



OPEN ACCESS

EDITED BY

Abdul Wahab,
International Islamic University
Malaysia, Malaysia

REVIEWED BY

Zongshui Wang,
Beijing Information Science
and Technology University, China
Gayle Stever,
SUNY Empire State College,
United States

*CORRESPONDENCE

Jacob Beutemps
jacob.beutemps@gmail.com
André Bresges
andre.bresges@uni-koeln.de

SPECIALTY SECTION

This article was submitted to
Digital Education,
a section of the journal
Frontiers in Education

RECEIVED 17 August 2022

ACCEPTED 21 November 2022

PUBLISHED 19 December 2022

CITATION

Beutemps J and Bresges A (2022)
The influence of the parasocial
relationship on the learning
motivation and learning growth with
educational YouTube videos in self
regulated learning.
Front. Educ. 7:1021798.
doi: 10.3389/feduc.2022.1021798

COPYRIGHT

© 2022 Beutemps and Bresges. This
is an open-access article distributed
under the terms of the [Creative
Commons Attribution License \(CC BY\)](#).
The use, distribution or reproduction in
other forums is permitted, provided
the original author(s) and the copyright
owner(s) are credited and that the
original publication in this journal is
cited, in accordance with accepted
academic practice. No use, distribution
or reproduction is permitted which
does not comply with these terms.

The influence of the parasocial relationship on the learning motivation and learning growth with educational YouTube videos in self regulated learning

Jacob Beutemps* and André Bresges*

Faculty of Mathematics and Natural Sciences, Institute for Physics Didactics, University of Cologne, Cologne, North Rhine-Westphalia, Germany

Parasocial relationships (PSRs) or parasocial interactions (PSIs) have been extensively researched in the field of marketing and television. As a result, we know that viewers form strong relationships with presenters and this greatly impacts the product they sell. However, whether this effect also impacts learning through educational videos is rarely researched. In this study, the correlation between PSI and learning growth, as well as learning motivation, was investigated. The results showed no correlation between PSI and learning growth, but a slight correlation between PSI and learning motivation, especially in the case of female participants. This shows potential for the creation of educational videos. Simultaneously, the findings are important for the training of teachers, because through research on PSI we understand the factors that can lead to the improvement of interaction and relationships.

KEYWORDS

educational video, parasocial interaction, parasocial relationship, learning motivation, learning growth, digital learning, digital education

Introduction

An increasing number of people use educational videos to learn new topics (Rosenthal, 2017; Jebe, 2019). One of the peculiarities of videos is that there is no direct interaction between learners and presenters. Nevertheless, studies show that a form of interaction between the viewer and the presenter still occurs and a relationship is formed between the two. This is known as a parasocial interaction (PSI) or parasocial relationship (PSR) (Horton and Wohl, 1956; Rubin et al., 1985; Frederick et al., 2012). Lauricella et al. (2011) showed that a better PSR leads to greater learning effects in young children. Other studies also suggest that the presenters are an important component

of videos, and therefore, they play an important role in learning (Wigfield et al., 2016; Beautemps and Bresges, 2021). To the best of our knowledge, the strength of the effects on learning motivation and the related learning success has not yet been investigated (Bloom, 1973; Aktinson, 1974; Heller, 1991; Helmke and Weinert, 1997). This gap is addressed in this study to better understand the influence of PSR on the learning process and also how the learning process could be improved through our already existing knowledge regarding PSR.

Literature and hypothesis

Parasocial interaction

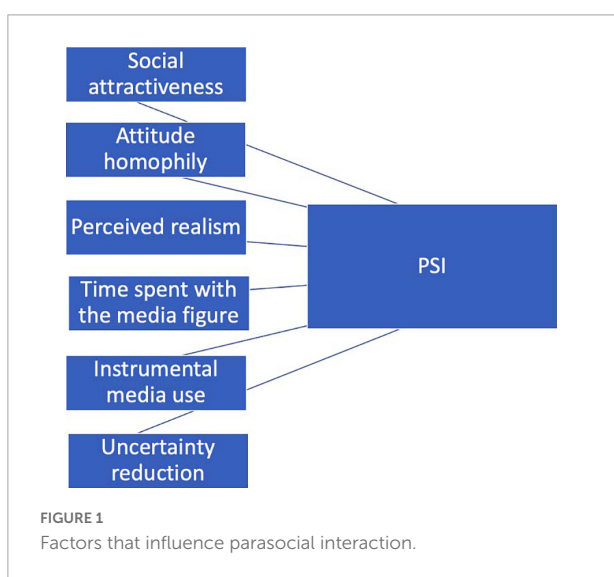
The PSI describes the connection between a media user and a media personality. Here, it is particularly important that the media user establishes a relationship with the media personality, although no direct contact takes place. This is called the PSR (Horton and Wohl, 1956; Rubin et al., 1985; Frederick et al., 2012). In media research, this phenomenon has been investigated again and again, and different factors that constitute this relationship have been identified.

These factors include the following: (i) social attractiveness: how likable a person is and how much a viewer wishes the media personality to be their friend (Rubin and McHugh, 1987; Lee and Watkinson, 2016), (ii) attitude homophily: similarity in the characteristics, beliefs, attitudes, etc., of the media personality and the viewer (Turner, 1993; Frederick et al., 2012), (iii) perceived realism: how authentic a media personality and the setting they are presenting in is (Rubin et al., 1985; Frederick et al., 2012), (iv) time spent watching the media personality: several studies have shown that the time a viewer spends watching the media personality correlates strongly with the

PSR (Frederick et al., 2012; Lee and Watkinson, 2016), (v) uncertainty reduction: a basic for fostering a relationship by getting to know more about the other person (Perse and Rubin, 1989), and (vi) instrumental media use: viewers use media not just for getting information but also for companionship (Frederick et al., 2012; Figure 1).

