Development and implementation of VR-simulated experiences to train communication skills

Hoek, K.

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PATIENT-EMBODIED VIRTUAL REALITY AS A LEARNING TOOL FOR THERAPEUTIC COMMUNICATION SKILLS AMONG ANAESTHESIOLOGISTS: A PHENOMENOLOGICAL STUDY

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Authors:

Krista Hoek
Monique van Velzen
Elise Sarton

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ABSTRACT

Objective

In medicine, training of effective therapeutic communication skills with creation of rapport is challenging, since communication is often implicitly copied from the professional environment. Therapeutic language and communication are particularly useful in preoperative setting as patients often experience preoperative anxiety. This phenomenological study describes the development of two patient-embodied virtual reality experiences designed to be used as an educational tool for training in communication for anaesthesiologists.

Method

Two patient-embodied VR experiences were developed deploying negative or positive therapeutic communication styles. The experiences were designed from a first-person patient perspective. The authors investigated the lived learning experiences of these experimental patient-embodied VR tools through semi-structured interviews with ten anaesthesiologists adapting a thematic analysis framework.

Results

Interviews revealed acknowledgement of the importance of good communication skills. Overall, participants had not followed any specific training, having learned and adapted their style of communication 'on the job'. Patient-embodied VR was effective for a full immersive experience as participants expressed to have felt as if they had been a patient. Analysis of the reflection on therapeutic communication skills before and after the patient-embodied experiences showed a shift in perception, implying effective immersive Experiential Learning.

Conclusions

This study elaborated the potency of Experiential Learning with VR in therapeutic communication in a preoperative setting. Patient-embodied VR can influence beliefs and values and demonstrated effective as an educative tool.

Practical implications

The findings of this study can contribute to further research and healthcare education programs to use Experiential Learning with patient-embodied VR.

INTRODUCTION

Anaesthesiologists are in charge of preoperative care and acknowledge the importance of communicational skills in the operating room as a cornerstone of their practice (1). In a preoperative setting, good communicational skills become particularly useful as patients often experience preoperative anxiety. Preoperative anxiety describes an adverse state of uneasiness or tension that is secondary to patient worries regarding disease, hospitalization, the planned use of anaesthesia, surgery and the unknown (2). It usually peaks during induction of anaesthesia and is associated with difficulty of induction, an increased need of hypnotic and analgesic medication, a higher risk of emergence delirium and post-traumatic stress disorder amongst others (3-5). Such outcomes, affecting patient well-being and health, gain a more central role in modern medicine and medical education. Hence, modern medicine advocates patient-centered care (PCC), with great contributions to patient reported outcomes such as satisfaction and comfort (6-8).

Nevertheless, there is no general agreement nor regulation in the educational system on how to teach and learn communication skills. Communication skills seem to be acquired 'on the job' greatly depending on implicit contextual factors rather than conventional classes or training. The question arises how to best teach and learn therapeutic communication skills and how to sensitize clinicians about its importance. We hypothesized that a real lived experience of a patient could be a useful learning experience.

In this light, we have used Virtual Reality (VR) to create experiences from the perspective of a patient, referred to as 'patient-embodied VR'. VR technology has become a promising field in modern medical skills training (9-11). This technology substitutes the real world by using a head-mounted display (HMD) that allows users to be fully immersed and experience situations from a different perspective. In virtual interactions, avatars become users' self-representation and can affect people's attitudes, behaviors in an implicit or explicit manner (12, 13) making it potentially a very effective and innovative teaching method. In this article we will elaborate:

1. how patient-embodied VR can simulate a lived experience for immersive educational purposes
2. how we developed two patient-embodied experiences with positive or negative communication styles
3. how patient-embodied experiences may influence believes and attitudes of anaesthesiologists towards therapeutic communication.

METHODS

This prospective exploratory research was carried out at the Leiden University Medical Center (LUMC, Leiden, the Netherlands), a large tertiary academic teaching hospital. The protocol was approved by the Institutional Science Committee and received a certificate of no rejection from the Institutional Review Ethics Committee. Personal data protection and obtaining consent forms from research participants was obtained prior to study start. Data was collected and recorded between February 2019 to February 2020. Participants received no financial compensation.

Conceptual framework

Therapeutic language and communication can be defined as the process of exchanging ideas, thoughts and knowledge between a physician and a patient with the objective to guide a patient's internal and behavioral state towards an anxiety-neutral position (14-18). *Empathy* and *rapport* are two main elements of effective therapeutic language and communication (7, 8). *Empathy* requires the ability to understand and identify another person's internal state, including their emotions and motivations (19). Creating *rapport*, which is the process of establishing a 'connection', relates to collaboration and parity between patient and physician (20).

The conventional approach of 'See one, do one, teach one' lacks a multi-faceted approach needed for the development of these skills (21) and has limited impact on how well physicians communicate with their patients (22). Physicians' communication skills appear to be copied from their professional environment as a "hidden curriculum", rather than explicitly being taught in medical education classes (23). Hitherto, how well physicians communicate seems to be dependent on the specific context by which these skills are required and can be reproduced (24). This concords with the connectionist framework where one may learn through experience (25).

