Review

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Sonopsychology: integrating psychological awareness and patient-centered outcomes into ultrasound practice

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Abstract

Sonopsychology refers to the multidimensional psychological interactions occurring before, during, and after ultrasound examinations. While the psychological effects of radiological examinations are documented, the unique context of ultrasound, marked by real-time imaging and close examiner-patient interaction, has not received equivalent attention. This review explores the psychological dynamics in various contexts – radiology, oncology, and interventional ultrasound – highlighting key domains such as communication, emotional attunement, examiner self-awareness, and the influence of environmental and procedural factors. The concept of Sonopsychology emphasizes that ultrasound is not merely a diagnostic tool or process but also a human encounter. By integrating emotional intelligence and relational competencies into routine practice, examiners can enhance patient satisfaction, trust, and even clinical outcomes. Ultimately, this integrative approach reframes performance assessment emphasizing patient-centered outcomes, moving beyond a solely technical evaluation.

Keywords: ultrasound; patient-centered outcomes; psychology; communication; incidental findings; patient preference; patient perspective

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Introduction: understanding the psychological dimensions of ultrasound

Ultrasound (US) examinations are a routine part of clinical practice for healthcare providers. However, for patients – especially those with little prior exposure to medical imaging – these procedures can be emotionally charged, unfamiliar, and deeply memorable. The psychological impact of imaging has been widely discussed in

the context of radiology, yet specific research and terminology addressing the emotional and cognitive experience of US remain limited. The increasing emphasis on patient-centered care in medicine has led to renewed interest in the relational aspects of the diagnostic processes [1,2]. Among these, US holds a unique place, given its dynamic, real-time nature and the active physical proximity between patient and examiner. Compared to radiological imaging using large devices (CT, MRI), neither the patient nor the examiner can avoid communication during an US examination; communication takes place both verbally and non-verbally. If US is integrated directly into the clinical examination process, this communication also becomes part of the diagnostic process.

The concept of *Sonopsychology* refers to the psychological processes that occur before, during, and after an US examination. It encompasses the interaction between examiner and patient, the patient's emotional and cognitive responses, and the broader psychosocial context in which the examination takes place. These processes are influenced by factors such as patient's prior medical experiences, emotional state, the examiner's communication style and the indication for imaging, reminding us that US is as much a human interaction as it is a diagnostic act, it is a dialogical diagnostic modality [3].

Sonopsychology is especially relevant in areas such as oncology and interventional US, where emotions like fear, vulnerability, hope, or uncertainty are particularly heightened. In these contexts, how information is delivered and how patients are emotionally supported can significantly affect both their short-term experience and their long-term health-related behavior.

Psychological implications before, during and after US examinations were first mentioned by Rettenmaier using the term "Clinical Ultrasound" [4,5]. The term "Sonopsychology" was introduced by Lucas Greiner 2009 [EFSUMB newsletter issue 1 – February 2009] and discussed as part of the Course Book published by the European Federation of Societies for Ultrasound in Medicine and Biology (EFSUMB) and in a German language update [6,7].

The aim of this paper is to introduce and explore the concept of "Sonopsychology", which examines the psychological dimensions and patient-centered outcomes (PCOs) associated with US examinations.

Specifically, this paper aims to: highlight how psychological, emotional, and cognitive factors influence patient experiences before, during, and after US procedures; emphasize the importance of empathetic communication, especially in oncology and interventional settings; encourage US practitioners to develop emotional intelligence, self-awareness, and communication skills as essential components of high-quality, patient-centered sonographic care.

To understand how these dynamics unfold in clinical practice, we explore both the patient's and examiner's perspectives, as well as their interactions.

The patient's perspective: needs, fears and expectations

Patients differ in their age, level of education, their native languages, cultural sensitivities, ability to communicate, previous health literacy [8], experiences of illness, past interactions with healthcare providers, and even coping mechanisms. The indications for US examinations are diverse and range from routine clinical examinations to screening procedures, emergencies and oncological issues. Depending on the indication, but also on the patient's personality and previous experiences, their expectations, hopes and fears associated with the examination also vary greatly. Some patients are very co-operative and grateful while others can be impatient and demanding. Patients with anxiety disorders may have difficulty even entering the US department. Although it may seem self-evident, all patients – regardless of their psychological state – deserve to be treated with respect and empathy. This entails more than simply conveying clinical information; it includes addressing emotional and psychological needs, such as offering reassurance, fostering a sense of safety, and being attuned to the patient's inner experience throughout the examination.

The examiner's perspective: stress, responsibility and emotional exposure

Whether consciously or subconsciously, the daily routine of medical staff is infused with psychology: considering and reflecting on their patients and their own behavior, reactions, emotions, interactions and roles [9]. For the examiner, the US examination is usually a routine procedure, while for the patient, the experience may be considered a memorable event, after which all the details can be subsequently recalled and evaluated [7].

This implies that the examiner should balance efficiency with empathy [10]. Maintaining this balance requires sustained emotional presence, which is only possible when the examiner prioritizes self-care and adopts effective strategies to mitigate stress; particularly when delivering distressing news. Among the varied techniques of stress management, peer support has been identified as

the most effective method for mitigating effects of stress but was noted to be least accessible [11].

Equally important is development of emotional intelligence, which encompasses both the ability to recognize patients' emotional cues as well as self-awareness to monitor how one's own state of mind might impact patient interaction. This requires adjusting the communication and approach to meet each patient's emotional needs [12].

Examiner–Patient interactions

The intersection of patient and examiner dynamics gives rise to a unique relational space, shaped by verbal and non-verbal exchanges, expectations, and the clinical context.

The quality of an examiner not only depends on their scientific and clinical competence but also on the ability to combine their technical expertise with meaningful interpersonal communication [3]. This often overlooked dimension – should be considered as it enables practitioners to resist the reductive scientifically and economically driven healthcare system tendencies. By valuing the relational aspect of the US examination both the patient and examiner can have a more humanized and satisfying experience [13].

