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Parasocial Learning - The Impacts of Social Entities in Learning with Educational Videos

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Parasoziales Lernen – Der Einfluss von sozialen Entitäten in Lehr-/Lernvideos

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Abstract

This thesis summarizes three papers (*Look into my eyes! Exploring the effect of addressing in educational videos*; *Ageism – Age coherence within learning material fosters learning* and *Mood-affect congruency. Exploring the relation between learners' mood and the affective charge of educational videos*) published in peer-reviewed journals (*Computers in Human Behavior*, *Computers & Education* and *Learning and Instruction*). This thesis will provide the theoretical background in terms of educational videos, emotional design, and social cues in multimedia learning. The most important basic theories and design principles will be outlined. Social and affective mechanics will be discussed, and their influence on cognitive, affective, and social processes will be broken down. Based on the discussed literature, research gaps will be identified and the resulting experimental methodology and operationalization of social and affective cues within video settings will be described. Furthermore, the results of the studies will be outlined and interpreted. The social-psychological perspective and the role of social entities in instructional videos have rarely been investigated to date; therefore, this thesis adds value to the field of multimedia learning and media psychology. Since several psychological mechanisms were investigated, theory-based, theoretical, and practical implications, as well as limitations and future directions, will be outlined and discussed.

Introduction

Since the beginning of the 21st century, easier access to fast internet and a decrease in technical barriers have made the production, processing, and distribution of videos possible for nearly everyone. In addition to entertainment videos, instructional videos have gained popularity as well and are increasingly used to supplement and replace classical classroom education. In particular, massive open online course (MOOCs) are traditionally video-based. These platforms for computer-mediated online education attract more than two million learners from more than 200 countries each year (Coursera; Waldrop, 2013). In addition, over 5.8 million students participated in at least one online course during their university education (Allen, Seaman, Poulin, & Straut, 2016). Video platforms like YouTube offer a wide range of videos with an instructional purpose including web lectures (Chen & Wu, 2015), knowledge clips (Day, 2008), and demonstration videos (Van der Meij & Van der Meij, 2013) which can be accessed by a wide range of potential viewers. The popularity of these types of instructional videos raises the question of how instructional videos should be designed in order to foster learning processes.

Even though the film medium has a long research tradition (e.g., Horton & Wohl, 1956) and the influence of various video elements on recipients has been investigated thoroughly (e.g., Coyne, Padilla-Walker, Holmgren, Davis, Collier, Memmott-Elison & Hawkins, 2018), the effective design of audiovisual instruction, especially novel elements of instructional design which have become affordable, has received little attention from researchers (Kizilcec, Bailesnson, & Gomez, 2015). By exploring the effects of an explicit design feature, social entities in instructional videos, on learning processes, this thesis contributes to an ongoing discussion of video-based learning and provides design recommendations for audio-visual instruction. The synopsis will summarize three research papers published in peer-reviewed journals. The theoretical background and the research methodology of the individual

experiments will be outlined. Furthermore, a summary of the quantitative analysis methods and results will be provided and discussed in order to highlight their scientific value and to integrate the results of the experiments into the current research landscape.

First, the goals and frame for the research will be defined. Current research regarding social entities in learning environments, especially instructional videos, will be outlined. Since the included experiments are strongly theory-driven, fundamental theories regarding learning with multimedia will be described. Next, selected theories regarding the relevant design features of social entities will be discussed, and a short overview of the included studies will be presented. The published articles will be presented in the original journal layouts followed by a discussion in which the results of the three studies will be combined and interpreted. Finally, major theoretical and practical implications will be outlined, and limitations and future directions for research in the field will be discussed.

Social Entities in Learning Environments

The appearance of social entities can vary across different multimedia learning environments. In student textbooks, social entities are implemented in order to exchange information or stimulate social identification. For example, English textbooks for secondary students in Germany contain characters that appear repeatedly throughout the book in order to help students with difficult vocabulary or grammar issues. These characters are shown as pictures and are given names so students can remember them (see Figure 1). While the characters are not an explicit instructor, they are interwoven with the learning material in order to strengthen social responses (e.g., Gunawardena, 1995). Furthermore, real-world contexts increase student engagement (Alexander & Jetton, 1996), highlight personal relevance (Walkington, 2013), and can decrease anxiety (Martinez, 1987).

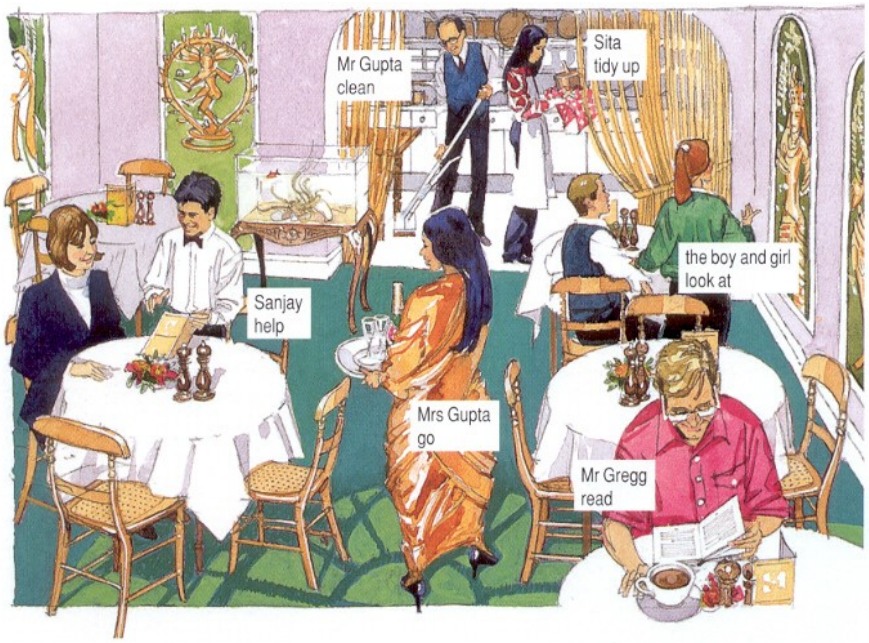

Figure 1. English G 2000 I,3; Cornelsen Verlag, Berlin, 1997 (2002), page 48.

In addition to static media such as textbooks, dynamic videos include social entities as well. Many instructional environments include a visual instructor. Even if the material does not

contain an explicit instructor, an additional component with a visual social entity is frequently included (see Figure 2).

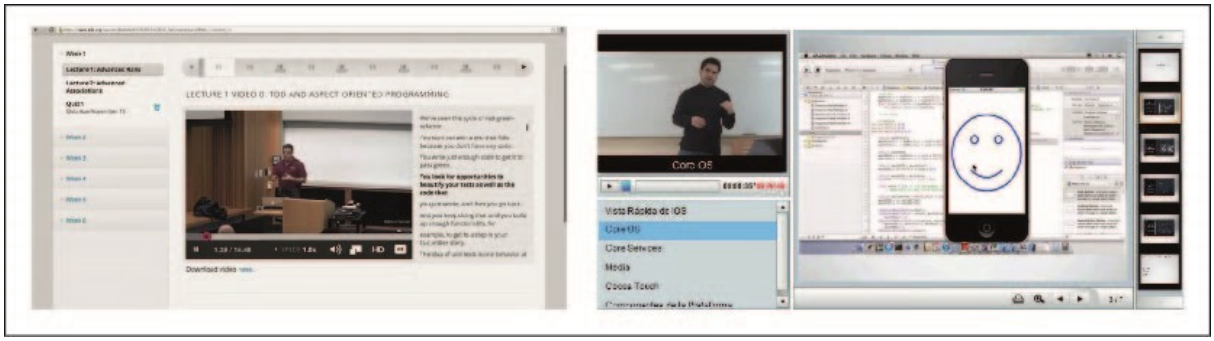

Figure 2. Left: MOOC with integrated lecturer (retrieved from Marcus, 2013); right: MOOC with additional lecturer (Hernandez, Gütl, & Chang, 2013; retrieved from Shehadeh & Guetl, 2016).

Therefore, social entities have different relevant learning tasks. In instructional videos, the social entity is often an explicit instructor who provides information aurally (e.g., Hoogerheide, van Wermeskerken, Loyens, & van Gog, 2016). Most instructional videos use real people, but fictional characters like cartoons are used as well, especially when teaching children (e.g., Lauricella, Gola, & Calvert, 2011). Since faces attract a significant amount of attention (Yee, Bailenson, & Rickertsen, 2007) since the viewer's gaze is automatically drawn to human or human-like faces (e.g., Beattie, Webster, & Ross, 2010). Other possible roles of social entities in learning environments are demonstrating, coaching, and testing (Schroeder & Gotch, 2015). In interactive learning environments, social entities can demonstrate tasks, provide individualized feedback or assistance, and act as administrators in order to test learners. Social entities in these interactive learning environments are defined as pedagogical agents. Pedagogical agent is a broad term used to classify virtual characters which are implemented in learning environments in order to facilitate learning (e.g., Lin, Arkinson, Christopherson, Joseph, & Harrison, 2013) and respond to learners' questions and problems (Veletsianos, Miller, & Doering, 2009). Pedagogical agents are not primarily real people. Fictional

characters, comic figures, and human-like anime figures are common as well (see Figure 3). Pedagogical agents can foster learning outcomes as well as motivational variables, but the results are currently inconsistent (Heidig & Clarebout, 2011; Schroeder, Adesope, & Gilbert, 2013).

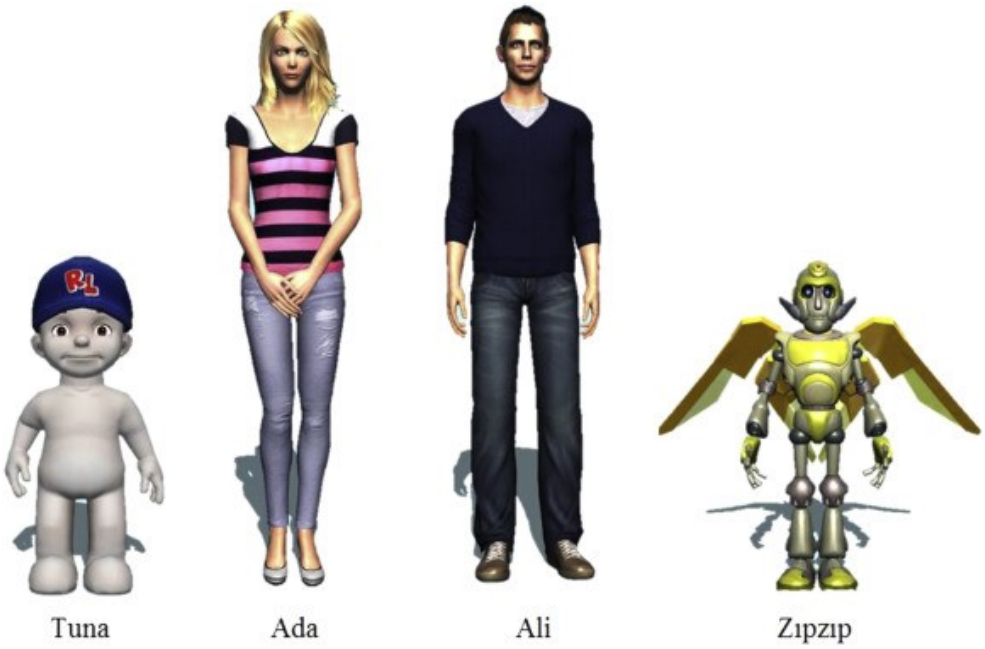

Figure 3. Different pedagogical agents (Dinçer & Doğanay, 2017).

Besides persons or agents, social entities are integrated into learning environments so that only relevant body parts are visible (see Figure 4). Especially in demonstration videos, hands or arms are visible to provide a more realistic context and show concrete movements to enhance understanding and teach new skills (e.g., Van Gog, Vereer, & Vereer, 2014). The appearance and behavior of social entities is also important for instructional material. For example, lecturers in instructional videos vary in terms of clothing, age, gender, and other visible features. Therefore, learning-relevant factors of social entities, such as the perceived similarity of the lecturer to the learner (Montoya & Horton, 2013) or perceived expertise of the lecturer (e.g., Simon, Ditrichs, & Speckhart, 1975), vary across instructional media.

Figure 4. Instructional video with visible hands in first-person perspective (Fiorella, van Gog, Hoogerheide, & Mayer, 2017).

The behavior of social entities is also crucial for learning success. For example, lecturers or pedagogical agents may gesture differently. Social entities can interact with learning material (see Figure 5) through signaling gestures which help the learners to connect different information (Wang, Li, Mayer, & Liu, 2018). On the other hand, behavior and gestures unrelated to learning can distract learners from relevant information (Clark & Choi, 2005).

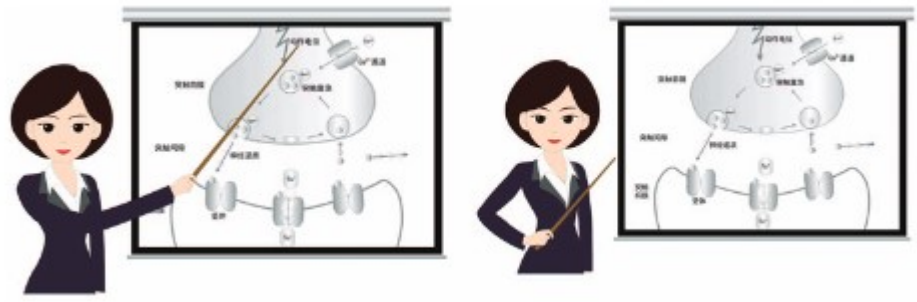

Figure 5. Gesturing of pedagogical agents (Wang, Li, Mayer, & Liu, 2018).

In addition to gesturing styles, lecturers have a different articulation styles, speech rates, and general appearances. All of these variables influence learning processes and should be

considered when designing instructional material (Beege, Schneider, Nebel, Schlemmel, Weidenmüller, & Rey, in prep; Beege, Schneider, Nebel, & Rey, submitted).

In summary, social entities are implemented in a wide range of instructional materials. These entities serve to transfer and support knowledge and provide social identification in static, dynamic, and interactive learning environments. Additionally, instructors and pedagogical agents differ in terms of task, appearance, and behavior. It is clear that research regarding social entities in instructional videos has a high practical relevance. Since designing an instructor, filming instructional videos or programming, and designing pedagogical agents increase production cost, design recommendations should be specified. The influence of social processes on learning processes and other cognitive, affective, and motivational process variables, as well as boundary conditions of learning with and from social entities, will be outlined within this synopsis and the three included papers.

Theoretical Foundation

Social Agency Theory and the CASA Paradigm

Teachers who act as instructors or supporters are common in classical classroom learning environments. The presence of a real social entity triggers social communication processes, attention, evaluation processes, and learning-relevant behavior since learners know teachers can react to their behavior and learning can be designed interactively. In contrast, when learners are watching instructional videos, learners are aware that they have entered a non-reciprocal reception situation (Hartmann, Schramm, & Klimmt, 2004a). This raises the question of how learners are influenced by social cues and entities in computer or video-mediated learning environments. One answer is provided by the social agency theory (Mayer, Sobko, & Mautone, 2003) and the Computers-Are-Social-Actors Paradigm (CASA; Nass, Steuer, & Tauber, 1994). According to the social agency theory, computer or video-based instructions are primarily interpreted as a social event (Moreno & Mayer, 2000; Reeves & Nass, 1996). Social cues in a multimedia environment (e.g., eye contact, voice, gestures) prime a social activation schema, which triggers processes of human-to-human communication (cooperation principle; Grice, 1975). According to Mayer (2001), deep cognitive processes like selecting, organizing, and integrating relevant information into a coherent mental model are enhanced because learners not only interpret computer-mediated instructions as pieces of information but also as a situation involving social communication. This is due to the fact that processes of social perception are highly automatic (Kanning, 1999); even simple social cues lead to social categorization, regardless of whether an actual person is part of the learning environment or the person is computer-mediated (Biocca & Harms, 2002).

Overall, the CASA paradigm supports the theoretical implications of the social agency theory. A human-computer interaction (and relationship) is primarily social. Social responses to computers are commonplace, unavoidable, and easy to generate (Lee & Nass, 2003). Simple

cues such as human-like voices or personification (through direct addressing and eye contact) within a multimedia environment create the sense of a social presence (awareness of another social entity during a communication process; Lee & Nass, 2003) and lead to a social response. Cues of humanness encourage individuals to apply social rules and promote cognitive processes (Nass & Moon, 2000).

In summary, the cognitive, affective, and behavioral repertoire of human-computer interaction is compellingly similar to human-human interaction (e.g., Perse & Rubin, 1989). Social entities in instructional videos activate similar interaction patterns as social entities in real-life learning environments and influence the cognitive, affective, and motivational variables of potential learners; therefore, the design and the behavior of these entities should be topic of thorough research in order to optimize instructional videos.

Learning with Multimedia

As a basis for investigating the effects of social entities on learning processes, five fundamental theories will be described. One of the most significant influences in research regarding multimedia learning is the widely acknowledged cognitive load theory (CLT; Sweller, 1994; Sweller, Ayres, & Kalyuga, 2011; Kalyuga & Singh, 2016). The theory distinguishes between a long-term memory and working memory. The long-term memory has an unlimited capacity (Sweller, Ayres, & Kalyuga, 2011), and all information is permanently stored in the long-term memory, organized into schemas (Paas & Ayres, 2014). Schemas are cognitive structures which provide generalized knowledge and determine cognitive processes (Paas & Van Merriënboer, 1994). Learning is defined as generating new schemas or the modification of pre-existing schemas in the long-term memory (Paas, & Sweller, 2014). Schema construction implies that new information has to be processed within the working memory consciously and permanently (Kalyuga & Singh, 2016). In contrast to the long-term memory, the capacity of the working memory is very limited in regard to time and the amount

of information which can be processed (Cowan, 2001). According to Sweller (2011), the working memory has a limit of two to three novel elements and a time limit of 20 seconds. The load on the learner's working memory which is induced while generating or modifying schemas is defined as the multidimensional construct of a cognitive load (Paas & Van Merriënboer, 1994). According to current literature concerning the CLT (e.g., Kalyuga & Singh, 2016), two types of cognitive loads are distinguished. The first major type is the intrinsic (productive) load which is the unavoidable load necessary for accomplishing a specific goal (Kalyuga & Plass, 2017). The load arises from cognitive processing of learning-relevant information and is dependent on the prior knowledge of the learner as well as on the element-interactivity (Sweller, Ayres, & Kalyuga, 2011). The second major type is the extraneous (unproductive) load which is not directly relevant to achieving a learning goal (Kalyuga & Plass, 2017). The load arises from cognitive processing of irrelevant information due to suboptimal instructional design (Mayer & Moreno, 2010). A typical source of irrelevant information is redundant information (information already provided in a different format; Kalyuga & Plass, 2017). These cognitive load facets are part of an ongoing discussion in the field of research. Additional cognitive load facets, such as germane load (Sweller, Van Merriënboer, & Paas, 1998) or metacognitive load (Valcke, 2002) were postulated, but these facets are not mandatory in current approaches (Kalyuga & Plass, 2017). The combined loads determine the overall load (Sweller, Ayres, & Kalyuga, 2011) which varies during learning (Paas, Tuovinen, Tabbers, & Van Gerven, 2003). Dependent on the current design and complexity of the learning material, the overall load can be low, but a cognitive overload can occur temporarily as well (see Figure 6). The CLT postulates that cognitive overload should be prevented since the construction of schemas gets disturbed (Sweller, Ayres, & Kalyuga, 2011). Therefore, especially under circumstances with a high intrinsic load, extraneous load should be minimized as much as possible through optimized instructional design (Sweller, 1994). The

CLT is a purely cognitive approach for learning with multimedia. Social entities in instructional videos must be viewed critically according to this frame theory. Social entities are additional visual materials which must be processed but are not necessary for understanding the basic learning material. Therefore, social cues can be viewed as extraneous material which induces unnecessary cognitive load and can lead to cognitive overload (Sweller, Ayres, & Kalyuga, 2011).

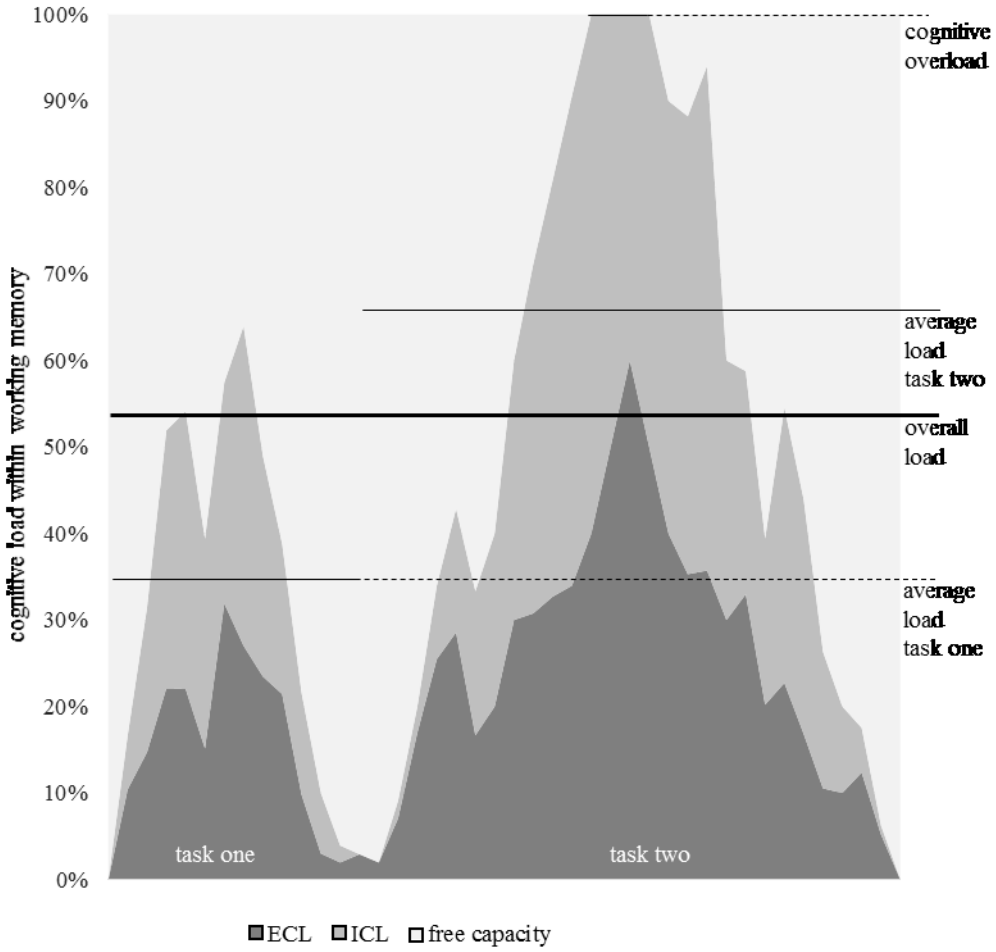

Figure 6. Cognitive Load during learning with two separate learning tasks (Paas, Tuovinen, Tabbers, & Van Gerven, 2003).

Similar implications can be derived from the cognitive theory of multimedia learning (CTML; Mayer, 2014a) which is associated with Baddeley's model of working memory (Baddeley, 1992; 1999). The CTML is based on three assumptions. First, the human perception

during learning includes multiple channels of processing. Based on the dual-coding theory (Clark & Paivio, 1991), the human information processing system contains two channels (visual/pictorial and auditory/verbal). Second, each channel has a limited capacity for information processing. Third, learners have to actively process relevant information in the learning environment. This includes attention allocation, organization, selection, and the integration of information (Mayer, 2014a). Furthermore, three memory stores are hypothesized to process information: sensory memory, working memory, and long-term memory (see Figure 7). At first, learners have to pay attention in order to select relevant visual or auditory information from the sensory memory. This information is further organized to build independent pictorial and verbal mental representations and models in the working memory. Finally, the verbal and pictorial model, as well as the prior knowledge of the learner, are integrated in order to construct a coherent model of the learning material (Mayer, 2014a).

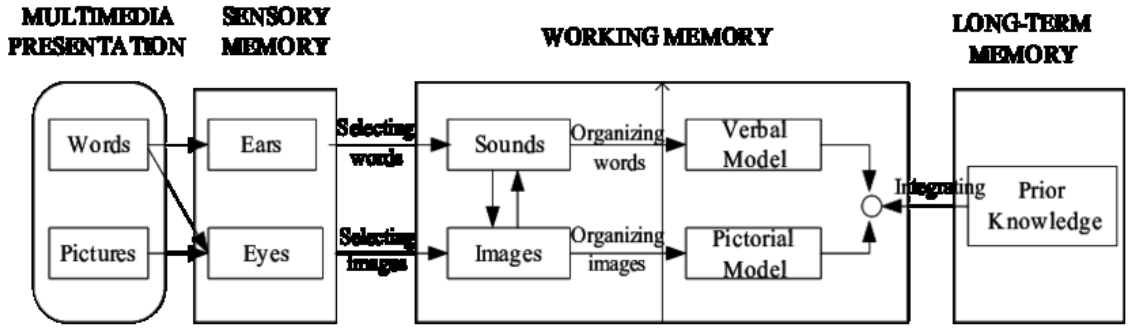

Figure 7. Cognitive Theory of Multimedia Learning (Mayer, 2003).

In line with the CLT, the CTML is a purely cognitive approach. The implementation of social entities in instructional videos cannot be recommended generally. People or fictional characters are additional visual cues which must be processed in the visual channel within the working memory. Additional entities can overload the visual channel, especially in instructional videos with extensive visual information; therefore, the construction of a complete pictorial model would be inhibited (Mayer, 2014a). However, it is difficult to provide design

recommendations for social entities in learning environments if only classical cognitive learning theories are considered, since CLT and CTML do not include affective, motivational, metacognitive, and social factors. Thus, further theories are used to explain and interpret the effects of social cues in multimedia learning.

An extension to the classical CTML is the cognitive-affective theory of learning with media (CATLM; e.g., Moreno & Mayer, 2007). In addition to the CTML, the authors postulate that motivational, affective, and metacognitive factors mediate learning processes by influencing cognitive engagement and the provision of cognitive resources (see Figure 8). According to Mayer and Moreno (2007), cognitive resources are only spent on actively processing if learners are motivated. Furthermore, individual differences (i.e. prior knowledge) are important to consider when learning with multimedia.

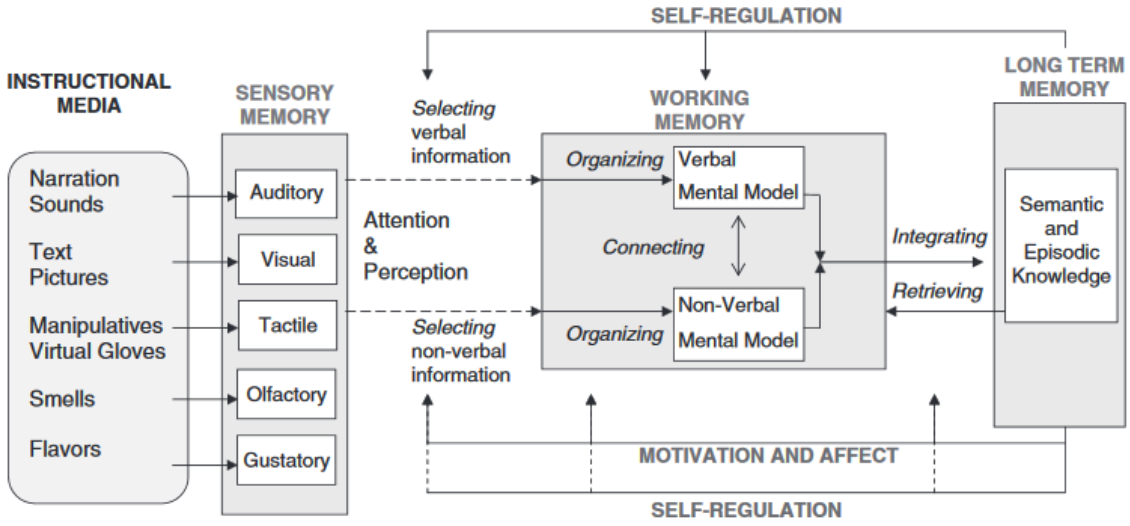

Figure 8. Cognitive-Affective Theory of Learning with Media (Moreno, 2006).

In the latest iteration, social processes are explicitly included in the theory. According to the cognitive-affective-social theory of learning with media (CASTLM; Schneider, Beege, Nebel, & Rey, 2018b), social cues do not have to impact learning processes negatively. In line with the augmented cognitive load theory (aCLT; Huk & Ludwigs, 2009), available cognitive

resources are not automatically used to deal with schema construction. Instead affective, motivational, and social processes activate and provide resources which can be used for productive processing. According to CASTLM and aCLT, social entities in instructional videos can foster learning. Due to processes of social identification, social communication, and affective and motivational stimulation, social entities can have a positive effect on cognitive activation, resource allocation, and learning.

