Deepening the Theoretical Foundations of Patient Simulation as Social Practice

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Simulation is a complex social endeavor, in which human beings interact with each other, a simulator, and other technical devices. The goal-oriented use for education, training, and research depends on an improved conceptual clarity about simulation realism and related terms. The article introduces concepts into medical simulation that help to clarify potential problems during simulation and foster its goal-oriented use. The three modes of thinking about reality by Uwe Laucken help in differentiating different aspects of simulation realism (physical, semantical, phenomenal). Erving Goffman's concepts of primary frames and modulations allow for analyzing relationships between clinical cases and simulation scenarios. The as-if concept by Hans Vaihinger further qualifies the differences between both clinical and simulators settings and what is important when helping participants engage in simulation. These concepts help to take the social character of simulation into account when designing and conducting scenarios. The concepts allow for improved matching of simulation realism with desired outcomes. It is not uniformly the case that more (physical) realism means better attainment of educational goals. Although the article concentrates on mannequin-based simulations that try to recreate clinical cases to address issues of crisis resource management, the concepts also apply or can be adapted to other forms of immersive or simulation techniques.
(*Sim Healthcare* 2:183–193, 2007)

How well a simulation replicates or represents "reality" is a core question in all fields that use simulation. There were many attempts by other scholars to describe this relationship; the most prominent approach refers to *simulation fidelity.* This concept is often further differentiated into subdimensions like physical fidelity, environmental fidelity, equipment fidelity, or psychologic fidelity.[1] Another approach builds on various forms of "validity" such as face validity, content validity, construct validity, and predictive validity. [2–5] Furthermore the concept of presence has been used to describe simulation-based environments, to compare them to their real-world counterparts, and to describe the relation between both settings.[6,7] Many investigators have tried to understand under which conditions simulation fidelity, validity, or presence are high or low, while other have looked at the relationship between aspects of those concepts and degree of learning achieved through simulation.[3,8–12] The results of these studies are not conclusive.

There is a widespread belief that simulation experiences (and effectiveness) improve proportionately as the precision of the replication of the real world improves.[1,13,14] Under this assumption, a perfectly realistic simulation becomes the gold standard. This view has been criticized early[15] and repeatedly[1,13,16] in various fields working with simulation. Indeed, some studies have failed to show positive effects of higher fidelity on training outcome, and others have shown that relatively low fidelity simulations can be effective.[3,10,14,17] Some researchers hold that simulation fidelity must be related and tailored to the specific goals and target population for the simulation,[18,19] yet exactly what this means has not been fully articulated. Salas and Cannon-Bowers argue that "[p]recisely why simulation and simulators work is not well known . . . there is a somewhat misleading conclusion that simulation (in and of itself) leads to learning."[20] Thus, the success of using simulation—whether for education, training, or research—depends on a wide variety of factors beyond the fidelity or validity of the simulator or simulation procedures.[8,16,21–23] A critical point that has often been missed is that the process of using simulators and simulations is a "social practice."[24]

Although there are many studies that address the use of simulation to teach social aspects (eg, team interactions),[25–31] there is very little work on the social aspects of using simulation.[12,32–35] A social practice can be defined as a contextual event in space and time, conducted for one or more purposes, in which people interact in a goal-oriented fashion with each other, with technical artifacts (the simulator), and with the

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Peter Dieckmann and Marcus Rall are cooperating (e.g., training of instructors) with Laerdal and SimuLearn (Bologna, Italy), a company providing simulation training for healthcare professionals. David Gaba has indicated that he has no conflict of interest to disclose.

DOI: 10.1097/SIH.0b013e3180f637f5

environment (including relevant devices). To regard simulation as a social practice puts an appropriate emphasis on the reasons why people take part in it and how they choose to interpret the various simulation endeavors. With regard to patient simulation, this social practice has been called the "simulator setting,"[36] describing the elements or "modules" of, for example, a typical simulation-based course: introduction, simulator briefing, scenarios, debriefing, and course ending. The influences of the simulator setting and the broader aspects of the social practice of simulation are important for understanding how and why appropriate goals can be achieved through simulation with specific target populations.

In this article, we introduce and apply several theoretical concepts in an effort to guide simulation-based education and training in healthcare by fully taking into account their social aspects.

SCOPE AND STRUCTURE

This article will concentrate on simulation in healthcare, and particularly on mannequin-based simulators and simulations that try to recreate clinical cases,[37] to address issues of crisis resource management (CRM).[38,39] Nonetheless, many of the concepts articulated here apply to other forms of immersive or simulation techniques,[40] including mental training,[41] role play,[42] so-called standardized or simulated patients,[43,44] computer-based training,[45] virtual reality systems,[46] partial task trainers,[47] and other simulation devices and procedures. The discussion will also focus on education and training applications of simulation. The use of simulations and simulators for research or performance assessment is beyond the scope of this article.

