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Visualization of Intensity Levels to Reduce the Gap between Self-reported and Directly Measured Physical Activity

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To the Manager of Review of Journal of Visualized Experiments

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November 21, 2018

Revision of a manuscript (JoVE58997)

Dear Nam Nguyen,

Thank you for giving us the opportunity to revise our manuscript “Visualization of Intensity Levels to Reduce the Gap between Self-reported and Directly Measured Physical Activity”. We appreciate the editorial team’s and reviewers’ valuable input and we hope that we have succeeded in addressing all comments.

I hope all figure files are in line with the guidelines for sufficient resolution. Please contact me if there is anything wrong with the figures format.

Kind regards,

Lisa Voigt

TITLE:

Visualization of Intensity Levels to Reduce the Gap between Self-Reported and Directly Measured Physical Activity

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KEYWORDS:

self-report, accelerometry, physical activity, validity, intensity levels, moderate-to-vigorous, physical activity questionnaire, video, bias, treadmill, exercise, behavior

SUMMARY:

This protocol describes a randomized controlled trial as a method to test the effect of a video demonstration on the intra-individual difference between self-reported and accelerometer-based moderate-to-vigorous physical activity.

ABSTRACT:

Physical activity (PA) assessment needs tools that are inexpensive and easy to administer. Common questionnaires inquire time spent in light, moderate, and vigorous PA. However, inaccuracies may occur due to individually different understanding of PA intensity levels. Alternatively used direct measures (e.g., accelerometers) are susceptible to reactivity bias and may lack the ability to capture certain activities. Compared to accelerometer measurement, respondents report more time spent in higher-intensity PA. A video that visualizes PA intensity levels might help to overcome this problem. This report describes the design of a randomized controlled trial as a methodology to investigate the effect of a video on the difference between

self-reported and directly measured PA. It is hypothesized that the video reduces the mean difference between the two measures. Individuals from the general population are recruited. Hip-worn accelerometers are used to collect directly measured PA data on seven consecutive days. Afterwards, participants are randomly allocated to the experimental and the control group. The experimental group receives a video demonstration on PA intensity levels and subsequent PA assessment via self-administered computer-assisted questionnaire. The control group receives PA assessment only. Thereafter, the data are processed to compare the difference between self-reported and accelerometer-based moderate-to-vigorous physical activity (MVPA) between the study groups using a two-sample t-test. This methodology is appropriate for investigating the effect of any existing or self-produced video on the difference between the two measurement methods. It can be used not only for persons from the general population, but for a variety of other populations and contexts as accurate measures are needed to evaluate PA levels.

INTRODUCTION:

Assessment of physical activity (PA) is commonly done by questionnaires because they are inexpensive and easy to administer. As positive associations between amounts of higher-intensity PA and cardiovascular health are well established[1-3], many questionnaires inquire frequency and time spent in light, moderate, and vigorous PA presenting examples of respective activities[4-8]. However, they may be flawed by inaccuracy due to individually different understanding of PA intensity levels[9]. Further, specific activity examples may not hold true for individuals with different physical constitutions. For example, overweight or obese persons may feel more exerted than persons with normal weight when performing the exact same activity. Direct measures on the other hand (e.g., accelerometry) require considerable amounts of time and costs and possess limited validity due to reactivity bias[10,11], sample selection bias[12], and the lack of ability to accurately capture certain activities[13]. A broad range of studies showed only low to moderate agreements between self-reported and accelerometer-based PA[14-16]. Most findings indicate that respondents report more time spent in higher-intensity PA compared to directly measured data. Throughout the manuscript, the term “gap” is used to designate this lack of agreement between accelerometry and self-reported PA.

A video as part of a computer-assisted self-completed questionnaire might help to reconcile the two measures by increasing the accuracy of self-reports. A video demonstration provides an opportunity to show different intensity levels of PA that are hard to explain by text only. Respondents receive a visual reference they may compare their performance levels with and thus, misclassification of light, moderate, and vigorous PA may be reduced. Up to now, videos to support assessments are available in the context of mobility and physical functioning validated for older adults[17-19]. To our knowledge, there are no video-supported assessments that provide a reference for light, moderate, and vigorous PA.

We developed a 3-minute video showing a middle-aged man on a treadmill in a fitness center who describes the terms light, moderate, and vigorous PA and simultaneously visualizes symptoms related to these intensity levels. The methodology described here is a randomized controlled trial to test the effect of the video demonstration on the gap between self-reported

and accelerometer-based moderate-to-vigorous physical activity (MVPA). In addition, standardized assessment of somatometry (height, body weight, and waist and hip circumference) is conducted to investigate whether effects differ according to participants' physical constitution.

The methodology is appropriate to test the effect of any video demonstration that is meant to support computer-assisted PA questionnaire assessment with the aim of reducing the gap between self-reported and directly measured PA. The methodology can be used in various populations and contexts as accurate measures are needed to evaluate current and changing PA levels, efficacy of PA interventions, and associations between PA and health outcomes.

PROTOCOL:

This protocol was approved by the ethics committee of the University Medicine Greifswald (number BB 076/18; June 2018).

1. Video construction and experimental design

1.1. Select a publicly available or self-produced video based on the specific experimental question. The video should explain the terms used in the self-report questionnaire to support participants' understanding. The video used here contains explaining and visualizing symptoms as well as naming examples of light, moderate, and vigorous PA.

1.1.1. In the video, have a person on a treadmill in a fitness center give a general introduction to the different intensity levels of PA.

1.1.2 Have the person explain differences in heart rate, breathing frequency, and capability to talk normally in accordance with the intensity levels. Have the person simultaneously demonstrate those symptoms while walking/running on a treadmill at the according pace.

1.1.3 Have the person give examples of daily-life activities and emphasize individual differences in the evaluation of PA intensity levels.