This is further supported by recent frameworks regarding affective influences in multimedia learning. The Integrated Cognitive Affective Model of Learning with Multimedia (ICALM; Plass & Kaplan, 2016) postulates a solid connection between emotions and cognition (see Figure 9). In addition to classical frameworks (e.g. CLT), emotional experiences during learning influence the learner's ability to self-regulate. Cognitive overload should not only be avoided, but the affective stimulation within an educational video should also be considered, since mental models have cognitive as well as affective components.

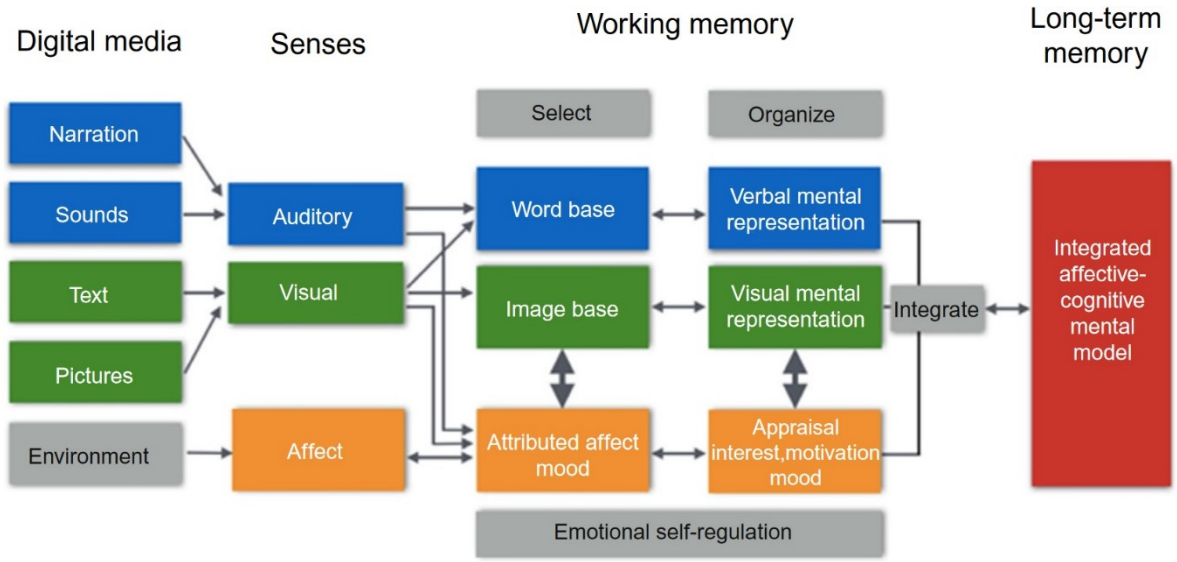

Figure 9. Integrated Cognitive Affective Model of Learning with Multimedia (Plass & Kaplan, 2016).

It should be clarified that these theories are rather unspecific and can only be used as a framework for this thesis. The aim of the current research is to specify how social entities

influence learning performance and which concrete design recommendations can be postulated for instructional videos. Therefore, experiments were designed and differentiated measurements were implemented to gather process variables in order to determine how social cues affect learners in multimedia learning environments.

Parasocial Interaction

A more concrete framework which can be used in order to determine how social entities influence learners during video reception is the theory of parasocial interaction (PSI; Hartmann, Schramm, & Klimmt, 2004b; Horton & Wohl, 1956). PSI is an ongoing process during media consumption and is described as the conversational give and take between a persona (i.e. the social entity) and a recipient; this has multiple influences on recipients and, therefore, potential learners (Horton & Wohl, 1956; Tsay-Vogel & Schwartz, 2014). In contrast to human-to-human interaction processes, only one social entity (the learner) is physically present. The persona is presented medially. Therefore, the persona is a subject of the cognitive attention of the learner, but the return channel does not exist (Gleich, 1997; Hartmann et al., 2004b). Thus, the interaction is asymmetrical, since the persona acts independently from the cognitions, emotions, and behavior of the learner (see Figure 10). In contrast, the learner is influenced by the social entity (Hartmann et al., 2004b).

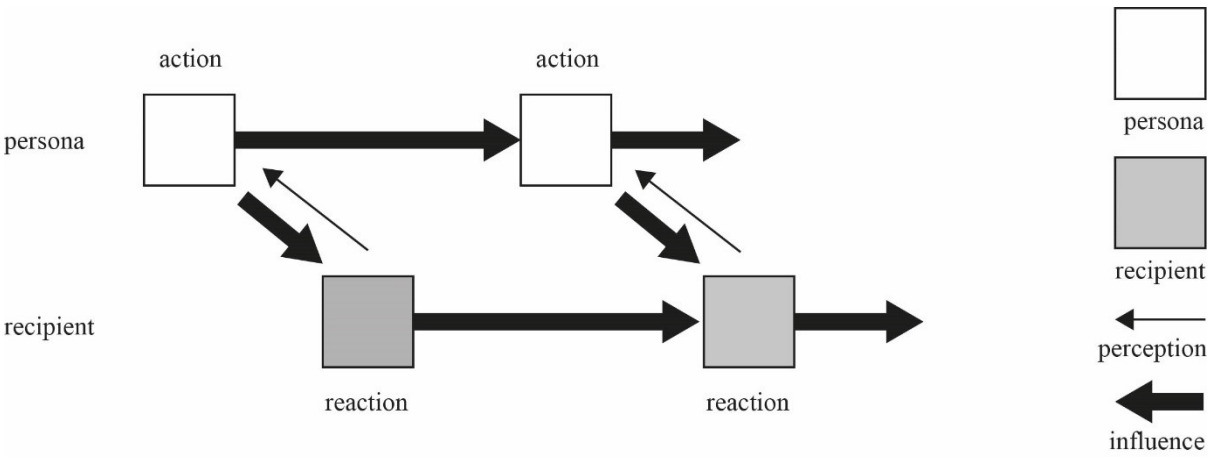

Figure 10. The process of a Parasocial Interaction (Hartmann et al., 2004a)

A prominent theory of *how* social entities influence potential learners is the Two-Level Model of Parasocial Interaction (see Figure 11) (Hartmann et al., 2004b). According to the authors, PSI is a multidimensional construct which is dynamically influenced by characteristics of the personae and recipients. PSI is an inevitable process which is, in line with the social agency theory and CASA, based on evolutionary social recognition and categorization processes.

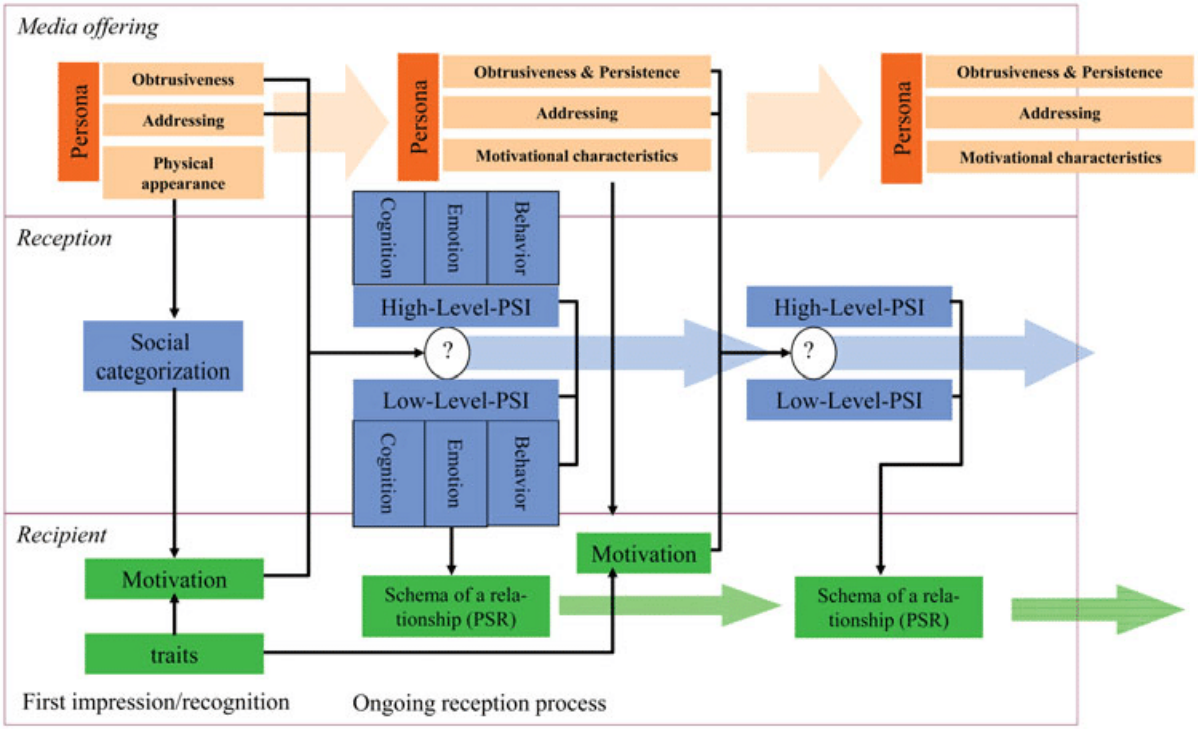

Figure 11. Two-Level Model of Parasocial Interaction (Schramm & Knoll, 2015)

As Figure 11 shows, personal characteristics of the recipient (Schramm & Wirth, 2010), as well as characteristics of the persona (Cummins & Cui, 2014) determine the strength of parasocial processes. If the recipient is not motivated to deal with the media content, or if the social entity is not addressing the recipient or is presented in the background, PSI is rather weak (low-level PSI); otherwise, parasocial processes are strong (high-level-PSI). Like social interaction, PSI is defined as a process with different facets (Hartmann et al., 2004b). First, there are perceptive-cognitive processes which refer to attention towards the persona, logical

understanding of the behavior of the persona, evaluation of the persona, linking the persona to the learner's prior knowledge, anticipation of future behavior of the persona, and the relation between the persona and the learner. The second facet refers to affective states such as sympathy, antipathy, empathy, and counter-empathy towards the persona. The third facet comprises behavioral intentions and observable behavior towards the persona. This model postulates that, dependent on characteristics of the personae and the recipient, the appearance and strength of these facets vary during media consumption. Parasocial interaction leads to the construction of a parasocial relationship. Since only processes occurring during media consumption (and therefore, learning) are relevant for this thesis and PSI and a parasocial relationship are considered as separate constructs in recent approaches (Dibble, Hartmann, & Rosaen, 2015), parasocial relationships will not be described further.

Numerous studies investigate parasocial influences on recipients (e.g., Giles, 2002; Klimmt, Hartmann & Schramm, 2006). Current research primarily investigates the influence of PSI on media engagement or media enjoyment (e.g., Hu, 2016; Ramasubramanian & Kornfield, 2012; Rasmussen, 2018; Tsay-Vogel & Schwartz, 2014), but does not consider how PSI can influence learning processes and outcomes. Especially, the cognitive facet of PSI is significant here. Enhanced PSI is associated with increased attention and evaluation processes. In audiovisual lecture-based learning media, attention towards aural information and evaluation of the lecture is crucial for learning success. Due to design features of the social entity within the video (e.g., addressing, obtrusiveness, or other physical characteristics; Hartmann et al., 2004b), parasocial processes and learning engagement can be influenced. Additionally, the affective facet might also influence learning processes. Brownlow (2014; 2015) pointed out that sympathy towards the persona acts as a catalyst for behavioral change. Positive emotional evaluation of the learning material such as sympathy for a lecturer in an instructional video directs the attention towards the learning material, using more cognitive

resources to process relevant information (Huk & Ludwigs, 2009). Creative thinking is enhanced in emotionally positive learning environments in contrast to negative learning environments; therefore, learning might be fostered (Nadler, Rabi, & Minda, 2010). Furthermore, emotions are strongly connected to motivational variables (Heidig et al., 2015). A positive emotional charge of a learning environment leads to increased intrinsic motivation, which might enhance learning outcomes. The current thesis aims to investigate how parasocial processes can be manipulated and used purposefully in order to foster learning processes.

Parasocial Learning

Two theoretical and practical implications can be derived from the aforementioned theories. According to classical cognitive load approaches, the implementations of social entities and specific behaviors of personae (i.e., gestures) distract learners from the original learning content (Sweller, Ayres, & Kalyuga, 2011). Social entities are an extraneous visual material, so social cues should be used as sparingly as possible (Fiorella & Mayer, 2018; Schroeder and Adesope 2014). According to other frameworks (e.g., CASTLM; low-level Model of PSI), social processes can activate and provide resources since available resources are not automatically used for schema construction. Social cues prime social identification schemas and personae can have a positive effect on cognitive activation, attention, evaluation, and resource allocation (Schneider et al., 2018b). In this section, design principles and current research regarding both perspectives will be thoroughly discussed.

In terms of the cognitive perspective, one of the most prominent theoretical foundations is the image principle (Mayer & DaPra, 2012). According to Mayer (2005, p.209), "people do not necessarily learn more deeply from a multimedia lesson when the speaker's image is added to the screen." Furthermore, images or videos from social entities causes distractions that detract from social benefits (Mayer, 2014b; Wilson, Martinez, Mills, D'Mello, Smilek, & Risko, 2018). A recent study has shown that visible personae distract the gaze of the learner from other important visual material (Stull, Fiorella, & Mayer, 2018). Schema construction is disrupted since the visual channel is overloaded due to the additional visual entity (CTML; Mayer, 2014a). Thus, a social presence should only be implemented via aural information (i.e., human voices) and not visual information (presence principle; Mayer, Dow, & Mayer, 2003). Social cues like gestures or facial expressions of personae are also a hindrance to learning. These results agree with the seductive detail effect (e.g., Harp & Mayer, 1998; Ginns, Martin, & Marsh 2013). The implementation of additional information which is interesting but

irrelevant for the actual learning task (seductive details) hinders learning. According to Rey (2012), seductive details inhibit learning processes since additional information uses up cognitive resources and distracts from the actual content. Additionally, seductive details activate irrelevant schemas which disorganize the learning content, and seductive details can break the congruence within the learning material (Rey, 2012).

In terms of parasocial theories and the CASTLM, the prominent psychological effects are the persona principle (Lester, Converse, Kahler, Barlow, Stone, & Bhogal, 1997) and the persona agent effect (Moreno, Mayer, Spires, & Lester, 2001). According to the author's principles, the presence of a social entity has positive effects on various process variables during learning. Social entities, like instructors or pedagogical agents, have positive effects on learners' perception of their learning experience (Lester, et al., 1997). Furthermore, learners are more motivated and interested when personae are implemented in a multimedia learning environment (Moreno et al., 2001), and learners reported an enhanced engagement in the learning task (Guo, Kim & Rubin, 2014). Previous studies have shown that simple social cues can enhance the motivation to learn, the attitude towards learning (Tung & Deng, 2006), and the academic success of students (Dinçer & Doğanay, 2017). Even simple anthropomorphic cues such as the implementation of smiley faces prime social schemas and lead to enhanced learning outcomes (Schneider et al., 2018a), which can be explained by the personalization and embodiment principle. According to the personalization principle, learning is fostered when the learner is directly addressed by the learning environment (Mayer, 2014a). Addressing can be separated into verbal addressing (for example, due to the use of the term "you") and bodily addressing (for example, eye contact). According to Keller (2009), learners are more motivated when the learning contents are designed in a familiar way. Therefore, using a personalized style in multimedia learning environments is recommended (Stiller, & Jedlicka, 2010). Furthermore, a personalized design reduces the cognitive effort which must be used for encoding multimedia

messages (Moreno & Mayer, 2000). According to the embodiment principle, human gestures, eye contact, and facial expressions represent a social context and prime the activation of a social response (e.g., “What is the media figure trying to teach me?”; Mayer, 2014a). This causes the learner to put more effort into making sense of the presented material (i.e., engaging in organizing and integrating), which leads to enhanced learning outcomes (see Figure 12) (Mayer & DaPra, 2012).

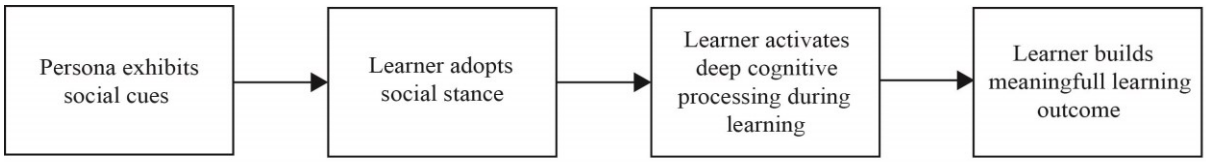

Figure 12. Embodiment Principle (Mayer & DaPra, 2012).

However, the cognitive load perspective and the social agency perspective must not exclude each other; instead, both perspectives have to be considered. Including social entities means that learners need additional resources to process the visual or aural social information (Mayer, 2014b). At the same time, social cues prime social responses which lead to enhanced engagement, motivation, and resource activation (Mayer & DaPra, 2012). Social entities need to be integrated in such a way that the benefits at least outweigh the costs. Therefore, it is not surprising that there are studies on the negative effects of implementing social entities on learning (Wilson, et al., 2018), positive effects of social cues on learning (Davis, 2018; Wang & Antonenko, 2017; Wang et al., 2018, Experiment 1) and studies which could not detect effects of social cues on learning (persona, zero-effect; Miksatko, Kipp, & Kipp, 2010; Stull et al., 2018; van Wermeskerken & van Gog, 2017; Wang et al., 2018; Experiment 2). If and how social cues work in multimedia learning environments is an ongoing discussion to this day. In particular, studies regarding pedagogical agents and instructor presence in instructional videos postulate contrarian findings. The implementation of social entities promotes process variables

like motivation, satisfaction, and engagement (Baylor, 2009; Baylor, 2011, Heidig & Clarebout, 2011). Social presence leads to enhanced enjoyment of the learning environment (Wilson et al., 2018), but results regarding learning differ. The effect of personae on learning is moderated by various variables. The most significant social cue is the choice of the model (Hoogerheide, et al., 2016). Therefore, it is important *how* the entity is implemented. The appearance of the entity (e.g., Kim & Baylor, 2016), as well as its voice, gesture and other behaviors, are crucial for learning success (Wang, Li, Xie, & Liu 2017). Furthermore, characteristics of the recipient, learning disciplines, and learner or system pacing seem to be important for coping with the additional cognitive load the entity introduces (Wang, et al., 2017).

By manipulating the presentation, look, and behavior of social entities in instructional videos, this thesis summarizes three studies in order to contribute to the ongoing discussion about the circumstances in which social entities and social cues foster or hinder learning. As a result, the concept of PSI will be integrated into the research field of multimedia learning. The influence of various design features on different cognitive and affective parasocial mechanisms are investigated, and the influence of PSI on learning, cognitive load, and effort are also studied. Theoretical and practical implications provide insight into the benefits of parasocial learning and how personae can be used effectively in instructional videos.

Study Presentation

The aforementioned investigations emphasize the importance of research regarding social entities in learning environments. Inconsistent results through very diverse studies show the need for empirical research regarding conditions and underlying mechanisms of parasocial learning. Studies are bundled within this synopsis in order to investigate specific design factors of social entities without manipulating the learning content itself. Cognitive, affective, and social variables were measured to provide detailed insight into multimedia learning with implemented social cues. To implement these research interests, educational videos were created specifically for the experimental context. This allowed for investigation into the effects of parasocial processes on learning without uncontrolled confusion and interference. All included papers (see Table 1) were published with multiple authors. The author of this thesis designed and developed the studies and created the learning material in the form of instructional videos. In addition, the author calculated all analyses and wrote the majority of the manuscripts. The coauthors helped edit the final papers and improved the language. Furthermore, the contributing authors provided discussion in order to improve the operationalization of variables and the management of experiments.

The regulation for Doctoral Studies for the Faculty of Behavioral and Social Science provides that segments within the thesis which have already been published should be marked (§9). In order to distinguish between the published segments and the segments which were explicitly written for this synopsis, the published papers are presented in their original journal-based layouts. Since the journal layouts and the formal guidelines for this synopsis differ significantly, this distinction should be sufficient to comply with the regulations.

Table 1. References for the publications in this thesis.

Study №.	Reference
1	Beege, M., Schneider, S., Nebel, S., & Rey, G. D. (2017). Look into my eyes! Exploring the effect of addressing in educational videos. *Learning and Instruction, 49*, 113-120. https://doi.org/10.1016/j.learninstruc.2017.01.004
2	Beege, M., Schneider, S., Nebel, S., Mittangk, J., & Rey, G. D. (2017). Ageism - Age coherence with learning material fosters learning. *Computers in Human Behavior, 75*, 510-519. https://doi.org/10.1016/j.chb.2017.05.042
3	Beege, M., Schneider, S., Nebel, S., Häßler, A., & Rey, G. D. (2018). Mood-Affect Congruency. Exploring the relation between secondary school learners' mood and the emotional charge of educational videos. *Computers & Education. 123*, 85-96. https://doi.org/10.1016/j.compedu.2018.05.001

Look into my eyes! Exploring the effect of addressing in educational videos

The first study investigated the influence of the visual presentation of a social entity in an instructional video. A single lecturer held an oral presentation about statistics and differed in terms of proximity and addressing. These variables were chosen because prior studies detected effects of the presentation of the personae in terms of parasocial processes (e.g., Hartmann & Goldhoorn, 2011). Proximity was operationalized by placing the camera 1.5 m or 10 m from the lecturer. Addressing was operationalized by placing the camera exactly in front of the lecturer or by filming the lecturer from an angle of 40°. Both characteristics (proximity and addressing) influence parasocial processes (Hartmann et al., 2004b). Four cameras filmed the lecture simultaneously with one controlled audio track in order to ensure a clean manipulation. Students had to watch the lecture and rate their experienced parasocial interaction, and their learning scores were assessed and examined.

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Look into my eyes! Exploring the effect of addressing in educational videos

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ABSTRACT

Numerous studies were conducted to investigate how recipients are affected by the miscellaneous characters in multimedia. However, there is a lack of research concerning the connection between parasocial processes and learning performances. This study aims to investigate the influence of *addressing* (as a social encounter of *parasocial interaction*) on learning performance in an educational video. *Addressing* was operationalized by manipulating proximity (near vs. far) and orientation (frontal, vs. lateral) of a presented lecturer. We conducted an experiment with 88 participants who were randomly assigned to one of the four experimental groups. Results revealed a large significant orientation effect for retention performance with higher learning outcomes for frontal orientation. Proximity did not significantly influence learning outcomes. Results were interpreted suggesting perceived *parasocial interaction* which was enhanced in the frontal condition. Parasocial interaction might lead to deeper cognitive processing and affective states which are beneficial for learning. The findings of this study show that learning is fostered by personae in educational learning environments by giving learners the impression to be *addressed* directly through eye contact.

1. Introduction

Away from classical teaching and learning situations, learning media are often implemented with persons, fictional characters or other social entities in order to enrich the learning environment. For example, social entities are represented in educational textbooks, in interactive learning media as pedagogical agents or in educational videos as lecturers. However, to date, no study has examined the (para-) social focus of learning with multimedia. The term parasocial refers to parasocial interaction (PSI) which inevitably takes place when a social entity is implemented in the learning environment and influences learning.

PSI is an extensively studied concept in media research. The construct was first defined by Horton and Wohl (1956, p.215) and refers to a "conversational give and take" between recipients and media figures, characters and entities (personae; Hartmann, Schramm, & Klimmt, 2004). With respect to the original definition, PSI is one-sided, non-directional and not susceptible of mutual development (Horton & Wohl, 1956). The concept is characterized as a cognitive, affective or/and behavioral action from the recipient towards media figures who cannot respond or reciprocate (e.g., Hartmann et al., 2004; Tsay-Vogel & Schwartz, 2014). This missing communication channel from the recipient towards the persona is outlined with the term "para". More precisely, the recipient cannot influence the persona but audience members get effected by media figures. There are numerous findings that specify this parasocial influence (e.g., Giles, 2002; Klimmt, Hartmann, & Schramm, 2006; Tsay & Bodine, 2012). Parasocial interaction has multiple implications for enjoyment, identification and learning (Tsay-Vogel & Schwartz, 2014). Though, even 60 years after the first definition of PSI, the influence of PSI between the recipient and personae on learning is not clearly specified. This study aims to extend the understanding of PSI by introducing the concept of parasocial learning (PSL) and adding this concept in multimedia learning research. Prominent theories, such as the Cognitive Load Theory (CLT; Sweller, 1988; Sweller, Ayres, & Kalyuga, 2011) and the Cognitive Theory of Multimedia Learning (CTML; Mayer, 2005; 2014), only consider cognitive influences and were later extended on affective, motivational and metacognitive factors (aCLT; Huk & Ludwigs, 2009; CATLM; Moreno, 2006). Therefore, this study aims to take a first step in order to supplement these theories by considering

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parasocial influences.

2. Literature review

2.1. Parasocial interaction

Parsocial und social interaction are scarcely different from each other. Both processes arise from evolutionary social recognition mechanisms (Reeves & Nass, 1996). Basal stimulus-response schemata ensure that minimal optical information is sufficient to create the illusion of a social entity (e.g. Biocca & Harms, 2002). This applies to real persons as well as animated social entities within media environments. According to the paradigm of *computers are social actors* (CASA; Nass, Steuer, & Tauber, 1994), social responses to computers are commonplace, incurable and easy to generate. Simple cues like voices or personifications within a multimedia environment create the sense of a social presence (Lee & Nass, 2003) and lead to a social response. Cues of humanness encourage individuals to apply social rules and change cognitive processes (Nass & Moon, 2000). Therefore, even large deviations from natural human appearance lead to parasocial processes. For the current investigation, the understanding of PSI is based on Hartmann et al. (2004) which relates to the original definition of Horton and Wohl (1956). Like social interaction, PSI is defined as a process with different facets (Hartmann et al., 2004). At first, there are perceptive-cognitive processes as attention, understanding and evaluation. The second facet refers to affective states such as sympathy and antipathy. The third facet comprises observable behavior towards the personae. The appearance and strength of these facets vary during media consumption. These findings are summarized in the two-level model of parasocial interaction (Hartmann et al., 2004). PSI processes can be strong (high level PSI) or weak (low level PSI). The strength of parasocial processes depends on many factors in terms of the personae (e.g., perspective, proximity, attractiveness) and the recipient (e.g., personality variables, motivation; Hartmann et al., 2004; Schramm & Hartmann, 2008; Schramm & Wirth, 2010).

The current investigation focusses on processes during media reception and therefore, during learning. In this context, it is necessary to differ between parasocial interaction and parasocial relationships. PSI is a process that only occurs during media reception. Repeated consumption of media with constant social entities leads to differentiated schema creation over theses personae and a so-called parasocial relationship (PSR; Hartmann et al., 2004). In contrast to PSI, this relationship still remains after media reception. PSI might lead to PSR and PSR affects PSI in case of a latter media reception. Despite their mutual influence there is a strict distinction between these constructs. Thus, measurements must be considered critically. Often used instruments like the PSI-Scale (Rubin, Perse, & Powell, 1985) define PSI as a long-term social involvement and thus do not measure PSI and PSR separately (Dibble, Hartmann, & Rosaen, 2015). Even if scales are used that measure PSI as a separate construct (PSI-Process Scales; Schramm & Hartmann, 2008; EPSI Scale; Hartmann & Goldhoorn, 2011), it is difficult to measure a process with a single questionnaire following the reception.

2.2. Addressing

In addition to the question of suitable measurement instruments, there are many studies that investigated triggers and reinforcing factors of PSI. One factor with a broad empirical basis is addressing (e.g., Cummins & Cui, 2014; Dibble et al., 2015; Hartmann & Goldhoorn, 2011). Hartmann and Goldhoorn (2011) argued that there are several cues provided by personae that trigger automatic cognitive processes which cause PSI. These cues include physical orientation, eye-gazing or for example direct approach of the recipient. For the current investigation, all these potential cues are summarized in the concept of addressing. Cummins and Cui (2014) differentiated between two channels in verbal and bodily addressing. Verbal addressing refers to every auditory involvement of the recipient like talking to the viewer or concrete responses with “you” (parasocial communication; Blickle, 1999; Hartmann et al., 2004). In contrast, bodily addressing refers to the visual presentation of the character. Media figures can either be presented frontal to the camera or in lateral orientation. This involves a possible eye-contact with the recipient. Furthermore, the personae could not be on screen or presented in a large or small distance (obtrusiveness; e.g., Hartmann & Klimmt, 2005).

