Knowledge, Practices, and Acceptance of Physiotherapists Regarding the Use of Immersive Virtual Reality in Clinical Practice: A Cross-Sectional Online Survey.

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Abstract

Purpose: To assess French- and Dutch-speaking physiotherapists' knowledge, practices, and acceptance of immersive virtual reality (VR) in clinical settings.

Materials and methods: A cross-sectional online survey (NCT06252363) was conducted from February to July 2024, targeting French- and Dutch-speaking physiotherapists via non-probability sampling methods. Data were analyzed descriptively.

Results: A total of 155 physiotherapists from eight countries participated, mostly from Belgium. Most (75.5%) had never used immersive VR, while 12.25% were current users and 12.25% past users. Physiotherapists generally demonstrated satisfactory knowledge of immersive VR. Key facilitators and barriers to usage, reasons for discontinuation, and factors contributing to non-use were identified. Half of the never-users showed interest in future use, a minority of past users planned to resume, and nearly all current users intended to continue. Attitudes toward immersive VR were mostly positive, though concerns about cost and value for money were noted. Immersive VR was generally perceived as clinically useful and not overly complex. Social influence did not appear to be a key factor in its adoption.

Conclusions: These findings provide insights into the perspectives of French- and Dutch-speaking physiotherapists regarding the use of immersive VR in clinical settings and may help inform the development of implementation strategies targeting physiotherapists.

Keywords: Virtual reality; Survey; Physiotherapy; Knowledge; Acceptance; Practice

Implications for Rehabilitation

- Although immersive virtual reality is increasingly being studied in physiotherapy and shows promising results across various conditions, only a small proportion of physiotherapists incorporate it in their clinical practice.
- Understanding physiotherapists' perspectives and the factors influencing their adoption of immersive virtual reality is essential for its successful implementation into clinical practice.
- The majority of respondents demonstrated satisfactory general knowledge of immersive virtual reality and reported a favorable level of acceptance, although intention to use varied across user subgroups and social influence appeared to exert little impact on its adoption.
- Key facilitators and barriers to its use, reasons for discontinuation, and factors contributing to non-use were also identified.
- The findings of this study could help inform the design of dissemination and integration strategies targeting physiotherapists.

Introduction

The European health workforce is facing a severe crisis due to an ageing population, which is driving increased demand for health services, as well as an ageing workforce itself.[1] The need for rehabilitation services is also growing and is substantial, particularly due to the ageing population and the rise of noncommunicable diseases.[2,3] Expanding the use of digital health technologies could help address these challenges by improving healthcare professionals' productivity, enhancing patient engagement in their own health management, and advancing universal health coverage.[1,4]

Among these digital health technologies is virtual reality (VR), which can be defined as "a computer-based technology that allows users to interact with a multisensory simulated (virtual) environment and receive real-time feedback on performance."[5] Despite inconsistencies in terminology and classification, VR systems in healthcare are generally categorized into three groups based on their level of immersion: non-immersive, semi-immersive, and (fully-) immersive VR.[6,7] Immersive VR refers to a type of VR system that creates a highly immersive experience within a three-dimensional virtual environment, typically accessed through devices such as head-mounted displays (HMDs).[6–8] Examples of immersive VR systems include smartphone-based, PC-connected, and standalone VR headsets, as well as those with integrated platforms.

Immersive VR is increasingly being studied for its effectiveness in physiotherapy, showing promising results across various conditions. Notable examples include stroke,[9,10] cancer,[11] cardiovascular diseases,[12] and musculoskeletal disorders.[13] Immersive VR holds promise for rehabilitation, as it can be used for both assessment and intervention. Its advantages include the ability to be tailored to patients' needs, real-time performance feedback, increased engagement in therapy, enhanced immersion, and the flexibility to be used in different settings, including at home.[14] However, despite its potential in physiotherapy, recent surveys indicated that only a small proportion of physiotherapists incorporate immersive VR into clinical practice.[15–18] Numerous facilitators and barriers to the implementation of VR in various healthcare settings, including physiotherapy, have been identified. These encompass factors related to patients, clinicians, technology (hardware and software), and organizations (e.g., hospitals and healthcare systems).[15-20] Clinician-related factors influencing VR implementation include, for example, a lack of or sufficient knowledge and skills, positive or negative attitudes and opinions toward immersive VR, as well as perceptions of its ease of use and clinical usefulness.[16-20]

Given the emergence and potential of immersive VR in physiotherapy, contrasted with its limited implementation to date, it is crucial to explore the perspectives of frontline stakeholders and the factors that influence its adoption in clinical practice. Stakeholders such as physiotherapists play a key role as mediators in their patients' access to specific interventions, technologies, or devices.[21] Moreover, since evidence-based practice relies in part on the clinician's individual expertise, it is essential to consider physiotherapists' viewpoints.[22] Understanding their perspectives and the factors influencing their adoption of immersive VR is therefore essential for its successful implementation into clinical practice.[21] In addition, exploring the perspectives of physiotherapists who currently use immersive VR, those who have discontinued its use, and those who have never used it can provide valuable insights into its current implementation in physiotherapy. Such insights can help identify adoption barriers and facilitators, but also guide strategies to promote its integration into clinical practice.

Recent surveys have explored clinicians' perspectives on VR, but they have primarily focused on physiotherapists treating specific patient populations,[15,18] been limited to one country,[15–17,23–26] included therapists other than physiotherapists,[23–25,27,28] or examined broader digital technologies beyond VR.[29] Furthermore, it is often unclear whether these studies investigated only immersive VR or all VR systems, as this distinction is not always specified by the authors. This reflects the current inconsistencies in VR terminology and classification.[6]

Physiotherapists' perspectives may vary depending on the specific patient populations they treat or the country in which they practice. Therefore, exploring these perspectives across different countries and domains of physiotherapy can provide a more comprehensive understanding of the current state of the field. To the best of our knowledge, no study has yet explored the perspectives of French- and Dutch-speaking physiotherapists from all domains of physiotherapy regarding immersive VR. Thus, this survey aimed to evaluate French- and Dutch-speaking physiotherapists' knowledge, practices, and acceptance of immersive VR in clinical settings.

Materials and methods

Study design

This was a cross-sectional online survey conducted among French- and Dutch-speaking practicing physiotherapists from February 23, 2024, to July 23, 2024. This survey was similar to knowledge, attitude, and practice surveys but was broader in scope, as it assessed acceptance rather than just attitude.[30] The reporting of this study aligns with the Checklist for Reporting Results of Internet E-Surveys (CHERRIES),[31] and the Checklist for Reporting of Survey Studies (CROSS).[32]

Since this study evaluated healthcare professionals' practices, formal approval from an ethics committee was not required under Belgian law. However, a favorable opinion was obtained from the Ethics Committee of the Cliniques Universitaires Saint-Luc and Université Catholique de Louvain on December 11, 2023.

The study protocol was preregistered on ClinicalTrials.gov (NCT06252363) and conducted in accordance with the Declaration of Helsinki. Electronic informed consent was obtained from all participants on the second page of the questionnaire, following a comprehensive informed consent form. Participants were explicitly asked to answer "yes" or "no" to the statement: "I declare that I agree of my own free will to take part in this survey." Anonymity was ensured, as no information that could directly identify participants was collected. Confidentiality was rigorously maintained, with each participant assigned a unique identifier based on their order of entry into the study.

Eligibility criteria and recruitment strategy

Participants were eligible for inclusion if they held a degree in physiotherapy, were actively practicing in a clinical setting, and spoke either French or Dutch. They could work in any physiotherapy domain, in any setting (e.g., hospital, private clinic), and on either a part-time or full-time basis.

French- and Dutch-speaking practicing physiotherapists were recruited using non-probability sampling techniques. These included contacting national and international physiotherapy organizations and associations (Belgian, Swiss, Canadian [Quebec], French, Luxembourgish, Dutch) via email to share the survey in their newsletters, displaying posters in relevant locations (e.g., universities, hospitals), posting on social media platforms (e.g., Facebook, LinkedIn), presenting the survey at national and international congresses, and distributing flyers to physiotherapists. Additionally, recruitment was facilitated through the research team's and participants' networks using a snowball approach.

All recruitment materials (i.e., emails, electronic newsletters, posters, flyers, presentations, and social media posts) included information about the survey along with a web link and QR codes to access the online questionnaire. Individuals interested in participating could click the link or scan the QR codes, which directed them to the questionnaire.

Questionnaire development and testing

Design of the questionnaire

The initial version of the questionnaire was developed in two phases. The first phase involved a literature review to identify similar surveys, particularly those investigating the use of VR in healthcare or assessing physiotherapists' knowledge, attitudes, practices, or acceptance of VR, other technologies, or interventions. This helped identify relevant questionnaire items. In the second phase, the research team engaged in in-depth discussions to draft the questionnaire, designing the most relevant and essential items to align with the study's objectives. Items related to acceptance (i.e., intention to use, attitudes, perceived usefulness, perceived ease of use, and social influence) were partially based on the Unified Theory of Acceptance and Use of Technology (UTAUT) model.[33] Additionally, several methodological papers informed the questionnaire design.[30,34,35]

Testing of the questionnaire

The testing of the questionnaire took place after the initial version was designed and involved several phases. The first phase was an expert review to assess the content validity of the questionnaire.[34,35] Next, a cognitive pre-testing phase was conducted with French-speaking physiotherapists to ensure that participants understand the items as intended and can answer in a way that accurately reflects their experiences.[34,36] Two pilot tests followed: one with French-speaking physiotherapists to assess the French version of the questionnaire, and the other with Dutch-speaking physiotherapists to evaluate the Dutch version. These tests primarily aimed to assess the functionality of the questionnaire (accessibility, usability, technical issues) under real-world conditions similar to those of the main survey, determine the average completion time, and verify the proper export of data.[36] After each testing phase, the questionnaire was revised accordingly, and all changes made to the initial version were documented. All testing phases (i.e., objectives, procedures, and samples) are detailed in **Supplementary Appendix 1**.

Final version of the questionnaire

The final questionnaire was presented with 17 screens/pages. The first page provided information about the research team, the study's purpose and description, the voluntary and anonymous nature of participation, the data storage, the personal data protection in accordance with Belgian and European laws, and the ethics committee approval. The second page contained the informed consent form, while the third page asked respondents whether they had already completed the questionnaire in its entirety. The remaining 14 pages comprised the questionnaire itself, which included closed-ended items with response options such as numerical inputs, dichotomous choices (yes/no), multiple-choice selections, and 5-point Likert scales ranging from "strongly disagree" to "strongly agree," with a "neutral" midpoint option.

The final version of the questionnaire consisted of 96 items, organized into the following 14 sections: demographics and professional information (11 items); knowledge about immersive VR (7 items); use of immersive VR in clinical practice (4 items); current use of immersive VR (current users only) (13 items); past use of immersive VR (past users only) (12 items); intention to use immersive VR (never-users only) (7 items); intention to continue using immersive VR (current users only) (2 items); intention to use immersive VR again (past users only) (1 item); attitudes toward immersive VR (never-users only) (8 items); attitudes toward immersive VR (current and past users only) (12 items); perceived usefulness of immersive VR (12 items); perceived ease of use of immersive VR (4 items); social influence (never-users and past users only) (2 items); remarks (1 item). A detailed description of the sections is available in **Supplementary Appendix 1**. The maximum number of items varied by user subgroup, with never-users answering up to 54 items, and both current and past users up to 65 items.

Survey launch

The first six days of the launch involved a "soft launch," during which a convenience sample of 20 physiotherapists was invited to complete the questionnaire. This allowed us to verify the proper functioning of the software and ensure that the questionnaire could be completed seamlessly across different devices (e.g., computer, tablet, smartphone).

Data collection

The survey was conducted and data were collected in real time using LimeSurvey software version 5.6.68 (LimeSurvey GmbH, Hamburg, Germany), a free online survey tool for creating questionnaires and surveys. This software ensured anonymous participation and securely stored data on a designated server (in this case, a server from UCLouvain). Initially planned for four months, the data collection period was extended by one additional month due to a low number of respondents. Therefore, data collection took place over five months, from February 23, 2024, to July 23, 2024.

The survey was open and did not require password protection, as the recruitment strategy aimed to reach a diverse range of physiotherapists. The order of the items remained fixed, without alternation or randomization, since some sections built upon responses and information provided in earlier sections. All items were mandatory; however, the questionnaire included filter questions, meaning certain items were displayed based on previous responses. As a result,

respondents did not answer all items. Participants were not allowed to navigate back between sections but had the option to save their progress and complete the questionnaire at a later time if needed. However, they did not have the possibility to review and change their responses before submitting the questionnaire. Participation was entirely voluntary, with no compensation or incentives provided. Responses were recorded when participants clicked the "Finish" button, and all completed responses were securely stored in the online survey system.

We were unable to prevent participants from responding multiple times, as IP addresses were not stored in compliance with the General Data Protection Regulation, and additional measures such as cookies or user registration were not implemented. However, to minimize the likelihood of duplicate responses, the page following the informed consent form asked participants whether they had already completed the questionnaire in its entirety. If they answered "yes," the questionnaire automatically ended.

Data analysis

Results were exported from LimeSurvey in CSV format and imported into IBM SPSS Statistics (version 27) for analysis. Participants' characteristics as well as outcomes (knowledge, practices, acceptance) were summarized using descriptive statistics. Data normality was assessed through inspections of quantile-quantile (Q-Q) plots. Continuous variables were presented as medians and quartiles, while categorical variables were reported as frequencies and percentages. When reporting levels of agreement from the Likert scales, the responses "somewhat agree" and "strongly agree" were combined into a single "agree" category, while "somewhat disagree" and "strongly disagree" were grouped together as "disagree." Only completed questionnaires were included in the final sample and considered for analysis. Responses from the pre-tests were not included in the final analysis. No methods were used to adjust for non-representativeness of the sample.

Results

The questionnaire was accessed 283 times, including 99 partial responses and 29 individuals stating they had previously completed it in full. Consequently, a total of 155 complete responses were collected over the 5-month period (61% completion rate). Due to the nature of the sampling method and data collection process, it was not possible to determine the number of individuals who viewed the survey or declined to participate. As a result, the response rate, as well as relevant proportions such as view and participation rates, could not be calculated or reported.

Sample characteristics

The median age and professional experience of the total sample were 28 years (Q1–Q3: 25–35; min–max: 22–67) and 5 years (Q1–Q3: 2–13; min–max: 0–43), respectively. The majority of respondents were female (n = 91, 58.7%). Practicing physiotherapists from eight countries participated in the survey, though most were based in Belgium (n = 85, 54.8%) and France (n = 38, 24.5%). The most common primary practice setting was a private clinic, either within a

group (n = 72, 46.5%) or individually (n = 34, 21.9%). Physiotherapists primarily treated young and middle-aged adults (n = 121, 78.1%) and individuals with musculoskeletal pathologies (n = 100, 64.5%). **Table 1** presents the demographic and professional characteristics of the total sample and each subgroup of users.

Knowledge

Most respondents (n = 93, 60.0%) reported having little to no knowledge of immersive VR in a general, non-clinical context, though only a few (n = 2, 1.3%) reported having never heard of it. Others described their knowledge as moderate (n = 30, 19.4%), fairly good (n = 23, 14.8%), or very good (n = 9, 5.8%). While most participants correctly identified immersive VR—compared to non-immersive and semi-immersive VR—when provided with written descriptions (n = 127, 81.9%), fewer did so when presented with images (n = 94, 60.6%). More than 80% (n = 129) agreed that various immersive VR systems and devices are currently available to the general public, while only 7 respondents (4.5%) disagreed.