Preparing for the encounter

It is self-evident that the patient's consent must be obtained before every examination. In situations where the examiner is unfamiliar with the patient, building trust and gaining the patient's confidence requires additional effort. The examiner must become familiar with the individual patient, identify the patient's needs and concerns early on and tailor their approach accordingly. This underscores the broad range of required competencies, from technical US skills, like psychomotor abilities and image interpretation, to communication skills refined to fluidly adjust to the patient's health literacy, managing anxieties, and to offer reassurance.

In everyday life with time and economic constraints, the medical assistant may accompany the patient into the examination room and, place them undressed on the examination table while the examiner is still writing the findings of the previous patient. This vulnerable position can lead to the patient feeling degraded, gaining the impression that they are just one of many patients and scans for the examiner that day.

It is critical that examiners familiarize themselves with the clinical question before engaging with the patient, to ensure a fully focused interaction from the onset.

Communication and transparency

Individualized and personal care is paramount, beginning with proper introductions. The examiner's body language should convey professionalism and trust, positioning themselves to face the patient while making eye contact. This approach fosters a direct connection and promotes open communication [14-16]. Transparency helps manage patient expectations and prevents potential misunderstandings [16]. A preparatory briefing is helpful, especially for patients unfamiliar with US scanning. This implies preparing the patient by providing clear information about what to expect before, during, and after the procedure. It is important to briefly explain the examination technique and process to the patient, including the objectives of the examination and any personal or technical limitations, if applicable, such as the examiner's level of experience with US.

Effective communication during an US examination is key to ensuring a positive patient experience [16]. The unique conditions of the examination, such as the proximity, calm environment, and scheduled time, offer a valuable opportunity to engage with the patient. This setting allows the examiner to confirm and clarify referral information and to gather more details about the patient's medical history, symptoms, or any areas of discomfort, thus allowing the examination to be tailored accordingly. The clarity of communication is essential: practitioners should give jargon-free information adapted to the known or estimated patient's health literacy. In general, real-time information or results provided immediately after the examination are highly appreciated by patients. A recent study of musculoskeletal US scans found that patients who were randomized to directly receive their examination results from the US examiner reported significantly higher satisfaction compared to patients who did not receive their results directly [14].

Managing uncertainty and vulnerability

Being transparent about any technical difficulties during the examination helps build trust between the examiner and the patient. Open communication about challenges encountered is less likely to generate anxiety than withholding information, as it reassures the patient that the practitioner is handling the situation with professionalism and care.

Patients may feel alarmed when the doctor takes measurements and transfers images to the findings documentation system. Patients often ask whether something is wrong. At the beginning of the examination, the doctor should explain that normal findings are also documented

so that they can be reproduced by other doctors and are available for follow-up checks. At the beginning, the patient should be told that the findings will be evaluated with them. During the examination, it can be explained which organ is currently being examined.

The overall well-being of the patient should be prioritized throughout the entire examination. The examiner should pay close attention to body language cues indicating potential pain [17,18], such as discomfort from transducer pressure, holding a specific position, or prolonged breath-holding, as well as signs of fear and anxiety.

US examinations inherently involve a power imbalance, with the examiner holding greater authority due to their medical expertise, while the patient may feel vulnerable, especially when lying partially undressed during the procedure. The examiner must be mindful of this dynamic and actively work to mitigate it. In addition to maintaining an empathetic posture, ensuring that any body parts not involved in the examination are appropriately covered to maintain patient comfort and dignity, and communicating clearly and transparently to the patient, the examiner should offer to the patient the possibility to engage in a shared decision-making process, allowing the patient to participate in their own care [19].

Negative patient experiences include when the examiner only enters the room once the patient is lying undressed on the examination table, does not know why the examination is being carried out, makes unsettling comments during the examination, or fails to inform the patient of the results of the examination and follow-up plans. In some outpatient situations it is not uncommon for patients to be discharged with the information that the results will be sent to the referring doctor in the next few days or weeks. This may cause uncertainty and fear.

Preserving the relational space

A recurrent challenge during US examinations is the interruption by phone calls. In acute care hospitals, doctors expect to be reachable via phone. Experienced doctors are often asked to make decisions over the phone. For the patient, this means that their examination is interrupted, and the doctor's attention is no longer focused solely on them. In addition, they witness phone calls about potentially serious symptoms and illnesses of other patients. This is very unpleasant and worrying for patients. In this situation, the patient may feel that their complaints are less important and that they are taking up resources that could be used for people who are more seriously ill. The team should seek organizational solutions to avoid this situation.

On the other hand, if assistants or other staff enter the room during the examination to ask the doctor urgent questions, one should always be aware in communication that the patient is present and absorbing all the content of the conversation. The content of the conversation can be disturbing. The patient may also get the impression that the doctor is under a lot of pressure and that their own examination may not be carried out thoroughly.

In conclusion, examiners should ensure that patients understand the results and their implications: time should be provided for the patient to ask any further questions or seek clarification. To empower the patient further, direct feedback on their experience should be asked. Finally, the patient should be thanked for their cooperation.

Organizational and environmental influences

Beyond individual competencies, the quality of the US encounter is also shaped by organizational structures and environmental conditions, which influence the examiner's behavior, the relational dynamic, and ultimately, the patient experience.

The radiology point of view

Owing to the increasing diagnostic speed and volume of imaging procedures, radiologists face significant reporting burdens and consequently have less time to interact with patients [20]. A prospective and randomized study conducted by Gutzeit A et al [21] investigated how well patients remember the radiologist's name after a radiological examination, and whether giving the patient a business card improves the patient's perception of the radiologist's professionalism and esteem. They found that using business cards significantly increased the recall of the radiologist's name (85 % vs. 7 %) and could be an important tool in improving the relationships between patients and radiologists and enhancing service professionalism.

In radiology departments, the US examiner may view the referring clinician as the primary stakeholder rather than the patient. In such contexts, sonographers become the primary points of contact during imaging, serving as the main communicators between referring clinician, US examiner and patient [2].

