Virtual Patients and Clinical Decision-making Skills: How Students Learn to Diagnose Depending on Their Psychological Characteristics

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Abstract

Background: The goal of this exploratory study is to analyse which psychological characteristics of clinical psychology students are related to the effectiveness of learning clinical decision-making skills with the use of virtual patient (VP).

Methods: Authors' VP was used for measuring the ability to learn the decision-making: negative vs positive aspects of a patient's functioning, reactance, coping, stage of change, cognitive errors, adequacy of assessment data, and the quality of assessment. Psychological questionnaires were used for measuring student's: need for cognitive closure; ability to achieve closure; beliefs of changeability on human traits; the level of hope, intelligence, positive vs negative affect, and academic knowledge.

Results: Developing clinical decision-making with the use of VP is effective for students who have a higher ability to tolerate ambiguity and complexity of data. Students convinced of the changeability of human traits take into consideration more diverse data and the process of diagnosis requires the analysis of complex phenomena. Students with dominant negative affect seem to build diagnoses more carefully and make fewer cognitive errors than those with positive affect.

Conclusions: Our study indicates which properties of participants support and which weaken the acquisition of the ability to make a diagnosis.

Background

The process of conducting clinical assessment is a highly complex task [1, 2].It encompasses the application of knowledge to collect and integrate information from various sources to arrive at a diagnosis and treatment plan [3]. Healthcare students acquire clinical decision-making skills during their education and continue to build upon them in their work [4]. It is important to give students a solid foundation of diagnostic skills early in their health care studies, to allow them to develop proper operating schemes and procedures, used in both the education process and future professional careers [5].

The first papers about using computer interactive simulations in clinical decision-making were published in the 1970s and rapidly gained popularity in medical education [6–10]. The virtual patient (VP) has gradually become a significant teaching method in training and assessing students for real patient encounters, and supporting their clinical decision-making competencies [11–13]. There are many ways how VP can enhance decision-making skills [14]. Moreover VP has been integrated into undergraduate healthcare curricula in different forms, such as blended learning scenarios [15], during clinical clerkships [16], and as assessment tools [17, 18].

The standard training of healthcare students in clinical decision-making should teach them with skills, such as building a cooperative relationship with the patient and collecting diagnostic data. Furthermore, students should also dynamically search, accumulate and select developing knowledge about different types of psychological mechanisms [3, 19], which involves equally the necessity of analysing and integrating complex data coming from the patient, causing significant cognitive burdens and social interactions involving the element of social exposition. In addition, contact with patient's personal problems is a source of emotional burden [20].

The virtual patient tool

The VP is online representation of clinical case study which enhance student's learning [21]. The VP in this study is based on the psychological assessment model resulting from the evidence-based assessment approach: EBA [22]. The diagnosis focuses on dimensions that, according to the results of research, most effectively predict the effects of the psychological / psychiatrically treatment, matching it to the patient and their problems. Those dimensions increase the chances for effectiveness treatment [23]. In our study, students evaluate symptoms presented by VP. In turn, we check how effectively they can learn this kind of clinical assessment. In the research we looked for factors which could significantly affect the process of learning. There is no model or list of individual factors that affect the level of performance of this type of task. We are convinced that this is of great importance that the authorities responsible for process of medical education take advantage of those factors affective learning in their programmes. Our research is innovative in this matter. The available data is mostly related to cognitive distortions in clinical decision-making. Based on those distortions, we assessed the level of performance, the individual characteristics of diagnosticians [24], as well as the factors that should naturally affect the learning process. In the pilot study we examined many different variables (e.g., anxiety, well-being, temperament or attention shifting), but here we present only those that gave preliminary significant results. We recognise the level of theoretical knowledge and intelligence as necessary to control.

Goal of the study

A review of the literature shows almost no interest in the matter of the conditions for the development of diagnostic competencies. The goal of this exploratory study is to analyse which psychological characteristics of clinical psychology students are related to the effectiveness of learning clinical decision-making skills with the use of VP. In our research individual psychological characteristics of students are independent variables. Efficiency measurement of learning clinical decision-making skills with the use of VP are dependent variables. Although the study concerns clinical psychology students, we believe that the results will be applicable to a wider group of health care students, who need the competence of collecting interview with the patient.