A total of 135 respondents (87.1%) had already heard of immersive VR applications in physiotherapy, with the most commonly cited sources of information being colleagues (n = 64, 47.4%), scientific articles (n = 59, 43.7%), conferences (n = 49, 36.3%), pre-diploma physiotherapy courses (n = 43, 31.8%), and social networks (n = 39, 28.9%).

Practices

Overall, 117 respondents (75.5%) had never used immersive VR in clinical practice (referred to as never-users). Among them, the most commonly reported barriers were lack of equipment in the workplace (n = 73, 62.4%), equipment cost (n = 58, 49.6%), insufficient knowledge (n = 52, 44.4%), and insufficient skills (n = 46, 39.3%).

Of the 38 respondents (24.5%) who had used immersive VR in their clinical practice, half (n = 19) were still using it at the time of the survey (referred to as current users), while the other half (n = 19) had stopped (referred to as past users).

Current and past users' practices

The detailed characteristics of the practices of current and past users are presented in **Table 2**. Current users reported longer and more frequent use of immersive VR compared to past users (see **Table 2**). However, the overall experience level with immersive VR was similar between both groups, with a median score of 7 on a scale from 0 ('very bad experience') to 10 ('very good experience'). Neurological and musculoskeletal pathologies were the most commonly treated with immersive VR for both current (n = 11, 57.9% for both) and past users (n = 11, 57.9%, and n = 8, 42.1%, respectively). The primary patient age group treated with immersive VR was young and middle-aged adults, for both current users (n = 14, 73.7%) and past users (n = 16, 84.2%).

Systems combining VR headsets and computers were the most commonly employed immersive VR setups among current users (n = 15, 78.9%), while standalone VR headsets were

predominantly employed by past users (n = 12, 63.2%). All current users (n = 19) and nearly all past users (n = 17, 89.5%) reported conducting immersive VR-based rehabilitation in a clinical setting (i.e., clinic, hospital, or rehabilitation center).

Among current users, the main reported reasons and therapeutic goals for using immersive VR were improving stability/balance (n = 17, 89.5%), improving coordination/motor control (n = 15, 78.9%), improving mobility (n = 14, 73.7%), adding fun to rehabilitation (n = 13, 68.4%), and diversifying treatment (n = 13, 68.4%). Among past users, the main reported reasons and therapeutic goals were similar to those of current users, but differed in their ranking: adding fun to rehabilitation (n = 13, 68.4%), improving stability/balance (n = 11, 57.9%), improving coordination/motor control (n = 9, 47.4%), and diversifying treatment (n = 9, 47.4%).

Facilitators to usage reported by most current users included sufficient space to use immersive VR (n = 12, 63.2%), the fun aspect of rehabilitation (n = 12, 63.2%), and patient adherence (n = 10, 52.6%). Barriers to usage reported by most current users included lack of time to use immersive VR (n = 11, 57.9%) and the equipment cost (n = 10, 52.6%). Facilitators and barriers to the use of immersive VR in clinical practice among current users are shown in **Table 3**. Among past users, the three most frequently reported reasons to discontinue using immersive VR were equipment cost (n = 12, 63.2%), lack of space to use it (n = 7, 36.8%), and equipment being unavailable or no longer available (n = 6, 31.6%). Reasons to discontinue using immersive VR in clinical practice among past users are shown in **Table 4**.

Most current users (n = 15, 78.9%) and past users (n = 13, 68.4%) agreed that immersive VR is or was compatible with the other treatment modalities they use(d).

Acceptance

Comprehensive descriptive data on the acceptance of immersive VR across the total sample and all user subgroups are provided in **Supplementary Appendix 2** (raw data) and **Supplementary Appendix 3** (graphs).

Intention to use

Almost half of the never-users expressed interest in incorporating immersive VR into their treatments (n = 57, 48.7%). Among them, the most frequently reported pathologies they would treat included musculoskeletal pathologies (n = 35, 61.4%), neurological pathologies (n = 29, 50.9%), persistent pain (n = 28, 49.1%), and geriatric conditions (n = 27, 47.4%). The three most frequently reported reasons and therapeutic goals for the integration of immersive VR into practice were adding fun to rehabilitation (n = 47, 82.5%), improving coordination/motor control (n = 46, 80.7%), and increasing patient motivation (n = 42, 73.7%). Despite this interest, only a minority intended to use immersive VR in the next two years (n = 18, 31.6%).

Among current users, nearly all (n = 16, 84.2%) intended to continue using immersive VR, with 8 (42.1%) stating they will always try to incorporate it at least once in their treatments if it aligns with the patient's therapeutic goals. In contrast, only a minority of past users intended to use immersive VR again in the future (n = 6, 31.6%), while nearly half (n = 9, 47.4%) remained neutral.

Attitudes

Overall, respondents held positive attitudes toward immersive VR and its application in physiotherapy, with most agreeing with the survey statements (between 54.2% and 77.5%) and only a small proportion expressing disagreement (between 6.4% and 19.3%) (**Figure 1.A**). The only exception was the statement concerning the suitability of immersive VR for children in the context of rehabilitation, which received a lower agreement rate (44.5%) and a higher level of disagreement among physiotherapists (27.8%). Similar trends were observed across user subgroups, although an even smaller proportion of past users agreed with the statement regarding the suitability of immersive VR for children (26.3%), with a higher proportion remaining neutral (47.4%) (see **Supplementary Appendices 2 and 3**).

Additionally, when considering current and past users together, most reported enjoying working with immersive VR (n = 24, 63.2%) and agreed that working with it is fun (n = 30, 78.9%). However, only a minority found the price of immersive VR to be reasonable (n = 5, 13.1%) and believed that it offers good value for money (n = 6, 15.8%) (**Figure 1.A**). Similar trends were observed among current and past users individually, although a smaller proportion of past users agreed with the last two statements compared to current users (see **Supplementary Appendices 2 and 3**).

Perceived usefulness

Overall, physiotherapists perceived immersive VR as useful in clinical practice, with most agreeing with positive statements (e.g., "I think immersive VR can be useful for my current treatments") and disagreeing with negative ones (e.g., "I think immersive VR can negatively interfere with the therapeutic relationship with my patients") (**Figure 1.B**). The statements with the highest agreement rates were those stating that immersive VR could be effective in improving motor function (86.4%), provide a more motivating way to perform exercises compared to traditional therapy (82.0%), be used as a treatment tool (69.7%), and be useful in their treatments over the next five to ten years (68.4%). Notably, almost half of physiotherapists (45.2%) responded neutrally to the statement that immersive VR is poorly tolerated due to its side effects, and fewer than half (48.4%) believed that immersive VR could be useful as a home-based treatment option. Similar trends were observed across user subgroups (see **Supplementary Appendices 2 and 3**).

Perceived ease of use

Overall, a minority of physiotherapists believed that using immersive VR is or would be too complicated for themselves (n = 24, 15.5%), for other physiotherapists (n = 25, 16.1%), or for their patients (n = 42, 27.1%). However, fewer than half (n = 75, 48.4%) felt that using immersive VR in their treatments would be easy, while 39 (25.2%) disagreed (**Figure 1.C**). Similar trends were observed across user subgroups, although a larger proportion of current users agreed with the latter statement (73.7%) (see **Supplementary Appendices 2 and 3**).

Social influence

Overall, when considering never-users and past users together, very few agreed with the statements (n = 5, 3.7%, and n = 9, 6.6%, respectively). For both statements, nearly half were neutral and the other half disagreed (**Figure 1.D**). Similar trends were observed for never-users and past users individually, although a larger proportion of past users disagreed with the second statement (see **Supplementary Appendices 2 and 3**).

Discussion

This cross-sectional online survey aimed to assess French- and Dutch-speaking physiotherapists' knowledge, practices, and acceptance of immersive VR in clinical settings. A total of 155 practicing physiotherapists from eight countries completed the questionnaire.

Although most physiotherapists reported having little to no knowledge of immersive VR, the results of this survey indicate that the overall sample demonstrated an acceptable level of general knowledge, with the vast majority of respondents having already heard of its use in physiotherapy. This suggests a potential discrepancy between physiotherapists' perceived and actual knowledge about immersive VR. This is particularly relevant, as insufficient knowledge about immersive VR was identified in this survey as one of the main reasons for never having used it, whereas sufficient knowledge was reported as one of the main facilitators to usage among current users. Moreover, clinicians' knowledge has been recognized in the literature as a key factor influencing the implementation of VR in healthcare.[19,20] A perceived low level of knowledge among physiotherapists regarding VR and VR-based interventions was also found in the study by Salama et al.[26]

In this survey, nearly a quarter of respondents had used or were currently using immersive VR in clinical practice, a higher proportion than reported in other recent similar studies.[15–18] This discrepancy could be explained by the use of non-probability sampling methods in the present study, which likely introduced selection bias (see the *Strengths and limitations* section for further details). Therefore, this proportion should not be considered a reliable estimate of the actual prevalence of physiotherapists using immersive VR in clinical practice across the represented countries. The sampling method, the small sample size, and the fact that estimating prevalence was not the present survey's objective all limit the generalizability of this finding.

Current and past users in this survey exhibited similar practice characteristics regarding the overall experience level, the primary patient age group and pathologies treated with immersive VR, the rehabilitation setting, and the main reasons and therapeutic goals for integrating immersive VR into their treatments. Both user subgroups also agreed on its compatibility with other treatment modalities. However, several differences were observed, including the duration and frequency of use, and the type of VR system utilized. Some practice characteristics reported in this survey align with findings from previous studies. For example, young and middle-aged adults were the most frequently treated individuals with immersive VR, and musculoskeletal and neurological pathologies were among the most commonly treated conditions.[16–18] Regarding the latter, this may be due to the characteristics of the samples, in which the musculoskeletal and neurological domains were among the most represented.[16,18] Additionally, the main reasons and therapeutic goals for using immersive VR—such as improving

coordination, stability, and mobility—are consistent with those identified in other surveys.[16,18] However, unlike these studies, the present one highlighted that adding fun to rehabilitation and diversifying treatment were also key reasons for using immersive VR. This is noteworthy, as these elements are core features of immersive VR. Similarly, Felsberg et al.[17] reported that using VR as a motivator was one of the primary reasons for its use, which may be closely related to the notions of fun and diversification identified in the present survey. In addition, reducing pain was not a primary therapeutic goal reported in this study, unlike in Slatman et al.[18] This difference may be explained by the focus of the latter survey on persistent pain,[18] whereas the present study examined all physiotherapy domains and conditions, where reducing pain may not always be the primary therapeutic goal.

Equipment cost was one of the main reasons never-users in this study reported for never having used immersive VR, unlike findings from previous surveys.[16,18] Only the study by Salama et al.[26] reported that equipment-related costs (i.e., purchase and maintenance) were perceived as the most important barrier to implementing VR-based interventions in musculoskeletal care. Other key barriers identified in the present study, such as the lack of equipment in the workplace, insufficient knowledge, and insufficient skills, were not highlighted in previous research.[15,16,18,26] This may be partly due to the relatively limited number of response options in previous surveys compared to the present one. However, barriers such as lack of funding and insufficient support for setting up and administering VR, as identified by Alrashidi et al.,[15] may be linked to the concerns about equipment cost and insufficient skills reported in this survey. Similarly, the "clinician familiarity" barrier reported in Salama et al.[26] may be related to the concerns about insufficient knowledge reported in the present survey.

The main facilitators and barriers to immersive VR usage reported by current users, as well as the main reasons past users stopped using it, align with factors previously identified as influencing the implementation of VR in healthcare.[19,20] However, some findings differed from those of other surveys.[15,16] For instance, in this study, lack of time was perceived as a barrier to using immersive VR, whereas Alrashidi et al.[15] identified it as one of the main facilitators. These discrepancies between surveys may stem from the fact that facilitators and barriers vary based on multiple factors, such as country or region, practice setting, and physiotherapy domain.

The proportion of never-users in this survey who reported that they would like to use immersive VR in their treatments was higher than that found in Elser et al.,[16] where only 34.4% of all never-users imagined using VR in the future. However, in the present survey, only a minority of interested never-users intended to use immersive VR within the next two years. In both surveys, musculoskeletal pathologies and persistent pain were among the most commonly reported conditions that physiotherapists would treat with immersive VR.[16] The predominance of these conditions likely reflects the characteristics of the samples in both surveys, where most physiotherapists worked in the musculoskeletal domain. In contrast to Elser et al.,[16] only a minority of past users in the present survey intended to use immersive VR again in the future.

Overall, physiotherapists—whether considered as a whole or within each subgroup of users—held positive attitudes toward immersive VR and its application in physiotherapy. They believed it could be clinically useful and did not perceive it as overly complicated to use, either for themselves, other physiotherapists, or their patients. However, social influence did not appear to be a key factor in the use of immersive VR in clinical practice. These findings may be important considering that attitudes, intention to use, perceived usefulness, and perceived ease

of use all could play a key role in the implementation of VR in healthcare.[19,20] Notably, the findings of Salama et al.[26] also indicate that physiotherapists hold positive perceptions toward VR-based interventions, in the context of musculoskeletal pain management and rehabilitation.

It is important to note that the differences observed between this survey and others may be influenced by various factors, including the country where the survey was conducted and physiotherapists' personal and professional characteristics, such as age, professional experience, affinity with technology, practice setting, and specialization. The fact that some surveys do not specify which type of VR system they investigate, or include a mix of different systems (e.g., immersive and non-immersive), could also help explain some of the differences observed with the present study.

More negative attitudes were observed regarding the suitability of immersive VR for children, which aligns with the recommendations of companies developing VR products, which advise against using immersive VR below a certain age. However, a notable number of studies have been conducted in this population, suggesting that using immersive VR is both feasible and safe.[37,38] Physiotherapists also expressed concerns regarding the cost and value for money of immersive VR. This is noteworthy, as the availability of immersive VR technology has improved in recent years, with increasingly accessible price points, which should help mitigate these concerns in the future.[27] However, since the present survey did not investigate the specific hardware and software used, it is not possible to directly link these negative attitudes to them.

The discrepancy between physiotherapists' acceptance of immersive VR and its current usage in clinical practice may reflect the complexity of the implementation process in healthcare, which involves more stakeholders than just physiotherapists and more factors than just acceptance.[19,20,39,40] This is further evidenced by the fact that fewer than half of the physiotherapists in this survey felt it would be easy to integrate immersive VR into their treatments.