Advantages of US scanning by highly trained sonographers

The advantages of US scanning by highly trained sonographers working within a radiology department have been recently discussed [5,7]. This approach enhances efficiency, flexibility, and coverage. A single US examiner can reasonably and accurately report over 100 US exams a day when the scans are performed by a team of experienced sonographers. This approach usually enables standardization and rigorous quality assurance, since all exams are performed using standard institutional protocols. Patient dissatisfaction has been reported in cases

where sonographers were conducting the US examination because they weren't qualified to provide direct image interpretation. Nonetheless, sonographer-performed examinations may offer a more relaxed experience, as they are generally subject to fewer time constraints than those performed by clinicians.

The Clinician as examiner

The dialogic nature of US is most clearly manifested when the medical history, physical examination, and US imaging merge together in the concept of Clinical Ultrasound – the treating physician is personally performing the US as an extension of the clinical examination [4]. Like diagnostic catalysts, patients become directly involved in a dynamic, bidirectional exchange of diagnostic information with the treating physician. In this situation, the examination immediately can be extended to other parts of the body or beyond B-mode scanning by involving multiparametric modalities like attenuation imaging, elastography, color Doppler or contrast-enhanced imaging or even performing simple US-guided diagnostic or therapeutic interventions. Clinical and imaging information arising from this clinical US examination can be bundled without any time-delay by the clinician, offering the opportunity for immediate management decisions. The patient–examiner encounter is most intense in clinical US: dialogue, examination, documentation, clinical evaluation, reporting and patient information flow seamlessly into one another. At the same time, however, clinical US places very high demands on the examiner's skills, which must extend equally to US imaging, clinical expertise, and the ability to communicate professionally and empathetically [5].

The role of the examination rooms

The characteristics of the waiting area and the examination room should not be underestimated, as they can influence the patient's experience, their ability and willingness to cooperate, the relationship of trust with the examiner, and thus also the outcome of the examination: temperature, smell, colors and aesthetic design, the comfort of the patient couch, the availability of positioning aids, and the possibility of following the examination procedure on a screen. A special aspect is that, as a rule, the US examination rooms are darkened, at least during the examination. There are two aspects to consider regarding darkened examination rooms: the impact on examiners and the short-term impact on patients during an US examination. Individuals working permanently in an US department may go entire workweeks without exposure to daylight, especially in the winter months. Prolonged lack of natural light has been associated with increased risks of mental health issues or vitamin D deficiency. This can be counteracted through rotating shift schedules that vary work locations and encouraging outdoor breaks and leisure activities in natural light.

For patients, the darkened room represents a temporary condition allowing fewer external visual stimuli during the scan. However, this carries the drawback that examiner and patient may not clearly see each other's faces. This can be addressed by initially keeping the lights on during introductions, clinical history taking and patient positioning on the scanning bed. An alternative approach is "daylight sonography", i.e. using brightness-coded color-tinted images enabling US imaging under photopic (daylight) conditions [22].

The patient and US training of inexperienced practitioners

Part of US training involves performing scans on real patients. It has been shown that the most effective way to learn is through practical experience in the clinical situation. It is difficult in this context to strike an appropriate balance between allowing sufficient examination time for training purposes and avoiding undue burden on the patient [23,24].

It is not unusual in US departments for practitioners in training to carry out a preliminary examination, which is then reviewed and potentially repeated by a qualified practitioner. Patients must be given the choice to consent to examination by a trainee. Ideally, the trainee and the supervising practitioner should introduce themselves together and ask the patient for permission. In educational institutions where educational scans are routine, it is helpful to use a standardized introduction to clarify the objectives and limitations of such scans [24]. It is also important for patients to understand that, while trainees may perform parts of the exam, the final interpretation and clinical decision-making remain the responsibility of the supervising practitioner.

Clinical contexts with specific sonopsychological relevance

The psychological significance of an US encounter varies greatly depending on patient characteristics and clinical context. The following sections outline specific sonopsychological considerations in vulnerable or emotionally charged scenarios [25]. The pediatric and obstetrical view is discussed elsewhere.

Elderly patients

Elderly patients have unique needs. Communication challenges are common due to impairments in vision and/or hearing and additional barriers can arise from limited understanding of the technicalities of the US examination. To effectively convey information about procedures and obtain informed consent, it is essential to select the

relevant information and present it in an accessible manner. The examiner should collaborate with family members or caregivers if communication with the patient is impaired [19,26-28].

Older patients often have physical limitations. They need more time and help to undress, position themselves, and be repositioned during the examination. The team must accept this additional time and not show any impatience.

Oncological patients

When making the initial diagnosis of tumors or during initial tumor staging, it is important to communicate the results carefully [29,30]. Patients usually want to know that "everything is well." When it comes to tumor findings, you should only communicate the results that are truly confirmed beyond doubt. If the findings are suspicious but unclear, you should explain to the patient that you have seen a suspicious finding, what it could mean, and what options there are to clarify it. The imaging team should present itself as a competent group that is looking for solutions in the interests of the patient and that the next necessary diagnostic steps are explained and organized promptly. Involving physicians from different fields to formulate a personalized treatment plan can further strengthen the patient's confidence. Patients undergoing follow-up care for tumor diseases report that they are anxious and suffer from sleep disorders weeks before the examination appointment [31].

If a negative result is found for tumor recurrence or tumor progression, empathic communication is very important. When patients are confronted with concerning findings, they must be given reassurance that all information will be compiled and communicated to the oncologist. They should be asked when their next appointment is with the oncologist to ensure that follow-up occurs in a timely manner. It is always an advantage if the patient is accompanied by their relatives so that they are not alone in the event of unfavorable results. Some patients are no longer able to think clearly in this situation and are unable to absorb the information at all or ask crucial questions. If they are alone, offer to contact a support person for them.