THEORETICAL FRAMEWORKS FOR ANALYZING MEDICAL SIMULATION

To better appreciate simulation as a social practice, we need theoretical concepts that ideally should later be integrated into a common framework as the field progresses. First, we introduce the work of social psychologist Uwe Laucken[24] who describes three modes of thinking to describe "reality" that can help users of simulation understand what is meant by simulation realism. Then, we analyze the nature of the relationship between actual clinical cases and simulation scenarios using the concepts of primary frames and modulations introduced by the sociologist Erving Goffman.[48] Finally, we refer to the "as-if" concept as detailed by Hans Vaihinger,[49] which helps in understanding under which conditions people interact with the simulation manikin as they would with an actual patient. Our intention is to introduce these theoretical concepts and show how they allow for delineating what simulation can mean to different users at different times, and how simulation might be best structured as a social practice for a variety of different purposes. Table 1 provides a practical example of a scenario and debriefing analyzed in terms of the relevant theoretical points.

THREE MODES OF THINKING ABOUT REALITY

The meaning of simulation "realism" can be more fully explored by adapting the three modes of thinking—physical, semantical, and phenomenal—needed to understand reality as described by Uwe Laucken.[24] Laucken holds that all three modes of thinking are needed to describe and specify any situation.

The *physical mode* concerns entities that can be measured in fundamental physical and chemical terms using measurable dimensions (eg, centimeters, grams, and seconds). In this mode, a simulator might be described in its physical dimensions like its weight, or the force generated by its moving thorax. The simulation environment could similarly be described in terms of its physical characteristics including any equipment residing there and physical aspects of the movements conducted (eg, the shape and weight of a ventilator, or the force patterns needed to intubate the simulated patient's trachea).

According to the physical mode of thinking, existing simulator mannequins have many unrealistic elements despite their roughly human shape. They are clearly constructed from different materials than human beings. Breath sounds in a mannequin are typically qualitatively distinguishable from actual breath sounds, and they are not heard at all the usual sites of an actual patient. For any given model of mannequin, only a few features can be altered to represent different patients (eg, the patient voice, genitals) while others are practically fixed in a physical sense (eg, the mannequin's basic shape). In the physical realm, there is some choice available; for example, different mannequins can be used (eg, baby, child, or adult or from one manufacturer versus another, special kits can be used). Some of the equipment used in mannequin-based simulation is fully functional clinical equipment and thus physically identical to the "real thing." Even so, real equipment or supplies sometimes have to be used in a simulated way when applied to the simulator mannequin (eg, the endotracheal tube in the plastic trachea may need more air in the cuff to achieve a plastic-on-plastic seal). Other equipment may appear real but have functional physical limitations for convenience or safety.[2] Consider, for example, labeled syringes that contain only water instead of opioids, or a real defibrillator that has been modified so that it does not actually deliver a shock ("Hollywood defibrillator"). That certain physical properties and functions of such entities might be altered (eg, electrical current delivered) may not be apparent to participants, at least without special briefings or labels.

The *semantical mode* of thinking concerns concepts and their relationships—such as theories, meaning, or information—presented via text, pictures, sounds, or events. This mode describes "those portions of the world that are facts only by human agreement."[50] For example, within the semantical mode, a simulation of hemorrhage might be described as: "If *A* (bleeding) happens then *B* (decreasing blood pressure) will result." In this mode, it is irrelevant how the information (about the hemorrhage) is transmitted. The same pieces of information could be represented using a vital signs monitor, a verbal description, the tactile perception of decreasingly palpable pulses, or still other means. Thus, scenarios can be semantically realistic if the information presented is reasonably interpretable even if the physical basis to transport this information is not realistic: water-filled syringes can be used as if they contained a drug.

The *phenomenal mode* includes emotions, beliefs, and self-aware cognitive states of rational thought that people directly experience while in a situation. The phenomenal mode is relevant for simulation because it describes the different elements of the experience. Participants directly experience the scenario as: 1) a complex real-time situation (eg, interacting with the simulator mannequin and equipment within the logic of the simulated case); and, at the same time 2) a real educational event that is set up to physically approximate another real situation (a clinical situation with an actual patient). If the simulation "works," then participants experience the simulation scenario relevant to the goal of the session and they are able to make semantical sense of the scenario despite its physical differences from the clinical situation. Note that a feeling of relevance does not necessarily mean that the experience of the simulation scenario is phenomenally the same as the experience in the clinical setting. As long as participants understand how the experience within the simulation scenario is related to clinical practice, they will accept phenomenal (as well as physical and semantical) differences between the settings and not question the relevance. In our experience, the feeling of phenomenal relevance is more related to semantic fidelity than the physical fidelity of the simulator and especially how the scenario is integrated into the simulator setting. The semantical and the phenomenal mode can be used to further differentiate the often-used concept of psychologic fidelity.[1]