Historically, this term comes from the times of television and was created in 1956 by Donald Horton and Richard Wohl. It described the relationships between television presenters and their viewers. Strictly speaking, religious relationships between believers and their gods or between voters and politicians can also be seen as PSI. However, Horton and Wohl opined that media personalities, in particular, are good at PSI, because their relationship with the viewer is close to a friendship. They explained this with the fact that media personalities, or as they called them, persona, have no special talents and are more like ordinary characters to the viewers. Specifically, this relationship is not reciprocal, although at the same time the media personalities try to create the illusion that there is probably a mutual interaction. This also explains the term PSI, that is, the apparent social interaction (Horton and Wohl, 1956). However, the question here is, how do the media personalities manage to evoke this feeling? Basically, the camera takes the position of the viewer and the media personalities interact with the camera as if they were talking to a person or, more precisely, speaking directly to the viewer. Thus, the course of the interaction is controlled by the media personality. Therefore, the viewer can only react, by laughing or crying or even by directly addressing the television set—situations that probably every one of us has encountered (Potthoff, 2016).

In modern social media, PSI is more prevalent than ever. This could be because through the internet a limited, real interaction with the viewer is possible. Comments can be written and answered by the media personality. The creators of videos and photos on platforms such as YouTube or Instagram can take suggestions from their viewers and implement them promptly. Bond (2016) showed that participants who had just one online interaction with an internet persona but got a comment or a retweet in return had a higher PSR with this persona. Simultaneously, modern platforms with formats like vlogs build on the highest possible authenticity and proximity to the media. Vlogs stand for video blogs and are a documentation of the life of a media personality using video. Moreover, the effect of “normal” characters, as mentioned by Horton and Wohl (1956), is even more effective here, as any person can become a media personality by uploading a video or image of themselves. However, a second effect is more relevant here—people can write comments and even if their interaction is pretty low and media personalities cannot always reply, due to the sheer number of comments, this is still a form of interaction. Even if a viewer receives no reply, it is a more advanced version of PSI. Even more important should be the



factor of time spent together. Since videos are available online at any time, media users can spend even more time with their media personalities and thus build a stronger PSR. This has a huge impact, for example, on buying intentions as [Lee and Watkinson \(2016\)](#) examined in a study about luxury brands. In their study, participants were shown reviews of luxury fashion items by vloggers. Buying intention and PSI were measured.

The result showed that a strong correlation exists between PSI and buying intention. The higher the measured PSI, the more the positive perception and the desire to buy increased in the viewers. This has led to the question of whether these effects could also be used in the field of self-regulated learning (SRL) with educational videos to increase motivation and the learning effect.

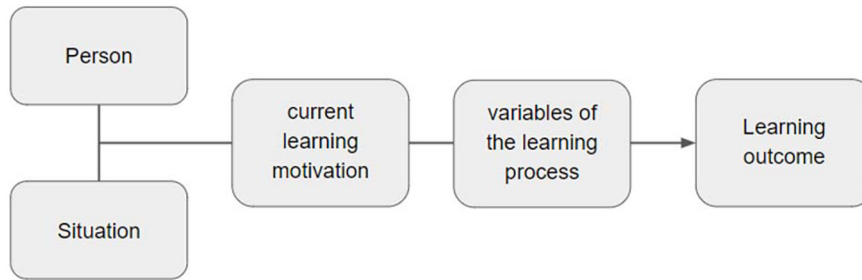


FIGURE 2
Motivation in self-regulated learning (compare [Rheinberg et al., 2000](#), p. 83).

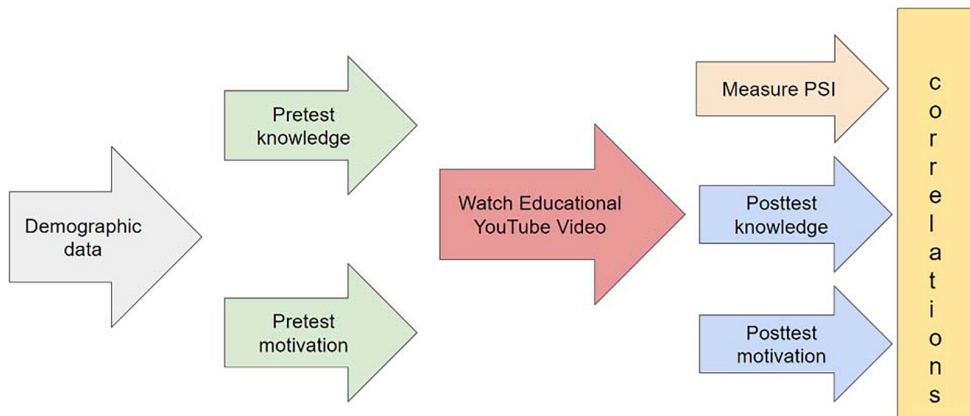


FIGURE 3
Research design.

