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The Impact of Virtual Audience Engagement on Presentation Performance through Affective Experience: Results from a Virtual Reality Experiment

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Abstract

Presentation skills are important for an individual's future career but because of their dependence on environmental, personal, and behavioural factors, it makes it difficult to achieve higher levels of presentation performance. Older methods for practising presentation skills are time-consuming thus evidence suggests that virtual reality is seen as a promising tool. Having the opportunity to practise a presentation in front of a virtual audience is seen as beneficial for individuals too. However, not a lot of studies investigated the influence of different types of audience engagement (low and high) on the presentation performance or affective experience of the presenters. Independently from the influence of audience engagement (low and high) on presentation performance through affective experience, audience engagement is supposed to influence affective experience and presentation performance. In addition, since public speaking anxiety remains an obstacle in improving presentation performance, we expected it to be related both to (a) negative affective experience and (b) presentation performance. The study sample contained $N = 13$ participants. To assess affective experience and public speaking anxiety state we used the Positive and Negative Affect Schedule Scales, and the Public Speaking Anxiety Scale. Presentation performance was measured by software Ovation VR. The linear mixed model analysis as well as the correlation showed insignificant results for all the hypotheses except for the influence of affective experience on presentation performance. Positive affective experience influenced presentation performance results in two conditions of audience engagement and the same applied to negative affective experience. Despite the limitation of a small sample size, this study is a promising start to investigate further the influence of audience engagement and affective experience on presentation performance. Besides, it will contribute to the further improvement of the framework for the development of presentation skills training which could consider audience engagement as an environmental factor.

Keywords: Presentation Performance, Virtual Reality, Virtual Audience Engagement, Positive Affective Experience, Negative Affective Experience

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The Impact of Virtual Audience Engagement on Presentation Performance through Affective Experience: Results from a Virtual Reality Experiment

Achieving a successful career, being an active voice in a society, and being aware of changes in the modern world imply having competencies for lifelong learning and one of them is the ability to communicate and present ideas to others (The Council of the European Union, 2018). An individual's ability to confidently present in front of others is important for different domains such as accounting (Kerby & Romine, 2009), marketing (Girard et al., 2011), business and entrepreneurship (Luthy & Deck, 2007), engineering (Galindo et al., 2020; Haase et al., 2013) etc. When building future leaders, scientists or entrepreneurs, individual's presentation skills should be considered because of their importance and relevance for future careers (Joint Quality Initiative, 2004).

Meanwhile, performing a good presentation is a complex step because of its dependence on both environmental and personal factors (De Grez et al., 2009). The personal factors, such as fear of speaking in front of people (known as public speaking anxiety), remain a problem for achieving a good presentation performance (Sheets & Tillson, 2007). The avoidance that is implied by the public speaking anxiety negatively affects one's actions to engage in communication or presentation practice (Sheets & Tillson, 2007). On the other side, one of the environmental factors might be the lack of opportunities to receive feedback, which is one of the seven design principles in developing oral presentation skills (van Ginkel et al., 2015). Also, a traditional way of instruction for the development of presentation skills includes a bigger group size, is teacher-centred, and students mostly work in groups when practising presentation, thus instructors do not have enough time to properly evaluate performance of the individuals (De Grez et al., 2009). Accordingly, using modern technologies such as virtual reality (VR) is beneficial for providing individuals with an opportunity to independently practice and improve their presentation performance (Boetje & Ginkel, 2021). VR is seen as a promising time-saving method (Boetje & Ginkel, 2021). Some studies demonstrated the usefulness of VR for providing automatic feedback to a learner while practicing (Tanveer et al., 2015) and improving performance in public speaking skills (Batrinca et al., 2013).

Also, VR brings an opportunity to practice in front of a virtual audience which is found to improve presentation performance (Boetje & Ginkel, 2021). The audience in a VR environment could be of different sizes and placed in different venues (Ovation, 2021) starting from two to three people in a meeting room to a huge theatre with an audience of more than 100 people. The size and venue, as well as their design, would depend on the VR software

used. In general, the virtual audience is similarly perceived by individuals when compared to a real audience (Zanbaka et al., 2007). For example, people expressed nervousness when being exposed to a virtual audience (Monteiro et al., 2020). In addition, people were able to disclose more in front of virtual humans (Lucas et al., 2014). Therefore, practising in front of a virtual audience in a VR environment is seen as a safe and good opportunity to develop presentation skills because not every time a real audience can be provided (Boetje & Ginkel, 2021; Lear & Vasquez, n.d.). However, to understand the effect of a virtual audience on presentation performance as an environmental factor, one needs to consider the effect that the audience has on an individual's emotions and behaviour while developing presentation skills (De Grez et al., 2009).

Specifically, the influence of the audience on the emotions and behaviour of a performer, also known as *the audience effect*, is grounded in the social impact theory from Latané (1981). Kelly et al. (2007) found that performers' emotions are differently affected while performing in front of an audience (real, virtual, or imagined). In addition, Lemasson et al. (2021) found that various emotional components (cognitive, physiological, or behavioural) were affected differently by the audience size. Also, Lemasson et al. (2018) found that actors reported higher anxiety levels while performing in front of a large audience. Furthermore, Pertaub et al. (2002) discovered that several types of audience engagement such as neutral, positive, or negative influenced public speaking anxiety in different ways. However, most of the mentioned studies focused on measuring anxiety levels induced by being exposed to an audience and it is worth emphasizing that these studies are valuable for understanding the impact that an audience can have on performers, in both virtual and real environments.

Besides the audience size, VR programs also provide an opportunity to use different types of audience engagement, such as low or high (Ovation, 2021). On the one hand, an audience that ignores the VR user's presentation or acts neither interested nor polite is known as the low-engaged audience (Ovation, 2021). On the other hand, an audience that pays attention to the VR user's presentation, and uses body expressions such as smiling, head nodding, etc. is referred to as the high-engaged audience (Ovation, 2021). For instance, to train public speaking skills using direct feedback, Chollet et al. (2015) in their study involved two different types of virtual audiences, passive and interactive. Passive was the audience that did not interact with the user, just listened to the presenter, and interactive was the one that leaned back and forth, smiled, and applauded (providing indirect non-verbal feedback) based on the learner's performance. Even though the focus of their research was specifically on the influence of the audience's feedback on presentation performance, they also mentioned that both types

of audiences led to positive learning outcomes with no difference in results between different audience engagement as rated by experts who were also measuring presentation performance indicators next to the software. In their study, learning outcomes were related to improved eye contact, gesture usage, presentation structure etc.

In general, besides the study from Chollet et al. (2015), research on the impact of the audience on evoking emotional or affective reactions that influence presentation performance is related to public speaking anxiety or treating public speaking anxiety with exposure therapy (Anderson et al., 2005; Harris et al., 2002). Nevertheless, even though the affective or emotional experience were not included in their studies, this is a good start for the current research on how different types of audience engagement might or might not have different influences on presentation performance through an affective experience. This gives an example of which the current study will build on for inspecting the mediation role of the affective experience further. For that reason, the current study is motivated by the absence of research that focuses on the role of audience engagement on affective experience other than anxiety or public speaking anxiety. We aim to further research the environmental factors, such as the role of audience engagement (low or high) on presenters' affective experience, such as feeling good (positive) or bad (negative) that influences presentation performance at the end. In addition, we will address what other variables influence audience engagement and affective experience that could influence performance differently.

Virtual Audience and Presentation Performance

In general, practising before the audience elicits better presentation performance than practising without the audience (Kolb, 1994; Smith & Frymier, 2006; Tucker & McCarthy, 2001). From the social perspective, the explanation for these findings could be grounded in *social impact theory* according to which an individual's physiological, emotional, cognitive, and behavioural state is affected by the presence or action of others, whether others are real, imagined, or implied individuals (Latané, 1981). For instance, in higher education, the method Shaw (2001) used, where the audience was in charge of helping and motivating students to do their presentation professionally, demonstrated that students were more responsible for their learning because they were both presenters and audience in the classroom respectively. They had two tasks. On the one side, they were attentive audience because they needed to evaluate the presenter, on the other side, they carefully prepared their presentations for the audience since they all needed to do their presentation. Shaw suggests here that "if a speaking student is held accountable for his or her performance by the audience, he or she would make an effort in researching an issue and presenting his or her research in a clear, informative, and convincing

way." (Shaw, 2001, p. 140). Even though Shaw (2001) talks about the audience in the context of classroom experience, we should still consider the results given the finding that virtual and real audiences are perceived similarly (Zanbaka et al., 2007).

Furthermore, to improve the presentation performance while practising, it is important to practice in a safe environment and to receive feedback during or after the presentation (Batrinca et al., 2013). Feedback helps to improve presentation performance and become aware of the parts of the performance that should be improved (van Ginkel et al., 2015). Computer-mediated feedback, such as non-verbal feedback/reaction from the virtual audience is beneficial for participants because it could help to improve performance on the spot (Batrinca et al., 2013). For example, if the presenter talks too quickly this could be reflected evidently for the presenter by the reaction of the virtual audience (Van Ginkel et al., 2020). This is important for the immediate improvement of performance because of the awareness and self-understanding that is raised in the presenter on the spot (Chollet et al, 2015). When paying attention to indirect cues from the audience the presenter can change and adapt their speaking style to those indirect behaviours and in that way greatly improve presentation performance (Batrinca et al., 2013).