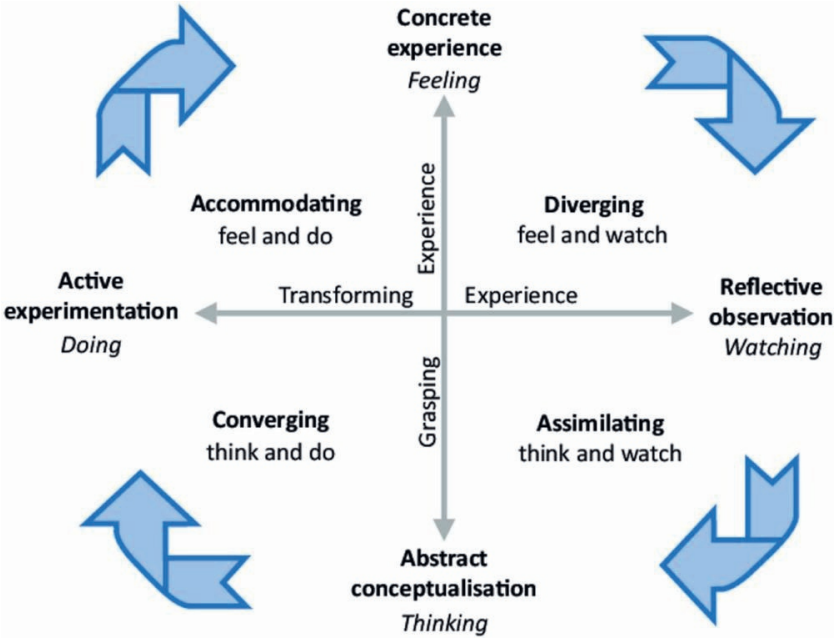

Figure 1. Kolb's Experiential Learning Cycle.

In particular, Kolb's experiential learning cycle describes the internal cognitive processes required to develop new skills and may provide a framework on how to teach and learn therapeutic language and communication (26).

As shown in **Figure 1**, in the four-stage model, a learner must first encounter a concrete experience which may shed light on a certain concept. Next, the learner can reflect on the new experience, conceptualize the experience, and finally actively experiment with newly created or modified concepts. For instance, doctors who became patients due to illnesses were able to gain the perspective of being a patient which consequently increased their sensitivity to patient experience and fostered empathy in their subsequent professional interactions with patients (27-29).

Not every healthcare professional will experience what it feels like to become a patient. Patient-embodied VR can generate an innovative possibility to provide a concrete immersive experience as a patient. This can affect attitudes and beliefs of healthcare providers through the *Proteus effect*. The *Proteus effect* describes the phenomenon where the avatar becomes users' self-representation. In our case, a healthcare providers (user) becomes a patient (avatar). We have hypothesized it can substitute the first phase of the concrete experience of Kolb's learning cycle. In VR, embodiment can increase users' engagement and provide emotional fidelity invoking a sense of *presence* creating realistic emotional and neurocognitive responses (12, 13, 30).

Study design

In this study we have used a phenomenological approach, i.e. understanding the meaning of a lived experience (31). The phenomenon studied here is a VR experience through the perspective of a patient who is prepared to undergo general anaesthesia and surgery, using two different communication styles. We will describe how we developed the patient-embodied VR experiences and how they may add richness through immersive learning. We have conducted semi-structured interviews with anaesthesiologists that underwent the VR experiences to further substantiate the potential of patient-embodied VR and how it can be used as a learning tool.

Patient-embodied VR experience

We have created a patient journey map of a patient who would undergo elective general anaesthesia and surgery. The patient was brought to the preoperative holding area. Standard preoperative procedures were performed and an intravenous cannula was inserted. Preoperative control questions were asked while the patient would wait in a hospital bed before taken to the operating room. An anaesthesiologist would take the patient to the operating room where the journey would end after the last checks with the medical team were effectuated and anaesthetic drugs were given to induce general anaesthesia as shown in **Figure 2**.

For this study, two scripts for patient-embodied VR experiences were written. One experience would display current practice. This experience contained more negative communication styles with limited therapeutic communication skills. For instance, the Preoperative Holding Area Nurse would stand next to the patient while engaging communication with the patient as shown in **Figure 3a** [8]. She would use some negative verbal suggestions such as 'this needle is going to hurt' before needle insertion (32). In the background, other healthcare providers would not salute the patient as the patient entered the preoperative holding area as shown in **Figure 3b** (33). This version would show signs of nonverbal behaviors suggesting the healthcare professionals were in a hurry, paying little attention to the patient with little empathy and/or rapport (7). All adverse effects of medication were also specified ("this medication will sting, and this could hurt a little") (32).