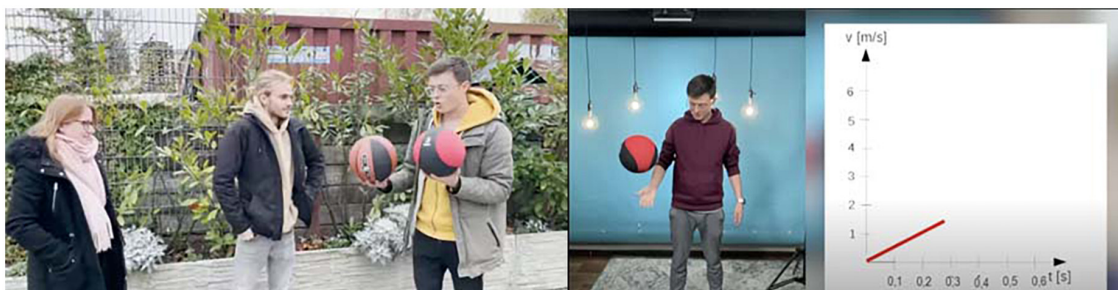


FIGURE 4
Screenshots of the video: (left) interview which addressed misconceptions, (right) experiment with animation of velocity over time of a falling ball.

Self-regulated learning and learning motivation

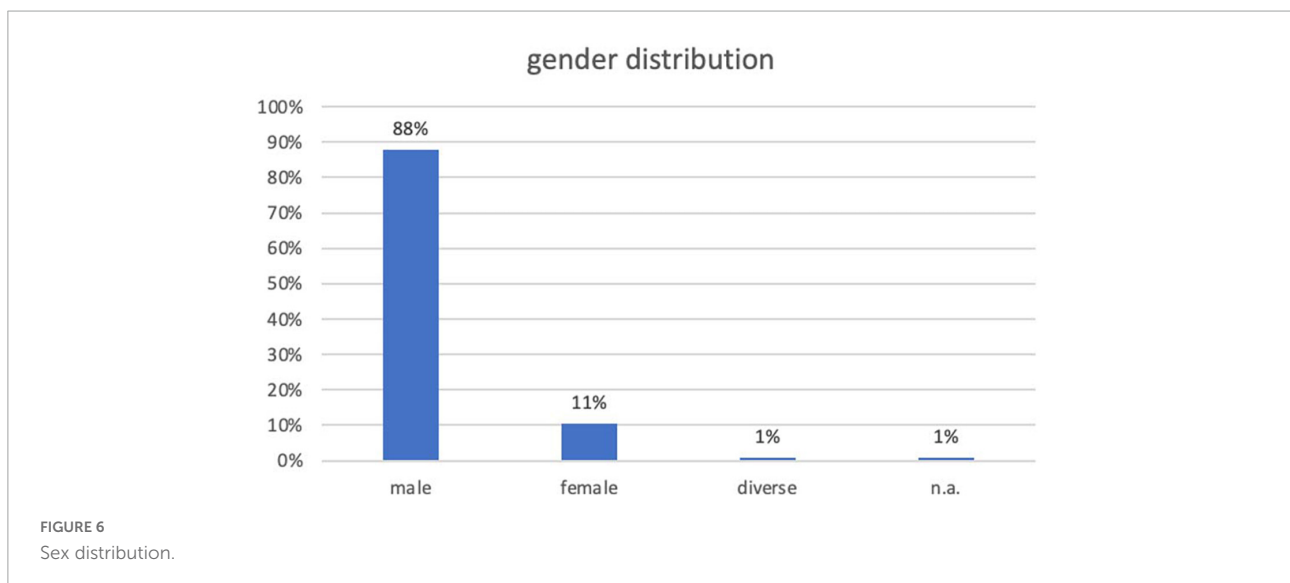
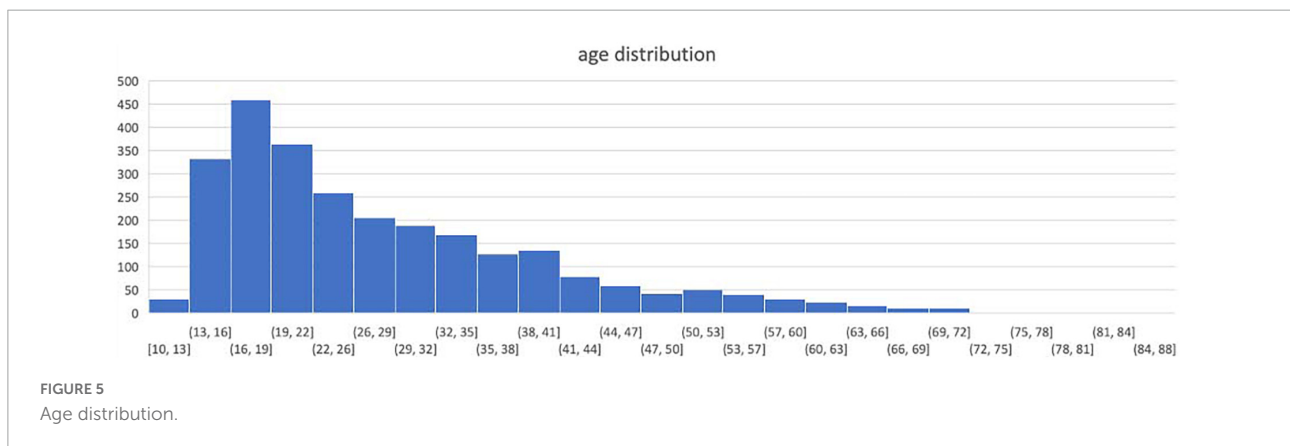
Self-regulated learning describes the learning process without a tutor for a specific goal (Rheinberg et al., 2000; van Alten et al., 2020). When learning through watching videos at home, chances are high that no tutor is controlling the learning process, thus, it is self-regulated. Over half of the pupils between the ages of 12 and 19 years in Germany, who watch YouTube videos at home, also learn from those videos (Jebe, 2019). Therefore, educational videos are often used for SRL. We define an educational video as one with the goal to convey knowledge and information (Beautemps and Bresges, 2021).