To understand how and why simulations and simulators can be used for various goals, a first step is to clearly recognize the different modes outlined above and to address them appropriately during the design, preparation, conduct, and debriefing of simulation scenarios. For the design of scenarios, the modes can help identify areas that need special attention. In many cases, it is more cost effective to establish strong semantical and phenomenal frameworks of the scenario that help participants interpret information and enact their roles, rather than merely trying to maximize the physical fidelity. Similarly, during debriefing it is important to analyze what semantical sense the participants constructed from the scenario and how they phenomenally experienced it. Instructors need to work with this version of reality, even if it is considerably different from what they intended for the scenario (Table 1). Rudolph et al.[32] discuss in detail the implications of such differences for the conduction of debriefing.[51]

PRIMARY FRAMES AND MODULATIONS

Although the three modes of thinking discussed above can accurately describe the various elements of a simulation scenario, different people will experience a given situation differently depending on its surrounding context.[22,52,53] Furthermore, a person might experience the "same" situation differently when encountering it at different times. Such influences on this intra- and interindividual variability might be modulated by persistent individual traits (eg, personality, character), dynamically changing states (eg, fatigue, stress), or other external factors. To better understand contextual variables that affect how the situation is experienced, we apply the concepts of "primary frames" and "modulations" based on Erving Goffman's theory of frame analysis.[48]

PRIMARY FRAMES

Goffman tries to explain how humans find an answer to the basic question, "What is going on in this situation?" He proposes the construct of a *primary frame* as the cognitive structure that a person uses—consciously as well as unconsciously[32,54]—to make sense of a situation.[48] The primary frame guides which aspects of a situation a person attends to, actively perceives and interprets, evaluates as relevant, and which actions the person will take. A primary frame can be thought of as containing "slots" (our term, not Goffman's) for specific chunks such as attitudes, beliefs, information, prior experiences, or common choices. Further examples for slots are expected perceptions, assumed relationships, preferred related actions, or anticipated failure pathways.

Consider a primary frame for using a specific medical device, for example, a "performing intubation by direct laryngoscopy" primary frame. The primary frame helps a knowledgeable user to perform this task: she "knows" what tools are needed (laryngoscope blade, handle, and battery), how the larynx should look (expected perception), which signs indicate difficulties during intubation (assumed relationships), how to enact the laryngoscopy (preferred related actions), and how it might succeed or fail (failure pathways). Prototypical clinical cases or diagnoses are also examples of primary frames in this sense. They help the person perceive relevant diagnostic elements, relate them to each other, enact or defer treatments, and consider contraindications and possible complications.

The more experienced people become with a specific task, the more detailed and differentiated are the primary frames they use to interpret and manage this task. From this point of view, simulation is beneficial because of the safe feedback it provides, by which existing primary frames can be modified. Slots can be added to frames or wholly new primary frames can be established. For example, in a CRM-related course, participants can learn ways to improve their planning processes by experience during the scenario and by reflection during the debriefing. They might refine their "preparing for an anesthetic primary" frame by creating new or more detailed slots (eg, recognizing more subtle influences of communication on success or failure of this process).

Goffman distinguishes between two types of primary frames: natural and social primary frames. Natural primary frames are related to natural laws of physics, chemistry, physiology, and anatomy, for example. More important for simulation though is Goffman's seminal work on social primary frames, which apply to human decision making, motivation, goals, and interactions.[48] Social primary frames set the expectations for and patterns of interactions, whether between clinicians and patients or between different health care professionals within or between disciplines (eg, physicians versus nurses, resident versus attending staff, emergency medicine versus internal medicine).

Many primary frames, both natural and social, might be active in parallel in any given situation, accounting for the

Table 1. Example of a Scenario and a Debriefing Analyzed per the Framework of this Article