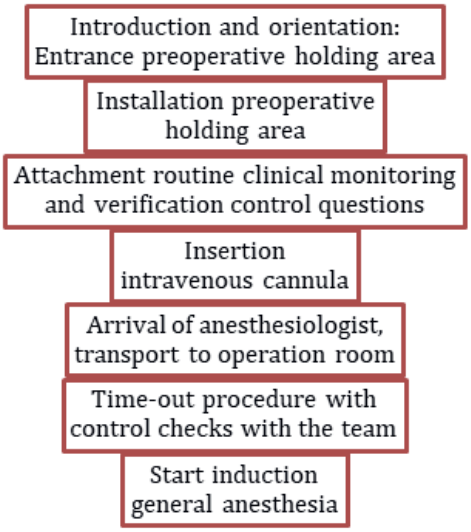

Figure 2. Structure patient-embodied VR experience.

A second version focused on more positive therapeutic communication; for example, asking "are you warm enough" instead of asking if a patient was feeling cold. This version included the use of hypnotic language and patient-centered talking styles to comfort the patient and promote the patient's endogenous ability to reduce pain and stress (34, 35). Nonverbal behaviors were also modified (33, 36). For instance, healthcare professionals would sit next to the patient and make eye contact to confirm they connected and paid attention to the needs of the patient (rapport) as shown in **Figure 3.b**.

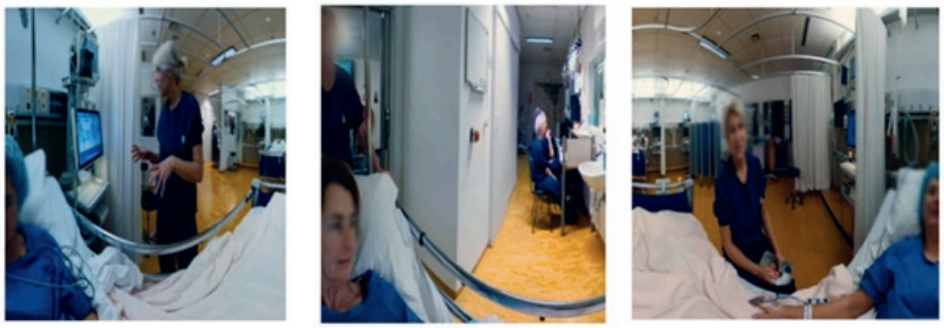

Figure 3. A: (left) Preoperative Holding Area nurse stands next to the patient. 3B (middle): Health care professionals don't salute the patient as she enters the preoperative holding area. 3 C: (right) Preoperative Holding Area Nurse sits next to the patient to ask preoperative questions (identity, known allergies).

Nevertheless, the two versions would only differ slightly, avoiding exaggerated behavior or communicative styles. They would display the same procedures, total duration and actors with only modest adaptations. The negative version would display regular care, with

Figure 4. Example of subtle differences between VR experiences where a HCP needs to rapidly bring blood to the OR for another (bleeding) patient. 4 A (left): positive experience: OR nurse provides no additional information, smiles politely to the patient. 4B: (right): negative experience: OR nurse expresses that he is in a hurry to bring blood, preoperative nurse is concerned.

examples inspired by reality. The positive version displayed an example of how reality could also look like, as a reachable alternative as shown in **Figure 4.**

Differences in attitudes, word choice and behaviors were based on several studies on rapport building and therapeutic language, all combined for these videos (7, 8, 18, 32-35, 37-40). The scripts were validated by two anaesthesiologist-hypnotherapists, with one amongst them independent of the research team.

The patient-embodied VR experiences were filmed with a 360° camera from the perspective of the patient. They were shown to the participants with an Oculus-Go® head mounted device.

Participants and procedures

Anaesthesiologists and residents in anaesthesiology were invited to participate in the study. They were recruited via email or phone between November 2020 and February 2021. Their participation consisted of a semi-structured interview before and after viewing the patient- embodied VR experiences as shown in **Figure 5**. The participants did not contribute to developing the patient-embodied VR experiences, nor did they know its contents beforehand. We chose to show the negative version first, as it displayed current practice.

During the first introductory part of the interview, participants were questioned about their current communication techniques, skills and training. Participants were asked how they perceive patient's preoperative anxiety in general, what they assume the causes and effects are, and how they manage it. General introductory questions were followed up with more in-depth core questions where participants were invited to give personal clinical examples to illustrate and elaborate their answers. The interview was designed to take up to 30 min.