Incidental findings

Incidental findings are those that are newly diagnosed and have no connection with the clinical symptoms that led to the US examination. Focal lesions in young, previously healthy people are highly likely to be benign, whereas in older patients or those with a history of tumors, the probability of clinically and prognostically relevant findings increases. The handling of a large number of incidentalomas from various organs has been published [32-46]. The presence of an abnormal finding must be communicated with appropriate care. If this is an unequivocally benign finding such as a cyst, this should also be articulated immediately so as not to cause alarm. If the finding cannot be clearly assigned, this should also be communicated by explaining what the possible findings could be and how this can be clarified further [47]. For more details we refer to the recently published updates on incidental findings mentioned above [7,33,38,48].

Breaking bad news

Breaking bad news requires an appropriate setting for all medical disciplines including US, sufficient time to manage potentially unpredictable reactions, and appropriate training to deliver difficult news [49]. The first step entails reducing communication barriers using clear language and minimizing medical jargon [50]. Bad news should always be communicated in a protected environment and in an easily understood manner and respectful words should be used. It is important to understand how much a patient is able to take in the information and it may be necessary to vary the pace of delivery with respect to the patient's emotions. It is important to note that active listening and the physician's empathetic reaction is part of emotional support [25]. Proposing a follow-up plan is reassuring and gives the patient a sense of control over their illness. If handled well, delivering bad news is a therapeutic intervention and enhances the patient's ability to deal with illness. Having a clear protocol in place can facilitate this challenging task, providing structure and guidance for the examiner, while ensuring that the patient's emotional and psychological needs are addressed with sensitivity and care. The SPIKES approach (Setting, Perception, Invitation/ Information, Knowledge, Empathy, Summarize) can help to present distressing information in an organized way to patients and families [51].

US guided interventions

Meira M et al [52] described the profile of anxious patients before an US-guided intervention. They found that significantly higher anxiety scores were observed in female patients, those who believed they had received inadequate information from their referring physician, and in patients who considered online information unreliable or difficult to access. However, participants who defined themselves as proactive online reported lower anxiety levels. Although US-guided core needle breast biopsy is a minimally invasive diagnostic procedure, it is reported that patients may experience anxiety and pain. Music has been shown to reduce anxiety and pain related to US-guided core needle breast biopsy [53,54].

Moreover, the suggestion of sedation with propofol is very gratefully accepted by patients and is not associated with any increased risk. This applies to US-guided percutaneous needle biopsy as well as the insertion of

drains. Careful explanation, the announcement of monitoring and sedation with propofol without after-effects reduces patient anxiety. The wish repeatedly expressed by patients is that they not be aware of the procedure at all. For the examiner, this often translates into a less stressful working environment. A patient who has undergone this examination "asleep" without any complaints may also consent to further necessary interventions much more easily [55-58]. However, sedation that requires increased monitoring, documentation and the presence of other providers can change the logistics associated with an otherwise simple and rapid procedure, markedly slowing turnover and severely burdening providers and the medical facility.

Patient-Centered Outcomes (PCOs) in US: a sonopsychological perspective

The majority of evidence-based evaluations of diagnostic tests, including radiological examinations, have mainly focused on diagnostic sensitivity, specificity and accuracy [59]. However, outcomes are influenced by more than diagnostic performance alone [3,60]. Additional factors – such as patient-related variables, psychological profiles, examiner characteristics and diagnostic accuracy of the imaging technique – play an important role [1,2,61-67].

Patient-centered outcomes have gained increasing relevance in medical imaging [66-75]. Compared to other imaging modalities, however, relatively little is known about PCOs in US, a more operator-dependent imaging method in which patient interaction plays a central role. Since the 1970s, efforts to define and evaluate outcomes that matter most to patients have evolved significantly, culminating in the establishment of the Patient-Centered Outcomes Research Institute (https://www.pcori.org/about/about-pcori) in 2010.

Patient-centered outcomes can be defined, for example, as "an assessment of harms and benefits highlighting comparisons and outcomes that matter to people; a focus on outcomes that people notice and care about; and the incorporation of a wide variety of settings and diversity of participants" [2]. Other definitions focus on slightly different characteristics [62,63]. Subgroups or domains of PCOs include cognitive, behavioral, emotional (psychological), social and physical side effects as well as financial costs [76, 77].

Core domains of Patient-Centered Outcomes

A qualitative study by Zigman Suchsland et al identified several core domains of PCOs relevant to US imaging, along with potential moderating factors revealed through thematic analysis [2]. These domains include: knowledge outcomes (e.g., understanding symptoms or receiving answers to clinical questions), emotional outcomes (e.g., reassurance or anxiety), physical effects outcomes (e.g., discomfort and procedural side effects) and patient burden (e.g., financial and opportunity costs).

Knowledge outcomes

Patients seek clarity on why an US is performed, what is being examined, and how the results impact their care. Effective communication is essential, yet may be hindered by literacy, cultural differences, or examiner uncertainty. Balancing information - neither overwhelming nor withholding - is critical to building trust and supporting informed decision-making.

Emotional outcomes

Patients may experience anxiety, fear, or distress before, during, and after an examination. Factors influencing these emotions include prior imaging experiences, cultural background, and the quality of examiner communication. Positive, empathetic interaction can reassure patients, while silence or ambiguous behavior may increase anxiety.

Physical outcomes

Although US is generally safe and pain-free, patients may experience physical discomfort, due to positioning, probe pressure or prolonged breath-holding. Feelings of vulnerability, especially related to undressing, are common and could be amplified by cultural or gender sensitivities. For interventional procedures and contrast-enhanced scans, the risk of rare side effects may be addressed. A careful balance between diagnostic quality and patient comfort should guide the examination.

Patient burden

Patients may face several types of burden: time investment, scheduling delays, long waiting times, out-of-pocket costs, transportation issues and potential disruption to daily schedules. For some, the examination may involve opportunity costs such as missing work or arranging transport - especially relevant in rural or underserved settings.