Hartmann et al. (2004) considered addressing as important trigger of parasocial processes within their two-level model of PSI. Hartmann and Goldhoorn (2011) operationalized bodily addressing with videos where the persona either was presented in front of the recipient and looked into the camera, or was shown from the side. The authors investigated the influence of orientation on PSI and found a significant medium effect size with respect to the frontal condition. Cummins and Cui (2014) and Dibble et al. (2015) clarified the positive influence of bodily addressing on PSI. Based on these empirical findings, bodily addressing was used in the current investigation to manipulate PSI.

2.3. Parasocial learning

How can PSI be combined with learning in multimedia? Lauricella, Gola, and Calvert (2011) examined the influence of parasocial processes on learning with infants. Twenty-one month old children learned better from known media figures within a video than with unknown personae. Results were complemented by Gola, Richards, Lauricella, and Calvert (2013) who pointed out that children's learning performance is increased from unknown personae over time, because of an emotional bond with these figures. In addition, Calvert, Richards, and Kent (2014) found that 18 month old children learn better with personalized personae. Personalization was operationalized through same sex, favorites (e.g., food, favorite song) and direct addressing by their names. These findings provide insights in parasocial processes in learning contexts. However, these studies investigated PSR rather than PSI and the toddler-samples might not allow for a generalization. Another approach is discussed by Brownlow (2014) who modified the communication circuit (Sabido, 2002) in terms of the roles of characters in educational videos. The author emphasized that PSI fosters learning through emotional processes of empathy and antipathy towards the personae. An induced sympathy towards the persona leads to reflection of the own behavior and approximation to the behavior of the persona. Thus, these emotional processes act as a stimulus for change. The parasocial nature allows a safe exploration of difficult experiences (Brownlow, 2015). However, the model is explorative and has no empirical support until now. Previous studies focused on affective variables (such as sympathy and aversion to a personae; Brownlow, 2015) as a key to enhance learning, but neglected other factors. Furthermore, parasocial processes might differ in terms of age and the educational context. In summary, research that investigates parasocial influences in learning processes is very specific and cannot be generalized. In order to get a better insight into the explanation and effects of PSL more general principles in multimedia learning can be taken into account.

It is possible that cognitive (Sweller et al., 2011) or metacognitive factors (Bannert, Hildebrand, & Mengelkamp, 2009) are affected by PSI. A possible explanation might be supplied by the

personalization principle or embodiment principle (Mayer, 2014). Social cues in learning environments lead to a deeper cognitive processing and thus, foster learning. Additionally, learning processes are enhanced when personae display human gestures, eye contact, movement and facial expressions (Mayer & DaPra, 2012). Social cues prime the activation of a social response (e.g., "What is the persona trying to teach me?", Mayer, 2014). This social response will lead to an enhanced active cognitive processing and increased learning outcomes. These findings might be combined with the mentioned two-level model of parasocial interaction (Hartmann et al., 2004). Especially, an enhanced cognitive facet (attention, understanding and evaluation) might lead to better learning outcomes through social cues or explicit (para-) social entities. These findings can also be transferred to the implementation of pedagogical agents. The meta-analysis from Schroeder, Adesope, and Gilbert (2013) pointed out that the integration of these social entities had a positive effect on learning.

The current study aims to explore the concrete influence of PSI in multimedia learning. Initially examined PSL influences are transferred to a concrete learning context within a video setting.

2.4. The present experiment

In the present study educational videos showing a lecture on statistics in an auditorium were produced. The level of addressing was systematically manipulated by varying how the lecturer was presented within the video screen. With this, the presentation differed in proximity (near vs. far) and orientation (frontal with eye contact and lateral). These two factors were chosen because the two-level model of parasocial interaction explicitly refers to the visual presentation of personae. The size of people within the screen can be considered as social cue to the social distance of social entities from the recipient. This so called para-proxemic relationship (Meyrowitz, 1986) is of central importance in the media context because educational videos can establish different spatial distances of personae. In addition to proximity, orientation and especially, eye contact with the social entity is an important social cue. Frontal orientation is a key stimulus for perceived addressing (e.g., Bailenson, Blascovich, Beall, & Loomis, 2001), primes the activation of a social response (Mayer, 2014) and can be explicitly manipulated in the context of educational videos.

Following previous empirical findings (e.g., Dibble et al., 2015; Hartmann & Goldhoorn, 2011; Hartmann et al., 2004), higher proximity and frontal orientation should lead to an increased subjective perception of addressing (manipulation check). Furthermore, students reporting a subjective addressing should show stronger (high level) parasocial interaction processes. With respect to prior research, medium effects might be generated for the current exploratory experiment (e.g., Hartmann & Goldhoorn, 2011).

Hypothesis 1: Learners watching a video with high proximity presentation report a higher subjective perceived addressing and stronger PSI than learners watching a video with the low proximity presentation.

Hypothesis 2: Learners watching a video with frontal orientation report a higher subjective perceived addressing and stronger PSI than learners watching a video with lateral orientation.

This study aims to go beyond triggering PSI and investigate impacts on learning. As mentioned, there is a lack on research how parasocial processes influences learning. Previous studies are either concerned with PSR (e.g. Calvert et al., 2014) or have not yet been thoroughly tested empirically (Brownlow, 2015). Nevertheless, results which are related to this topic (Schroeder et al., 2013) lead to the adoption of a positive impact from parasocial processes on learning. Therefore, it was assumed that PSI fosters learning.

Hypothesis 3: Learners watching a video with high proximity presentation achieve better learning outcomes than learners watching a video with the low proximity presentation.

Hypothesis 4: Learners watching a video with frontal orientation achieve better learning outcomes than learners watching a video with lateral orientation.

3. Method

3.1. Participants

Overall, 88 students (70.1% female; age: $M = 23.75$, $SD = 4.25$) from the Chemnitz University of Technology participated in this experiment. The participants studied in the first (15.9%), second (29.5%), third (25%), fourth (9.1%) or higher semester (19.5%). Students were enrolled in media and communication studies (47.7%), instructional and media psychology (17.2%), general psychology (10.3%), Europe studies (5.7%), sociology (4.5%) and others (14.6%). Each participant received either 6 € (39.8%) or a one hour course credit (60.2%). Furthermore, there were no significant differences between the four treatment groups in terms of age ($p = 0.63$), gender ($p = 0.06$), subject of study ($p = 0.17$), amount of semesters ($p = 0.63$), or type of incentive for participation ($p = 0.26$). Nevertheless, gender is distributed marginally unequally. In the condition with high proximity and frontal orientation the percentage of women is 75%, in the condition with high proximity and lateral orientation the percentage is 57%. In the low proximity and frontal addressing condition, the percentage of women is 91% and in the low proximity and lateral orientation condition, the percentage is 62%.

3.2. Design & materials

Each student was randomly assigned to one cell of a two (proximity: near vs. far) × two (orientation: frontal vs. lateral) between-subjects design by drawing lots. This allowed to investigate the effect of bodily addressing on PSI from both perspectives. Each group consisted of 22 students.

In order to implement the experimental design, the learning material consisted of four educational videos of a male lecturer which were simultaneously filmed from four different positions within a lecture hall (see Fig. 1).

Therefore, the lecture hall was prepared with four cameras (cameras: JVC GY-HM150E and Canon EOS 600D). In the near condition cameras were placed approximately 1.5 m from the lecturer. In the far condition cameras were placed approximately 10 m from the lecturer. In the frontal condition cameras were placed exactly in front of the lecturer. In the lateral condition the lecturer was filmed from an angle of 40°. Within this video, a pretrained male lecturer held an oral presentation on facts about statistical analyses based on the textbook of Sedlmeier and Renkewitz (2007) in front of an empty room without any additional electronical material, while all cameras recorded this presentation simultaneously. It is important to keep the lecturer the same because gender or age of the lecturer can influence process variables and learning outcomes (Hoogerheide, Loyens, & van Gog, 2016; Hoogerheide, van Wermeskerken, Loyens, & van Gog, 2016). The lecturer was unknown for the participants. The audio track was taken from camera 1 to ensure same audio qualities. The presenter guided students from simple to more difficult themes including correlations, *t*-tests, bootstrap techniques and the Bayes' theorem. Contents were chosen because prior knowledge was considered low and because statistics is a central subject which is part of numerous fields of study. Furthermore, topics varied from low to high difficulty, to obtain a broad variance in learning

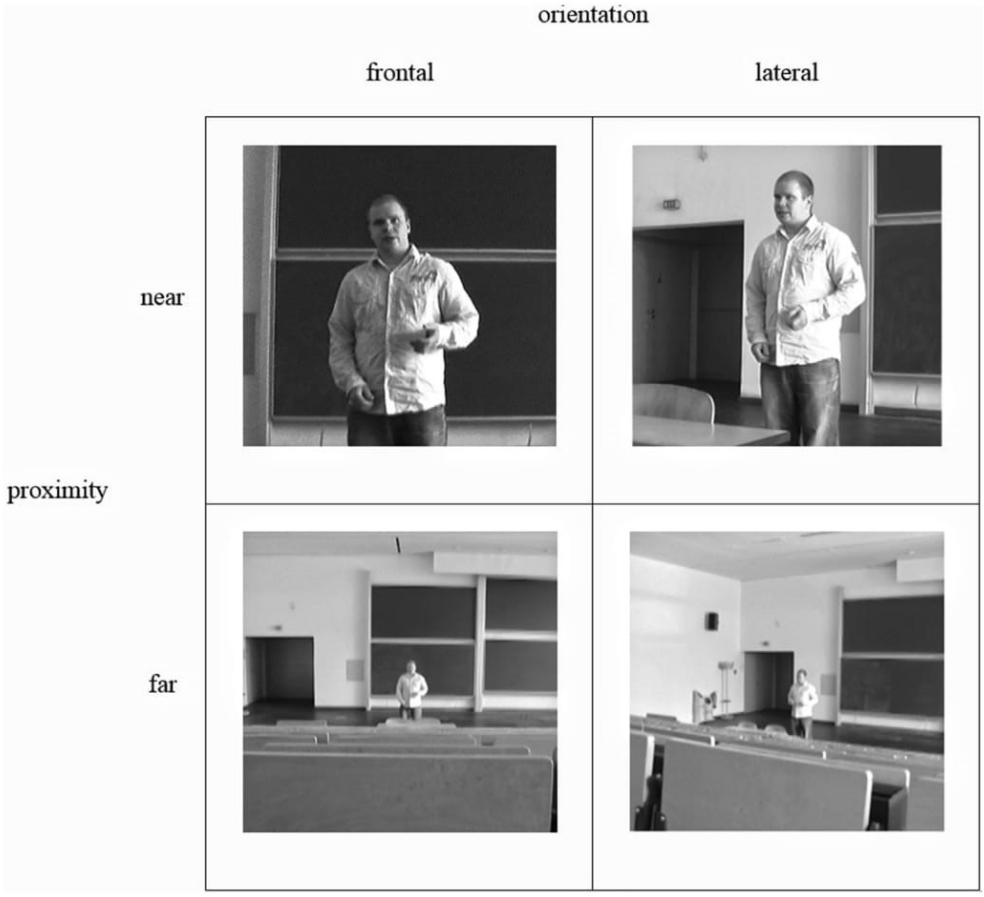

Fig. 1. Screen example of the experimental manipulation.

performances. Complex subjects (bootstrap, Bayes' statistics) were only addressed superficially in order to not overtax the students with the learning material because the video was rather short (overall: ten minutes). No additional information was shown in the videos in concentrate the attention of the participants on the lecturer. Because of the fact that effects of social entities on learner should be explored unbiased, distraction through additional visual information was avoided. Each video was split into three parts in order to define segments of the content. By this procedure, four learning videos (each consisting of three subtheme videos) about statistics were created which only differ regarding their recording perspective according to the manipulation.

3.3. Measures

In order to address the different facets of our manipulation, several measures were used. First of all, one item from the PSI process scales (Schramm & Hartmann, 2008); "I felt like the tutor addressed me personally" (translated from german), was taken as a manipulation check. To address PSI and to differentiate this concept from PSR, the six-item experienced parasocial interaction scale (EPSI scale; Hartmann & Goldhoorn, 2011) was implemented ($\alpha = 0.95$). The EPSI scale especially refers to the construct attention as important sub-facet of parasocial interaction. EPSI refers to the feeling of *mutual awareness* between the recipient and the persona while watching the educational video. Students had to rate items which assess the intensity of the parasocial experience like "The lecturer was aware of me." or "The lecturer knew I was there." on a scale from 1 (I do not agree at all) to 7 (I totally agree). Therefore, this scale is particularly suitable to explore the effect of addressing in multimedia learning with a focus on the cognitive facet of PSI. Since PSI and addressing are conceptualized as a continuous and changing process variables, these concepts were measured after each subtheme video in order to cover up these constructs as processes. Additionally, mean scores over time were computed.

Another one item scale to measure prominence of the lecturer; "I already knew the speaker before I watched the video" (translated from german), was used. As Lauricella et al. (2011) pointed out, prominence can influence parasocial processes. Therefore, this item was used as a covariate for PSI calculations. Another covariate for PSI calculations was the sex of the participants. The sex of the lecturer is male but the sex of most of the participants is female. Since gender is marginally distributed unequally ($p = 0.06$), the sex may play an additional in parasocial interaction and therefore learning processes.

Finally, we integrated three types of knowledge measures. Prior knowledge was measured with ten questions on facts of statistic knowledge ($\alpha = 0.64$). Students had to answer questions about all substantive topics which are mentioned in the educational videos, e.g. "What is not an assumption for the *t*-test analyses." This knowledge score serves as a covariate for the statistical analyses. In order to be able to measure retention knowledge, ten questions were developed asking for information that was explicitly mentioned in the video ($\alpha = 0.55$), e.g. "In which range of values moves the Pearson correlation coefficient?" For transfer knowledge, nine questions were created testing if the participants could apply their received knowledge to novel problems ($\alpha = 0.61$). For example, they had to decide whether a correlation could be

computed or not under certain circumstances, or they had to judge under which conditions the statistical power is optimal. All knowledge measures were single choice questionnaires with four possible answers each. Additionally they could choose the "I don't know" category. If correct, the question was rewarded with one point. For this, a maximum of ten points could be reached at prior knowledge and retention test and a maximum of nine could be reached at the transfer test. To be able to compare scales, analysis were conducted with proportion of correct answers, ranging from 0 (no correct answers) to 1 (all answers were correct). The low reliabilities of the prior knowledge and transfer test can be explained by considering the boundaries of classical test theory. The current knowledge measures aim to assess different statistical topics (bootstrap, Bayes statistics, correlations, etc.). These topics differ in complexity of the learning material and nature of knowledge. Factual knowledge as well as knowledge about analysis processes were implemented in the current measures. In addition to the implementation of heterogeneous subtopics, the items are designed to assess different levels of difficulty in order to generate a broad variance in the responses. Therefore, internal consistency (measured with Cronbach's alpha) might be inadequate to evaluate the used knowledge scales were rather multidimensional.

3.4. Procedure

Prior to each experimental session, a computer laboratory with four identical computers was prepared. For this, the first video was opened on the 24″ monitors and the pen-and-pencil questionnaire was placed on each workstation. Up to four participants belonging to the same experimental condition were tested simultaneously. They were separated by sight blocking partition walls ensuring that every participant had to work on their own. At first, the participants were informed that the experiment is a video study with the content of statistical analyses. After this, they had to answer the demographic questionnaire and the prior knowledge test. Afterwards, they had to watch the first video (with a duration of 2:38 min), followed by addressing and PSI questionnaires. This procedure of combining a video material and questionnaires was repeated with two more videos (with a video duration of 3:21 min and 3:45 min). Directly after viewing the educational videos and processing the PSI questionnaires, the retention and transfer tests were implemented. If all tests were completed, the participants were thanked and could leave the room. Altogether, the experiment lasted from 35 to 50 min.

4. Results

4.1. Manipulation check and the influence of orientation and proximity on PSI

A repeated measures analysis of variance (ANOVA) showed no difference in perceived addressing over time $F(2,86) = 1.17$, $p = 0.06$, $\eta_p^2 = 0.02$. Therefore, the following analyses regarding manipulation check were conducted with mean scores over measuring times. An ANOVA was conducted with proximity and orientation as between-subject factors and subjective perceived addressing as dependent measure. All pre-defined test assumptions were not significantly impaired, Levene test $(3, 84) = 1.17$, $p = 0.33$. Considering the mean scores over time, a large significant effect was found for orientation, $F(1,87) = 16.89$, $p < 0.001$, $\eta_p^2 = 0.17$. Students watching videos with frontal presentation reported a higher subjective addressing than students watching videos with the lateral presentation of the lecturer. There was no main effect for proximity, $F(1,87) = 0.71$, $p = 0.40$, $\eta_p^2 = 0.01$, and no significant interaction $F(1,87) = 0.99$, $p = 0.32$, $\eta_p^2 = 0.01$. Statistically, null hypothesis for the proximity-effect and interaction cannot be accepted at least for a medium effect size of $f = 0.25$, because of insufficient power ($1 - \beta = 0.66$ for $\alpha = 0.05$). According to the high effect size (Cohen, 1988), manipulation for orientation can be seen confirmed. Manipulation with respect to proximity failed.

A repeated measures ANCOVA showed no difference in PSI over time $F(2,86) = 0.05$, $p = 0.96$, $\eta_p^2 = 0.001$. Therefore, the following analyses regarding influences of lecturer presentation on PSI were conducted with mean scores over measuring times. An ANCOVA was conducted with proximity and orientation as between-subject factors, PSI as dependent measure and familiarity with the lecturer and gender of the participants as covariates. No pre-defined test assumptions were significantly impaired, Levene test $(3, 84) = 0.01$, $p = 0.999$. Considering the mean scores over time, a medium significant effect was found for orientation, $F(1,87) = 7.44$, $p = 0.008$, $\eta_p^2 = 0.09$. Students watching videos with frontal presentation reported a higher PSI than students watching videos with the lateral presentation of the lecturer. There was no main effect for proximity, $F(1,87) = 2.77$, $p = 0.19$, $\eta_p^2 = 0.03$ and no significant interaction $F(1,87) = 3.00$, $p = 0.09$, $\eta_p^2 = 0.04$. Statistically, null hypothesis for the proximity-effect and interaction cannot be accepted for at least a medium effect size of $f = 0.25$, because of insufficient power ($1-\beta = 0.66$ for $\alpha = 0.05$). Descriptive data regarding means of perceived addressing and PSI are outlined in Table 1.

4.2. The influence of orientation and proximity on learning

A multivariate analysis of covariance (MANCOVA) was conducted with proximity and orientation as between-subject factors, retention and transfer score as dependent measures and prior knowledge as covariate. All pre-defined test assumptions were not significantly impaired, Box's M $(9, 78392.24) = 19.83$, $p > 0.001$ (Hakstian, Roed, & Lind, 1979). A large effect was found regarding orientation (Wilk's $\Lambda = 0.86$); $F(2,81) = 6.54$, $p = 0.002$, $\eta_p^2 = 0.14$. No significant effect was found regarding proximity (Wilk's $\Lambda = 0.96$); $F(2,81) = 1.71$, $p = 0.19$, $\eta_p^2 = 0.04$ and no interaction could be observed (Wilk's $\Lambda = 0.996$); $F(2,81) = 0.17$, $p = 0.84$, $\eta_p^2 = 0.004$. Follow up ANCOVAS with retention or transfer as dependent variables, orientation and proximity as between-subject factors and prior knowledge as covariate were conducted in order to get a detailed insight in both measures of learning. Considering retention, a large significant effect was found for orientation, $F(1,87) = 13.17$, $p < 0.001$, $\eta_p^2 = 0.14$. Students watching videos with frontal presentation outperformed students watching videos with the lateral presentation of the lecturer. There was no main effect for proximity, $F(1,87) = 2.00$, $p = 0.16$, $\eta_p^2 = 0.02$, and no significant interaction $F(1,87) = 0.22$, $p = 0.64$, $\eta_p^2 < 0.01$. Statistically, null hypothesis for the proximity-effect and interaction cannot be accepted for a medium effect size of $f = 0.25$, because of insufficient

Table 1
Impact of orientation and proximity on perceived addressing and PSI.

Manipulation			Outcome measure			
			Addressing		PSI	
Orientation	Proximity	*N*	*M*	*SD*	*M*	*SD*
frontal	near	22	6.53	2.36	3.54	1.10
frontal	far	22	6.45	2.05	2.72	1.12
lateral	near	22	4.25	1.63	2.54	1.03
lateral	far	22	5.09	2.15	2.58	1.05

Note. The descriptive data correspond to the mean scores over time. Addressing scores ranged from 1 to 7 and PSI scores ranged from 1 to 9 (higher scores encode higher addressing and PSI), M = mean value, SD = standard deviation, N = number of participants.

power (1- β = 0.66 for α = 0.05). Considering transfer, no significant main effect was found for orientation, $F(1,87) = 2.61$, $p = 0.11$, $\eta_p^2 = 0.03$, no significant main effect for proximity $F(1,87) = 2.75$, $p = 0.10$, $\eta_p^2 = 0.03$ and no significant interaction $F(1,87) = 0.60$, $p = 0.60$, $\eta_p^2 < 0.01$. Statistically, null hypothesis for the main effects and interaction cannot be accepted for a medium effect size of $f = 0.25$, because of insufficient power (1- β = 0.66 for α = 0.05). Results are outlined in Table 2. Retention and transfer correlated with $r = 0.66$; $p < 0.001$.

In order to integrate the construct of PSI into the learning process, a mediator analysis was conducted with orientation as predictor, retention score as criteria and PSI as mediator. The mediation was conducted with the mediation procedure for SPSS (Hayes, 2013) and a bootstrap estimation approach with 20000 samples (Shrout & Bolger, 2002). The results of the mediator analysis is displayed in Fig. 2.

Basically, orientation was a significant predictor of retention performance β = 0.09; $t(86) = 2.02$; $p = 0.047$ and of PSI β = 0.54; $t(86) = 2.25$; $p = 0.02$. However, orientation was no longer a significant predictor of retention performance after controlling for the mediator PSI: β = 0.09; $t(86) = 1.93$; $p = 0.06$ and PSI was no significant predictor of retention as well β = 0.003; $t(86) = 0.14$; $p = 0.89$. Thus, no mediation could be shown what is reflected in the small amount of explained variance ($R^2 = 0.05$).

5. Discussion

This study aimed to investigate the impact of parasocial designs on learning. Therefore, the influence of proximity and orientation of a lecturer on PSI and learning was examined separately. It could be shown that frontal orientation increased the perception of addressing and PSI in contrast to students who watched the same videos with the lateral presentation. Regarding proximity, no effect was found with respect to a subjective addressing and PSI. Thus, the manipulation was only successful for orientation. The severity of perceived addressing and PSI did not differ during media reception. Students watching learning videos with frontal orientation outperformed students watching the videos with lateral presentation on retention but not on transfer score. Proximity did not influence learning outcomes at all. No interaction effects occurred concerning proximity, orientation and both learning scores. Furthermore, no significant mediation of PSI between orientation and retention could be shown.

The manipulation concerning proximity failed but descriptively students felt more addressed in the far condition. With respect to prior research and the two-level model of PSI it was expected that a higher proximity leads to a higher perceived addressing. Therefore, the descriptive impression which is provided by the current investigation contradicts the theoretical foundation of the paraproxemic relationship (Meyrowitz, 1986). A possible explanation might be derived from the fact that videos were filmed in a lecture hall. There were a lot of additional objects visible on screen in the far condition, like the blackboard, seat rows and the entrance door. These objects might have strengthened the impression of a school context and the students reported a higher perceived addressing of the lecturer because they experienced a more familiar teaching situation. A further explanation is based on the fact that the lecturer was just a small part on the screen in the far condition (Fig. 2). The additional objects might have distracted the participants and therefore, the students intentionally focused more on the lecturer in order not to miss learning relevant information. However, this effect was non-significant and therefore, data in perceived addressing regarding proximity can be due to chance. Frontal orientation led to a higher perceived addressing and stronger PSI. This supported earlier findings of increased mindreading activities due orientation/addressing (Hartmann & Goldhoorn, 2011). Frontal orientation might act as a reciprocal social encounter and resulted in enhanced awareness, attention and adjustment with the persona.

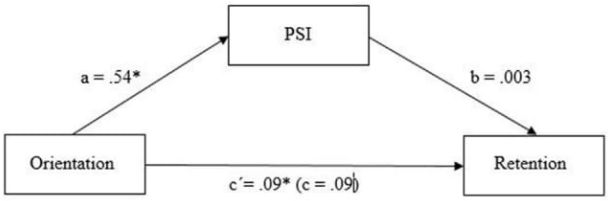

Fig. 2. Mediation by PSI (orientation: frontal = 1; lateral = 0; *$p < 0.05$).

Frontal presentation within the media fostered learning from personae. This result cannot be explained directly with PSI because of the missing mediation (see Fig. 2). Nevertheless, PSI was significantly increased in the frontal condition. As mentioned, PSI has multiple influences on recipients (e.g., Giles, 2002; Klimmt et al., 2006; Tsay & Bodine, 2012) and therefore PSI might foster learning indirectly. With respect to Hartmann et al. (2004), a high-level-PSI is characterized by a strong appreciation of media figures, attention and evaluation processes and this was reflected in the used EPSI measure which had a strong focus on the cognitive component of PSI. According to Mayer and DaPra (2012), retention performance might have been enhanced because of the stronger perception of social cues (especially eye contact). Social cues primed the activation of a social response and resulted in better retention performance (Mayer, 2014). This statement is supported by the embodiment principle. Furthermore, a direct addressing might have been considered as a form of personalization (Mayer, 2014). Thus, the benefits of the personalization principle could be transferred to specific optical representations of personae. This cognitive influences of PSI might be crucial for understanding parasocial learning processes but affective influences should be considered as well. A high level PSI is associated with a high arousal (Hartmann et al., 2004). A high arousal impacts learning processes positively due to enhancing emotional memory (Kensinger, 2009). Events with high emotional intensity are remembered frequently and detailed. Pekrun and Stephens (2011) concretized this approach and highlighted that inducing activating emotions could foster learning. Emotional states and affective arousal can strongly impact learning performance and should be taken into account when motivation, concentration and learning strategies are discussed (control-value theory of achievement emotions; Pekrun & Perry, 2014, pp. 120–141). Although the affective component of the two-level-model of parasocial interaction and Brownlow's model of parasocial learning only referred to sympathy and antipathy, literature highlighted that the affective component of PSI might be additionally important in order to explain learning

Table 2
Impact of orientation and proximity on learning outcomes.

Manipulation			Outcome measure			
			Retention		Transfer	
Orientation	Proximity	*N*	*M*	*SD*	*M*	*SD*
frontal	near	22	0.63	0.26	0.45	0.26
frontal	far	22	0.57	0.16	0.36	0.21
lateral	near	22	0.52	0.18	0.39	0.29
lateral	far	22	0.51	0.19	0.36	0.17

Note. Retention and transfer scores ranged from 0 to 1 (higher scores encode higher learning outcomes), *M* = mean value, *SD* = standard deviation, *N* = number of participants.

outcomes. It was shown that emotional designs have positive influences on learning processes (e.g. Schneider, Nebel, & Rey, 2016; Um, Plass, Hayward, & Homer, 2012) and PSI might be a tool to induce activating emotions which are beneficial for learning. In contrast, a low level PSI is characterized by a low cognitive and emotional processing (Hartmann et al., 2004). The persona (the lecturer) was subjectively irrelevant and behavioral activity and learning processes were not encouraged. Furthermore, the lateral condition seemed to be rather unusual. In school contexts eye contact and interaction between students and teachers/lecturers are an important and relatively frequent issue. Therefore, a lecturer who never looks into the camera (to give an impression of social interaction) might distract learners. Irrelevant thinking might occur because learners kept asking themselves why the lecturer behaved like that. Thus, the attention focus deviated from the learning content and retention performance decreased.

Regarding transfer performance, no significant effects occurred. This can be explained due the characteristics of the learning material. A video of overall ten minutes might be too short to observe differences in a deeper understanding of the statistic topics. Students could remember several facts and thus, retention score was affected positively but deeper comprehension or transfer knowledge were not affected. Furthermore, additional practice or feedback mechanism are essentially for the acquiring deep knowledge from educational videos.

5.1. Implications and limitations

This study gives a first experimental insight in parasocial designs in learning contexts. Practical implications primary refer to educational videos or Massive Open Online Courses (MOOCs). In addition to the context, learning can be fostered by optimizing the presentation and orientation of personae within the video. Especially in MOOCs learning is primary mediated via educational videos. Here the presentation of the lecturer should be optimized. Additionally, pedagogical agents should be presented in frontal orientation to maximize learning benefits. Furthermore, videos might be presented over a longer period of time to solidify a parasocial relationship. As Gola et al. (2013) pointed out, that stronger PSR fosters learning through educational videos.