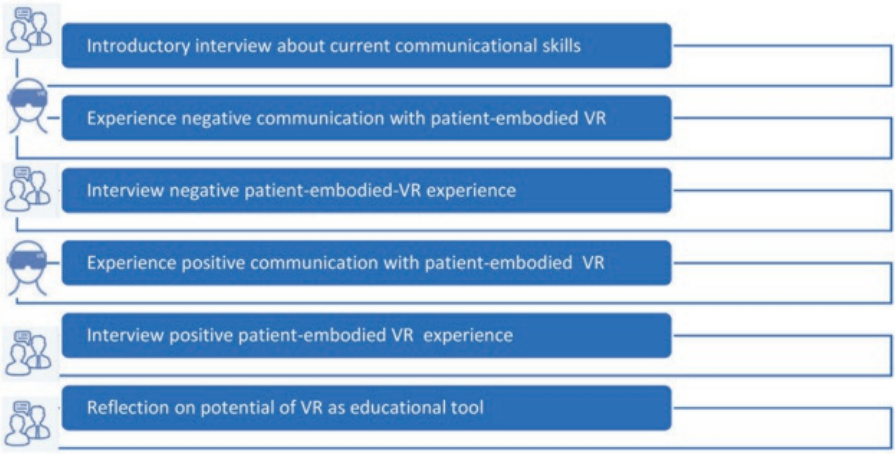

Figure 5. Structure study participation anaesthesiologists.

Next, participants were invited to engage the negative patient- embodied VR experience without being informed about its content beforehand. After completion, participants were asked to describe how they felt during the experience. This part of the interview had a flexible structure where the participant could elaborate on self-reported topics. Detailing questions were asked depending on participants responses. This part was designed to take between 15 and 30 min.

Subsequently, participants were invited to engage the positive patient-embodied VR experience. In a similar manner as the negative experience, participants were asked to describe how they felt during the positive experience. The interview was designed to take between 15 and 30 min.

In the final reflective part of the study, follow up questions could be used to provide further clarification if needed. The participants were asked to compare the negative and positive experience. Did they perceive differences and how did those differences change the clinical encounter? How did the patient-embodied VR experiences affect them and how could they be used as an educational tool. This last part of the interview was designed to take up to 20 min.

Data analysis

Semi-structured interviews were conducted to explore how patient- embodied VR was experienced and how it can be a learning tool in therapeutic communicational skills. Data were retrieved until theme saturation, that is until the researcher was empirically confident a category was saturated, and additional data would not lead to any new emergent input (41, 42).

The interviews were analyzed using an applied thematic analysis with an inductive process, based on the six phases of thematic analysis outlined by Braun and Clarke: data familiarization, code generation, theme development, theme revision, theme definition and report production. A codebook was created as themes were developed by two coders separately before they were discussed together until consensus was reached (43). The analysis continued with the clustering of codes into categories, and then structured and grouped to overarching themes. The final validation of codes against data extracts was undertaken by a third researcher to ensure the consistent representation of categories and themes of the entire data set.

RESULTS

Sample characteristics

Ten anaesthesiology staff members and residents in anaesthesiology participated in the patient-embodied VR experiences and one of the researcher conducted semi-structured interviews until data saturation was obtained. Six (60%) participants were staff members and four (40%) were residents. Five (50%) were female. Demographics are shown in Table 1.

Table 1. Demographic characteristics of the VR development team and study participants.

Participants (10)	Years in practice staff members:	
	5–10 years	5
	> 10 years	5
	Sex:	
	Male	5
	Female	5
	Clinical role	
	Resident	4
	Staff member	6

Qualitative findings of semi-structured interviews

Analysis of the transcriptions resulted in the identification of five major themes. First, perceptions of therapeutic communication before patient-embodied VR are described, followed by the VR experiences and final reflection. Verbatim quotations from the transcripts are included to support themes which emerged from the data. Quotations have been translated from Dutch to English and grammatical structure has been left unchanged for the sake of authenticity.

Perceptions of preoperative anxiety and therapeutic communication before the patient-embodied VR experiences

Participants globally agreed in presumed causes of preoperative anxiety varying between the surroundings of the OR, the fear for the unknown and the more technical aspects of the procedures. Most of the participants indicated that they could recognize preoperative anxiety by observing verbal and nonverbal signs. All participants stated the importance of providing information e.g., answering questions, explaining the procedure, explaining the risks that may come along. Many participants asked questions to their patients and adapted their approach and attitude depending on the patients' answers. They sought to make a connection with their patients by standing close to them, looking them in the eyes, or assuring if the patient wants to proceed with the surgery. None of the staff anaesthesiologists mentioned having received a particular training in communicational skills to comfort a patient. One resident mentioned having classes during medical stud-

ies, however these classes did not contain specific therapeutic linguistic features. An overview with subthemes and verbatim quotations can be found in **Tables 2–6**.