Behavioral and social outcomes

US can also act as a behavioral intervention. Studies show that sonographic visualization – e.g., of subclinical atherosclerosis, liver fibrosis or inflammatory arthritis – can lead to improved health behaviors, including better diet and increased exercise. In chronic diseases, US enhances understanding, supports shared decision-making, and improves adherence to treatment [78-84]. It can also help manage anxiety by showing treatment effects or disease stability. US evaluation contrasts clinical disease activity evaluation in rheumatoid arthritis patients with concomitant anxiety or depression [85,86].

PCOs: conclusion

US exams are not purely technical events – they have cognitive, emotional, physical, and social dimensions. Recognizing and responding to these domains enables more effective, patient-centered care. Integrating sonopsychological awareness into US routine practice helps ensure that patients feel informed, respected, and supported throughout the diagnostic process.

PCOs do not exist in isolation. They are influenced by several contextual factors: patient's perspective, underlying health status, baseline health literacy, perceived self-efficacy (usually identified as loss of control during examination and waiting time), expectations for the imaging test (realistic and unrealistic), previous experiences, insurance coverage and cultural background. Additionally, the quality and appeal of the US equipment could modify outcomes experienced by patients [2].

Future directions

Integrating sonopsychology into US practice improves patient experience, promotes emotional engagement, and enhances clinical trust. Embedding sonopsychology into US practice not only enhances individual encounters but also sets the stage for future research, training reforms, and performance metrics that reflect the full human complexity of diagnostic imaging.

Training

US training should be attentive to the relational and psychological dimensions of the examination, incorporating selected learning points that promote awareness of communication, patient experience, and emotional context.

Research

Further studies on sonopsychology could explore the following areas:

- The effect of real-time sharing of US images on diagnostic anxiety and patient engagement.
- The influence of examiner characteristics (e.g., gender, training level, specific communication training) on patient satisfaction.
- Cross-cultural studies examining the role of gender, religious beliefs, and health literacy in shaping US-related psychological experiences.
- The emotional burden of US practitioners, particularly in high-stakes or emotionally charged settings, and the potential role of peer support and organizational strategies.
- The impact of clinical US in primary care on doctor-patient relationships and thereby optimized diagnostic pathways
- The behavioral impact of visualizing subclinical conditions (e.g., fatty liver, atherosclerosis) and its role in promoting health behavior change.
- Development and validation of US-specific patient-centered outcome measures encompassing emotional, cognitive, and behavioral domains.

Conclusion

The concept of sonopsychology emphasizes the complex and dynamic interaction between patient and examiner during US examinations (fig 1, fig 2). The full potential of US is expressed when it goes beyond being an imaging technique and becomes a patient-centered encounter integrating cognitive, emotional and behavioral dimensions of both participants.

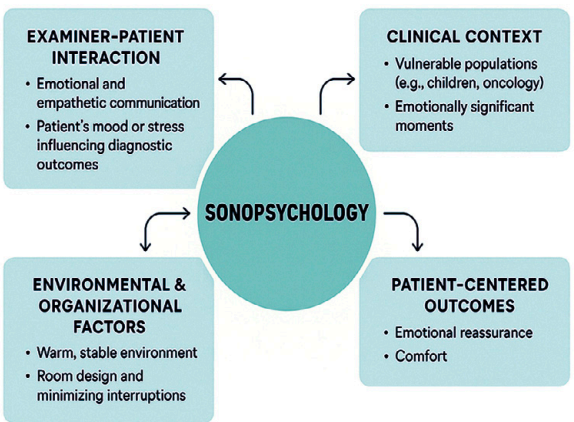

Fig 1. Sonopsychology in practical content. Relation of examiner-patient-interaction, clinical context, environmental and organizational factors and patient centred outcome.

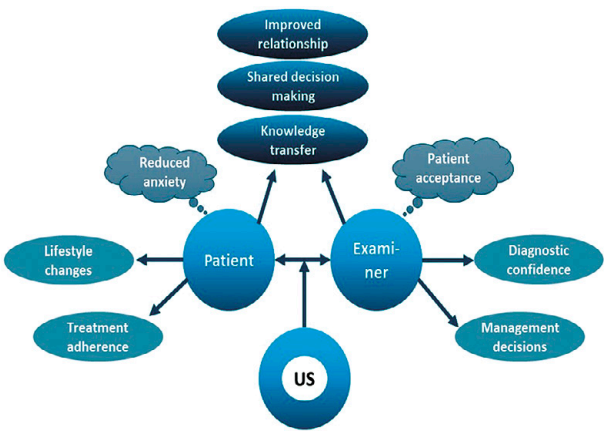

Fig 2. The triangle and relation of patient, examiner and ultrasound.

The motivations, expectations, and fears of both patient and examiner reflect a shared humanity, rooted in common struggles and emotional responses. Both look for answers, assurances, and positive outcomes, each bringing their own hopes and anxieties to the examination.

Including these relational aspects introduces a higher level of complexity into the encounter. Examiners must be competent not only in image acquisition and interpretation but also in communication, relational abilities and emotional attunement. Incorporating relational and communicative dimensions can significantly improve the patient experience. Drawing on psychological concepts in US practice has the potential to transform the examination itself from a mere procedure to a collaborative and supportive experience, and, in some cases, even a therapeutic one.

This shift invites a broader assessment of the US encounter, moving beyond a purely technical evaluation of performance to include patient-centered outcomes, such as effective communication, emotional reassurance, comfort during the procedure, and behavioral impact [3, 87].

Ultimately, this integrative approach reaffirms that imaging is not only about what is seen on the screen, but also about what is felt, understood and communicated within the human interactions that surround it.

