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Abstract

Background

Shifting towards patient-centeredness, medical doctors need patient-centred communication skills. Motivational Interviewing (MI) is an evidence-based, collaborative, goal-oriented communication technique to strengthen a person's own motivation and commitment to change. The purpose of this study is to evaluate the effectiveness of a brief virtual role-play MI-training program on MI-knowledge and skills in first-year undergraduate medical students, making use of both a pre-test and a then-test (retrospective pre-test) to check for response shift in evaluating the educational intervention.

Methods

Four 10-15 minute MI-game-based training conversations embedded in the Kognito Conversation Platform™ were offered to the students using a single-group Interrupted Time Series design.

Results

Participants included 339 undergraduate medical students (RR= 83.1%). The one-hour MI virtual training proved effective in two ways: participants gained knowledge and skills, and increased awareness of the existing intrinsic knowledge and skill they already possess to communicate with future patients in a patient-centred way.

Conclusion and

A brief one-hour MI-training simulation can be effective even if offered at an early stage during medical education. Furthermore, response shift varied and was not present in all students.

Practice Implication

The addition of a then-test to the study design reveals results that otherwise would not have been found.

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Effectiveness of a minimal virtual motivational interviewing training for first years medical students: differentiating between pre-test and then-test

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ABSTRACT

Background: Shifting towards patient-centeredness, medical doctors need patient-centered communication skills. Motivational Interviewing (MI) is an evidence-based, collaborative, goal-oriented communication technique to strengthen a person's own motivation and commitment to change. The purpose of this study is to evaluate the effectiveness of a brief virtual role-play MI-training program on MI-knowledge and skills in first-year undergraduate medical students, making use of both a pre-test and a then-test (retrospective pre-test) to check for response shift in evaluating the educational intervention.
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Results: Participants included 339 undergraduate medical students (RR= 83.1%). The one-hour MI virtual training proved effective in two ways: participants gained knowledge and skills, and increased awareness of the existing intrinsic knowledge and skill they already possess to communicate with future patients in a patient-centered way.
Conclusion: A brief one-hour MI-training simulation can be effective even if offered at an early stage during medical education. Furthermore, response shift varied and was not present in all students.
Practice Implication: The addition of a then-test to the study design reveals results that otherwise would not have been found.

1. Introduction

Today's medical standards are strongly moving from paternalistic toward patient-centered patient-doctor relationships [1]. As a consequence, today's patients are increasingly expected to self-manage their health and illness, and prevent disease [2]. As such, medical doctors need patient-centered counseling skills to communicate with patients about their life-style factor related concerns, (unhealthy behaviors and health behavior change), to guide them in making healthy lifestyle changes [1,2]. Given the importance of healthy behaviors, the self-management of medical disorders, and the impact that sound communication skills of healthcare providers can have on health [3], teaching Motivational Interviewing (MI) as a technique to communicate with patients about unhealthy behaviors and behavior change might be essential in the context of the medical interview.

1.1. Motivational Interviewing (MI)

MI is a collaborative goal-oriented style of communication that blends patient-centered counseling skills (e.g. open questions, reflections) with strategies or techniques that directly elicit patient's motivations for change and commitment to a behavior change plan [2,4]. Thus, it creates an opportunity for medical practitioners to help patients explore and resolve ambivalence towards changing unhealthy behaviors, and reduces patient resistance by eliciting and exploring the person's own reasons for change in an accepting and

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compassionate environment [4]. MI has gained empirical support of its effectiveness in offering the clinician opportunities to engage the patient to change their unhealthy behaviors, instead of enforcing change, or advising, which have shown to increase resistance [1,5]. Even brief MI-led medical conversations have proven effective for constructively addressing health behavior change [1]. Furthermore, there is evidence that a short MI-training can have a significant impact on medical students' confidence, and knowledge and skills, to effectively addressing behavior change in the medical interview in the future, supporting the integration of such a training in medical student education programs [1,4,5].