NOTE: The video used here was produced in the German language based on a video clip from the Centers for Disease Control and Prevention (CDC)[20]. If participants are native English speakers, the original video may be used with emphasis on minutes 1:46 to 3:25. The person in the present video is an approximately fifty-year-old, normal-weight, white male in good physical shape. See **Figure 1** for a visual depiction of video structure and contents.

1.2 Integrate the video into a self-administered tablet-computer survey to be presented directly before the PA questionnaire and make sure participants cannot skip the video. Randomize presentation of the video 1:1.

1.2.1 Integrate questions on sociodemographic and health related variables into the survey as desired for description of sample characteristics.

1.2.2 In the present study, assess self-reported PA using a modified version of the International Physical Activity Questionnaire Short Form (IPAQ-SF)[4], German version[21], addressing the last seven days. Two items each address number of days and respective time spent in moderate and vigorous PA. The original items on walking are replaced with questions on light PA as walking may be performed on different intensity levels[22] and walking is not equivalent to light PA measured by accelerometry. Sociodemographic and health variables included in the survey are sex, age, school education, employment, current living together with a partner, current smoking, and self-rated general health.

[Place **Figure 1** here]

2. Power calculation

2.1 Conduct a power analysis using respective software in order to define the sample size necessary to obtain statistically conclusive results. Include an interim analysis to verify underlying assumptions and early stopping of the study.

2.1.1 Choose a statistical test appropriate for the research question.

2.1.2 Based on the literature, set the assumed mean difference between questionnaire and accelerometer data in the control group, that is, the divergence between self-reported and directly measured PA without presentation of the video.

2.1.3 Set the assumed mean difference between questionnaire and accelerometer data in the experimental group, that is, the divergence between self-reported and directly measured PA with inclusion of the video demonstration.

2.1.4 Set the assumed standard deviation (SD) for both groups.

2.1.5 Choose power and alpha-level as desired.

2.2 Based on the literature and considering the specific study design, decide on an assumed drop-out rate to retrieve the final number of participants to be recruited.

2.3 Base the power analysis of the present study on a two-sample t-test assuming equal variance. Based on a comparable sample[10], the assumed mean difference between questionnaire and accelerometer data in the control group is 90 min per day of MVPA. The assumed mean difference in the experimental group is 60 min per day (*SD* in both groups = 100 min per day). As it is hypothesized that the integration of the video reduces the gap between the two measures, a one-sided significance level of $p = .05$ is chosen (power = .80). Results of power calculation including interim analysis revealed that a total number of 314 participants is

needed for demonstrating the experimental effect. Assuming a drop-out rate of about 10%, it is planned to recruit 350 participants (**Figure 2**).

[Place **Figure 2** here]

3. Participant recruitment and preparation for data collection

3.1 Choose a recruitment setting that permits enough time to hand out the accelerometer and to prepare it for data collection (e.g., in a shopping mall or at the workplace) in order to keep efforts of participants low and to increase adherence to the study.

3.1.1 Recruit participants who have the ability to walk independently (e.g., no permanent use of a wheelchair) and who are physically and cognitively capable of completing a self-report questionnaire. Be sure to recruit a similar number of male and female participants of all ages within the desired age range.

3.1.2 As an incentive for participation, point out that participants are going to receive a feedback letter on directly measured PA and sedentary time after completing the study. Use monetary incentives as desired.

3.1.3 Obtain written informed consent from each person prior to their participation.

3.2 For objective measurement, use a three-axial accelerometer to be worn on the right hip. Alternative devices can be used but should have the memory capacity for data collection on seven consecutive days. In order to most accurately capture daily PA, follow the instructions of the specific device used.

3.2.1 Have accelerometers prepared with elastic belts of various sizes and select one that fits the participant comfortably.

3.2.2 Give adequate information on how to handle the accelerometer according to instructions provided by the producer of the device. Instruct participants to start wearing the device on the next day. Ensure that participants wear the device during waking hours (i.e., every day after getting up until going to sleep).

3.2.3 Initialize the accelerometer on a computer using the appropriate software. Make sure to set up the wearing period correctly. Select a sampling rate of 30 Hz[23]. If applicable, choose to fill in participant specific information as desired (e.g., body weight or date of birth for reasons of participant identification).

3.2.4 Schedule each participant for an assessment session to obtain self-reported PA and somatometry. Ensure this session takes place one day after the last accelerometer wearing day. Hence, accelerometer and questionnaire data refer to the same period of time. If this is not possible for reasons of time, admit a maximum delay of two days.

3.2.5 Dismiss the participant with encouragement to engage in normal daily activities and make sure the participant remembers to return the accelerometer when appearing for the session.

NOTE: This study is conducted in Greifswald, a city in Western Pomerania, a rural area in Northeastern Germany. Persons from the general population aged between 40 and 75 years are recruited proactively at a shopping mall. Accelerometer feedback letters and shopping vouchers in the amount of 10 euros are used as incentives. Participants are instructed to wear the device for seven consecutive days and to remove it for any water-based activities (e.g., showering or swimming).

4. Participant assessment session

NOTE: Conduct this session within three days after the last accelerometer wearing day.

4.1 Collect the accelerometer from the participant.

4.2 Set up a new participant in the tablet-computer survey and type in the individual study identification number of the participant.

4.3 Hand over the tablet computer to the participant to answer the self-administrative questionnaire.

4.4 When the participant has completed the questionnaire, collect the tablet computer and continue with measurement of somatometry.

4.4.1 Ask the participant to take off their shoes and to stand on calibrated scales for measurement of body weight. Type in the result into the tablet computer.

4.4.2 Ask the participant to stand straight in front of a mirror with toes at a mark on the ground for measurement of body height. Type in the result into the tablet computer.

4.4.3 Ask the participant to remove upper layers of clothing for measurement of waist and hip circumference. Measure waist circumference midway between lowest rib and iliac crest. Measure hip circumference about two inches below iliac crest. Use the mirror to check accurate position of the tape. Type in the results into the tablet computer.

