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Moved to action? Gender differences in perceived effort and motor performance after video-based achievement motive arousal

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ABSTRACT

Achievement incentives in sports are assumed to trigger achievement motivation, which in turn increases performance. We used a within-subject-design to test achievement motive arousal (using an A-B-A design) using video clips. We hypothesized that an ACH-video clip arouses the achievement motive (PSE) stronger, leads to better performance in a skipping task and elicits stronger perceived effort and commitment for the task than the NEUTRAL- and NO-video conditions. We investigated gender differences. 184 students (92 women, age: M 27.66 years, SD 9.72) participated in a three-part web-survey. Neither main nor interaction effects of Video-Condition and Gender were found on motive arousal and skipping frequency. Significant interaction effects on skipping slope and perceived effort, however, showed that women are more engaged after the ACH-video than after the NEUTRAL-video and NO-video and here even outperformed men. Results are discussed in terms of why external "motivators" (e.g., videos) affect men and women differently.

Numerous screens in fitness studios show video clips with successful sportsmen and sportswomen who perform at their best showing strong emotional expressions of pride and joy about their performance. These videos are expected to motivate people for sport and to increase their will to perform well. But are these video clips really motivating in the strict scientific sense (achievement motive theory)? The main objective of the present study is to test whether achievement videos are indeed able to arouse the achievement motive and thereby increase motivation and motor performance in a simple skipping task.

1. The implicit achievement motive, motivation, and performance

The implicit achievement motive is conceptualized as a relatively stable disposition to prefer challenging situations that allow to assess one's own standard of excellence (Brunstein & Heckhausen, 2008; McClelland, Atkinson, Clark, & Lowell, 1953). Schultheiss (2008, p. 603) described the implicit achievement motive as "the capacity to derive satisfaction from the autonomous mastery of challenging tasks". In contrast to the explicit achievement motive that represents a part of a person's self-concept (measured using questionnaires), the implicit achievement motive guides attention, behavior, and emotions without people being aware of the underlying driving force (McClelland, 1985, 1987). Arousing the achievement motive results in higher commitment to performance tasks and a greater willingness to invest effort (Brunstein & Maier, 2005; Gröpel & Kehr, 2014; McClelland, 1987). Therefore, it is not surprising that the implicit achievement motive is associated with performance in various life domains, for example, in learning contexts (e.g., Baumann & Scheffer, 2010; Busch, Hofer, Chasiotis, & Campos, 2013; Dahme, Jungnickel, & Rathje, 1993; McKeachie, 1961; O'Connor, Atkinson, & Horner, 1966; Schultheiss & Köllner, 2014), at the work place (e.g., Baumann & Scheffer, 2011; Andrews, 1967; Lang, Zettler, Ewen, & Hülsheger, 2012; McClelland & Franz, 1992), and in research laboratories with a broad variety of achievement tasks (e.g., Biernat, 1989; Brunstein & Hoyer, 2002; Brunstein & Maier, 2005; Fodor & Carver, 2000; Lowell, 1952; Pang, 2010; Puca & Schmalt, 1999; Thurstone, 1937). Most importantly for the present study, the implicit achievement motive is associated with performance in sports (Gröpel, Wegner, & Schüler, 2016; Wegner, Sieber, & Schüler, 2014; Wegner & Teubel, 2014). It is therefore of great interest to understand the

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mechanisms behind the arousal of the achievement motive in sport and exercise settings.

2. Arousal of the implicit achievement motive

Studies that analyzed the relationship between achievement motive and performance are theoretically-based on the assumption that it is necessary to first arouse the motivational or need state before the motive can come into action (for this basic principle see also Beckmann & Heckhausen, 2018; McClelland, 1985, 1987). Situations that contain achievement *incentives* such as challenging tasks, whose mastery promises positive affect, and the announcement of feedback that enables people to better assess how well they are doing, are appropriate to arouse the achievement motive. These incentives occur either naturally (e.g., in performance sport contexts) or can be artificially created in experiments (e.g., setting high standards of excellence, announcement of feedback, or priming achievement motivation).

In motive-arousal studies, this process of implicit motive arousal has been analyzed in more detail, but with a research focus on a methodological question. These studies are directed to gain evidence for the *causal validity* (Borsboom, Mellenbergh, & van Heerden, 2004) of implicit motive measures. Causal validity means that variations in the attribute causally produce variations in the outcomes of the measurement procedure (Borsboom et al., 2004, p. 1061). Referring to implicit motive research and according to McClelland (1980, p.34), implicit motive measures such as the Picture Story Exercise (PSE, Murray, 1943; Schultheiss & Pang, 2007) should sensitively respond to the arousal of motivational states in experiments. McClelland (1980) used the analogy of a *thermometer* when describing the sensitivity of an implicit motive measure to motive arousal conditions. He stated that “a thermometer is sensitive, if it responds in a linear fashion as a lighted match is moved closer to it” (McClelland, 1980, p. 34). In most classical studies, first, the motive of interest (e.g., achievement, affiliation, power) was assessed at a baseline, then, secondly, an experimental condition was placed that should arouse the motive and then, thirdly, the implicit motive measure was administered again and is expected to show sensitivity in terms of higher motive scores. Classical motive-arousal studies confirmed this principle for the hunger motive (Atkinson & McClelland, 1948), the affiliation motive (Atkinson, Heyns, & Veroff, 1954; Shipley & Veroff, 1952), the intimacy motive (McAdams, 1980), the power motive (Uleman, 1972; Veroff, 1957), and for the achievement motive (McClelland et al., 1953; McClelland, Clark, Roby, & Atkinson, 1948). More recent research has updated these classical studies and confirmed the basic principle by using more timely approaches to arouse implicit motives (assessed using the Picture Story Exercise, Schultheiss, Wirth, & Stanton, 2004; Wirth & Schultheiss, 2006). Further research successfully confirmed the causal validity of the Operant Motive Test (Kuhl & Scheffer, 1999) with respect to motives (Baum, 2020; Scheffer, Eichstaedt, Chasiotis, & Kuhl, 2007) and motive enactment strategies (Baumann & Kuhl, 2020). Baum and Baumann (2021) added to the existing literature that the basic principle of motive arousal also holds true for the autonomy motive assessed using the OMT.