Model of the study

The independent variables are psychological features that may affect the effectiveness of the clinical decision-making

1. *Need for cognitive closure* is a tendency to formulate judgments immediately, to take the very first hypotheses as final conclusions, with an unwillingness to look for alternative solutions [25].

2. Ability to achieve closure refers to the individual's ability to reach swift decisions and structure in life. The level of the AAC can be understood as the extent to which individuals are able to use different styles of information processing according to their NFC [26].
3. *Beliefs of changeability vs stability on human traits* are meaningful for the level of motivation, the tendency to take up challenges, social-emotional functioning, and engagement in effortful tasks, which translates into, among other things, educational achievements and the ability to cope with stressful situations [27, 28].
4. A high *level of hope* fosters psychological wellness, which involves taking up challenges and achieving goals that are important for the individual [29]. A high level of hope can thus be related to a readiness to invest more resources in the task, which can prevent the negative influence of anxiety [30].
5. *Intelligence*. Conducting a clinical interview is a very complex cognitive task [1]. Therefore, it seems necessary to control the intelligence level of the participants.
6. *Positive affect/negative affect*. Positive affect is associated with better cognitive functioning and can improve verbal fluency performance [31, 32]. It has also emerged that positive affect is related to a higher level of cognitive control [33], as well as a higher level of problem-solving and decision-making abilities, facilitating flexible, creative, and effective cognitive processing [34].
7. Level of *academic knowledge*. In the situation of performing a cognitively complex task which involves analysing a lot of data of diverse significance, limited abilities in conscious information processing constitute a significant difficulty [35]. Possessed knowledge is helpful in dealing with limited abilities in conscious data processing [36].

The dependent variables are the measures of learning efficiency based on the following dimensions presented in VP

1) The *negative and positive aspects of functioning* of a patient are understood as the level of disorders closest to psychiatrically diagnosis (classification) [37]. Positive aspects are understood as patients' resources and strengths, important to designing optimal forms of intervention [38].

2) The *reactance* of a patient is a stable personality trait. A reactant patient is easily provoked and responds oppositional to perceived external demands. High reactance indicates the need for nondirective, patient-directed interventions during psychological treatment, which improves clinical outcomes [39].

3) The *coping style* of a patient is an enduring personality trait when a person confronts new problematic situations. We distinguish two styles: externalising (impulsive, stimulation-seeking, extraverted) and internalising (self-critical, inhibited, introverted). Symptom-focused "interventions" are more effective in psychological treatment of externalising patients. Use of insight and awareness-enhancing "interventions" is typically most effective among internalising patients [23].

4) The *stage of change* of a patient represents a person's readiness to psychological change, defined as a period of time and set of tasks needed for movement to the next stage. The stages are behaviour- and time-specific, not enduring personality traits [23].

5) The following are cognitive errors in clinical decision-making:

(a) Confirmation bias: the tendency to look for confirming evidence to support a diagnosis rather than look for disconfirming evidence to refute it, despite the latter often being more persuasive and definitive [40].

(b) Overconfidence bias: a universal tendency to believe we know more than we do. Overconfidence reflects a tendency to act on incomplete information, intuitions or hunches. More faith is placed in opinion instead of carefully gathered evidence [40].

(c) Multiple alternative bias: a multiplicity of options on a differential diagnosis may lead to significant conflict and uncertainty [40].

(d) Overpathologisation bias: is not explicitly mentioned in medical literature, however, are very similar to other biases distinguished, e.g.: premature closure, representativeness restraint, search satisficing [41], ascertainment bias, diagnosis momentum [40] and focusing effect[42]. It concerns the assumption, in advance, that a person has a problem and narrows the search for data to the problem and interprets the incoming data as evidence of the disorder of the examined person.

6) *Adequacy of collected data.* Quality and completeness of collected diagnostic data presented by VP.

7) *General quality of assessment.* General measurement of quality of diagnosis.