4.5 Thank and dismiss the participant.

5. Download of accelerometer data for processing and creation of feedback letters

5.1 Download the data from the device using the appropriate software.

5.1.1 Select to use data from the vertical axis and choose an epoch length of 10 s.

5.1.2 Export the data to an appropriate program for further processing. According to the output metric used, choose cut points to determine non-wear time and to differentiate between PA intensity levels[24,25].

5.1.2.1 Define non-wear time as at least 60 min of consecutive zero counts, allowing for ≤2 min of counts between 0 and 100[24].

5.1.2.2 In an adult sample (ages 18 or older), classify values <100 counts per min as sedentary time, values between 100 and 2019 counts per min as light PA, values between 2020 and 5998 as moderate PA and values of 5999 or more counts per min as vigorous PA[24].

5.2 Import all relevant variables into a computer program appropriate for creating a computerized feedback letter using an algorithm to automatically integrate the individual data into a general template. The letter may contain a number of graphs visualizing accelerometer-based PA outcomes as well as sedentary time as desired. Have each graph accompanied by a paragraph of four to five sentences explaining the content of the figures and providing respective health recommendations.

5.3 Deliver the feedback letter as soon as possible after the participant completed the study.

NOTE: Accelerometer feedback letters in the present study include three graphs. The first graph visualizes daily steps across the wearing period. The second graph shows amounts of time spent sedentary and in light, moderate, and vigorous PA on each wearing day. The third graph depicts all observed 10-min-bouts of sedentary time between 6 and 10 pm exemplified on a weekday and on a weekend day. Recommendations on PA are presented according to the PA guidelines of the World Health Organization for apparently healthy adults[2]. Recommendations on sedentary breaks are presented based on relevant studies[26-28].

6 Statistical analysis

6.1 Calculate descriptive statistics for all variables.

6.2 Define a cut-off value for daily accelerometer wear time to avoid bias in accelerometer data.

6.3 Create a variable that presents the gap between the two measures. Calculate the variable as self-reported minus accelerometer-derived min of moderate-to-vigorous PA which results in a difference score (delta, Δ). Use a two-sample t-test to determine the difference of deltas between experimental and control group.

6.4 Create a graph to visualize the results of the main analysis as desired.

REPRESENTATIVE RESULTS:

The methods detailed above describe a randomized controlled trial to test whether a video demonstration of PA intensity levels reduces the gap between self-reported and accelerometer-based MVPA. An interim analysis (n = 157) was planned to evaluate whether the estimated sample size of 314 participants is sufficient to test our hypothesis. Up to this point, 142 participants completed the study protocol. Participants who were too old (n = 1) or who did not wear the accelerometer for ≥10 hours per day on ≥6 days (n = 10) were excluded from the analysis. Thus, data analysis was carried out using a sample of 131 participants to give an example of representative results among individuals from the general population aged between 40 and 75 years.

Table 1 presents descriptive statistics of the analysis sample (n = 131). Of this sample, 68 participants (52%) were randomized to the experimental group and 63 participants (48%) were randomized to the control group. The experimental group received a video demonstration before completing the PA questionnaire, whereas the control group received PA assessment only. It was hypothesized that the video demonstration reduces the gap between self-reported and accelerometer-based PA. Preliminary results of interim analysis revealed a lower formal mean difference in the video group (M = 21.8, SD = 108.9) compared to controls (M = 41.0, SD = 117.4, $t(129) = 0.97$, $p = .166$, **Figure 3**). The p-value lies between the significance ($p < 0.010$) and futility ($p > 0.269$) boundaries of the test simulations. Thus, the study may continue as planned until the total sample size is reached.

[Place **Table 1** here]

[Place **Figure 3** here]

[Place **Figure 4A** and **Figure 4B** here, in one row, if possible]

FIGURE AND TABLE LEGENDS:

Figure 1: Schematic structure of the video demonstration of different physical activity intensity levels. The main scenes of the video with according single shots, lengths, and summary of contents are depicted. The video was based on a video clip provided by the CDC[20].

Figure 2: Schematic depiction of the calculated participation flow. *n* = number of participants. All n refer to results of the power calculation.

Figure 3: Mean difference between self-reported and accelerometer-based moderate-to-vigorous physical activity compared between study groups. *Δ* = delta. *MVPA* = moderate-to-vigorous physical activity. *min/day* = minutes per day. The mean differences with according 95% confidence intervals of the control group (grey square) and the video group (blue diamond) are depicted. Mean differences were calculated as self-reported minus accelerometer-derived min of MVPA. The data refer to preliminary results of interim analysis (n = 131).

Figure 4: Bland Altman plots for visual depiction of the difference between self-reported and accelerometer-based moderate-to-vigorous physical activity in the control group (A) and in the video group (B). *MVPA* = moderate-to-vigorous physical activity. *min/day* = minutes per day. *SD* = standard deviation. Differences were calculated as self-reported minus accelerometer-derived min of MVPA. A perfect agreement between the measures would be present if all dots lied on a horizontal line at the value 0 of the y-axis (red line). The data refer to preliminary results of interim analysis (n = 131).

Table 1: Sample characteristics of participants included in the preliminary interim analysis. *N* = number of participants. *MVPA* = moderate-to-vigorous physical activity. Data are presented as mean ± standard deviation for continuous variables and as the number of participants (%) for categorical variables. Body mass index was calculated from objectively measured height and body weight at the participant assessment session. Self-reported general health was measured on a 5-point scale from 1 “very good” to 5 “very bad”. Self-reported and accelerometer-based MVPA as well as accelerometer wear time refer to average minutes per day across seven days.

DISCUSSION:

This report describes a methodology for testing the effect of a video demonstration on the gap between self-reported and accelerometer-based PA. If self-report assessment is preceded by a video demonstration of PA intensity levels, over-reporting of MVPA might be reduced. This protocol can be used to test the effect of any existing or self-produced information video on the gap between self-reported PA data derived from a computer-assisted assessment and directly measured PA.