Next, Chollet et al. (2015) in their study found that an interactive virtual audience improved the presentation skills of presenters and was perceived as joyful by the participants in the study (Chollet et al., 2015). Namely, the focus of their work was to investigate the influence of feedback from the audience using different feedback strategies that would affect presentation performance at the end. Their feedback strategies were: an interactive virtual audience expressing non-verbal feedback, a passive virtual audience with direct visual (written) feedback displayed on the screen above audience, and a passive virtual audience without feedback as a control condition. Among other findings, the most important for us is that presenters found interactive audience expressing non-verbal feedback the most engaging, but also challenging for presenters when compared to other conditions. Then, the presentation performance improved while practising with both passive and interactive audiences as rated by experts and the software itself which suggests that a virtual audience can influence on presenter's performance. Also, training in front of a virtual audience was perceived as joyful which suggests that a virtual audience could induce certain emotions. In that regard, these are important implications for the current study to investigate further both virtual audience influence on presentation performance and affective experience. Coming with that, after setting the base that virtual audience can affect presentation performance, further sections will address

the origin of the affective experiences and in what way it can be influenced by the virtual audience.

The Origin of Affective Experience

To understand the origin of affective experience it is important to go one step backwards and through an explanation of emotions and appraisal theories of emotions to come to its origins and focus of the current study. Emotions are described as one's reaction towards personally significant events (Pekrun 2016). Appraisal theories of emotions put cognition as a central aspect of emotions, where thought and emotions are inseparable (Pekrun, 2016). Appraisal theories describe emotions as an adaptive response that is preceded by the appraisal of the changes in the environment that are significant to the individual's well-being (Ellsworth, 2013; Moors et al., 2013; Pekrun, 2016). Significant for the individual means how important something is for the individual's needs, values, goals, and beliefs (Frijda, 2016). The added value of appraisal theories is that they consider differences in individuals, such as cultural or developmental, and this means that an individual's emotional response might differ based on the individual's appraisal of the event (Moors et al., 2013).

Appraisal theories see emotions as episodes that create changes in individuals' subsystems or components, thus they are described as consisting of multiple components (Moors et al, 2013). Furthermore, their process is continuous and recursive thus changes in one component will lead to changes in another and vice versa (Moors et al, 2013). These components are affective (subjective), cognitive, physiological, expressive, and motivational (Frenzel & Stephens, 2013). Frenzel and Stephens (2013) describe the components as follows. First, the affective (subjective) component represents how we feel about a certain event. Second, the physiological component considers how our body reacts and how our body processes are activated during the emotional process. Third, the expressive component is how our body and face react at the moment of an emotional episode. Fourth, the cognitive component represents what our thoughts are at that moment. Finally, the motivational component is the one that drives our behaviour and helps us survive and feel better about the moment in which we are, or we are running away from. In sum, emotions are seen as consisting of multiple components that can be predicted from a person's appraisals of self and environment.

Since emotional and affective experience are sometimes used interchangeably with the feeling component of emotion, it is important to clarify the difference (Shuman & Scherer, 2014). Namely, affective experience is a larger category and includes emotions, moods, and other categories, while emotions as consisting of multiple components include the feeling

component (Shuman & Scherer, 2014). For the current study, we will focus on the positive and negative affective experience of the individuals expressed with certain emotions which we will describe more in the method section.

Virtual Audience and Affective Experience

To begin with, as mentioned before, Chollet et al. (2015) found that an interactive virtual audience was perceived as joyful in their study. This is a good implication for our study because it shows that the virtual audience can influence emotions in one way, in this case positive emotion. Nevertheless, the limitation of their study was that they did not particularly assess emotions, but they got this finding by using a self-assessment questionnaire that included questions about felt rapport with the audience. This is promising for the current study, and we will build on and investigate affective experience further using a specific instrument to measure affective experience. However, because of the finding from Chollet et al. (2015) that audience could be perceived as joyful, one can assume that an individual's appraisal of the audience which is interactive (high-engaged) would lead to a positive affective experience.

Additionally, the study from Pertaub et al. (2002), is another example of how different types of engaged audience can influence the emotions and affective experience of individuals. Namely, in their study, participants were practicing presentation in front of three types of audience engagement. First, the neutrally engaged audience remained static during the experiment. Second, a positively engaged audience which expressed friendly behaviour towards participants. Finally, a negatively engaged audience expressed hostile and bored expressions during the experiment. Even though their study was in the context of practicing presentation skills, their focus was on investigating if the type of virtual audience would affect the emotional response such as anxiety. Their findings suggest that the negative virtual audience provoked a strong anxiety response in comparison to the static and positive audience. Even though their study design was between-subject and was limited to measuring anxiety only as an emotional response, this is a good implication which suggests the influence of audience engagement on affective experience, in particular, a negative one. Therefore, one can assume that a negatively engaged audience would lead to a negative affective experience.

Finally, in the context of our study, after understanding that a virtual audience can influence affective experience, which is a personal factor in achieving good presentation performance, we also need to consider its mediating effect further. Namely, the influence of affective experience on learning and presentation performance further.

Affective Experience, Learning and Performance

Besides understanding the origins of affective experience, it is important to mention what effects that experience would have on learning and performance. Since emotions are a category that describes the affective experience, an example of Pekrun's (2016) writing about the relevance of emotions and their effect on learning and performance is important implication for the current study. This is the root for the claim that affective experience mediates different type of virtual audience engagement and presentation performance. Among other categories that Pekrun (2016) mentioned, positive (pleasant) or negative (unpleasant) emotions have different effects on individuals' attention, motivation, self-regulation, and the use of learning strategies (Pekrun, 2016) which will be described briefly in the following paragraphs.

First, positive emotions lead individuals to focus attention on the object of emotion and as such promote or inhibit performance (Pekrun, 1992; Pekrun & Perry, 2014; Pekrun 2016). The key trigger here is what is the object of emotion. For instance, if the object of emotion is the task itself, positive emotions such as enjoyment and excitement of learning are helping individuals putting attention to the task thus promoting performance. According to Pekrun (2016), positive emotion such as enjoyment can also lead to learning flow which is a complete immersion in the task while learning. However, if the focus of emotional reaction is on getting a high grade and fantasizing about that, which is not related to the task directly, that will reduce the attention on the task and inhibit performance (Pekrun, 2016). Next, negative emotions' influence is detrimental to learning and performance because they are reducing task-related attention (Pekrun, 2016). For instance, Pekrun (2016) mentioned that anxiety leads to negative thoughts about the task and thinking about failure thus completely reducing attention on the task. In other words, it is detrimental to learning and performance because of the reduced attention on the task itself.

Second, both negative and positive emotions influence motivation and interest by inhibiting or promoting learning and performance (Pekrun, 2016). Positive control and value appraisal activate positive activating emotions such as enjoyment thus increase students' interest in the learning material and intrinsic motivation to learn (Pekrun, 2016). However, positive deactivating emotions such as relaxation, contentment and relief can reduce motivation to solve the task at hand but could later reinforce it after a certain period of rest (Pekrun, 2016). In contrast, negative activating emotions work differently, they reduce interest and intrinsic motivation but can reinforce motivation if the task is of significance for the student. Additionally, deactivating negative emotions, such as hopelessness and boredom are found to reduce motivation and interest to learn (Pekrun, 2016).

Third, positive and negative affective experiences are found to influence students' use of learning strategies. Positive activating emotions influence the use of learning strategies in a more profound way (Pekrun, 2016). For instance, students can better understand the scope of the learning material by comparing it with previous knowledge about the topic, they are able to think critically, and to better organize the learning material (Pekrun, 2016). In addition, when it comes to negative activating emotions, they are found to influence the use of learning strategies by students in a very superficial way (Pekrun, 2016). For instance, anxiety and shame could lead to the use of a strategy such as memorization of learning material or simple rehearsal only (Pekrun, 2016). Finally, both positive and negative deactivating emotions reduce the use of learning strategies or contribute to their use but in a very simplified way (Pekrun, 2016).

Fourth, positive and negative emotions can promote or inhibit self-regulation of learning (Pekrun, 2016). Positive activating emotions contribute to better self-regulation of learning because they promote flexibility in thinking and action behaviour while positive deactivating emotions do not have the same effect (Pekrun, 2016). When it comes to negative activating emotions, they do not promote flexibility in thinking and action behaviour and thus do not influence performance (Pekrun, 2016). They are found to promote external regulation instead since it is helpful for the students to receive external support during the moment of anxiety for instance (Pekrun, 2016).