Description of the Occurrence	Training-Related Goals	What the Occurrence Means and Points to Consider	Relationship to the Concepts Presented in this Paper
Setting			
Training course on Crisis Resource Management (CRM)	Create a learning atmosphere; set the stage for simulations; prime participants on CRM related contents; the course should facilitate reflection-based learning	This is training not testing; the focus is on CRM; these points could be summarized in a precourse flyer	Frame: simulation-based course involving simulation scenarios as modulations of primary frames (clinical cases); many frames can be used at the same time
Physicians and nurses take part in this combined-team course	Facilitate teamwork in the clinical setting through role-modeling and practice of CRM principles	Participants are of different disciplines and levels of authority gradient: the instructors need to facilitate cross-hierarchy interactions	The social character of the simulator setting and the simulation exercise is influenced by the composition of the training group
A "confederate" nurse from the simulation team is present	Adapt scenario optimally to the participants group	This "help" facilitates the conduct of the simulation in an unfamiliar environment	Modification of physical reality to enhance learning (eg, catching mistakes) in the simulation scenario (modulation)
Scenario			
Resuscitation in trauma bay of emergency department of a patient involved in motor vehicle collision (MVC)	Providing a coherent background for the scenario allows participants to understand the situation and their roles correctly	MVC sets certain clinical expectations	Scenario is a modulation of a real clinical case in a trauma bay (emergency department), MVC
Two "hot seat participants," physician and nurse, begin "ABC" checks of patient	Primary participants begin obtaining information in scenario; allowing for a shared experience that can later be discussed	Application of standard trauma protocol by participants	Within the scenario (modulation) the team performs the actions that would be performed in the clinical case (primary frame). However, focus on learning, not working.
Simulator operator inadvertently allows the pulse oximetry (SpO2) waveform to be visible	This is a flaw in the simulation operation and has as such no scenario-related goal	The operator intended the patient to have no effective circulation and thus an absent oximetry waveform; An error in the control of the scenario	The representation of the patient's physiology is incorrect (low semantical realism); the clinical case (natural frame = no circulation) is erroneously translated into the simulation scenario (modulation)
Nurse participant queries operator about SpO2 signal and is told its continued appearance was an error	Participant steps out of the "as-if" of the simulation to query the veracity of the data	Mismatch between expected signals, suspension of disbelief challenged; attempt made to rectify this by operator	Attempt to restore semantical reality via verbal meta-communication and correction of problem
Physician asks the confederate nurse to call the code team using the phone in the room	Allowing participants the direct experience of how effective it can be to call for help	Nurse uses simulation phone to call the control room, not real code team	The nurse maintains semantical reality (calling the code team) even with altered physical reality (no actual team is contacted)
A period of resuscitation with no chest compression occurs	In this course, clinicians are allowed to make errors and are supported in understanding their reasons and causes	Clinical error by participants if there is no circulation	Intended scenario (no circulation) not fully realized in semantical mode – possible erosion of semantical and phenomenal reality despite attempt to restore them
Simulation instructor tells confederate nurse to suggest resumption of compressions	Using one of the "unrealistic" features of simulation scenarios to help participants to continue scenario and thus learn the most	Probes willingness of participants to accept suggestions; prevents scenario from spiraling out of control	Adaptation of "as-if" of the simulation scenario (modulation) to enhance learning (the goal is learning, not treating a patient)
Patient resuscitated but unstable	Showing the effects of a cognitive error trap ("we made it") that might distort attention; sensitizing for the fact that successful resuscitation is only part of successful treatment of the patient	Reflection of cognitive pitfalls of solving intense problems; the final rescue prevents emotional consequences of dealing with "dead patient"	Modification of simulation scenario to enhance learning and avoid excessive shock to participant morale

(*Continued*)

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Description of the Occurrence	Training-Related Goals	What the Occurrence Means and Points to Consider	Relationship to the Concepts Presented in this Paper
Debriefing			
Anesthesia crew suggests they would never stop compressions in real resuscitation and mentions confusion about SpO2 waveform	Adapt debriefing to the cognitive and emotive status of participants by taking their version of the scenario experience into account	Participants defend their actions; what they would do in real case is unknown – artifacts and ambiguous clinical data may cause similar confusion in real cases	Mismatches in physical and semantical reality can affect the actions and the experience of participants; debriefing has social character that may lead to defensive attitude
Instructor apologizes for error about SpO2 waveform	Restoring common ground and relevance in order not to loose learning atmosphere	Maintains honesty about nature of simulation	Clarifies the rules by which a clinical case (frame) is transformed into a scenario (modulation) by disclosing simulation error in order to enhance learning via debriefing
Instructor asks team to analyze what did happen, whether or not they would have done this in a "real-case"; they comply	An additional attempt to understand the scenario from the participant's perspective and to conduct the debriefing based on this version	Seeks discussion about artifacts and distractions that can confuse or interrupt patient care	Participants and instructor ignore physical and semantical inconsistency, thereby re-establishing phenomenal relevance to achieve educational goal of the learning goal

complexity of both actual cases and simulation scenarios. The dominance of a specific primary frame in a given situation will be related in part to the main role of a person within the situation (eg, instructor versus participant, instructor versus facilitator, or inexperienced versus experienced).

Note that both natural and social primary frames are individual. They represent the view on the natural or social world by a specific person. This implies also that if several people approach the (seemingly) same situation with distinct primary frames, there might be considerable differences in their perception and interpretation of this situation. These differences can be highly relevant for simulation-based training. Consider that novices look at a clinical case with a less elaborate primary frame than experts do. The primary frames of the two groups are likely different, and those of individuals within the groups will also be different. Some differences in primary frames might stem from individual's unique clinical or social experiences (eg, the importance of a certain leadership style during an emergency, preferred drug therapy for a given disease, etc.). Such differences can lead to misunderstandings or disappointed expectations, especially if they are left unrecognized or are dismissed. But differences in frames can also trigger lively and constructive discussions about those situations. It is a matter of the social practice with which attitudes and such differences are addressed. Although certainly some interpretations of a situation are more practicable because they allow for a more precise prediction of future events, no one person has the only "correct" view of the situation—a notion worth keeping in mind for facilitating debriefings.[32] The different views can help a group to see the different aspects of a simulation or the different ways it can illuminate analogous clinical situations.