1.2. Serious games

A promising method to implementing MI-training into medical education is through using digital role-play interventions. Some of these serious games, which are games that are designed for a primary purpose other than entertainment, e.g. education, are specifically designed to build MI knowledge and skills in healthcare providers, preparing them for future collaborative patient-doctor conversations [3,6]. These serious games are intended to provide experiential learning with a focus on knowledge acquisition and skills development, and offer the possibility to teach and learn via a patient-centered way [6,7]. In addition, they offer a risk-free practice environment and minimize the anxiety and discomfort participants often experience when live role-playing in a workshop setting [3,7]. Using serious games in medical undergraduate education has proven effective [6,8,9], and offers an opportunity to increase standardization of the content in teaching sessions [3,6]. Furthermore, previous work has shown that students perceive digital learning as more interactive and engaging compared to traditional learning methods, offering them a higher degree of autonomy and independence in their learning [6]. Despite this, Gecht-Silver and colleagues (2016) reported a small overall decrease in student-rated importance of and commitment to the use of MI approaches. However, they argue that this might be due to overrated self-assessment at the pre-test [2].

1.3. Response shift

Changes in subjective beliefs after interventions are mostly measured by means of the prospective baseline and follow-up design, which is noted as pre-test-post-test design [10,11], assuming that the internalized perception of one's own abilities in relation to various dimensions does not change during this interval, but has a stability in itself [12]. However, this measurement design can lead to some problems or biases, especially if the standard of measurement changes between pre-test and post-test score. This change of internal standards to benchmark one´s own performance due to learning, IS known as response shift, and can lead to differences in ratings in addition to the actual changes [13–15].

1.4. Retrospective test

The extension of the traditional pre-test-post-test design by adding a so-called "thentest" that assesses past performance retrospectively, allows a more detailed consideration of the prevalent invalidity, RISKING MEASURING ERRORS DUE TO RESPONSE SHIFT [12,16,17]. In this case, in addition to the conventional post-test assessment, respondents are asked to complete a renewed judgment of their pre-test functioning. The design is characterized by the fact that post-test sessions entail two-time item query: First, the respondent's personal perception of the current skills and knowledge after the intervention is assessed (post). Subsequently, based on the identical items, the then-test assesses which perception the respondent has retrospectively of their abilities [18]. One assumption of this design is that by taking the post-test and then-test in close proximity, the content of respondent's underlying cognitive processes will be stable [14]. Therefore, the two scores would eliminate intervention-induced response shift and provide an unfounded assessment of the intervention effect [14,16,19].

Building on this evidence, this study examined (1) the SELF-PERCEIVED effectiveness of computer-simulated virtual human role-play conversations for practicing MI techniques in undergraduate, first year medical students in at a university medical center in Germany with regard to improving MI-knowledge and skills, (2) making use of both, a pre-test and a then-test in evaluating the educational intervention.

2. Methods

2.1. Study sample and design

All undergraduate medical students that took a first year's course in medical patient-doctor communication in 2018 at the University Medical Center of Göttingen (UMG), Germany were invited to participate in the study, either during the wintersemester or the summersemester, since German universities run two semesters. A single-group Interrupted Time Series (ITS) design [20], was used to control for several potential biases, such as possible confounds due to group differences, and history [21]. Outcomes were measured before and after the intervention at two different time-points in 2018, during the winter semester (February & March), and during the summer semester (July & September).