Methods

Participants

The sample consisted of 29 fifth-year clinical psychology students at the USWPS University of Social Sciences and Humanities, Warsaw, Poland (average age M = 28.48; Me = 24; SD = 8.53; 86% female). Participation in the study was one of the possibilities for completing obligatory student internship. Students received part of the required hours, they were not paid for it. Respondents could withdraw from participation at any time. We have notice significant number of participants dropout form the research due to multi-stacking, length and complexity of the study.

Training procedure

The participants took part in a two-day training course (12h) of clinical decision-making skills. The psychological features of students were measured (independent variables). In the next step, there were four VP sessions. Each consisted of completing VP and writing a clinical diagnosis afterwards. The goal of the initial session was to assess the primary level of students' clinical decision-making skills (dependent variables). Diagnoses constructed by participants were evaluated by competent judges. During the second and third VP sessions, participants received feedback generated by the VP program - how effective they were conducting the interview and how adequate the clinical data they collected was. Due to this, participants could prepare better diagnoses. The second and third VP sessions were training sessions. During the final session (fourth), competent judges assessed the level of clinical decision-making skills again.

VP generates teaching environment with a lower cognitive-emotional burden than real patient, since the student performs the diagnostic tasks without direct contact. At the same time, learners have the opportunity to be regularly provided with information about their steps while conducting the virtual interview, which can facilitate correction of one's own behaviours on a regular basis.

Tools

The independent variables (psychological features affecting the learning process) were measured by series of psychological questionnaires: (1) *The Need for Closure* (NFC) Scale [43], (2) *Efficacy at Fulfilling the Need for Closure* (EFNC) [26], (3) *Implicit Self-Theory Scale* [44], (4) *Basic Hope Inventory* (BHI-12) [30], (5) *Intelligence – Raven Progressive Matrices* [45], (6) *Positive and Negative Affect Schedule* (PANAS) [46], (7) *Level of academic knowledge* – single-choice test (20 questions, 20 minutes) at the end of the two-day training course.

The dependent variables were measured by the authors' VP tool designed to estimate the way of formulating conclusions after the conducted interview, used in the initial and final sessions. VP is the authors' computer tool for measuring the ability to learn the clinical decision-making skills. VP consisted of short recordings of the person playing the role of patient in consultation for psychological treatment, constituting in total of a 20–25 minute diagnostic interview (videos + participant's reactions). Students watched 9 successive fragments of the patient interview, and after each fragment, they chose one of two diagnostician interventions (better or worse). Depending on the decision, another fragment was launched. In total, the program enabled 512 combinations of selection paths, arranged in a decision tree. In VP training sessions (two and three) student received feedback after each decision. It contained information about correctness of the chosen intervention with an explanation and guidelines for further steps. The author's clinical material is based on the Keyes and Lopez dimension model [47, 48]. The patients' problems described in their model was based on a patient Struggling (with growing problems) that correspond to the level of personality disorders. We decided to use the VP presenting symptoms of such serious disorders because the pilot study pilot reveal that for students is difficult to recognize symptoms of less severity mental disorders (example in Appendix 1).

Competent judges evaluated whether students applied the following dimensions in the clinical decision-making: (1) *negative and positive aspects of a patient's functioning*, (2) *reactance,* (3) *coping style,* (4) *stage of change,* (5) *cognitive errors,* (6) *adequacy of assessmentdata,* and (7) the *quality of assessment* (protocol in Appendix 2). The competent judges were experienced clinicians who conduct psychological assessment on a daily basis, and also teach it at university. Both students and competent judges were anonymous to each other.

Statistics

IBM SPSS software was used for data analysis. Pearson correlations was conducted to investigate relationship among data.