The most important steps in the protocol include fundamental aspects of trial conduction that ensure the receipt of accurate data, such as correct accelerometer initialization and data download or making sure that the video may not be skipped by respondents. Further, there are more specific issues about the accelerometer wearing period and the daily wear time. First, the accelerometer wearing period and self-reported data should refer to the same time frame. To hand out accelerometers and agree on the date of the assessment session immediately after recruitment seems helpful to ensure participants’ adherence to the scheduled appointment. Second, participants may not always comply with the instructions for accelerometer wearing. The device may be worn for less than seven days and/or only a few hours per day, whereas subsequent self-reports refer to the complete wearing period. Thus, over-reporting of MVPA may be bound to occur. Moreover, if wear time substantially differs between study groups, results may be compromised due to biased accelerometer-based MVPA data. Inspection of interim descriptive statistics may uncover insufficient amounts of wear time. For example, among the participants who completed the study protocol (n = 142), only 115 participants wore the device at least 10 hours on each of the seven days. There were three participants with a wear time of 0 minutes on one or more days. Excluding outliers seems necessary to ensure that the data are representative for an entire day as well as the total assessment period. Although most studies on correlations between accelerometry and PA questionnaire data request a wear time of ≥10 hours per day on ≥4 days per week[29], investigations on the gap between measures

may require more conservative cut-off values. Thus, we decided to exclude participants from the analysis who did not wear the accelerometer for ≥10 hours per day on ≥6 days.

Further modifications of the protocol may be appropriate. Preliminary results of descriptive statistics shown in **Table 1** indicate an unbalanced proportion of men and women in our total sample and between study groups. If the video affects self-reports differentially in men and women, overall video effects may be biased. Thus, basic variables (e.g., sex and age) may need to be considered in the randomization algorithm. Moreover, the main analysis model may need to include sociodemographic and health related variables as potential confounders using a linear regression model instead of a t-test.

The methodology described here aims at reducing the gap between self-reported and accelerometer-derived PA by using a video to address comprehension of PA intensity levels. However, specific characteristics inherent to each measure remain to affect this gap. First, self-reported PA data is susceptible to recall bias[30] and may be affected by social desirability bias[31,32]. Second, bias in accelerometer data particularly origins in different motivation to wear the device. Third, hip-worn accelerometers may lack the ability to accurately capture cycling and swimming[13]. Finally, accelerometers capture absolute amounts of movement whereas self-reports account for relative physical exertion[33-35]. Considering these factors, the visualization of intensity levels may present only one of many options to reduce the gap between the measures.

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DISCLOSURES:

The authors have nothing to disclose.

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Figure 4A

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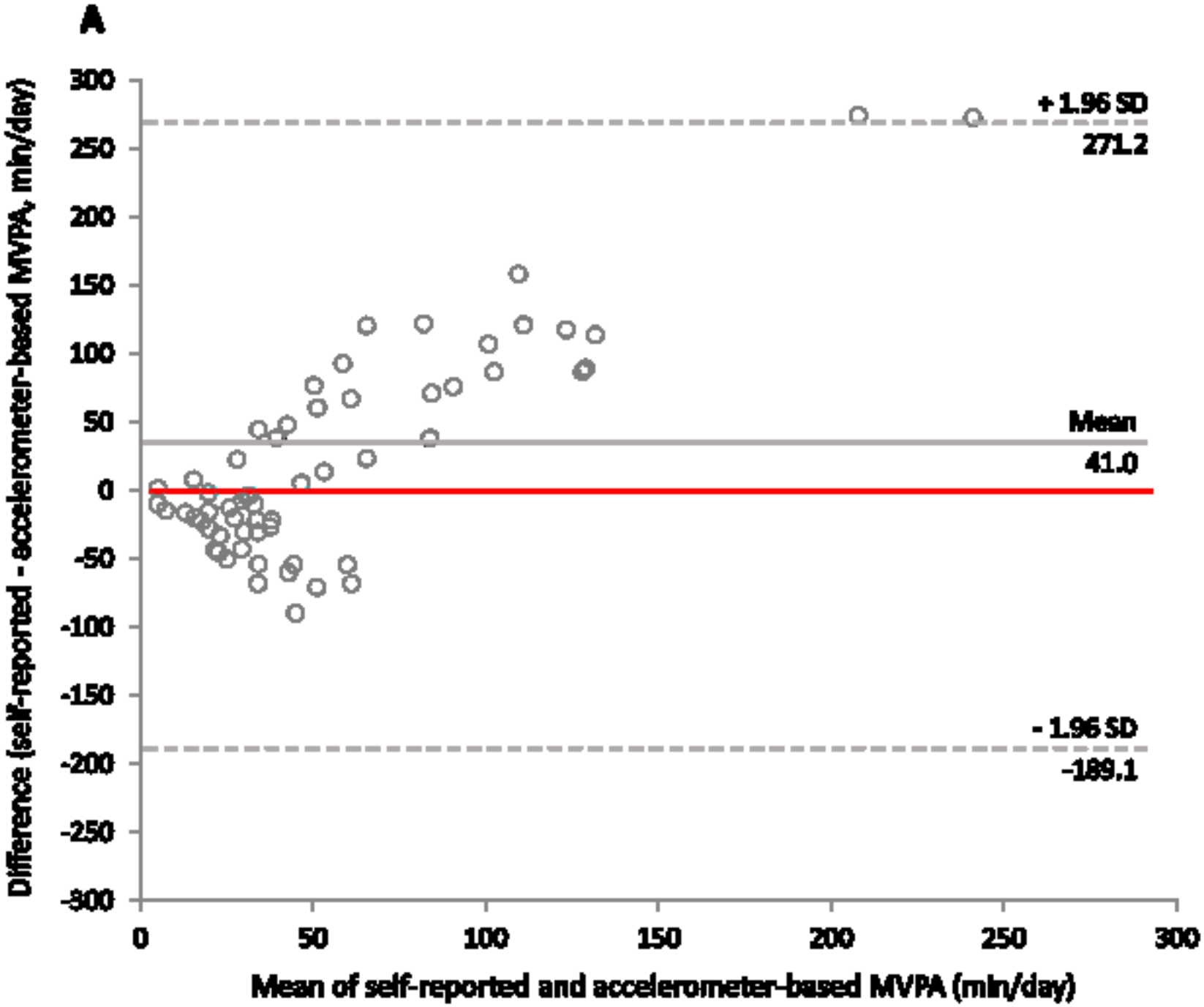