3. The implicit achievement motive in men and women

Previous research has found a relatively consistent pattern for gender differences in the affiliation and power motive. Men have higher power scores than women, whereas women have higher affiliation and intimacy scores than men (Denzinger, Backes, Job, & Brandstätter, 2016; Drescher & Schultheiss, 2016; McAdams, Lester, Brand, McNamara, & Lensky, 1988; Pang & Schultheiss, 2005; Schultheiss & Brunstein, 2001). For the achievement motive, however, previous study results are mixed showing higher achievement scores for men than for women (Denzinger et al., 2016), whereas other studies could not find gender differences (Duncan & Peterson, 2010; Langan-Fox & Grant, 2006; Pang & Baumann, 2020; Pang & Schultheiss, 2005; Stewart & Chester, 1982).

Besides differences in the strengths of the achievement motive, men and women also differ in how they enact the achievement motive and how they respond to achievement incentives. As Stewart and Winter (1976) stated 47 years ago, “Experimental procedures that arouse need for achievement *(n* Ach) in men do not always do so in women, and the behaviors correlated with motive score are not always the same for both sexes“ (p. 495). In line with this, Pang and Baumann (2020) show that women compared to men enact the achievement motive with higher fear of failure and respond to the visualizing of goal success with higher avoidant achievement motive scores. Also the hormonal correlates of motive arousal are different for men and women, as has been shown for the affiliation and power motive (Schultheiss, 2013; Schultheiss et al., 2004), and also for the achievement motive (Schultheiss, Wiemers, & Wolf, 2014). This further supports that motive arousal elicits different processes, even on a basic biological level.

4. Present research

As far as the authors know, however, no recent studies based on this classical motive arousal sequence (consisting of motive arousal assessment 1, experimental manipulation, motive arousal assessment 2) exist for *achievement* motive arousal. Another research gap is that previous studies - strictly speaking - provided support for only half of the assumption of causal validity. The studies compared a group of people whose motive was experimentally aroused with a group in which the motive was not aroused. Thus, these studies can only show that a motive could be aroused by appropriate motive-relevant conditions, or, in McClelland’s words, that the *thermometer* recorded an increase when a lighted match was approached, or in our words, that a motive could be *heated up*. In the present study, we additionally aimed to show on the individual level that moving a lighted match away from the thermometer *cools* the achievement motive *down*. This is similar to an A-B-A design in that a baseline condition (the “A" phase) is established, an intervention is introduced to effect some sort of change (the “B" phase), and then the treatment is removed to see if (motive arousal) scores return to their baseline. For this reason, we chose a within-subject design that included an achievement motive arousal baseline measure, a *heating-up* condition (motive arousal using achievement video clips), and a *cooling-down* condition (neutral video clip).[1]

We used video clips to heat up and cool down the achievement motive, because Winter (1973) assumed that motives can be aroused by *observing motives in action,* that is by observing other people who act in accordance to the motive. He confirmed this assumption for the power motive by showing that films (Winter & Stewart, 1978) and political speeches with strong power-related themes (Stewart & Winter 1976; Winter 1973) can arouse the power motive. Also more recent motive-arousal studies showed that film clips can arouse implicit motives, but they also focused on the affiliation and power motive (Schultheiss et al., 2004; Wirth & Schultheiss, 2006). It has not been analyzed or published so far whether the achievement motive can be aroused by observing others acting successfully in challenging situations. Therefore, in our study, we used video clips showing top athletic performances. Figure 1 summarizes the three step procedure of a “cool” motive (T1: no motive arousal, no video), a “heated-up” motive (T2: motive arousal by achievement video), and a “cooled-down” motive (T3: no motive arousal, neutral video). This figure also illustrates the hypotheses which are outlined in the following.

The ***motive-arousal hypothesis*** states that participants have higher achievement motive arousal scores in the achievement video clip condition (further referred to as ACH-Video) than in the baseline measure (NO-Video) and in the neutral video clip condition (NEUTRAL-Video). Motive arousal scores in the NO-Video and NEUTRAL-Video were

[1] Footnote 1: We counter-balanced conditions across T2 and T3 to control for order effects and therefore, strictly speaking, realized a A-B-A design for only the half of our sample (the other half had A-A-B).