Both natural and social primary frames can and should be seen from all three modes of thinking defined by Laucken. Consider the pathophysiology of anaphylaxis as a primary frame. The frame contains slots for the physical dynamics, but also slots that are related to relevant semantical concepts and to phenomenal aspects if a person is encountering it. A person knows about the involved (patho)physiology, can describe it using semantical aspects, and relates the encounter of such a case to a specific phenomenal experience. On the other hand, all three modes are also relevant for social primary frames. Consider an interaction in a leadership situation. Physical aspects (eg, facing each other or not, or the audibility of speech volume) are correlated to semantical aspects (seeing each others' responses, or ability to hear and interpret the others' utterances) and then to phenomenal aspects (feeling listened to or feeling part of a team).

Primary frames have borders that define where they are applicable. If a situation exceeds those borders, people may have difficulties in making proper sense of this situation. Consider a physician who, in a clinical case, administered a sufficient dose of muscle relaxant to a patient to render him immobilized, but the patient starts moving. This fact does not fit to a "provided sufficient muscle relaxation" frame and a plausible explanation and adaptation of the frame is needed. The physician could assume that the intravenous line has become blocked or disconnected so the dose of relaxant never entered the body, thereby changing her frame. More generally, when approaching the borders of primary frames, people can try to look for aspects that would help to "defend" the primary frame (potential for fixation errors but also concentration on the important things) or they can replace one primary frame by another (potential for dynamic decision making but also for indecisiveness). We will come back to the example, discussing it from the viewpoint of a simulation scenario.

MODULATIONS

The next step in applying Goffman's frame theory is to consider modulations, which are variations of primary frames. Typical modulations that were mentioned by Goffman are play,[54] rituals, and as-if situations, which we will discuss soon in more detail with reference to Hans Vaihinger,[49] who studied that concept earlier and in more detail. Simulation scenarios can be seen as modulations of clinical cases, as they are an example of as-if situations. In fact, it is surprising to know that Goffman, even in the early 1970s[48] as a pioneer of the study of social interaction, discussed the first patient simulator "SimOne"[55] in detail as an example of an as-if situation for the creation of safe learning in health care.

Like primary frames, modulations allow for the orientation within the world and in particular as-if situations. Modulations also provide interrelated slots that would be filled with aspects of the given situation. However, some additional prerequisites must be fulfilled to call a transformation of a primary frame a modulation and to distinguish it from, for example, deceptions. Attention to these characteristics can be important for simulation instructors to avoid creating simulation scenarios that are hard to understand for participants or that risk making participants feel duped. These practical aspects are discussed in more detail below. Defining characteristics of modulations are:

- The slots within the modulation must already be defined within a primary frame otherwise it would be a new primary frame. For example, simulation scenarios contain similar slots as the clinical cases they mimic (eg, relevant diagnostic steps and reasoning, treatments, other persons to interact with). If the modulation (simulation scenario) contains either more slots (eg, announcements by the simulator operator, which of course do not occur in any clinical setting), or fewer slots (eg, no color change of the mannequin), then participants will need special instructions on how to interpret the modulation correctly (eg, what kind of information to expect via announcements of the operator and how to react to them).
- Participants involved in the modulation must know and acknowledge that they are engaged in a situation that is in fact a modulation, and not the primary frame it represents (eg, participants know that they do not endanger any patient during simulation and can thus be more willing to experiment and learn). Different cues can signal the presence or borders of the modulation. For example, the simulation can be demarcated by time and space, using clear starting and ending points and occurring in a special physical set-up. Knowing where the modulation begins and ends makes it easier for participants as well as instructors to establish common ground and interpreting the simulation scenario in a similar way.
- Participants need to know the applicable rules by which a clinical case is transformed into a scenario. For example, when they should treat a foam-filled plastic bag labeled "ice" as if it were actually a bag of ice. Where participants play different roles than their own (eg, a physician acting as a nurse), or where some clinical roles are played by outside personnel, participants need a basic understanding of role-play: who is who and what role they are enacting. If this is not clear, participants can easily confuse the role-figure with the actor-person. This confusion (which can be unconscious as well as conscious) can be particularly problematic when the role-player is also an instructor as it can inhibit learning or change the intended flow of the session. Or participants might refuse to play a role if they fear that other participants would think that they as professionals actually have the beliefs or would act in the manner of the role-played figure.