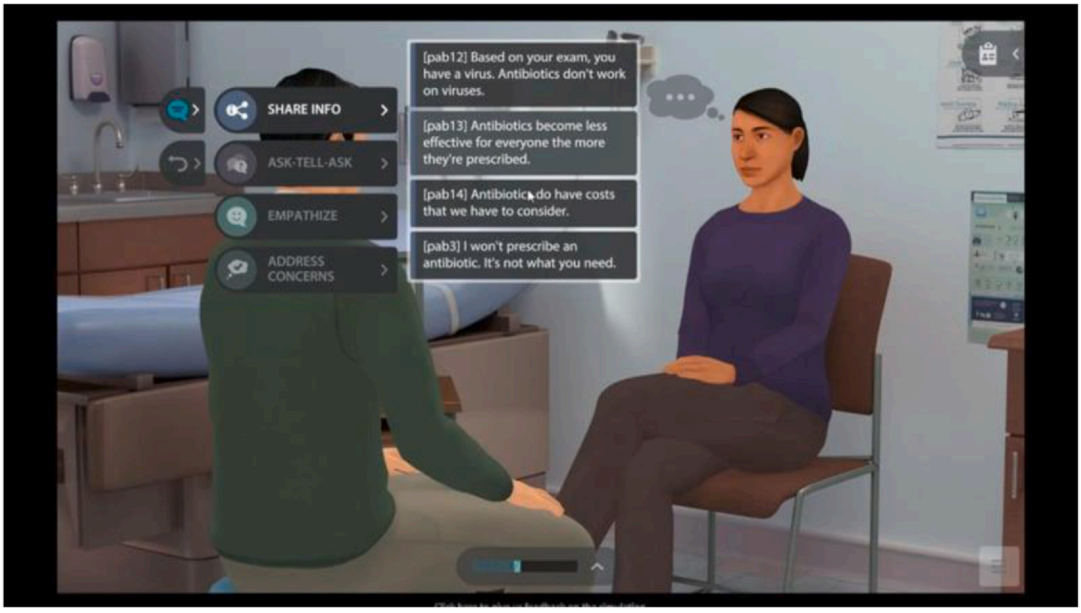
2.2. Patient-provider communication simulation

The MI simulation used for this study was developed by Kognito in collaboration with a group of MI experts [3,7]. A more detailed description of the iterative development process is described by Albright et al. (2016) [23]. Four 10–15 min conversations embedded into the Kognito Conversation Platform™ were offered to the students (https://www.conversationsforhealth.com/antibiotics), SEE Box 1. In each virtual role-play, the student assumes the role of healthcare provider, and engages in a conversation with an intelligent, fully animated, and emotionally responsive virtual patient that models human behavior. Learners communicate with the virtual patient by selecting from a dynamic menu of multiple dialog options. Each option represents a specific conversation tactic based on communications skills that may be more or less effective or ineffective in accomplishing the learner's goal. If learners select choices that include being critical, judgmental, or labeling, for example, they will lose some of their interlocutor's trust and willingness to talk openly. A virtual coach also provides feedback during and at the conclusion of the simulation based on the learner's performance, summing up all dialog choices made during the conversation [7]. During the patient-doctor communication undergraduate course, medical students were offered one hour of time to complete at least the first virtual role-play in which students assumed the role of Dr. Wei, the virtual provider, who has to manage a conversation with her virtual patient Laura about proper antibiotic use [7].

2.3. Procedure and measurement-instrument

Students were asked to complete two surveys: a short one-page questionnaire (pre-test) before starting the virtual MI training, and a longer one consisting of the post- and then-test, IMMEDIATELY after completing the virtual the simulation. The survey-items were those OF Albright, et al., (2017), who used similar items in examining the efficacy of a role-play simulation in training primary healthcare providers to screen for substance use and mental health disorders in their patients [7]. The items from this study were drawn in part from

Box 1
virtual role-play of Dr. Wei, the virtual provider with her virtual patient Laura about proper antibiotics use.



the validated Gatekeeper Scale [23]. In the pretest questionnaire, students were asked about their past-experience with professional patient-doctor conversations (If so, how often and how many patients). In addition, they had to rate their knowledge and skills using eight items each on a 5-point Likert scale (1 indicating "very low", and 5 indicating "very high") (see Box 2). The pre-test questionnaire was completed by students in the classroom before the intervention. After one hour of engaging in the simulations students completed the second questionnaire containing both the post-test and the then-test (Box 1). In addition, the students were asked to evaluate the virtual communications through closed- and open-ended questions (e.g. '*to what extent was this virtual training useful/ relevant to you?', 'overall how would you rate this training (poor-excellent)'?; 'would you recommend this training to others? (yes/ no)'*). The pre- and post- questionnaires were matched through a digital code that was assigned to the students on the spot. Students could not be identified through this code.