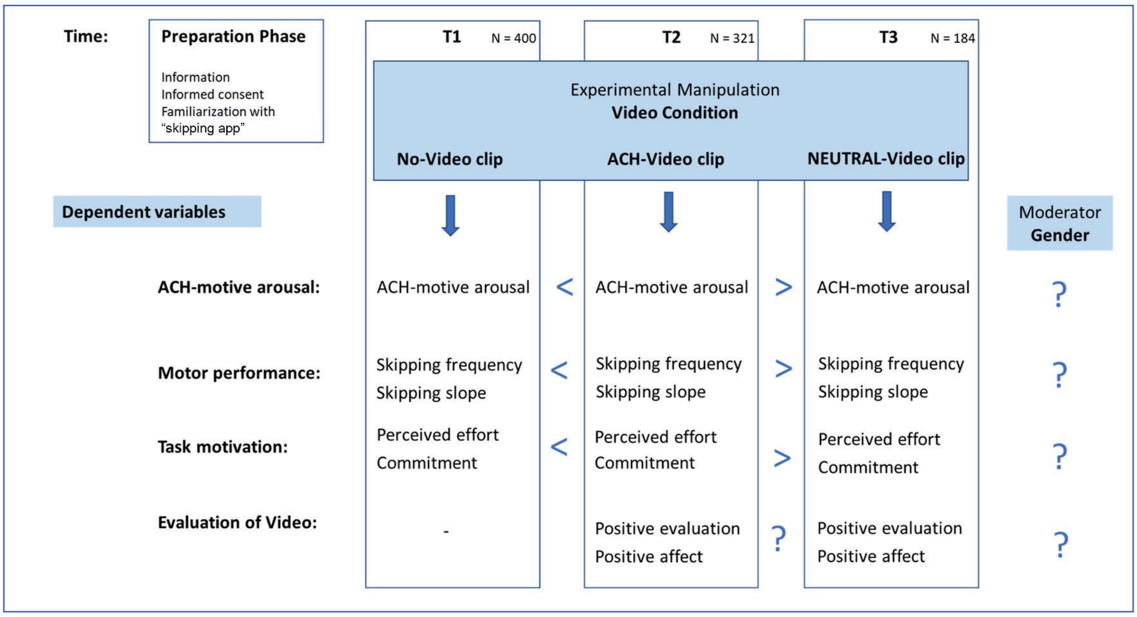

Figure 1. Illustration of the temporal study procedure, the assessed variables, and the hypotheses.

expected to not differ significantly.

More relevant for the applied sport, we assumed that achievement video clips also enhance participants' motor performance. In our ***performance hypothesis*** we predicted that participants perform better in the ACH-Video condition than in the NO-Video and in the NEUTRAL-Video condition. The last two conditions were not expected to differ significantly.

We furthermore aimed to examine whether the experimental conditions influence the motivation to perform the motor task (task motivation). We therefore asked participants how committed they feel to the motor task (commitment) and to rate their effort when performing the task (rating of perceived effort). We hypothesized that participants show ***higher task motivation*** towards the motor task (commitment, perceived effort) in the ACH-Video condition than in the NEUTRAL-Video and NO-Video condition. Again, the last two conditions were expected not to differ significantly. In summary, we have three blocks of main hypotheses, namely on ***motive arousal***, ***motor performance***, and ***task motivation.***

Another important concern is to consider participants' ***gender as a moderator variable.*** As outlined above, the inconsistent picture for the achievement motive in women and men in previous studies and also the small number of achievement motive arousal studies itself do not allow for a directed hypothesis for Gender as a moderator. We therefore simply test whether Gender interacts with video conditions to predict motive arousal, motor performance, and task motivation.

In order to analyze the effects of the achievement and neutral video clips in more detail, we asked participants about how they feel during watching the videos (affect) and had them make further assessments (concentration, liking, attractiveness, energization, boredom) to capture their overall evaluation of the video clips. We summarize these variables below under the heading ***evaluation of the videos***.

5. Methods

5.1. Participants and procedure

Participants were recruited among undergraduate students of different faculties and through social media posts by the authors to participate in a three-part study that we announced as a study about the relationship between verbal fluency and motor performance. Due to COVID-19 restrictions in 2020 and 2021, we designed the study "contact-free" by using e-mail lists of digital courses to recruit participants and have them fill in web-surveys, and do a motor performance task based on a smart phone app. Data collection took place in two consecutive semesters.

The procedure of data collection was as follows (for an illustration see Figure 1). In approximately the 9th week of the semester, students received information about the study, an informed consent form, and indicated a code that was used to link the different parts of the survey (LimeSurvey). Then they viewed a brief Youtube video that explained how to use the smart phone app that would later be needed to assess the step frequency in the 'skipping' task, where subjects had to make as many steps as possible within 30 s. Participants were asked to try out the app several times with the help of a manual and a video demonstrating its use (including a brief warm-up phase).

At about week 10 of the semester (Time 1 of data collection), 400 participants responded to the e-mail invitation to fill in the first web-survey (LimeSurvey). It contained a brief introduction, the achievement ***motive arousal*** measure (Picture Story Exercise), the ***motor performance*** measure (skipping app), and a brief questionnaire assessing the ***motivation for the skipping task***.[2] Two weeks later, 321 participants filled in the next web-survey (Time 2 of the data collection). It started with a brief introduction, this time followed by a video clip (either ACH-Video or NEUTRAL-Video). After the video clip, the dependent variables ***motive arousal***, ***skipping performance***, and ***task motivation*** were assessed as in T1. In addition, participants filled in a brief questionnaire about the videos (***evaluation of the videos***). The procedure for part three of the data collection (T3, 2 weeks after T2) was identical to T2 with the exception that the remaining video clip (either NEUTRAL- or ACH-Video) was presented. Participants were debriefed by a video in which the experimenter explained the research question and the measures in detail.

184 undergraduate students, 92 women and 92 men with a mean age of 27.66 years ($SD = 9.72$, range: 18–59 years) participated in all three parts of data collection and their data were included in the final data set.[1] Participants came from different fields of study. The most common fields were Sport Science (n = 21), Teaching (n = 7), Medicine and

[2] Footnote 2: Other variables were recorded which are not part of the present question. They refer to sports activities during the COVID-19, wave1 restrictions.

Biological Sciences (n = 7) and Economics (n = 6). Drop-out rates were 19,75% from T1 to T2 and 42.68% from T2 to T3. The study was carried out in accordance with the Code of Ethics of the World Medical Association (declarations of Helsinki, 1975; in its latest version 2013). In response to the authors' written request for an ethics votum, the Institutional Review Board (IRB) of the first authors university stated that "for this type of project, approval by the IRB or any regulatory body is not required according to our University's and national statutes in Germany".