Results

The *need for cognitive closure* presents a moderate negative correlation with a recognition of *positive aspects of patient's functioning* and low negative correlations with *reactance* and with the *stage of change* (all concerned the final session). The *ability to achieve closure* presents a moderate negative correlation with *positive aspects of patient's functioning* in the final session; a low positive correlation with *adequacy of collected data* in the initial session; a low positive correlation with *confirmation bias* in the initial session; a low positive in initial session, and a moderate positive in the final session for *overpathologisation bias*. The belief of *changeability of human traits* presents a moderate positive correlation with *negative aspects of patient's functioning* in the final session, and a low negative correlation with *over-confidence bias* in the initial session. The *level of hope* has a low positive correlation with *confirmation bias* in the initial session, a low positive correlation with *over-confidence bias* in the initial session, and a low positive correlation with *overpathologisation bias* in the final session. The *intelligence* presents a moderate negative correlation with *positive aspects of patient's functioning* in the initial session and a low negative correlation with the *quality of assessment* in the final session. The dominant *positive affect* presents a low positive correlation with *confirmation bias* in the initial session, and a moderate positive correlation with *overpathologisation bias* in the initial and final sessions. The *academic knowledge* presents a moderate positive correlation with *multiple alternative bias* in the final session.

Discussion

Students with a higher need for cognitive closure neglected to assess positive aspects of the patient's functioning and focused mainly on psychopathology. They also omitted most of the other dimensions important to the diagnosis: the level of reactance and the current stage of change. It may be that analysing various dimensions of the patient's functioning at the same time is too complicated at this stage of their education. These effects are consistent with the definition of the need for cognitive closure, where a high level limits the ability to understand complex phenomena but a low level strengthens it [49].

Students with a higher ability to achieve closure also increasingly focused on the diagnosis of patient's psychopathology, ignoring

the individual patient's other characteristics. In addition, they made two main cognitive errors: confirmation bias (which fortunately disappears during VP training) and overpathologisation bias (which persists regardless of VP training).

Participants with a higher level of those two features generally ignore the positive aspects of the patient's functioning and diagnose stronger and more severe disorders. It also means that students with a lower level of those features can take into consideration both the patient's problems and resources during diagnosis. In other words, these participants thinking in a more complex and comprehensive way. Those results differ from previous knowledge, according to which the higher need for cognitive closure should be compensated for by a high ability to achieve closure [50]. According to Kosic et al. research - a higher need for cognitive closure should allow students to withstand the frustration associated with cognitive chaos, under the condition that they quickly receive an effective method of analysing information[51]. In our study, it seems that a the most competent were the "slightly confused" diagnostician, who does not need a strong structure. They were able to build a more complete, more diverse picture of the patient. Presumably, a more chaotic and disordered way of thinking is conducive to recognising various psychological phenomena.This is in line with other studies, which indicates that the ability to make decisions in face of uncertainty is what constitutes expert clinical practice[3].

However, what allows the participant to effectively recognize patients' problems were beliefs about the variability of human traits. Students convinced of changeability takes into account more diverse data which is needed for the proper diagnosis, which requires analysis of complex phenomena. Diagnosticians convinced of the stability of human traits do not commit the over-confidence error when trained by VP, which is in line with our hypothesis. They made diagnoses with greater attention. Maybe development of diagnostic competencies was inhibited by the conviction of their own infallibility. This effect could be conducive to learning, because it gives a sense of competence and support in newly acquired skills, which is of high importance for students. However, during their education, they should be taught to critically review their own hypotheses.

Interestingly, the level of hope for success increased the likelihood of making cognitive errors and did not contribute to improving the quality of the diagnosis. Students with a higher level of that trait had the most distorted thinking. Initially, they were confident of their diagnoses and selectively chose data to confirm them (over-confidence and confirmation biases). These errors disappeared over time, but on the other hand, overpathologisation bias appeared. Those students improved the formal conclusions but with the cost of focusing solely on the search for disorders. Participants probably learned cognitive inhibition, i.e., error reduction, which limits attention processes[52]. Other attention processes are sufficient only to look for clear symptoms of pathology. Alternatively, participants with lower level of hope used more diverse data, tested their hypotheses more thoroughly, and were less confident of their validity. Positive affect was generally conducive to committing the same cognitive errors, while VP training was not conducive to reducing their occurrences. It seems that belief in personal abilities, belief in success and positive affect impair diagnostic decision-making and make it difficult to build proper diagnoses. As Kahneman indicates, we always should strive to falsify our hypothesis instead of proving them correct[53]. Participants with these psychological characteristics acted in the opposite way.