2.4. Ethical considerations

Participation in the study was voluntarily, and all data were anonymously collected. By submitting their answers to the survey, students agreed to having read and understood the nature of participating. Further, participants were informed that their answers might be combined with responses from others and may be presented at scientific or medical meetings or published in scientific journals.

2.5. Analyses

All analyses were conducted using Statistical Package for the Social Sciences (SPSS) 26.0 for Windows (Illinois, USA). Dependent *t*-tests were used to analyse effects within groups of respondents, independent-samples *t*-test, and analysis of variance (ANOVA) were applied to compare between groups of respondents (patient-

Box 2
Items to measuring MI knowledge and skills.

Pre-test: Please rate (low to high 5 point Likert scale) your knowledge/ skills to…:
If you do not have any prior professional experience with patients yet, please estimate your knowledge and skills.
Post-test: Please rate (low to high) your knowledge/ skills to…:
Then-test*:* In looking back, how would you now rate (low to high) the knowledge/ skills you had before you completed this course?:

		Very low	*low*	*Mode-rate*	*high*	*Very high*	*Don´t know*
i.	Identifying health risk factors in patients	□□	□□	□□	□□	□□	□□
ii.	Identifying mental health problems in patients	□□	□□	□□	□□	□□	□□
iii.	Discuss treatment options with patients	□□	□□	□□	□□	□□	□□
iv.	Engage patients in collaborative decision-making about treatment plans	□□	□□	□□	□□	□□	□□
v.	Build intrinsic motivation in patients regarding health behaviour change	□□	□□	□□	□□	□□	□□
vi.	Build intrinsic motivation in patients regarding therapy adherence	□□	□□	□□	□□	□□	□□
vii.	Increase overall patient engagement to treatment plans	□□	□□	□□	□□	□□	□□
viii.	Increase overall trust to treatment plans	□□	□□	□□	□□	□□	□□

Table 1
Demographic characteristics of participants in the winter semester of 2018 vs the summer semester of 2018.

	Winter semester 2018	Summer semester 2018
Female sex	62.3% (*N* = 104/162)	61.7% (*N* = 92/149)
Aged between 18 and 24	85.4% (*N* = 139/162)	82.1% (*N* = 120/146)
Having worked with patients in the past	79.5% (*N* = 140/176)	80.7% (*N* = 130/161)
Prior participation in a MI course	13.5% (*N* = 23/170)	14.8% (*N* = 22/149)
	N = 176	*N* = 163

caregiver experience, male/female). Oblimin factor analyses and reliability analyses (Cronbach's alpha) were also investigated. Significance level was determined at.05.

3. Results

3.1. Study sample

Of the 408 undergraduate medical students that took a first year's course in medical communication in 2018 at the University Medical Center of Göttingen (UMG), Germany, 339 completed at least one questionnaire (RR= 83.1%) (326 completed both questionnaires). Of those, 176 took part during the winter semester, and 163 during the summer semester. The vast majority (76.4%) were between 18 and 24 years of age, and 57.8% were women. Most students (79.6%) reported having worked with patients in the past, and many of these had some experience in patient communication, varying from 'rarely' (11.8%) to 'most of time' (24.2%). About one third (30.7%) had seen less than five patients during the last two months, whereas another third (30.1%) reported having seen over 20 patients during this period. Prior participation in a MI course was reported by 13.3%. The majority (54.6%) perceived the virtual MI course to be at their skill level, one quarter of the participants were unsure about this and selected 'don't know'. A small proportion (10.3%) rated the simulation to be under their skill level, and another 5.6% felt that this MI virtual training was above their skill level. In respect to demographics, there were no significant differences between participants during the winter semester and the summer semester (see Table 1).