5.2. *Experimental manipulation using video clips*

The ACH-Video and the Neutral-Video clips consisted of 24 and 26 sequences, and lasted 5:15 and 5:10 min, respectively. The ACH-Video sequences showed athletes who demonstrate unique accomplishments (e.g., climbing high rocks, multiple saltos) or athletes who fail to achieve high performance standards (e.g., failure in an acrobatic exercise, false start in swimming). Table 1 in the supplemental materials shows details about the sequence, type of sport, type of performance, and whether a man or a woman is displayed. The NEUTRAL-Video clip consisted of sequences displaying landscapes. We chose interesting landscapes (e.g., deep canyons, impressive mountains, high waves) to ensure that viewing the NEUTRAL-Video is also attractive and does not, for example, bore participants. With this, we aimed to exclude the interpretation that differences in general arousal rather than achievement content in the video clips enhances motive arousal and motor performance.

Five experts of implicit motive research who are experienced coders of the Picture Story Exercise (PSE) rated all sequences of both video clips according to motive arousal potential (see Supplemental Material, Table 1). Both videos were accompanied by the same music that experts rated to be equally suitable for sports and landscape images. The video clips were integrated into the web surveys and can be viewed here (sports: ACH-Video: www.youtube.com/watch?v=ZTAuWYUeGu4, landscapes: NEUTRAL-Video: www.youtube.com/watch?v=ecWY0FgThqc).

5.3. *Assessment of achievement motive arousal*

Implicit achievement motive arousal was assessed using the Picture Story Exercise (PSE, Murray, 1943; Schultheiss & Pang, 2007). We used standard instructions to ask participants to write imaginative stories about four pictures (see Table 2 in supplemental material). Stories were coded for achievement motive imagery (and additionally for affiliation and power motive imagery) by a coder with extensive coding experience (according to criteria suggested by Schultheiss & Pang, 2007) (interrater reliability with pre-scored expert codings >.90) using the Winter (1994) Manual for Scoring Motive Imagery in Running Text.

In addition, 35% of the stories written by participants in the summer semester were coded by a second rater. In the winter semester, only the main coder coded the stories. We used an online version of the Picture Story Test that has been shown to yield reliable and valid data (Bernecker & Job, 2011). According to Winter's scoring rules, we scored for achievement imagery indicating motive arousal whenever a character shows a concern with a standard of excellence. This is indicated by (1) positive evaluations of goals and performances, (2) winning or competing with others, (3) disappointment about failure, or (4) unique accomplishments. We additionally scored for affiliation imagery (AFF) and power imagery (POW), so that we can test for motive-specificity of arousal of our results. Inter-rater reliability between coders in the summer was high for ACH (ICC = 0.839), AFF (ICC = 0.873), and for POW (ICC: 0.796). Disagreements between the raters were resolved through discussion. The scores within the motive domains were summed. Because motive arousal scores and protocol lengths were significantly correlated, we used regression analysis to residualize the implicit motive scores for word count. The residual scores were then used in the analyses reported below.

The repeated measure of implicit motive arousal is a methodological challenge (e.g. due to memory effects, when people write about the same picture), and also a challenge for practical reasons (e.g., risk of high drop-out rates in a study that requires to fill in the Picture Story Exercise three times). We have met these challenges with creating three sets of pictures (Picture Set 1, 2, 3) that are displayed in Table 2 of the supplemental material. The most important criterion is the comparability of the picture sets with regard to their achievement motive arousal "pull" – or in other words, the expected amount of achievement motive imagery that they elicit. Pictures differ considerably in the amount of motive imagery they elicit and fortunately there are norms (Pang & Schultheiss, 2005; Schönbrodt et al., 2020; Schultheiss & Brunstein, 2001) that we could use to put together equally strong sets. Second, we systematically balanced pictures showing sport context and non-sport context to avoid that domain specificity of contexts might be confounded with our experimental setting. We also looked for pictures showing women in performance situations to avoid possible gender-bias (Gruber, 2017) and distributed them evenly across all picture sets. Fourth, we presented the same number of color photos and black and white sketches to avoid that complexity or color influence our results.[3] We counter-balanced Picture Set (Picture Set 1,2,3), experimental Condition (NO-Video, ACH-Video, NEUTRAL-Video), and Order of Condition (T2, T3; for all participants T1 was the NO-Video condition), and therefore created 12 lime-surveys. (For a detailed description of counter-balancing the material see supplemental Table 3.)

5.4. *Assessment of motor performance*

Participants performed skippings for a period of 30s. Accelerometry was used to record accelerations of one lower leg. To this end, subjects used their private smart-phones with the free app Phyphox (Stampfer, Heinke, & Staacks, 2020). The app was set to "recording without g", thus using preprocessed sensor data where gravitational accelerations are removed and only the acceleration of the device is recorded. Subjects were then instructed to place the device into a high and tight sock. Since the main outcome was the number of steps, movement of the device inside the sock did not affect the outcome measure. Participants were instructed to upload the data from the app to lime-survey in *.csv format. Custom written scripts in Matlab (The Mathworks, Natick, USA) were used for further analysis. We used the absolute acceleration of all

Table 1
Descriptive Statistics of Variables separated for Condition (NO, ACH, NEUTRAL-video).

	NO-video		ACH-video		NEUTRAL-video	
	M	SD	M	SD	M	SD
ACH Arousal raw[a]	4.228	2.601	4.962	2.939	4.842	2.985
Skippings - Frequency	3.240	.952	3.308	.904	3.294	.933
Skippings – Slope[b]	-.015	.026	-.018	.019	-.018	-.018
Perceived effort	4.929	3.380	8.016	3.044	8.418	2.919
Commitment	3.276	1.694	3.483	1.833	3.354	1.709
Positive affect	–	–	4.206	.807	3.919	.838
Positive evaluation	–	–	5.223	1.216	4.351	1.267

Note.
[a] Raw scores of achievement motive arousal. Please note that for the analyses reported in the text word-count corrected scores were used (standardized residualized scores).
[b] Skipping slopes with outliers (data with outliers removed: NO-video: *M* −.017, *SD* .019, ACH-video: *M* −.018, *SD* .019, NEUTRAL-video: *M* −.018, *SD* .019)

[3] Footnote 3: Testing how each of these criteria influence motive arousal in what person is also a highly interesting research question, but not the focus of the present study.

