Coproducing Virtual Reality Technologies for Rehabilitation

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Abstract Co-production: What is it, what it not and how to do it in relation to Virtual Reality technology design and research? A modified Delphi approach involving key stakeholders was used to: identify and prioritise outcomes of importance in relation to VR technology design in order to address clinical issues; usability/development of bespoke project measures and clinical trial design. Results reflect three key themes of motivation: autonomy, relatedness and competence. Key principles of co-production are discussed with consideration to impact on technology design and therapeutic strategies to support engagement and adherence to therapy protocols using VR technologies.

Keywords—coproduction, motivation, VR design, patient reported outcome measures

I. Introduction (*Heading 1*)

Co-production is being seen as increasingly important to engage key-stakeholders – patients and or individuals with disability – in critical issues involving health care and rehabilitation [1]. Co-production is not just about inviting articulate patients or clients to a meeting to discuss potential research priorities or review a research proposal. Co-production requires a number of essential ingredients, notably: Sharing of power in which decision making and research are owned jointly between team members to achieve a joint understanding; Inclusion of a representative team to cover multiple perspectives and skills; Equal importance of members giving respect and value of experience and knowledge to all equally; Reciprocity in which everybody will benefit from collaborative working; Relationship building and maintaining within the team; and, Power – whereby a joint understanding and consensus is set with clarity over roles and activities [2]. With respect to the design of Virtual Reality technologies and their use in rehabilitation, few projects have involved key stakeholders, patients and individuals with disability including children, young people and their families, in design concepts, research priorities and measurement of research outcomes.

This paper reports on a co-production project in which key stakeholders – children and young adults with disability – are involved in all stages of technology design, research design and determination and evaluation of research outcomes. The key issues to be addressed were to:

- discuss the key issues of importance in the design of VR rehabilitation tools
- define outcomes of importance in relation to the 5-themes of the VR4REHAB programme:
  1. Pain Management
  2. Engagement and Immersion to support (home-based) therapy adherence
  3. Behavioural and cognitive training in children and adolescents with brain injury
  4. Lower limbs and mobility
  5. Training of upper limb movements
- identify usability of recommended measurement tools and or consider development of bespoke project measures
- outline clinical trial format and methods evaluation

II. Methods

A. Participant Selection

Purposive sampling with snowballing was used to invite young people and or their parents to a 'co-production' afternoon. Individuals were identified via patient lists of children and young people as young people with Cerebral Palsy or Acquired Brain Injury for home intensive rehabilitation has been shown to be beneficial but for whom rehabilitation services are limited in the UK National Health Service. Individuals were free to promote the session to friends and teachers. Exclusions were younger children whose attention or cognitive ability may limit their ability to engage with the main discussions over the 3 hour period.

B. Process

A modified Delphi approach was used to begin a multistage process for gaining consensus on key issues, outcomes of importance and measurement tools. In the first session the

main theme of Immersion and Adherence to home-based therapy programmes was the main focus. Rather than use pre-defined questionnaires for multiple blind rankings, unconstrained ideas were encouraged through the use of individually completed 'post-it' notes.

In Round 1, each participant was asked to generate key thoughts of importance to them for three questions:

1. 'What are key design issues that Virtual reality rehabilitation tools need to incorporate to be motivating and encourage for use in rehabilitation?'
2. 'What key points need to be considered in the evaluation of the effectiveness of VR technologies (outcomes of importance): method of administration, questions to ask and types/formatting of questions?'
3. What issues are important to consider for research design to evaluate the effectiveness of VR technologies to enhance motivation and adherence to therapy protocols?'

Each person wrote key thoughts on post-it notes which were placed on a common poster. Discussions followed to consider overall themes and concepts that emerged from these and the 'post-it' notes arranged under relevant headings. Key topics were then summarised and discussed as to whether anything was missing. As only 3 key themes emerged for question 1 from the group, further Delphi validation was not undertaken as all 3 were considered priorities.

In Round 2, A summary of the session with the 'post-it' comments has been distributed to participants to: 1) verify the 3 key themes, 2) comment on developed evaluation form and 3) add to recommendations for the clinical trial-research design.

Round 3, will be integrated into the research process with invitation to the VR prototypes.

III. RESULTS FROM ROUND 1

From Round 1, three Main Themes emerged reflecting critical components of motivation: autonomy, relatedness and competence. In particular the system design needs to consider: 1) Universality/For everyone; 2) Motivation & Achievement 3) Functionality/Usability. Subthemes emerged relating to the mechanisms-key design issues to achieve objectives with some overlap of these points.

For Universality, subthemes included Plug in to existing systems, Scaling - training it so it learns existing skills and builds on these, and Competition in which success and progress is recognised.

For Motivation and Achievement subthemes emerged to include; Progress (linked to competitions), VR friend in programme, being in control and saving of progress.

For Functionality/Usability important subthemes were Accessibility, Voice activation (precision) / switch access Outcomes or relevance and you to define these resulted in recommendations for a questionnaire evaluation both within and outside of the system. Points to included considered
Question/feedback administration
e.g. "short term feedback versus long term feedback" (daily vs weekly average/top success), "5- point scale for responses"

"Character/mentor to ask questions within programme – my journal feature!"
Questions to include
e.g."Did it do what you wanted it to do?""What did you want it for?" "What went well?, What would you improve?, "Include some open-ended "why"questions."
Question type
e.g. *Questions need to be upbeat","Challenging" can mean many things e.g. physically challenging, too long,"
Question responses
e.g."There's no in between with the faces,…biased depending on who is rating. "Star system and rubbish bin? Coloured thumbs up or down", "Use simple language or provide definitions.","Don't ask too many questions, too often!"
Outcomes to Measure:
Enjoyment/fun, Achievement, Skill
Accessible/System Usability
Provide a screen-shot of a scene from the game and ask questions about the scene
Provide different questionnaires for each age range e.g. children and adults
Research Design recommendations
An Action Research involving 2 Phases
Phase 1 – Focus Group/Workshop,
     Trial with research team,
     Make instructional video (you tube)
     Bring in home tech –(to see if application works)
Revise prototype if required
Phase 2 – post to participants for 2 week trial
     Check out ease of set up
     Check out if tutorial or skype assist set up
     Trouble shooting *Chat* room
     Monitor set up time 1st and 2+ sessions (time/effort)

IV. DISCUSSION

These results will be discussed in light of their implications for VR technology design and evaluation both from a clinical and research perspective.

ACKNOWLEDGMENT *(Heading 5)*

REFERENCES

[1] Palumbo, R. (2016). Contextualizing co-production of health care: a systematic literature review. *International Journal of Public Sector Management, 29*(1), 72-90.
[2] 'INVOLVE' **Guidance on co-producing a research project** http://www.invo.org.uk/wp-content/uploads/2018/03/Copro_Guidance_Mar18.pdf