3.2. Scale properties (factor analyses and reliability)

Prior MI-knowledge and prior MI-skills were pretested through eight items each, using 5-point Likert scales. The scales used were good, with a max. of two explicatory factors, to testing for construct validity, using a strict cut off at.5, and Cronbach's alpha, to testing for retest reliability, resp. of.89 and.91. Current MI-knowledge, current MI-skills, retrospective prior MI-knowledge, and retrospective prior MI-skills were post-tested also through eight items each, using 5-point Likert scales. All scales showed good consistency with one explicatory factor, and an alpha over.80. Further, the perceived quality of the virtual MI training was measured through a four item scale (useful learning tool/ well-constructed/ easy to use/ relevant to the user) on a 5-point Likert scale ('not at all' indicating 1 to 'to the greatest extent', indicating 5). The items loaded on one factor, although the factor loading of item 3: 'easy to use' was just below.5. Cronbach's alpha was.79 (and.82 if item 3 would be deleted).

Table 2
Mean scores on self-rated Motivational Interviewing (MI) knowledge and skills.

	MI knowledge *M* (*SD*)	MI skills *M* (*SD*)
Pre-test	3.0 (0.74)	2.8 (0.78)
Then-test	3.1 (0.66)**p < .001	3.0 (0.74)**p < .001
Post-test	3.4 (0.66)*p < .001	3.3 (0.69)*p < .001

Note: *significant difference between the post-test and the pre-test; **significant difference between the post-test and the then-test.

Perceived usefulness of the simulated MI conversation was measured through six items (helpful in learning (1) to identifying patients' needs; (2) managing patients' care; (3) useful conversation tactics to increase patient engagement; (4) patient trust; (5) patients' adherence to treatment plans; (6) the simulated conversation was realistic) on a 5-point-likert scale ('not at all' indicating 1 to 'to the greatest extent', indicating 5). All items loaded on one factor, Cronbach's alpha was.90.

3.3. Effectiveness of the intervention

Both, prior self-assessed MI-knowledge at the pre-test (*M*=2.96; *SD*.69) and retrospective prior MI-knowledge at the post-test (then-test) (*M* = 3.1; *SD*.74) differed significantly from post intervention MI-knowledge (*M* = 3.35; *SD*.66) (resp. $F(44, 280) = 6.24$; $p < .001$, and $F(44, 278) = 10.93$; $p < .001$). Furthermore, both prior MI-skills (*M* = 2.76; *SD*.78) and retrospective prior MI-skills (*M* = 3.04; *SD*.74) differed significantly from post intervention MI-skills (*M* = 3.28; *SD*.69) (resp. $F(41, 264) = 4.9$; $p < .001$, and $F(42, 272) = 11.32$; $p < .001$), see Table 2. The 66 participants that had claimed to have been working with patients/ healthcare clients on a professional basis in the past did not significantly differ in their scores on the various scales compared to those who had not been working with patients so far, nor were there any significant differences between those that received training in MI before. However, those few (*N* = 35) that evaluated the course to being below their initial level retrospectively rated their prior knowledge and skills as equal to the knowledge and skills gained after completion of the course (Knowledge *M(then-test)* = 3.4 (SD.59); *M(post-test)* = 3.4 (*SD*.59); *Skills M(then-test)* = 3.4 (*SD*.69); *M(post-test)* = 3.4 (*SD*.68)). Furthermore, those that believed the MI course to being below their initial level show significantly higher scores on both pretests for knowledge ($F(2, 238) = 3.076$; $p = .48$) and skills ($F(2, 226) = 3.6$; $p = .027$), and both then-tests on knowledge ($F(2, 237) = 5.4$; $p = .005$) and skills ($F(2, 230) = 7.5$; $p = .001$), compared to those that perceived the MI course at over their initial level. There were no further significant differences between these groups at the post-test, neither for MI-knowledge, nor for MI-skills (see Table 2).