According to Pekrun (2016), it should be mentioned that emotions are also influenced by several individual factors and that line is not always straightforward when it comes to learning and emotions. He mentioned that these factors are genetics, background, personal values, and previous learning experiences. In that regard, self-confidence and task value are seen as important for learning and performance (Pekrun, 2016). According to Pekrun (2016), self-confidence gives students the feeling of being able to solve a task and it is found to promote the enjoyment of learning. In contrast, he also suggested that a lack of self-confidence leads to anxiety and hopelessness. Furthermore, he explained that task value is the value that students give to the task at hand, in other words, the task is of importance to them. If students perceive learning material or tasks as valuable and interesting, consequently, enjoyment will be promoted otherwise it would lead to boredom (Pekrun, 2016). In their study, Rowe and Fitness (2018) also found gender, life experience, and intensity of emotions as mediating factors between negative emotions and learning or performance which supports previously mentioned claims.

As a support, some empirical studies are in line with Pekrun's (2016) findings. In their study, Rowe and Fitness (2018) were investigating the influence of negative emotions on

achievement and learning. They found that negative emotions such as anger, sadness, fear, and boredom were most of the time salient in learning and that they were detrimental to learning, motivation, and performance. However, in some cases, negative emotions were beneficial too, they promoted external regulation, motivation, and the use of learning strategies such as memorization. Also, positive emotions such as happiness, excitement, pride, and relief are found to support social and cognitive functioning such as task engagement, learning process, and goal achievement in Higher education (Rowe et al., 2015). Interestingly, in their study Baumeister et al. (2015) found that the intensity of emotions impacts learning when compared to the neutral condition, as reported by participants, even though no real learning effect happened. This shows that emotions have the power to create an illusion of learning too (Baumeister et al., 2015). Finally, the effect of positive and negative emotions on attention is not fixed but rather flexible, meaning that both positive and negative emotions can influence attention positively or negatively depending on individual factors (Huntsinger, 2013) which confirms the claim that individual factors play the role in how emotions will affect learning and performance (Pekrun, 2016).

The Rationale for including Emotions in the Current Study

In the realm of the current study, first, appraisal theory contributes to understanding that affective experiences are induced based on the appraisal of personally significant events (Pekrun 2016). In that regard, different levels of virtual audience engagement would create a different affective experience. On the one hand, an audience whose engagement appears to be high would be appraised as positive leading to a positive affective experience following the finding from Chollet et al (2015) where the audience was perceived as joyful. On the other hand, an audience whose engagement appears to be low would lead to a more negative affective experience following the finding from Pertaub et al. (2002). Also, people appraise events depending on the significance it has for them, in that regard, the more important an event is for the individual the emotions are more likely to occur since they are arising as an appraisal of the event (Frijda, 2016). In that sense, the presentation in front of the audience could promote specific emotions that could describe positive or negative affective experience. As a support, we should consider a transactional model of interaction from Nurmi and Kiuru (2015) that is from the teaching domain. Based on large study review of the influence of student academic achievement and motivation on teachers' instruction as well as teacher-child relationship, they suggested that students' characteristics, such as attentive behaviour, good performance or misbehaviour could induce teachers' instructional or emotional responses, positively or negatively and also in a transactional way. That means that students and teacher both interpret

their reactions and based on the appraisal of those reactions certain behaviour would happen. Coming with this, in line with the current research, if students are in the role of an audience and teachers are in the role of presenters, it can be suggested that the same could happen while practising presentation skills in front of differently engaging types of virtual audience.

On the other hand, the quality of the presentation performance could be understood as a consequence of induced affective experience which is grounded in Pekrun's (2016) description of the emotional effect on learning and performance. However, it should be also considered that if the value of the event is insignificant for the individual it might not promote the same emotions and thus could have a less successful effect on the performance (Frijda, 2016). Finally, considering the two mentioned assumptions, the work of the current research is grounded in appraisal theory as a core support for the current research which explains that appraisal of events would lead to positive or negative affective experience which effect would later lead to a different quality of a presentation performance. In that way, one could understand the relationship between audience engagement and affective experience on the one side, and affective experience and presentation performance on the other side. However, the additional effects of public speaking anxiety should be considered because it is found to be detrimental to presentation performance (Sheets & Tillson, 2007).

Public Speaking Anxiety

Public speaking anxiety (PSA), as a trait, is defined as "an individual's level of fear or anxiety associated with either real or anticipated communication with another person or persons" (McCroskey, 1977, p. 78). This is important to mention because public speaking trait anxiety precedes public speaking state anxiety (Beatty & Friedland, 1990). According to Spielberger (1966; as cited in Addison et al., 2003), state anxiety is "a transitory state or condition of the organism that varies in intensity and fluctuates over time" (p. 12). State anxiety is characterised by people envisioning failure, avoiding presenting, having increased physiological signals, and perceiving the environment as hostile (Booth-Butterfield & Booth-Butterfield, 1990). It is found that people with a higher level of speaking anxiety take more time in preparing their speeches and collecting information, which could affect their performance (Brown & Morrissey, 2004), and are negatively oriented towards public speeches (Daly et al., 1989). Knowing this, in the focus of the current research, one can assume that negative affective state experiences would be intensified if individuals start the experiment with a certain level of state public speaking anxiety.

As a trait, public speaking anxiety is represented by emotions such as fear or anxiety (McCroskey, 1977) thus its influence on state affective experience is evident (Booth-

Butterfield & Booth-Butterfield, 2009). When we consider VR environments, studies show that practising presentation in VR in front of a virtual audience helps in reducing public speaking anxiety (Anderson et al., 2005; Harris et al., 2002). This should be considered because while practising, anxiety decreases due to an emotional regulation process as known as habituation (Rachman & Levitt, 1988) which tells us that there is an impact on emotions. However, not every time habituation happens, instead, anxiety could be prolonged also which is known as sensitization (Sawyer & Behnke, 2002). Furthermore, when it comes to presentation skill training, Boetje and Van Ginkel (2021), in their study were investigating the mediating effect of public speaking anxiety while practising presentation with a virtual audience for better presentation performance. They found that students perceived VR as a safe place to practice presentation with similar results for both students with PSA and without. However, the focus of their study was on the trait of public speaking anxiety. Finally, based on the theory and mentioned findings, the current study should consider the potential influence of state public speaking anxiety on affective experience and consequently on the quality of performance at the end.

Prediction of Presentation Performance

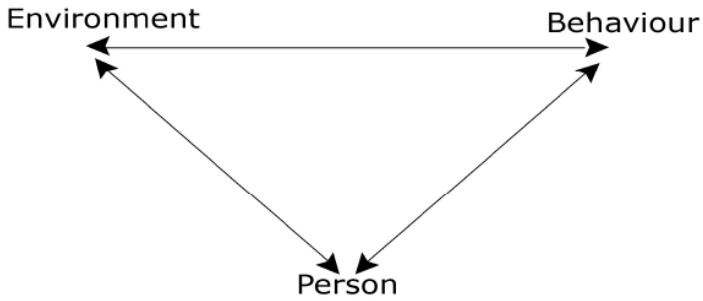
After we grounded the current work in theories that help to understand the impact of audience engagement on presentation performance through affective experience, it should be finally emphasized how presentation performance is predicted and how does that match with the previous findings about affective experience and audience engagement. The terms oral presentation skills, presentation skills or public speaking skills are used interchangeably but represent a similar concept (De Grez et al., 2009). For the current study purpose, presentation competence can be defined as “a combination of knowledge, skills and attitudes needed to speak in public in order to inform, self-express, relate, or to persuade” (De Grez et al., 2009, p. 5). In addition, presentation competence is seen as an interrelation between cognitive, affective and behavioural dimensions of communication competence (Bower et al., 2011) and improving any of these three components can enhance presentation performance (van Ginkel et al., 2015).

However, De Grez et al. (2009, p. 5) mentioned in his study that “knowing how to present is still no guarantee for actually performing the expected behaviour” because there are other characteristics that play the role in achieving good performance which is the best explained with the social-cognitive framework of human functioning from Bandura (1997). Based on the triadic reciprocal causal model of human functioning (see Figure 1) it is assumed that human functioning is determined based on the interrelation of behavioural, personal, and environmental factors (Bandura, 1997). Translated to presentation skill performance, one could

assume that presentation performance (behaviour) at the end would depend on the interaction of instruction (environment) and the presenter's characteristics (personal factors) thus it shows us the complexity of what it means to achieve the good presentation performance (De Grez et al., 2009). This is in line with the previous assumptions that affective experience, as a personal factor, induced by audience engagement, as the environmental factor, would affect presentation performance at the end.

Figure 1

The Triadic Reciprocal Causal Model of Human Functioning



Furthermore, one needs to understand what describes presentation performance when it is predicted. According to Quianthy and Hefferin (1999; as cited in Schreiber et al., 2012) effective presentation performance includes two main categories: message composition and message delivery. Accordingly, they mentioned that message composition includes designing the purpose of the presentation, choosing the topic, using appropriate statements, and supporting material, and establishing proper transitions between the ideas. On the other side, delivery considers the vocal variety and proper sound, proper language use, and non-verbal behaviour. In addition to previous suggesting, existing rubric that assesses presentation performance with appropriate reliability and validity is the Public Speaking Competency Instrument (PSCI) from Thomson and Rucker (Schreiber et al., 2012) which includes items that cover introduction, organization, supporting material, speech conclusion, verbal delivery, non-verbal delivery, and general competence.