The SRL model consists of two parts: the “person and the situation characteristics” (Rheinberg et al., 2000, p. 82). The situation is defined by the setting of the learning environment, as well as the subject or the difficulty level of the learning material and other external aspects. The person comprises the “motives, interests, (...) motivational orientation” and so

on. The interaction between the person and the situation leads to the aspects of current learning motivation (Rheinberg et al., 2000, p. 83). This is not the only model for describing learning motivation as several other conceptual models exist, but most of them describe this interaction between the internal characteristics of the learner and the external factors of the environment (Harlen and Deakin, 2003), or in other words, the intrinsic and extrinsic motivation (Deci and Ryan, 2010).

In Rheinberg et al. (2000) model, the current learning motivation is affected by the variables that influence the learning process, before leading to the learning outcome. The variables that influence the learning process could be time spent on the task, how well the learning process works, and the state of the learner. The learning outcome describes what knowledge is acquired, if the student can transfer the newly learned knowledge to other tasks and if there is an increase in performance (Figure 2).

When learning through the videos, the presenter, specifically, the relationship with the presenter, is part of the learning situation and therefore should have a direct impact



on the learning motivation. This relationship can be described through the PSI.

Influence of parasocial interaction on learning outcomes

A study by [Lauricella et al. \(2011\)](#) on the subject researched whether 21-month-old babies learned better from a fantasy character they already know and with whom they have a PSR or from an unknown character. The study showed that the learning effect was greater with known characters. Another study compared different forms of educational videos and suggested that the PSR is important for viewers to accept a video ([Boy et al., 2020](#)). Another study focused on the PSI and not on the relationship, by using an unknown person and changing the perspective and distance with the person to influence the interaction. The study suggested that parasocial influences have a positive effect on learning outcomes ([Beege et al., 2017](#)). Furthermore, a study focused on the effects of gestures in instructional videos showed that there can be positive effect of parasocial effects on the learning outcome ([Beege et al., 2020](#)). The CASTLE theory by [Schneider et al. \(2021\)](#), which emphasizes the importance of social processes in learning in digital environments, states that parasocial processes affect not only learning success but also motivation, which has been studied further ([Beege et al., 2022](#)).

This leads to the two hypotheses of this study:

H1: There is a correlation between the parasocial relationship and learning growth when working with educational videos.

H2: There is a correlation between the parasocial relationship and learning motivation when working with educational videos.

Materials and methods

Participants

The study was done online using questionnaires and tests. Participants were recruited *via* shout-outs^{1 2} in YouTube videos and Instagram stories from various channels. The participants

1 "Shout-outs" are short commercial breaks in YouTube videos that are unrelated to the actual video, but are included by the creators themselves, which distinguishes them from classic advertising.

2 Example of one of the shout-outs for this study can be seen here <https://www.youtube.com/watch?v=O7e4ZsQDFVA> (at timecode 4:22).

were asked for voluntary participation and requested to respond without bias. The channels that promoted this survey were from the science and technology fields.

The demographic data of the participant were asked. Subsequently, the participants were asked to solve a pretest that includes two parts. The first part is a knowledge test on Newton's first and second laws. The second part measures learning motivation. The participants then watch a video, created to teach the above-mentioned concepts. This is followed by a posttest, which has the same questions as the pretest. Then, the PSR with the presenter of the video is measured with another questionnaire. The basis for the tests and questionnaires is presented in more detail below.

The correlations between the parasocial relationship and the increase in learning motivation and learning growth of the participants will be analyzed in the next steps ([Cohen, 1997](#); [Figure 3](#)).

Questionnaire for parasocial interaction

The questionnaire used in this study is based on a questionnaire by [Rubin et al. \(1985\)](#). The original question items focused on newscasters and were changed for this study to match presenters of educational videos. Specifically, this means that the word "newscaster" was replaced by "YouTuber," or the sentence "If my favorite newscaster were to appear on another TV show, I would watch that show" was rewritten as "If the YouTuber were to appear on another channel, I would watch these videos." The entire questionnaire was in German, as the participants used that language. A translated version and the original version can be found in the appendix.

Questionnaire motivation

To measure the current learning motivation, the FAM test is used ([Rheinberg, 2000](#)). The test consists of 18 items to measure four components of learning motivation, namely, (1) fear of failure, (2) probability of success, (3) interest, and (4) challenge.

Fear of failure includes items related to the negative impact of the fear of failing the task. The items related to the probability of success measure the confidence of the participants to succeed in the task, which positively impacts the performance. The items related to the interest measure the assessment of the participant toward the topic. The component of the challenge measures to what extent the participant considers the exercise as a performance check.

The original questionnaire was developed to measure the learning motivation for a task where participants need to figure out the relation structure of a complex linear system at the computer. The questionnaire was slightly changed to fit the topic of this study ([Rheinberg, 2000](#)).

Questionnaire knowledge query

The pre- and post-test for the learning process gain questions from the German translation of the force concept inventory (FCI) (Hestenes et al., 1992). The seven selected questions covered topics regarding Newton’s first and second laws. The knowledge was tested before and after watching the video and answering the questions on PSI. The change in learning growth and learning motivation was calculated using Cohen (1997)’s D, to avoid the problem that people who already attempt the test with much prior knowledge or a high level of motivation can still be compared with those who have very limited prior knowledge and can, thus, still gain many points in the posttest.

$$D = \frac{\bar{x}_{post} - \bar{x}_{pre}}{SD}$$

The formula for Cohen’s D

Video

The video started with interviews that showed possible misconceptions about Newton’s laws. This starting was chosen because research by Muller et al. (2007) showed that addressing possible misconceptions in educational videos can improve learning outcomes. Subsequently, experiments that showed Newton’s laws accompanied by explanations through speech and small animations which gave background details and explained why the misconceptions of the interviews did not work out were shown (Figure 4).