Table 2. Themes and sub-themes

Themes	Subthemes
Presumed causes and effects of preoperative anxiety	Surroundings of the OR Fear for the unknown, the anesthesia, the surgical procedure Information provision Approach Effects of preoperative anxiety on induction, postoperative anxiety and pain, trauma
Recognition of preoperative anxiety	Non verbal signs Verbal signs
Current handling with preoperative anxiety	Information/ elucidate Medication Approach /Personalization
Current training and feedback	Current education concerning therapeutic communication Feedback from staff members Feedback from residents Feedback from patients
VR embodied experience	Negative VR experience Positive VR experience

Table 3. Presumed causes and effects of preoperative anxiety

Surroundings of the OR	"I think the OR, you open a door to another world, people look different, they have other clothes, a mask, there is a lot of medical equipment (5) It's all very impersonal, the holding area especially. We discuss quite some personal and sensitive information where there's not much room voor privacy" (4)
Fear for the unknown, the anesthesia, the surgical procedure	If I would be a patient I would want to know what is going to happen. And also what would be the solution if something happens not the way it's supposed to" (7) "You literally give your live in the hands of someone else, a complete stranger (they don't know me at all!)" (4)
Approach	"I think the team. It matters a lot what team is there, how relaxed or stressed they are." (2)
Effects during anesthesia and recovery	"Stress may be harmful for a patient with heart failure. Being able to reduce stress has therefore a direct function on patient safety." (3) "You can see that when a patient is very wild during the induction they are very fidgety when they wake up." (8) "When a patient is stressed, this effects the autonomous nervous system so the wellbeing…. The more high you start, the lower you fall. So in these regards its medically better if the patient is relaxed when they undergo anesthesia." (8)

Table 4. Recognition of preoperative anxiety

Verbal signs	"Some people when they are nervous they start to talk a lot, to raddle." (2) "You can see it and notice it, often they also express it and say they are afraid." (1)
Non verbal signs	"Facial expressions. Or, even though they say they are calm, their vital parameters tell me otherwise." (1) "I can see it in their eyes. And I appoint it". "I can hardly to anything against the stress if they say they are not stressed. But often it's stress" (2)

Table 5. Current handling with preoperative anxiety

Information	"I ask what they are afraid for. If they are afraid to die, which is often during a high risk procedure, I can hardly say this will not happen because the risk does exist." (1) "I explain we will do our best and make sure the patient wakes up." (8) "Explanation. Every step we take, what we do. Like that. It's like a standard talk you give." (4) "Some information is relevant. Some information is more destined to colleagues. You may rather say "I expect a little blood loss" instead of "I expect 200cc blood loss".(8) "I always tell opiates may cause nausea, dizziness, giddiness. Some things may hurt." (5)
	"I try to explain we really need it. And you can hardly avoid it, I do some tricks to ease. Like: ' Oh, you can say it when it hurts' , and then I check if it's better. But I'm not sure that if you don't say beforehand something is going to hurt it will hurt less." (5)
	"I present myself, tell the patient we'll take good care of him, then we speak with the team members before we start our anesthesia induction. It's a very short moment, and however they will, they will fall asleep anyway." (1)
	"If you're going to hurt someone, and you don't tell them beforehand, I don't think that's fair." (5)
Approach Personalization	"What I always do, consciously, is that I stand very close to the patient to really make contact. Make that connection." (5)
	"I always say: "If you don't want to do this, you don't have to, right?!". (4)
	"I will tell them. "I see your heart rhythm shows you're anxious, but that's not an issue". Or I will take their hand, sometimes you don't need to talk I try to level with a patient, make eye contact, not from a higher position, really look him in the eyes and tell we're gonna take good care of you." (7)
	"I believe the approach is the most important. People feel safe when they are approached in the right way." (3)
	"When they have to sleep, they will sleep. I'm not, just because they are afraid going to change my ways. Expect of course by guiding them." (1)
	"I just take my time. I sit beside the bed, even if it's 6hr30 in the morning or in the middle of the night. I don't care. Especially when I notice someone is afraid, I try to explain what is realistic about this fear and what isn't." (6)
	"I explain this is our comfort zone, this is what we do and where we feel passionate about." (5)
	"I know what suggestive questions are. Like: ' You're not in pain right'? No, you should ask: Are you in pain?" (6)
Medication	"Using medication. It's not always prescribed so I think this is where we may gain something." (8)

Table 6. Current training and feedback

Current training	"We don't really get classes in communication skills. In the OR I'm not really consciously using any special techniques." (7)
	"No, nothing during my studies. I think you kinda need to have it 'in you'…" (6)
	"I think we learn more during our practice." (7)
	"So no, we don't get any classes. So in the OR I'm not very aware of a particular communication technique I would like to use. I don't really apply any tools in the OR."(7)
	"I've had classes in communication, but never since my studies." (2)
Feedback	"Be interested in the patient. Make sure there is calmness in the OR." (4)
	"Well, you don't see your patients after surgery. When they go to sleep being relaxed they also wake up relaxed. But how patients really see or experience this we never here." (7)
	"We work very individually, making it hard to give each other feedback. Sometimes we accompany a resident, but we don't really give feedback. And of direct colleagues I never see how they communicate" (6)

Table 6. Current training and feedback (*continued*)

Feedback	"Yes, that's a good one. No we don't really have a method for this, to give each other feedback." (8)
	"Yes, well it's kind of part of our job. If someone says something very upsetting to the patient, I would definitely say something." (5)