Accordingly, to achieve an effective performance one should prepare properly, know the content, understand the goal of presentation, and know the audience beforehand if possible (Keshavan & Tandon, 2012; Medina & Avant, 2015). Also, the presentation structure should follow the order: introduction, body, conclusion, questions, and answers (Dolan, 2017; Keshavan & Tandon, 2012; Medina & Avant, 2015). Logical flow, and content divided in digestible chunks that lead to the main conclusion and transition to the next section are

necessary for the presentation to be effective (Keshavan & Tandon, 2012). Also, one should apply visual aids in the presentation slides and try to make the presentation interactive by involving the audience and asking them questions (Medina & Avant, 2015). Finally, the language used should be spoken rather than written on the slides and expressed with more active rather than passive verbs (Dolan, 2017). Dolan (2017) also mentioned that technical terms, jargon and slang should be avoided and being oneself, using own words is the best way to achieve an effective presentation performance.

Besides the message composition activities, the message delivery part such as the non-verbal behaviour also plays a role in achieving good performance, for instance, facial expression, eye gaze, gestures, and voice (Batrinca et al., 2013; Dolan, 2017). First, body position reflects the mental state and natural behaviour of the presenter (Zhou et al., 2021). For instance, Zhou et al. (2021), mentioned that standing inappropriately, shifting positions often, as well as inappropriate body posture during presenting reflects unnatural behaviour. Also, they suggested that standing straight, but not too straight reflects the confidence of the presenter. Next, they mentioned that maintaining eye contact is crucial for the speaker's credibility and an important factor for general communication. Then, when it comes to hand gestures, they should be in accordance with the speech and more natural, mostly used to emphasize the point or to point deliberately to the screen (Dolan, 2017; Fung et al., 2015). Furthermore, hand movements are seen as a reflection of the emotional state of the presenter thus the audience can recognize the emotion of the presenter based on hand movements (Zhou et al., 2021). For instance, crossing arms is not seen as polite and it might show a sign of self-defence (Fung et al., 2015). Finally, the tone of the voice should be loud and clear enough to maintain the attention of the audience (Keshavan & Tandon, 2012) and changing the pitch tone is one way to break the monotony and emphasize a point (Fung et al., 2015). In sum, following the suggestions to achieve effective presentation performance might help in improving it, however, to improve the presentation performance practicing is seen as one way (van Ginkel et al., 2015).

Research Questions

Audience Engagement and Affective Experience (RQ1)

The first research question (RQ1) of the current study is: *What is the influence of different level of audience engagement on affective experience of presenters?* Following the findings from Chollet et al. (2015) and Pertaub et al. (2002) that different types of audience engagement can induce different affective experiences, one can consider that the virtual audience whose engagement appears to be low or high will have different effects on the affective experience of the presenter. Based on these findings, we can predict the following hypotheses:

H1.1: An audience whose engagement appears to be low evokes a more negative affective experience compared to an audience whose engagement appears to be high.

H1.2: An audience whose engagement appears to be high evokes a more positive affective experience compared to the audience whose engagement appears to be low.

Audience Engagement and Presentation Performance (RQ2)

The second research question (RQ2) of the current study is: *What is the influence of different levels of audience engagement on presentation performance?* Considering the findings from Batrinca et al. (2013), Boetje and Van Ginkel (2020), as well as Chollet et al. (2015) that virtual audience in general, as well as different levels of virtual audience engagement, can have an influence on presentation performance directly, namely that presenters demonstrate better performance in front of a neutral or positively engaged audience, we hypothesise the following:

H2: Presenters demonstrate lower presentation performance in front of the audience whose engagement appears to be low rather than high.

Public Speaking Anxiety, Negative Affective Experience and Presentation Performance (RQ3)

The third research question (RQ3.1) is: *Is the difference in presentation performance between different levels of audience engagement moderated by public speaking anxiety?* Also, still related to public speaking anxiety state, next question (RQ3.2) is: *Is the difference in negative affective experience between different levels of audience engagement moderated by public speaking anxiety?* As public speaking anxiety is found to negatively influence negative affective experience as well as presentation performance as it was found in the studies from Brown and Morrissey (2004) and Daly et al. (1989) we first assume the relationship between mentioned variables and hypothesise:

H3.1: There is a relationship between public speaking anxiety and negative affective experience.

H3.2: There is a relationship between public speaking anxiety and presentation performance when presenting in front of the audience whose engagement appears to be low.

H3.3: There is a relationship between public speaking anxiety and presentation performance when presenting in front of the audience whose engagement appears to be high.

Also, we assume that public speaking anxiety is acting as a moderator between different levels of audience engagement and affective experience in two ways:

H3.4: The difference in presentation performance between the low and high-engaged audience will be larger with people with high state public speaking anxiety.

H3.5: The difference in negative affective experience between the low and high-engaged audience condition will be larger with people with high state public speaking anxiety.

Audience Engagement, Presentation Performance and Affective Experience (RQ4)

Finally, the last research question (RQ4) of the current study is: *What is the influence of virtual audience engagement on presentation performance through the affective experience of higher education students?* With this, we tend to address the gap in existing research since no study to date has investigated virtual audience engagement's influence on presentation performance through affective experience expressed with certain emotions. Based on the previous empirical findings from Chollet et al (2015) and Pertaub et al. (2002) and appraisal theory, we can assume that positive and negative affective experiences play a role in determining presentation performance at the end and as such hypothesise:

H4.1: A positive affective experience influences the difference in presentation performance between the low and high-engaged audience.

H4.1: A negative affective experience influences the difference in presentation performance between the low and high-engaged audience.

Methods

Sample

The study sample consisted of adult participants (N = 13) that study at the University of Twente (UT) in The Netherlands. Participants were recruited by promoting the study experiment via SONA (channel for study research recruitment for psychology and communication students), the official communication channels of UT, distributing posters, as well as on-the-spot recruitment at the University of Twente buildings. The requirement to participate in the study was to be at least 18 years old, to be a student of UT and to speak the English language since the experiment was conducted in the English language. The final sample included 7 male (M_{Age} = 24.5, SD_{Age} = 2.74), and 6 female (M_{Age} = 25, SD_{Age} = 2.74) participants. They had different nationalities and came from different countries such as Spain (2), Brazil (1), Belgium (1), China (2), Bahrain (1), Lithuania (1), Portugal (1), Bulgaria (1), Germany (1), and the Netherlands (2). Participants were at different study levels including Bachelor, Pre-Master, Master, and PhD attending study programs in Educational Science and Technology, Communication Science, Psychology, and Industrial Engineering and Management.

The exclusion criteria considered participants who refused to fill in the questionnaire or who did not finish it completely. There was no time limitation to fill in the questionnaire, the approximate duration of the experiment per participant was 45 minutes and data was collected in one week. After the experiment was done, the researcher explained the reason for collecting emotional data and debriefed the participants to finish the experiment on a good note. Finally, they were offered to withdraw their data from the experiment at any moment.