The video was 4 min 28 s long and included the researcher, who is a German Science YouTuber, as the presenter.

Results

In total, 1,512 participants were eliminated from the survey because their questionnaires were incomplete or they finished the questionnaire in less than 5 min; we assumed that they probably only clicked through the questionnaire once because the video alone took 4 min 29 s to watch.

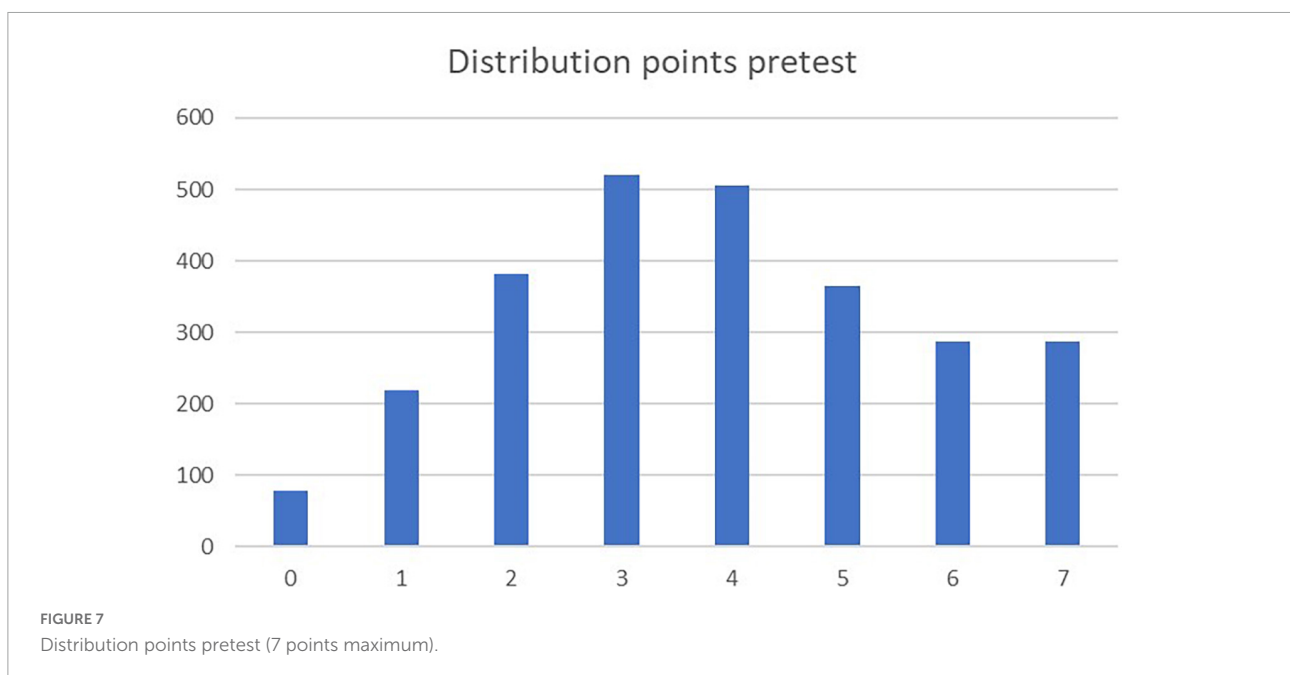
Thus, we retained 2,643 participants. The age distribution was from 10 to 86 years, and most participants were between 13 and 22 years. A more detailed distribution can be seen in Figure 5.

The sex distribution was strongly skewed with 88% male, 11% female, 1% diverse, and 1% not specified. This is due to the fact that the test participants were particularly addressed via various YouTube channels, and the audience here is often male (Figure 6).

All calculations of correlation were done using SPSS v28.0.1.1 (14).

Learning growth

In the pretest, the participants scored an average of 3.8 points, with a standard deviation of 1.9. In the posttest, the average score was 4.7 with a standard deviation of 1.6. The maximum score achievable was 7 points. Thus, an average score increase of 0.84 points was achieved after the completion of the



video unit, with a standard deviation of 1.3. The Cohen's D of the video learning unit was, thus, 0.65, which corresponds to a medium effect.

Learning growth

	N	Minimum	Maximum	Mean	SD
Diff	2643	-7,00	7,00	,8453	1,30823
Valid values (listwise)	2643				

Parasocial interaction

The PSI questionnaire was evaluated by taking the mean values. The mean score from the PSI was 3.21, with a standard deviation of 0.57. The scale ranged from 0 to 5, with 0 indicating very weak attachment and 5 indicating very strong attachment.

PSI

	N	Minimum	Maximum	Mean	SD
PSI_Mean	2621	1,29	4,95	3,2136	,56830
Valid values (listwise)	2621				

The correlation between the PSI mean and the learning gain with Cohen's D was determined. The correlation of 0.04 was found to be very weak and not significant.

Correlations

Correlation PSI – Learning growth

	PSI_Mean	Cohens_D
PSI_Mean	Pearson correlation	1
	Sig. (2-seitig)	,039
	N	2621
Cohens_D	Pearson correlation	,039
	Sig. (2-seitig)	,106
	N	1704

When the data set was split on the basis of the sex of the participants, no strong correlations were detected.