Discussion of the negative patient-embodied VR experience

Participants saw the negative VR experience first. Eight of the participants spoke in the first person while reflecting on the video:

> *"This team was very distant. I don't think I would have gone easily to sleep. No, I don't think any trust is created here." (7)*

In the negative video all participants experienced distance. Three noticed they felt scared, three noted they felt uncomfortable, three explicitly noted a lack of empathy within the medical team. Five participants did not feel 'seen' as a patient with needs and insecurity. One participant said the following:

> *"This team was so distant. I don't think I would have gone under anaesthesia." (7)*

Another participant wanted to call off the surgery: "I almost have the urge to, in this situation, to just go home. Thinking no one listens to me, everyone is doing something else.

> *"Yes, I don't feel safe." (6)*

Participants agreed that aspects of the video were realistic and could have happened in real life.

> *"I recognize a lot of things, (….), The empathic capacity of all parties is very mediocre. They should imagine themselves this is a very special day for me (…), something important is going to happen to me and my bodily integrity." (8)*

An overview with subthemes and verbatim quotations can be found in **Table 7.**

Table 7. VR experience

Negative experience	"This team was very distant. I don't think I would have gone easily to sleep. No, I don't think any trust is created here." (7)
	"It's very impersonal, patients are ignored, a lot of things go wrong." (1)
	"I almost have the urge to, in this situation, to just go home. Thinking no one listens to me, everyone is doing something else. Yes, I don't feel safe." (6) "I recognize a lot of things, (….), The empathic capacity of all parties is very mediocre. .. They should imagine themselves this is a very special day for me (…), something important is going to happen to me and my corporal integrity." (8)

Table 7. VR experience (*continued*)

Negative experience	"I felt very uncomfortable and embarrassed. I also felt like there was no time." (3)
	"This team was so distant. I don't think I would have gone under anesthesia." (7)
	"It felt like you're a production number. Oh, here is a new knee, and this one is for me." (5)
	"They should imagine more that for me this is a special day, that I'm getting all these new impressions and something is going to happen with my physical integrity. That's what's really lacking here. More empathy and compassion." (8)
Positive experience	"There was more calmness, more friendliness. (…) Everyone had attention for the patient." (3)
	"A lot more calm (…) There was clearly a 'information hygiene', this is how it should be done. Friendly, polite, empathic, calm." (8)
	"This felt more relaxed. Yes, absolutely a good feeling. Much better." (4)
	"I was more relaxed. I felt heard and informed. You know what's happening, these persons around me are important. (…) People make contact with me, less noise." (1)
	"They made me feel like I was in good hands." (2)
	"It was more calmer, you felt seen, there was more attention. I think sadly in our daily practice we should do more things." (5)
	"An oasis. Much better, but better relaxation. A world of difference." (8)
	"Much different. They answered questions, there was distraction when the IV was put in, they made contact with me." (2)
	"Yes, this was very relaxing. It felt so good." (5)
	"This was a 180 degrees turn, it was more calm. How people moved, but also the alarms were turned off. More friendliness, being polite to the patient. Like sitting next to the patient instead behind her. There was a hygiene in what information was given to the patient. This is how it should be." (8)

Discussion of the positive patient-embodied VR experience

Participants saw the positive VR experience after they reflected on the negative VR experience. Seven of the participants spoke in the first person while describing the video:

"They made me feel like I was in good hands." (2)

All participants reacted positively on the style of communication in this video. All participants agreed this version to be much more relaxing:

"There was more calmness, more friendliness. (…) Everyone had attention for the patient." (3)

"An oasis. Much better, but better relaxation. A world of difference." (8)

The majority of the participants expressed positive feelings and emotions. Two participants stated they wished their own handling would be more like this positive experience:

"It was calmer, you felt seen, there was more attention. I think sadly in our daily practice we should do things more like this." (5)

One participant did say the style of communication not to be theirs but added this style to be more relaxing. One of the participants expressed this style to be nice but noted it would become 'strange' if exaggerated.

An overview with subthemes and verbatim quotations can be found in **Table 8.**

Table 8. Response to positive experience

Calm/Relax	"A lot more calm (...) There was clearly a 'information hygiene', this is how it should be done. Friendly, polite, empathic, calm."(8) "This felt more relaxed. Yes, absolutely a good feeling. Much better."(4) "I was more relaxed. I felt heard and informed. You know what's happening, these persons around me are important. (...) People make contact with me, less noise."(1) "There was more calmness, more friendliness. (...) Everyone had attention for the patient."(3) "An oasis. Much better, but better relaxation. A world of difference."(8) "Yes, this was very relaxing. It felt so good."(5)
Professional trust	"They made me feel like I was in good hands."(2) "Much different. They answered questions, there was distraction when the IV was put in, they made contact with me."(2) "This was a 180 degrees turn, it was more calm. How people moved, but also the alarms were turned off. More friendliness, being polite to the patient. Like sitting next to the patient instead behind her. There was a hygiene in what information was given to the patient. This is how it should be."(8)

Reflection by participants

Participants were invited to compare the two VR experiences and reflect on how they were affected by them. All participants were able to note differences between the experiences. They agreed the experiences to be realistic, seven participants explicitly said the positive VR experience was more the method they would prefer.