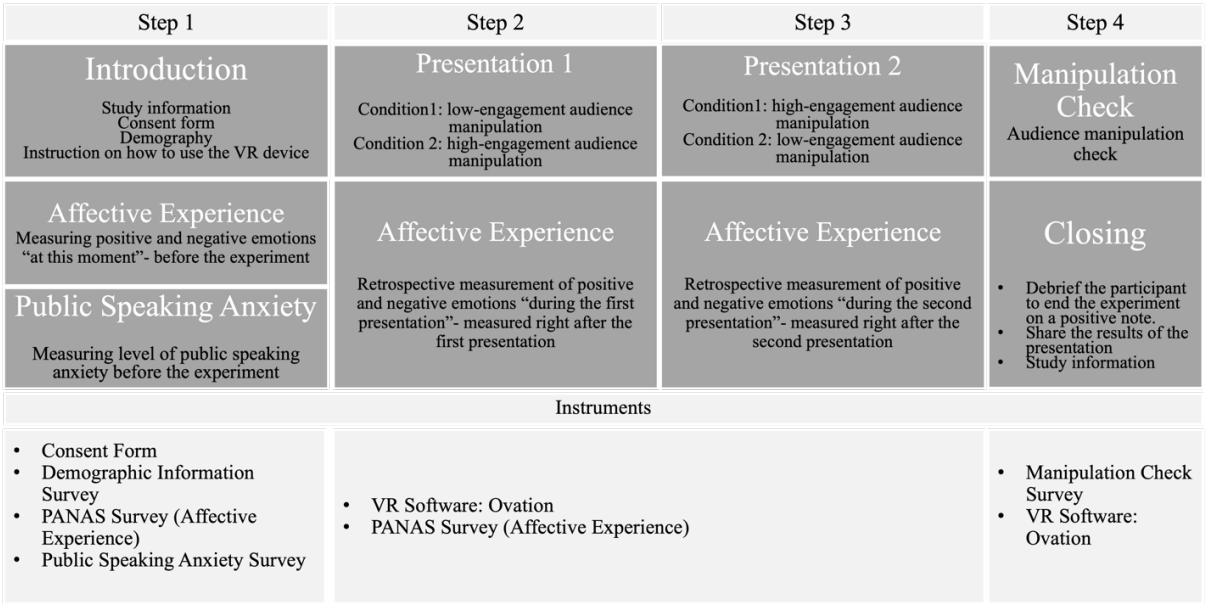
Study Design and Procedure

In the current, within-subject, cross-sectional design study, quantitative methods were applied. A similar study design and methods were used in the study by Kollöffel and Heuvel (2020) which was adapted for the purposes of the current study. Prior to the experiment, approval from the Ethical Committee at the University of Twente was received to conduct this experiment. This was followed by the recruitment of participants. All the participants were informed in advance to prepare a short presentation (maximum five minutes) about their topic of choice which they would practice during the experiment. Right before the experiment, the participants were randomly allocated into two groups for counterbalancing reasons since the experiment was conducted in two different conditions. Accordingly, these were high-engagement audience condition and low-engagement audience condition. Furthermore, on the day of the experiment, each participant was informed about the purpose of the study research

before participation. Nevertheless, only partially due to a reason of potentially biased results. At the end of the experiment, they were informed about the complete study's research purpose. Finally, before they participated in the experiment, they were asked for consent. The overall study design and procedure with all used questionnaires and collected variables are summarized in Figure 2.

Figure 2

Study Design and Procedure



Overall, the participant's task was to practice their presentation in a VR environment with the virtual audience using VR hardware and software. The presentations were audio and video recorded with an avatar mimicking the presenter's postures and movements, as well as recording the voice during the presentation. Participants presented two times, one time in a low-engagement virtual audience condition and one time in a high-engagement virtual audience condition with a small break in between presentations. In one condition, participants started with a presentation in front of a high-engaged virtual audience, followed by a presentation in front of a low-engaged audience. In other condition, they started with a low-engaged virtual audience followed by presenting in front of a high-engaged virtual audience. The level of the audience's engagement was manipulated by the researcher, and it could be set to be either on or off. On indicating high-engaged audience and off indicating low-engaged audience. Nevertheless, the audience's behaviour was expressed in a subtle form unless the specific behaviour such as talking on the phone, coughing, or completely avoiding the presenter wasn't present. For each participant, the people in the audience were differently organized and expressed their behaviour in a different order. Each presentation was finished with applause

from the audience. In addition, participants who presented in front of the disengaged audience for the second time were told at the end that the audience's reaction was manipulated and that their talk did not influence their reactions. In total, the experiment lasted 45 minutes per participant.

Before the first presentation, participants were asked to fill in the demographic questionnaire, the Positive and Negative Affect Schedule Scales (PANAS) questionnaire (Watson et al., 1988) that measured positive and negative emotions "at the moment", as well as the Public Speaking Anxiety questionnaire (Bartholomay & Houlihan, 2016) that measured the level of public speaking anxiety state. This was followed by instruction on how to use the VR device and then they were given a moment to familiarize themselves with the VR environment before they started with the first presentation. After the presentation participants received feedback on their presentation performance from the software. Results were related to behavioural indicators such as eye gaze, hand movement, and tone of voice they expressed during the presentation. However, the researcher did not give any feedback to the participants during or after the experiment. After the first presentation, they were asked to fill in the PANAS questionnaire (Watson et al., 1988) that retrospectively measured positive and negative emotions after the presentation. The same procedure was followed for the second presentation. Finally, since the audience in the VR software Ovation was manipulated, we measured at the end of the experiment how did participants perceive those manipulations. In the end, participants were informed about the possibility of receiving the study results by contacting the researcher.

Instruments

Measures (Hardware and Software)

The VR hardware HP Reverb G2 Omnicept Edition with two HP Reverb G2 motion controllers were used in the study. The software application *OvationVR* (Ovation, 2021) was used with the main purpose to provide learners with a virtual environment where they can practice their communication and public speaking skills in front of a virtual audience of different sizes (small meetings or big theatres). For the current study purpose, participants were practicing presentations in a small meeting room environment that involved five people in the audience. PowerPoint slides can be uploaded before the presentation and during the speech, the slides are visible either on the laptop screen or on the wall in the virtual environment. In addition, as already mentioned, the audience behaviour was manipulated by the researcher and with this application. On the one side, the audience in high-engagement condition usually showed interest in the speech by nodding their heads or by looking at the participant. On the

other side, the audience in low-engagement condition was not interested in the speech, and they showed that by looking down, coughing, checking their phones or talking to each other. At the end of the speech, both high and low-engaged audiences were set by the researcher to give a round of applause.

The *OvationVR* application tracks three categories of behavioural indicators during the presentation (Ovation, 2021). These are the presenters' eye gaze, voice, and hand movement. First, eye gaze includes metrics about attention distribution (e.g., "Prioritize attention on audience", "Distribute attention equally among audience members") and audience stare (e.g., "Avoid staring at audience sections") which measures if the presenter stares for too long at one person or spot in the room. Second, the voice category provides measurements of words per minute (e.g., "Maintain a clear and comfortable speaking rate" or "Use pauses regularly") and filler words (e.g., "Avoid overuse of filler words", "Avoid monotony"). Third, hand movement (e.g., "Avoid excessive similarity of hand movement") shows the measurements of the presenter's hand movement. At the end of the speech, the software provides the Total Score based on the score of the three mentioned indicators expressed in a percentage scale from 0 as the minimum to 100 as the maximum score. After the second presentation, the trend of participants' improvement could be seen. Finally, even though the software provides information about the presentation performance, we do not have any information related to the reliability of the measurement scale nor how the score was built which will be addressed in the discussion of the current paper.

Positive and Negative Affect Schedule Scales - PANAS

At the beginning of the experiment and after each presentation, the presenter's emotions were assessed by using the *Positive and Negative Affect Schedule Scale* (PANAS) developed by Watson et al. (1988). This self-report scale consisted of twenty items (See Appendix A), 10 positive (e.g., "attentive", "proud", "enthusiastic", and "excited") and 10 negative (e.g., "upset", "ashamed", "nervous", afraid). Participants rated on a 5-point Likert scale, ranging from 1 (not at all) to 5 (extremely), to what extent they experienced specific emotions in a specific moment ("at the moment", "during the first presentation", "during the second presentation"). Scores can range from 10 to 50 for both the Positive and Negative Affect, with the lower scores representing lower levels of Positive/Negative Affect and higher scores representing higher levels of Positive/Negative Affect. In this way, we assessed their general emotional state "at the moment" (before the presentation), and "during the presentation" (retrospectively after each presentation).

To assess the reliability of the PANAS scale, we calculated Cronbach's alpha coefficient separately for Positive Affect Scale and Negative Affect Scale. First, the raw alpha coefficient for the Positive Affect Scale before the experiment was .64, meaning that the items in the scale are correlated and consistent. Second, for the Negative Affect Scale, raw alpha was .49. Furthermore, we also assessed the reliability of the measurements after the first and second presentation practice for both the Positive and Negative Affect Scale. After the first presentation practise, the raw alpha coefficient for Positive Affect Scale was .79, while for the Negative Affect Scale was .53. After the second presentation practice, the raw alpha for Positive Affect Scale was .81 and for the Negative Affect Scale was .38. Finally, considering the rule of thumb from George and Mallery (2003; as cited in Gliem & Gliem, 2003) our results suggest that the scale is a mostly reliable measure of the construct we are interested in.

Public Speaking Anxiety Scale

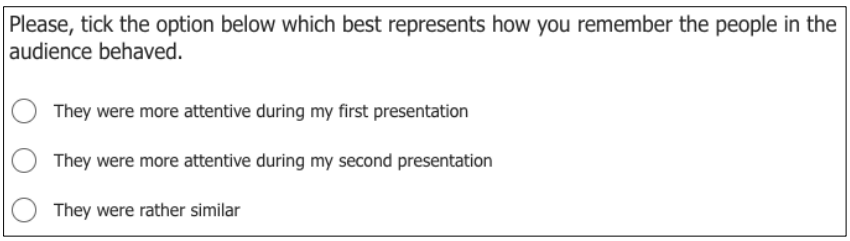
To assess public speaking anxiety, we used *Public Speaking Anxiety Scale* developed by Bartholomay and Houlihan (2016). This self-report scale assessed and tracked public speaking anxiety state (Bartholomay & Houlihan, 2016). The scale was developed to measure the three-component model of anxiety (cognitive, behavioural, and physiological) as described by Lang (1971; as cited in Bartholomay & Houlihan, 2016). It consists of 17 items, 8 cognitive (e.g., “I am afraid that I will be at a loss for words while speaking”), 4 behavioural (e.g., “I do not have problems making eye contact with my audience”), and 5 physiological (e.g., “I sweat during my speech”). The scale was measured on a 5-point Likert scale, ranging from 1 (not at all) to 5 (extremely). Five items on the scale are reverse-coded (See Appendix B for the full scale). Scores on this scale can range from 17 to 85 indicating different levels of public speaking anxiety. Scores from 17 – 63 indicate low public speaking anxiety level, 64 – 73 indicate elevated level of public speaking anxiety. Finally, scores above 73 indicate high level of public speaking anxiety. To assess the reliability of Public Speaking Anxiety Scale we calculated Cronbach's alpha coefficient. The results show high reliability of the scale with raw alpha .77 and standardized alpha .94.