On the theoretical side, parasocial influences through personae in learning environments is relevant for future research. One novelty of the current research refers to the explicit investigation of parasocial interaction in a multimedia context. An experimental manipulation could provide a first evidence for parasocial benefits in learning in a controlled learning environment. This empirical evidence extend the few previous findings in parasocial processes in learning (e.g., Brownlow, 2014; Lauricella et al., 2011). In order with prominent theories which refer to non-cognitive influences on learning (aCTL; Huk & Ludwigs, 2009; CATML; Moreno, 2006), parasocial interaction should be considered when learning environments with social entities are created. In addition to uses-of-gratification approaches, the findings of this study go beyond the development and maintenance of PSI. Therefore, another important implication of the current investigation is the specification of potential influences of PSI on viewer. Causes, maintenance and breakup of parasocial processes subject of empirical research. However, PSI can have broad influences on media recipients and the current study suggests that parasocial processes can be profitably implemented in learning environments. The processes behind the positive impact of PSI on learning should be differentiated in future studies.

The findings of the current study are subject of limitations. First, cognitive load was not examined. Therefore, concrete influences of parasocial processes on cognitive processes and resources could not be investigated. It is possible that a lateral presentation seems unnatural and causes irrelevant thinking. This might be reflected in the cognitive load score. Statistical power was insufficient. Missing PSI and transfer effects could be explained by that only 88 participants could be acquired for the current experiment. Furthermore, findings from the far-condition with frontal orientation are difficult to explain. It is possible that eye contact at high proximity is hardly perceived. Thus, different processes might play a decisive role. Learning test were implemented at the end of the study. Participants had to edit three PSI questionnaires between and after video presentation. These distractions from the learning content may have had a negative impact on learning, especially with respect to the early video content. Statistical analyses as learning content involved the problem that especially master students had a slight amount of prior knowledge. However, prior knowledge was not significantly unequally distributed between experimental conditions. Future research should be focused on other learning content and different samples, to strengthen the external validity of these results. Furthermore, future studies should solve the problem of the reliability of the knowledge measures which occurred in the current investigation. Statistical analysis on the basis of the item-response theory (Rasch Model; Rasch, 1960) might be more adequate to evaluate the quality of a knowledge measure.

5.2. Future directions

As mentioned, PSI consists of a cognitive, affective and behavioral component. In the current investigation PSI was measured as a global construct and facets were not differentiated. Future research should measure facets separately (PSI process scales; Schramm & Hartmann, 2008) and investigate whether a special facet is particular relevant for learning support. PSI is measured almost exclusively with questionnaires after media reception. Since PSI is defined as process during reception, a valid online measurement instrument should be developed. Cummins and Cui (2014) gave a first insight by implementing EPSI(CRM) as PSI measurement. The challenge is to develop an instrument which gathers online data, but does not claim a significant amount of cognitive resources of learners. Otherwise learning would be inhibited. Hartmann et al. (2004) developed the two-level model of parasocial interaction only for reception of audiovisual media. It would be interesting to investigate, if parasocial processes had a positive influences in other media (text-image combinations, instructional pictures, virtual reality learning, etc.) or educational videogames (Nebel, Schneider, & Rey, 2016). Studies on PSI might support previous findings with respect to benefits of social cues (Schneider, Nebel, Pradel, & Rey, 2015). Since PSI seems not to be linked to learning directly, additional variables such as arousal, affective or motivational variables should be investigated as well, in order to get a deeper understanding of PSL. Based on the dynamic model of Hartmann et al. (2004), it would be interesting to investigate the influence of the number of personae within an educational video. The outcomes in terms of learning performance and PSI remain unclear at a dynamic presentation of multiple personae. In the current study PSI was manipulated by the perception of addressing. In addition to proximity and orientation other design elements should be varied to create parasocial designs in learning environments. For example, increasing anthropomorphism might lead to stronger parasocial processes (Burgoon et al., 2000) and therefore, better learning outcomes. Brownlow (2014; 2015) and Gola et al. (2013) provided affective processes as key. Cognitive load and mental effort should be investigated as well, to specify influences of PSI on cognitive processes. Furthermore, it is interesting to examine benefits of parasocial designs which go beyond influences of cognitive load.

In summary, it becomes clear that PSL might be a complex and multifaceted process. Research on parasocial learning and parasocial designs in learning environments is still at its infancy. This study gave an experimental insight in benefits of addressing and parasocial designs for learning, but many questions remain unanswered. Additional studies would help to discuss multiple influences from PSI on affective and cognitive processes and to reveal a clear description, explanation and prognosis of PSL processes. Thus, parasocial influences in context of multimedia learning are promising areas for future research.

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Ageism–Age coherence within learning material fosters learning

The second study did not exclusively focus on the design of social entities. The internal consistency between the design of a pedagogical agent and the content of the learning material was investigated since prior studies pointed out that coherence (or congruence) within the learning material is beneficial for cognitive processes (e.g., Barenholtz, Lewkowicz, Davidson, & Mavica, 2014; Van Rompay, De Vries, & Van Venrooij, 2010). Therefore, an aural speech about allergies was prepared. The educational content was kept the same in all conditions; however, additional sentences were included in order to signify that the speech was relevant for older or younger individuals. The speech was taught by a pedagogical agent which was designed as an old or a young woman. All the other characteristics of the agent were kept the same. Cognitive as well as motivational variables and learning scores were assessed in order to acquire detailed insight into the effect of internal congruence on learning with instructional videos with social entities.

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Ageism – Age coherence within learning material fosters learning

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ABSTRACT

Pedagogical agents are frequently used in digital learning environments. On the basis of the computers-as-social-actors paradigm (CASA), learners do not differentiate between the interaction with these characters and any other social interaction. Therefore, the appearance of pedagogical agents is vulnerable to stereotyping mechanisms such as ageism. In addition, research suggests that the activation of stereotypes also depends on the context of accompanying verbal information. In this study, participants were randomly assigned to one cell of a 2 (stereotype of the agent: young vs. old) × 2 (stereotypical priming within the text: young vs. old) between-subjects factorial design in order to examine if stereotypes impact learning processes. In addition to retention and transfer scores, cognitive load and motivational data of learners were collected. Results revealed that transfer performance is only enhanced when agents and texts activate together either old or young stereotypes, whereas retention performance was not affected by the manipulation. In addition, the manipulation did not result in differences in any cognitive or motivational scores. The results can be explained by the coherence principle which postulates that information from different media should be congruent in order to foster process fluency.

1. Introduction

The popularity of multimedia learning increases significantly in times of fast technological advancement and it has led to comprehensive research regarding the design of learning environments. Whereas aspects such as cognitive processing and visual orientation during learning have been investigated closely (for an overview: Mayer, 2014), the impact of social variables has not been considered sufficiently. Common parts of social interaction are processes of stereotyping social entities (Werth & Mayer, 2008). However, social entities are implemented in various multimedia learning environments, like educational videos. Therefore, stereotypes should not be disregarded considering the influence and perception of these entities in learning situations. Referring to the CASA paradigm (Computers as social actors; Nass, Steuer, & Tauber, 1994) and the media equation theory (Reeves & Nass, 1996), learners interpret a multimedia-based message as a social event. Social cues in an instructional media environment (e.g., voices, eye contact, or gestures of a social entity) prime a social schema and activate the social processes of human-to-human communication (also called the *cooperation principle*; Grice, 1975). Thus, social entities in video-based learning can also be stereotyped. Although the consequences of stereotypes usually seem to be rather negative, for example in the case of discrimination, there are also positive aspects. The stereotyping of social entities is useful for saving cognitive resources (Macrae, Milne, & Bodenhausen, 1994). The current investigation aims to investigate the influence of stereotypes within multimedia learning environments by varying different stereotypes triggered by a pedagogical agent.

1.1. Stereotypes

It is important to discriminate between the constructs of the stereotype and prejudice. Even if these constructs are often used as synonyms, their initial definitions vary. A prejudice refers to an attitude towards outgroup members that is only based on their group membership (Werth & Mayer, 2008). A prejudice consists of cognitive, affective and behavioral components. The cognitive part – the *stereotype* – describes the knowledge structure which is the basis for any prejudice (Werth & Mayer, 2008). On the affective level, the so-called *stereotype activation* represents the positive or negative perception towards another person as a result of their group membership (Werth & Mayer, 2008). The interaction of a stereotype and its stereotype activation results in defined behavior

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towards members of a specific outgroup (also called *discrimination*; Werth & Mayer, 2008). Thus, stereotypes are the collection of knowledge about the totality of the social group of each person which is not individual but contains similar information in each culture or society (Cuddy, Norton, & Fiske, 2005; Stangor & Schaller, 2000). Stereotypes do not only influence face to face communication, stereotypes influence computer-mediated communication (CMC; e.g., Walther, Hoter, Ganayem, & Shonfeld, 2015) as well. According to Hasler and Friedman (2012) culturally (and therefore stereotypically) free environments do not exist and stereotypical behavior could be observed in virtual, avatar-mediated environments. Because of the sufficient anonymity during media-based communication and limited information about a social entity within an educational video, social identification takes place via through few available salient social information. This social identification leads to various positive and negative appraisals towards ingroup and outgroup members (Lea, Spears, & de Groot, 2001; Postmes & Baym, 2005). However, research regarding stereotypes in CMC produced contradictory results to date. CMC has potential to reinforce stereotypes (Epley & Kruger, 2005) or reduce the expression of stereotypes (Walther, DeAndrea, & Tong, 2010) and is tied on various mediators (Hasler & Amichai-Hamburger, 2013). These results outline the importance of additional research in the multiple influences of stereotypes in multimedia environments. Therefore, the current investigation complements the current discussion regarding computer-mediated stereotypes by implementing stereotypes in an educational video.

The four most common groups of stereotyping are: sexism, racism, appearance stereotypes (for example fattism), and ageism (Werth & Mayer, 2008). Ageism, which refers to discrimination against persons of a certain age, is considered in the current investigation. Basically, every age group is affected by stereotyping (Westman, 1991) but ageism provides the basis for discrimination especially towards the elderly (Duncan & Loretto, 2004). The allocation of children to class levels according to their age is one of the most demonstrative example of classifying people. Furthermore, this example shows that ageism occurs in educational contexts. However, it is not only the pupils' age but also the age of the teachers which can influence learning situations. According to a representative survey, students suggest that older teachers give lower marks than younger teachers (Pfeiffer & Baier, 2008). Additionally, older teachers were not as positively rated by pupils as their younger colleagues (Pfeiffer & Baier, 2008). These results show that age might have differentiated effects of the evaluation of a lecturer. Elderly people are mainly connected with negative attributes like illness and tiredness (Kite, Deaux, & Miele, 1991) as well as limited agility (Palmore, 1999). In contrast, positive features such as wisdom (Palmore, 1999) or warmth (Cuddy et al., 2005) are associated with the elderly.

The activation of stereotypes is often realized by priming. Priming is defined as the activation of a cognitive schema by previously presented and schematically relevant stimuli. Empirical research has shown that phrases or single words (Bargh, Chen, & Burrows, 1996; Devine, 1989), and also features of the outer appearance, are useful for activating stereotypes (Eyssel & Hegel, 2012). In the case of ageism, the physical characteristics of a person, referred to as *age markers*, can be found particularly in the area of the face (e.g., grey hair; Filipp & Mayer, 1999). Therefore, photographs or other pictures are commonly used in research on ageism stereotypes and lead to significant effects (e.g. Hummert, 1994; Yoo, Peña, & Drumwright, 2015). A stereotype could also be activated successfully by the use of age-related words or phrases (like grey or forgetful) (e.g., Bargh, et al., 1996; Chasteen, Schwarz, & Park, 2002).

If the stereotype is activated successfully, a limited time for fulfilling a task and a high cognitive load increase the use of stereotypes (e.g., Macrae, Hewstone, & Griffiths, 1993; Payne, 2001; Sherman, Groom, Ehrenberg, & Klauer, 2003). During a challenging cognitive situation, resources are depleted which results in the use of existing schemata (Gilbert & Hixon, 1991; Payne, Shimizu, & Jacoby, 2005). Stereotypes seem to be cognitive aids for orientating oneself in a complex socio-cognitive environment and are essential in human information processing (Lippmann, 1922). Social categorization and pre-existing schemata help to save time and cognitive resources that can be used for other tasks which are more relevant in the current situation (e.g., monitoring processes; Macrae et al., 1994). Thus, cognitive overload could be prevented because processes of social categorization and evaluation are not necessary. Prior research regarding cognitive benefits of stereotypes in challenging cognitive situations outlines the potential influence of stereotypes on learning. According to the cognitive load theory (CLT; Sweller, 1994; Sweller, Ayres, & Kalyuga, 2011) reduction of irrelevant cognitive processing leads to higher learning efficiency. Moreover, cognitive resources might be focused on schema construction because irrelevant processes are reduced through stereotyping. In order to specify these potential impacts of stereotyping on learning processes, a learning video with a pedagogical agent as a social entity was created for the current investigation.

1.2. Pedagogical agents

Pedagogical agents are defined as virtual characters that are implemented in multimedia learning environments in order to support learning through various mechanisms (Domagk, Poepperling, & Niegemann, 2006). The positive impact of pedagogical agents on learners is highlighted in various investigations (e.g., Heidig & Clarebout, 2011; Schroeder, Adesope, & Gilbert, 2013). Pedagogical agents support the learning process through the use of feedback (Lester et al., 1997), interaction with the learner (Johnson, Rickel, & Lester, 2000), or knowledge transfer directly through the agent (Craig & Gholson, 2002). Furthermore, pedagogical agents increase motivation as they create a more entertaining and interesting learning environment (Craig & Gholson, 2002).

However, design factors such as appearance, age, or gender of the agent are influencing factors on motivation, cognition, and therefore on the learning processes (Baylor, 2011; Schroeder et al., 2013; van der Meij, 2013). These visual factors are exactly the salient features that cause stereotypes (Werth & Mayer, 2008). Even small cues like the length of the hair can activate gender-stereotypes (Eyssel & Hegel, 2012). Rosenberg-Kima, Baylor, Plant, and Doerr (2008) underlined the connection between stereotypes and pedagogical agents. Young women's attitudes and beliefs against choosing an engineering-related profession could be influenced positively by implementing agents as social role models in an interactive online video. Apart from gender-stereotypes, stereotypes referring to age-related attitudes can influence learners while interacting with pedagogical agents. Yoo et al. (2015) pointed out that an interaction with an elderly agent in a virtual shopping center environment led to slower movements while shopping in a virtual environment. These findings indicate that the ageism stereotype can be activated successfully in video based learning environments with implemented pedagogical agents. With respect to prior research, the potential influence of stereotypes on the behavior of learners results from the transfer of schematic behavior known from human-human-interaction to situations in human-computer-interaction because of missing alternative behavior patterns (Niegemann et al., 2008).

1.3. Stereotypical coherence

For the current experiment, stereotypes were investigated regarding coherence within the learning material. Therefore, the learning material was manipulated regarding the age of the pedagogical agent (young vs. old) and the age to which the learning text referred (priming: young vs. old). The content-related coherence of provided information within the learning material has been investigated from various perspectives up to now. For example, learning is fostered in terms of text-picture congruence (Van Rompay, De Vries, & Van Venrooij, 2010), action-effect congruence (Horvath, Gray, Schilberg, Vidrin, & Pascual-Leone, 2015) or categorical congruence (Barenholtz, Lewkowicz, Davidson, & Mavica, 2014). Macrae et al. (1993) already pointed out that the perceiver of video material, under demanding cognitive conditions, recalls stereotype-consistent information more frequently. Process fluency is affected positively by providing congruent information because the expectation of the learner is supported (Van Rompay et al., 2010). Incongruent and therefore, disrupting information disrupt learning processes and impair the development of a coherent mental model (Harp & Mayer, 1998). Though, enhanced process fluency is not only associated with cognitive benefits and learning success. Winkielman, Schwarz, Fazendeiro, and Reber (2003) pointed out, that process fluency increases learners positive affect. A positive affect is associated with significant higher motivation (e.g., Pekrun, Goetz, Titz, & Perry, 2002) which is a core variable for learning. Motivation is crucial for arousing, directing and sustaining learning performance (e.g., Duttweiler, 1986). The implementation of technology in learning environments can foster motivational variables (e.g., Chang, 2005) and therefore, it is important to clarify boundary condition for enhancing motivation in multimedia learning through additional research. The current experiment aims to extend these empirical findings to stereotypical coherence within the learning material. Therefore, the effects of stereotyping on learning, cognitive and motivational variables are investigated in detail.

1.4. Hypotheses

According to the CASA paradigm and the media equation theory, behavior concepts like stereotypes are relevant in interacting with virtual characters (Nass et al., 1994; Reeves & Nass, 1996). Research has shown that ageism can be activated and used while working with pedagogical agents as well as with text-priming (e.g. Rosenberg-Kima et al., 2008; Yoo et al., 2015). In addition, stereotypes avoid cognitive overload in challenging cognitive situations, as in the case of learning or test scenarios (Macrae et al., 1994). According to CLT, decreasing cognitive overload influences learning outcomes positively (Sweller et al., 2011). Especially, coherence between the age of the pedagogical agent and the primed age of the text should foster learning (Van Rompay et al., 2010). With respect to prior research, the following hypothesis is postulated:

Hypothesis 1. *Learners watching the educational video with a fit between the age of the pedagogical agent and the primed age of the learning material will achieve higher learning outcomes (retention and transfer) than learners receiving the educational video without a fit between the age of the pedagogical agent and the primed age of the learning material.*

Stereotypes are used to reduce cognitive load in our complex social environment (Werth & Mayer, 2008). Especially, coherence within the learning material should lead to a higher process fluency and cognitive benefits during learning (Van Rompay et al., 2010). According to literature regarding CMC, stereotyping takes place in multimedia environments and leads to cognitive change (e.g., Epley & Kruger, 2005) but research regarding CMC and stereotypes are contradictory to date. Furthermore, computer-mediated stereotypes had not been reviewed in the learning context up to now, the current experiment explores this cognitive effect in computer-mediated learning situations. With this in mind, the following hypothesis was generated:

Hypothesis 2. *Learners watching the educational video with a fit between the age of the pedagogical agent and the primed age of the learning material will report a lower cognitive load than learners receiving the educational video without a fit between the age of the pedagogical agent and the primed age of the learning material.*

According to the conducive effects of using pedagogical agents on learner motivation and the interest in the topic pointed out in earlier research (e.g., Domagk, 2008), the current study assumes that this tendency could lead to increased intrinsic motivation and interest in conditions with a fit between the age of the pedagogical agent and the primed age of the learning material. This assumption is underpinned by research regarding enhanced process fluency in content-related congruent learning materials (Van Rompay et al., 2010) which leads to enhanced affective and motivational processes (e.g., Pekrun et al., 2002; Winkielman et al., 2003).

Hypothesis 3. *Learners watching the educational video with a fit between the age of the pedagogical agent and the primed age of the learning material will report a higher interest and intrinsic motivation than learners receiving the educational video without a fit between the age of the pedagogical agent and the primed age of the learning material.*

In summary, learners in the age coherence conditions will demonstrate: (1) higher retention and transfer of learning materials, (2) lower cognitive load, and (3) higher intrinsic motivation and interest in the learning materials, than learners in conditions where the age of the agent and the primed age of the learning material did not match.

2. Method

2.1. Pre-tests

Two pre-tests with student samples were conducted in order to examine which pedagogical agent, appropriate voice, learning content, and priming of the stereotype within the text would be suitable for the current investigation. For the first pre-test, three female pedagogical agents were created using Autodesk Character Creator (2014) and three female agents were created using the character editor of The Sims 4 (2014). Each of the six agents was presented as a young woman (estimated age of 21) or as an old woman (estimated age of 65). In summary, 12 agents were pretested regarding perceived age, sympathy, and expertise in order to identify a young and an old agent who differed significantly in perceived age but not in perceived sympathy and expertise. This was important because the potential effect on learning outcomes should be due to age stereotypes and not to perceived expertise and sympathy (Baylor & Kim, 2005; Domagk, 2008). In addition, the concrete theme of the learning content was implemented in the first pre-test in order to avoid that a theme was chosen which is in general perceived as stereotypically old or young. Five main themes and three sub themes were chosen (travelling [Cyprus, Mallorca, Rimini], gardening [grow potatoes, plant magnolia, home-grown vegetables], household [traditional cooking, home remedies, household Apps], diseases [heart diseases, allergies, sport accidents] and pets [tropical fishs, chihuahuas, finches]). Fifty students were required for the online pre-test, designed with LimeSurvey

Fig. 1. Screen example for the experimental condition with the young agent.

(2014). Based on the results, a female character, created with The Sims 4 was chosen for the current investigation (Figs. 1 and 2). A multivariate analysis of variance (MANOVA) with the two different agents (old vs. young) as within-subject factor and perceived age, sympathy, and expertise as dependent variables was conducted. Results revealed that the young and old versions differed significantly in terms of perceived age, $F(1.49) = 633.86$, $p < 0.001$, $\eta_p^2 = 0.93$. Furthermore, the agents had average values and did not differ significantly regarding sympathy, $F(1,49) = 2.14$, $p = 0.15$, $\eta_p^2 = 0.04$ and expertise, $F(1,49) = 1.31$, $p = 0.26$, $\eta_p^2 = 0.03$. Regarding the learning content, the theme "diseases [allergies]" was chosen for the current experiment because the age associated with this subject was average and the learning topic was not explicitly associated with an old or young stereotype. Therefore, this rather age neutral theme could be manipulated using priming in order to activate the stereotypes.

The second pre-test was conducted to select a suitable voice for the agent and to check whether the priming works. This pre-test was designed in LimeSurvey (2014) and was also sent online to the participants. Twenty-six participants were required in order to rate the voices and the fictional text regarding the priming. The voices of the young and old agent were kept the same in order to avoid effects which are based on the differences between two potential speakers. Therefore, a female voice had to be selected which suited a young and an old agent. Six women recorded a fictional text. Each audio file was rated in terms of expertise, sympathy, and if the voice belongs to an older or a younger. A voice from a 26-year-old women was used because her voice was rated average in terms of sympathy and expertise. A problem was that all voices were rated rather young. Thus, the voice was lowered in pitched and slowed down to a small extent because a deeper intonation and slower speed are characteristic of an aging voice (Brückl & Sendlmeier, 2003; Kofler, 1931; Oyer & Deal, 1985). The change was minimal to avoid an artificial sounding voice. In order to show generalizable effects, a fictional text was created (about a fictional Spanish town named *Pontevedra*) and recorded as an audio file in order to test the priming. The focus of the pre-test is to test whether additional sentences within the learning material can trigger age related stereotypes reliably. These additional sentences were for example (translated from german): "Young/old people particularly like to travel to Pontevedra." or "Pontevedra is a popular destination for old/young people." These sentences were distributed equally over the entire text in order to trigger the stereotype consistently. The audio file was rated in terms of the perceived age of the target group. The results revealed that the priming was successful. The young primed text reached a perceived age of the target group for $M = 28.85$ ($SD = 9.09$) and the old primed text reached a perceived age of $M = 42.69$ ($SD = 15.83$); $F(1,25) = 10.73$, $p = 0.003$, $\eta_p^2 = 0.30$. Based on these results, priming with additional sentences was undertaken for the primary study.

2.2. Participants and design

Overall, 90 students could be acquired for this experiment. Four students had to be excluded because they had seen through the experimental manipulation. Two students had to be excluded because they had trouble understanding the speech. Data from the remaining 84 students (73.8% female; age: $M = 22.48$, $SD = 3.88$) from the Chemnitz University of Technology could be used for statistical analyses. The participants where completing the second ($n = 44$), fourth ($n = 27$) or other ($n = 13$) semester. Students were enrolled in media and communication studies (66.7%), media and instructional psychology (11.9%), or other fields of study (21.6%). Each student received a 1 h course credit or €5 for their participation. Furthermore, there were no significant differences between the treatment groups in terms of age ($p = 0.49$), gender ($p = 0.86$), field of study ($p = 0.56$), semester ($p = 0.64$), prior knowledge ($p = 0.74$), and basic interest in the learning theme ($p = 0.68$). Each student was randomly assigned to one cell of a two (stereotype of the agent: young vs. old) × two (stereotypical priming within the text: young vs. old) between-subjects design. Twenty-two students were assigned to the condition with the young agent and the young text-priming, 20 students were assigned to the condition with the old agent and the old text, 22 students were assigned to the condition with the young agent and the old text and 20 students were assigned to the condition with the old agent and the young text.

2.3. Materials

The learning material consisted of educational videos. Within the video, each pre-tested agent was presented on the left side of the screen and a classroom scenario was visible in the background (see Fig. 1 for the young agent and Fig. 2 for the old agent). The videos were made of fixed images with a controlled background and a slightly moving agent. Furthermore, notes appeared on the white board with basic information and headings to guide the

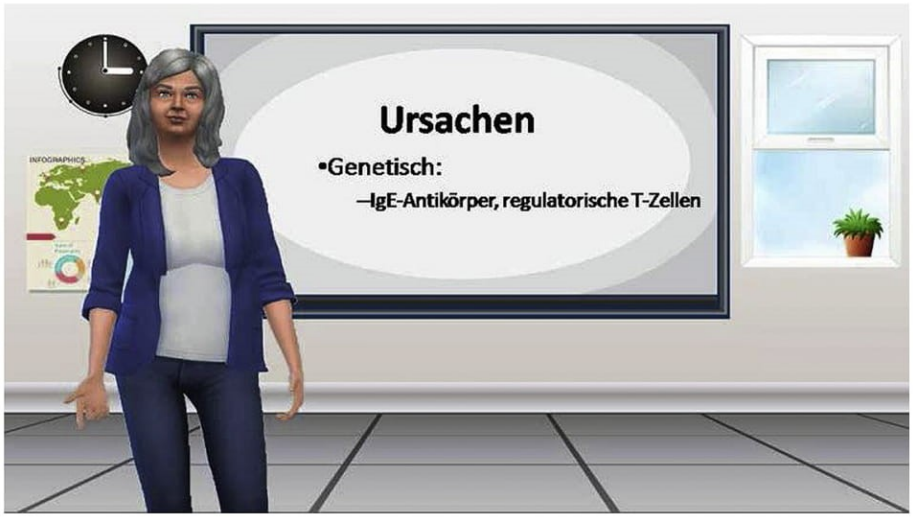

Fig. 2. Screen example for the experimental condition with the old agent.

participants through the educational video content.

The pre-tested voice gave a lecture about allergies. The lecture contained the definition, causes, and diagnoses of allergic diseases. At the beginning, the fictional agent introduced herself with the translated text: "Welcome. I am 25/65 years old and today I will talk to you about allergies". After the introduction, the relevant learning information followed. In order to operationalize the perceived stereotypical expression of the text, the pre-tested priming within the video was used. The priming was implemented as additional sentences throughout the learning relevant content. To trigger the perception of a stereotype, translated sentences were, for example: "Young/old people are particularly affected by allergies." "This diagnostic procedure is often used in the elderly/for young people." These sentences were distributed equally over the entire text in order to trigger the stereotype consistently. This allowed the learning content to be kept equal in all conditions. After combining each agent (young vs. old) with each text priming (young vs. old), four educational videos were produced for the current investigation. Overall, each video lasted 6:20 min.

2.4. Measures

In order to address the different facets of the manipulation and the constructs, several measures were used. All measures are outlined in Table 1. First, the item "For what age is the video intended?" was implemented in the questionnaire. Participants could indicate any appropriate age in a free response format. This item was used as an indicator for the influence of the agent and the text on perceived age as a manipulation check.

The learning material was explicitly designed for the current investigation and therefore, adequate and validated learning measures were not available. Learning measures regarding prior knowledge, retention, and transfer were created by ourselves in order to cover the entire learning content adequately. A 9-item questionnaire was used to measure prior knowledge, asking questions on the definition, symptoms, causes, course, and treatments of allergies with an open answer format. Participants could gain one point per item if they specified information which was part of the following learning material or zero points if they reported other (or no) information. Two raters assessed the responses separately and the overall inter-rater reliability (intra class correlation coefficient of aggregated prior knowledge score) was high, ICC $(2, k) = 0.98$, $F(83, 83) = 45.05$, $p < 0.001$. Retention was measured by a 9-item multiple choice questionnaire. Students had to choose between four possible answers. There could be one, two, three or four correct answers within a question. A point was given for either a correct answer or a correct omission and therefore, students were able to earn up to four points per question. The questions covered information that was explicitly presented within the learning material. In order to gather transfer scores, a 9-item scale with the same question format was created. Every item presented a new scenario which could be solved with the knowledge which had been obtained from the learning material. The low reliabilities of the learning measures can be explained by the fact that different heterogeneous subtopics are summarized (symptoms, causes, treatments, etc.). Factual knowledge, as well as knowledge regarding processes were implemented in the current measures. Furthermore, the items are designed to assess different levels of difficulty in order to generate broad variance in the responses. Because of this multidimensionality of knowledge, the internal

Table 1
Measures and Scales of the current investigation.