The findings of this study could help inform the design of implementation strategies targeting physiotherapists. For instance, the primary sources of information on the use of immersive VR in physiotherapy, as identified in this survey, could be leveraged in dissemination strategies to enhance physiotherapists' awareness, knowledge, skills, attitudes, and intention to adopt immersive VR in clinical practice.[41] These strategies could include, for example, the integration of immersive VR into initial physiotherapy training programs, continuing education training with hands-on workshops, webinars or educational videos, targeted dissemination of simplified scientific publications (such as infographics), or even testimonials from physiotherapists using immersive VR in clinical practice supported by clinical case examples. Additionally, the identified facilitators and barriers to the use of immersive VR, along with the reasons for never having used it or for discontinuing its use, could be considered in integration strategies aimed at promoting the adoption of immersive VR in clinical physiotherapy practice.[41]

Strengths and limitations

To our knowledge, this is the first survey to explore the knowledge, practices, and acceptance of immersive VR in clinical settings among French- and Dutch-speaking physiotherapists, offering new insights into this topic. The questionnaire development process adds to its robustness, incorporating insights from the research team and previous literature, following

methodological papers,[30,34–36] utilizing the UTAUT model[33] to assess acceptance, undergoing multiple testing phases, and being translated by certified translators. However, the absence of a validated questionnaire, such as the Assessing Determinants Of Prospective Take-up of Virtual Reality (ADOPT-VR) instrument,[21,24] may be considered a limitation. Additionally, eligibility criteria were broad, allowing all practicing physiotherapists who spoke French or Dutch to participate, which helped avoid the limitations associated with overly restrictive inclusion criteria. Moreover, the online mode of data collection facilitated widespread distribution of the questionnaire, minimized data entry errors, and may have encouraged more accurate reporting of attitudes and behaviors.[34]

Several limitations must be acknowledged. First, as previously mentioned, the non-probability sampling methods may have introduced selection bias, likely influencing the sample characteristics (e.g., resulting in a relatively low median age and a predominance of physiotherapists practicing in Belgium, working in private practice, and in the musculoskeletal domain), the proportions of current and past users, and some of the results (e.g., physiotherapists with a particular interest in immersive VR may have been more inclined to participate, leading to more positive attitudes). The recruitment strategies used may also have excluded a proportion of physiotherapists (e.g., use of social media, presentation of the survey at conferences, placement of posters in specific locations). This, in turn, limits the sample's representativeness and the generalizability of the findings.[42] However, the inclusion of more current and past users provided deeper insights into their practices and acceptance of immersive VR. Second, the small overall sample size and the limited size of user subgroups further restrict the generalizability of the findings and prevented meaningful comparisons across the represented countries and physiotherapy domains. Third, the data collection method prevented the estimation of a response rate for the survey and other relevant proportions such as view and participation rates. Finally, due to the anonymous nature of the questionnaire and the absence of cookie or IP address tracking, multiple submissions may have been possible. However, this is likely minimal, as a related question at the beginning of the survey helped mitigate this issue.

Conclusions

The results revealed that the majority of respondents had never used immersive VR in clinical practice. However, most demonstrated a satisfactory general knowledge of the technology, as assessed by our questionnaire. The survey identified the practice characteristics of both current and past users, highlighting their similarities and differences. Key facilitators and barriers to the use of immersive VR, reasons for discontinuation, and factors contributing to non-use were identified. Regarding acceptance, the intention to use immersive VR varied across user subgroups: half of never-users expressed interest in integrating it into their practice, a minority of past users intended to resume its use, and nearly all current users intended to continue using it. Overall, physiotherapists held positive attitudes toward the use of immersive VR in physiotherapy, although concerns were raised about its cost and value for money. Additionally, most respondents perceived immersive VR as clinically useful and not overly complex. Social influence did not appear to play a key role in its adoption. Given the aforementioned limitations, these findings should be interpreted with caution, taking into account the sample characteristics, and should not be generalized to all physiotherapy domains or to all countries represented in the survey.

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Declaration of interest

The authors report there are no competing interests to declare.

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Data availability statement

The data that support the findings of this study are available from the corresponding author [A.L.], upon reasonable request.

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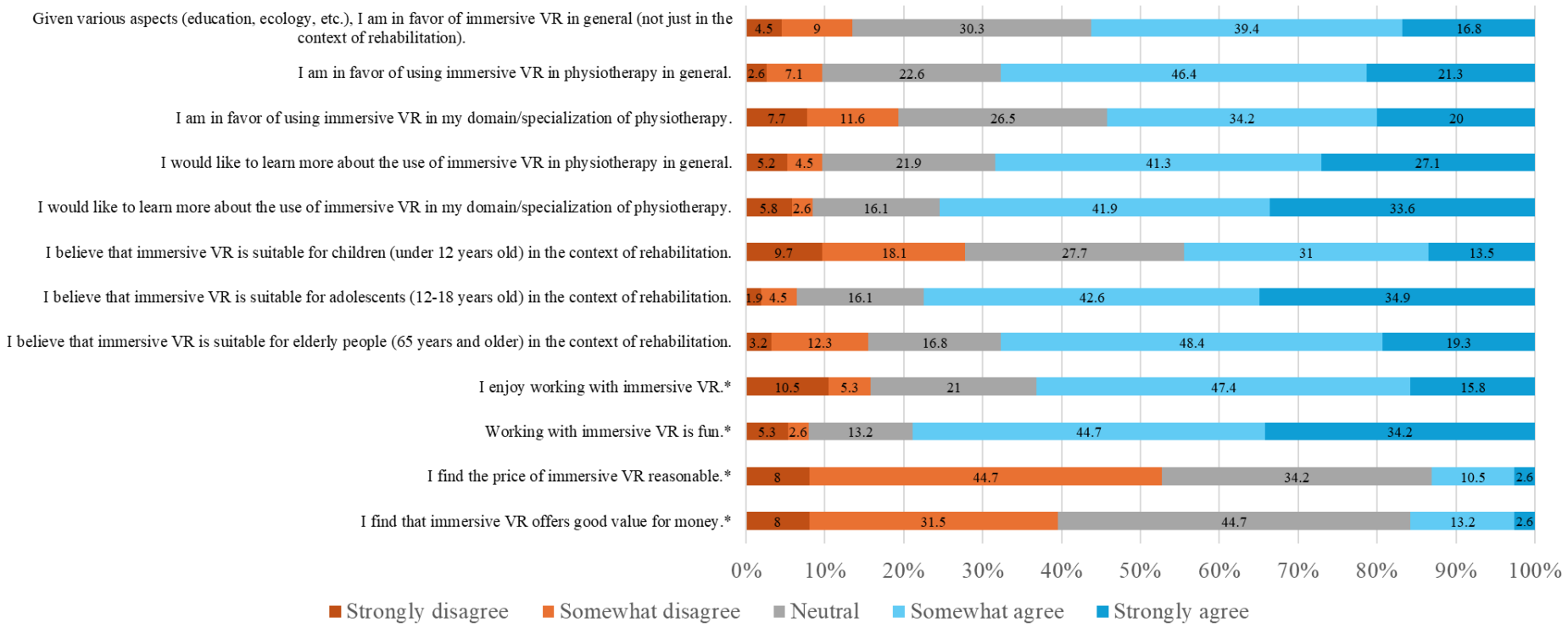


Figure 1.A. Attitudes toward the use of immersive VR in clinical practice (total sample). *Only current and past users.

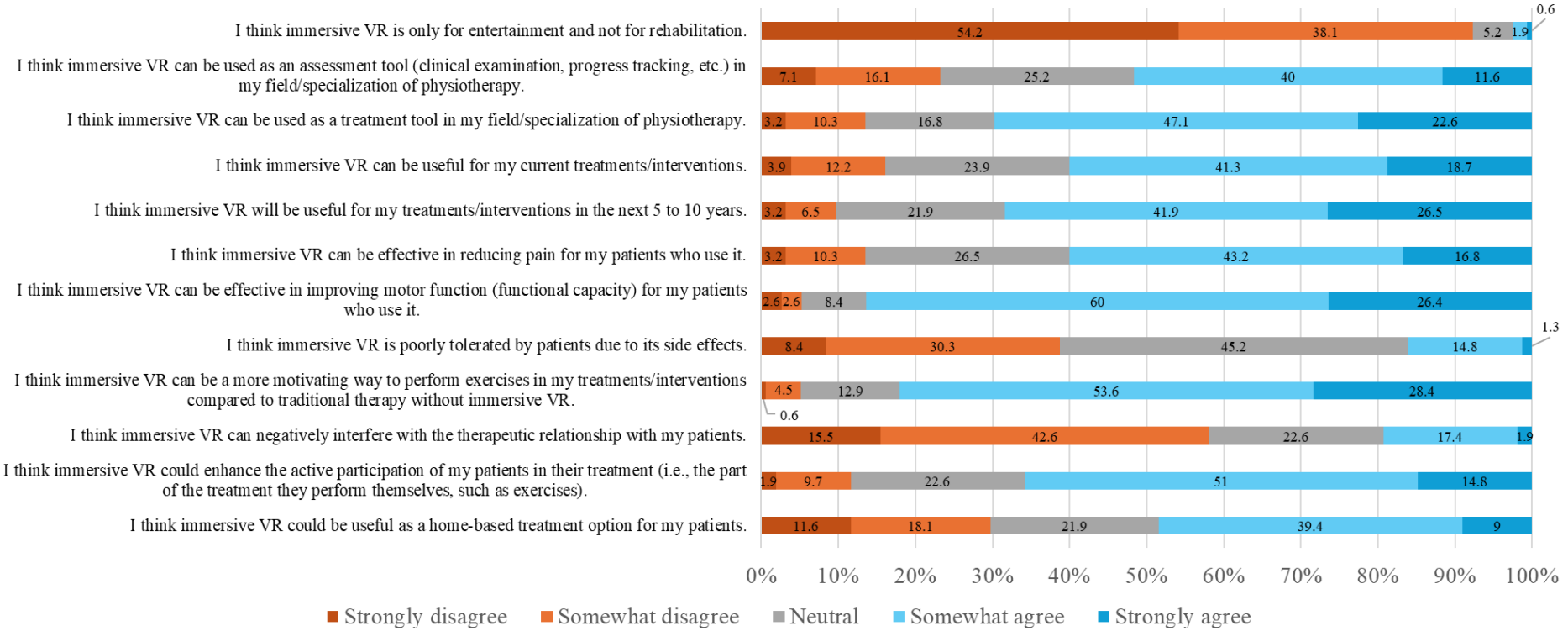


Figure 1.B. Perceived usefulness of immersive VR in clinical practice (total sample).

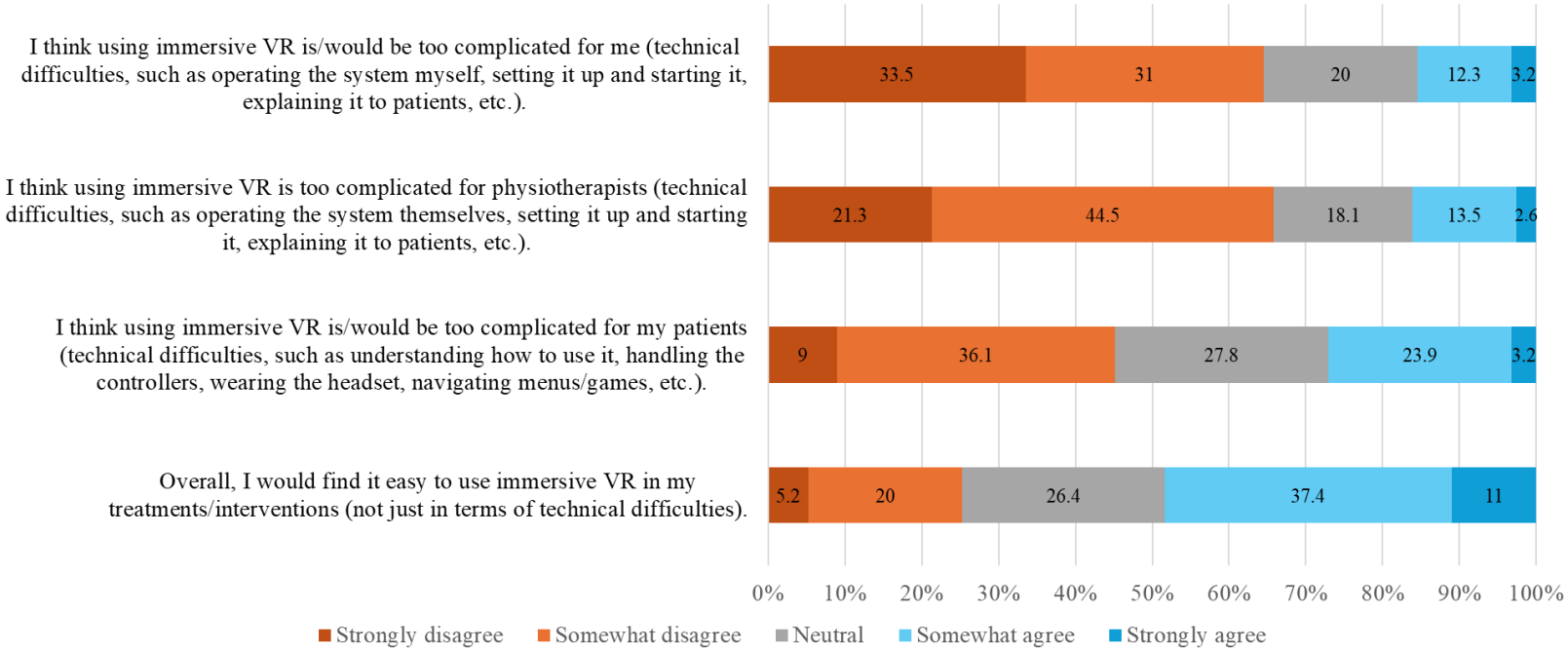


Figure 1.C. Perceived ease of use of immersive VR in clinical practice (total sample).

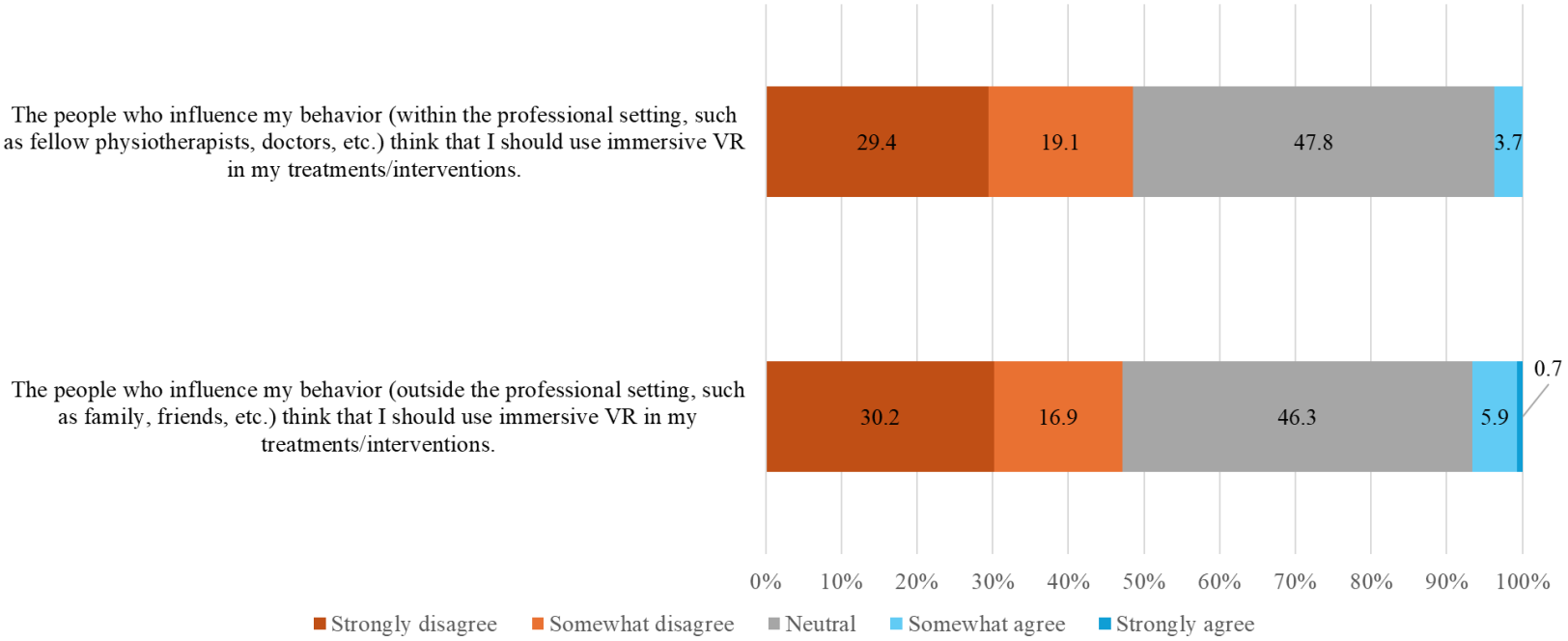


Figure 1.D. Social influence on the use of immersive VR in clinical practice (never-users and past users).