Figure 4B

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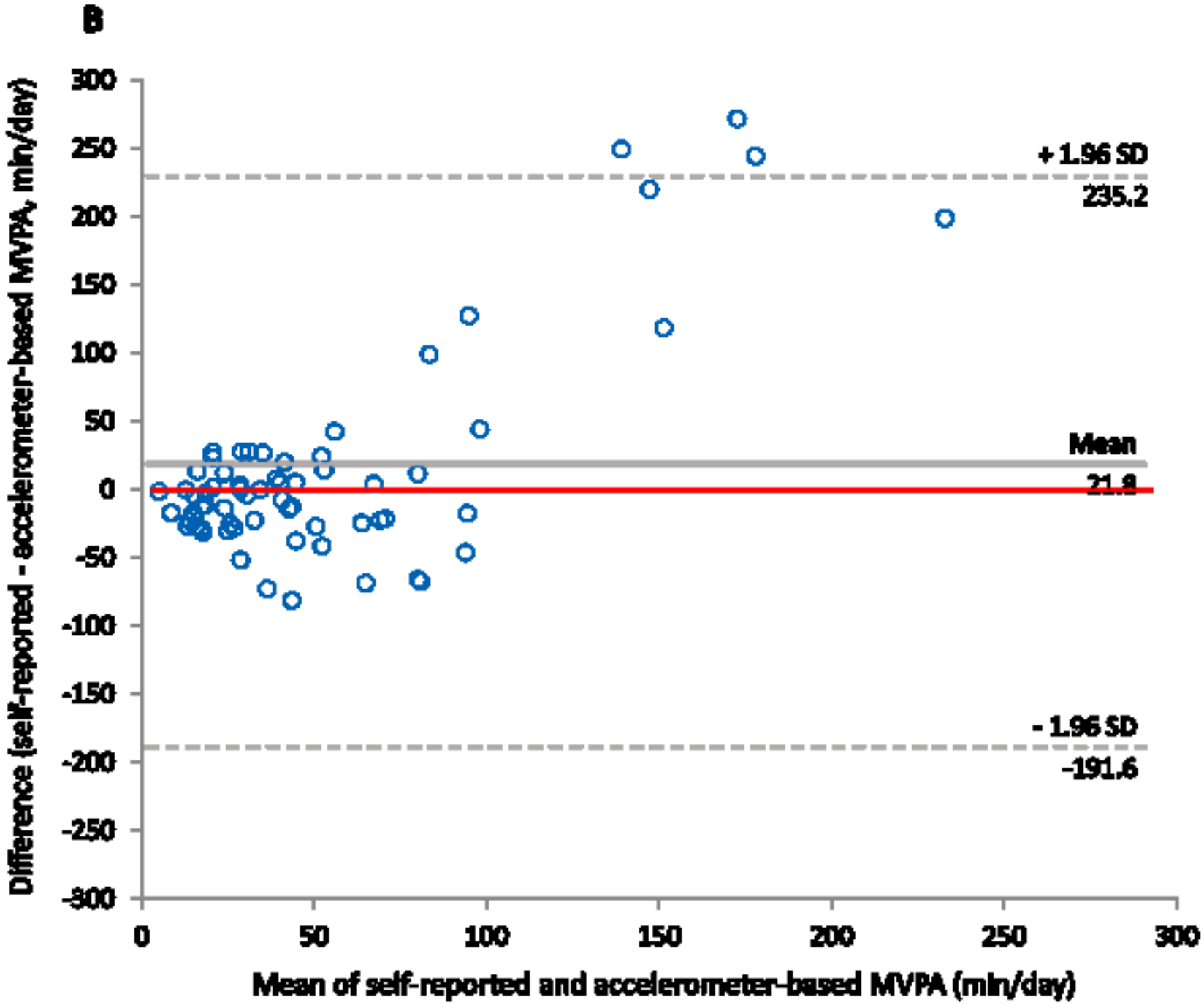

Figure 1


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Figure 2


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Figure 3


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Table

	Total Sample	Control group	Video group
N	131	63 (48%)	68 (52%)
Sex, women	85 (65%)	46 (73%)	39 (57%)
Age, years	60.1 ± 8.9	58.1 ± 9.6	61.9 ± 7.9
Current living together with a partner, yes	102 (78%)	51 (81%)	51 (75%)
School education			
< 10 years	20 (16%)	12 (19%)	8 (12%)
10 years	64 (50%)	27 (44%)	37 (56%)
> 10 years	44 (34%)	23 (37%)	21 (32%)
Not specified (n = 3)			
Employment			
Full-time or part-time	55 (42%)	33 (52%)	22 (32%)
Irregularely	23 (18%)	8 (13%)	15 (22%)
Not employed or retired	53 (40%)	22 (35%)	31 (46%)
Current smoker, yes	22 (17%)	12 (19%)	10 (15%)
Body mass index			
< 25 kg/m^2	34 (26%)	23 (37%)	11 (16%)
≥ 25 kg/m^2 and < 30 kg/m^2	55 (42%)	22 (35%)	33 (49%)
≥ 30 kg/m^2	42 (32)	18 (29%)	24 (35%)
Self-reported general health	2.8 ± 0.7	2.8 ± 0.8	2.8 ± 0.6
Accelerometer wear time, min/day	883.0 ± 82.8	896.1 ± 74.4	870.8 ± 88.7
Accelerometer-based MVPA, min/day	45.2 ± 27.7	44.1 ± 24.3	46.2 ± 30.7
Self-reported MVPA, min/day	77.2 ± 117.2	85.2 ± 119.0	68.0 ± 115.8