Conflict of interest: none

References

1. Thompson MJ, Suchsland MZ, Hardy V, et al. Patient-centred outcomes of imaging tests: recommendations for patients, clinicians and researchers. BMJ Qual Saf 2023;32:536-545.
2. Zigman Suchsland M, Cruz MJ, Hardy V, et al. Qualitative study to explore radiologist and radiologic technologist perceptions of outcomes patients experience during imaging in the USA. BMJ Open 2020;10:e033961.
3. Maio G. Medicine and the holistic understanding of the human being: ultrasound examination as dialog. Ultraschall Med 2014;35:98-107.
4. Rettenmaier G. [Sonographic status of upper abdomen. Diagnostic significance and indications of the ultrasonic sectional examination of the upper abdomen]. Internist (Berl) 1976;17:549-564.
5. Nurnberg D, Jenssen C, Lucius C, et al. [Clinical Ultrasound (ClinUS) - Concepts and Controversies]. Z Gastroenterol 2025;63:279-292.
6. Greiner L. Sonopsychology. In: Dietrich CF, ed. EFSUMB Course Book. London: EFSUMB, 2013;1-5.
7. Lucius C, Jenssen C, Nurnberg D, et al. [Clinical Ultrasound Part II - Sonopsychology or Psychological Interactions using Ultrasound]. Z Gastroenterol 2025.
8. Yeung AWK, Tosevska A, Klager E, et al. Medical and health-related misinformation on social media: bibliometric study of the scientific literature. J Med Internet Res 2022;24:e28152.
9. Balint M. The doctor, his patient and the illness. 2nd ed. London, Pitman Paperbacks, 1968:xii,395.
10. Kerasidou A. Empathy and Efficiency in Healthcare at Times of Austerity. Health Care Analysis 2019;27:171-184.
11. Hardicre NK, Arezina J, McGuinness A, Johnson J. Managing the unmanageable: A qualitative study exploring sonographer experiences of and training in unexpected and difficult news delivery. Radiography 2021;27:369-376.
12. McNulty JP, Politis Y. Empathy, emotional intelligence and interprofessional skills in healthcare education. J Med Imaging Radiat Sci 2023;54:238-246.
13. Doyle C, Lennox L, Bell D. A systematic review of evidence on the links between patient experience and clinical safety and effectiveness. BMJ Open 2013;3:e001570.
14. Kwee TC, Kasalak Ö, Yakar D. Radiologist-patient communication of musculoskeletal ultrasonography results: a choice between added value and costs. Acta Radiologica 2024;65:267-272.
15. Silverman J, Kinnersley P. Doctors'non-verbal behaviour in consultations: look at the patient before you look at the computer. Br J Gen Pract 2010;60:76-78.
16. Vijan A, Bhagwanani A, Calle F, Brun-Vergara ML. Optimizing Patient Communication in Radiology. RadioGraphics 2023;43:e230002.
17. Walker J, van Niekerk M, Hobbs H, et al. The prevalence of anxiety in general hospital inpatients: A systematic review and meta-analysis. Gen Hosp Psychiatry 2021;72:131-140.
18. Morone NE, Belnap BH, He F, Mazumdar S, Weiner DK, Rollman BL. Pain adversely affects outcomes to a collaborative care intervention for anxiety in primary care. J Gen Intern Med 2013;28:58-66.
19. Rockall AG, Justich C, Helbich T, Vilgrain V. Patient communication in radiology: Moving up the agenda. European Journal of Radiology 2022;155:110464.
20. Rosenkrantz AB, Pysarenko K. The Patient Experience in Radiology: Observations From Over 3,500 Patient Feedback Reports in a Single Institution. J Am Coll Radiol 2016;13:1371-1377.
21. Gutzeit A, Fischmann A, Forstner R, et al. "I was seen by a radiologist, but unfortunately I can't remember the name and I still have questions. What should I do?" Radiologists should give thoughts to improve service professionalism and patient esteem. Cancer Imaging 2020;20:18.
22. Bleck JS, Gebel M, Witt B, et al. Sonography under Daylight Conditions. Ultraschall Med 1998;19:259-264.
23. Cao LL, Peng M, Xie X, et al. Artificial intelligence in liver ultrasound. World J Gastroenterol 2022;28:3398-3409.
24. Goldflam K, Goett RR, Lewiss RE, Bania TC, Saul T. Patient Perceptions of Ultrasound Educational Scans in the Emergency Department. The Journal of Emergency Medicine 2014;46:833-838.
25. Rhudy JL, Meagher MW. The role of emotion in pain modulation. Current Opinion in Psychiatry 2001;14:241-245.