Figure 1. Acceptance of the use of immersive VR in clinical practice. VR = Virtual reality.

Table 1. Characteristics of the total sample and subgroups of users.

Characteristics	Total sample	Never-users	Current users	Past users
Sample size	155	117	19	19
Age (years)	28 (25–35; 22–67)	28 (25–34; 22–67)	33 (26–46; 22–51)	27 (24–40; 23–57)
Professional experience (years)	5 (2–13; 0–43)	5 (2–10; 0–43)	13 (3–23; 1–30)	3 (1–10; 0–34)
Sex				
Female	91 (58.7)	71 (60.7)	9 (47.4)	11 (57.9)
Male	64 (41.3)	46 (39.3)	10 (52.6)	8 (42.1)
Country of studies				
Belgium	117 (75.5)	92 (78.6)	14 (73.7)	11 (57.9)
The Netherlands	13 (8.4)	7 (6.0)	3 (15.8)	3 (15.8)
France	12 (7.7)	9 (7.7)	1 (5.3)	2 (10.5)
Canada	5 (3.2)	3 (2.6)	1 (5.3)	1 (5.3)
Switzerland	4 (2.6)	4 (3.4)	0 (0.0)	0 (0.0)
Spain	2 (1.3)	0 (0.0)	0 (0.0)	2 (10.5)
Algeria	1 (0.6)	1 (0.9)	0 (0.0)	0 (0.0)
Germany	1 (0.6)	1 (0.9)	0 (0.0)	0 (0.0)
Highest level of education				
Diploma of Collegial Studies in physiotherapy techniques	4 (2.6)	3 (2.6)	0 (0.0)	1 (5.3)
Bachelor's degree or equivalent	18 (11.6)	15 (12.8)	3 (15.8)	0 (0.0)
Master's degree or equivalent	131 (84.5)	98 (83.8)	16 (84.2)	17 (89.5)
Doctorate (PhD) or equivalent	2 (1.3)	1 (0.9)	0 (0.0)	1 (5.3)
Country of practice				
Belgium	85 (54.8)	70 (59.8)	10 (52.6)	5 (26.3)
France	38 (24.5)	25 (21.4)	3 (15.8)	10 (52.6)
The Netherlands	12 (7.7)	7 (6.0)	2 (10.5)	3 (15.8)
Luxemburg	9 (5.8)	7 (6.0)	2 (10.5)	0 (0.0)
Canada	5 (3.2)	3 (2.6)	1 (5.3)	1 (5.3)
Switzerland	4 (2.6)	4 (3.4)	0 (0.0)	0 (0.0)
Algeria	1 (0.6)	1 (0.9)	0 (0.0)	0 (0.0)
Mexico	1 (0.6)	0 (0.0)	1 (5.3)	0 (0.0)
Primary practice setting				
Group private practice/clinic	72 (46.5)	57 (48.7)	6 (31.6)	9 (47.4)
Individual private practice/clinic	34 (21.9)	26 (22.2)	3 (15.8)	5 (26.3)
Public hospital	13 (8.4)	8 (6.8)	2 (10.5)	3 (15.8)
Multidisciplinary rehabilitation center	11 (7.1)	6 (5.1)	5 (26.3)	0 (0.0)
Medical center	9 (5.8)	9 (7.7)	0 (0.0)	0 (0.0)
Private hospital	6 (3.9)	3 (2.6)	2 (10.5)	1 (5.3)
Patient's home	3 (1.9)	3 (2.6)	0 (0.0)	0 (0.0)
Nursing home/Residence for older adults	2 (1.3)	2 (1.7)	0 (0.0)	0 (0.0)
Academy/Research	2 (1.3)	1 (0.9)	0 (0.0)	1 (5.3)
Specialized schools or institutions	2 (1.3)	1 (0.9)	1 (5.3)	0 (0.0)
Company/Corporate	1 (0.6)	1 (0.9)	0 (0.0)	0 (0.0)
Specialized				
Yes	110 (71.0)	86 (73.5)	12 (63.2)	12 (63.2)
No	45 (29.0)	31 (26.5)	7 (36.8)	7 (36.8)
Specialization				
Musculoskeletal	49 (44.5)	42 (48.8)	2 (16.7)	5 (41.7)
Sports	12 (10.9)	9 (10.5)	2 (16.7)	1 (8.3)
Pediatric	10 (9.1)	9 (10.5)	1 (8.3)	0 (0.0)
Neurological	9 (8.2)	2 (2.3)	4 (33.3)	3 (25.0)
Perineological/Pelvic health	7 (6.4)	6 (7.0)	1 (8.3)	0 (0.0)
Other	7 (6.4)	5 (5.8)	1 (8.3)	1 (8.3)
Respiratory	5 (4.5)	5 (5.8)	0 (0.0)	0 (0.0)
Vestibular	3 (2.7)	0 (0.0)	1 (8.3)	2 (16.7)
Oncological	2 (1.8)	2 (2.3)	0 (0.0)	0 (0.0)
Geriatric	2 (1.8)	2 (2.3)	0 (0.0)	0 (0.0)
Persistent pain	2 (1.8)	2 (2.3)	0 (0.0)	0 (0.0)
Cardiovascular	1 (0.9)	1 (1.2)	0 (0.0)	0 (0.0)
Psychosomatic	1 (0.9)	1 (1.2)	0 (0.0)	0 (0.0)
Burn victims	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)

Main treated patients' age category				
Children (under 12 years)	8 (5.2)	7 (6.0)	1 (5.3)	0 (0.0)
Teenagers (12-18 years)	2 (1.3)	1 (0.9)	0 (0.0)	1 (5.3)
Young and middle-aged adults (18-64 years)	121 (78.1)	90 (76.9)	13 (68.4)	18 (94.7)
Older adults (65+ years)	24 (15.5)	19 (16.2)	5 (26.3)	0 (0.0)
Main treated patients' condition category				
Musculoskeletal	100 (64.5)	82 (70.1)	8 (42.1)	10 (52.6)
Neurological	19 (12.3)	7 (6.0)	8 (42.1)	4 (21.1)
Sports	11 (7.1)	8 (6.8)	1 (5.3)	2 (10.5)
Other	8 (5.2)	7 (6.0)	1 (5.3)	0 (0.0)
Persistent pain	5 (3.2)	4 (3.4)	0 (0.0)	1 (5.3)
Vestibular	4 (2.6)	1 (0.9)	1 (5.3)	2 (10.5)
Respiratory	3 (1.9)	3 (2.6)	0 (0.0)	0 (0.0)
Perineological/Pelvic health	2 (1.3)	2 (1.7)	0 (0.0)	0 (0.0)
Oncological	2 (1.3)	2 (1.7)	0 (0.0)	0 (0.0)
Cardiovascular	1 (0.6)	1 (0.9)	0 (0.0)	0 (0.0)
Burn victims	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)
Intensive care	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)

Data are presented as median (Q1-Q3; min-max) and number (%).

Table 2. Practices characteristics of current users (n = 19) and past users (n = 19).

Practices characteristics	Current users	Past users
Duration of use (years)	2 (1–3; 0.5–8)	0.1 (0.1–0.5; 0–2)
Overall experience level (0-10)	7 (6–8; 3–10)	7 (5–8; 0–8)
Frequency of use		
Every day	2 (10.5)	0 (0.0)
One to several days per week, but not every day	7 (36.8)	2 (10.5)
One to several days per month, but not every week	5 (26.3)	4 (21.1)
One to several days per year, but not every month	4 (21.1)	1 (5.3)
Almost never	1 (5.3)	12 (63.2)
Pathologies treated*		
Neurological	11 (57.9)	11 (57.9)
Musculoskeletal	11 (57.9)	8 (42.1)
Vestibular	6 (31.6)	3 (15.8)
Sports-related	5 (26.3)	4 (21.1)
Persistent pain	5 (26.3)	2 (10.5)
Geriatric	3 (15.8)	3 (15.8)
Cardiovascular	1 (5.3)	1 (5.3)
Oncological	0 (0.0)	0 (0.0)
Pediatric	0 (0.0)	2 (10.5)
Respiratory	0 (0.0)	0 (0.0)
Perineological/Pelvic health	0 (0.0)	0 (0.0)
Burn victims	0 (0.0)	0 (0.0)
Other	0 (0.0)	2 (10.5)
Patients' age categories treated*		
Children (under 12 years)	2 (10.5)	3 (15.8)
Teenagers (12-18 years)	5 (26.3)	8 (42.1)
Young and middle-aged adults (18-64 years)	14 (73.7)	16 (84.2)
Older adults (65+ years)	8 (42.1)	6 (31.6)
Immersive VR systems used*		
Immersive VR with a headset and computer	15 (78.9)	8 (42.1)
Immersive VR with a standalone headset	6 (31.6)	12 (63.2)
Immersive VR with a platform	1 (5.3)	2 (10.5)
Immersive VR with a headset and smartphone	0 (0.0)	2 (10.5)
Immersive VR with a CAVE system	0 (0.0)	0 (0.0)
Rehabilitation types*		
Clinic/hospital/center-based rehabilitation	19 (100.0)	17 (89.5)
Home rehabilitation	1 (5.3)	0 (0.0)
Self-rehabilitation at home	0 (0.0)	0 (0.0)
Telerehabilitation	0 (0.0)	1 (5.3)
Other	0 (0.0)	1 (5.3)
Reasons and therapeutic goals to use immersive VR*		
Improve stability/balance	17 (89.5)	11 (57.9)
Improve coordination/motor control	15 (78.9)	9 (47.4)
Improve mobility	14 (73.7)	7 (36.8)
Add fun to rehabilitation	13 (68.4)	13 (68.4)
Diversify treatment	13 (68.4)	9 (47.4)
Increase motivation	11 (57.9)	6 (31.6)
Distraction	9 (47.4)	8 (42.1)
Encouragement (challenge)	8 (42.1)	7 (36.8)
Intensification of treatment	7 (36.8)	2 (10.5)
Improve adherence to treatment	7 (36.8)	8 (42.1)
Improve muscular endurance	6 (31.6)	2 (10.5)
Multisensory stimulation	6 (31.6)	8 (42.1)
Active approach to treatment (exercises)	6 (31.6)	7 (36.8)
Escape (going outside the therapeutic framework)	6 (31.6)	8 (42.1)
Pain reduction	5 (26.3)	2 (10.5)
Improve cognitive function	5 (26.3)	4 (21.1)
Improve strength	5 (26.3)	1 (5.3)
Progressive exposure to movement (gradual exposure)	3 (15.8)	7 (36.8)
Relaxation	2 (10.5)	1 (5.3)
Other	2 (10.5)	5 (26.3)
Self-rehabilitation	1 (5.3)	1 (5.3)

Improve walking	1 (5.3)	3 (15.8)
Improve cardiorespiratory endurance	1 (5.3)	1 (5.3)
Therapeutic education	0 (0.0)	1 (5.3)
No specific reason	0 (0.0)	0 (0.0)

Data are presented as median (Q1-Q3; min-max) and number (%).
VR = Virtual reality; CAVE = Cave automatic virtual environment.
*Questions where multiple responses were possible.

Table 3. Facilitators and barriers to the use of immersive VR among current users (n = 19).

Facilitators to usage	**N (%)**
Sufficient space to use it	12 (63.2)
Fun aspect of rehabilitation	12 (63.2)
Patient adherence	10 (52.6)
Sufficient knowledge	9 (47.4)
Sufficient skills	8 (42.1)
Effectiveness for patients	8 (42.1)
Time available to use it	7 (36.8)
Patients who can benefit	7 (36.8)
Cost of equipment	6 (31.6)
Particular interest in this means of rehabilitation	6 (31.6)
Ease of use for physiotherapist	6 (31.6)
Perceived clinical usefulness	5 (26.3)
Requests from patients	4 (21.1)
Ease of use for patients	3 (15.8)
Accessibility of information about immersive VR	2 (10.5)
Being able to manage several patients at the same time	1 (5.3)
No specific reason	0 (0.0)
Other	0 (0.0)
Barriers to usage	**N (%)**
Lack of time to use it	11 (57.9)
Cost of equipment	10 (52.6)
Lack of space to use it	5 (26.3)
Side effects of immersive VR	5 (26.3)
Few patients who could benefit	4 (21.1)
No/less perceived clinical usefulness	3 (15.8)
Number of patients to manage at the same time (more than 1)	3 (15.8)
Insufficient skills	2 (10.5)
Insufficient knowledge	2 (10.5)
Lack of requests from patients	2 (10.5)
Difficulty of use for patients	2 (10.5)
No/few benefits for patients	2 (10.5)
Other	2 (10.5)
Inadequate or outdated immersive VR system/device	1 (5.3)
No/less adherence of patients	1 (5.3)
Difficulty of use for physiotherapist	1 (5.3)
No specific reason	0 (0.0)

Data are presented as number (%).
VR = Virtual reality.

Table 4. Reasons to discontinue using immersive VR among past users (n = 19).

Reasons to discontinue using immersive VR	N (%)
Cost of equipment	12 (63.2)
Lack of space to use it	7 (36.8)
Equipment not/no longer available	6 (31.6)
Side effects of immersive VR	4 (21.1)
Insufficient skills	3 (15.8)
Insufficient knowledge	3 (15.8)
Difficulty of use for patients	3 (15.8)
Few patients who could benefit	2 (10.5)
No particular interest in this means of rehabilitation	2 (10.5)
Difficulty of use for physiotherapist	2 (10.5)
Lack of time to use it	1 (5.3)
Inadequate or outdated immersive VR system/device	1 (5.3)
Lack of requests from patients	1 (5.3)
No/less adherence of patients	1 (5.3)
No/few benefits for patients	1 (5.3)
Bad experiences as a physiotherapist	1 (5.3)
No specific reason	1 (5.3)
Other	1 (5.3)
No/less perceived clinical usefulness	0 (0.0)
Number of patients to manage at the same time (more than 1)	0 (0.0)

Data are presented as number (%).
VR = Virtual reality.

Supplementary Appendix 1

Supplementary Appendix 1.1. Testing of the questionnaire (experts review and pre-testing phases).