Name of Material/ Equipment	Company	Catalog Number	Comments/Description
Accelorometers	ActiGraph, LLC	ActiGraph Model GT3X+	This is the most common device on the market. Similar products are available from other vendors.
Access Software	Microsoft		The software ist used for creation of computerized feedback letters.
Actilife Software	ActiGraph, LLC		Software to prepare, initialize, download, and processing of data collected by the accelerometers.
Belts	ActiGraph, LLC	Elastic Belt	Elastic bands for accelerometer wearing on the hip.
Computational software	StataCorp		The software Stata ist used for statistical analysis.
Digital scales (height)	ADE GmbH & Co.	MZ 10020	The scales are used for measurement for body height.
Digital scales (weight)	Soehnle Industrial solutions GmbH	SOEHNLE 7720	The scales are used for measurement for body weight.
Excel Software	Microsoft		The software ist used for calculations on accelerometer-based data.
PASS Sample Size Software	NCSS	PASS Sample Size 16	The software is used for power calculations.
Tablet	Apple Inc.	iPad MC769FD/A	The tablet comupter ist used for the self-administered assessment.
USB cable	ActiGraph, LLC	USB cable	USB cable for device communication and charging of accelerometers.

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Title of Article:	Visualization of Intensity Levels to Reduce the Gap between Self-reported and Directly Measured Physical Activity
Author(s):	Lisa Voigt, Antje Ullrich, Ulrike Siewert-Markus, Marcus Dörr, Ulrich John, Sabina Ulbricht

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Signature:	
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We have carefully read and considered both the editors' and reviewers' comments. Below, please find our detailed answers to each comment. We revised the manuscript to be in line with all modifications. All modifications and revised sections are highlighted in green in the original manuscript.

EDITORS		AUTHORS
EDITORIAL COMMENTS		
01.	Changes to be made by the Author(s): 1. Please take this opportunity to thoroughly proofread the manuscript to ensure that there are no spelling or grammar issues. The JoVE editor will not copy-edit your manuscript and any errors in the submitted revision may be present in the published version.	We thank the editorial team for this advice. We proofread the manuscript and revised spelling and grammar to our best knowledge.
REVIEWER #1		**AUTHORS**
MAJOR CONCERNS		
01.	Are the title and abstract appropriate for this methods article? Yes. Although the term "gap" is used throughout the paper without providing an operational definition or even a reference to delta (besides in the figure)	Thank you for this comment. We agree and, thus, rephrased sections in the Summary (Line 33) and in the Abstract (Lines 44, 51, 54). Also, we added a sentence to the Introduction to clarify the meaning of "gap" (Line 73) and to the Statistical Analysis section to specify the definition and to refer to delta (Line 302, 350).

02.	Are there any other potential applications for the method/protocol the authors could discuss? This hard to agree with based on their research design and non-significant findings.	Thank you for indicating this issue. We agree with the statement, that it is hard to suggest other applications of the presented method/protocol, mostly because it is the first study to investigate the effect of a video on the accuracy of self-reported moderate-to-vigorous physical activity and final results remain to be presented. However, as stated in Summary, Abstract, and Discussion the subject of our manuscript is the whole trial whereas the video as the specific intervention content may be replaceable. As protocol steps work as intended and lead to data eligible to answer the research question (independent of whether results are significant or not), we conclude that the trial's steps are reasonable.
03.	Do you think the steps listed in the procedure would lead to the described outcome? Yes. if powered correctly. The video addition to these procedures is interesting and warrants further investigation.	Thank you for this comment. This relates to our answer to comment number 02. We agree that further investigation is needed, also to provide reliable assumptions for a priori power analysis.
04.	Are any important steps missing from the procedure? The statistical analysis section is a bit thin. No mention of delta, or an a priori alpha (which leads to a wishy-washy result), what about effect size?	In line with JoVE's scope and manuscript guidelines, the subject of the manuscript is method and design with emphasis on how to apply all steps relevant to replication. We based our manuscript structure on examples and templates provided by JoVE's editorial team. Alpha as well as assumed deltas are presented in the Power Calculation section (page 4, Protocol section 2.3). The "wishy-washy" result (including deltas) refers to preliminary results of interim analysis as indicated throughout the manuscript. As agreed upon with JoVE's editorial team, preliminary results are sufficient to give readers an idea of how results may look like.
05.	Are the anticipated results reasonable, and if so, are they useful to readers? No. They lost power along the way which may have contributed to their lack of findings. I would try again. Across several clusters.	This relates to our answer to comment number 04. Results refer to preliminary interim analysis. As we understand JoVE's aims and scope, they are supposed to illustrate an example. Hypothesis testing is not the focus of the manuscript. Nevertheless, an analysis across several clusters surely is a

		good idea for future studies with respective sample sizes.
06.	Are any important references missing and are the included references useful? I believe the requisite referenced information in the decision making of several steps of the procedures requires attention.	We referenced all information that we found necessary for the reader to comprehend our decision. However, some aspects of study design are decisions to be made considering feasibility and effective trial conduction without being based on specific literature. If there are aspects that need to be referenced, please designate them specifically.
MINOR CONCERNS		
01.	Reference page needs attention. Caps for article titles? Inconsistent. Check throughout ref list.	Thank you for pointing this out. We revised the reference list accordingly (Line 497).
REVIEWER #2		**AUTHORS**
MAJOR CONCERNS		
01.	My main concern is why the authors present the results of the interim analysis instead of waiting for the final results.	Thank you for this comment. We agree that final results would have been more informative. However, in line with JoVE's scope and manuscript guidelines, the subject of the manuscript is method and design with emphasis on how to apply all steps relevant to replication. As we understand JoVE's aims and scope, hypothesis testing is not the focus of the manuscript. As agreed upon with JoVE's editorial team, preliminary results are sufficient to give readers an idea of how results may look like.