Modulations emphasize the shared responsibility of instructors and participants in making simulation work. Participants are asked to "suspend disbelief"[56] and conversely, it is important for instructors to stick to the rules that they have set. Consider the above example again: a patient who has received a sufficient intravenous dose of a muscle relaxant, but starts moving anyway. In the clinical case, a physical explanation within a natural primary frame would be likely (eg, the intravenous line got displaced). If the same happens during a simulation scenario, the physical frame is still relevant, but referring to social frames seems to be more likely (eg, "the simulation operator made a mistake" or "the instructor is trying to trick me"). Simulator instructors have witnessed both kinds of frame-based interpretations used by scenario participants[12] but we still have very limited understanding of how and why learners activate different kinds of primary frames when faced with the same events.[20] However, one might assume that the willing suspension of disbelief is easier, if inconsistencies within the scenario are not due to operator mistakes but have logical reason within the scenario. Only than are the rules by which the modulation is created from the primary frame comprehensible.

For some participants (eg, junior physicians or professional students), the simulation scenario may in fact be the very first (quasi)clinical encounter. In this case, it would not be a modulation but the basis to form a primary frame that the junior clinicians will use in clinical care. This again emphasizes the need for a thoughtful design of scenarios, reflection about the applicability of what is presented during simulation to the clinical setting, and the potential for "negative learning" if the modulation is not well handled.

We have described the different modes of thinking about reality (physical, semantical, phenomenal) and how these can be used to construct modulations (simulations) of primary frames (clinical cases). However, simulation users play a very active role in this whole process and decide when to suspend disbelief. In the next section, we will use the as-if concept to further explore the relationship between simulation scenarios and clinical cases and to investigate how participants can be supported to "buy-in" to the experience.

THE AS-IF CONCEPT

The *as-if* concept was discussed extensively by Hans Vaihinger[49] and is a corner stone of effective simulation.[1,16] The intent of simulation is typically to have participants treat a mannequin as if they were treating a real patient. The key consequences of the diagnostic and therapeutic actions are represented as if they would really occur, even though they are not physically real.

The as-if concept allows for creating a realistic semantical and phenomenal reality based on physical realities that are markedly different from actual patients and clinical cases. This is the case in every scenario in which participants are deeply engaged and that they take (at least partially) for real. Consider an anaphylaxis case and how easily participants often can and do integrate a verbal description of a rash on the patient's chest that they cannot actually see. They often act as if the rash would be given. However, we still do not know enough about the conditions under which they do so or not. One might assume that it helps participants to integrate such information, if they have much experience with similar situations from primary frames in the clinical setting (an emergency physician knows what a trauma patient looks like). On the other hand, detailed primary frames might emphasize differences to the modulation within the simulation scenario (the experienced person recognizes inconsistencies in the scenario that might have been easily overlooked by novices).

Often the scenario is allowed to play out as if the physiology of the simulated patient would follow naturally from the participants' actions. Sometimes the instructor or simulator operator may modify how the scenario plays out in ways that enhance the experience or aid reaching the scenario goal. For example, they might speed up or slow down physiological responses; keep the deteriorating patient state from transitioning to cardiac arrest; provide extra hints, feedback, or help; or even pause and restart the scenario to allow a second chance. The as-if character of the simulation scenario offers much freedom to facilitate learning. In this sense, simulation is sometimes "even better than the real thing," as the rock band U2 might say. Simulation can be become a hyper-reality.[57]

Instructors need to understand this flexibility to use it sensibly, but they also need to be wary of the borders of the as-if concept. For simulation to be effective, participants should either willingly accept this "as-if" character and where necessary suspend disbelief[56], taking on as real patient care what they know is not; or they can acknowledge and accept the artificial character of simulation and the differences from the clinical setting while still seeing the relevance of the exercise for its stated pedagogical goal (or other purposes). For example, they might need to accept that certain mappings between the real and simulated will inherently be flawed (eg, errors by the simulator operator, noised auscultation sounds, robotic-looking arm-movements), and they will need to actively set these aside to maintain the needed as-if character of the exercise. Similarly, they might also have to adapt when a role-player overacts to create a more dramatic (but still plausible) and challenging leadership that can later be discussed. This kind of acceptance occurs mainly in the phenomenal mode: it concerns the experience of the situation that is constructed in relation to its physical and semantical features and with relation to the overall motive of learning.

Helping participants to accept the as-if character is key to increasing the overall fidelity of the simulation experience. A basic (sometimes mechanistic) assumption is often made that participants will be more likely to accept the as-if character of the simulation merely by increasing the physical fidelity of the simulator and the simulation environment. According to this reasoning, the closer the "as-if" of simulation scenarios (their realism) comes to the "it-is-so" of clinical cases (the clinical reality), the easier it is for participants to engage in the simulation scenario and the more willing are they to do so. In doing so, too much emphasis can be placed on the physical aspects of simulation at the expense of the social aspect. If participants, due to social influences, are not willing to suspend disbelief[56] and do not engage into a "fiction contract",[58] there is no way that the physical characteristics of the simulator can make them change their mind.