3.4. Pre-test vs retrospective post-tests (then-test)

The pre-test and the retrospective pre-test on both MI-knowledge and skills differed significantly (resp. $t(323) = -5.12$, $p < .001$; $t(301) = -7.7$, $p < .001$). Participants rated their prior knowledge (*M* = 3.1; *SD* = 0.74) and skills (*M* = 3.0; *SD* = 0.73) higher when looking back after completing the virtual MI training (then-test) compared to what they had thought on beforehand (pre-test) (knowledge (*M* = 2.9; *SD* = 0.69); skills (*M* = 2.7; *SD* = 0.75). However, those who perceived this MI training program to be too difficult given their initial level (*N* = 22), showed the same mean score on both the pre- and retrospective test concerning their initial MI-knowledge (resp. *M* = 2.76 (*SD*.83) vs *M* = 2.78 (*SD*.99)), see Table 3. Further, the mean scores on the then-test of students that took part during the winter semester (*M* = 3.0; *SD* = 0.71) different significantly from that of those who took part during the summer semester (*M*=3.2; *SD*=0.77) ($F(1, 322) = 6.1$; $p = .014$). No other

Table 3
Differences in Response Shift between groups.

	Below entry level	At entry level	Above entry level
	M (SD) (N = 35)	*M (SD)* (N = 184)	*M (SD)* (N = 22)
MI Knowledge			
Pre-test	3.2	2.9 (0.69)	**2.8 (0.83)**
Then-test	**3.4 (0.59)***p < .001	3.1 (0.74)* ** p < .001	**2.8 (0.99)**
Post-test	**3.4 (0.699***p < .001	3.3 *p < .001	3.0 *p < .001
MI Skills			
Pre-test	3.0	2.7 (0.75)	**2.6 ()**
Then-test	**3.4 (0.69)***p < .001	3.0 (0.73)* **p < .001	**2.7**
Post-test	**3.4 (0.68)***p < .001	3.3 *p < .001	3.0 *p < .001

Note: *significant different from the pre-test; **significant different from the posttest; ***significant different from the pre-test and the post-test.

Table 4
Mean scores on self-rated Motivational Interviewing (MI) knowledge and skills.

	WiSe 2018	SoSe 2018
Pre-test		
MI Knowledge M (SD)	2.9 (0.68)	3.0 (0.7)
MI Skills M (SD)	2.7 (0.78)	2.9 (0.78)
Then-test		
MI Knowledge M (SD)	3.0 (0.71)*p < .05	3.2 (0.77)*p < .05
MI Skills M (SD)	3.0 (0.72)	3.1 (0.75)
Post-test		
MI Knowledge M (SD	3.3 (0.65)	3.4 (0.66)
MI Skills M (SD))	3.2 (0.7)	3.3 (0.7)

Note: *significant difference between the two measurement time points winter semester and summer semester.

differences in outcome were found between the two different time points, see Table 4.

3.5. Overall rating of the program

The mean score on the overall rating of the course on a 4 Point Likert Scale (1 indicating poor to 4 indicating excellent) was 2.8 (*SD*=0.73; *N* = 325). The vast majority (69%) rated good (3) or excellent (4). Very few of the participating students (4%) rated 'poor'. Those that believed the virtual MI training to be below their initial level appreciated the course significantly lower compared to those that judged the virtual MI training as over their level (*M*=2.3 (SD) vs *M (level fit)* = 3.0 & *M (over level)* = 2.8; *F(2238)* = 12.24; *p* < .001). Further participants believed the virtual MI training to be ('pretty much') of use to them (*M*=3.4; *SD*=0.75; *N* = 329), and were content with its quality (*M*= 3.8; *SD*=0.84; *N* = 330).