02.	Some other outcomes might be taken into account in additional analyses: the whole time of PA (including light PA); the proportion of moderate and vigorous PA.	Thank you for this advice. We agree that there are more outcomes worth to be investigated. We decided to focus on moderate-to-vigorous PA (MVPA) because this outcome is of main importance in the context of cardiovascular health (as indicated in the Introduction line 61). Nevertheless, light PA may be interesting to investigate because on the one hand individuals may overestimate it similar to how they overestimate MVPA. On the other hand they may have miss-classified light PA as moderate PA which could lead to lower light PA in the video group compared to controls. As JoVE manuscripts do not focus on outcome analyses, we decided to retain these ideas for future studies.
03.	I suggest the authors should discuss what the importance of more accurate self-reports of PA is. E.g., for purposes of confounder adjustment, correct ordinal information might be sufficient.	Thank you for this comment. In response, we added a sentence to the Introduction to point out research areas that may profit from higher accuracy (line 97).
MINOR CONCERNS		
01.	The power analysis cannot be changed any more but I am astonished that the authors assumed a gap of 90 minutes for the control group. I guess most people are far from having 90 minutes of MVPA, so a gap of 90 minutes is even more unlikely.	We thank the reviewer for pointing this out. As indicated in the manuscript (line 170), we based our assumptions on data of a comparable sample from a previous study of ours. Please see Baumann et al. *Scand J Med Sci Sports.* 2018;28:1056‐1063 for information on sample and study context. Accelerometry-derived MVPA per day is very similar in both studies. The gap we found in the previous study amounted to 90 minutes per day which appears to be very much. But from our experience, the IPAQ is not the most user-friendly questionnaire. The item format makes it hard for respondents to accurately assess their PA. Apart from the difficulty to remember daily activities during the last seven days they need to remember the exact days, count the days, judge the intensity of the activities, count the amounts of time

		per day being active before breaking it down to an average. However, we agree with the reviewer that our assumption of the gap in controls obviously was set too high as indicated by our preliminary results.
REVIEWER #3		**AUTHORS**
MAJOR CONCERNS		
01.	Line 145: I think that given you are assessing differences a Bland Altman plot should be used.	We thank the reviewer for this advice. We agree and, thus, added Bland Altman plots for both control group and video group to the Results section.
02.	Line 131: Why use the IPAQ? It may be useful to employ a questionnaire that records the types of activity given the evidence of accelerometers' inability to capture certain types of data (e.g., resistance training, inclined walking/running, swimming, biking, etc.)	Thank you for pointing this out. We chose the IPAQ because it is one of the most widely used PA questionnaires. Assessment of PA intensity levels seems inevitable in cardiovascular health research (as indicated in line 61). Thus, it seems reasonable to create strategies that might help to overcome limitations of the IPAQ. Our video is one approach to do this. Nevertheless, we agree with the reviewer that accelerometers may miss certain activities (as indicated in line 70) which adds to the gap (as discussed in line 411). Thus, comparing accelerometry with data derived from a questionnaire that records types of activity is an intriguing idea for future research.
MINOR CONCERNS		
01.	Line 86: Can you explain briefly the rationale for investigating whether effects differ according to participant's physical constitution? (please elaborate on the brief reference on line 66)	Thank you for this reasonable question. We are interested in results among overweight and obese persons because we assume that the numbers may be a little different compared to normal-weight persons. First, the gap among controls may be higher because they should be more exerted performing PA

		(and report this correctly in the questionnaire), whereas, to our knowledge, accelerometer counts do not account for relative exertion, thus, accelerometers may under-estimate PA intensity among overweight and obese persons. Second, the video may affect responses differently as obese persons may not identify with the model and his performance. We added a sentence in the manuscript to elaborate this issue a little more (line 66).
02.	Line 111: I agree these are important cues. What is the reason for highlighting these specific cues for intensity. Other cues may include mental focus, sweating (in some populations), how muscles feel, temperature.	We agree with the reviewer that there are more cues for intensity than those we addressed, such as those mentioned by the reviewer. We decided to address heart rate, breathing, and ability to talk because they are easy to understand and salient to individuals during their performance. In the attempt to “keep it simple” for respondents, we decided to keep the amount of cues to a minimum.
03.	Line 113: Using the treadmill is a nice way of depicting intensity in a controlled environment. However, it's possible that accurately identifying intensity is more difficult in other activities such as strength training, intermittent sport. Perhaps other activity intensity examples may be appropriate or at least mentioned.	We agree with the reviewer that the treadmill in a fitness center is a controlled environment and also may be a bit artificial. We decided to use this environment mainly for financial reasons. Shooting a video in more than one setting would have multiplied production costs. To accurately identify intensities of activities other than running absolutely would be more difficult. The problem with specific activity examples remains that the same activity may be moderate for one person whereas for another it may be vigorous. However, we mentioned other activity examples in the video as depicted in Figure 1.
04.	Line 200: How do you ensure the participant wears the device during all waking hours? Are prompts sent? When analyzing the data is a minimum wear time cut-off used- be specific (I see that now in your discussion line 373, please move to methods)?	Thank you for indicating this important issue. We pointed out the importance of wear time towards participants during recruitment but we did not send prompts. We agree that a cut-off should be applied in the analysis. Thus, we added step 6.2 to the Statistical Analysis section, line 299 and adjusted the results in line with the adjusted analysis sample (lines 314, 320, 326, 327, 351, 395 as well as Table 1 and Figure 3. However, since a cut-off value