Upon studying the PSI mean and the individual motivational factors closely, some correlations emerged.

Correlations male

	PSI_Mean	Cohens_D
PSI_Mean	Pearson Correlation	1
	Sig. (2-tailed)	,052*
	N	2323
Cohens_D	Pearson Correlation	,052*
	Sig. (2-tailed)	,046
	N	1473

*Correlation is significant at the 0.05 level (2-tailed).

Correlations female

	PSI_Mean	Cohens_D
PSI_Mean	Pearson correlation	1
	Sig. (2-tailed)	-,044
	N	251
Cohens_D	Pearson correlation	-,044
	Sig. (2-tailed)	,538
	N	197

There was a slight correlation between the PSI score of an individual and the interest in a topic with $\rho = 0.187$ and between the PSI score and the challenge (to what extent the participants considered the task as a performance check)—with $\rho = 0.11$, both with a two-sided significance level of 0.01.

Upon dividing the participants into two groups based on their sex, it was found that the correlation was stronger with the female viewers than with the male viewers. For example, the female viewers had 1.3 times stronger correlation with the factor interest and a 2.1 times stronger correlation with the challenge.

Discussion

The study showed that the first hypothesis was not confirmed. This is in contrast to another study by Lauricella et al., who measured a correlation in young children. This difference could be due to the significantly older age of the participants in their research. However, the results are also in contrast with other studies that suggest a positive influence of the PSR on the learning effect (Beege et al., 2017, 2020; Boy et al., 2020). One effect that led to this difference probably is the difference in the measurement of the PSI, PSR, especially since some studies deliberately focused on the PSI rather than PSR. Furthermore, the audience was acquired through channels that focus on science, technology, engineering, and mathematics (STEM) content, and this might

**Correlation
PSI –
Motivation**

	PSI Mean	M) Fear of failure	E) Proba- bility of success	I) Interest	H) Challenge
PSI Mean					
Pearson- Correlation	1	,073**	,063**	,187**	,110**
Sig. (2-seitig)		<,001	,001	<,001	<,001
N	2621	2222	2614	2522	2603
M) Fear of failure					
Pearson- Correlation	,073**	1	–,084**	–,044*	,174**
Sig. (2-seitig)	<,001		<,001	,038	<,001
N	2222	2224	2219	2174	2217
E) Probability of success					
Pearson- Correlation	,063**	–,084**	1	,027	,405**
Sig. (2-seitig)	,001	<,001		,179	<,001
N	2614	2219	2626	2522	2609
I) Interest					
Pearson- Correlation	,187**	–,044*	,027	1	,188**
Sig. (2-seitig)	<,001	,038	,179		<,001
N	2522	2174	2522	2524	2512
H) Challenge					
Pearson- Correlation	,110**	,174**	,405**	,188**	1
Sig. (2-seitig)	<,001	<,001	<,001	<,001	
N	2603	2217	2609	2512	2614

*The correlation is significant at the 0.05 level (2-sided).
**The correlation is significant at the 0.01 level (2-sided).

influence the results, because of the higher prior knowledge of the participants. As seen in **Figure 7**, the participants' prior knowledge tended to be higher, and as many as 11% of the participants achieved the maximum score in the pretest.

The second hypothesis was partially confirmed. It has been shown that there is a slight increase in correlation between learning motivation and PSI. This correlation was measured especially in the area of “interest” with $\rho = 0,187$. This could indicate that the interest of a person in a topic could be strengthened by a stronger relationship between the presenter and the viewer. This positive effect on learning motivation supports previous research (Beege et al., 2022) and the CASTLE theory by Schneider et al. (2021).

Other studies have also shown a positive influence of motivation on learning success, thus, we can conclude that the PSR and parasocial interaction have a positive influence on learning (Robbins et al., 2004; Hattie, 2009; Wigfield et al., 2016). While this study did not measure any short-term learning gain, it may be that a long-term learning session with a presenter

**Correlations
Male PSI –
Motivation**

	PSI Mean	M) Fear of failure	E) Proba- bility of success	I) Interest	H) Challenge
PSI Mean					
Pearson Correlation	1	,073**	,073**	,179**	,098**
Sig. (2-tailed)		,001	<,001	<,001	<,001
N	2323	1961	2317	2231	2306
M) Fear of failure					
Pearson Correlation	,073**	1	–,086**	–,035	,166**
Sig. (2-tailed)	,001		<,001	,123	<,001
N	1961	1963	1959	1919	1957
E) Probability of success					
Pearson Correlation	,073**	–,086**	1	,023	,427**
Sig. (2-tailed)	<,001	<,001		,268	<,001
N	2317	1959	2328	2231	2312
I) Interest					
Pearson Correlation	,179**	–,035	,023	1	,183**
Sig. (2-tailed)	<,001	,123	,268		<,001
N	2231	1919	2231	2233	2222
H) Challenge					
Pearson Correlation	,098**	,166**	,427**	,183**	1
Sig. (2-tailed)	<,001	<,001	<,001	<,001	
N	2306	1957	2312	2222	2316

**Correlation is significant at the 0.01 level (2-tailed).

where there is a strengthened relationship could have a positive effect on learning gains. This should be investigated in more detail in the future.

The difference in the correlation between the PSI and learning motivation in relation to the sex of the participant is difficult to explain. Other research by Jonathan Cohen showed that women form stronger PSR (Cohen, 1997); however, there were no big differences in our data between the PSI of female and male viewers.