Variable	Scale	Reliability	Item-Example
Prior knowledge	Self made	0.61	What are the causes of allergies?
Retention	Self made	0.36	Which statements are true regarding the causes of allergies?
Transfer	Self made	0.44	A patient was tested positive for an allergic substance. However, no symptoms occur during the next contact with this substance. How is this possible?
Cognitive Load	Eysink et al., 2009	0.89	How easy or difficult is it for you to work with the learning environment?
Basic Interest	Rakoczy et al., 2005	0.88	It is exciting to learn something about allergies.
Learning-Interest	Rakoczy et al., 2005	0.84	When I was watching the video, time flew by.
Intrinsic Motivation	Schiefele, 1990	0.77	I found the educational video meaningful.

Note. Reliability is defined as Chronbachs α.

consistency (measured with Cronbach's alpha) might be inadequate to evaluate the knowledge scales used because high correlations between the items within the questionnaire were not expected.

The cognitive load was assessed by the questionnaire from Eysink et al. (2009). The questionnaire includes three items addressing extraneous load (ECL) and one item for each measurement of intrinsic load (ICL), germane load (GCL), and overall load (OL). In this study, OL was considered as mental effort (ME; cf. Nebel, Schneider, & Rey, 2016). ICL comprises the complexity of the used learning material as well as learners' previous knowledge. ECL is defined as irrelevant cognitive processing which arises from the design of the instructional material itself. Relevant learning processes of schema acquisition and automation were assigned to GCL. Students had to rate items on a 9-point Likert scales ranging from *very easy* to *very hard*. The scale was chosen because it was used in multiple investigations dealing with multimedia learning (e.g., Schneider, Nebel, Pradel, & Rey, 2015; Skulmowski, Pradel, Kühnert, Brunnett, & Rey, 2016). Furthermore, this cognitive load scale is an adapted version of the SOS scale (Swaak & De Jong, 2001) which was investigated differentiated in learning contexts.

Interest was measured in two ways. First, the basic interest in the learning topic "allergies" was measured in order to use the interest score as a covariate for further analyses. Therefore, the 8-item interest scale provided by Rakoczy, Buff, and Lipowsky (2005) was used. The questionnaire assesses the basic interest in dealing with a specific topic on a 5-point Likert scale ranging from *strongly disagree* to *strongly agree*. Secondly, interest during learning was assessed with the 8-item scale of thematic interest from Schiefele (1990). Participants rated on a 5-point Likert scale ranging from *strongly disagree* to *strongly agree*. Intrinsic motivation was assessed by the questionnaire from Rakoczy et al. (2005; based on Prenzel, Kristen, Dengler, Ettle, & Beer, 1996). The scale consisted of four items. Participants rated on a 5-piont Likert scale ranging from *strongly disagree* to *strongly agree*. These measures were especially designed and evaluated for investigations in the learning context (Schiefele, 1990) and were used for a comprehensive swiss-german video study (Rakoczy et al., 2005) which made them optimal for the current investigation.

2.5. Procedure

The study was conducted in a computer lab with four work stations. Partition walls were placed between the working stations in order to keep participants focused on their screens. Numbers of students within one experimental run differed between one and four. Each workplace was prepared with all paper materials and pre-opened versions of the educational videos on the computer desktops. However, monitors were switched off prior to the experiment. After the participants arrived, they were randomly assigned to one of the experimental conditions by drawing lots. The students were welcomed and told that they will participate in a video study about facts about allergies. The manipulation and more accurate information were initially concealed. After the experiment started, all students completed their tasks according to demographic information, prior knowledge, and basic interest, autonomously within 25 min. After each participant finished these materials, the experimenter opened the videos and instructed the students to watch the video by themselves with headphones. The videos were presented on 24 inch monitors on Windows 7 PCs. Afterwards, students were instructed to complete the cognitive load, thematic interest, intrinsic motivation, retention and transfer questionnaire in this order. This phase lasted 15 min and, overall, the experiment required 45–50 min. Afterwards, students were informed about the manipulation and purpose of the investigation.

3. Results

3.1. Manipulation check and expression of the stereotype

U-tests were conducted in order to investigate whether the instructional material differed in terms of perceived age of the target group of the educational videos, because pre-defined test assumptions for an ANOVA were impaired, Levene-test, $F(3, 80) = 13.96$, $p < 0.001$. In particular, the manipulation regarding the primed text had to be checked because the agent named her precise age (21/65). The perceived age was used as a dependent variable age of the agent and the primed age of the text as between-subject factors. Results revealed that students estimated the age marginally higher in the videos with the old agent ($M = 29.90$, $SD = 20.72$) than in the videos with the young agent ($M = 20.32$, $SD = 12.72$; $U = 686.00$, $p = 0.08$). Students gave a higher estimate of age in the videos with the primed old text ($M = 32.38$, $SD = 20.83$) than in the videos with the primed young text ($M = 17.38$, $SD = 8.72$; $U = 441.50$, $p < 0.001$). Overall, in the conditions with the old agent or the primed old text, the target group estimated younger than expected and the manipulation check revealed that the experimental manipulation must be considered critically. However, the group with the young agent and the primed young text ($M = 16.55$, $SD = 7.05$) and the group with the old agent and the old primed text ($M = 41.50$, $SD = 22.15$) differed greatly from each other ($d = 1.52$).

3.2. The influence of stereotypes on learning

Hypothesis 1. *Learners watching the educational video with a fit between the age of the pedagogical agent and the primed age of the learning material will achieve higher learning outcomes (retention and transfer) than learners receiving the educational video without a fit between the age of the pedagogical agent and the primed age of the learning material.*

The domain specific prior knowledge of the participants was rather low (mean score in the prior knowledge test: $M = 3.67$, $SD = 1.56$ on a scale from 0 to 9) and did not differ significantly between the experimental conditions ($p = 0.74$). Due to descriptive deviations regarding prior knowledge, the prior knowledge score was included as a covariate in the following analyses regarding retention and transfer performance and cognitive load.

To investigate the effects of stereotypes on learning outcomes in general, a multivariate analysis of covariance (MANCOVA) was conducted with age of the agent and primed age of the text as between-subject factor, retention and transfer scores as dependent measures and prior knowledge as a covariate. All pre-defined test assumptions were not significantly impaired, Box's M (9, 70599.49) = 6.80, $p = 0.69$. No significant effect was found for age of the agent, Wilk's $\Lambda = 0.98$; $F(2,78) = 0.94$, $p = 0.39$, $\eta_p^2 = 0.02$, and for primed age of the text Wilk's $\Lambda = 1.00$; $F(2,78) = 0.01$, $p = 0.99$, $\eta_p^2 = 0.00$. However, an approached significant interaction effect was found, Wilk's $\Lambda = 0.93$; $F(2,78) = 2.88$, $p = 0.06$, $\eta_p^2 = 0.07$.

A follow up analysis of covariance (ANCOVA) with retention and transfer as dependent variables, age of the agent and primed age of the test as between-subject factors and prior knowledge as covariate was conducted in order to get further insights in the interaction. No significant interaction was found regarding retention performance $F(1,83) = 1.61$, $p = 0.21$, $\eta_p^2 = 0.02$ but a medium significant interaction was found considering transfer performance $F(1,83) = 5.82$, $p = 0.02$, $\eta_p^2 = 0.07$. Fig. 3 illustrates the direction of the effect.

Transfer performance was enhanced when age of the agent and

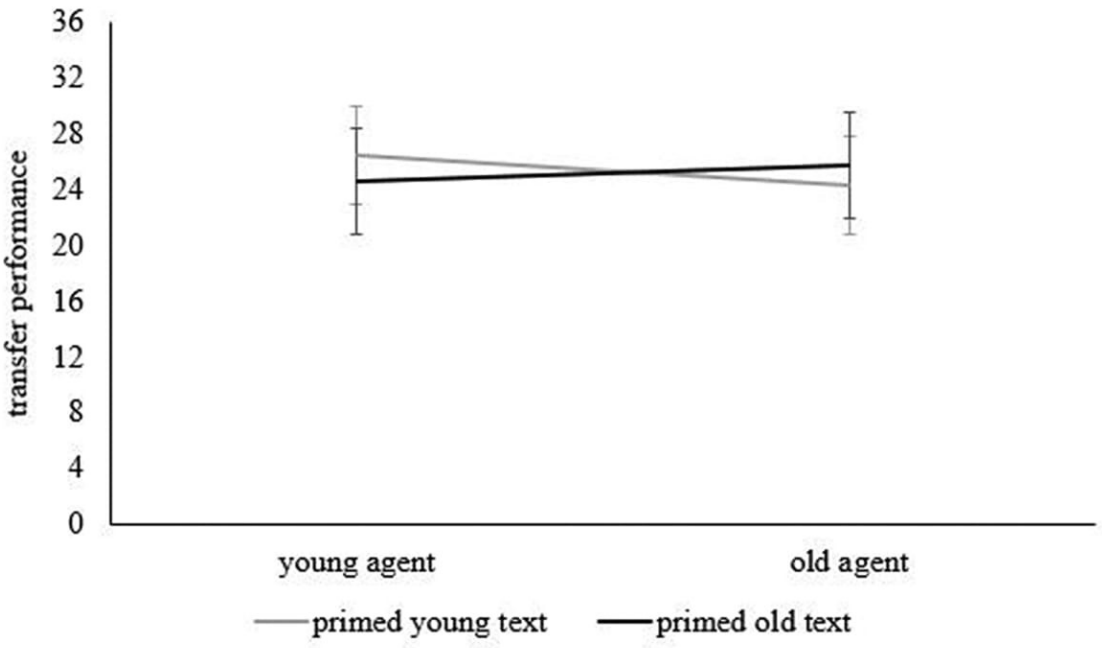

Fig. 3. Interaction between the age of the agent and the primed age of the learning material regarding retention performance.

primed age of the text fitted to each other. Students receiving a young agent and a text with priming on a young age as well as an old agent and a text with priming on an old age outperformed students who received learning videos where age of the agent and primed age of the text did not fit. This result was found descriptively in retention scores, as well. Descriptive results are outlined in Table 2.

3.3. The influence of stereotypes on cognitive load

Hypothesis 2. *Learners watching the educational video with a fit between the age of the pedagogical agent and the primed age of the learning material will report a lower cognitive load than learners receiving the educational video without a fit between the age of the pedagogical agent and the primed age of the learning material.*

In order to investigate the effects of stereotypes on cognitive load, a MANCOVA was conducted with age of the agent and primed age of the text as between-subject factor, cognitive load facets and mental effort as dependent measures, and prior knowledge as a covariate. All pre-defined test assumptions were not significantly impaired, Box's M (30, 17288.66) = 32.02, $p = 0.51$. No significant effect was found for age of the agent, Wilk's $\Lambda = 0.94$; $F(4,76) = 1.19$, $p = 0.32$, $\eta_p^2 = 0.06$, for primed age of the text Wilk's $\Lambda = 0.93$; $F(4,76) = 1.51$, $p = 0.21$, $\eta_p^2 = 0.07$ and no significant interaction effect was found, Wilk's $\Lambda = 0.99$; $F(4,76) = 0.16$, $p = 0.96$, $\eta_p^2 = 0.01$. Descriptive results are outlined in Table 3.

Table 2
Impact of age of the agent and primed agent of the text on learning outcomes.

Manipulation			Outcome measure			
			retention		transfer	
Age of the agent	Primed age of the text	*N*	*M*	*SD*	*M*	*SD*
young	young	22	27.09	2.76	26.41	3.07
young	old	22	26.18	3.23	24.55	3.92
old	young	20	25.30	3.95	24.30	4.32
old	old	20	25.80	3.38	25.80	3.38

Note. Retention and transfer scores ranged from 0 to 36 (higher scores encode higher learning outcomes), M = mean value, SD = standard deviation.

3.4. The influence of stereotypes on interest and intrinsic motivation

Hypothesis 3. *Learners watching the educational video with a fit between the age of the pedagogical agent and the primed age of the learning material will report a higher interest and intrinsic motivation than learners receiving the educational video without a fit between the age of the pedagogical agent and the primed age of the learning material.*

Table 3
Impact of age of the agent and primed agent of the text on cognitive load.

Manipulation			Outcome measure			
			ICL		ECL	
Age of the agent	Primed age of the text	*N*	*M*	*SD*	*M*	*SD*
young	young	22	4.55	1.97	4.45	1.63
young	old	22	4.27	1.67	4.56	1.54
old	young	20	4.75	1.97	4.37	1.64
old	old	20	4.50	1.67	4.77	1.63
Manipulation			Outcome measure			
			GCL		OL (ME)	
Age of the agent	Primed age of the text	*N*	*M*	*SD*	*M*	*SD*
young	young	22	3.23	1.72	4.59	2.26
young	old	22	3.27	1.64	5.05	2.08
old	young	20	3.30	2.00	4.00	2.36
old	old	20	3.95	2.16	4.90	2.05

Note. Cognitive load scores ranged from 1 to 5 (higher scores encode higher cognitive load), M = mean value, SD = standard deviation, ICL = intrinsic cognitive load, ECL = extraneous cognitive load, GCL = germane cognitive load, OL = overall cognitive load, ME = mental effort.

The domain specific basic interest of the participants was average to high (mean: $M = 3.34$, $SD = 0.78$ on a scale from 1 to 5) and did not differ significantly between the experimental conditions ($p = 0.68$). However, due to descriptive deviations regarding basic interest, the basic interest score was included as a covariate in the following analysis regarding interest and intrinsic motivation.

To investigate the effects of stereotypes on interest and intrinsic motivation, a MANCOVA was conducted with age of the agent and primed age of the text as between-subject factor, thematic interest and intrinsic motivation as dependent measures and basic interest as a covariate. All pre-defined test assumptions were not significantly impaired, Box's M (9, 70599.49) = 8.71, $p = 0.50$. No significant effect was found for age of the agent, Wilk's $\Lambda = 0.99$; $F(2,78) = 0.58$, $p = 0.58$, $\eta_p^2 = 0.01$, for primed age of the text Wilk's $\Lambda = 1.00$; $F(2,78) = 0.05$, $p = 0.95$, $\eta_p^2 = 0.001$ and no significant interaction effect was found, Wilk's $\Lambda = 0.99$; $F(2,78) = 0.52$, $p = 0.59$, $\eta_p^2 = 0.01$. Descriptive results are outlined in Table 4.

4. Discussion

The aim of this study was to investigate the influence of stereotypes on learning processes, cognitive and motivational variables. The age of a female pedagogical agent and the primed age of the learning material were manipulated systematically in order to trigger the "ageism" stereotype in the learning environment. Transfer performance was enhanced in the conditions where the age of the agent and the primed age of the text fitted. Retention performance did not significantly differ between the experimental conditions. Thus, hypothesis 1 is partially supported. Regarding cognitive load, interest, and intrinsic motivation, no significant differences between the experimental conditions could be found. Therefore, hypothesis 2 and hypothesis 3 must be rejected.

The significant effect regarding transfer performance could be explained by considering the cognitive benefits of stereotyping. Even if cognitive load scores did not differ between the experimental conditions, stereotypical fit between the learning material and the social entity who teaches the content might lead to a lower level of irrelevant thinking. According to the coherence principle, stereotypical fit within the learning material leads to increased process fluency (Van Rompay et al., 2010). The engagement of learners is continuously supported by consistent information and therefore, especially transfer performance, which refers to understanding and the quality of learning, is fostered (Mayer, 2009). The missing effects regarding retention performance can be explained by considering the element interactivity, the complexity of the learning material (Sweller, Van Merienboer, & Paas, 1998). The content of the educational video was not overly complex and the retention tests probably referred to learning content with a lower element of interactivity. Therefore, effects are smaller than in learning environments with a high element of interactivity. Another explanation can be provided by considering the prior knowledge test. During the test, keywords were queried which appeared later in the educational video. Thus, learners may already have been primed on important learning content and may have processed this content more intensively. This resulted in good retention performance, independent of the experimental manipulation. The missing effects regarding cognitive load might be explained by the use of the questionnaire from Eysink et al. (2009). The questionnaire might measure the facets of cognitive load insufficiently because ICL and GCL were measured with just one item. Furthermore, the cognitive benefits of stereotyping might not be reflected adequately in the cognitive load facets. Stereotyping is a mostly unconscious process and therefore, effects are not reflected in a post-hoc questionnaire but in learning results. A further explanation would be that processes of stereotyping occur especially in a challenging, demanding, cognitive environment and the learning videos used might not be challenging enough to observe explicit cognitive change. The missing effects regarding motivational variables can be explained by considering the prior interest in the topic of allergies. The prior interest was higher than expected ($M = 3.34$ on a scale from 1 to 5) and therefore, the increase in interest and motivation was rather low.

Table 4
Impact of age of the agent and primed agent of the text on interest and intrinsic motivation.

Manipulation			Outcome measure			
			interest		intrinsic motivation	
Age of the agent	Primed age of the text	*N*	*M*	*SD*	*M*	*SD*
young	young	22	3.41	0.51	2.95	0.79
young	old	22	3.49	0.62	3.09	0.72
old	young	20	3.48	0.66	2.93	0.72
old	old	20	3.34	0.39	2.81	0.75

Note. Interest and intrinsic motivation scores ranged from 1 to 5 (higher scores encode higher interest and intrinsic motivation), M = mean value, SD = standard deviation.

4.1. Implications

The results of this experiment offer several theoretical and practical implications for the design of pedagogical agents and multimedia learning content. Previous approaches have demonstrated that (para-)social processes can foster learning (Beege, Schneider, Nebel, & Rey, 2017). This research enriches this theoretical and empirical foundation and support the CASA paradigm and the media equation theory. Stereotypes influence the perception of pedagogical agents as well as real humans and lead to changes in the learning processes. The current investigation provides a contribution to the discussion about stereotypes in computer-mediated communication (CMC). Stereotypes influence face to face interaction as well as CMC and digital environments. Although, there is no direct contact of potential (para-)social interaction partners, stereotypes might lead to cognitive change and influences in learning processes. Therefore, stereotypes or social coherency influence learning and should be taken into consideration when discussing learning environments with implemented social entities. This could lead to a theory of *stereotypes in learning contexts* that further explains the mechanics of matching of educational content and (para-)social context. Thus, the first empirical evidence towards this theory is provided, although deeper exploration of the mechanisms involved is needed.

On the practical side, clear design recommendations can be derived from the current experiment. Because of the carefully pretested content, insights unbiased from further influential factors like sympathy or expertise can be provided. It was demonstrated that it is no certain stereotype that is beneficial for learning, but the coherency between the pedagogical agent and the triggered associations within the learning content. Many learning materials are associated with a certain stereotype and therefore, educational videos or interactive digital learning environments could be designed in order to create stereotypical coherence within the material. More specifically, it was shown that learning material which is associated with a certain age or period of life, should be transported by the matching pedagogical agents to foster transfer of the learning outcomes. For example, young child actors or voices could be implemented in educational videos for elementary schooler in order to create a stereotypical fit between the social

entity and the learning content within the video and the target group. It is especially important to note that, not only do social entities cause stereotypical perception, but also the learning content could also be influenced by the processes of stereotyping. This recommendation might be applicable within other media types such as videos, but it needs further empirical validation.

4.2. Limitations

This research is limited by several methodical and social factors. First of all, a manipulation check revealed that the experimental variation was successful overall, but the perception of the age of the target group of the video did not significantly depend on the age of the pedagogical agent. This might have happened because only one voice was used for both of the agents. One voice was chosen in order to prevent further variation within sympathy or expertise, but as a downside, this might have lowered the impact of our experimental manipulation. The comparably medium perceived age of the text might have impaired coherency with the older agent, limiting the learning results. The participants were university students and they were quite young. This is especially relevant, because age is the main focus of the study. The fact that the students may identify with the young agent because of their similarity limits the results regarding the fit between the age of the agent and the primed age of the learning content. Overall, statistical power was low. Data from 84 participants could be used for statistical analyses which means that 20 to 22 students were assigned to a single cell of an ANOVA. Therefore, it is possible that small effects regarding cognitive load and motivational variables were not detected with the current sample. Additionally, other measures of cognitive load (e.g., Leppink, Paas, Van Gog, van Der Vleuten, & Van Merriënboer, 2014) might have provided different insights into the processing of the educational material. This is especially important as the lack of results within the CL and other measures limits possible explanations for the observed effect within the transfer results. An effect regarding interest and intrinsic motivation could not be observed. Students had to participate in order to get course credits or to get money. Therefore, students were highly extrinsically motivated. This might have superimposed effects regarding other motivational variables and an actual intrinsic motivation might not occur. Finally, there are social limitations as well. As it is very important to overcome stereotypes and to reduce prejudice, the transfer of the results to educational material remains a challenging task. Beyond this, stereotypes and their attribution might vary from one cultural background to another. Thus, we can only safely transfer our results within a similar (middle European) cultural background. Additionally, attributions might also change over time, further increasing the challenge of maintaining coherency and raising the need for constant empirical validation.

4.3. Future directions

(Para-)social influences in multimedia learning are insufficiently investigated to date. The current investigation considered the effects of coherence within the learning material from the perspective of social psychology but several questions remain unanswered. Future research could investigate if not only the coherence within the learning material, but also the coherence between the agent and the learner, is crucial for learning. Furthermore, a more dynamic presentation (e.g. an educational video with a moving agent) could strengthen the parasocial presence and thus, cause stronger effects. The physical appearance of the pedagogical agent might not be the only factor which influences learning. The voice, behavior (gestures, facial expressions) or induced sympathy and antipathy should be investigated in further studies. Furthermore, the perspective, orientation and obtrusiveness of the agent within the video could be manipulated. Similar studies on stereotypes and coherence could go beyond the boundaries of pedagogical agents. Researchers could investigate whether these results are transferable to real persons in a video, to real learning situations in a classroom, or to simple learning materials, like text-picture combinations. It could be possible that the (para-) social effect of stereotypes gets stronger in videos with real persons and weakens in pictures of persons. The biggest scope for further investigation is the underlining of the processes of influences of stereotypes in learning. For example, underlining cognitive processes could not be explicitly observed in the current investigation. Future investigations should implement a more adequate measure of cognitive load during learning or increase the element interactivity of the learning material in order to foster the processes of stereotyping. Furthermore, motivational and affective variables should be investigated during learning with physiological measurements because explicit questionnaires might measure mostly unconscious processes inadequately. Nevertheless, investigating underlining processes might lead to a differentiated insight into stereotyping in learning environments because stereotypes can also have negative influences (*stereotype threat*; Spencer, Logel, & Davies, 2016).

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Mood-affect congruency. Exploring the relation between secondary school learners' mood and the affective charge of educational videos

The third study extended the focus of coherence by examining the coherence between the instructional video and the learner. Furthermore, an advance in the field of emotional design in instructional videos was made. Therefore, two instructional videos were prepared which included a speech about prominent attractions of the city Chemnitz. The information was kept the same in both videos, but the videos differed in their affective charge. One video had a positive charge as the female lecturer was smiling and used friendly intonation during the speech. The other video had a neutral charge as the lecturer used neutral facial expressions and had monotonous intonation. As second independent variable, the mood of the learner was manipulated before watching the instructional video. Standardized pretested pictures (IAPS; Bradley & Lang, 2007) were used to induce mood. Affective variables, as well as cognitive variables and learning scores, were examined.

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Mood-affect congruency. Exploring the relation between learners' mood and the affective charge of educational videos

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ABSTRACT

In the educational context, the influences of the emotional charge of audiovisual media are rarely investigated. Additionally, the mood of the learner influences learning with multimedia. This study aims to investigate the influence of both variables on learning with videos. Therefore, 162 school students watched educational videos which were manipulated in terms of emotional charge. The participants were randomly assigned to one cell of a 2 (learners mood: positive vs. negative) × 2 (emotional charge of the educational video: positive vs. negative) between-subjects factorial design. Retention and transfer performance were measured in order to examine learning effects. Furthermore, mental load, mental effort, and affective variables were collected. Results revealed that the mood of the learner did not influence learning outcomes and cognitive assessments. The positive emotional charge of the video fostered retention performance and led to a reduced mental load. Transfer performance was fostered in the conditions with congruence between learners mood and the emotional charge of the video. Results are discussed by considering the emotion-*as*-facilitator hypothesis and the mood congruency effect.

1. Introduction

School teachers use educational videos as a welcome change in daily teaching. According to Hoogerheide, Loyens, and van Gog (2016), a wide range of students watch instructional videos for formal and informal learning purposes on diverse online platforms. These videos are consulted in order to get deeper understandings in relevant learning topics or even replace classical face to face learning activities. Especially in the World Wide Web, numerous video lectures (Traphagan, Kucsera, & Kishi, 2010), knowledge clips (Day, 2008), and demonstration videos (Ayres, Marcus, Chan, & Qian, 2009) are available and used frequently. Instructional videos are also becoming more popular in school (Spires, Hervey, Morris, & Stelpflug, 2012). Educational videos offer numerous design possibilities in order to create an interesting and appealing learning environment (e.g., Papa et al., 2000) and are an ideal multimedia applications to deliver emotions and information (Chen & Sun, 2012). Especially, educational videos which induce positive emotions are found to significantly influence learning-relevant cognitive mechanisms like memory, attention and perception (Izard, 1993, 2007; Lewis, 2005; Lewis, Haviland-Jones, & Barett, 2010). In addition to the affective influence due to the emotional charge of an educational video, learner always have a basic mood when entering the learning situation. This mood influences learning processes as well (Brose, Schmiedek, Lovden, & Lindenberger, 2012; Um, Plass, Hayward, & Homer, 2012). The current study aimed to investigate the impact of emotional charge of educational videos on cognitive and learning processes. Furthermore, an interaction between the current mood of the learner and the affective charge of the video will be examined.

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1.1. Cognitive-Affective Theories of learning with media

Two major frameworks were developed in order to describe learning processes with various multimedia environments. The Cognitive Theory of Multimedia Learning (CTML; Mayer, 2014) describes how information is selected, organized and integrated. Information get processed via a verbal and a pictorial channel and are organized into coherent models within the working memory. Afterwards both models have to be integrated and transferred to the long-term memory. However, knowledge transfer to the long-term memory is mediated by the amount of domain-specific prior knowledge (Kalyuga, Ayres, Chandler, & Sweller, 2003). According to the Cognitive Load Theory (CLT; Kalyuga & Singh, 2016), two cognitive processes can be identified during learning: (1) *Intrinsic cognitive load* (ICL) is defined as the processing of the relevant information which is affected by the element-interactivity and prior knowledge, (2) *extraneous cognitive load* (ECL) is defined as processing of learning-irrelevant information which are caused by the design of the learning environment.

However, affective variables are not included in the CLT and CTML. These variables have proven influences in learning with media (e.g., Plass & Kaplan, 2016). Learning with media is always associated with an affective quality. Affective charge of a learning environment evokes an emotional episode within the learner which can be categorized in terms of valence (positive vs. negative) and arousal (activating vs. deactivating; Plass & Kaplan, 2016). Watching educational videos can cause such an emotional episode (Becher, 1999). Cognitive processes can be enhanced and learning processes are fostered especially by evoking an emotional episode with positive valence (emotion-*as*-facilitator hypothesis; Park, Knörzer, Plass, & Brünken, 2015). In contrast, emotions can also lead to distraction and inhibit learning processes (emotion-*as*-suppressor hypothesis; Park et al., 2015). Therefore, extended frameworks, like the Cognitive-Affective Theory of Learning with Media (CATLM; Moreno & Mayer, 2007) and the Integrated Model of Cognitive-Affective Learning with Media (ICALM; Plass & Kaplan, 2016) were developed in order to implement affective and motivational influences in learning with multimedia. Both theories intertwine cognitive and affective processes at various stages of the learning process. Information is rather integrated as an affective-cognitive mental model in contrast to a purely cognitive mental model.

1.2. Affective influences in learning with media

When arguing about effects of affect during learning in terms of cognitive processes and learning success, two perspectives have to be taken into account. First, the current mood of the learner may influence the learning process. Second, the learning environment consists of its own emotional charge which may influence learning as well. Therefore, mood and emotions must be distinguished from another by definition. Mood can be defined as long-lasting affective states which are rather diffuse and often labeled as “good”, “neutral”, or “bad” (Ekkekakis, 2012). In comparison with concrete emotions, mood can be described as enduring and of lower intensity (Frijda, 2009). Emotional episodes are of stronger intensity and shorter duration as moods (Shuman & Scherer, 2014).