> *"This was 180 degrees turn, more calm. How people moved, but also the alarms were turned off. This is how it should be." (8)*

Four participants noted their body responded to the VR experiences. They noted that their body had reacted to the two videos in a different way:

> *"I felt it. I felt a lot more relaxed". (1)*

A majority of the participants reflected that the videos permitted to see a change in the style of communication and how this affected them, if they would have been a patient:

> *"I question now, it is true that children who go to sleep while they are fighting, also wake up like this, this may also really feel the same for adults." (1)*

"I really believe the communication styles of the video's matter for the lived experience of the patient". (2)

Four participants specifically suggested the use of patient-embodied VR and the training or use of communication skills to be useful:

"I think we should start training people like this. Especially because there are people who don't have affinity with this subject, or people who still have a lot to learn. Especially in the OR, this is very important" (3).

"Sometimes we're thinking about a next patient. But we have to really be aware. Awareness is very good, especially using these kinds of videos. It's a way to create awareness." (9)

Many participants reacted in a positive way on VR to be used in an educational purpose. Learning in a practical way was preferred by a majority of the participants:

"I think we can learn more while doing it". (7)

DISCUSSION AND CONCLUSION

Discussion

With our study we elaborated on how VR can simulate a lived experience in a preoperative setting. Adapting Kolb's Experiential Learning Cycle, embodied VR offers an innovative possibility to provide a concrete experience not easily available in real life. Patient-embodied VR can therefore simulate Kolb's diverging phase to 'Feel and Watch' and its assimilating phase to 'Think and Watch' as shown in **Figure 6**.

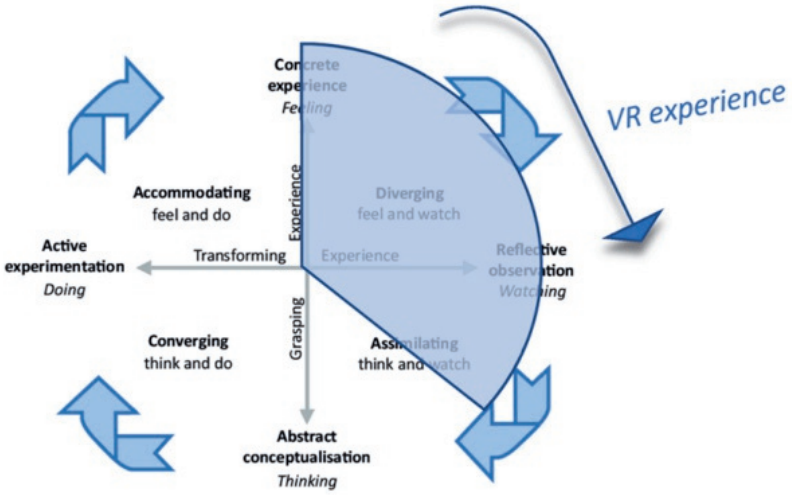

Figure 6. Patient-embodied VR may simulate the first two diverging and assimilating phases: 'Feel and Watch', 'Think and Watch'.

To create the sense of *presence*, immersive storytelling with VR offered an experience where participants could create their own story. For this purpose, the 360^0 VR tools included several actions happening around the patient. Indeed, our VR tool was able to simulate a lived experience in a preoperative setting implying internal validity of our study. Participants reported their lived experiences from a first-person perspective and explained how they had felt a change in their own body.

Finally, we've conducted semi-structured interviews to substantiate how our VR tool may influence the beliefs and opinions of anaesthesiologists. The immersion of the reality of a patient created a shift in perception and understanding of the participants. During the reflective phase of the interviews many participants noted positive effects of therapeutic communication and suggested the start or use of training of these skills. The use of narrative-based medicine had been put into practice contributing to a better understanding of physician's role in communication and handling of preoperative anxiety. The results of our study congruent with other studies that demonstrated that VR affects crucial transformation memory processes (10, 11). The interviews permitted Kolb's second phase of *reflective observation* as shown in **Figure 7.**