Phase 1: Experts review

This phase aimed to assess the content validity of the questionnaire. After designing the initial version of the questionnaire, a non-probability purposive sample of six independent external experts was invited to review it and provide feedback on its content, including relevance, accuracy, clarity, conciseness, and completeness. The experts came from diverse fields (including engineering, physical and rehabilitation medicine, neuropsychology, and physiotherapy) and represented multiple countries (including Belgium, the Netherlands, France, and Canada). They had research expertise in rehabilitation and emerging technologies, including immersive VR. Experts' evaluations were not quantified using statistical measures such as Cohen's kappa coefficient.[1,2]

Phase 2: Cognitive pre-testing

This phase aimed to gain insight into the cognitive processes underlying survey responding, ensuring that respondents understand the questionnaire items as intended and can answer in a way that accurately reflects their experiences.[1,3] The focus was on actively testing individual items that might be difficult for respondents to understand, interpret, or answer (as applicable). Various cognitive processes were explored, including comprehension and interpretation of the items, retrieval of relevant information and events from memory (recall), making judgments about the appropriateness of responses (decision), and selecting and reporting responses.[3]

This phase involved conducting cognitive interviews with a non-probability sample of individuals who shared similar characteristics with the target population, except for the age range and the country distribution. This sample included 11 French-speaking physiotherapists (six males, aged 27–37 years, nine of whom were Belgian) with varying levels of experience with immersive VR in clinical practice (current, past, or none). Sample characteristics are detailed in **Supplementary Appendix 1.2** (below). This sample size is considered optimal for cognitive pre-testing.[1] Since cognitive interviewing does not aim at testing translations and because minimal cultural differences were expected between French- and Dutch-speaking physiotherapists regarding the questionnaire, cognitive interviews were not conducted among Dutch-speaking physiotherapists.

Various techniques were employed during this phase, including think-aloud interviewing (i.e., asking participants to "think aloud" and verbalize all the thought processes that have led, or are leading, to their response), verbal probing (i.e., asking participants one or more follow-up questions about the meanings, understanding, and interpretations of terms, items or responses), paraphrasing (i.e., asking participants to formulate the item in their own words), and confidence rating (i.e., asking participants to rate the certainty or reliability of their responses).[1,3]

An interview protocol was drawn up to guide the interviews, which included the individual questionnaire items to be tested along with several questions for each item based on the cognitive techniques mentioned earlier. However, the interviews were not completely standardized and were adapted based on the discussion with participants.[3] This meant that not

all questions were necessarily asked for each questionnaire item, and unprepared cognitive techniques and probing questions were spontaneously introduced during the interviews. Interviews were audio-recorded using a Dictaphone and conducted either face-to-face (in-person) or via videoconference. All interviews were performed in one round and lasted between 39 and 95 minutes. The interviews were carried out using the same mode of delivery that would be used in the actual survey (i.e., online).

Cognitive interviews followed an iterative process, where the questions and interview guide, revised based on the findings of the interviews, were tested with subsequent participants.[3] This phase confirmed that the items were well understood and interpreted as intended by the research team, that participants found them feasible to answer, and that the response options were clear and comprehensive.

After this phase, the questionnaire was revised accordingly, and all changes made to the initial version were documented. These revisions included modifications to terminology, rephrasing of and adding precision to items and response options, as well as adding or removing items and response options. The ordering of items and the overall appearance of the questionnaire were also adjusted (e.g., changes to picture choices and sizes, words in bold).

Phase 3: Pilot testing of the French and Dutch versions of the questionnaire

This phase aimed to evaluate the functionality of the questionnaire under realistic conditions that mirrored those of the main survey (i.e., participants completed the questionnaire online, independently, and in their homes).[3] The objectives included assessing the questionnaire's accessibility and usability, identifying technical issues or difficulties encountered during completion, determining the average completion time (automatically recorded by the LimeSurvey software), and verifying the proper exportation of data. Additionally, this phase provided an opportunity to reassess participants' comprehension of the questionnaire, albeit to a lesser extent than during cognitive interviewing, and collect their overall feedback through an open-ended question at the end.[3]

The first part of this phase involved conducting a pilot test of the French version of the questionnaire with a diverse, non-probability sample resembling the target population. The sample included 16 French-speaking physiotherapists (nine males, aged 27–62 years, eight of whom were Belgian) with varying levels of experience with immersive VR in clinical practice (current, past, or none). Sample characteristics are detailed in **Supplementary Appendix 1.3** (below). Once finalized, the French version of the questionnaire was translated into Dutch by certified professional translators (ElaN Languages).

The second part of this phase involved conducting a pilot test of the Dutch version of the questionnaire with a non-probability sample resembling the target population, except for the sex distribution and the age range. The sample included five Dutch-speaking physiotherapists (four females, aged 26–46 years, four of whom were Dutch) with varying levels of experience with immersive VR in clinical practice (current, past, or none). Sample characteristics are detailed in **Supplementary Appendix 1.4** (below).

Minor adjustments were made following this phase, primarily refining item wording and adding or modifying some response options. All modifications were documented in a separate report.

Participants' feedback confirmed that the questionnaire, in both languages, was clear, easy to understand, and not too long to complete, with an average completion time of 14 minutes and 26 seconds. The usability of the online platform across various devices (laptops, smartphones, and tablets) was also confirmed.

References

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3. Lenzner T, Neuert C, Otto W. *Cognitive Pretesting (GESIS Survey Guidelines)Kognitives Pretesting (GESIS Survey Guidelines)*. GESIS - Leibniz Institute for the Social Sciences; 2016. doi:10.15465/GESIS-SG_EN_010

Supplementary Appendix 1.2. Sample characteristics of the cognitive pre-testing phase.

Participant	Sex	Age (years)	Education level	Specialization	Nationality	Country of study	Country of practice	Years of practice	Primary sector	Immersive VR use	Interview length (minutes)
1	Male	30	Master	Cardio-respiratory	Belgian	Belgium	Belgium	6	Public hospital	Never	57’21”
2	Female	31	PhD	Neurologic	Belgian	Belgium	Belgium	5	Public hospital	Current	84’11”
3	Male	29	Master	Musculoskeletal	Belgian	Belgium	Belgium	4	Group private clinic	Past	65’25”
4	Female	31	Master	Musculoskeletal	Franco-Canadian	Canada	Canada	6	Group private clinic	Never	95’17”
5	Female	35	Master	Neurologic	Belgian	Belgium	Belgium	9	Public hospital	Current	71’01”
6	Male	34	PhD	Respiratory	Belgian	Belgium	Belgium	13	Public hospital	Never	54’54”
7	Male	29	Master	Musculoskeletal	Belgian	Belgium	Belgium	6	Group private clinic	Never	52’29”
8	Female	37	Master	Musculoskeletal	Belgian	Belgium	Belgium	15	Private clinic	Never	56’06”
9	Male	27	Master	Neurologic	Belgian	Belgium	Belgium	3	Group private clinic	Current	42’52”
10	Male	31	Master	Neurologic	Belgian	Belgium	Belgium	7	Private clinic / Private hospital	Current	69’04”
11	Female	32	Master	Musculoskeletal/Sportive	Canadian	Canada	Canada	8	Group private clinic	Never	39’05”

VR = Virtual reality.

Supplementary Appendix 1.3. Sample characteristics of the pilot test of the French version of the questionnaire.

Participant	Sex	Age (years)	Education level	Specialization	Country of study	Country of practice	Years of practice	Primary sector	Immersive VR use	Patients' main age category	Patients' main condition category	Time to complete questionnaire (minutes)
1	Male	34	Master	Neurologic	Belgium	Belgium	13	Private hospital	Current	18-64	Neurologic	9'59''
2	Male	43	Master	Sportive	Belgium	Belgium	20	Group private clinic	Past	18-64	Sportive	10'44''
3	Male	47	Master	Vestibular	Belgium	France	20	Group private clinic	Current	65+	Persistent pain	17'33''
4	Female	29	Master	Neurologic	Belgium	Belgium	8	Public hospital	Current	18-64	Neurologic	11'48''
5	Male	53	PhD	Cardiovascular	Belgium	Luxemburg	29	Public hospital	Never	65+	Cardiovascular	15'34''
6	Female	47	Master	Perineological	Belgium	Belgium	25	Public hospital	Never	18-64	Perineological	14'43''
7	Female	62	Master	Vascular	Belgium	Belgium	40	Private hospital	Never	18-64	Vascular	19'17''
8	Female	32	Master	Oncologic	Canada	Canada	8	Individual private clinic	Never	18-64	Musculoskeletal	11'09''
9	Male	39	Master	/	France	Canada	14	Group private clinic	Never	18-64	Musculoskeletal	22'26''
10	Female	49	Master	Persistent pain	France	France	27	Individual private clinic	Current	18-64	Persistent pain	21'30''
11	Male	39	Master	/	Canada	Canada	14	Individual private clinic	Never	18-64	Musculoskeletal	6'34''
12	Female	28	Master	Respiratory	Belgium	France	5	Public hospital	Never	18-64	Intensive care	10'06''
13	Male	53	Bachelor	Neurologic	Belgium	Luxemburg	31	Multidisciplinary rehabilitation center	Current	18-64	Neurologic	18'47''
14	Female	58	Master	Pediatric	Belgium	Belgium	36	Specialized schools or institutions	Never	Less than 12	Neurologic	15'34''
15	Male	27	Master	Musculoskeletal	Belgium	Belgium	5	Group private clinic	Never	18-64	Musculoskeletal	17'20''
16	Male	28	Master	Musculoskeletal	Belgium	Belgium	5	Individual private clinic	Never	18-64	Musculoskeletal	8'38''

VR = Virtual reality.

Supplementary Appendix 1.4. Sample characteristics of the pilot test of the Dutch version of the questionnaire.

Participant	Sex	Age (years)	Education level	Specialization	Country of study	Country of practice	Years of practice	Primary sector	Immersive VR use	Patients' main age category	Patients' main condition category	Time to complete questionnaire (minutes)
1	Female	28	Master	Musculoskeletal	The Netherlands	The Netherlands	6	Group private clinic	Past	18-64	Musculoskeletal	11'26''
2	Male	30	Master	Musculoskeletal	Belgium	Belgium	7	Group private clinic	Never	18-64	Musculoskeletal	8'49''
3	Female	26	Master	Musculoskeletal	The Netherlands	The Netherlands	5	Group private clinic	Current	18-64	Musculoskeletal	22'51''
4	Female	46	Master	Psychosomatic	The Netherlands	The Netherlands	22	Individual private clinic	Current	18-64	Stress-related persistent complaints	13'54''
5	Female	27	Bachelor	Geriatric	The Netherlands	The Netherlands	5	Home visits	Never	65+	Geriatric	58'40''

VR = Virtual reality.

Supplementary Appendix 1.5. Final version of the questionnaire consisting of 96 items organized into 14 sections.

Sections	Items
Demographics and professional information (**11** items)	Age; sex (assigned at birth); country of physiotherapy studies; highest level of education; country of practice; years of clinical experience; primary practice setting; physiotherapy specialization; and main patient demographics (age groups and condition categories).
Knowledge about immersive VR (**7** items)	Self-reported familiarity with immersive VR technology; ability to recognize immersive VR from images and written descriptions (compared to non-immersive and semi-immersive VR); awareness of the availability of immersive VR systems and devices on the market; awareness of the application of immersive VR in physiotherapy as well as sources of information; and knowledge of cave automatic virtual environment systems.
Use of immersive VR in clinical practice (**4** items)	Items to identify never-users, current users, and past users. Additional items assessed overall experience with immersive VR use in clinical practice (for current and past users) and reasons for non-use (for never-users).
Current use of immersive VR (current users only) (**13** items)	Frequency and duration of use; conditions and patient populations for which immersive VR is applied; types of immersive VR systems used; rehabilitation settings (e.g., in-clinic, at home); reasons and therapeutic goals for its use; facilitators and barriers to implementation in clinical practice; discussions about immersive VR with patients; compatibility with other treatment modalities; and patient requests to use immersive VR in their treatments.
Past use of immersive VR (past users only) (**12** items)	The same items as in the 'current use of immersive VR' section were included, excluding those related to facilitators and barriers to implementation in clinical practice, and adding an item on reasons for discontinuation.
Intention to use immersive VR (never-users only) (**7** items)	Desire to use immersive VR in treatments; conditions for which physiotherapists would like to use immersive VR; reasons and therapeutic goals for its application; amount of money physiotherapists would be willing to invest; intention to use immersive VR within the next 2 years; and searches conducted to learn more about the use or efficacy of immersive VR in physiotherapy.
Intention to continue using immersive VR (current users only) (**2** items)	Intention to continue using immersive VR in the future and commitment to always integrating it into treatments (at least once) if it fits within the patient's therapeutic goals.
Intention to use immersive VR again (past users only) (**1** item)	Intention to use immersive VR again in the future.
Attitudes toward immersive VR (never-users only) (**8** items)	Level of agreement* with eight statements regarding attitudes toward immersive VR, including being in favor of immersive VR in general; being in favor of the application of immersive VR in physiotherapy; willingness to learn more about the application of immersive VR in physiotherapy; and perceived suitability of immersive VR for specific populations (children, adolescents, and older adults).
Attitudes toward immersive VR (current and past users only) (**12** items)	The same statements as in the section above (for never-users) were included, along with four additional statements regarding the enjoyment of working with immersive VR, its cost, and its value for money.
Perceived usefulness of immersive VR (**12** items)	Level of agreement* with twelve statements regarding the perceived usefulness of immersive VR in clinical practice, including its use as an assessment and treatment tool; its usefulness in treatments at present and in the next 5 to 10 years; its effectiveness in reducing pain and improving function; its tolerability for patients; its role as a motivating way to perform exercises; its impact on the therapeutic relationship and on patients' active management; and its usefulness for home-based treatment.
Perceived ease of use of immersive VR (**4** items)	Level of agreement* with four statements regarding the perceived usability of immersive VR in clinical practice, including the perceived ease of use for themselves, other physiotherapists, their patients, and the ease of integrating immersive VR into their treatments.
Social influence (never-users and past users only) (**2** items)	Level of agreement* with two statements regarding the influence of individuals both within and outside the professional setting on the adoption of immersive VR in clinical practice.
Remarks (**1** item)	An optional open-ended question inviting additional comments.

VR = Virtual reality.

*Assessed using 5-point Likert scales ranging from "strongly disagree" to "strongly agree," with a "neutral" midpoint option.

Supplementary Appendix 2 (Acceptance – raw data)

Supplementary Appendix 2.1. Intention to use immersive VR in clinical practice.