The current mood may deplete resources in working memory (Brose et al., 2012; Mitchell & Phillips, 2007). Negative and positive mood prime learning-irrelevant thoughts. Therefore, working memory capacity is limited because of the split of attention between the learning task and mood processing (Brand, Reimer, & Opwis, 2007; Seibert & Ellis, 1991). Certainly, a positive mood may enhance motivation and engagement towards the learning task (Isen & Reeve, 2005). In particular, intrinsic motivation is enhanced by positive mood (e.g., Um et al., 2012). Additionally, positive mood is associated with a higher attention span and a global processing of information (Fredrickson & Branigan, 2005), and increased creativity and a higher usage of problem solving skills (Isen, 1999) as well as enhanced learning outcomes (Liew & Su-Mae, 2016). However, negative mood may also increase motivation and effort (Forgas, 2013). Forgas pointed out that a negative mood leads to a more systematic and analytical processing of information and thus, may foster learning.

In addition to the mood of the learner, the learning environment consists of its own emotional charge. Positive or negative emotions can be induced via various techniques (e.g., decorative elements; Schneider, Nebel, Beege, & Rey, 2018). Positive emotional states were shown to foster learning outcomes in contrast to neutral (e.g., Park et al., 2015) and negative states (e.g., Heidig, Müller, & Reichelt, 2015). Positive emotions direct the attention towards the learning material, while more cognitive resources can be used in order to process relevant information (Huk & Ludwigs, 2009). Creative thinking is enhanced in emotionally positive learning environments in contrast to negative learning environments and therefore, learning might be fostered (Nadler, Rabi, & Minda, 2010). Furthermore, emotions are strongly connected to motivational variables (Heidig et al., 2015). A positive emotional charge of a learning environment led to an increased intrinsic motivation and therefore, learning was fostered. In summary, there are several evidences that a positive mood of the learner as well as a positive emotional charge of the learning environment is beneficial for learning in comparison with a neutral mood or a learning environment which does not induce emotional episodes.

1.3. The mood congruency effect

The mood of the learner and the emotional charge of the learning environment were rarely investigated separately. Nevertheless, there might be interaction effects between these two constructs. A thoroughly investigated effect which combines the effects of mood of the learner and the emotional charge of the learning material is the so called mood congruency effect (e.g., Bower, 1981; Kim & Pekrun, 2014; Schwarz, 2000). This effect implies that learning with congruent mood of the learner and emotional charge of the learning material lead to a deeper processing during learning process and a better recall of information (Bower, 1981). For example, Bower, Monteiro, and Gilligan (1978) investigated the mood congruency effect by inducing emotions by two word lists at different times either with positive or negative emotions. Words with an emotional content which matched with the emotional state of the learner during the recall were significantly recalled more often. The mood congruency effect is often explained by considering

associative networks. According to the CLT, memory is constructed by concepts and schemata (Kalyuga & Singh, 2016). As mentioned, emotions are inextricably linked to events of daily life and therefore, the objective knowledge is not stored free from emotions in the long-term memory. If a mood is experienced, mood-related concepts are more easily available in the working memory (Levine & Pizarro, 2004). In consequence, storage and recall in a material-congruent affect facilitates the access to information because affect-congruent stimuli receive a stronger activation than incongruent stimuli (Fiedler, Nickel, Asbeck, & Pagel, 2003). Especially, a positive emotional charge of the learning material in combination with a positive mood of the learner is conducive for learning (Mayer, Gayle, Meehan, & Haarman, 1989), whereas arousal of the learner or the learning material (which can be defined as activation; Plass & Kaplan, 2016) does not seem to influence the mood congruency effect (Mayer et al., 1989; Varner & Ellis, 1998).

1.4. The present experiment

The current study aims to investigate two knowledge gaps which result from the reviewed literature: (1) Learning effects in the field of emotional design were almost exclusively determined on pictures and websites (e.g., Heidig et al., 2015; Schneider, Nebel, & Rey, 2016). In contrast to this research history, Chen and Sun (2012) pointed out that videos are an ideal multimedia application to deliver emotions and information. Therefore, the current study used educational videos to implement a positive emotional charge (which is henceforth called positive charge) and a neutral emotional charge (which is henceforth is called neutral charge) in order to investigate if previous design recommendations and effects can be transferred to audio-visual media. (2) The mood congruency effect is dealing with learning processes but was mostly examined in the context of clinical psychology (e.g., Clark & Teasdale, 1982; Teasdale & Taylor, 1981). Furthermore, the mood congruency effect describes the emotional fit between the learning and recall situation and thus, indicates that an emotional congruence is crucial for learning. The current study extends this effect by investigating the emotional fit and interaction between the mood of the learner when entering a learning situation and the emotional charge of the learning material.

Learners got a mood induction (positive vs. neutral) at the beginning of the investigation and then received an educational video with congruent or incongruent emotional charge (positive vs. neutral). According to the reviewed literature, especially a positive mood of the learner is beneficial for learning in comparison to neutral mood (e.g., Fredrickson & Branigan, 2005). Still, empirical results showed that a positive mood can be harmful for learning as well (e.g., Brand et al., 2007). In order to consider both effect directions, two contrasting hypotheses are postulated:

H1a: Learners with a positive mood will achieve **higher** learning outcomes than learners with a neutral mood.
H1b: Learners with a positive mood will achieve **lower** learning outcomes than learners with a neutral mood.

In particular, recent research results pointed out that a positive charge of a learning environment is beneficial for learning in contrast to a control group (Schneider et al., 2016; 2018). Therefore, a positively charged educational video should be beneficial for learning. A hypothesis was formulated in order to check if existing results regarding the emotional design of learning environments are transferable to audiovisual media:

H2: Learners watching an educational video with a positive charge will achieve **higher** learning scores than learners watching the educational video with a neutral charge.

The mood congruency effect indicates that emotional congruence during learning elicits a positive impact on learning outcomes (e.g., Fiedler et al., 2003). The current study broadens this effect in order to investigate not only the emotional congruence between learning and recall but also the emotional congruence between the general mood of the learner and the emotional charge of the learning environment.

H3: Learners in the conditions with congruence between their mood and the emotional charge of the video will achieve **higher** learning scores than learners in the conditions without congruence between their mood and the emotional charge of the video.

Furthermore, research has shown that cognitive processes are influenced by emotional design factors and the mood of the learner (e.g., Isen & Reeve, 2005). Finally, the detailed effect of mood induction before the learning situation and the emotional design factors in educational videos on the emotional response of the learner should be explored. Therefore, these variables will be additionally examined in the current experiment.

2. Method

2.1. Participants & design

Overall, 165 students in grade ten ($N = 78$), eleven ($N = 49$) and twelve ($N = 35$) from a secondary school in Thuringia (Germany) participated in this experiment. Because of incomplete data records, three students had to be excluded from statistical analyses. The remaining 162 participants (58% female; age: $M = 16.49$, $SD = 0.96$) were randomly assigned to one cell of a two (mood induction: positive vs. neutral) × two (emotional charge of the videos: positive vs. neutral) factorial between-subjects design by drawing lots. Thirty-two students were assigned to the condition with the positive induction and positive videos, 51 students were

assigned to the condition with the positive induction and neutral video, 40 students to the condition with the neutral induction and the positive video and 39 students to the condition with the neutral induction and the neutral video. Furthermore, there were no significant differences between the four treatment groups in terms of gender ($p = .28$) or prior knowledge ($p = .88$). Nevertheless, "grade" was unequally distributed between the experimental conditions ($p < .001$). There was a tendency for older students to be assigned in the conditions with positive induction. Therefore, the variable "grade" was used as covariate in further statistical analyses.

2.2. Materials

2.2.1. Induction

Media are often explicitly used in order to induce mood. According to a meta-analysis (Westermann, Spies, Stahl, & Hesse, 1996), imagination, stories, movies etc. are useful for inducing positive and negative mood. According to actual literature regarding the mood congruency effect, emotionally charged media are adequate in order to induce mood (Knott & Thorley, 2014; Thorley, Dewhurst, Abel, & Knott, 2016). Because of a possible confounding of different stories, musical compositions etc., emotional images were used. According to Lench, Flores, and Bench (2011), pictures are very effective in inducing various emotions. For the current investigation, the pre-tested International Affective Picture System (IAPS; Bradley & Lang, 2007) was searched for suitable pictures. For the positive induction the pictures 2501, 5621, 8200 and 8300 were used, for the neutral induction the pictures 2214, 2221, 2393 and 7550 were used. Apart from to the manipulation of valence, the pictures were very similar to each other (e.g., all pictures showed people). Especially, the facial expression varied in most of the pictures. Whereas the pictures for the positive induction involve enthusiastic or excited expressions or situations, the pictures for the neutral induction contained people with neutral expressions. This is especially important because several studies have shown that facial expressions can be used for positive mood induction (Schneider, Gur, Gur, & Muenz., 1994; Westermann et al., 1996). Four pictures were presented in all conditions in order to implement an effective induction. The pictures were presented on the start screen of the learning environment and among the entry of the participation number in order to induce positive mood before the learning material is shown.

2.2.2. Educational videos

Two educational videos were filmed in order to implement a positive and neutral charge. Within these videos, a pre-trained female lecturer held an oral presentation on facts about attractions of the City Chemnitz (Saxony, Germany). The content was chosen because attractions of a city never visited before has a neutral emotional charge and the prior knowledge of the participants was considered to be low. The valence-free learning content ensured that the perceived emotional charge of the educational video is due to the manipulation and not due to the learning content. The video shoot took place in front of the themed attractions and therefore, the scenes were changing during the educational videos (see Fig. 1).

The charge manipulation of the educational videos was operationalized by mimetic and vocal changes. In the condition with the positive video, the pre-trained female lecturer smiled and the intonation of the words was friendly. According to Ekman (2007),

Fig. 1. Screenshot of different scenes of the experimental videos.

smiling is a strong indicator for positive emotions and smiling is frequently used to express positive emotions (e.g., De Melo, Carnevale, & Gratch, 2012; Guadagno, Swinth, & Blasovitch, 2011). In the condition with the neutral video, the lecturer had neutral facial expressions because a lack of facial expressions is not associated with positive or negative emotions (Ku, Jang, Kim, Kim, Park, Lee, Kim, & Kim, 2005). Furthermore, the intonation of the voice of the lecturer was unemotional and nearly monotonous. Because of the manipulation, every scene had to be shot twice. At first, the scene with the positive expression of emotions was shot and afterwards the neutral video was recorded. In order to eliminate confounding, other variables were kept constant. In both conditions, gestures were not used. Furthermore, the amount of eye contact with the camera was kept the same. The perspective was identical in both conditions and the speaking tempo was nearly identical. Finally, scenes in which people walked through in the immediate surroundings and possibly distracted the participants were removed or recorded again.

2.3. Measures

Because of the ongoing criticism of Cronbach's α (for an overview: McNeish, 2017), the coefficient Revelle's omega (ω; Revelle & Zinbarg, 2009; McDonald, 1999) was chosen in order to calculate reliability estimates for all measures.

2.3.1. Emotion

In order to check the manipulation and investigate the emotional impacts of the induction as well as the videos on all learners, the Self-Assessment Manikin (SAM; Bradley & Lang, 1994) was used. The SAM has been used for both, measuring mood which was induced through pictures (e.g., Backs, da Silva, & Han, 2005) and measuring emotional responses to videos (e.g., Handayani, Wahab, & Yaacob, 2015) in prior research. Therefore, the SAM is suited for the current investigation because comparable scales can be used in order to investigate the influence of affective variables in learning. The questionnaire consisted of three subscales (valence, arousal, dominance) in which six opposing adjective-pairs were rated on a 9-point Likert scale ranging from -4 to $+4$. For example, regarding valence the participants had to rate the adjective-pair "unlucky/lucky". Students could rate if they are rather unlucky (rating -4 to -1), neutral (rating from 0) or lucky (rating from 1 to 4). The questionnaire was presented after the mood induction (valence, $\omega = 0.90$; arousal, $\omega = 0.86$; dominance, $\omega = 0.82$) and after the educational video (valence, $\omega = 0.94$; arousal, $\omega = 0.91$; dominance, $\omega = 0.87$).

2.3.2. Mental load and mental effort

Mental load and mental effort were measured with a questionnaire developed by Krell (2015). Six items assessed mental load (ML; $\omega = 0.86$; e.g., "The contents of the tasks were complicated") and six items assessed mental effort (ME; $\omega = 0.87$; e.g., "I have given my best to complete the tasks"). Students had to rate these items with the help of a 7-point Likert scale ranging from "not at all" to "totally".

2.3.3. Prior knowledge

Prior knowledge was assessed by two self-report questions. At first, students had to answer whether they ever were in the City Chemnitz. If they answered with "yes", students got one point. Afterwards, students had to answer the question: "Which attractions from Chemnitz do you know?" If the students reported an attraction which was part of the learning content, he or she was given one point per correct attraction. Therefore, students were able to achieve four points for the second question and overall a maximum of five points regarding prior knowledge.

2.3.4. Retention and transfer

Retention ($\omega = 0.64$) and transfer tests ($\omega = 0.75$) were implemented in order to adequately assess the learning performance. Retention refers to remembering and reproducing the learning content and transfer is defined as understanding and solving novel problems, which are were not explicitly presented in the learning content based on their coherent model (Mayer, 2014). Retention was measured with 12 multiple choice questions (e.g., "In which languages the inscription of the Karl Marx monument is presented?") and eight open questions (e.g., "On which language the brand name Bruno Banani is based?"). The multiple choice questions consisted of four possible answers. There could be one to four correct answers within a question. A participant gained a point if he marked one item correctly or correctly decided not to mark it in the case of a wrong answer. Therefore, the participants could gain a maximum of four points per question. The open questions could always be answered with a short sentence or with a few words. If the question was answered correctly, students could gain one point. If the answer was partially correct, 0.5 points were reached. A preset of possible answers was created in order to ensure a rating which was as objective as possible. The open questions were rated by two independent pre-trained raters. Inter-rater reliability was perfect because both raters evaluated exactly the same. Transfer was measured with seven multiple choice questions (e.g., "Why do you think Bruno Banani is successful?"). The same question format as for retention was used to gather the transfer scores.

2.4. Procedure

The experiment lasted 45 min and took place in a computer lab in a secondary school in Saxony-Anhalt. Students had to draw lots in order to be assigned to the experimental conditions. In the first phase of the experiment, the mood induction took place. The students received an URL to the electronic questionnaire with either the neutral mood induction or a link with the positive mood induction. Overall, the first part of the survey consisted of the mood induction through the described images, the prior knowledge test

Table 1
Mean and standard deviations of all dependent variables for the four experimental groups.

	Experimental groups							
	Positive Induction				Neutral Induction			
	Positive Video (N = 32)		Neutral Video (N = 51)		Positive Video (N = 40)		Neutral Video (N = 39)	
	M	*SD*	*M*	*SD*	*M*	*SD*	*M*	*SD*
Valence (Induction)	1.39	1.27	1.40	1.30	0.95	1.18	1.05	1.25
Arousal (Induction)	−1.05	1.20	−0.91	1.10	−0.93	1.16	−1.10	1.35
Dominance (Induction)	0.31	0.84	0.45	0.95	0.25	0.98	0.33	0.997
Valence (Video)	0.99	1.28	0.69	1.43	0.83	1.34	0.65	1.44
Arousal (Video)	−1.39	1.01	−1.25	1.08	−1.29	1.18	−1.17	1.51
Dominance (Video)	0.10	1.02	0.32	0.83	0.08	1.01	0.07	1.05
ML	3.96	1.24	4,37	0.91	4.07	1.23	4.43	1.06
ME	4.69	1.22	4.59	1.04	4.33	1.32	4.47	1.27
Retention	11.39	2.08	10.75	2.63	12.20	2.93	12.01	2.50
Transfer	6.91	1.71	6.04	2.10	6.63	2.11	6.74	1.57

Note. ML = Mental Load, ME = Mental Effort, *M* = mean scores, *SD* = standard deviation. The scores of the affective variables ranged from −4 to +4, the scores from ML and ME ranged from 1 to 7, retention score ranged from 0 to 24, transfer score ranged from 0 to 11.

and the SAM which should serve as a manipulation check. Afterwards, the second phase took place. The students got randomly assigned to the conditions with either the positive or neutral video. The students could not pause the video or repeat specific parts. Students were given headphones in order to individually adjust the sound and undisturbedly watch the video. After finishing the video, the students fulfilled the second questionnaire by re-assessing their emotional situation (SAM). Finally, the third phase (test phase) took place. The cognitive load questionnaire was shown and retention and transfer test followed. In the end, demographic data (i.e., age, sex, and grade) were collected. If all tests were completed, the students were instructed to wait quietly until all students finished the experiment.

3. Results

In order to investigate differences between the experimental groups, multivariate analyses of covariance (MANCOVAs) and univariate analyses of covariance (ANCOVAs) were conducted. For all analyses the experimental factors mood induction (positive vs. neutral) and the charge of the video (positive vs. neutral) were used as independent variables. Since the variable “grade” significantly differed among the experimental groups, this variable was used as covariate in all analyses. Test assumptions were examined and only reported if these assumptions were significantly violated. Furthermore, effect sizes for all differences were only reported if at least a marginal level of significance ($ps < .10$) was reached. Descriptive results for all dependent variables are outlined in Table 1.

3.1. Emotion

Emotions were assessed after the mood induction and after the educational video. Therefore, two MANCOVAs were conducted with valence, arousal and dominance (subscales of the SAM) as dependent variables in order to investigate the emotional effects of the mood induction (first MANCOVA) and the emotional effects of the video (second MANCOVA). The first MANCOVA revealed no significant main effect regarding the emotional induction; Wilk's $\Lambda = 0.98$; $F(3, 155) = 1.32$, $p = .27$. Follow-up ANCOVAS were conducted in order to get a detailed insight in the three sub-facets of the SAM. Considering valence, a small marginal significant effect was found, $F(1, 161) = 3.85$, $p = .052$, $\eta_p^2 = 0.02$. Students receiving pictures with positive valence reported a higher valence than students receiving pictures with neutral valence. Therefore, the manipulation by pictures was very weak. This has to be considered when interpreting further results. Arousal, $F(1, 161) = 0.03$, $p = .86$, and dominance, $F(1, 161) = 0.34$, $p = .56$, were not influenced by the induction. Main effects of the valence of the videos and interaction effects were not conducted because the educational video was not shown at the time of the first SAM.

The second MANCOVA revealed no significant main effect regarding the emotional induction; Wilk's $\Lambda = 0.99$; $F(3, 155) = 0.78$, $p = .51$, no main effect regarding the valence of the video; Wilk's $\Lambda = 0.98$; $F(3, 155) = 0.93$, $p = .43$, and no significant interaction; Wilk's $\Lambda = 0.996$; $F(3, 155) = 0.23$, $p = .87$. However, the influence of the covariate “grade” was significant; Wilk's $\Lambda = 0.95$; $F(3, 155) = 2,72$, $p = .047$, $\eta_p^2 = 0.05$. Follow-up ANCOVAS revealed no specific effects regarding valence, arousal and dominance.

3.2. Mental load and mental effort

A MANCOVA was conducted with mental load (ML) and mental effort (ME) as dependent variables. No significant effect was found for the induction; Wilk's $\Lambda = 0.997$; $F(2, 156) = 0.27$, $p = .77$. A marginal significant main effect regarding the charge of the video; Wilk's $\Lambda = 0.97$; $F(2, 156) = 2.55$, $p = .08$, $\eta_p^2 = 0.03$, and no interaction was found; Wilk's $\Lambda = 0.998$; $F(2, 156) = 0.15$, $p = .86$. Follow up ANCOVAs with ME and ML as dependent variables and charge of the video as independent variable was conducted

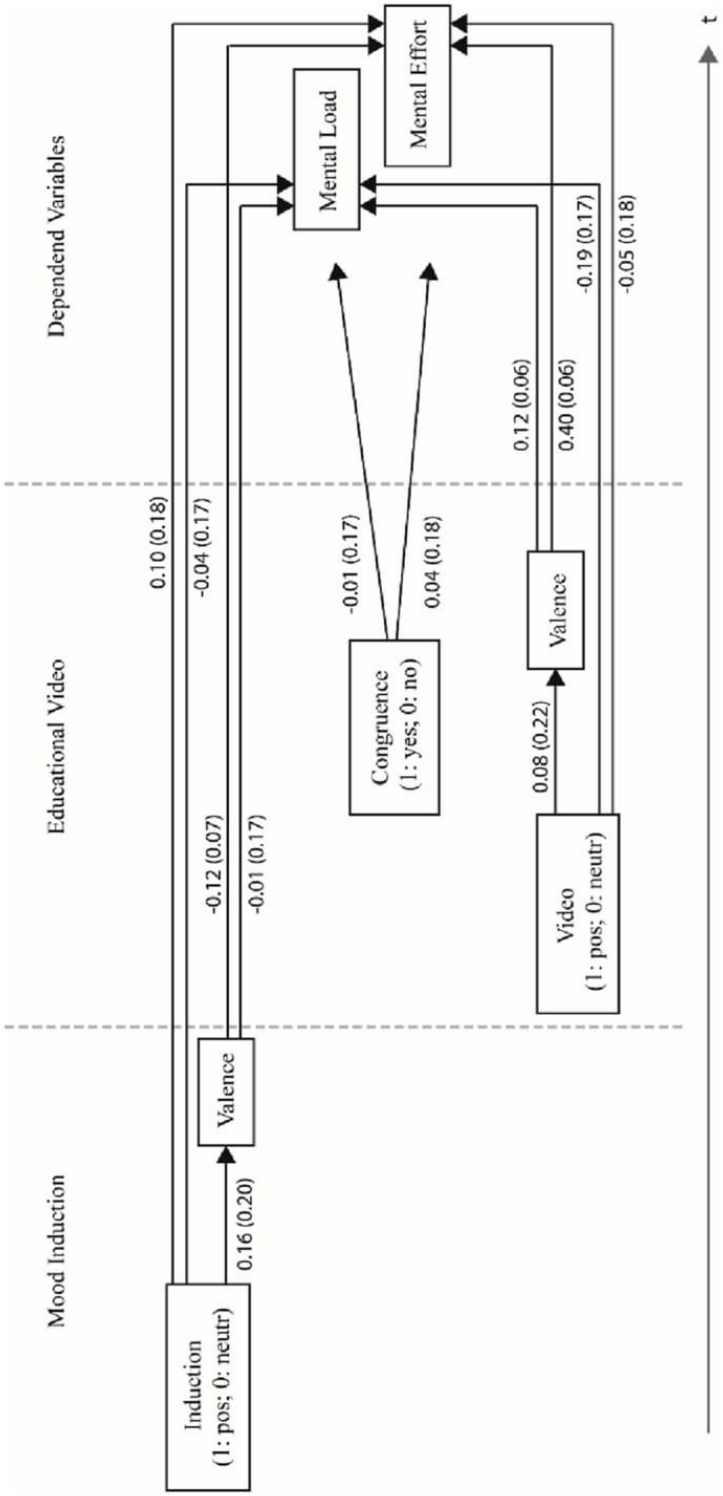

Fig. 2. Path analysis with mental load and mental effort as dependent variables; β (*SE*).

in order to get further insights in the effects of the charge of the video. A small significant main effect for ML; $F(1, 161) = 5.08$, $p = .03$, $\eta_p^2 = 0.03$, and no main effect regarding ME; $F(1, 161) = 0.05$, $p = 82$ were found. Students watching the video with the neutral charge reported a higher ML than students watching the video with the positive charge. An additional mediator analysis was conducted in order to get deeper insights in how mood induction and affective charge of the video influences cognitive processes during learning.

Additionally, a path analysis was conducted in order to get a deeper insight into the expression of mental load and effort effects during learning (see Fig. 2).

Mood induction, affective charge of the video and congruence of these affective states were implemented as independent variables. Valence after mood induction and after the presentation of the educational videos were used as mediators and ML as well as ME were used as dependent variables. Positive mood induction had a positive direct effect on ME ($\beta = 0.10$; SE = 0.18) and a negative effect on ML ($\beta = -0.04$; SE = 0.17). Furthermore, positive mood induction had a positive effect on the valence scale of the SAM after mood induction ($\beta = 0.16$; SE = 0.20). The perceived valence after mood induction had no influence on ML ($\beta = -0.01$; SE = 0.07) and a negative influence on ME ($\beta = -0.12$; SE = 0.07). In line with the conducted ANOVA, watching a video with positive affective charge had a negative direct effect on ML ($\beta = -0.19$; SE = 0.17) and had no effect on ME ($\beta = -0.05$; SE = 0.18). Watching a video with positive affective charge had a positive effect on the valence scale after watching the video ($\beta = 0.08$; SE = 0.22). A higher perceived valence after watching the educational video furthermore, led to a higher mental effort of the participants ($\beta = 0.40$; SE = 0.06) as well as to an increased mental load ($\beta = 0.12$; SE = 0.06). The congruence of mood and affective charge had no effect on perceived valence after watching the video ($\beta = 0.02$; SE = 0.22), ML ($\beta = 0.04$; SE = 0.17) and ME ($\beta = -0.05$; SE = 0.18).

3.3. Learning outcomes

The domain specific prior knowledge of the participants was low ($M = 1.70$, $SD = 0.50$ with a maximum of five points). Prior knowledge was included as additional covariate because prior knowledge is an important mediator of learning with media (Chen, Kalyuga, & Sweller, 2017).

A MANCOVA was conducted with retention and transfer as dependent variables. The influence of the covariate "grade" was significant; Wilk's $\Lambda = 0.95$; $F(2, 155) = 4.34$, $p = .02$, $\eta_p^2 = 0.05$. There was no significant main effect regarding the emotional induction; Wilk's $\Lambda = 0.99$; $F(2, 155) = 0.96$, $p = .38$, a marginal significant main effect regarding the charge of the video; Wilk's $\Lambda = 0.97$; $F(2, 155) = 2.84$, $p = .06$, $\eta_p^2 = 0.04$, and no significant interaction; Wilk's $\Lambda = 0.98$; $F(2, 155) = 1.87$, $p = .16$. A first follow up ANCOVA was conducted in order to get a deeper insight in the marginal significant effect of the charge of the video. Results revealed a small effect regarding retention performance; $F(1, 161) = 5.12$, $p = .03$, $\eta_p^2 = 0.03$. Students who watched the video with positive charge outperformed students who watched the video with the neutral charge. No significant effect regarding transfer performance could be found; $F(1, 161) = 1.80$, $p = .18$. A second follow up ANCOVA revealed a marginal significant interaction regarding transfer performance; $F(1, 161) = 3.77$, $p = .05$, $\eta_p^2 = 0.02$. Students in the conditions with a fit between the valence of the induction and the valence of the educational video outperformed students in the condition without matching valence. There was no significant interaction regarding retention performance; $F(1, 161) = 0.20$, $p = .66$.

In order to examine indirect influences of our manipulation and affective variables on learning, an additional path analysis was conducted (see Fig. 3).

Mood induction, affective charge of the video and congruence of these affective states were implemented as independent variables. Valence after mood induction and after the presentation of the educational videos were used as mediators and retention as well as transfer were used as dependent variables. Positive mood induction had a negative direct effect on retention ($\beta = -0.18$; SE = 0.15) and a negative effect on transfer ($\beta = -0.07$; SE = 0.30). Furthermore, positive mood induction had a positive effect on the valence scale of the SAM after mood induction ($\beta = 0.16$; SE = 0.20). The perceived valence after mood induction had no influence on retention ($\beta = -0.01$; SE = 0.07) and a positive influence on transfer ($\beta = 0.09$; SE = 0.12). Watching a video with positive affective charge had a positive direct effect on retention ($\beta = 0.17$; SE = 0.17) and a positive direct effect on ME ($\beta = 0.11$; SE = 0.30). Watching a video with positive affective charge had a positive effect on the valence scale after watching the video ($\beta = 0.08$; SE = 0.22). A higher perceived valence after watching the educational video furthermore, led to a lower retention score ($\beta = -0.05$; SE = 0.06) as well as to a decreased transfer score ($\beta = -0.08$; SE = 0.11). The congruence of mood and affective charge had no effect on perceived valence after watching the video ($\beta = 0.02$; SE = 0.22) and retention ($\beta = 0.02$; SE = 0.15) but a positive effect on transfer ($\beta = 0.13$; SE = 0.30).

4. Discussion

Results demonstrated that the induced mood of the students did not influence learning outcomes according to the conducted ANOVAs. Indeed, a path analysis revealed that a positive mood affects the learning scales rather negatively. Therefore, H1a and could not be confirmed and a small evidence for H1b was found. Furthermore, students in the condition with the positive video outperformed students in the condition with the educational video with neutral charge regarding retention performance. This result supports H2 only partially because the emotional charge of the video did not influence transfer performance. Transfer performance only got influenced marginally by an interaction between the mood of the learner and the charge of the video. Because transfer is enhanced in the conditions with congruence of the mood of the students and the charge of the video, an evidence was found to support H3.