Table 2
Achievement Motive Arousal, Skipping Performance, and Task Motivation as a Function of Condition (ACHvsNEUTRAL, ACHvsNO), Gender (1: women, 2: men) and the Interaction of both Variables.

	Main Effect Model	Interaction Model	Main Effect Model	Interaction Model
ACH-motive arousal				
Intercept	.170	.363		
ACHvsNEUTRAL	.006	-.479†		
ACHvsNO	-.045	-.137		
Gender	-.106	-.234†		
ACHvsNEUTRAL x Gender		.324†		
ACHvsNO x Gender		.061		
R^2	.004	.009		
R^2 change	.004	.005		
Skipping performance:	**Frequency**		**Slope**	
Intercept	3.237***	3.324***	-.020	-.014
ACHvsNEUTRAL	-.145	-.067	-.001	-.006
ACHvsNO	-.069	-.278	-.001	-.010
Gender	.052	.005	.001	-.002
ACHvsNEUTRAL x Gender		.035		.004
ACHvsNO x Gender		.138		.008*
R^2	.002	.003	.005	.012
R^2 change	.002	.001	.005	.007
Task Motivation:	**Perceived Effort**		**Commitment**	
Intercept	7.497***	9.011***	3.568***	3.711***
ACHvsNEUTRAL	.406	-.734	-.137	.189
ACHvsNO	3.087***	6.487***	-.217	-.975
Gender	.342	-.663	-.052	-.146
ACHvsNEUTRAL x Gender		.756		-.217
ACHvsNO x Gender		2.262***		.503†
R^2	.202	.220	.003	.010
R^2 change	.202	.018	.003	.007

Note.
†p < .10 *p < .05 ***p < .01 ***p < .001
ACHvsNEUTRAL: dummy achievement video vs. neutral video; ACHvsNO: dummy achievement video vs. no video
The main effect models include the dummy-coded Conditions and Gender. The interaction model consists of the main effect model to which we had added the two-way interaction of Condition and Gender. Displayed are the estimates of the hierarchical analyses as well as the percentage of variation explained by the regression line out of the total variation (R^2) and changes in R^2 when using the more complex model.

three axes, visually determined start and stop of the 30-s skipping interval, and calculated the spectrogram with a time resolution of 3s using the Matlab function 'psspectrum'. Finally, the maximum of the power spectrum at each time step was obtained, and the mean thereof used as main output (***skipping frequency***). We visually verified the selected frequencies in both frequency and time domain. Furthermore, a slope score was calculated from a linear regression over the time course of the frequency. A negative slope means a decrease in frequency over time. We refer to this variable as ***skipping slope.***

5.5. Assessment of task motivation for skipping task

Perceived effort was assessed using the 15-grade scale for ratings of perceived exertion (RPE) by Borg (1970). It is "a general intensity scale that can be used to estimate most kinds of perceptual intensities" (Borg, 1998, p. 15). Participants were asked to indicate how much effort they perceived during the skippings using a scale ranging from 6 ("very very light") to 20 ("very very hard"). ***Commitment to skipping task*** was captured by four self-developed items ("I tried very hard during the skippings", "I showed my full commitment in carrying out the skippings", "I did the skipping a bit half-heartedly", "I performed the skippings a little cautiously"; last two items were re-coded) that participants responded to using a 7-point rating scale (1: does not apply at all to 7: applies very well). Because Cronbach's Alpha improved considerably when the first item was dropped, we removed it from the scale (Cronbach's Alphas at the three points of measurement: 0.75, 0.66, 0.64).

5.6. Assessment of participants' evaluation of the video clips

To further examine the effects of the video clips, five items (response scale ranged from 1: "does not apply at all" to 7: "fully applies") captured whether participants found it easy to concentrate on the video clips, whether they liked them or did not feel appealed to them, whether they felt energized or bored while watching the video clips. After having revised one item ("The video clip did not appeal to me"), we took the average of the five items. We refer to this overall score as ***positive video evaluation*** (Cronbach's Alpha: ACH-Video: .89, NEUTRAL-Video: 0.86). Participants' affect after the video clip was measured using three positive ("I feel happy/satisfied/energetic") and three negative ("I feel sad/low/sluggish") affect items. After recoding the negative affect items, we aggregated all variables to a general ***positive affect*** score (Cronbach's Alpha: ACH-Video: .90, NEURAL-Video: 0.88).

6. Results

6.1. Statistical data analyses

We used the statistical software R (RCoreTeam, 2017) to identify outliers, to conduct descriptive statistics, correlational analyses, T-Tests and multi-level regression analyses (lme4 package, Bates, Maechler, Bolker, & Walker, 2015), and to create the graphs (visreg package, Breheny & Burchett, 2017). To test the hypotheses, we ran hierarchical linear regression analyses for each of the dependent variables (DVs: motive arousal, skipping frequency, skipping slope, perceived effort, commitment). The three experimental sessions (NO-Video, ACH-Video, and NEUTRAL-Video) were examined using two dummy variables (ACH-NEUTRAL: compares ACH-Video condition with NEUTRAL-Video condition/ACH-NO: compares ACH-Video condition with NO-Video condition). We tested for main effects of experimental session (Condition), and participants' gender (1: women, 2: men), as well as for the interaction effect of Condition × Gender. Therefore, we built sequential (nested) regression models by adding variables at each step after an intercept-only model (*intercept only model*) and its random intercept had been specified (*baseline model*). We then added the single predictors (Condition, Gender) to the baseline model with Condition allowed to vary between participants to create the *main effect model.* The *interaction model* consists of the main effect model to which we had added the two-way interaction of Condition and Gender. We saved each model in R and used ANOVAs for model comparison.

