their adequacy in helping participants accurately attach their monitors should be evaluated. The research conditions may have overstated the accuracy and the acceptability of the video in particular. Participants may be more inclined to ignore instructions without the researcher observing and participants may have been disinclined to say negative things about the video since the researcher who collected data was clearly identifiable as the actor in the video.

CONCLUSION

This study examined the accuracy and acceptability of self-attachment of the activPAL monitor using two instructional methods that might be used for mail out distribution: written instructions and written plus video instructions. The findings indicated that either of the instruction conditions were sufficient for self-attaching the monitor in what is broadly the correct orientation and position. However, more subtle placement errors were apparent that have an unknown impact on data quality that merits further investigation. The addition of the video instructions made placement more accurate and was desired by most participants. Hence, it is recommended that participants are provided with both the written materials and video instructions. Future studies using the activPAL could employ these methods to instruct initial self-attachment by participants, therefore providing wider reach and reducing costs in public health research, with photographic verification of correct device placement being advisable.

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Table 1: Participant characteristics (n=50)

Characteristic	n (%) or mean ±SD
Women	30 (60%)
Age (years)	35.04 ±14.13
Highest education competed	
Year 12 or less	8 (16%)
Trade/certificate/diploma	8 (16%)
University degree/postgraduate qualification	34 (68%)
Employment status	
Full-time	21 (42%)
Part-time/casual	9 (18%)
Studying	17 (34%)
No paid work or study	3 (6%)
Occupation	
Professional/managerial	17 (34%)
White collar/administrative	9 (18%)
Blue collar/ pink collar	3 (6%)
Not working/student	21 (42%)
Body mass index (kg/m^2)	23.75 ±2.74
% overweight/obese (BMI ≥25 kg/m^2)	19 (38%)
% English as first language	31 (62%)

Table 2: Vertical and horizontal placement of the activPAL according to written instruction only (WMO) and written and video instruction (WV).

	Vertical Error (cm above intended placement)		Horizontal Error (cm lateral to the intended placement)	
	WMO	WV	WMO	WV
Minimum, Maximum	-12.91, 0.30	-8.55, 1.65	0.12, 4.15	-0.38, 5.09
Mean difference ±SD	-5.15 ±2.75	-4.16 ±2.15	1.90 ±0.92	2.08 ±1.24
95% Limits of agreement	-10.55, 0.25	-8.37, 0.05	0.1, 3.7	0.34, 4.5
Absolute error (M±SD)	5.17 ±2.70	4.23 ±2.01	1.90 ±0.92	2.10 ±1.20

n=50; cm (centimetres), M (mean), SD (standard deviation)

Table 3: Differences between sociodemographic groups in absolute error for vertical and horizontal placement of activPAL when receiving written instruction only (WMO) and written and video instruction (WV).

		Vertical Error		Horizontal error	
		Mean difference (95% CI)	**p**	**Mean difference (95% CI)**	**p**
Women vs Men	WMO	-1.72 (-3.23, -0.21)	**0.026**	-0.14 (-0.67, 0.40)	0.614
	WV	-1.56 (-2.65, -0.47)	**0.006**	0.20 (-0.51, 0.90)	0.573
Age: <40 vs ≥40 years	WMO	-1.32 (-2.94, 0.31)	0.110	0.16 (-0.41, 0.72)	0.577
	WV	-0.23 (-1.47, 1.01)	0.714	0.40 (-0.34, 1.13)	0.284
Education: university vs not	WMO	-0.21 (-1.88, 1.46)	0.801	-0.39 (-0.94, 0.16)	0.162
	WV	-0.70 (-1.92, 0.52)	0.256	-0.12 (-0.86, 0.62)	0.750
BMI: overweight/obese vs normal/underweight	WMO	0.17 (-1.44, 1.77)	0.836	0.19 (-0.35, 0.73)	0.481
	WV	-0.69 (-1.86, 0.49)	0.245	0.20 (-0.91, 0.51)	0.575
Occupation: “office” vs other [a]	WMO	1.55 (-0.03, -3.13)	0.055	-0.03 (-0.59, 0.53)	0.916
	WV	0.74 (-0.47, 1.94)	0.225	0.14 (-0.59, 0.87)	0.694
First language: English vs not	WMO	0.56 (-1.04, 2.15)	0.484	0.10 (-0.44, 0.64)	0.712
	WV	0.37 (-0.82, 1.55)	0.539	-0.20 (-0.91, 0.52)	0.582

n=50, CI = confidence interval; estimates obtained as comparisons of marginal means from mixed models with participants’ data repeated across instructional conditions, main effects and interactions for demographic characteristics and instructional conditions.

[a] Professional/managerial, white collar/administrative versus blue/pink collar, not working/student

Table 4: Participant ratings of satisfaction (1 = very poor to 10 = very good) of the instructional methods (n=50)

	Mean ± SD	
	Written	Video
How easy it was to read (written) or understand (video)	8.52 ± 1.26	9.62 ± 0.67
The length of the written material/video	7.88 ± 1.93	9.36 ± 0.99
Was it sufficiently descriptive?	8.34 ± 1.44	9.50 ± 0.79

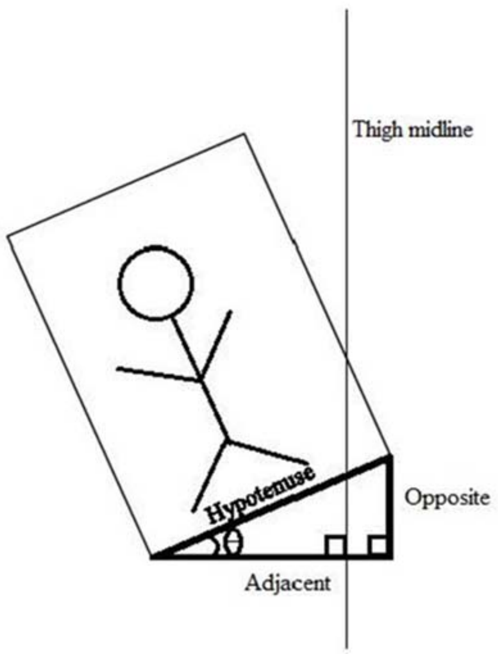

Figure 1. Calculation of angle of rotation.