Students with dominant negative affect seem to build diagnoses more carefully and make fewer cognitive errors than those with positive affect. This result is consistent with the literature: clinicians confident in the accuracy of their diagnoses commit more cognitive errors[3].

The conclusions arising from the level of intelligence and theoretical knowledge are unexpected. The clinical decision-making of participants with a higher level of intelligence became more intuitive and less systematic. It seems as though higher intelligence students believed in their 'genius' and were not worried about in-depth data analysis or validating the conclusions. On the other hand, this result means that students with a lower level of intelligence tend to analyse more data and in more systematic way during training. It seems that drawing conclusions from complex data is more difficult for them, so they try to learn more systematic clinical decision-making. And this is what our VP tool favours. As a result, participants with a lower level of intelligence learn the correct clinical decision-making, while participants with a higher intelligence level increasingly rely on their intuition. Interestingly, participants with a lower level of intelligence initially focus mainly on diagnosing patient's resources, while those with a higher level systematically skip this area. It is worth noting that the differences in intelligence between participants of our study was only slightly differential.

Surprisingly, the higher level of theoretical knowledge acquired during two-day training course did not improve the clinical decision-making. It sounds contradictory but extensive knowledge promoted the multiple alternative error after VP training. We can explain it by stating that knowledge makes it possible to build many different hypotheses, but participants could not argue them coherently. Fortunately this effect could probably be easily modified during training, giving students tips to make fewer hypotheses, but to articulate them better. However, it is disappointing that academic knowledge does not support other aspects of clinical decision-making. Perhaps measurement of knowledge by using a simple, short test, was not effective enough and participants' knowledge should be verified in different, more detailed way.

Limitations

First, there are small number of participants, which limits the possibility of generalization the results for population of students. Second, the study was conducted at one university and looked at clinical psychology students (fifth year of study), thus limiting the transferability of the findings to general populations of clinicians. Second, all the results and conclusions relate to education of clinical decision-making with the use of virtual technology. Fourth, due to multi-stage, length and complexity of the research high rate of dropouts occurred.

Conclusions

1. The most important features for learning clinical-decision making are - a need for cognitive closure and a higher ability to achieve closure. During clinical decision-making, participants with a higher level of these features often committed cognitive errors and ignored the positive aspects of patient functioning. Contrary to current knowledge, these factors narrow the possibility of taking into account many of the patient's properties during diagnosis.

2. The results also show that more positive feelings a diagnostician experiences toward patient the more often he/she overpathologise patients' problems, diagnosing it as stronger and more severe than in reality. Moreover, students with a high level of three features - positive affect, level of hope and ability to achieve closure - not accurately recognise patients with a lower level of psychopathology and mistakenly found more serious disorders.
3. Developing clinical decision-making with the use of virtual technology (VP) is effective for students who have a higher ability to tolerate ambiguity and complexity of data. Similarly, for students who effectively cope with feelings such as being lost during clinical decision-making and uncertain of their diagnoses.
4. University curricula should support those students in focusing on assessing positive aspects of patient functioning, level of reactance, which indicates the need for nondirective, patient-directed interventions, and being attentive to a patient's readiness to develop. Education should particularly focus on the development of the systematic reasoning of students with a lower level of hope and dominant negative effect.
5. It is worth remembering that the VP method does not replace real life training but supplements it. It would be important as an intermediate step between classroom workshops[15], simulated patients and clinical training of diagnostic skills enhancing student's self-regulated learning[54].

Abbreviations

VP: virtual patient

Declarations

Ethics approval and consent to participate

This research programme was conducted in accordance with the guidelines of the Ethical Review Board at the University of Social Sciences and Humanities in Warsaw, Poland, which reviewed and approved the project (by decision 23/IV/11-12). Written consent was obtained from all participants.

Consent for publication

Not applicable

Availability of data and materials

The datasets used and/or analysed during the current study are available from the corresponding author on reasonable request.

Competing interests

The authors declare that they have no competing interests

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Authors' contributions

BZ designed the research study and collected the data. BZ, MW, and MG analysed and interpreted data, collected the literature, and wrote the manuscript. We assess our intellectual contributions as: BZ, 50%; MW, 40%; and MG, 10%. All authors approved the final version for publication and have agreed to be accountable for all aspects of the work.