To analyze whether ACH-Video clips and NEUTRAL-Video clips were differently evaluated by the participants, we conducted the same hierarchical regression analyses as reported above but with *Condition* consisting of two levels (ACH-Video, NEUTRAL-Video) (no video was presented at T1).

6.2. *Descriptive statistics*

Mean and standard deviations for ACH-motive arousal, skipping performance, motivation for task, and participants ‘evaluation of the video clips separated for each of the experimental conditions are depicted in Table 1.

6.3. *Achievement motive arousal*

T-Tests revealed no differences in ACH-motive arousal between men and women (NO-Video: $t(182) = 1.308$, $p = .192$, ACH-Video: $t(182) = 1.586$, $p = .115$, NEUTRAL-Video: $t(182) = -.648$, $p = .517$). Table 2 summarizes the result of the hierarchical analyses testing for Condition main effect and for Condition × Gender interaction. The *main effect and interaction effect models* revealed no significant results. In the *interaction effect model*, Condition (dummy ACH-Video vs NEUTRAL-Video, $b = 0.480$, SE: 0.273, $p = .079$), Gender ($b = 0.234$, SE: 0.139, $p = .094$), and Gender x Condition (dummy: ACH-Video vs NEUTRAL-Video, $b = 0.234$, SE: 0.173, $p = .061$) failed to reach significance. In order to show the trend, the interaction is illustrated in the supplemental material (Figure 1). ANOVA testing for differences between *main effect model* and *interaction effect model* showed no significant effects (X^2 (2) = 4.01, $p = .135$).

6.4. *Skipping performance*

As displayed in Table 2, the analyses to predict **frequency of skippings** revealed no significant main effects of Condition, Gender, or the interaction of both variables. ANOVA revealed that *main effect model* and *interaction effect model* did not differ (X^2 (2) = 1.784, $p = .410$). Inspection of **slope of skippings** revealed four outliers (defined as data points that are located outside the “whiskers” of the boxplot, e.g.: outside 1.5 times the interquartile range above the upper quartile and below the lower quartile). The outliers are neither a measurement error or data entry error, nor do the subject’s other data show unusual characteristics. Thus, it is unlikely that they are “error outliers“. We assume that they are “interesting outliers“ (for differentiation of outliers see Aguinis, Gottfredson, & Joo, 2013), and decided to report both, analysis including and excluding the outliers (see Aguinis et al., 2013). The analysis including outliers revealed a significant Gender × Condition interaction effect (dummy: ACH-Video vs. NO-Video, $b = 0.008$, SE: 0.003, $p = .012$). The *interaction effect model* differed significantly from the *main effect model* (X^2 (2) = 6.307, $p = .043$). Figure 2 illustrates that women had higher skipping slope scores after the ACH-Video than men as well as other women after the Neutral-Video and the NO-Video condition. Men, in turn, performed better in the NEUTRAL and NO-Video condition than in the ACH-Video condition. In the analysis in that the outliers were removed, the interaction effect Gender x Condition was only marginal (dummy: ACH-Video vs. NO-Video, $b = 0.005$, SE: 0.002, $p = .058$). The *interaction effect model* did not differ significantly from the *main effect model* (X^2 (2) = 3.848, $p = .146$).

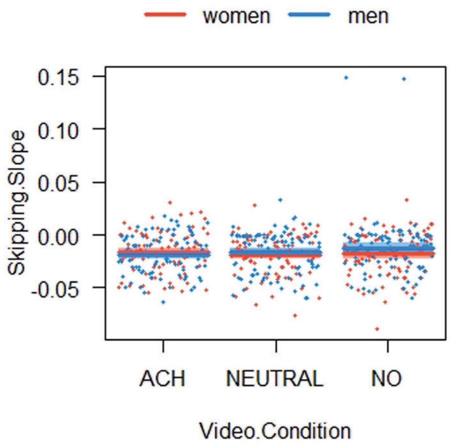

Figure 2. Interaction of Video-Condition x Gender on skipping slopes.

6.5. *Task motivation*

We repeated the structure of the hierarchical regression models reported above with participants’ perceived effort during the skipping task and their commitment to this task (see Table 2). The main effect of Condition (dummy: ACH-Video vs. NO-Video, $b = 6.487$, SE: 0.941, $p < .0001$) and Gender x Condition (dummy: ACH-Video vs. NO-Video, $b = 2.263$, SE: 0.594, $p < .0001$) on **perceived effort** was significant. The interaction effect model significantly differed from the main effect model (X^2 (2) = 14.865, $p < .0001$). As shown in Figure 3, women perceived more effort after the ACH-Video than after the NEUTRAL-Video or in the NO-Video condition. Only in the ACH-Video condition, they perceived more effort than men. No significant main or interaction effects were found for **commitment.**

6.6. *Evaluation of videos*

We found significant main effects of Condition on *positive affect* (dummy: ACH-Video vs. NO-Video, $b = -.287$, SE: 0.087, $p < .001$) and *positive evaluation* (dummy: ACH-Video vs. NO-Video, $b = 1.322$, SE: 0.353, $p < .001$), but no significant Gender × Condition interactions (Table 2).