Audience Manipulation Check Questionnaire

Finally, in the current study, the presenters were presenting under two conditions, one time in the high-engagement audience condition, and one time in the low-engagement audience condition. To assess how the participants perceived the audience manipulation they were asked to fill in the *Audience Manipulation Perception* questionnaire (See Figure 2 for a detailed description).

Figure 3

Audience Manipulation Check Questionnaire



Statistical Analysis

Data was collected using Microsoft Forms (Microsoft Corporation, 2022), inspected for missing and invalid points, and then organized using Microsoft Excel software (Microsoft Corporation, 2022). To run the statistical analysis, we used statistical software R (RStudio Team, 2022) version 4.2.2. Before running the analysis, descriptive statistics (means, standard deviations, minimum and maximum) and correlation of the main variables were calculated. Then we calculated the reliability of our scales by running the package *psych* (Revelle, 2022). For the purposes of the current study, we used a linear mixed model to check the influence of audience engagement on positive and negative affective experience and presentation performance. We used linear mixed model analysis because our study design included data with repeated measures, and it allowed us to include fixed and random effects in the same model which helped us to control for variables while still allowing for individual differences (Field et al., 2012; Baayen et al., 2008). We ran the package *lmerTest* (Kuznetsova et al., 2017) to build the linear mixed models which reports regression coefficients and significance values.

First, to check the difference between the two conditions of variables audience engagement and affective experience (positive and negative) we checked the assumptions and then ran the linear mixed model analysis for repeated measures. When long format data was created variable affective experience was named *Experience* and variable audience engagement was named *Engagement*. In addition, for the first analysis, we ran two times, once for the positive and once for the negative affective experience. Second, to check the difference between the two conditions and presentation performance we used the linear mixed models for repeated measures to determine differences within individuals between the two conditions over time. When long format data was created variable affective experience was named *Experience* and variable presentation performance was named *Performance*. Next, to check the influence of affective experience (positive and negative) on presentation performance in two conditions we also ran linear mixed model analysis.

Also, we ran Pearson's and Spearman's correlation to check the relationship between public speaking anxiety and negative affective experience, as well as public speaking anxiety and presentation performance. After checking for the main effects, we were planning to run a moderation analysis using a linear mixed model by specifying the interaction between public speaking anxiety and *Engagement* (variable audience engagement named after transforming data in a long format). Finally, because of the small sample size in the current research, we decided to run the non-parametric tests to double-check the results we got from linear mixed models. We ran Friedman rank sum test and Wilcoxon signed-rank test.

Results

In the current study, during the experiment participants were randomly allocated to two different groups for counterbalancing purposes. First group was practising presentation in a low-engagement and then in a high-engagement audience condition while the second group practised the other way around. For that reason, we first run descriptive statistics of the variables per group to check for differences between the groups (See Table 1). Besides, Table 2 shows the descriptive statistics for the participants in total.

Audience Manipulation Check

To check how participants perceived audience manipulation we will describe the results per group. The first group did the presentation in order low- and then high-engagement condition and the second group did it in order high- and low-engagement condition. The results for the first group show that four out of seven participants perceived the audience manipulated as it was (57%) while three participants (43%) had a feeling that low-engagement condition showed a more attentive audience. The results for the second group show that four out of six participants perceived the audience as it was manipulated (67%) while of the remaining two participants (33%) one perceived the manipulation in the opposite order and one did not find any difference.

Table 1

Descriptive Statistics per Group

Group 1 (n = 7) low – high*	Before the experiment				Low-engagement condition				High-engagement condition			
	M	SD	Min	Max	M	SD	Min	Max	M	SD	Min	Max
Affective Experience												
Positive	3.6	0.3	3.3	4.3	3.4	0.6	2.5	4.4	3.7	0.2	3.4	4.0
Negative	1.5	0.4	1.0	2.1	1.6	0.5	1.0	2.4	1.2	0.2	1.0	1.6
Public Speaking Anxiety	46.3	6.0	38.0	55.0								
Presentation Performance					73.6	16.0	47.3	90.3	78.8	11.2	63.8	91.9
Group 2 (n = 6) high – low*												
Affective Experience												
Positive	3.2	0.8	2	4.3	3.3	1.2	1.9	4.6	3.3	1	2	4.6
Negative	1.4	0.4	1	2.0	1.4	0.5	1	2.3	1.6	0.5	1.2	2.5
Public Speaking Anxiety	50.8	16.9	34	77								
Presentation Performance					79.5	10.3	68.8	95	79.6	8.2	63.9	85.7

*Note. *low-high or high-low indicate the manipulation order of audience engagement per group. In addition, the score range for Affective Experience is from 10 to 50, for Public Speaking Anxiety from 17 to 85, while for Presentation Performance from 0 to 100 (expressed in %, see details in Method section).*

Table 2

Descriptive Statistics Total

N = 13	Before the experiment				Low-engagement condition				High-engagement condition			
	M	SD	Min	Max	M	SD	Min	Max	M	SD	Min	Max
Affective Experience												
Positive	3.4	0.6	2	4.3	3.4	0.9	1.9	4.6	3.5	0.7	2	4.6
Negative	1.5	0.4	1	2.1	1.5	0.5	1	2.4	1.4	0.4	1	2.5
Public Speaking Anxiety	48.4	11.9	34	77								
Presentation Performance					79.6	14.7	47.3	95	79.2	9.5	63.8	91.9

Note. The score range for Affective Experience is from 10 to 50, for Public Speaking Anxiety from 17 to 85, while for Presentation Performance from 0 to 100 (expressed in %, see details in Method section).

Audience Engagement and Affective Experience (RQ1)

First, as the main effect, to answer our RQ1: *What is the influence of different level of audience engagement on affective experience of presenters?* we hypothesised (H1.1) that the audience whose engagement appears to be low evokes a more negative affective experience compared to an audience whose engagement appears to be high. The data were analysed using a linear mixed model, with a fixed effect for *Engagement* (high/low-engagement condition) and a random effect for *Participants*. The results showed that the average *Negative Affective Experience* score was higher in the low-engagement audience condition than in the high-engagement audience condition (See Table 3 for more). However, even though the result was not significant with $t(12) = 0.69$, $p > 0.05$, we still see the expected negative trend of the lower condition. This means that the presence of low-engaged audience is associated with higher negative affect. See Table 3 for more details. Furthermore, because our sample was low $N = 13$, we also ran the non-parametric test to double-check the significance level. A Friedman's rank sum test was run to check whether the difference in negative affective experience between two conditions is significant. Results showed that the difference between the low and high-engagement conditions and the negative affective experience was not significantly different with $F_r = 0.09$, $p > 0.76$. Therefore, we did not reject the null hypothesis.

Then, we hypothesized (H1.2) that the audience whose engagement appears to be high evokes a more positive affective experience compared to the audience whose engagement appears to be low. With a fixed effect for *Engagement* (high/low-engagement condition) and a random effect for *Participants*, the results showed that the average *Positive Affective Experience* score was 0.12 ($SE = 0.15$) points higher in the lower condition than in the higher condition. However, it was not significant with $t(12) = -0.8$, $p > 0.05$. The same as for hypothesis H1.1, even though the results were not significant, we still see the expected positive trend of the higher condition (See Table 3 for details). This means that the presence of the high-engaged audience is associated with higher positive affect. The same as with the previous hypothesis, we ran the non-parametric test to double-check the significance due to the low sample size. A Friedman's rank sum test was run to check whether the difference in positive affective experience between two conditions is significant. Results showed that the difference between the low and high-engagement conditions and the positive affective experience was not significant with $F_r = 0.81$, $p > 0.36$. Therefore, we did not reject the null hypothesis.

Audience Engagement and Presentation Performance (RQ2)

As one of the main effects, to answer our RQ2: *What is the influence of different audience engagement on presentation performance?* we hypothesised (H2) that presenters demonstrate lower presentation performance in front of the audience whose engagement appears to be low rather than high. The data were analysed using a linear mixed model, with a fixed effect for *Engagement* (high/low-engagement condition) and a random effect for *Participants*. The results showed that the average *Presentation Performance* score was higher in the lower condition than in the higher condition (see Table 3 for more). However, with $t(12) = 0.2$, $p > 0.05$, the results were not significant thus we did not have enough evidence to support the hypothesis. Nevertheless, as an addition, we also run a non-parametric test to double-check the results. A Wilcoxon signed-rank test was conducted to check if there was a difference in presentation performance between conditions. Results showed that the difference was not significant across the two conditions ($T^+ = 49$, $p > 0.83$). The null hypothesis was not rejected, indicating that there were no significant differences between the two audience engagement conditions.