Never-users	N (%)
I would like to use immersive VR in my treatments/management.	**N = 117**
Strongly disagree	9 (7.7)
Somewhat disagree	19 (16.2)
Neutral	32 (27.4)
Somewhat agree	48 (41.0)
Strongly agree	9 (7.7)
Pathologies that would be treated*	**N = 57**
Musculoskeletal	35 (61.4)
Neurological	29 (50.9)
Persistent pain	28 (49.1)
Geriatric	27 (47.4)
Vestibular	23 (40.4)
Sports-related	22 (38.6)
Pediatric	16 (28.1)
Cardiovascular	9 (15.8)
Respiratory	8 (14.0)
Oncological	6 (10.5)
Perineological/Pelvic health	2 (3.5)
Burn victims	2 (3.5)
Other	2 (3.5)
Reasons and therapeutic goals to use immersive VR*	**N = 57**
Add fun to rehabilitation	47 (82.5)
Improve coordination/motor control	46 (80.7)
Increase motivation	42 (73.7)
Diversify treatment	37 (64.9)
Multisensory stimulation	36 (63.2)
Improve stability/balance	35 (61.4)
Encouragement (challenge)	35 (61.4)
Intensification of treatment	34 (59.6)
Improve adherence to treatment	32 (56.1)
Improve mobility	31 (54.4)
Progressive exposure to movement (gradual exposure)	31 (54.4)
Active approach to treatment (exercises)	31 (54.4)
Improve cognitive function	30 (52.6)
Distraction	30 (52.6)
Pain reduction	28 (49.1)
Escape (going outside the therapeutic framework)	28 (49.1)
Self-rehabilitation	21 (36.8)
Improve walking	20 (35.1)
Improve muscular endurance	16 (28.1)
Therapeutic education	13 (22.8)
Improve cardiorespiratory endurance	12 (21.1)
Improve strength	10 (17.5)
Relaxation	7 (12.3)
No specific reason	1 (1.8)
Other	0 (0.0)
I intend to use immersive VR in my treatments/management in the next two years.	**N = 57**
Strongly disagree	4 (7.0)
Somewhat disagree	9 (15.8)
Neutral	26 (45.6)
Somewhat agree	17 (29.8)
Strongly agree	1 (1.8)

I have already done some research (scientific databases, books, Internet...) to find out more specifically about the use and/or effectiveness of immersive VR in physiotherapy.	**N = 117**
Never	69 (59.0)
Rarely	14 (12.0)
Sometimes	23 (19.7)
Often	8 (6.8)
Very often	3 (2.5)
Current users	**N (%)**
I intend to continue using immersive VR in my treatments/management in the future.	**N = 19**
Strongly disagree	0 (0.0)
Somewhat disagree	0 (0.0)
Neutral	3 (15.8)
Somewhat agree	11 (57.9)
Strongly agree	5 (26.3)
I will always try to use immersive VR (at least once) in my treatments/ management (if it fits in with the patient's therapeutic goals).	**N = 19**
Strongly disagree	0 (0.0)
Somewhat disagree	6 (31.6)
Neutral	5 (26.3)
Somewhat agree	7 (36.8)
Strongly agree	1 (5.3)
Past users	**N (%)**
I intend to use immersive VR again in my treatments/management in the future.	**N = 19**
Strongly disagree	3 (15.8)
Somewhat disagree	1 (5.3)
Neutral	9 (47.4)
Somewhat agree	4 (21.0)
Strongly agree	2 (10.5)

Data are presented as number (%). VR = Virtual reality.

*Questions where multiple responses were possible.

Supplementary Appendix 2.2. Attitudes toward the use of immersive VR in clinical practice.

Statements	Users' category	Strongly disagree	Somewhat disagree	Neutral	Somewhat agree	Strongly agree
Given various aspects (education, ecology, etc.), I am in favor of immersive VR in general (not just in the context of rehabilitation).	Total sample (n = 155)	7 (4.5)	14 (9.0)	47 (30.3)	61 (39.4)	26 (16.8)
	Never-users (n = 117)	4 (3.4)	13 (11.1)	38 (32.5)	44 (37.6)	18 (15.4)
	Current users (n = 19)	0 (0.0)	1 (5.3)	5 (26.3)	9 (47.4)	4 (21.0)
	Past users (n = 19)	3 (15.8)	0 (0.0)	4 (21.0)	8 (42.2)	4 (21.0)
I am in favor of using immersive VR in physiotherapy in general.	Total sample (n = 155)	4 (2.6)	11 (7.1)	35 (22.6)	72 (46.4)	33 (21.3)
	Never-users (n = 117)	2 (1.7)	10 (8.5)	29 (24.8)	55 (47.0)	21 (18.0)
	Current users (n = 19)	1 (5.3)	0 (0.0)	3 (15.8)	8 (42.1)	7 (36.8)
	Past users (n = 19)	1 (5.3)	1 (5.3)	3 (15.8)	9 (47.4)	5 (26.2)
I am in favor of using immersive VR in my domain/specialization of physiotherapy.	Total sample (n = 155)	12 (7.7)	18 (11.6)	41 (26.5)	53 (34.2)	31 (20.0)
	Never-users (n = 117)	10 (8.6)	17 (14.5)	30 (25.6)	40 (34.2)	20 (17.1)
	Current users (n = 19)	1 (5.3)	0 (0.0)	4 (21.0)	6 (31.6)	8 (42.1)
	Past users (n = 19)	1 (5.3)	1 (5.3)	7 (36.8)	7 (36.8)	3 (15.8)
I would like to learn more about the use of immersive VR in physiotherapy in general.	Total sample (n = 155)	8 (5.2)	7 (4.5)	34 (21.9)	64 (41.3)	42 (27.1)
	Never-users (n = 117)	5 (4.3)	5 (4.3)	24 (20.5)	51 (43.6)	32 (27.3)
	Current users (n = 19)	1 (5.3)	2 (10.5)	4 (21.0)	9 (47.4)	3 (15.8)
	Past users (n = 19)	2 (10.5)	0 (0.0)	6 (31.6)	4 (21.1)	7 (36.8)
I would like to learn more about the use of immersive VR in my domain/specialization of physiotherapy.	Total sample (n = 155)	9 (5.8)	4 (2.6)	25 (16.1)	65 (41.9)	52 (33.6)
	Never-users (n = 117)	6 (5.1)	2 (1.7)	16 (13.7)	52 (44.4)	41 (35.1)
	Current users (n = 19)	1 (5.3)	1 (5.3)	4 (21.0)	9 (47.4)	4 (21.0)
	Past users (n = 19)	2 (10.5)	1 (5.3)	5 (26.3)	4 (21.1)	7 (36.8)
I believe that immersive VR is suitable for children (under 12 years old) in the context of rehabilitation.	Total sample (n = 155)	15 (9.7)	28 (18.1)	43 (27.7)	48 (31.0)	21 (13.5)
	Never-users (n = 117)	12 (10.3)	21 (17.9)	28 (23.9)	41 (35.1)	15 (12.8)
	Current users (n = 19)	1 (5.3)	4 (21.0)	6 (31.6)	5 (26.3)	3 (15.8)

	Past users (n = 19)	2 (10.5)	3 (15.8)	9 (47.4)	2 (10.5)	3 (15.8)
I believe that immersive VR is suitable for adolescents (12-18 years old) in the context of rehabilitation.	Total sample (n = 155)	3 (1.9)	7 (4.5)	25 (16.1)	66 (42.6)	54 (34.9)
	Never-users (n = 117)	2 (1.7)	6 (5.1)	16 (13.7)	58 (49.6)	35 (29.9)
	Current users (n = 19)	1 (5.3)	1 (5.3)	3 (15.8)	3 (15.8)	11 (57.8)
	Past users (n = 19)	0 (0.0)	0 (0.0)	6 (31.6)	5 (26.3)	8 (42.1)
I believe that immersive VR is suitable for elderly people (65 years and older) in the context of rehabilitation.	Total sample (n = 155)	5 (3.2)	19 (12.3)	26 (16.8)	75 (48.4)	30 (19.3)
	Never-users (n = 117)	2 (1.7)	16 (13.7)	16 (13.7)	60 (51.3)	23 (19.6)
	Current users (n = 19)	2 (10.5)	1 (5.3)	4 (21.0)	8 (42.2)	4 (21.0)
	Past users (n = 19)	1 (5.3)	2 (10.5)	6 (31.6)	7 (36.8)	3 (15.8)
I enjoy working with immersive VR.	Current users (n = 19)	2 (10.5)	1 (5.3)	3 (15.8)	9 (47.4)	4 (21.0)
	Past users (n = 19)	2 (10.5)	1 (5.3)	5 (26.3)	9 (47.4)	2 (10.5)
Working with immersive VR is fun.	Current users (n = 19)	1 (5.3)	0 (0.0)	4 (21.0)	6 (31.6)	8 (42.1)
	Past users (n = 19)	1 (5.3)	1 (5.3)	1 (5.3)	11 (57.8)	5 (26.3)
I find the price of immersive VR reasonable.	Current users (n = 19)	1 (5.3)	8 (42.1)	6 (31.5)	3 (15.8)	1 (5.3)
	Past users (n = 19)	2 (10.5)	9 (47.4)	7 (36.8)	1 (5.3)	0 (0.0)
I find that immersive VR offers good value for money.	Current users (n = 19)	0 (0.0)	7 (36.8)	7 (36.8)	4 (21.1)	1 (5.3)
	Past users (n = 19)	3 (15.8)	5 (26.3)	10 (52.6)	1 (5.3)	0 (0.0)

Data are presented as number (%). VR = Virtual reality.

Supplementary Appendix 2.3. Perceived usefulness of immersive VR in clinical practice.

Statements	Users' category	Strongly disagree	Somewhat disagree	Neutral	Somewhat agree	Strongly agree
I think immersive VR is only for entertainment and not for rehabilitation.	Total sample (n = 155)	84 (54.2)	59 (38.1)	8 (5.2)	3 (1.9)	1 (0.6)
	Never-users (n = 117)	65 (55.5)	43 (36.8)	6 (5.1)	2 (1.7)	1 (0.9)
	Current users (n = 19)	9 (47.4)	8 (42.1)	2 (10.5)	0 (0.0)	0 (0.0)
	Past users (n = 19)	10 (52.6)	8 (42.1)	0 (0.0)	1 (5.3)	0 (0.0)
I think immersive VR can be used as an assessment tool (clinical examination, progress tracking, etc.) in my field/specialization of physiotherapy.	Total sample (n = 155)	11 (7.1)	25 (16.1)	39 (25.2)	62 (40.0)	18 (11.6)
	Never-users (n = 117)	7 (6.0)	19 (16.2)	33 (28.2)	47 (40.2)	11 (9.4)
	Current users (n = 19)	1 (5.3)	2 (10.5)	3 (15.8)	11 (57.9)	2 (10.5)
	Past users (n = 19)	3 (15.8)	4 (21.0)	3 (15.8)	4 (21.0)	5 (26.4)
I think immersive VR can be used as a treatment tool in my field/specialization of physiotherapy.	Total sample (n = 155)	5 (3.2)	16 (10.3)	26 (16.8)	73 (47.1)	35 (22.6)
	Never-users (n = 117)	3 (2.5)	13 (11.1)	20 (17.1)	58 (49.6)	23 (19.7)
	Current users (n = 19)	1 (5.3)	0 (0.0)	3 (15.8)	9 (47.3)	6 (31.6)
	Past users (n = 19)	1 (5.2)	3 (15.8)	3 (15.8)	6 (31.6)	6 (31.6)
I think immersive VR can be useful for my current treatments/interventions.	Total sample (n = 155)	6 (3.9)	19 (12.2)	37 (23.9)	64 (41.3)	29 (18.7)
	Never-users (n = 117)	4 (3.4)	16 (13.7)	28 (23.9)	47 (40.2)	22 (18.8)
	Current users (n = 19)	1 (5.3)	0 (0.0)	4 (21.0)	10 (52.7)	4 (21.0)
	Past users (n = 19)	1 (5.3)	3 (15.8)	5 (26.3)	7 (36.8)	3 (15.8)
I think immersive VR will be useful for my treatments/interventions in the next 5 to 10 years.	Total sample (n = 155)	5 (3.2)	10 (6.5)	34 (21.9)	65 (41.9)	41 (26.5)
	Never-users (n = 117)	3 (2.6)	7 (6.0)	28 (23.9)	48 (41.0)	31 (26.5)
	Current users (n = 19)	1 (5.3)	1 (5.3)	4 (21.0)	7 (36.8)	6 (31.6)
	Past users (n = 19)	1 (5.3)	2 (10.5)	2 (10.5)	10 (52.6)	4 (21.1)
I think immersive VR can be effective in reducing pain for my patients who use it.	Total sample (n = 155)	5 (3.2)	16 (10.3)	41 (26.5)	67 (43.2)	26 (16.8)
	Never-users (n = 117)	4 (3.4)	13 (11.1)	30 (25.7)	50 (42.7)	20 (17.1)
	Current users (n = 19)	1 (5.3)	1 (5.3)	4 (21.0)	9 (47.4)	4 (21.0)

	Past users (n = 19)	0 (0.0)	2 (10.5)	7 (36.9)	8 (42.1)	2 (10.5)
I think immersive VR can be effective in improving motor function (functional capacity) for my patients who use it.	Total sample (n = 155)	4 (2.6)	4 (2.6)	13 (8.4)	93 (60.0)	41 (26.4)
	Never-users (n = 117)	3 (2.6)	3 (2.6)	9 (7.7)	71 (60.6)	31 (26.5)
	Current users (n = 19)	1 (5.3)	0 (0.0)	2 (10.5)	11 (57.9)	5 (26.3)
	Past users (n = 19)	0 (0.0)	1 (5.3)	2 (10.5)	11 (57.9)	5 (26.3)
I think immersive VR is poorly tolerated by patients due to its side effects.	Total sample (n = 155)	13 (8.4)	47 (30.3)	70 (45.2)	23 (14.8)	2 (1.3)
	Never-users (n = 117)	8 (6.8)	32 (27.4)	60 (51.3)	15 (12.8)	2 (1.7)
	Current users (n = 19)	3 (15.8)	8 (42.1)	5 (26.3)	3 (15.8)	0 (0.0)
	Past users (n = 19)	2 (10.5)	7 (36.9)	5 (26.3)	5 (26.3)	0 (0.0)
I think immersive VR can be a more motivating way to perform exercises in my treatments/interventions compared to traditional therapy without immersive VR.	Total sample (n = 155)	1 (0.6)	7 (4.5)	20 (12.9)	83 (53.6)	44 (28.4)
	Never-users (n = 117)	1 (0.9)	4 (3.4)	15 (12.8)	62 (53.0)	35 (29.9)
	Current users (n = 19)	0 (0.0)	1 (5.2)	4 (21.1)	10 (52.6)	4 (21.1)
	Past users (n = 19)	0 (0.0)	2 (10.5)	1 (5.3)	11 (57.9)	5 (26.3)
I think immersive VR can negatively interfere with the therapeutic relationship with my patients.	Total sample (n = 155)	24 (15.5)	66 (42.6)	35 (22.6)	27 (17.4)	3 (1.9)
	Never-users (n = 117)	17 (14.5)	50 (42.7)	27 (23.1)	20 (17.1)	3 (2.6)
	Current users (n = 19)	6 (31.6)	8 (42.1)	2 (10.5)	3 (15.8)	0 (0.0)
	Past users (n = 19)	1 (5.3)	8 (42.1)	6 (31.6)	4 (21.0)	0 (0.0)
I think immersive VR could enhance the active participation of my patients in their treatment (i.e., the part of the treatment they perform themselves, such as exercises).	Total sample (n = 155)	3 (1.9)	15 (9.7)	35 (22.6)	79 (51.0)	23 (14.8)
	Never-users (n = 117)	1 (0.9)	12 (10.2)	22 (18.8)	64 (54.7)	18 (15.4)
	Current users (n = 19)	2 (10.5)	1 (5.3)	6 (31.6)	7 (36.8)	3 (15.8)
	Past users (n = 19)	0 (0.0)	2 (10.5)	7 (36.9)	8 (42.1)	2 (10.5)
I think immersive VR could be useful as a home-based treatment option for my patients.	Total sample (n = 155)	18 (11.6)	28 (18.1)	34 (21.9)	61 (39.4)	14 (9.0)
	Never-users (n = 117)	13 (11.1)	19 (16.3)	24 (20.5)	50 (42.7)	11 (9.4)
	Current users (n = 19)	2 (10.5)	5 (26.3)	4 (21.1)	6 (31.6)	2 (10.5)
	Past users (n = 19)	3 (15.8)	4 (21.0)	6 (31.6)	5 (26.3)	1 (5.3)

Data are presented as number (%). VR = Virtual reality.