Limitations and further research

One limitation of this research is that it is only a short-term measure of the correlation between PSI and learning growth and motivation. Further research should investigate if there are long-term effects between a higher PSI and learning and motivation.

Furthermore, the number of women in the group was less than the number of men, which was not ideal. The participants were all acquired by social media channels related

Correlations female PSI - Motivation

	PSI_Mean	M) Fear of failure	E) Probability of success	I) Interest	H) Challenge
PSI_Mean					
Pearson Correlation	1	,023	−,056	,250**	,209**
Sig. (2-tailed)		,732	,377	<,001	<,001
N	251	224	251	248	250
M) Fear of failure					
Pearson Correlation	,023	1	−,100	−,097	,165*
Sig. (2-tailed)	,732		,134	,149	,014
N	224	224	224	221	223
E) Probability of success					
Pearson Correlation	−,056	−,100	1	,053	,069
Sig. (2-tailed)	,377	,134		,403	,279
N	251	224	251	248	250
I) Interest					
Pearson Correlation	,250**	−,097	,053	1	,208**
Sig. (2-tailed)	<,001	,149	,403		<,001
N	248	221	248	248	247
H) Challenge					
Pearson Correlation	,209**	,165*	,069	,208**	1
Sig. (2-tailed)	<,001	,014	,279	<,001	
N	250	223	250	247	250

*Correlation is significant at the 0.05 level (2-tailed).
 **Correlation is significant at the 0.01 level (2-tailed).

Descriptive statistics Male

	N	Minimum	Maximum	Mean	Std. Deviation
PSI_Mean	2323	1,29	4,95	3,2147	,56175
Valid N (listwise)	2323				

Descriptive statistics Female

	N	Minimum	Maximum	Mean	Std. Deviation
PSI_Mean	251	1,53	4,53	3,2083	,60813
Valid N (listwise)	251				

to STEM, and this could have had an influence on the results, which is another limitation of the study. Further research

should analyze a more diverse group of people, with different backgrounds and interests.

The study indicates that the personality in videos has a positive effect on learning motivation and no effect on learning gains—at least when it comes to short-term learning success. This might mean that even in the real-world classroom, teacher personality has an effect primarily on motivation but not so much on student understanding.

Using the knowledge of PSI, the relationship between teacher and learners could be strengthened by enhancing the effects that proved to have a positive impact on the PSR. These can include, for example, time spent with a person (Frederick et al., 2012; Lee and Watkinson, 2016) or authenticity (Rubin et al., 1985; Frederick et al., 2012). These possible effects in the classroom should be investigated in further research, as they can prove to be immensely beneficial in teachers’ training.

Data availability statement

The raw data supporting the conclusions of this article will be made available by the authors, without undue reservation.

Ethics statement

Ethical review and approval was not required for the study on human participants in accordance with the local legislation and institutional requirements. Written informed consent from the participants’ legal guardian/next of kin was not required to participate in this study in accordance with the national legislation and the institutional requirements.

Author contributions

JB and AB contributed to conception and design of the study and performed the analysis of the data. JB produced the video, assembled the questionnaires, and wrote the manuscript. AB feedbacked the video and the questionnaire and checked and corrected the manuscript. Both authors contributed to manuscript revision, read, and approved the submitted version.

Acknowledgments

We acknowledge support for the Article Processing Charge from the DFG (German Research Foundation, 491454339).

Conflict of interest

The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

Publisher's note

All claims expressed in this article are solely those of the authors and do not necessarily represent those of their affiliated

organizations, or those of the publisher, the editors and the reviewers. Any product that may be evaluated in this article, or claim that may be made by its manufacturer, is not guaranteed or endorsed by the publisher.

Supplementary material

The Supplementary Material for this article can be found online at: <https://www.frontiersin.org/articles/10.3389/feduc.2022.1021798/full#supplementary-material>