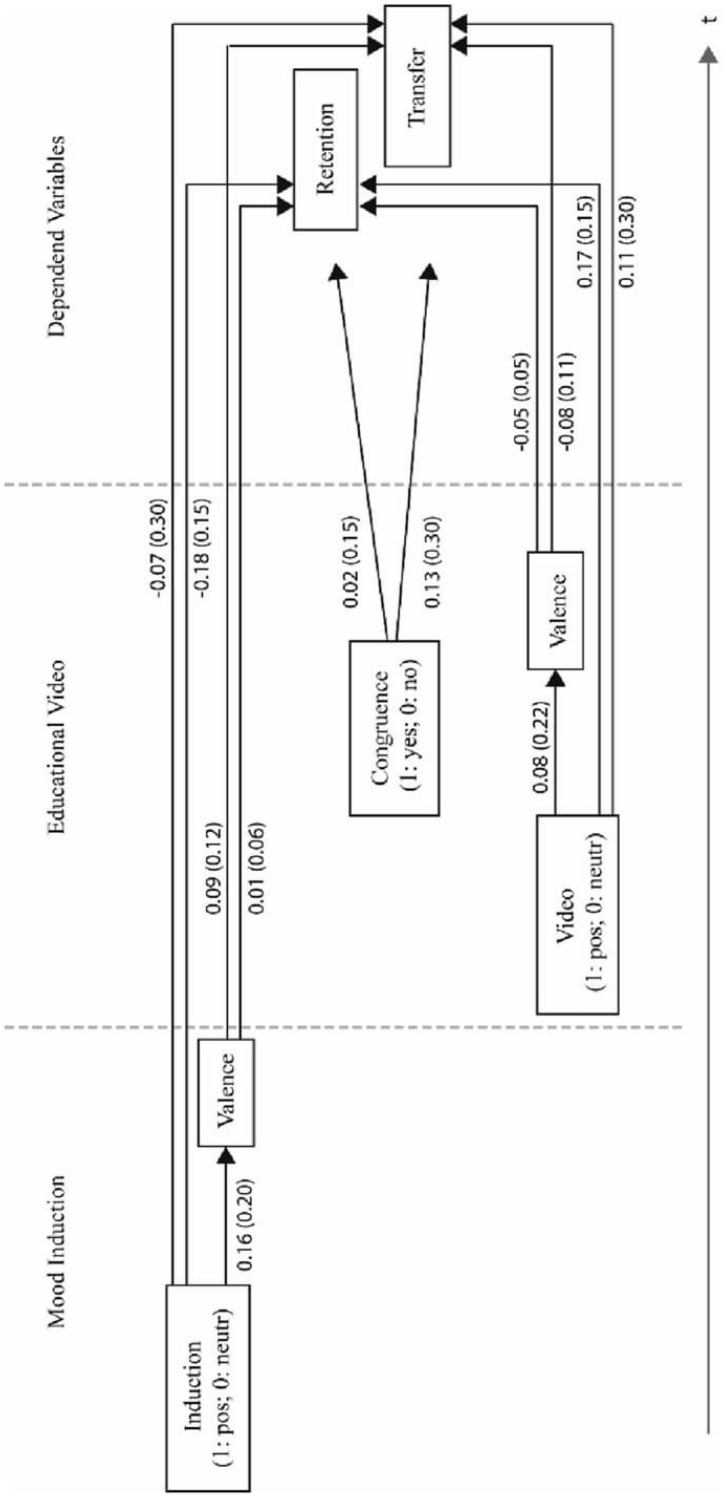

Fig. 3. Path analysis with retention and transfer as dependent variables; β (*SE*).

The first phase of our experiment only partially worked and therefore, the induction of a positive valence was only marginally successful. In order to explain this missing mood effect, the affective measures of the SAM have to be taken into account. The SAM scale was used in order to get a detailed insight in the affective effects which were triggered by pictures in the current experiment. Because of the fact that mood is a rather weak affective state, different expressions of mood were not explicitly reflected in the valence scale of the SAM and the effect was weakened. Another explanation concerns the use of the emotional pictures. The induction of a positive mood with the three pictures might be too weak and therefore, main effects regarding learning and cognitive measures for mood might not be observed. Other methods for mood induction (music, narrations, videos, etc.) might induce a stronger mood and therefore, effects of mood on learning processes which are postulated in prior research (e.g., Liew & Su-Mae, 2016) might be detected.

The second phase, the affective charged educational video, failed to generate affective effects which were measurable on the SAM. A possible explanation might lay within the use of educational videos. Reception and therefore, knowledge acquisition and affective influences do not just depend on the medium itself. The cognitive engagement of the viewer is an important requirement for the reception process and learning with videos because information is presented fluently, whether the learner attends carefully (Carini, Kuh, & Klein, 2006). Watching educational videos in an experimental setting might cause that participants allocate their processing resources to memory processes and affective information are only processed unconsciously (Sinha, Jermann, Li, & Dillenbourg, 2014). This might explain why the affective charge of the video influenced cognitive variables and learning, but not the SAM scores.

Finally, learning outcomes and cognitive variables should be discussed. Learning scores and cognitive ratings were not influenced by the induced mood of the learners. This can be explained by the fact that the participants watched an emotionally charged video after the induction. The impressions of the video overlaid the affective state which was induced by the emotional pictures. Therefore, only the interaction of the affective states was important for further processing of the learners, test performance, and ratings, but the induced mood had no detectable main effect on the dependent variables anymore. Interestingly, positive mood descriptively seemed to have a rather negative influence on learning according to the path analysis. This might be an indication fore depleted resources in working memory because a positive mood might prime learning-irrelevant thoughts (Brose et al., 2012; Brand et al., 2007). However, since the MANOVAs revealed non-significant results, this interpretation has to be viewed with caution. Retention was fostered in the condition with the positive video. This result supports current research results regarding the benefits of emotional design in learning environments (e.g., Schneider et al., 2016). Thus, the first evidence was found that the emotion-*as*-facilitator hypothesis (Park et al., 2015) can be transferred to audiovisual media. A positive emotional charge of a video had positive impacts on cognitive processes. This could be shown in the measurement of ML which was significantly reduced in the condition with the positive video. A possible explanation may be delivered from D'Mello and Graesser (2012). Watching an educational video with an unemotional lecturer might lead a decreased engagement in the content of the video. Missing engagement might lead to confusion which led to frustration and boredom. Once, the participants lost the track of information because of missing engagement, participants might get confused and bored during the experiment. This led to an increased mental load by working on the learning tests and a decreased retention score in the condition with the neutral video. Therefore, a positive affective charge of an educational video not only had positive effects on an objective learning score but also process variables like cognitive load might be influenced positively as well. The congruence between the mood of the learner and the charge of the video fostered transfer performance. This can be explained by considering the mood congruency effect. A positive mood might foster the processing of information with positive valence because positive mood served as a central unit in associative network what, in turn, fostered the processing of following information with positive affective charge (e.g., Mayer et al., 1989). Finally, retention and transfer got influenced differently by the manipulation in the current experiment. An explanation might be provided with respect to the incommensurability or learning and performance (Kapur, 2016; Soderstrom & Bjork, 2015). A positive affective charge of a video directs the attention toward the material and focusses cognitive resources on relevant information (Huk & Ludwigs, 2009). Though, the affective charge of the current learning environment may only lead to a short-term memory effect. Therefore, retention performance was fostered but deeper processes of schema acquisition were not triggered. Explicit learning effects might occur in the conditions with mood-affect congruence. The positive mood might lead to a deeper processing of congruent stimuli (Fiedler et al., 2003) and increased availability of congruent information in the working memory (Levine & Pizarro, 2004). Therefore, transfer as a symptom of profound learning processes was enhanced in the congruent conditions.

4.1. Implications

There are two theoretical main implications which can be derived from the results of the current investigation. According to the aims of the study, it could be shown that results from emotional design studies can be transferred to educational videos. There are numerous studies which investigate the emotional impacts of audiovisual media (e.g., Newhagen, 1998; Teixeira, Wedel, & Pieters, 2012) but there is a lack of studies regarding emotional impacts of educational videos. Furthermore, results indicate that emotional congruence between a learner and the emotional charge of the learning material is beneficial for learning. In contrast to the classical mood congruency effect, emotions do not only enhance the availability of mood congruent information, but also the processing and learning of mood congruent information.

On the practical side, educational videos should be designed with an emotional positive charge. Especially, social entities in videos should smile and convey a positive emotionality. Videos are an ideal multimedia application to deliver emotions and information (Chen & Sun, 2012) and therefore, designers should be encouraged to create educational videos with positive emotional effects in order to foster learning processes.

4.2. Limitations

Of course, research addressing such complex media such as educational videos, is limited by several factors. Although, even if a lot of effort was invested into the videos to ensure both videos were comparably equal, they were not exactly the same. Minor unintended differences within pronunciation or emphasis could have induced disturbing effects. This is especially important as one of the conditions included a neutral charge. As the allegedly opposing meanings of the words *neutral* and *charge* already suggests, neutral conditions need to be interpreted with caution. Maybe not a neutral charge was induced (i.e., the absence of positive or negative charges), but a mixture of positive and negative elements. Within this possible uncertainty, even small variations within the videos might have strong disturbing effects acting contrary to the intended manipulations. Additionally, human facial expressions are very complex and the line between friendly and insincere, respectively neutral and stiff might be very thin. Furthermore, this might be perceived very differently, depending on the characteristics, attitudes and personal experiences of each participant. Finally, as the modification of mood through videos is comparably scarce and the use of pictures is widespread and validated, a combination of pictures and videos was used within the experiment. However, in contrast to the long, vivid and informative video, the influence of the pictures might have been comparably small and therefore, overlaid by the effect of the video. Additionally, the participants might have evaluated the video as more important to them, while the effect of the mood manipulation with pictures further weakened. Alternatively, the initially induced moods might vanish during the experiment reducing the intended mood effects. Overall, the terminology might be a problem. The current investigation refers to "mood" induction because of a broad base of prior literature (e.g., Knott & Thorley, 2014; Westermann et al., 1996) which uses media to explicitly induced "mood". Since mood is a rather long-lasting and diffuse affective state and media (pictures, narrations, videos, music, etc.) are also used to induce short-term affect (e.g., Schneider et al., 2018) a clearer terminology is needed."

4.3. Conclusion and future directions

Overall, the current study aimed to transfer current findings regarding emotional design to educational videos. Furthermore, the current study extended the mood-congruency effect by investigating the emotional fit and interaction between the mood of the learner when entering a learning situation and the emotional charge of the learning material. A positive emotional charge of an educational video had a positive impact on retention and mental load. The mood of the learner did not influence learning outcomes, mental load or mental effort. Finally, the coherence between the mood of the learner and emotional charge of the video fostered transfer performance.

Emotional design in educational videos are not thoroughly investigated. A lot of questions remain unanswered and therefore, there is much scope for future research. In the current investigation, charge of the video was operationalized by manipulating the behavior of a social entity. It might also be interesting to investigate the effect of the charge of the learning material. According to the mood congruency effect, topics with negative charge might be better processed by learner with negative mood in comparison to learner with positive mood. Motivational effects should be investigated in future studies because empirical research has shown that emotion and motivation are highly connected (e.g., Um et al., 2012). Finally, the current study was carried out with secondary school students. Additional research should be carried out with older participants, since these participants might differ from students with respect to emotional suggestibility and thus, regarding their cognitive processing and learning from media with emotional design features.

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Method

In this section, a short summary of the participants, design, materials, and the measured variables is provided. An in-depth overview of the methods can be found in the included papers.

Participants

Instructional videos are especially useful when implemented into secondary and university education; therefore, students from the Chemnitz University of Technology and secondary students from a school in Thuringia participated in the included experiments (see Table 2). The experiments were conducted in the university computer laboratories consisting of multiple workstations separated by partition walls. This approach enabled control of the experimental environment and ensured students worked independently. The experiment in the secondary school was conducted in the school's computer labs. The examiner for the study made sure that all students worked on their own. In order to ensure valid analyses without confounding variables, group differences regarding age, gender, and prior knowledge were checked.

Table 2. Overview of the descriptive data for each experiment in the articles regarding their samples.

Study №.	***N***	**Age in Years (Mean)**	**Age (*SD*)**	**%-female**	**Major disciplines/grades of the participants**		
					#1	**#2**	**#3**
1	88	23.75	4.25	70.1	Bachelor Media Communications (47.7%)	Media and Instructional Psychology (17.2%)	General Psychology (10.3%)
2	90	22.48	3.88	73.8	Bachelor Media Communications (66.7%)	Media and Instructional Psychology (11.9%)	Other fields of study (21.6%)
3	165	16.49	0.96	58.0	Grade ten (47.3%)	Grade eleven (29.7%)	Grade twelve (21.2%)

Note: N=Sample size of participants included in the data analysis.

Design

The experimental designs of the individual studies were chosen to examine the main effects of and interactions between specific designs or behaviors of social entities. Therefore, all experiments have a multifactorial between-subject design (see Table 3).

Table 3. Experimental designs and learning topics of the studies.

Study №.	Design	Factors	Factor levels	Learning topic
1	Two-factorial, two levels (2×2)	1. Addressing 2. Obtrusiveness	Frontal/Lateral Near/Far	Statistics
2	Two-factorial, two levels (2×2)	1. Age of the agent 2. Primed age of the text	Young/Old Young/Old	Allergies
3	Two-factorial, two levels (2×2)	1. Mood of the learner 2. Affective charge of the video	Positive/Neutral Positive/Neutral	Chemnitz

Materials

The instructional videos for all three studies were created especially for the experimental research. Two different approaches were used in order to create the learning material. First, instructional videos were filmed with professional video cameras (for example JVC GY-HM150E), and the raw versions were edited with Adobe Premiere Pro CS6 (2012) and Adobe After Effects Pro CS6 (2012) in order to create stimulus material which only differed regarding the desired manipulation. Second, pedagogical agents were created using the character creator from The Sims 4 (2013). This software was suitable for experimental purposes because social entities could be created that only differed in their specific characteristics, which rules out a possible confounding variable. The instructional videos lasted an average of eight minutes. This video length was chosen because current research shows instructional videos on complex topics including detailed information should not last longer than 15 minutes (e.g., Berg, Brand, Grant, Kirk, & Zimmermann, 2014; Victor, 2018). All videos included a single social entity delivering an oral presentation about the learning topics.

The learning materials were divided into various subtopics in order to create a structured and realistic lecture. In the instructional videos of study one, only the lecturer was visible within the lecture hall in order to examine parasocial processes without additional visual distraction. In the videos of study two, an additional visual text was visible to summarize key information, provide a more realistic learning environment, and strengthen external validity. In contrast to the videos from study one and two, which were filmed and designed in a static classroom environment, the videos of study three were filmed at different locations in Chemnitz, since information about these locations was part of the lecture content. The materials for each study are summarized in Table 4.

Table 4. Characteristics of the instructional videos of the three studies.

Study №.	Duration (mm:ss)	Entity	Additional learning relevant material	Location
1	09:44	Real person	No	Lecture hall
2	06:20	Pedagogical agent	Summarizing key sentences	Virtual lecture hall
3	07:35	Real person	Content-related environment	Chemnitz

Note: Detailed descriptions of the instructional videos and the experimental manipulation within the videos can be found in the papers.

Measures

Since each study had a different research focus, the measures differed between the studies. Each experiment followed a specific research purpose; therefore, parasocial processes, emotional processes, cognitive load, mental effort, and learning scores were examined. Table 5 summarizes the measures used in each experiment. In the studies published in 2017, Cronbach's Alpha (α; Cronbach, 1951) was used as reliability measure. Because of the ongoing criticism of Cronbach's α (for an overview: McNeish, 2017), the coefficient Revelle's omega (ω; Revelle & Zinbarg, 2008; McDonald, 1999) was chosen in order to calculate reliability estimates for all measures of the study published in 2018. The interpretation of the level of reliability is identical to Cronbach´s α. In order to measure learning outcomes, retention and

transfer were chosen. Retention refers to remembering and reproducing learning content. Transfer is defined as understanding and using learned information to solve problems not explicitly presented in the learning content (Mayer, 2014a).

Table 5. Measures of the experiments.

Study №.	Measure	Reliability	Reference
1	Experienced Parasocial Interaction	α=.95	Hartmann & Goldhoorn (2011)
1	Prior Knowledge	α=.64	Self-created
1	Retention	α=.55	Self-created
1	Transfer	α=.61	Self-created
2	Cognitive Load	α=.89	Eysink, de Jong, Berthold, Kolloffel, Opfermann, & Wouters (2009)
2	Prior Interest	α=.88	Rakoczy, Buff, & Lipowsky (2005)
2	Interest	α=.84	Schiefele (1990)
2	Intrinsic Motivation	α=.77	Rakoczy, Buff, & Lipowsky (2005)
2	Prior Knowledge	α=.61	Self-created
2	Retention	α=.36	Self-created
2	Transfer	α=.44	Self-created
3	Emotion	ω=.88	Bradley & Lang (1994)
3	Mental Load	ω=.86	Krell (2015)
3	Mental Effort	ω=.87	Krell (2015)
3	Prior Knowledge		Self-created
3	Retention	ω=.64	Self-created
3	Transfer	ω=.75	Self-created

Note: Detailed information about the measurements can be found in the papers. Prior knowledge in study 3 was measured with one open question; therefore, reliability was not conducted. ω of the emotional measure in study 3 is the mean score of all subscales.

Results and Discussion

This section provides an overview and discusses the empirical findings of each study. Overall, the data were analyzed with multivariate analyses of variance and covariance (MANOVAs/MANCOVAs). In order to provide more detailed insight into processes during learning, mediation and path analyses were conducted. Test assumptions were examined and only reported if these assumptions were significantly violated. Furthermore, effect sizes for all differences were only reported if significance ($p<.05$) was reached. To avoid redundancy with the papers, only the core results which provide significant contributions to the discussion are summarized. In addition to the inference statistical analyses, graphical representations are provided.

Look into my eyes! Exploring the effect of addressing in educational videos

The most important finding of the first study is that addressing (and therefore, eye contact) is an important social cue (see Figure 13 and Figure 14).

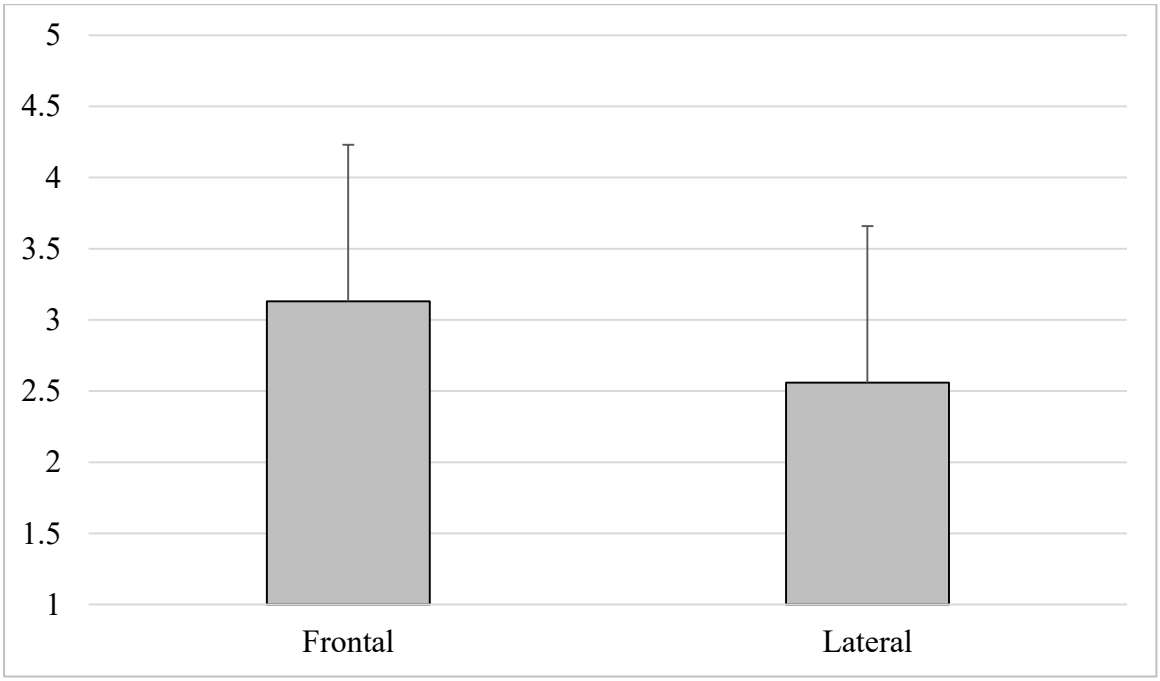

Figure 13. Influence of addressing on PSI in study 1 (*M* and *SD*).

Frontal addressing led to an enhanced PSI, $F(1,87)=7.44$, $p=.008$, $\eta_p^2=.09$, and an enhanced retention performance, $F(1,87)=13.17$, $p<.001$, $\eta_p^2=.14$. Addressing led to a high-level PSI characterized by a strong appreciation for media figures and attention and evaluation processes. This first study postulated that the cognitive component of PSI could be crucial for understanding parasocial learning processes. The increased involvement with personae could foster learning because of a deeper processing of the content communicated by the media figure (Hartmann et al., 2004b). This resulted in medium to high effect sizes of addressing on PSI and retention (Cohen 1988). Furthermore, the results revealed more detailed insight into learning processes since a differentiated categorization of learning was used. Addressing had an influence on retention, but deeper learning processes like transfer performance were not enhanced. Obtrusiveness of the persona had no influence on PSI and learning scores. Even if descriptive advantages of a high proximity could be obtained, these differences did not reach significance ($p=.16$).

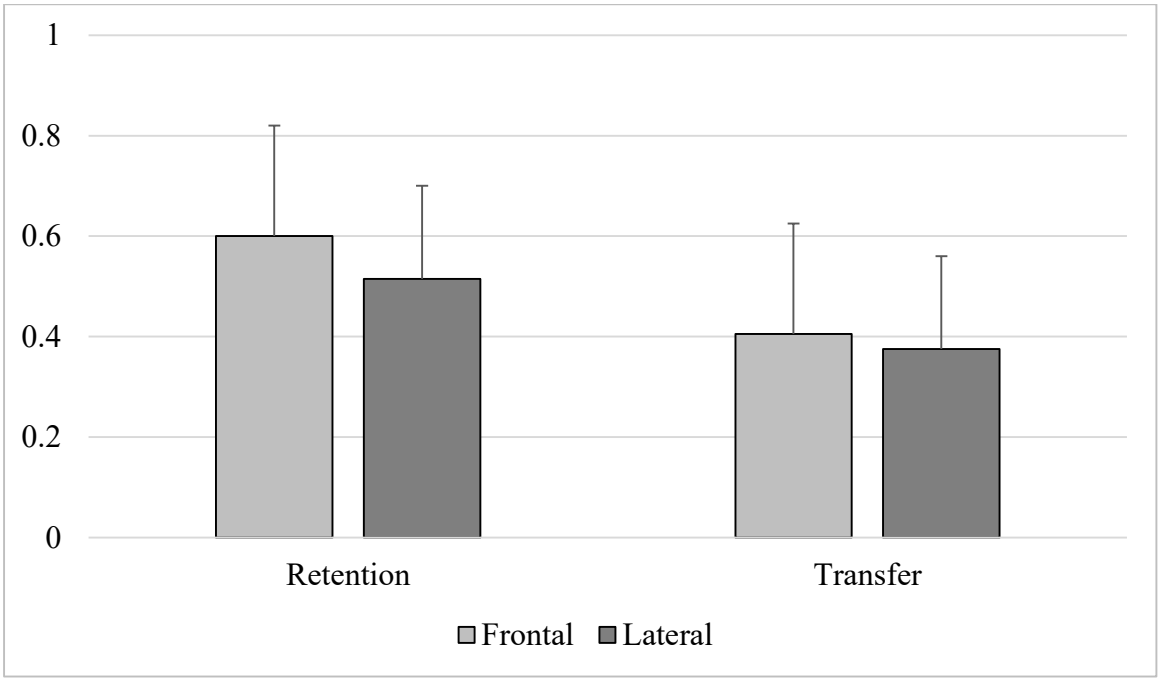

Figure 14. Influence of addressing on learning scores in study 1 (*M* and *SD*).

Therefore, it is not important how far away a social entity is presented; however, direct addressing with eye contact is important for activating social categorization and interaction schemas. No interaction effects between the independent variables could be found. This study served as the first evidence that characteristics of personae associated with enhanced PSI can influence learning outcomes.

Ageism–Age coherence within learning material fosters learning

The second study focused on the interaction effect between the agent's age and the primed age of the instructional text on the learner. As hypothesized, transfer performance was enhanced when the age of the agent and primed age of the text matched, as the conducted ANCOVA regarding the interaction of the between-subjects factors reached significance, $F(1,83)=5.82$, $p=.02$, $\eta_p^2=.07$. Students receiving a young agent and a text with priming on a young age as well as an old agent and a text with priming on an old age outperformed students who received learning videos where the age of the agent and primed age of the text did not fit (see Figure 15).

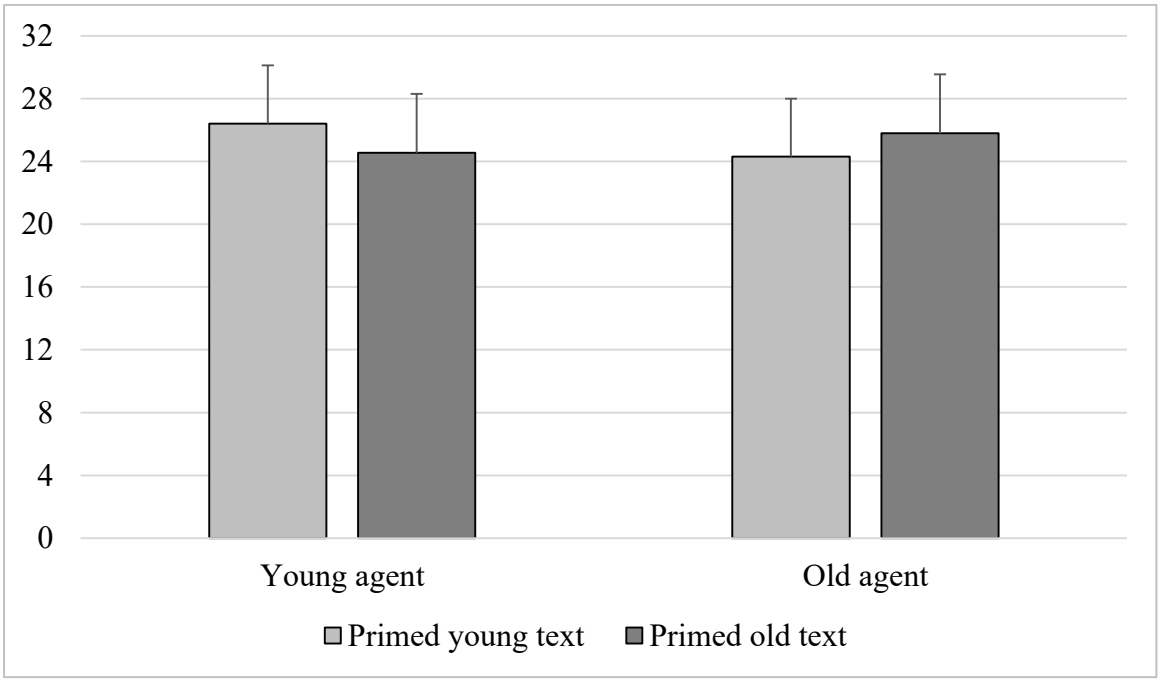

Figure 15. Influence of age of the agent and implied age of the text on transfer in study 2 (*M* and *SD*).

An interaction effect regarding retention performance could not be found (p=.21). Furthermore, effects regarding cognitive load and motivation did not reach significance ($.96 \geq p \geq .21$). This experiment expanded the findings of study 1 because the results revealed social entities should not only be considered independently; the manner of how the entity interacts with additional material or fits into the context of the learning environment is also important for learning. In this study, a stereotypical fit between the learning material and the social entity teaching the content might lead to a decrease in irrelevant cognitive activity. With respect to the congruence principle, a contextual fit within the learning material led to increased process fluency (Van Rompay et al., 2010). Since stereotyping is a mostly unconscious process, these effects might not be represented in the included cognitive load questionnaire. Cognitive processing of the learner is continuously supported by consistent information and therefore, especially transfer performance, which refers to understanding and the quality of learning, is fostered (Mayer, 2009).

Mood-affect congruency. Exploring the relation between secondary school learners' mood and the affective charge of educational videos

A positive affective charge of the educational video led to enhanced retention performance, $F(1, 161)=5.12$, p=.03, η_p^2=.03, and a lower mental load, $F(1, 161)=5.08$, p=.03, η_p^2=.03, in contrast to the instructional video with a neutral charge (see Figure 16). Current research regarding the benefits of a positive emotional design (e.g., Park et al., 2015) can be transferred to audiovisual media. In line with CTML and ICALM, affective stimulation through a lecturer can have a positive effect on cognitive activation, resource allocation, and learning. This could be shown in the measurement of the mental load, which was significantly reduced in the videocondition with the positive affective charge. The effect of mood induction did not reach significance (p=.38).