26. Frohlich E, Beller K, Muller R, et al. Point of Care Ultrasound in Geriatric Patients: Prospective Evaluation of a Portable Handheld Ultrasound Device. Ultraschall Med 2020;41:308-316.
27. Weinrebe W, Kreppenhofer S, Dietrich CF. [Geriatric ultrasound : Prospective evaluation of ultrasound as extended screening in acute geriatric patients]. Z Gerontol Geriatr 2023;56:647-652.
28. Froehlich E, Pauluschke-Froehlich J, Debove I, Vey W, Klinger C, Dietrich CF. [Geriatric ultrasound]. Z Gastroenterol 2017;55:277-290.
29. Nürnberg D. Palliativmedizinische Interventionen und Bedeutung der Sonografie in der Palliativmedizin In: Dietrich CF, Nürnberg D, eds. Interventioneller Ultraschall. Lehrbuch und Atlas für die Interventionelle Sonografie. Stuttgart, New York: Thieme Verlag, 2011;565-573.
30. Nürnberg D, Jenssen C, Cui X, Ignee A, Dietrich CF. [Ultrasound in palliative care medicine]. Z Gastroenterol 2015;53:409-416.
31. Derry-Vick HM, Heathcote LC, Glesby N, et al. Scanxiety among Adults with Cancer: A Scoping Review to Guide Research and Interventions. Cancers 2023;15:1381.
32. Dietrich CF, Correas JM, Dong Y, Nolsoe C, Westerway SC, Jenssen C. WFUMB position paper on the management incidental findings: adrenal incidentaloma. Ultrasonography 2020;39:11-21.
33. Dietrich CF, Westerway S, Nolsoe C, Kim S, Jenssen C. Commentary on the World Federation for Ultrasound in Medicine and Biology Project "Incidental Findings". Ultrasound Med Biol 2020;46:1815-1820.
34. Jenssen C, Nolsoe CP, Lorentzen T, et al. Incidental findings of gallbladder and bile ducts – Management strategies: Normal findings, anomalies, "silent gallstones" and bile duct dilatation - A World Federation of Ultrasound in Medicine and Biology (WFUMB) position paper. WFUMB Ultrasound Open 2024;2:100034.
35. Sirli R, Popescu A, Jenssen C, et al. WFUMB Review Paper. Incidental Findings in Otherwise Healthy Subjects, How to Manage: Liver. Cancers (Basel) 2024;16.
36. Cekuolis A, Schreiber-Dietrich D, Augustiniene R, et al. Incidental Findings in Pediatric Patients: How to Manage Liver Incidentaloma in Pediatric Patients. Cancers (Basel) 2023;15.
37. Jenssen C, Lorentzen T, Dietrich CF, et al. Incidental Findings of Gallbladder and Bile Ducts-Management Strategies: General Aspects, Gallbladder Polyps and Gallbladder Wall Thickening-A World Federation of Ultrasound in Medicine and Biology (WFUMB) Position Paper. Ultrasound Med Biol 2022;48:2355-2378.
38. Dietrich CF, Fraser AG, Dong Y, et al. Managing Incidental Findings Reported by Medical, Sonography and Other Students Performing Educational Ultrasound Examinations. Ultrasound Med Biol 2022;48:180-187.
39. Petousis S, Chatzakis C, Westerway SC, et al. World Federation for Ultrasound in Medicine Review Paper: Incidental Findings during Obstetrical Ultrasound. Ultrasound Med Biol 2022;48:10-19.
40. Trenker C, Görg C, Freeman S, et al. WFUMB Position Paper-Incidental Findings, How to Manage: Spleen. Ultrasound Med Biol 2021;47:2017-2032.
41. Lewicki A, Freeman S, Jedrzejczyk M, et al. Incidental Findings and How to Manage Them: Testis- A WFUMB Position Paper. Ultrasound Med Biol 2021.
42. Jenssen C, Kahl S. Management of Incidental Pancreatic Cystic Lesions. Viszeralmedizin 2015;31:14-24.
43. Gorg C, Kunsch S, Neesse A. [Incidental findings in abdominal ultrasound. Characteristics and clinical interpretation]. Internist (Berl) 2014;55:998, 1000-1002, 1004-1006 passim.
44. Dietrich CF, Jenssen C. [Focal liver lesion, incidental finding]. Dtsch Med Wochenschr 2012;137:2099-2116.
45. Bialek EJ, Lim A, Dong Y, Fodor D, Gritzmann N, Dietrich CF. WFUMB position paper. Incidental findings of the salivary glands. Med Ultrason 2021;23:329-338.
46. Osterwalder J, Hoffmann B, Blaivas M, Horn R, Matchiner E, Dietrich CF. A Plea for a Paradigm Shift from X-Ray to Ultrasound in Adults: An Update for Emergency Physicians, General Practitioners, Orthopedists and Sports Medicine Physicians. Diagnostics (Basel) 2025;15:1827.
47. Rosenkrantz AB. Differences in Perceptions Among Radiologists, Referring Physicians, and Patients Regarding Language for Incidental Findings Reporting. AJR Am J Roentgenol 2017;208:140-143.
48. Siegel-Richman Y, Kendall JL. Incidental Findings in Student Ultrasound Models: Implications for Instructors. J Ultrasound Med 2017;36:1739-1743.
49. Simpson R, Bor R. 'I'm not picking up a heart-beat': Experiences of sonographers giving bad news to women during ultrasound scans. Br J Med Psychol 2001;74 Part 2:255-272.
50. Harvey JA, Cohen MA, Brenin DR, Nicholson BT, Adams RB. Breaking Bad News: A Primer for Radiologists in Breast Imaging. Journal of the American College of Radiology 2007;4:800-808.
51. Kaplan M. SPIKES: a framework for breaking bad news to patients with cancer. Clin J Oncol Nurs 2010;14:514-516.
52. Meira M, Bitencourt AGV, Travesso DJ, Chojniak R, Barbosa P. Relationship between anxiety and internet searches before percutaneous ultrasound-guided diagnostic procedures: A prospective cohort study. PLoS One 2022;17:e0275200.
53. Soo MS, Jarosz JA, Wren AA, et al. Imaging-Guided Core-Needle Breast Biopsy: Impact of Meditation and Music Interventions on Patient Anxiety, Pain, and Fatigue. J Am Coll Radiol 2016;13:526-534.
54. Akın ME. Effect of music on anxiety and pain during ultrasound-guided core needle breast biopsy: a randomized controlled trial. Diagn Interv Radiol 2021;27:360-365.
55. Dietrich CF. EFSUMB guidelines 2015 on interventional ultrasound. Med Ultrason 2015;17:521-527.
56. Dietrich CF, Lorentzen T, Appelbaum L, et al. EFSUMB Guidelines on Interventional Ultrasound (INVUS), Part III - Abdominal Treatment Procedures (Short Version). Ultraschall Med 2016;37:27-45.