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Tables

Table. 1.

Relations between psychological features of diagnosticians and clinical decision-makingskills learned with the use of virtual pa

Independent vs dependent variables	1.1. Negative aspects of patient's functioning	1.2. Positive aspects of patient's functioning	2. Reactance	3. Coping style	4. Stage of change	5.1. Confirmation bias	5.2. Over-confidence bias	5.3. Multiple alternative bias	5.4. Overpathologisatio bias
1. Need for cognitive closure		F - - - r(22)=-0.644 p=0.001	F - - r(22)=-0.431 p=0.045		F - - r(21)=-0.499 p=0.021				
2. Ability to achieve closure		F - - - r(21)=-0.566 p=0.008				I + + r(23)=0.484 p=0.019			I + + r(28)=0.395 p=0.038 F + + + r(21)=0.556 p=0.009
3. Beliefs of changeability on human traits	F + + + r(21)=0.565 p=0.008						I - - r(26)=-0.412 p=0.036		
4. Level of hope						I + + r(28)=0.448 p=0.017	I + + r(28)=0.385 p=0.043		F + + r(22)=0.444 p=0.039
5. Intelligence		I - - - - r(25)=-0.707 p=0.000							
6. Positive affect						I + + r(27)=0.397 p=0.040			I + + + r(27)=0.506 p=0.007 F + + + r(22)=0.558 p=0.007
7. Academic knowledge								I + + + r(16)=0.614 p=0.011	

I - initial session, F - final session

+ + + +	.70 to .90	high positive correlation
+ + +	.50 to .70	moderate positive correlation
+ +	.30 to .50	low positive correlation
+	.00 to .30	negligible correlation
- - - -	−.70 to −.90	high negative correlation
- - -	−.50 to −.70	moderate negative correlation

- -	−.30 to −.50	low negative correlation
-	.00 to −.30	negligible correlation

Figures

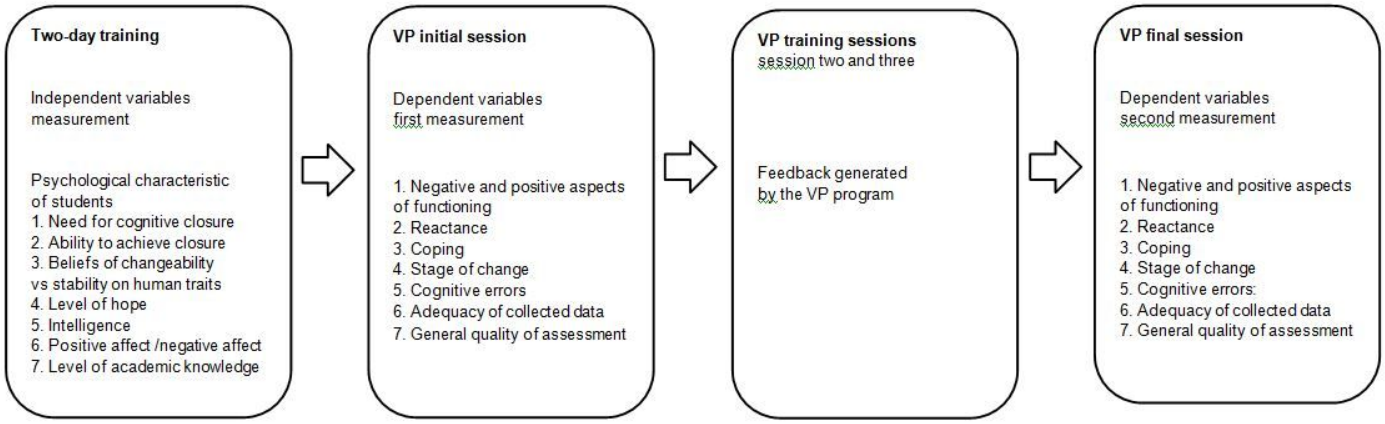

Figure 1

The study procedure

Supplementary Files

This is a list of supplementary files associated with this preprint. Click to download.

- Appendix1.docx
- Appendix2.docx