Supplementary Appendix 2.4. Perceived ease of use of immersive VR in clinical practice.

Statements	Users' category	Strongly disagree	Somewhat disagree	Neutral	Somewhat agree	Strongly agree
I think using immersive VR is/would be too complicated for me (technical difficulties, such as operating the system myself, setting it up and starting it, explaining it to patients, etc.).	Total sample (n = 155)	52 (33.5)	48 (31.0)	31 (20.0)	19 (12.3)	5 (3.2)
	Never-users (n = 117)	33 (28.2)	40 (34.2)	24 (20.5)	15 (12.8)	5 (4.3)
	Current users (n = 19)	8 (42.1)	7 (36.8)	3 (15.8)	1 (5.3)	0 (0.0)
	Past users (n = 19)	11 (57.9)	1 (5.3)	4 (21.0)	3 (15.8)	0 (0.0)
I think using immersive VR is too complicated for physiotherapists (technical difficulties, such as operating the system themselves, setting it up and starting it, explaining it to patients, etc.).	Total sample (n = 155)	33 (21.3)	69 (44.5)	28 (18.1)	21 (13.5)	4 (2.6)
	Never-users (n = 117)	20 (17.1)	58 (49.6)	19 (16.2)	16 (13.7)	4 (3.4)
	Current users (n = 19)	5 (26.3)	7 (36.8)	4 (21.1)	3 (15.8)	0 (0.0)
	Past users (n = 19)	8 (42.1)	4 (21.1)	5 (26.3)	2 (10.5)	0 (0.0)
I think using immersive VR is/would be too complicated for my patients (technical difficulties, such as understanding how to use it, handling the controllers, wearing the headset, navigating menus/games, etc.).	Total sample (n = 155)	14 (9.0)	56 (36.1)	43 (27.8)	37 (23.9)	5 (3.2)
	Never-users (n = 117)	7 (6.0)	45 (38.4)	34 (29.1)	27 (23.1)	4 (3.4)
	Current users (n = 19)	3 (15.8)	8 (42.1)	2 (10.5)	5 (26.3)	1 (5.3)
	Past users (n = 19)	4 (21.1)	3 (15.8)	7 (36.8)	5 (26.3)	0 (0.0)
Overall, I would find it easy to use immersive VR in my treatments/interventions (not just in terms of technical difficulties).	Total sample (n = 155)	8 (5.2)	31 (20.0)	41 (26.4)	58 (37.4)	17 (11.0)
	Never-users (n = 117)	6 (5.1)	26 (22.2)	33 (28.2)	42 (35.9)	10 (8.6)
	Current users (n = 19)	0 (0.0)	2 (10.5)	3 (15.8)	11 (57.9)	3 (15.8)
	Past users (n = 19)	2 (10.5)	3 (15.8)	5 (26.3)	5 (26.3)	4 (21.1)

Data are presented as number (%). VR = Virtual reality.

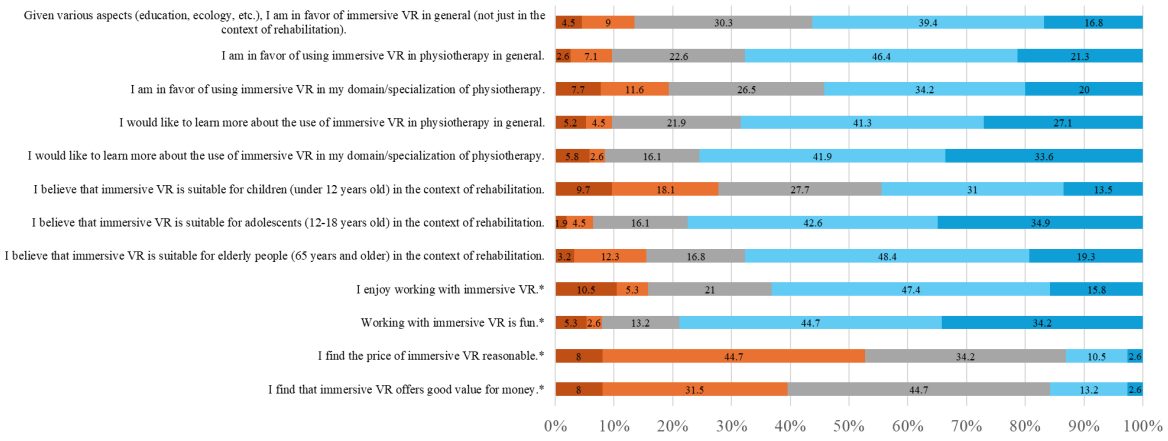
Supplementary Appendix 2.5. Social influence on the use of immersive VR in clinical practice.

Statements	Users' category	Strongly disagree	Somewhat disagree	Neutral	Somewhat agree	Strongly agree
The people who influence my behavior (within the professional setting, such as fellow physiotherapists, doctors, etc.) think that I should use immersive VR in my treatments/interventions.	Total sample (n = 136)	40 (29.4)	26 (19.1)	65 (47.8)	5 (3.7)	0 (0.0)
	Never-users (n = 117)	32 (27.4)	24 (20.5)	57 (48.7)	4 (3.4)	0 (0.0)
	Past users (n = 19)	8 (42.1)	2 (10.5)	8 (42.1)	1 (5.3)	0 (0.0)
The people who influence my behavior (outside the professional setting, such as family, friends, etc.) think that I should use immersive VR in my treatments/interventions.	Total sample (n = 136)	41 (30.2)	23 (16.9)	63 (46.3)	8 (5.9)	1 (0.7)
	Never-users (n = 117)	32 (27.3)	20 (17.1)	57 (48.7)	7 (6.0)	1 (0.9)
	Past users (n = 19)	9 (47.3)	3 (15.8)	6 (31.6)	1 (5.3)	0 (0.0)

Data are presented as number (%). VR = Virtual reality.

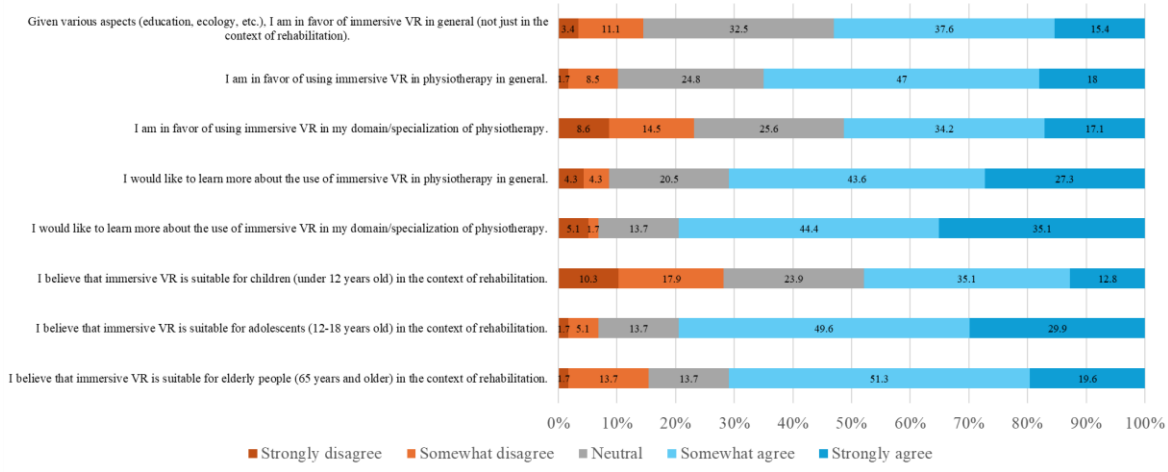
Supplementary Appendix 3 (Acceptance – graphs)

Supplementary Appendix 3.1. Attitudes toward the use of immersive VR in clinical practice (A = Total sample; B = Never-users; C = Current users; D = Past users).



A.

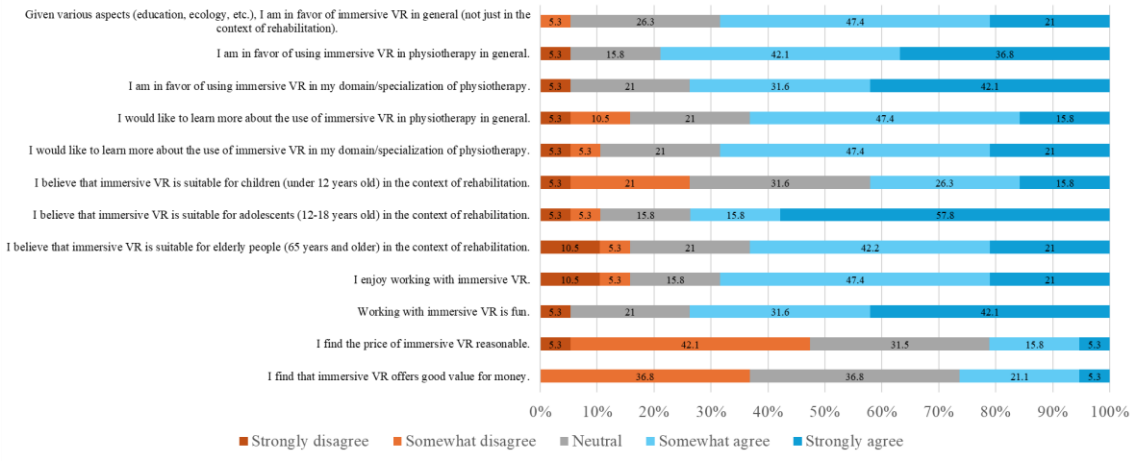
*VR = Virtual reality. *Only current and past users.*



B.

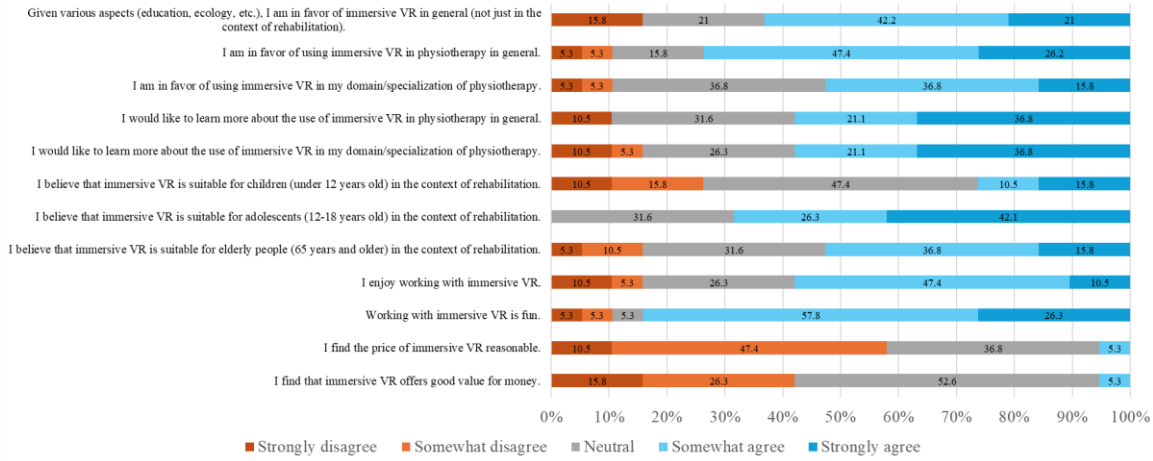
VR = Virtual reality.

C.



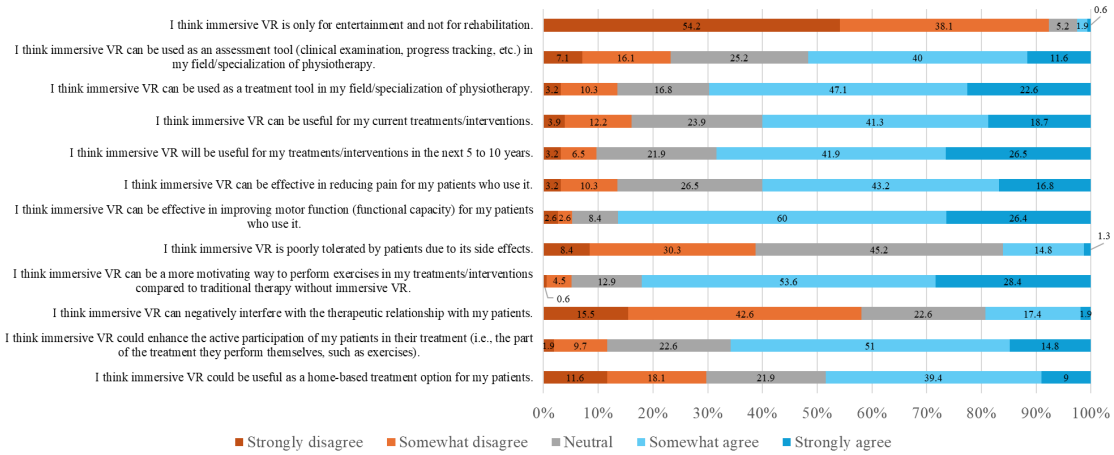
VR = Virtual reality.

D.



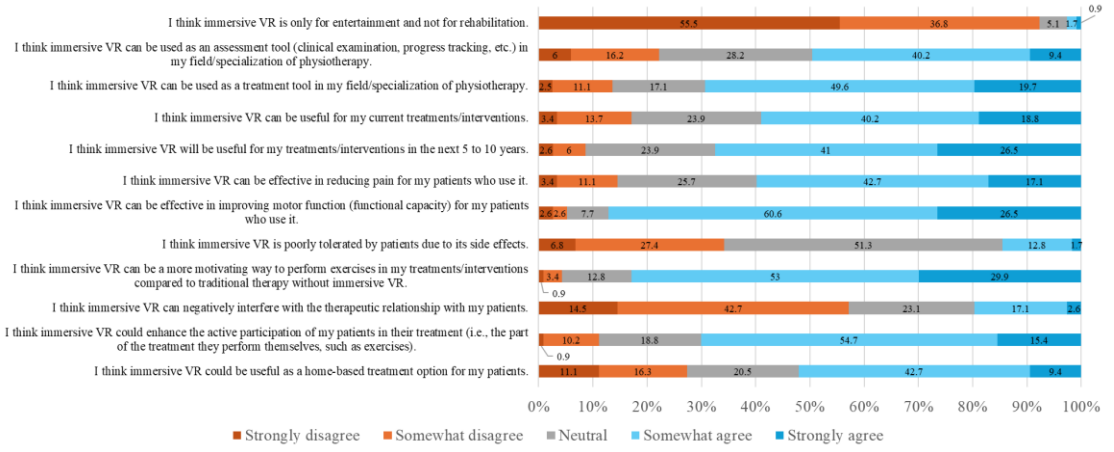
VR = Virtual reality.

Supplementary Appendix 3.2. Perceived usefulness of immersive VR in clinical practice (A = Total sample; B = Never-users; C = Current users; D = Past users).