57. Dietrich CF, Lorentzen T, Appelbaum L, et al. EFSUMB Guidelines on Interventional Ultrasound (INVUS), Part III - Abdominal Treatment Procedures (Long Version). Ultraschall Med 2016;37:E1-E32.
58. Schmitt T, Seifert H, Dietrich CF, Caspary WE, Wehrmann T. [Propofol sedation in endoscopic manometry of Oddi's sphincter]. Z Gastroenterol 1999;37:219-227.
59. Hollingworth W, Jarvik JG. Technology assessment in radiology: putting the evidence in evidence-based radiology. Radiology 2007;244:31-38.
60. Maio G. Ethik in der Medizin. Stuttgart: Schattauer Verlag, 2012.
61. Thompson MJ, Hardy V, Zigman Suchsland M, et al. A Secondary Analysis to Identify Patient-Centered Outcomes in the ACR's Appropriateness Criteria. J Am Coll Radiol 2019;16:1645-1655.
62. Thompson MJ, Zigman Suchsland M, Jarvik J, et al. Identifying Health Outcomes that Matter to Patients Getting Imaging Tests: Patient-Centered Outcomes Research Institute (PCORI); 2021.
63. Thompson MJ, Zigman Suchsland M, Jarvik J, et al. PCORI Final Research Reports. In: Identifying Health Outcomes that Matter to Patients Getting Imaging Tests. Washington (DC): Patient-Centered Outcomes Research Institute (PCORI) Copyright © 2021. University of Washington. All Rights Reserved., 2021.
64. Mustafa RA, Wiercioch W, Cheung A, et al. Decision making about healthcare-related tests and diagnostic test strategies. Paper 2: a review of methodological and practical challenges. J Clin Epidemiol 2017;92:18-28.
65. Van den Bruel A, Cleemput I, Aertgeerts B, Ramaekers D, Buntinx F. The evaluation of diagnostic tests: evidence on technical and diagnostic accuracy, impact on patient outcome and cost-effectiveness is needed. J Clin Epidemiol 2007;60:1116-1122.
66. Zigman Suchsland ML, Hardy V, Zhang Y, et al. Provider Perspectives of Patient Experiences in Primary Care Imaging. J Am Board Fam Med 2019;32:392-397.
67. Zigman Suchsland ML, Witwer E, Truitt AR, et al. Patient-Centered Outcomes Related to Imaging Testing in US Primary Care. J Am Coll Radiol 2019;16:156-163.
68. Ferrante di Ruffano L, Hyde CJ, McCaffery KJ, Bossuyt PM, Deeks JJ. Assessing the value of diagnostic tests: a framework for designing and evaluating trials. BMJ 2012;344:e686.
69. Fineberg HV, Bauman R, Sosman M. Computerized cranial tomography. Effect on diagnostic and therapeutic plans. JAMA 1977;238:224-227.
70. Fryback DG, Thornbury JR. The efficacy of diagnostic imaging. Med Decis Making 1991;11:88-94.
71. Gazelle GS, Kessler L, Lee DW, et al. A framework for assessing the value of diagnostic imaging in the era of comparative effectiveness research. Radiology 2011;261:692-698.
72. Lijmer JG, Leeflang M, Bossuyt PM. Proposals for a phased evaluation of medical tests. Med Decis Making 2009;29:E13-21.
73. Starfield B. Is primary care essential? The Lancet 1994;344:1129-1133.
74. Swan JS, Pandharipande PV, Salazar GM. Developing a Patient-Centered Radiology Process Model. J Am Coll Radiol 2016;13:510-516.
75. Ware JE, Jr., Sherbourne CD. The MOS 36-item short-form health survey (SF-36). I. Conceptual framework and item selection. Med Care 1992;30:473-483.
76. Bossuyt PM, McCaffery K. Additional patient outcomes and pathways in evaluations of testing. Med Decis Making 2009;29:E30-38.
77. Harris RP, Sheridan SL, Lewis CL, et al. The harms of screening: a proposed taxonomy and application to lung cancer screening. JAMA Intern Med 2014;174:281-285.
78. Balmuth EA, Luan D, Jannat-Khah D, Evans A, Wong T, Scales DA. Point-of-care ultrasound (POCUS): Assessing patient satisfaction and socioemotional benefits in the hospital setting. PLoS One 2024;19:e0298665.
79. Andersson EM, Johansson H, Nordin S, Lindvall K. Cognitive and emotional reactions to pictorial-based risk communication on subclinical atherosclerosis: a qualitative study within the VIPVIZA trial. Scand J Prim Health Care 2023;41:69-80.
80. Andersson EM, Lindvall K, Wennberg P, Johansson H, Nordin S. From risk communication about asymptomatic atherosclerosis to cognitive and emotional reactions and lifestyle modification. BMC Psychol 2024;12:47.
81. Kjaergaard M, Lindvig KP, Thorhauge KH, et al. Screening for Fibrosis Promotes Lifestyle Changes: A Prospective Cohort Study in 4796 Individuals. Clin Gastroenterol Hepatol 2024;22:1037-1047.e1039.
82. Joshua F, Bailey C, Marabani M, Romas E, White R, Wong P. Perceptions of Doppler ultrasound for rheumatoid arthritis disease activity assessment and education. Int J Rheum Dis 2019;22:55-61.
83. Joplin SK, van der Zwan R, Bagga H, Joshua F, Wong PK. Pilot study assessing the novel use of musculoskeletal ultrasound in patients with rheumatoid arthritis to improve patient attitudes and adherence to medication. Int J Rheum Dis 2016;19:658-664.
84. Bourke S, Taylor WJ, Doyle AJ, Gott M, Dalbeth N. The patient experience of musculoskeletal imaging tests for investigation of inflammatory arthritis: a mixed-methods study. Clin Rheumatol 2018;37:2261-2268.
85. Michelsen B, Sexton J, Kvien TK, Provan SA, Hammer HB. Ultrasound evaluation contrasts clinical disease activity evaluation in rheumatoid arthritis patients with concomitant anxiety or depression. Semin Arthritis Rheum 2024;68:152502.
86. Rajagopalan A, Sathananthan D, An YK, et al. Gastrointestinal ultrasound in inflammatory bowel disease care: Patient perceptions and impact on disease-related knowledge. JGH Open 2020;4:267-272.
87. Jenssen C, Lauer NJ, Burmester E, Will U, Hocke M, Dietrich CF. "Art Meets Science" – Thoughts on Interfaces between Art and Science, and on the Relationship between Information and Aesthetics in Endoscopy and Imaging. Endheu 2013;26:2–12.