Main effect and interaction effect models did not differ significantly (*affect*: X^2 (1) = 0.467, $p = .494$, *positive evaluation:* X^2 (1) = 1.878, $p = .170$). The main effects state that participants’ *affect* and *positive evaluation* after the ACH-Video (affect: $M = 4.206$, $SD = 0.807$, *positive evaluation:* $M = 5.223$, $SD = 1.216$) were higher than after NO-Video (affect: $M = 3.919$, $SD = 0.838$, positive evaluation: $M = 4.351$, $SD =$

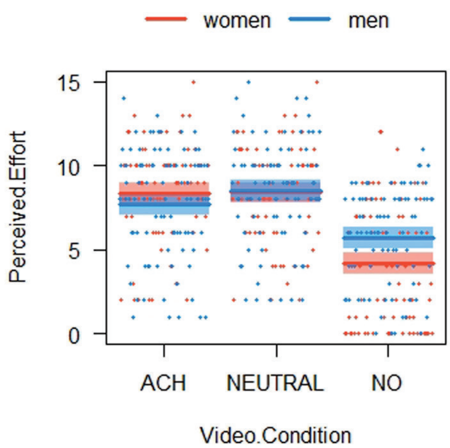

Figure 3. Interaction of Video-Condition x Gender on perceived effort.

1.267).

7. Discussion

The initial question of whether the content of video clips flickering across screens in fitness studios (or elsewhere) arouses the achievement motive and thus contributes to increased motivation and motor performance, can only be partly answered by the present data.

7.1. Motive-arousal hypothesis: video clips did not heat-up the achievement motive

The video clips could not "heat-up" (ACH-Video) and "cool-down" (NEUTRAL-Video) the achievement motive, indicated by the fact that achievement motive arousal scores were not significantly different in the two video and the no-video conditions. Marginal effects for Condition, Gender, and Condition x Gender (see supplemental material, figure 1), however make us optimistic that an adaptation of the motive arousal measure in a future study could show the expected effects: In the present study, a skipping task was announced to the subjects and was made salient through the information about the skipping app at the beginning of the study. Therewith, participants were attuned to the sports task. However, the sports video was then followed by a long period of writing picture stories (Picture Story Exercise, approx. 15–20 min) rather than starting the sport task. We suspect that this may have created an inconsistency that adversely affected the measurement of motive arousal. To reduce this inconsistency, future studies could either reduce the time taken by the motive arousal measure tool (to move more quickly to the actual announced sports task). A motive arousal measure that is shorter and better suits the experimental setting by not distracting participants too long from their main task (skippings) (e.g., Operant Motive Test, Kuhl & Scheffer, 2001) might reveal the effects we expected. Another way to reduce the inconsistency would be to adapt the content of the motive arousal measure a bit better to the context, that is, to use pictures that are similar to the situations in which the dependent variables are assessed (as also recommended by Schultheiss & Pang, 2007). This could be done, for example, by exclusively using sport relevant pictures in the Picture Story Exercise.

7.2. Performance hypotheses: video clips moved women to better performance – but not men

Our assumption that the *frequency of skippings* is higher after the ACH-Video than after the NEUTRAL-Video and in the NO-Video condition was not confirmed. Regarding the *skipping slopes*, however, there was a significant interaction effect with Gender, when outliers remained in the data set. Women showed lower decrease in skipping frequency over time (higher skipping slope) in the ACH-Video clip condition than in the NO-Video condition, and in the NEUTRAL-Video condition (the latter on a descriptive level). The reason for the stronger effect of the ACH-Video for women cannot be that women generally liked the ACH-Video clip better or that it triggered stronger positive affect in them. We found only main effects (in favor of the ACH-Video) in positive affect after the videos and in general ratings of the videos, however, no interaction effects with Gender. The significant Condition x Gender effect, however, was much weaker and failed to reach significance, when outliers were removed from the sample. What does this mean for the validity of the result? While there is widespread consensus that outliers should be reported (Valentine et al., 2021), the question of how to interpret them is more complex. Researchers have suggested different categories of outliers (Osborne et al., 2004), of which the following three are found in most categorizations: experimenter error (e.g., error in data collection), participant behavior (e.g., intentional misreporting), and natural variability (legitimate data that does not fit into the expected theme) (Valentine et al., 2021). We assume that our outliers fall into the latter category, since the data are within the range of what is possible and there is no apparent evidence of errors in data collection. Intentional bias of participants is also rather unlikely. We agree with Aguinis et al. (2013) that studying outliers can result in novel theoretical insights that can be considered in future studies. Of the two participants with the highest skipping slope scores in the NO-Video condition (right corner in Figure 2), one person has a high achievement motive arousal score (M = 1.53, almost two *SD*s above the mean) and high skipping frequency (M = 4.79, clearly more than one *SD* above mean), and may have followed the strategy of giving good performance from the beginning and trying to increase it over time. The second person, on the other hand, has a moderate achievement motive arousal score (M = 0.01) and a low skipping frequency (M = 2.53, clearly more than one *SD* below mean). This person may have followed the strategy of starting with low performance in order to be able to maintain and even increase it easily. In future studies, we need to ask about conscious strategies that may be dependent or independent of the achievement motive arousal, but in any case, influence performance and development of performance. Applying such strategies might explain extreme scores in skipping slopes.

Inspection of the marginal Condition × Gender interaction on achievement motive arousal (see above and supplemental material, Figure 1) shows that at a descriptive level, women in the ACH-Video condition show stronger achievement motive arousal than men and other women in the NEUTRAL-Video condition. This hint reinforces our assumption that applying a motive arousal measure that is better suited to our context might reveal motive arousal differences that could in turn explain differences in motor performance.