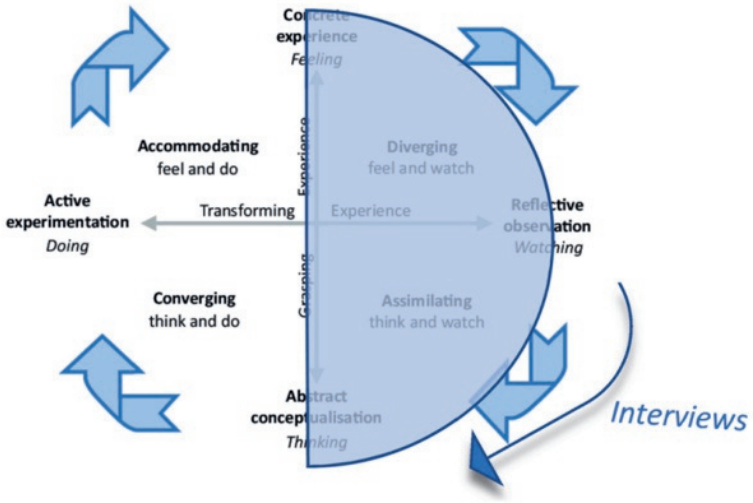

Figure 7. Reflecting during semi-structured interviews may simulate 'Abstract conceptualization'.

Elements indicating generalisability were the concordance of study data concerning preexisting knowledge and beliefs of preoperative anxiety, on communicational skills, and training. Participants seemed to give great importance to the reduction of preoperative anxiety as they all pointed out one or more negative clinical effects of it. Causes and effects cited by the participants accord with previous research concerning preoperative anxiety and rapport-making between healthcare providers and patients (2-5, 44-46).

Likewise, participants elaborated how they would read verbal and non-verbal signs of the patients to be able to adapt their personal approach. They pointed out how distance could occur, especially when they are busy. This concords with other studies in a broader medical context that have already shown patients reporting dissatisfaction derived from a lack of rapport or empathy exhibited by physicians, which often resulted from work exhaustion and the medical culture's emphasis on 'distance', professionalism (47).

Implicatively, participants did suggest the importance of *connection* with their patients. However, specific knowledge and skills on the creation of rapport and other aspects of therapeutic language and communication lacked amongst the participants. Moreover, specific teaching or training in therapeutic communication was insufficient as participants reported no specific courses or methods, nor standardized evaluations or feedback by patients or colleagues. These findings confirm earlier research such as the work of Lave and Wenger as well as Billet who describe how professional acculturation occurs through social processes of on-the-job or situated learning within the workplace sometimes called the 'hidden curriculum' (23, 48-50). It outlines how VR can be used as an educational tool to create awareness and intrinsic motivation to learn more about therapeutic language

and communication. This is in line with studies demonstrating the feasibility of VR to train soft skills and communication in medical education (51, 52).

One limitation of the study might be the interviewing of anaesthesiologists of only one hospital, as clinical setting and contextual factors may differ in another hospital or country. Another limitation might be a certain selection bias as study participation was voluntary, However, we estimate little bias as participants knew very little about the objectives of the interview, they knew nothing of the content of the VR experiences.

CONCLUSION

In conclusion this study elaborated the potency of Experiential Learning with VR in therapeutic communication in a perioperative setting. The patient-embodied VR experiences were experienced by anaesthesiologist participants as if they had been a patient, a setting rarely possible in a real life. Semi-structured interviews revealed that participants were able to distinguish the subtle changes in communication and language. Furthermore, participants have the same knowledge and believes of preoperative anxiety as known in literature. The latter suggests external validity despite a modest sample size.

Analysis of the reflection on therapeutic communication skills before and after the patient-embodied experience showed a shift in perception, implying effective immersive Experiential Learning. As *rapport* is a corner stone of clinical interactions, we believe this methodology may be particularly relevant for stakeholders seeking to improve patient-centered care through therapeutic communication. Patient-embodied VR might be an effective educative tool that can be used in training in therapeutic communication skills.

PRACTICE IMPLICATIONS

The methodology using a VR-embodied experience may indeed be used in a broader context in medical education where 'becoming a patient' is relevant, but difficult to elaborate. In the last decade it has successfully been developed in psychiatry and geriatrics to train healthcare providers to communicate with patients with whom communication is challenging (53, 54).

Earlier research outlined the need of more research on VR implementation in health profession education (9). This research may contribute to fill in this gap of consistent knowledge on how to use VR in medical education as it gives a rich description on the design, development and potential of our VR tool.

However, in our study set-up, not all phases of Kolb's learning cycle were completed. One still needs to converge (*think and do)* and accommodate (*feel and do)*. Further research with these elements is needed to evaluate the effects of the implementation of a training in therapeutic communication with an integrated patient-embodied VR experience.

Research should also examine how these experiences might affect future patient interactions and patient outcomes, including assessing whether training healthcare professionals using a patient-embodied VR approach could lead to subsequent reduction in patient-reported pre- operative anxiety and improved communicational skills.

COMPETING INTERESTS

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Author contributions

Krista Hoek: Conceptualization, Methodology, Software. Formal analysis, Investigation, Data curation, Writing – original draft, Writing – review & editing, Visualization, Project administration.

Elise Sarton: Conceptualization, Methodology, Formal analysis, Supervision, Validation.

Monique Van Velzen: Conceptualization, Data curation, Supervision, Project administration.

DECLARATION OF COMPETING INTEREST

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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