		should be chosen depending on the specific research question, we decided to additionally keep the discussion of this issue in the original section (line 383-396).
05.	Line 262: Why vertical axis and not vector magnitude?	Thank you for pointing this out. We agree that using vector magnitude may be appropriate but we wanted to stay in line with previous publications for reasons of comparability. Nevertheless, we are thankful for the advice and are going to consider using vector magnitude in future analysis.
06.	Line 271: Please specify the population this is specific to, this would vary depending on level of mobility, age, etc.	We agree and revised this section accordingly (line 273).
REVIEWER'S COMMENTS FROM ATTACHED PDF		**AUTHORS**
	In addition to the comments listed directly in the email, we also received a pdf with further comments. This person stated: "I am not sure if I am the best person to review this paper. I am unfamiliar with the formatting of this paper. I have never reviewed a non-traditional journal article like this read my review through this lens. If presenting your data like this is typical for this journal then please take or leave any of my irrelevant comments." Considering some comments' lack of application to JoVE's specific journal format we agree with this statement. Thus, we did not take comments into account we believe to be irrelevant but indicated "**not applicable**" instead.	
01.	Line 52: I would place the hypothesis before the method sentences.	Thank you for this advice. We agree and moved the hypothesis (line 45).
02.	Line 55: Did you measure this? Then be more humble	This statement refers to our believe that a randomized controlled trial to test the effect of a video the way it is described in the manuscript should be applicable for other populations and contexts.
03.	Line 71: Could add our work here.	We believe the authors are blinded to reviewers' names.

04.	Line 72: That is a big jump between sentences. No justiifcation as to why?	The reasons behind that are explained subsequently. The sentence was supposed to build a junction to the next section. We agree that this might appear a bit abrupt. Thus, we moved the sentence to the next section (line 76)
05.	Line 82: Why is this the target population?	In this sentence we describe the person in the video. We aimed at showing a person that is similar to our target group. We indicate the target group in section 3.3.
06.	Line 91: Says who? Place this after the results, if warranted.	**not applicable** (We structured the manuscript to our best knowledge of JoVE's manuscript format and respective author instructions. As we did not receive editorial comments on moving contents to other sections of the manuscript we decided to adhere to the current version.)
07.	Line 93: This sentence too. Why here? Unjustified.	**not applicable** (We structured the manuscript to our best knowledge of JoVE's manuscript format and respective author instructions. As we did not receive editorial comments on moving contents to other sections of the manuscript we decided to adhere to the current version.)
08.	Line 96: I am unfamiliar with this type of method presentation. Perhaps you need a reviewer more familiar with this journal.	**not applicable**
09.	Line 121: What do these subjective clarifiers mean?	The person that is shown in the video is described so readers may get an idea of the video content and which cues may have been salient to participants.
10.	Line 148: refs?	**not applicable** (Researchers who apply our method may do this among other population samples or in other study contexts than ours. Appropriate assumptions on mean differences in controls and intervention group are not fixed but need to be made according to the target population. The literature

		we based our specific assumptions on, is cited in section 2.3, line 170).
11.	Line 182: One word	Thank you for this advice. We corrected spelling as suggested.
12.	Line 213: Do you need references for all of this decision making? I think so.	**not applicable**
13.	Line 297: I would discuss delta here.	We agree. Revised as described in our answer to comment number 1 of reviewer #1.
14.	Line 298: alpha? effect size?	Revised as described in our answer to comment number 4 of reviewer #1.
15.	Line 313: Why only half? Do you disentangle this in the results? Why report on the other half?	In the manuscript, results of an interim analysis of a randomized controlled trial to test the effect of a video are presented. Thus, there is one group that received the video and one group that did not receive the video. Descriptives of both groups are reported. However, as our phrasing appears to be difficult to understand, we revised this section (line 320).
16.	Line 316: T value? Not significant. Call it like it is.	We thank the reviewer for this comment. As stated throughout the manuscript, we presented preliminary results of an interim analysis. To our best knowledge, our phrasing is appropriate to report results of an interim analysis. The presented results do not refer to hypotheses testing but to verification of early stopping of the study. Apart from that, we added the t-value to the manuscript (line 327).
17.	Line 336: These formulae could be better defined in the method section.	**not applicable** (According to JoVE's format we believe that the method section, i.e. protocol, would not be the right place for this information.)
18.	Line 344: Again. Why are you introducing these concepts in the figure legends and not the method/results text?	**not applicable** (We structured the manuscript to our best knowledge of JoVE's manuscript format and respective author instructions. As we did not receive editorial comments on moving contents to other sections of the

	I am not sure if I am the best person to review this paper. I am unfamiliar with the formatting of this paper. I have never reviewed a non-traditional journal article like this read my review through this lens. If presenting your data like this is typical for this journal then please take or leave any of my irrelevant comments.	manuscript we decided to adhere to the current version.)
19.	Line 364: Cant you just take a ratio if this occurs?	Thank you for this comment. To our knowledge, it is common practice to use cut-off values for accelerometer wear time. However, using a ratio is an interesting idea we are going to consider in our main analysis.
20.	Line 369: Your numbers are getting lower and lower, have you thought this may be the reason you did not reach significance?	Thank you for this comment. As stated above, we presented preliminary results of an interim analysis (n=131) as agreed upon with JoVE's editorial team. Our results did not reach significance because they refer to an interim analysis. Apart from that, participants' adherence to accelerometer wear time surely is an issue when investigating differences between self-reports and accelerometry data. Thus, we are discussing this in the manuscript.
21.	Line 378: Can you relate any of your suggestions to previous literature? Surely you are not the first researchers to make these suggestions.	We believe our suggestions refer to basic statistical knowledge, such as considering adjustment. for potential confounders, which is why we did not present references.
22.	Line 384: Which you did not accomplish? Where is your acceptance of the null hypothesis explanation?	**not applicable** (see above comments and remarks)
23.	Line 392: This paragraph is just a re-iteration of the introduction with no explanation of the findings, relation to literature, or practical application of the null findings. My advice....conduct the full study and report those	**not applicable** (see above comments and remarks)

	results. This paper does not add to the literature. Maybe once, you have found significant improvement in your video model, will others attempt to replicate your method for other populations.	
24.	Line 474: Caps for article titles? Inconsistent. Check throughout ref list.	Thank you for pointing this out. We revised the reference accordingly.