Table 3

Linear Mixed Model Results for the First and Second Hypothesis.

Variable	*Negative Affective Experience*			*Positive Affective Experience*			*Presentation Performance*		
	B	*SE*	*p*	*B*	*SE*	*p*	*B*	*SE*	*p*
(Intercept)	1.41	0.12	0.001	3.49	0.22	0.001	79.16	3.44	0.001
Engagement	0.09	0.13	0.49	–0.12	0.15	0.43	0.46	2.40	0.85

Public Speaking Anxiety, Negative Affective Experience and Presentation Performance (RQ3)

As the last main effect, our research questions were RQ3.1: *Is the difference in presentation performance between different levels of audience engagement moderated by public speaking anxiety?* and RQ3.2: *Is the difference in negative affective experience between different levels of audience engagement moderated by public speaking anxiety?* We hypothesized (H3.1, H3.2, H3.3) that there is a relationship between (1) public speaking anxiety and negative affective experience, (2) public speaking anxiety and presentation

performance when presenting in front of the audience whose engagement appears to be low., and (3) public speaking anxiety and presentation performance when presenting in front of the audience whose engagement appears to be high. Accordingly, we could see the relationship trend between these variables, however, we did not have enough evidence to support the hypotheses (See Table 4 for details).

Table 4

Correlations of Model Variables

`		1	2	3	4	5
1.	Presentation Performance (low-engagement condition)	—				
2.	Presentation Performance (high-engagement condition)	—	—			
3.	Public Speaking Anxiety	–.11	–.40	—		
4.	Negative Affective Experience	–.40	–.45	.49	—	
5.	Positive Affective Experience	.47	.34	–.05	—	—

Note. Correlation is not significant for any of the variables, $p > 0.05$.

First, we conducted Pearson's correlation to check for the relationship between public speaking anxiety and negative affective experience. The results showed a moderately positive correlation with a value $r = 0.49$, $p > 0.05$. This means, the higher the public speaking anxiety, the higher the negative affective experience during the presentation. However, we did not have enough evidence to support the hypothesis. Furthermore, we ran Spearman's correlation to check for the relationship between public speaking anxiety and presentation performance in low-engagement and high-engagement audience conditions. The results showed a negative correlation with a value $\rho = -.11$, $p > 0.05$ for low-engagement conditions. This means, the higher the public speaking anxiety, the lower the presentation performance in low-engagement audience conditions. Again, it is not significant despite the visible trend. Finally, the correlation between public speaking anxiety and presentation performance in the high-engagement audience condition is moderately negative with $\rho = -.04$, $p > 0.05$. This means the higher the public speaking anxiety, the lower the presentation performance in high-engagement audience conditions and despite this trend, it is still insignificant

Moderation Effect

In relation to our RQ3.1 and RQ3.2 we assumed that public speaking anxiety was acting as a moderator between low- and high-engagement conditions and affective experience in two ways. First, we hypothesised (H3.4) that the difference in presentation performance between

the low and high-engaged audience will be larger with people with high state public speaking anxiety. Accordingly, for an increase of public speaking anxiety for one raw score point, the estimated change of conditional slope between two conditions and the negative affective experience was estimated to be -0.006. This is a very small effect; the relationship between the two conditions and negative affective experience was not significantly moderated by public speaking anxiety with $t\ (11) = -0.5,\ p > 0.05$. Here, we did not have enough evidence to support the first moderation hypothesis. Second, we hypothesized (H3.5) that the difference in negative affective experience between the low and high-engagement audience condition will be larger with people with high state public speaking anxiety. The results showed that for an increase of public speaking anxiety for one raw score point, the estimated change of conditional slope between two conditions and presentation performance was estimated to be 0.23. However, with $t\ (11) = 1.1,\ p > 0.05$ we did not have enough evidence to support the second moderation hypothesis either.

Audience Engagement, Affective Experience and Presentation Performance (RQ4)

To answer our RQ4: *What is the influence of virtual audience engagement on presentation performance through the affective experience of higher education students?* we hypothesized (H4.1) first that a positive affective experience influences the difference in presentation performance between the low and high-engaged audience. First, for the positive affective experience, with $t\ (23) = 3,\ p = 0.006$ we got significant results and enough evidence to support our hypothesis. This means that with a higher positive experience score, we will expect higher predictive performance. If the positive affective experience score increases by 1 point the expected presentation performance increases by 8 points. Also, we hypothesized that a negative affective experience influences the difference in presentation performance between the low and high-engaged audience. We also got significant results here with $t\ (15) = -5.1,\ p < 0.01$. In other words, for the negative affective experience we can see that with the higher negative affective experience score, we would expect lower predictive presentation performance. Meaning, if the negative affective experience score increases by 1 point the expected presentation performance decreases by 14.7 points. See Table 5 for more.

Table 5

Linear Mixed Model results: Affective Experience and Presentation Performance

Variable	*Positive Affective Experience*			*Negative Affective Experience*		
	B	*SE*	*p*	*B*	*SE*	*p*
(Intercept)	51.6	9.67	0.001	100.9	4.97	0.001
Performance	8.07	2.66	0.006	−14.7	2.85	0.001

Discussion

In the current study, we tried to answer, among others, the research question *What is the influence of virtual audience engagement on presentation performance through the affective experience of higher education students?* We hypothesized for the main effect first that different level of virtual audience engagement has a different effect on affective experience, as such that the high-engaged audience evokes a more positive affective experience while the low-engaged audience evokes a more negative affective experience. For both, we found the results insignificant. Then, we expected that audience engagement influences presentation performance differently which was also found insignificant. Next, we hypothesised that public speaking anxiety has a relationship with (a) negative affective experience and (b) presentation performance. Here, we found that there is a relationship between these variables, even though insignificant because of the low power, and we continued further with the analysis. We expected that public speaking anxiety modifies the relationship between different levels of audience engagement and (a) negative affective experience and (b) presentation performance. Unfortunately, we did not get significant results. Finally, we expected that positive and negative affective experience influence presentation performance in two different conditions and we got significant results.

First, we got insignificant results for the effect of different levels of virtual audience engagement on affective experience. The difference between low- and high-engagement audience condition was insignificant. This is not in line with previous findings from Pertaub et al. (2002) that a negative audience evokes anxiety (negative emotion), nor with the findings from Chollet et al. (2015), that audience evokes a joyful experience. However, we should take in consideration that Chollet et al. (2015) in their study did not assess emotions directly with a specific instrument but more as felt rapport with the audience. Also, in the study from Pertaub et al. (2002) they focused only on measuring one emotion – anxiety unlike on overall affective experience like we did in the current study. The reason for the current results might be the habituation effect which means that participants accustomed to a presence of a virtual audience which decreased the influence of the audience on the affective experience (Rachman & Levitt, 1988). Finally, if we consider the effect of focused attention that can influence individuals to pay attention on other characteristics in the visual space (Suzuki & Cavanagh, 1997) we might suggest that if our participants were fully focused on the presentation task itself, they would be less affected by the virtual audience because they did not pay enough attention to the audience.

Second, we hypothesized that different levels of audience engagement would influence presentation performance differently. In other words, we expected that presenters will demonstrate lower presentation performance in front of the audience whose engagement appears to be low rather than high. For this hypothesis, the results were also insignificant. When inspecting descriptive statistics from the presentation performance results, we notice that, regardless of the condition, presentation performance results increased during the second presentation. This is important because this shows the added value of an "extra" practice in VR environment for the improvement of presentation performance as Boetje and van Ginkel (2020) suggested. However, because of this reason, we should additionally do the analysis that is controlled for learning effect to inspect further if the audience engagement affects performance differently. Furthermore, even though the result of our hypothesis is insignificant, based on the presentation performance results in our study we can still say that this is in line with findings from Batrinca et al. (2013), and Boetje and Van Ginkel (2020) that practising presentation performance in front of virtual audience improves it. However, the reason why different audience engagement did not influence presentation performance might be due to an increased self-efficacy which is someone's belief that they are capable to do the task at hand good (Bandura, 1977; as cited in Bong & Skaalvik, 2002). Additionally, a previous experience of the participants should also be considered since previous experience is found to precede self-efficacy (Bandura, 1986;1997; as cited in Bong & Skaalvik, 2002) meaning that presenters would be more confident and being less influenced by the audience if they have previous presenting experience as well as increased self-efficacy.