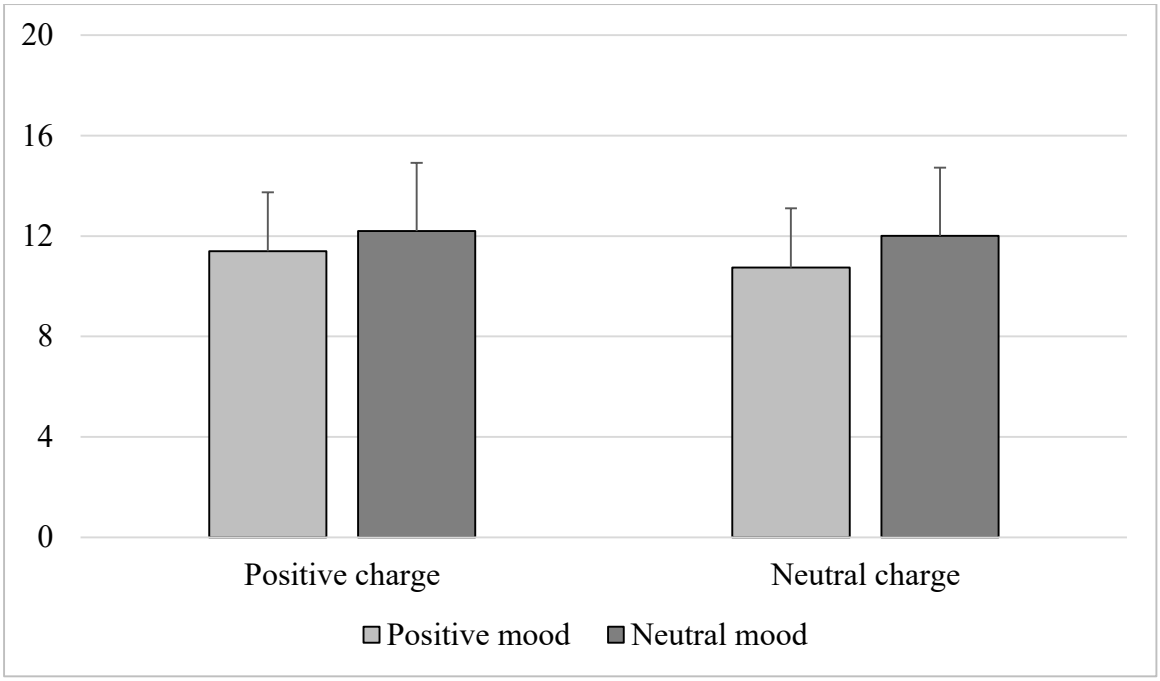

Figure 16. Influence of affective charge and learner's mood on retention in study 3 (*M* and *SD*).

According to D´Mello and Graesser (2012), a positive emotional state can enhance the engagement of a video's content. In contrast, an unemotional lecturer in an instructional video can lead a learner to confusion, frustration, or boredom. Once learners lost track of the instructional video, mental load during the test increased and retention performance decreased. In addition to the effects of affective charge in instructional videos on learning, interaction effects were also analyzed. Transfer performance showed a tendency for the hypothesized interaction, $F(1, 161)=3.77$, $p=.05$, $\eta_p^2=.02$ (see Figure 17). Students in the conditions with a fit between the valence of the induction and the valence of the educational video outperformed students in the condition without matching valence. This result is in agreement with previous findings regarding the mood congruency effect (e.g., Mayer, Gayle, Meehan, & Haarman, 1989). According to the authors, a positive mood might foster the processing of information with positive valence because a positive mood served as a central unit in the associative network which, in turn, fostered the processing of the subsequent information with positive affective charge. This study is especially interesting as a research focus on social entities in

instructional videos could be extended even further. A congruence between the social entity and the learner is crucial for activating deeper learning processes such as knowledge transfer.

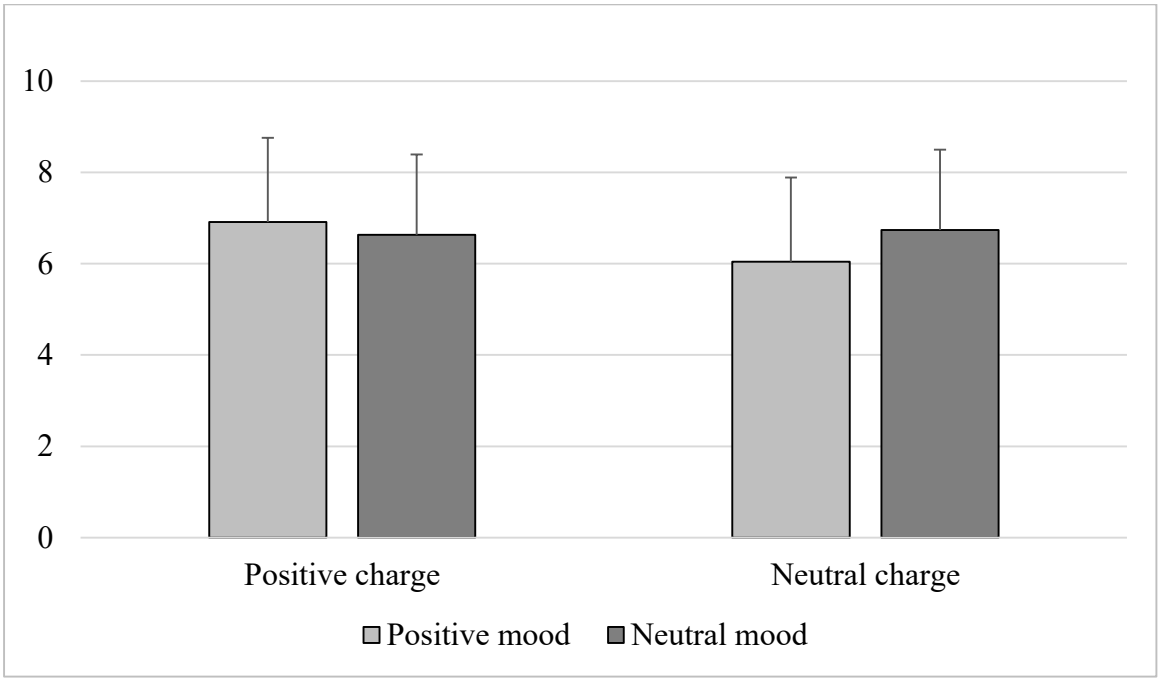

Figure 17. Influence of affective charge and learner's mood on transfer in study 3 (*M* and *SD*).

Theoretical and Practical Implications

On the theoretical side, this thesis provides three main implications. First, these studies contribute to the ongoing discussing regarding social cues in multimedia learning environments. PSI can have broad influences on media recipients, and the current study suggests that parasocial processes can be effectively implemented in learning environments. Therefore, the design of the social entity should be considered when instructional videos are created. Even simple design factors such as addressing prime a social activation schema and foster deep cognitive processes like selecting, organizing, and integrating relevant information into a coherent mental model (Mayer, 2001). Social perception is a highly automatic process (Kanning, 1999); therefore, the benefits of social categorization should be considered and used explicitly. Overall, this thesis supports the social agency theory and the CASA paradigm and extends prior findings that social processes can vary in their expression through design changes in the personae. Enhanced social processing can be linked to enhanced retention performance which emphasizes that classical cognitive learning theories like CLT or CTML are not sufficient to explain complex dynamic learning environments with social entities. Expanded theories like the CASTLM may be more suitable to explain parasocial learning processes since the first study outlines that enhanced PSI cannot be seen as additional extraneous processing but as supportive processing which can activate and provide resources for schema construction. Second, results show the implementation of a social entity should not be considered without further boundary conditions. One of these boundary conditions is the stereotypical fit between the learning content and the implemented persona. According to social agency and CASA, computer-mediated communication primes processes of stereotyping and human-to-human communication. Since a lot of learning materials prime stereotypical expectations, the included social entity should match these expectations to foster learning. Computer-mediated stereotyping leads to cognitive change and influences learning processes. The congruence

principle is supported by the second experiment. Besides postulated effects regarding text-picture congruence (Van Rompay et al., 2010), action-effect congruence (Horvath, Gray, Schilberg, Vidrin, & Pascual-Leone, 2015), or categorical congruence (Barenholtz et al., 2014), the results of this thesis expands the congruence principle in terms of stereotypical congruence. Third, a learning medium implementing social entities should not be considered isolated. In addition to the classical mood congruency effect, emotions not only enhance the availability of mood-congruent information during recall, but also enhance the processing and acquisition of mood-congruent information. The third study supports research regarding model-observer similarities (e.g., Zmyj, Aschersleben, Prinz, & Daum, 2012) in terms of affective variables. With respect to the CATLM and ICALM, affective factors mediate learning processes by influencing cognitive engagement, streamlining the provision of cognitive resources, and enhancing self-regulation. The fit between the current mood of the learner and the affective charge of the implemented social entity medium seems to be particularly crucial for self-regulation, engagement, and deeper cognitive processing. Overall, the thesis delivers a broad theoretical impact which considers the presentation of the entity, the congruence between the entity and the learning material, and the congruencies between the entity and the learner. Strictly controlled experimental settings showed that it is not only significant *if* social entities are implemented in learning environments but also *how* personae are interwoven into the learning environment. Various design factors and interaction effects within the learning material and between the entity and the learner shows the complexity of the field and make it difficult to make generalize statements.

Still, practical implications can be derived from this thesis. The main implication of the experiments is that even small changes in the design of social entities, which can be achieved with a small budget, can influence the learning success of an instructional video. Since all learning media have to be funded, it is important to keep in mind that simple and inexpensive

design factors can determine how learners interact with the learning environment. First, social cues regarding the entity should be used explicitly. Personae should maintain eye contact with the learner in order to trigger social activation schemas. Other social cues are possible, but more empirical validation is necessary (e.g., gestures; Beege et al., submitted). Second, the mimetic behavior and speech of the entity should deliver positive emotions. According to Chen and Sun (2012), videos are an excellent vehicle for transmitting information and emotions simultaneously, and this potential should be used definitively. Finally, the internal congruence of the learning material and consistency between the entity and the learner should be considered. The social entity should be tailored to the learning content, and the target of the learning material should be considered in the design of instructional videos.

Limitations and Future Directions

Research which addresses complex media such as instructional video games is limited by a few factors. Even if the included studies provide insight into *how* social entities should be implemented in learning environments, it is not clear if learning outcomes would be increased or decreased if social entities were absent from instructional videos. Control groups were not included because the implementation or omission of a social entity change many differentiated variables and possible effects could not be traced back to a specific design feature. For example, in study 1, all information was presented aurally by the instructor; without the instructor, only a static lecture hall would be visible. This would be unnatural and might lead to irrelevant thinking and distort the learner. A general recommendation of whether social entities should be implemented cannot be delivered. The reliabilities of prior knowledge or learning scales were low. This can be explained by considering the boundaries of the classical test theory. The self-created scales aimed to assess different subtopics, and the items differed in complexity and difficulty in order to generate a broad variance in responses. Therefore, classical reliability measures might be inadequate to evaluate these multidimensional learning scales. External validity of the three experiments has to be viewed with caution. A common problem within this research field is the overrepresentation of female participants and the strong focus on student samples; this also applies to study 1 and study 2 in this thesis. Until these results can be replicated with other samples such as different age groups, a generalization without restrictions is not possible. Finally, it must be noted that retention and transfer were influenced differently by the manipulation in the experiments, so no general implication for all learning processes can be delivered. Some manipulations such as perspective seemed to influence basic retention abilities, whereas coherency influenced deeper transfer abilities. An explanation might be provided by noting the incomparable nature of learning and performance (e.g., Kapur, 2016; Soderstrom & Bjork, 2015). Perspective directs attention towards the persona and

focuses cognitive resources on relevant information which might lead to only a short-term effect on memory. Simple manipulations lead to increased retention performance, but deeper processes of schema acquisition were not triggered.

Overall, there is a significant potential for future research in this area. Each of the included experiments had a different focus and were the initial motivation for different research projects. Current projects investigate the influence of different social cues. Since perspective had a positive impact on social variables and learning, additional cues like gestures (Beege et al., in prep.) and clothing (Beege et al., submitted) are being investigated. Future studies could differentiate between different kinds of gestures, investigate different kinds of perspectives (e.g., worm's eye vs. bird's eye), or investigate completely different cues (e.g., attractiveness; Beege et al., in preparation). Another current research project investigates the effects of the social entity's voice. Different voices (neutral, affective, computer-generated, etc.) could have different influences on social, affective, and cognitive processes. Furthermore, social cues can generate inconsistent findings in terms of learning outcomes, so different moderator variables should be considered. For example, social cues might have different influences in learning environments with high or low elements of interactivity (c.f. Sweller, 2010). Other research questions whether social entities could improve learning in environments with a high extraneous load due to an unfavorable design or if the social entity would instead induce additional irrelevant processing. Finally, priming is the author's current research focus. It is possible that the social entity does not necessarily have to be manipulated explicitly. Instead, narration may prime specific characteristics of personae and lead to cognitive change.

The discussion of social entities and cues in learning environments is ongoing and far from finished, and this thesis provides meaningful insight into processes of parasocial learning and offers design recommendations for video designers. Nevertheless, a lot of scientific work is still necessary in order to gain a broader understanding of the research field. The ongoing

digitalization of university and school teaching, the increased popularity of video education worldwide, and a decrease in the cost and effort necessary to create semi-professional media increases the need for future research to optimize learning processes for instructional videos.

Deutschsprachige Zusammenfassung

In der vorliegenden Synopse werden drei veröffentliche Publikationen gebündelt. Die Experimente tragen zur aktuellen wissenschaftliche Diskussion über die positiven oder negativen Auswirkungen sozialer Entitäten und sozialer Hinweisreize in digitalen Lernmedien bei. Zunächst werden die theoretischen Grundlagen zusammengefasst. Weiterhin werden die Methoden, die zentralen Ergebnisse und auch die Implikationen und Limitationen diskutiert. Die bisherige und vor allem aktuelle Literatur zu diesem Forschungsschwerpunkt hat inkonsistente Ergebnisse hervorgebracht (z.B., Dinçer & Doğanay, 2017; Mayer & DaPra, 2012; Stull et al., 2018; Wang et al., 2018; Wilson, 2018). Klassische kognitive Lerntheorien wie die *Cognitive Load Theory* (CLT; Sweller, 1994; Kalyuga, & Singh, 2016) und die *Cognitive Theory of Multimedia Learning* (Mayer, 2014a) postulieren einen negativen Einfluss zusätzlich implementierter sozialer Entitäten auf Lernprozesse. Zusätzliches visuelles Material muss zwangsläufig zusätzlich zu dem eigentlichen Lernmaterial verarbeitet werden, wodurch eine kognitive Überlastung resultieren kann (Sweller et al., 2011). Soziale Entitäten wirken somit tendenziell ablenkend und sollten nicht implementiert werden. Andere Theorien, wie die *Social Agency Theory* (Mayer et al., 2003) oder die *Cognitive-Affective-Social Theory of Learning with Media* (CASTLM; Schneider et al., 2018b) postulieren im Gegensatz positive Einflüsse sozialer Entitäten und Hinweiszeichen auf Lernprozesse. Verfügbare kognitive Ressourcen werden nicht automatisch zur Schemakonstruktion genutzt (Huk & Ludwigs, 2009). Stattdessen aktivieren erst affektive, motivationale und auch soziale Prozesse diese Ressourcen. Soziale Entitäten können somit lernförderlich implementiert werden, da durch Prozesse der sozialen Identifikation, parasozialen Kommunikation sowie der affektiven und motivationalen Stimulation, Lernprozesse positiv beeinflusst werden können. Trotz dieser inkonsistenten Befundlage sind soziale Entitäten in zahlreichen Lernmedien integriert. Sichtbare Dozierende befinden sich in vielen *Massive Open Online Courses* (MOOCs; z.B.,

Hernandez et al., 2013). Zusätzlich zu Lehrvideos sind soziale Entitäten, wie beispielsweise pädagogische Agenten in interaktiven Lernmedien enthalten (Lin et al., 2013). Neben vollständigen Figuren, sind simplere soziale Hinweiszeichen, wie beispielsweise sichtbare Hände vor allem in Demonstrationsvideos integriert (Fiorella et al., 2017). Neben den empirischen Inkonsistenten besteht somit allerdings eine große praktische Relevanz. Mit experimentellen Untersuchungen muss der Forschungsschwerpunkt aufgegriffen und weiter ausdifferenziert werden.

Die inkludierten quantitativ-experimentellen Studien werden in Tabelle 1 zusammengefasst. Im Weiteren wird die Methodik der Untersuchungen kurz zusammengefasst. Hierzu werden Probanden, Designs der Studien, Materialen und Messverfahren der abhängigen Variablen skizziert. Wie auch bei den anschließenden Ergebnissen ist die Beschreibung stark komprimiert, um Redundanzen mit den enthaltenen Artikeln zu vermeiden. So werden in der Synopse jene relevanten Kernergebnisse präsentiert, welche später im Fokus der Diskussion stehen. Neben Lernergebnissen werden hierbei auch kognitive, soziale und affektive Variablen untersucht, um einen detaillierten Einblick in den Lernprozess zu erlangen. Daraus leiten sich die folgenden Implikationen, Limitation und zukünftigen Forschungsprozesse ab.

Es konnte experimentell festgestellt werden, dass durch gezielte Veränderungen des Designs, der Präsentation oder des Verhaltens von sozialen Entitäten Lernprozesse gefördert werden können. Dies spiegelt sich nicht nur in den Lernergebnissen wieder, auch Prozessvariablen wie bestimmte Facetten der parasozialen Interaktion konnten gezielt beeinflusst werden. Somit konnten Grundannahmen und Implikationen der Social Agency Theory und CASTLM experimentell gestützt werden. Die Wirkmechanismen sozialer Hinweisreize in Instruktionsvideos konnten herausgearbeitet werden und somit wurde durch theoriegeleitete experimentelle Methodik ein essentieller Beitrag zur gegenwärtigen

Diskussion bezüglich sozialer Entitäten in multimedialen Lernumgebungen erbracht. Darüber hinaus können aus den Untersuchungen unmittelbare praktische Implikationen zur Gestaltung sozialer Entitäten abgeleitet werden.

Die vorliegende Synopse zielte darauf ab zu untersuchen, wie soziale Entitäten möglichst effektiv in Lernumgebungen integriert werden können. Sie untersucht allerdings nicht ob eine grundlegende Integration sinnvoll ist, da keine Kontrollgruppen ohne Entitäten untersucht wurden. Diese bisherige Einschränkung ist eine Forschungsherausforderung gegenwärtiger und zukünftiger Projekte des Autors. Weiterhin sind die einbezogenen Studien der Synopse Grundlage weiterer Forschungsprojekte zu Effekten von Perspektive, Stimme und Verhaltensweisen von Personen und pädagogischen Agenten in Lehr-/Lernszenarios.

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Appendix A: Curriculum Vitae

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Akademische Ausbildung

2012 bis 2015	**Studium Master Psychologie** Technische Universität Chemnitz Schwerpunkt: Medienwissenschaften Abschluss Master of Science mit der Note 1,7
2009 bis 2012	**Studium Bachelor Psychologie** Technische Universität Chemnitz Schwerpunkt: Medieninformatik Abschluss: Bachelor of Science mit der Note 1,7

Akademische Tätigkeit

2015 bis heute	**Wissenschaftlicher Mitarbeiter** TU Chemnitz, Professur für E-Learning und Neue Medien
2017 bis heute	**Wissenschaftlicher Mitarbeiter** ESF-Projekt „Digitalisierung der Lehre im Bereich Mathematik“

Gutachtertätigkeiten

Journals:	Learning and Instruction; Journal of Medical Education and Training
Fachtagungen: (Auszug)	59th Conference of Experimental Psychologists (TeaP) 2016; 17th Biennial conference of the European Association for Research on Learning and Instruction (EARLI) 2017; Annual Conference GDMV 2018
Sonstiges:	Fachstudienberater Master „Medien- und Instruktionspsychologie“

Appendix B: Further Publications by the Author

Paper (peer-reviewed)

Nebel, S., Schneider, S., Beege, M., & Rey, G. D. (2017). Leaderboards within educational videogames: The impact of difficulty, effort and gameplay. *Computers & Education, 113*, 28-41.

Nebel, S., M., Schneider, Beege, S., Rey, G. D. (2017). You cannot do this alone! Increasing task interdependence in cooperative educational videogames to encourage collaboration. *Educational Technology Research and Development*, *65*, 993-1014.

Nebel, S., Beege, M., Schneider, S. & Rey, G. D. (2016). The higher the score, the higher the learning outcome? Heterogeneous impacts of leaderboards and choice within educational videogames. *Computers in Human Behavior, 65*, 391-401.

Schneider, S., Beege, M., Nebel, S., & Rey, G. D. (2018). A meta-analysis of how signaling affects learning with media. *Educational Research Review, 23*, 1-24.

Schneider, S., Beege, M., Nebel, S., & Rey, G. D. (2018). Theoretischer Beitrag: Soziale Prozesse beim Lernen mit digital präsentierten Lernmaterialien. *Psychologie in Erziehung und Unterricht.*

Schneider, S., Dyrna, J., Meier, L., Beege, M. & Rey, G. D. (2018). How affective charge and text-picture connectedness moderate the impact of decorative pictures on multimedia learning. *Journal of Educational Psychology, 110*, 233-249.

Schneider, S., Häßler, A., Habermeyer, T., Beege, M., & Rey, G. D. (2018). The more human, the higher the performance? Examining the effects of anthropomorphism on learning with media. *Journal of Educational Psychology.* Advance online publication.

Schneider, S., Nebel, S., Beege, M. & Rey, G. D. (2018). Anthropomorphism in decorative illustrations: Benefit or harm for learning? *Journal of Educational Psychology, 110*, 218-232.

Schneider, S., Nebel, S., Beege, M., & Rey, G. D. (2018). The autonomy-enhancing effects of choice on cognitive load, motivation and learning with digital media. *Learning and Instruction, 58*, 161-172.

Wirzberger, M., Beege, M., Schneider, S., Nebel, S., & Rey, G. D. (2016). One for all?! Simultaneous examination of load-inducing factors for advancing media-related instructional research. *Computers & Education, 100,* 18-31.

Book Chapters (peer-reviewed)

Nebel, S., Beege, M., Schneider, S. & Rey, G. D. (2016). Worauf zielen wir ab? Die Herausforderung der Zielsetzung im digitalen Lernspiel. Ein Beitrag aus der Perspektive der Instruktionspsychologie [What are we aiming for? The Challenge of Goal-Setting in Educational Video Games. A Contribution Using the Perspective of Instructional Psychology]. In T. Junge, C. Schumacher & D. Clausen (Eds.), *Digitale Spiele im Diskurs. Level 2: Anwendung von digitalen Spielen (z.B. Gamification).* Retrieved from www.medien-im-diskurs.de

Presentations (peer-reviewed)

Beege, M., Nebel, S., Schneider, S., & Rey, G. D. (2018). *Gestaltung sozialer Entitäten in Lehr-Lernvideos [Design of Social Entities in Instructional Videos].* Presentation at the 51th Conference of the German Psychological Society, Frankfurt am Main.

Beege, M., Mikheeva, M., & Rey, G. D. (2018). *Designing educational videos in order to foster mathematical and statistical retention and transfer performance.* Presentation at the GDMV Conference, Paderborn.

Beege, M., Schneider, S., Nebel, S., Rey, G. D. (2017). *The influence of age coherence between pedagogical agents and verbal information on learning and cognitive load.* Presentation at the 59th Conference of Experimental Psychologists (TeaP), Dresden.

Beege, M., Schneider, S., Nebel, S., Rey, G. D. (2017). *A Meta-Analytic Review of Signaling Effects on Cognition and Learning.* Presentation at the 17th Biennial EARLI Conference, Tampere.

Beege, M., Nebel, S., Schneider, S., & Rey, G. D. (2017). Addressing and Professionalism: Social Influences in Learning with Educational Videos. Vortrag wird gehalten auf der 16. Fachgruppentagung für Entwicklungspsychologie und pädagogische Psychologie (PAEPSY), Münster.

Beege, M., Schneider, S., Nebel, S., Wirzberger, M., Rey, G. D. (2016). *Look into my eyes! Exploring the effect of addressing in multimedia learning.* Presentation at the 58th Conference of Experimental Psychologists (TeaP), Heidelberg.

Beege, M., Nebel, S., Schneider, S., Wirzberger, M., Schmidt, N., & Rey, G. D. (2016). *Bedingt räumliche Nähe bessere Lernergebnisse? Die Rolle der Distanz und Integration beim Lernen mit multiplen Informationsquellen [Does spatial proximity enhance learning outcomes? The role of distance and integration in learning from multiple sources of information].* Presentation at the 50th Conference of the German Psychological Society, Leipzig.

Mikheeva M., Schneider, S., Beege, M., & Rey, G. D. (2017). *Examining the politeness effect in online learning materials for higher mathematics.* Presentation at the 59th Conference of Experimental Psychologists (TeaP), Dresden.

Mikheeva M., Schneider, S., Beege, M., & Rey, G. D. (2017). *The influence of decorative pictures on online learning of statistic.* Presentation at the Gemeinsamen Tagung der Fachgruppen Entwicklungspsychologie und Pädagogische Psychologie (PAEPSY), Münster.

Nebel, S., Schneider, S., Beege, M., Rey, G. D. (2018). *Artifizieller, sozialer und agentenbasierter Wettbewerb im digitalen Lernspiel - eine experimentelle Vergleichsstudie.* Presentation at the 51th Conference of the German Psychological Society, Frankfurt am Main.

Nebel, S., Schneider, S., Beege, M., & Rey, G. D. (2017). *Developing Better Educational Videogames: Optimizing Gameplay and Difficulty within Leaderboards.* Presentation at the European Association for Research on Learning and Instruction, EARLI 2017. Tampere, Finnland: Universität Tampere.

Nebel, S., Schneider, S., Beege, M., Wirzberger, M., Rey, G. D. (2016). *Using the jigsaw principle to increase task interdependence in cooperative educational videogames.* Presentation at the 58th Conference of Experimental Psychologists (TeaP), Heidelberg.

Nebel, S., Beege, M., Schneider, S. & Rey, G. D. (2016). *Highscore! The Impact of Feedback and Competition through Leaderboards within Educational Videogames - Highscore! Die Auswirkungen von Feedback und Wettbewerb durch Ranglisten in digitalen Lernspielen.* Presentation at the 50th Conference of the German Psychological Society. Leipzig: Universität Leipzig.

Schneider, S., Nebel, S., Beege, M., & Rey, G. D. (2018). *„Das stand doch gleich neben dem Bild!" – Eine Untersuchung zum Nutzen seduktiver Bilder als Abrufhilfe von Lernmaterialien.* Presentation at the 51th Conference of the German Psychological Society, Frankfurt am Main.

Schneider, S., Nebel, S., Beege, M., & Rey, G. D. (2017). *Decorative pictures - the good, the bad, and the ugly*. Presentation at 17th Biennial EARLI Conference, Tampere, Finnland: University of Tampere.

Schneider, S., Nebel, S., Beege, M., & Rey, G. D. (2017). *The use of decorative pictures for designing digital learning media.* Presentation at Media Psychology 2017, Landau in der Pfalz, Germany: University of Koblenz-Landau.

Schneider, S., Nebel, S., Beege, M., & Rey, G. D. (2017). *Schaden oder Nutzen von Anthropomorphisierungen dekorativer Bilder in multimedialen Lernumgebungen.* Presentation at the Gemeinsame Tagung der Fachgruppen Entwicklungspsychologie und Pädagogische Psychologie (PAEPSY 2017), Münster, Germany: Westfälische Wilhelms-Universität Münster.

Schneider, S., Nebel, S., Beege, M., Rey, G. D. (2016). *Politeness in multimedia instructions as facilitator of learning and motivation.* Presentation at the 58th Conference of Experimental Psychologists (TeaP), Heidelberg, Germany.

Poster (peer-reviewed)

Mikheeva, M., Schneider, S., Beege, M., & Rey, G. D. (2018). *Der Einfluss einer fingierten Adaptation auf das Online-Lernen im Bereich Mathematik.* Poster session at the 51th Conference of the German Psychological Society, Frankfurt am Main.

Wirzberger, M., Beege, M., Schneider, S., Nebel, S., & Rey, G. D. (2016, May). *Separating cognitive load facets in a working memory updating task: An experimental approach.* Poster session at the International Meeting of the Psychonomic Society, Granada, Spain.

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