References

- Atkinson, J. W. (1974). "Motivational determinants of intellectual performance and cumulative achievement," in *Motivation and achievement*, eds J. W. Atkinson and J. O. Raynor (Washington, DC: Winston), 389–410.
- Beautemps, J., and Bresges, A. (2021). What comprises a successful educational science youtube video? A five-thousand user survey on viewing behaviors and self-perceived importance of various variables controlled by content creators. *Front. Commun.* 5:600595. doi: 10.3389/fcomm.2020.600595
- Beege, M., Krieglstein, F., and Arnold, C. (2022). How instructors influence learning with instructional videos—the importance of professional appearance and communication. *Comput. Educ.* 185:104531. doi: 10.1016/j.compedu.2022.104531
- Beege, M., Ninaus, M., Schneider, S., Nebel, S., Schlemmel, J., Weidenmüller, J., et al. (2020). Investigating the effects of beat and deictic gestures of a lecturer in educational videos. *Comput. Educ.* 156:103955. doi: 10.1016/j.compedu.2020.103955
- Beege, M., Schneider, S., Nebel, S., and Rey, G. D. (2017). Look into my eyes! Exploring the effect of addressing in educational videos. *Learn. Instr.* 49, 113–120. doi: 10.1016/j.learninstruc.2017.01.004
- Bloom, B. S. (1973). "Individuelle unterschiede in der schulleistung: ein überholtes problem?," in *Bedingungen des bildungsprozesses*, eds W. Edelstein and D. Hopf (Stuttgart), 251–284.
- Bond, B. J. (2016). Following your "friend": social media and the strength of adolescents' parasocial relationships with media personae. *Cyberpsychol. Behav. Soc. Net.* 19, 656–660. doi: 10.1089/cyber.2016.0355
- Boy, B., Bucher, H.-J., and Christ, K. (2020). Audiovisual science communication on TV and YouTube. How recipients understand and evaluate science videos. *Front. Commun.* 5:608620. doi: 10.3389/fcomm.2020.608620
- Cohen, J. (1997). Parasocial relations and romantic attraction: gender and dating status differences. *J. Broadcast. Electr. Media* 41, 516–529. doi: 10.1080/08838159709364424
- Deci, E. L., and Ryan, R. M. (2010). Intrinsic motivation. *Corsini. Encyclop. Psychol.* 2010:467. doi: 10.1002/9780470479216.corpsy0467
- Frederick, E. L., Lim, C. H., Clavio, G., and Walsh, P. (2012). Why we follow: an examination of para-social interaction and fan motivations for following athlete archetypes on twitter. *Int. J. Sport Commun.* 5, 481–502. doi: 10.1123/ijsc.5.4.481
- Harlen, W., and Deakin, C. R. (2003). Testing and motivation for learning. *Assess. Educ. Princ. Policy Pract.* 10, 169–207. doi: 10.1080/0969594032000121270
- Hattie, J. A. C. (2009). *Visible learning: a synthesis of 800+ meta-analyses on achievement*. Oxford: Routledge.
- Heller, K. A. (1991). "Schuleignungsprognostik" in *Begabungsdiagnostik in der schul- und erziehungsberatung*, ed. K. A. Heller (Bern: Huber), 213–235.
- Helmke, A., and Weinert, F. E. (1997). "Bedingungsfaktoren schulischer leistungen," in *Enzyklopädie der psychologie. serie pädagogische psychologie, psychologie des unterrichts und der schule*, ed. F. E. Weinert (Göttingen: Hogrefe), 71–176.
- Hestenes, D., Wells, M., and Swackhamer, G. (1992). Force concept inventory. *Phys. Teach.* 30:141. doi: 10.1119/1.2343497
- Horton, D., and Wohl, R. R. (1956). Mass communication and para-social interaction: observations on intimacy at a distance. *Psychiatry* 19, 215–229. doi: 10.1080/00332747.1956.11023049
- Jebe, B. C. (2019). Effective educational videos: principles and guidelines for maximizing student learning from video content. *CBE Life Sci. Educ.* 15:es6. doi: 10.1187/cbe.16-03-0125
- Lauricella, A. R., Gola, A. A., and Calvert, S. L. (2011). Toddlers' learning from socially meaningful video characters. *Med. Psychol.* 14, 216–232. doi: 10.1080/15213269.2011.573465
- Lee, J. E., and Watkinson, B. (2016). YouTube vloggers' influence on consumer luxury brand perceptions and intentions. *J. Bus. Res.* 69, 5753–5760. doi: 10.1016/j.jbusres.2016.04.171
- Muller, D. A., Bewes, J., Sharma, M. D., and Reimann, P. (2007). Saying the wrong thing: Improving learning with multimedia by including misconceptions. *J. Comput. Assist. Learn.* 24, 144–155. doi: 10.1111/j.1365-2729.2007.00248.x
- Perse, E. M., and Rubin, R. B. (1989). Attribution in social and parasocial relationships. *Commun. Res.* 16, 59–77. doi: 10.1177/009365809016001003
- Potthoff, M. (2016). *Schlüsselwerke der medienwirkungsforschung*. Berlin: Springer Fachmedien Wiesbaden.
- Rheinberg, F. (2000). *Motivation*. Stuttgart, Germany: Kohlhammer.
- Rheinberg, F., Vollmeyer, R., and Burns, B. D. (2000). Motivation and self-regulated learning. *Adv. Psychol.* 2000, 81–108. doi: 10.1016/s0166-4115(00)80007-2
- Robbins, S. B., Lauver, K., Le, H., Davis, D., Langley, R., and Carlstrom, A. (2004). Do psychosocial and study skill factors predict college outcomes? A meta-analysis. *Psychol. Bull.* 130, 261–288. doi: 10.1037/0033-2909.130.2.261
- Rosenthal, S. (2017). Motivations to seek science videos on YouTube: Free-choice learning in a connected society. *Int. J. Sci. Educ. B* 8, 22–39. doi: 10.1080/21548455.2017.1371357
- Rubin, A. M., Perse, E. M., and Powell, R. A. (1985). Loneliness, parasocial interaction, and local television news viewing. *Hum. Commun. Res.* 12, 155–180. doi: 10.1111/j.1468-2958.1985.tb00071
- Rubin, R. B., and McHugh, M. (1987). Development of parasocial interaction relationships. *J. Broadcast. Electr. Med.* 31, 279–292. doi: 10.1080/08838158709386664
- Schneider, S., Beege, M., Nebel, S., Schnaubert, L., and Rey, G. D. (2021). The cognitive-affective-social theory of Learning in digital environments (CASTLE). *Educ. Psychol. Rev.* 34, 1–38. doi: 10.1007/s10648-021-09626-5
- Turner, J. R. (1993). Interpersonal and psychological predictors of parasocial interaction with different television performers. *Commun. Quart.* 41, 443–453.
- van Alten, D. C. D., Phielix, C., Janssen, J., and Kester, L. (2020). Self-regulated learning support in flipped learning videos enhances learning outcomes. *Comput. Educ.* 158:104000. doi: 10.1016/j.compedu.2020.104000
- Wigfield, A., Tonks, S., and Klauda, S. L. (2016). "Expectancy-value theory," in *Handbook of motivation in school*, 2nd Edn, eds K. R. Wentzel and D. B. Miele (New York, NY: Routledge), 55–74.