In future research, it would also be informative to differentiate hope and fear components of achievement motive arousal. On the one hand, fear of failure is higher and more easily aroused (e.g., after visualizing success) in women compared to men which is partially due to women's higher failure-related state orientation (Pang & Baumann, 2020; see also Chatterjee, Baumann, Osborne, Mahmud, & Koole, 2018). Many findings show that failure-related state orientation benefits motor performance in disciplines that require short maximized efforts (100 m races) rather than endurance over an extended amount of time (marathons) (Beckmann, Ehmann, Kossak, Perl, & Hähl, in press; Beckmann & Kossak, 2018). The present skipping task requires such short-term efforts and may have benefitted from aroused fear of failure after the ACH-Video. On the other hand, women's higher state orientation helps them to benefit from external motivators such as instructions from the coach (Beckmann et al., in press), social support primes (Chatterjee, Baumann, & Osborne, 2013), and specifically targeted videos or audios (Baumann & Kuhl, 2020). Thus, the ACH-video may have moved women to action by increasing their hope for success. Future studies may explore whether women's advantage in motor performance after achievement-related video clips is mediated through fear of failure or hope for success by applying motive measures that differentiate such enactment components (e.g., OMT, Kuhl & Scheffer, 1999). Thinking a bit further, the depiction of athletic successes or failures in video clips could very specifically arouse hope and fear components of the achievement motive, which could be captured separately via the OMT. Video clips offer a variety of possibilities for motive arousal.

What needs to be further addressed, is why the video clips affect the two outcomes *skipping frequency* and *skipping slopes* differently. We speculate that they may represent different aspects of motivation. Motivation is typically differentiated into direction, intensity, and persistence (e.g., Bandura, 1991, p. 158; Kanfer, 1994). Frequency of skippings better captures the *intensity* aspect of motivation, that is, the amount of effort a person devotes to accomplishing a given task. Skipping slopes, however, better represent the *persistence* aspect of motivation. Whether skipping performance increase or decrease (skipping slopes) depends on one's willingness to spend extra effort when task performance becomes difficult – when one's legs get tired and physical exhaustion increases. Analyses of task motivation gives further insights that support this line of arguments.

7.3. Task motivation hypotheses: Do commitment and perceived effort refer to the intensity and persistence aspects of motivation?

We asked participants for their *perceived effort* and here we found an interaction pattern for women that fits to their skipping slope performance: Women perceived more exertion in the ACH-Video condition than men as well as other women in the NO-Video and NEUTRAL-Video condition (the latter on a descriptive level). It seems that the ACH-Video encourages them to maintain their performance over the 30-s period at the expense of an increased experience of effort. No main or interaction effects, however, were found for participants' *commitment* to the skipping task. The differentiation into *intensity* and *persistence* aspects of motivation might again help to systematize why we get effects for one motivation variable (perceived effort), but not for the other (commitment). *Commitment* represents one's willingness to invest effort in the task (intensity), but *perceived effort* indicates persistence, that is, staying on track when task performance becomes difficult in face of physical exertion.

That ACH-Video clips might affect the *persistence* component of motivation stronger than the *intensity* component, is a post-hoc explanation that must be tested in a future study. Such a study should also manage to better disentangle the intensity and persistence aspects. Different from longer-term sport tasks (related workout in sport) that allow to disentangle intensity and persistence much more clearly, in our short task, intensity and persistence are highly intertwined. Starting with a high frequency of skipping (intensity) increases the probability of not being able to maintain intensity over the entire period (lower slope). In addition, individuals who have experience with skippings might have started with a moderate frequency to be able to maintain or even increase it over the 30-s period. In future studies, we need to ask participants about pacing strategies they may have used.

7.4. Future outlook: testing the whole motivational sequence in future studies

We originally aimed to examine the whole motivational sequence that we outlined in the introduction: Motive relevant incentives (such as achievement videos) should arouse the corresponding motive (i.e., achievement motive arousal), which in turn unfolds positive effects on more general aspects of task motivation (perceived effort, commitment) and behavior (performance in skipping task). This mediation effect is theoretically established in motivation psychology (for a summary see Beckmann & Heckhausen, 2018; McClelland, 1985, 1987), but could not be tested with the present data, because the predictor-to-mediator link (video conditions – motive arousal) was not significant. As already mentioned, it was, however, marginally significant when considering the interaction with participants' gender. In a future study, we aim to use an alternative motive arousal measure and, if the link between Video Condition x Gender and motive arousal is strong enough, test the whole motivational sequence.

7.5. Summary and conclusion: encouraging but more research needed

Summing up, the data could not confirm the motive arousal hypothesis (only marginal interaction effect) and supports the motor performance hypothesis and the task motivation hypothesis only partly (for one out of two variables). Because good theoretical or methodological explanations could be found for the findings that did not conform to the hypotheses, we suggest that the hypotheses be retained and that the specific optimization options (e.g., Operant Motive Test instead of Picture Story Exercise) be used in future studies.

Another reason to invest in future research on this issue is that motive arousal through videos is not only theoretically interesting for sport psychology (that for example aims to identify predictors of sport performance), but above all has a high benefit in practical sports in different domains. Video clips can be easily created and adapted for different health- and performance-oriented contexts (e.g., in fitness studios, in the laboratory, in rehabilitation facilities, at home). Without the motive arousal measure (which is only needed as an intermediate step in research to better capture the mechanism), the video clips are a short intervention that additionally is rather inexpensive and highly accepted. Therewith, video clips fulfill important criteria of an intervention that is "scalable" in terms of being applicable for larger groups of people (WHO, 2016). Video clips can also be easily tailored to sub-groups, for example, to women and men, as our results indicate that they might respond to different incentives (see also Pang & Baumann, 2020).

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Author contributions

Julia Schüler: Conceptualization, data analyses, writing - original draft, supervision.

Mirko Wegner: Methodology, writing - review & editing.

Lorenz Assländer: Methodology, writing - review & editing.

Alisa Haufler & Tobias Krauss: Data collection, project administration.

Marcel Lang & Julia Somhegyi: Data collection.

Nicola Baumann: review & editing, supervision.

Declaration of competing interest

None.

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