Third, we expected the relationship between public speaking anxiety and (a) negative affective experience and (b) presentation performance. At the end, there was a relationship between these variables, but it was not significant. This is not in line with the findings from Brown and Morrissey (2004) and Daly et al. (1989) that public speaking anxiety affects presentation performance and negative affective experience respectively. However, the main reason for this finding might be the small sample size, as mentioned before because the relationship between variables is existing even in our study. Also, we hypothesized that public speaking anxiety modifies the difference in presentation performance between low- and high-engaged audience. Here, we found insignificant results too. The reason for our finding might be the participant's ability to manage anxiety by applying cognitive and behavioral strategies such positive self-talk, deep breathing or focus on presentation performance (Roland, 1994) which can help to deliver higher performance despite feeling anxious. Furthermore, being exposed to a virtual audience was found to reduce public speaking anxiety (Anderson et al.,

2005; Stupar-Rutenfrans et al., 2017) which also might be a reason for our results. Finally, another reason for our findings might be the preparation and practice of presentation which are found to correlate with presentation performance and one's competence (Pearson et al., 2006). However, even though people with a higher level of speaking anxiety take more time in preparing their speeches and collecting more information and are negatively oriented towards public speeches (Daly et al., 1989), practising presentation is also found to reduce public speaking anxiety and increase the level of confidence of students (Bower et al., 2011).

Finally, we expected that positive and negative affective experience influence presentation performance in two different conditions and we got a significant result. This is interesting because we did not find the main effect significant. However, this is in line with our theoretical reasoning which suggests, from one side if the presenters appraise the audience positively, their positive affective experience could have an effect on performance at the end because of the effects that emotions have on learning and performance (Pekrun, 2016). On the other side, if the audience is appraised negatively, that could lead to a negative affective experience thus being detrimental to learning and performance for the same reason (Pekrun, 2016). In sum, the significant results for both negative and positive affective experience on presentation performance in two conditions indicate an important finding.

Limitations and Future Research

There are several limitations in our study that should be addressed. First, even though the PANAS scale, which we used to assess positive and negative affective experience, shows high reliability results we should consider that it is a retrospective self-reported measure. Self-report measures of emotions are widely used for measuring emotions (Pekrun & Bühner, 2014) however, we should not forget that emotions are measured after the performance has ended and as such the successful assessment would depend on how well someone can retrieve the memory of the emotions that occurred during the performance (Park & Ryu, 2019). Second, our limitation comes from the small sample size for two reasons. Due to the long duration of an experiment and complexity of the study design the recruitment of the participants was difficult. Several participants that registered did not show up at the end because this experiment required an effort to practice presentation performance and actively participate. Next, the small sample size contributed to get insignificant results in the study because linear mixed models are sensitive to small sample sizes (Baayen et al., 2008). Also, the audience manipulation in the software we used sometimes was too subtle that one could not notice that there is a difference thus this might be the reason why not everyone perceived an audience manipulation as it was. Finally, our study design was within-subject including two repeated measurements and the time

between measurements was only five minutes long thus the limitation might be the carry-over effect that within-subject design might induce (Greenwald, 1976). In our case, that means that the affective experience from the first presentation practice might still be actual at the time of measuring the second presentation practice.

Furthermore, when it comes to the measurement of presentation performance, it is important to mention as a limitation that we do not have information about the reliability of the performance results reported by the *OvationVR* software. Even though the results show the score, it is not clear how that score was built, nor if it meets the instrument's validity and reliability standards. Additionally, after the participants finished their first presentation performance, the software automatically showed the results of the performance. This means that in case their performance was lower the first time they might appraise the event negatively which could further influence their performance if we consider the effects of emotions on learning and performance (Pekrun, 2016). Future studies should consider looking for a software that is more reliable or including presentation skills development experts that could also evaluate the performance at the same time, as it was done in the study from Chollet et al. (2015).

Future research should also consider adjusting slightly study design, using a longer break between the treatments to avoid the carry-over effect that within-study design might induce. Also, one should consider expanding the study duration to a longer period, instead of having two measures only to include several presentation measurements. In addition, the audience behaviour should be more explicit for future experiments in order to achieve a stronger effect. Furthermore, to avoid a low participation rate, future studies should focus on organizing the recruitment of participants in cooperation with professors and faculties for whose subjects practising presentation would be an added value thus promoting it. The experiment should be actively promoted over a longer period as an added value for the student's growth. Finally, even though participants brought their own presentation that they used before, to avoid bias future studies should suggest that participants should make a new presentation for the study specifically to avoid the influence of previous experience since it can have an effect on the performance (Pearson et al., 2006).

Theoretical and Practical Implications

First, the main theoretical contribution of the current study is to support the suggestions from the appraisal theory of emotions and the effect that emotions can have on performance. Even though we found the main effect insignificant, we still found that affective experience has an influence on presentation performance. Second, knowing that developing presentation skills involves different factors and is a complex step, expanding the seven design principles

in developing oral presentation skills from van Ginkel et al. (2015) and including affective experience as a personal factor might be beneficial for the future design of training for presentation skills. Also, as the main implication, the added value of our research is the inclusion of the environmental factors such as low and high audience engagement to understand its influence on presentation performance at the end. This would further serve in expanding the framework for developing presentation skills (van Ginkel et al., 2015).

When it comes to practical implications, practising presentation in virtual reality and in front of a virtual audience is even before found time-saving and beneficial for students (Batrinca et al., 2013). In our case, we contribute to previous findings by introducing audience engagement as an environmental factor. Namely, if we take for example engineering studies, presentation skills are usually not included in the curricula although they are very important for the professional development of future engineers (Galindo et al., 2020). Future engineers besides mathematical and technical skills must be able to adapt and apply their skills in different fields, collaborate in an international environment and master their communication skills (Haase et al., 2013). For that reason, providing training of presentation skills in virtual reality during the study program that consider audience engagement and affective experience might be beneficial for their faster development of presentation skills.

In conclusion, to answer the research question of our study that audience engagement (low and high) influences presentation performance through affective experience (positive and negative) we can mention that even though we did not have the main effect in our study, we still see the influence of affective experience on presentation performance. This is a good start for the future research that can further contribute to building the framework for presentation skills training design and include larger sample size. Finally, developing presentation skills is a complex activity that consider environmental, behavioural and personal factors thus every small step in the research towards understanding how those factors interact would enrich the framework for building training for presentation skills development.

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Appendix A: PANAS before presentation, and after 2 presentations

We would like to know how you feel at the moment. This scale consists of a number of words that describe different feelings and emotions. Read each item and mark the appropriate box which best indicates to what extent you feel this way right now, that is, at the present moment.

Right now I feel…/During my first presentation I felt…/During my second presentation I felt…

	not at all 1	a little 2	Moderately 3	quite a bit 4	Extremely 5
interested	☐	☐	☐	☐	☐
distressed	☐	☐	☐	☐	☐
excited	☐	☐	☐	☐	☐
upset	☐	☐	☐	☐	☐
strong	☐	☐	☐	☐	☐
guilty	☐	☐	☐	☐	☐
scared	☐	☐	☐	☐	☐
hostile	☐	☐	☐	☐	☐
enthusiastic	☐	☐	☐	☐	☐
proud	☐	☐	☐	☐	☐
irritable	☐	☐	☐	☐	☐
alert	☐	☐	☐	☐	☐
ashamed	☐	☐	☐	☐	☐
inspired	☐	☐	☐	☐	☐
nervous	☐	☐	☐	☐	☐
determined	☐	☐	☐	☐	☐
attentive	☐	☐	☐	☐	☐
jittery	☐	☐	☐	☐	☐
active	☐	☐	☐	☐	☐
afraid	☐	☐	☐	☐	☐

Appendix B: Public Speaking Anxiety Scale

Now we would like to hear how do you feel towards presenting. This scale consists of a number of items that describe different feelings and emotions towards presenting.

Please, read each item and mark the appropriate box which best indicates to what extent you feel this way right now.

	not at all 1	Slightly 2	Moderately 3	Very 4	Extremely 5
Giving a speech is terrifying	☐	☐	☐	☐	☐
I am afraid that I will be at a loss for words while speaking	☐	☐	☐	☐	☐
I am nervous that I will embarrass myself in front of the audience	☐	☐	☐	☐	☐
If I make a mistake in my speech, I am unable to re-focus	☐	☐	☐	☐	☐
I am worried that my audience will think I am a bad speaker	☐	☐	☐	☐	☐
I am focused on what I am saying during my speech*	☐	☐	☐	☐	☐
I am confident when I give a speech*	☐	☐	☐	☐	☐
I feel satisfied after giving a speech*	☐	☐	☐	☐	☐
My hands shake when I give a speech	☐	☐	☐	☐	☐
I feel sick before speaking in front of a group	☐	☐	☐	☐	☐
I feel tense before giving a speech	☐	☐	☐	☐	☐
I fidget before speaking	☐	☐	☐	☐	☐
My heart pounds when I give a speech	☐	☐	☐	☐	☐
I sweat during my speech	☐	☐	☐	☐	☐
My voice trembles when I give a speech	☐	☐	☐	☐	☐
I feel relaxed while giving a speech*	☐	☐	☐	☐	☐
I do not have problems making eye contact with my audience*	☐	☐	☐	☐	☐

*Reverse-coded