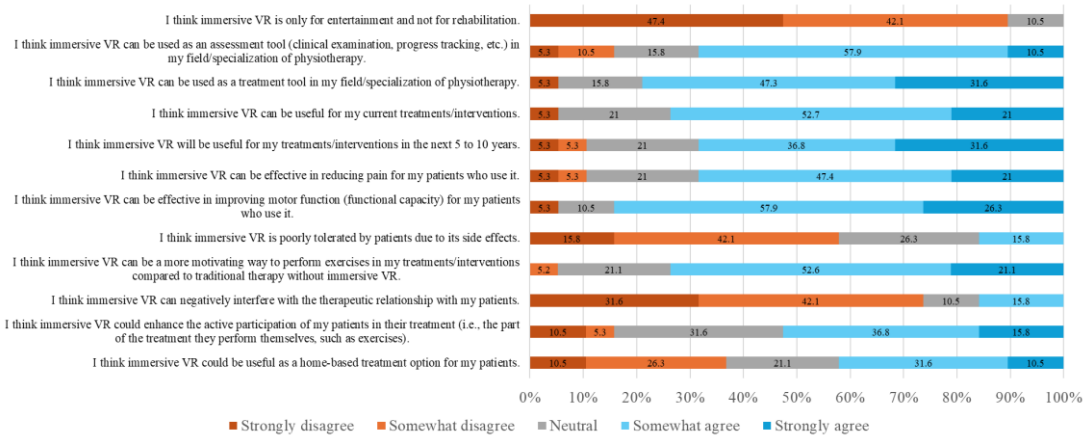
A.

VR = Virtual reality.



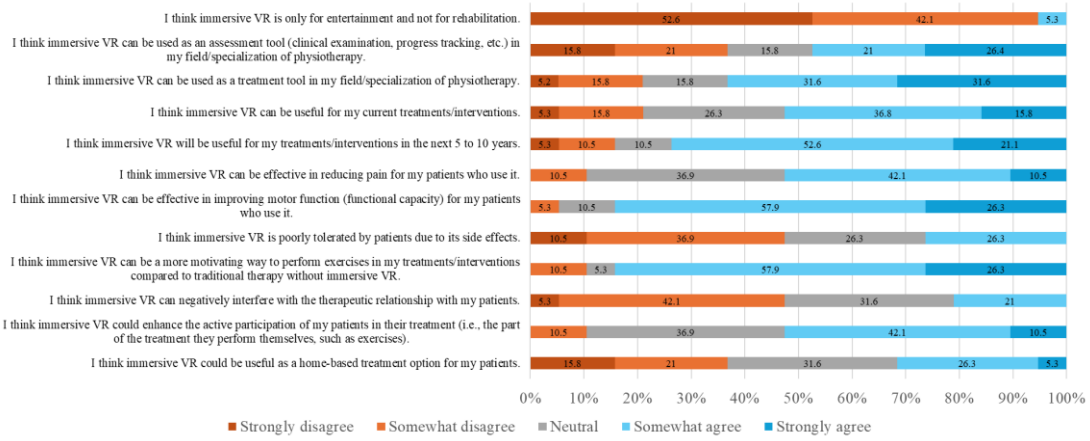
B.

VR = Virtual reality.



C.

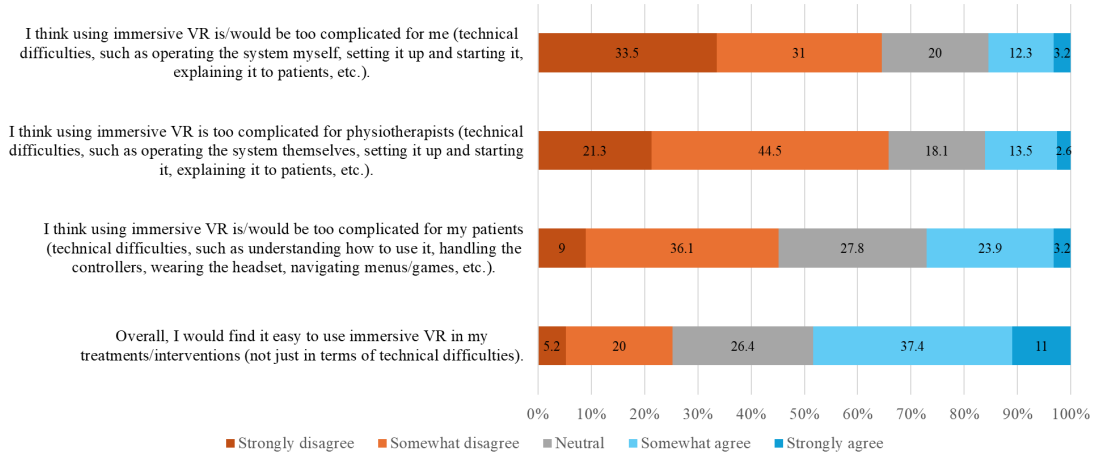
VR = Virtual reality.



D.

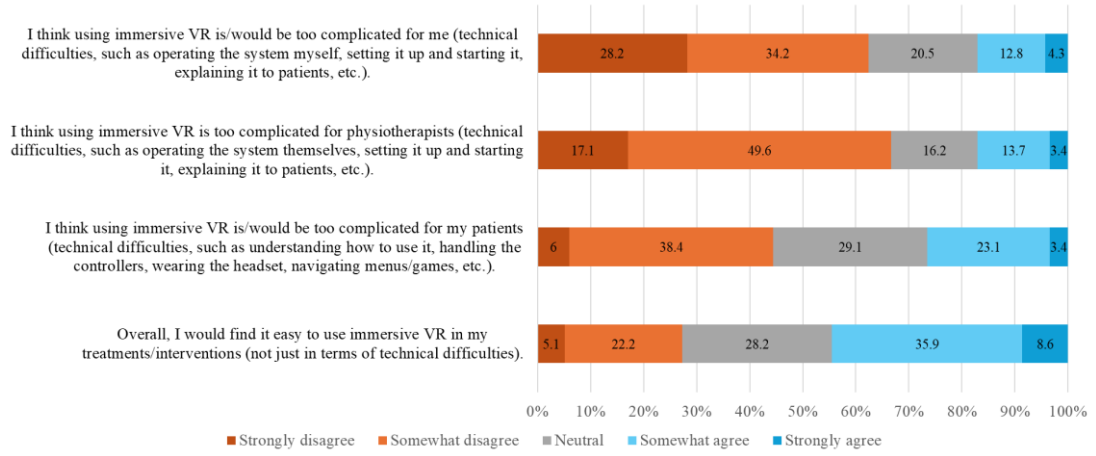
VR = Virtual reality.

Supplementary Appendix 3.3. Perceived ease of use of immersive VR in clinical practice (A = Total sample; B = Never-users; C = Current users; D = Past users).



A.

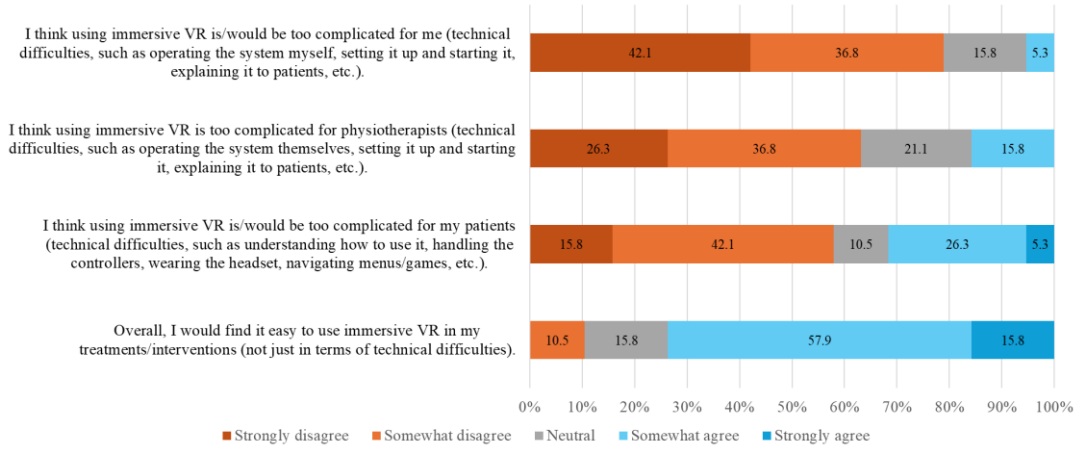
VR = Virtual reality.



B.

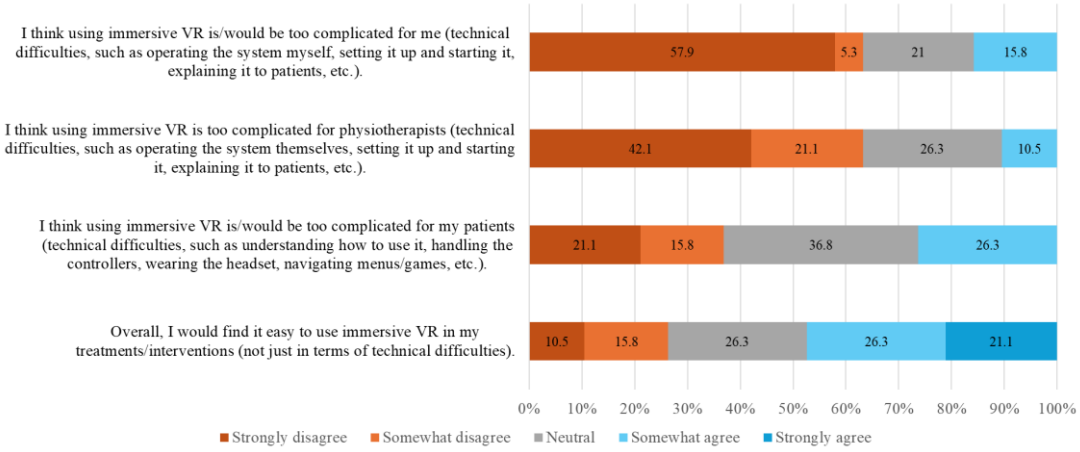
VR = Virtual reality.

C.



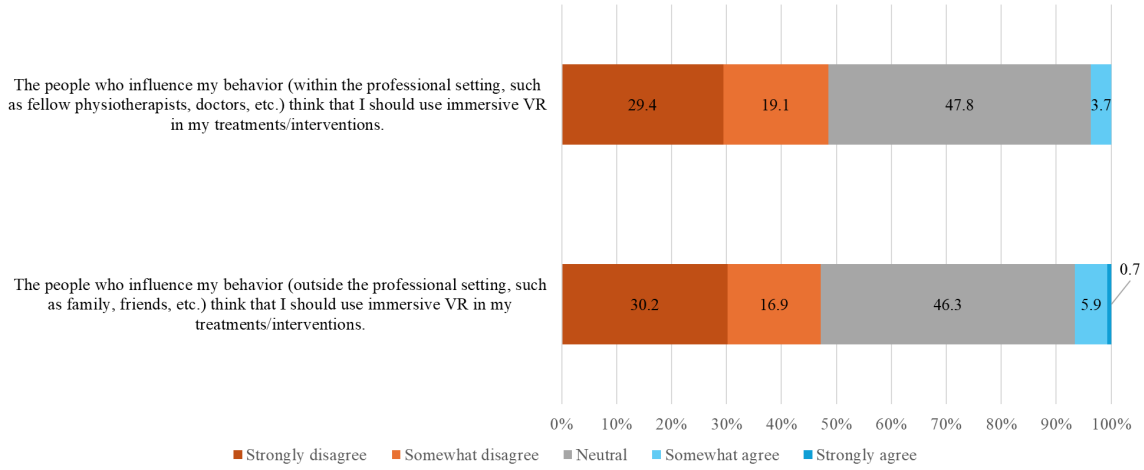
VR = Virtual reality.

D.



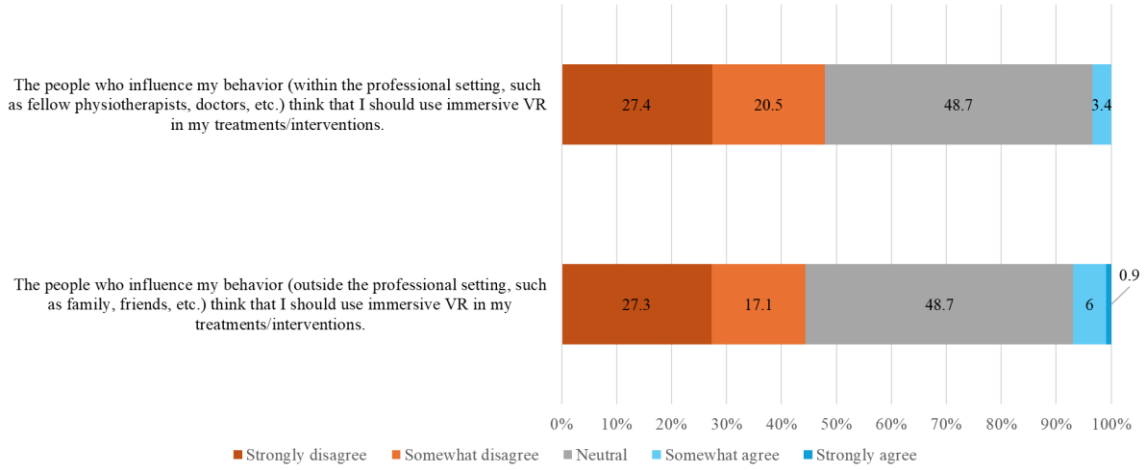
VR = Virtual reality.

Supplementary Appendix 3.4. Social influence on the use of immersive VR in clinical practice (A = Total sample; B = Never-users; C = Past users).



A.

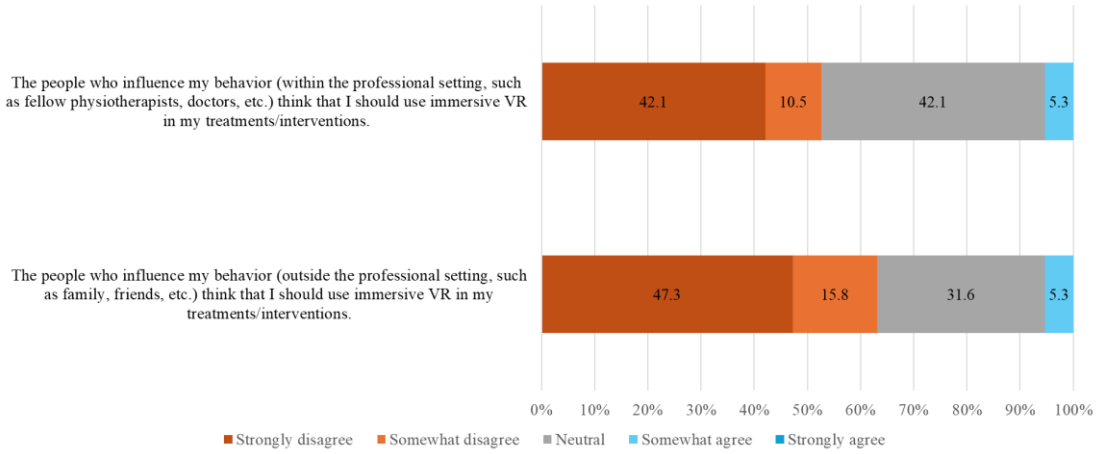
VR = Virtual reality.



B.

VR = Virtual reality.

C.



VR = Virtual reality.