PRACTICAL IMPLICATIONS FOR THE EDUCATIONAL USE OF SIMULATION

In the following sections, we will provide practical applications for the previously described concepts concerning the use of simulators and simulations for CRM-oriented courses. Table 1 applies these concepts to a fictional example of a simulation scenario and its debriefing. For optimizing simulation scenarios, it is important to recognize, plan, and construct the context in which they are embedded, with particular emphasis on their social character.[33,59–64] Otherwise, many opportunities for making the simulation effective are missed and potential problems in the conduct of the exercise may arise.

THE SOCIAL SIDE OF SIMULATION

The social aspects within and around the simulation scenario include, among others: explicit and implicit motivations and goals of the instructors and participants, the structure and contents of the encounters, the type and intensity of feedback or debriefing, and the overall style or culture of the interactions between participants and instructors. For example, in a research study, participants might be willing to perform certain activities that they would refuse to do in an educational setting.[52] Participants might be more willing to engage in simulation and be more open to self-reflection and learning if the roles of those involved are made very clear, if participants have a basic trust in the instructors, and if they feel that the simulator setting offers a safe educational environment.[32,51,65]

APPLYING THE DIFFERENT MODES OF THINKING

Laucken's different modes of thinking are often traded off against each other in relation to the goals of the simulation: a simulator might be deficient in the physical mode, but it might still be used for simulation scenarios that are highly realistic in semantical or phenomenal mode. For example, the reactivity of pupils can be verbally described even if they cannot be adjusted in a given mannequin, so that this information can still influence diagnosis and treatment. There is no fixed relationship between physical reality of the objects in a simulation and the semantical meaning that participants attach to these objects and how they experience the situation; every participant experiences the same scenario differently. This relationship can be used constructively when all parties involved are able and willing to accept the need to do so, and are competent to make the appropriate semantical and phenomenal translations. In general, participants have to want to simulate. In fact, without this interplay between different modes of thinking, the whole concept of simulation would be impossible, because participants could never get past the gulf between the physical differences between a human being and the artificial mannequin.

Certainly, simulators can and should be improved in terms of their physical aspects (eg, clinical signs). However, considering semantical and phenomenal aspects might help instructors and participants to make more of what is physically already available; in this sense, the whole (simulation scenario) can be more than the sum of its part (the mannequin, role players, interactions, etc.).

Explicitly instructing participants and helping them to reflect on the relationships between simulation and the clinical reality might increase their semantical understanding and phenomenal sense participants make of the scenario. A detailed discussion of such differences might actually trigger many reflection processes about clinical reality and be useful learning in itself. By admitting and maybe even emphasizing these differences (mainly in the physical mode), it might be easier to achieve learning goals instead of focusing simulation realism. The focus could be shifted from the detail features of the simulator (and what it does not provide) to how to maximize learning from the features it has. In fact, simulation is often beneficial not in spite of these differences, but because of them; they make patient simulation a safe environment for education, training, and research and in which many things can be addressed that cannot be addressed in the clinical setting.

The agreement on the relevance of simulation (a mainly phenomenal feature) depends also on transparence within the simulator setting and during simulation scenarios (a mainly semantical feature). If participants believe that the simulation scenario is not constructed or presented according to the rules that were established, they might start to consider it as a "deception" and not accept it as a "modulation." Thus, instructors should strive to "say what they do" and "do what they say."

During debriefing, it can be helpful to analyze the way in which participants experienced the simulation scenario with respect to the different modes of thinking. One key aspect for doing so is to analyze which semantical and phenomenal reality they constructed from the scenario, based on the (physical) properties of the simulator and the social aspect of the (role-played) interactions. Instructors should not assume that participants experienced the scenario in a way in which they were supposed to experience it. Keeping this aspect in mind, every discussion during debriefing should start by asking participants about their view of the scenario. Consider a scenario involving an intracranial hemorrhage in which the pupils are asymmetric and unequally reactive to light. Sometimes participants check only one pupil and assume that the other is the same, or sometimes they check both but do not perceive a difference; they construct their own semantical and phenomenal reality different from that intended by the scenario. During debriefing, it might be more effective to ask, "What did you see when you checked the pupils?", rather than assuming that they perceived the scenario in the way as intended in the scenario. It is important to base the debriefing on the participants' perception of the scenario.

EFFECTIVELY USING THE AS-IF CHARACTER OF SIMULATION

During simulation, it is important to carefully bring participants both into and out of the "as-if" of the scenario. This is easiest when its borders in space and time are defined very clearly and emphasized using rituals. Rituals for starting scenarios can include a strict dress code that is maintained when the scenario is active; crossing a certain door (into the simulation room) to start the scenario; or an official announcement by the simulator controller that the scenario is beginning. It also helps if participants are introduced into a scenario with a plausible case briefing, by which they are given a coherent story about the patient so that they can start to make sense of the simulation scenario.[59,66] On the other end of the scenario, it can be helpful to have a clear marking of the termination of the scenarios, making it easier to actually leave it, both physically and psychologically.