4. Discussion and conclusion

4.1. Discussion

This study investigated the effectiveness of a brief one-hour computer-simulated role-play conversation (serious game) in practicing motivational interviewing (MI) techniques in undergraduate, first-year medical students with regard to improving MI knowledge and skills. Consistent with others, we found this virtual MI training to be effective [1,2,4,5], while at the same time no serious threats to the validity of the study occurred [21]. Participants reported to having gained in both MI knowledge and skills, even though the training was offered at an early stage during medical training and lasted for only one hour. A few students felt that their initial knowledge and skills level were too minimal to receive the maximum of benefit of the training. However, they too gained from it as their scores after completing the role-play simulation did not significantly differ from those that perceived the training to fit to their initial level or even judged its level as being below. Those students that believed the MI computer-simulated training to be below their initial level gained by becoming better aware of their initial MI competencies after completing the course. However, they reported to not having gained any additional knowledge or skills.

As such, the raising of awareness of intrinsic MI competencies already present seems an added effect, which might be as important as the increase of MI knowledge and skills in itself. Especially, since increasing learners awareness is regarded the first step in the process of learning, improving cognitive processes in learners [24]. Interestingly, this response shift did not occur in participants that judged the level of the course as being too high to them at this stage of their medical study: They retrospectively rated their knowledge and skills at exact the same level as they did during the pre-test. Based on our finding that students became better aware of initial knowledge and skills they already had prior to the course, we argue against the idea that a serious game is insufficient to improving performance [9]: In being better aware and more confident about one's competencies, overall performance might improve as well [6].

Furthermore, our results show that the response shift may indeed occur as a result of exposure to teaching [19]. If an intervention, e.g. communication skills training, aims at getting trainees to reconsider their knowledge, skills etc., then the response shift should be considered an intended result of the intervention [19]. However, our results show that this recalibration of internal standards can go either way, and can become more favorable as well. Moreover, response shift was found to differ between groups, being the highest in those that perceived the virtual MI-training as below their entry, and was absent in those that judged the MI-training as above their entry level.

4.2. Limitations

The main limitation of our study is the lack of a performance test to check for actual improvement. However, the raising of awareness about MI and personal competencies can be seen as a goal in itself at this stage in the medical education. For future researcg it might be of interest to study whether the effect found consolidates over time, and in what way the raising of awareness of internal MI skills contributes to future patient-centered communication skills. Furthermore, it might be important to investigate whether the early raising of awareness of these internal skills would lead to overestimating their abilities at a later stage.

4.3. Conclusion

A MI training simulation to raise medical student's awareness about their personal capacities in communicating with patients in a patient-centered way can be offered at a very early stage during medical education, and needs not to be too time-consuming. Further we recommend to both make use of a pre-test and then-test in evaluating educational interventions, to revealing results, that otherwise might not be found.

4.4. Practice Implications

In the context of the medical interview it might be of great use to offering a training in practicing patient-centered communication techniques at a very early stage during medical education already, to improving patient-centered communication knowledge and skills and to raising awareness of the existing intrinsic knowledge and skill they already possess to communicate with future patients in a patient-centered way. The implementation of a computer-simulated role-play conversation (serious game) in practicing motivational interviewing (MI) techniques in undergraduate medical education would be ideally suited for this, offering medical students a higher degree of autonomy and independence in their learning. Furthermore, in evaluating future educational interventions, it is important to taking response shift which was found to occur as a result of exposure to teaching, into account and to making use if both a pretest and a then-test in order to better determining the actual impact of the intervention.

CRediT authorship contribution statement

Anne Marie Plass: Investigating, Writing – original draft, Conceptualization, Methodology, Supervision. **Amra Covic:** Writing – review & editing. **Louisa Lohrberg:** Investigating, Data management, Writing. **Ron Goldman:** Conceptualization, Software. **Glenn Albright:** Software, Writing and Editing. **Nicole von Steinbüchel:** Conceptualization, Editing.

Conflict of interest

Glenn Albright and Ron Goldman are members of Kognito. All other authors state that they do not have any conflict of interest.

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