For optimally using such rituals, metacommunication—the communication about communication—can establish a shared understanding of the rituals and "rules of the game" that are used. This is, for example, important when "verbal simulations" to announce clinical signs are used. Metacommunication also helps to establish predictability, which is (as discussed above) important for learning. In an interview study, we found negative effects on the experience of a scenario when metacommunication and rituals were inadequate or absent. One participant mentioned that he was insecure about how to act within the simulation scenario because he did not know how he would recognize that the scenario was over.[12]

Often and for many reasons, participants question the "realism" of the scenario. Discussing in more detail which aspects they criticize and how they relate semantically and phenomenally to the scenario might help to re-establish commitment, training motivation, and relevance. In the pupil example above, the instructor might say, "I didn't notice whether you checked the pupils. That can happen because my task of controlling the simulator is demanding, too. Ok, you assumed that they were equally reactive to light, that was your scenario. So let's discuss your actions based on that assumption, shall we?" It becomes clear that the same physical situation was related to different semantical and phenomenal realities of instructors and participants. We have found that by recognizing and admitting this, it is easier to re-establish the common ground and go on with the debriefing instead of getting involved in arguments of the simulator's fidelity.

RELATING REALISM TO GOALS

For each training goal in a simulator-based training course, the salient characteristics of the targeted tasks need to be delineated. These should be replicated with sufficient fidelity of the salient characteristics of the task, depending on the targeted goals and with respect to the target group. A goal of concept acquisition might mean focusing mostly on semantical reality, regardless of the physical representation of the information from which it is constructed. A goal of acquiring dexterity might mean focusing on physical properties of the movements and the feedback forces of the task to be performed. However, even for dexterity, the simulator does not necessarily have to look like the real thing, as long as it replicates the force patterns with sufficient precision. Addressing and changing attitudes might require an even greater than usual focus on phenomenal reality. There should be enough realism of the right type for the purpose of the simulation, and a design of the social interaction in a way that participants see the simulation endeavor as a relevant environment for the goals with which the simulation is conducted. We still do not know exactly how to design these factors—right now, only trial and error—can determine whether the design is effective. Theoretical approaches [67–70] can guide the design in a more structured way but are used only minimally so far.[32,71]

The different forms of realism, however, might be used more creatively than just trying to maximize fidelity in every aspect. In some cases, it might be beneficial or even necessary to purposefully "depart from realism to provide the most effective training."[1] Participants could repeat the scenario after a debriefing; role-players could emphasize specific difficult aspects of social interactions; the deterioration of the patient's status can be slowed down to provide participants with more time to think; or participants could be integrated in planning their own scenario which might help them reflect about it more deeply. All these elements are not "realistic" uses of simulators but they may be effective for learning. Even looking at the mannequin itself, the lack of physiological signs or the fact that audible signs are noised could trigger reflective discussions about their function in the clinical setting. How exactly do you use physiological signs? What do they tell you? What happens if you do not have them available?

CONCLUSION

Simulation as a complex social endeavor is a powerful technique with many requirements that need to be considered for it to be used optimally. We believe that establishing more clarity about the concepts presented here can help advance the "rational use of simulation"[13] and are beneficial for the training of simulation instructors.[72] Designing, running, and explaining simulation where the goals are primary and the means are secondary opens many possibilities for uses that cannot be readily achieved in the clinical setting. Focusing on the physically exact replication of the clinical setting only does not make the best use of many of the simulation-specific possibilities above and beyond what is possible in the real clinical setting—what makes simulation in many regards "even better than the real thing." When learning is the focus, the flawless recreation of the real world is less important. It is necessary to find situations that help participants to learn, not necessarily the ones that exactly mimic any clinical counterparts.

The conceptual distinctions we articulate can help transform the salient characteristics of clinical tasks into meaningful and relevant scenarios, to increase simulation fidelity where and how it is needed, and to depart from realism where appropriate. They can help refine the communication within the simulator team and between participants and instructors. In the end, the key reality of simulation is the willingness of instructors and participants to meet on common ground for the improvement of the quality and safety of care for the real human beings that are the heart of the healthcare endeavor.

ACKNOWLEDGMENTS

Many people helped in improving this article from its original version. The authors thank Robert Simon (Center for Medical Simulation, Cambridge, MA), Uwe Laucken (Carl-von-Ossietzky University Oldenburg, Germany), and Barry Issenberg, who made extensive efforts to help us revise this manuscript and motivated us with his kind words to keep on working. The Whener Swiss Federal Institute of Technology supervised P. Dieckmann's Ph.D. thesis, on which this text draws exclusively. Last, but not least, we thank the reviewers who helped with constructive feedback and thoughtful suggestions to improve the paper.

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