**Supplement 1. Search Strategy**

(((("Proteus Effect") OR (self AND avatar AND representation) OR (virtual AND self OR doppelgänger OR agent OR model OR “Models, Anatomic” OR “digital twin” OR 2d OR 3d OR realistic OR representation OR “virtual reality” OR “Imaging, Three-Dimentional/psychology” OR digital AND representation OR virtual AND image OR virtual AND representation OR representation AND of AND body OR physical AND representation OR “digital image” OR “digital body” OR digital AND picture AND of AND body) OR ("mHealth" OR “Mobile Applications” OR mobile AND health AND smartphone AND application OR app))))

**AND**

((health OR “Health/psychology” AND (diet OR exercise OR physical AND activity OR adherence OR wellbeing OR “quality of life” OR “life satisfaction” OR compliance OR concerdanc\* OR alcohol OR consumption OR "ultra violet" OR “ultra violet rays” OR smoking OR “smoking cessation” OR sex\* OR coitus OR substance OR "Behavior, Addictive" OR addiction OR (body OR image OR “body image” OR “Body Dissatisfaction” OR dissatisfaction)) AND (behavio\* AND (change OR intention) AND (intervention) AND (mechanism))))

**AND NOT**

(("mental health" OR "e-mental health" OR anxiety OR anxious OR psychiat\* OR "video game" OR game OR computer OR “computer game”))

**meSH terms**

"Proteus Effect"; “Avatar”; “Digital Twin”; “Virtual Representation; “Doppelgänger”; “mHealth”; “Applications”; “Behaviour”; “Intention”; “Intervention”

**Supplement 2. Screening and selection tool and TIDier checklist**

**Review question:** How might a virtual representation on an mHealth app intervention influence health-related outcomes?

* Population = Any age, gender, country, ethnicity
* Intervention = Any mHealth app + any virtual representation (subject/ object)
* Comparator = Any comparator/ control
* Outcome = Any health behaviour (any risk and positive health behaviour)
* Setting = Any
* Design = Any

|  |  |  |  |
| --- | --- | --- | --- |
| **Reviewer:** |  | **Date:** |  |
| **Author name/ Study ID:** |  | **Year:** |  |
| **Title:** |  | **Journal:** |  |
|  | | | |
|  | **Include** |  | **Exclude** |
| **Population** | Any age, gender, country, ethnicity | **Population** | Clinical/ mental health |
|  | | | |
| **Intervention** | mHealth app that includes a virtual representation | **Intervention** | mHealth app only  Virtual representation only |
|  | | | |
| **Comparators** | Any | **Comparator** | N/A |
|  | | | |
| **Outcomes** | * Types of virtual representation * Behaviour change intentions and support * Effectiveness of outcomes * Extent and maintenance of behaviour changes * Mechanisms of change * Digital features of technology * Behaviour change techniques * Observed behaviour/ intention/ outcome during study * Observed post-intervention behaviours/ intentions/ outcomes * Self-report post-intervention behaviours/ intentions/ outcomes * Improvement in health outcome, however measured by study authors * At least one measure of a health behaviour as an outcome variable * Behavioural intention * Extent and maintenance of behavioural changes * Adherence to intervention, feasibility, usability * Overall effectiveness of intervention and understanding the behavioural change techniques (if any) that have been applied * Studies must include at least one virtual representation-based mHealth app intervention | **Outcomes** | Does not report any outcome specified in inclusion criteria |
|  | | | |
| **Design:** | * All studies in which a measure of behaviour outcome was taken before and after interaction with a visual representation will be considered * Experimental and non-experimental studies * Qualitative and mixed-methods studies * Single-arm intervention studies * Randomised and non-randomised trials published in English * No specific comparator required | **Design:** | Grey literature |
| **Overall decision** | **Included:** |  | |
| **Excluded:** |  | |
| **Notes:** |  | | |

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**The TIDieR (Template for Intervention Description and Replication) Checklist\*:**

Information to include when describing an intervention and the location of the information

|  |  |  |  |
| --- | --- | --- | --- |
| **Item number** | **Item** | **Where located \*\*** | |
|  | Primary paper  (page or appendix  number) | Other † (details) |
|  | **BRIEF NAME** |  |  |
| **1.** | Provide the name or a phrase that describes the intervention. | \_\_\_\_\_\_\_\_\_\_\_\_ | \_\_\_\_\_\_\_\_\_\_\_\_\_\_ |
|  | **WHY** |  |  |
| **2.** | Describe any rationale, theory, or goal of the elements essential to the intervention. | \_\_\_\_\_\_\_\_\_\_\_\_ | \_\_\_\_\_\_\_\_\_\_\_\_\_ |
|  | **WHAT** |  |  |
| **3.** | Materials: Describe any physical or informational materials used in the intervention, including those provided to participants or used in intervention delivery or in training of intervention providers. Provide information on where the materials can be accessed (e.g. online appendix, URL). | \_\_\_\_\_\_\_\_\_\_\_\_ | \_\_\_\_\_\_\_\_\_\_\_\_\_ |
| **4.** | Procedures: Describe each of the procedures, activities, and/or processes used in the intervention, including any enabling or support activities. | \_\_\_\_\_\_\_\_\_\_\_\_ | \_\_\_\_\_\_\_\_\_\_\_\_\_ |
|  | **WHO PROVIDED** |  |  |
| **5.** | For each category of intervention provider (e.g. psychologist, nursing assistant), describe their expertise, background and any specific training given. | \_\_\_\_\_\_\_\_\_\_\_\_ | \_\_\_\_\_\_\_\_\_\_\_\_\_ |
|  | **HOW** |  |  |
| **6.** | Describe the modes of delivery (e.g. face-to-face or by some other mechanism, such as internet or telephone) of the intervention and whether it was provided individually or in a group. | \_\_\_\_\_\_\_\_\_\_\_\_ | \_\_\_\_\_\_\_\_\_\_\_\_\_ |
|  | **WHERE** |  |  |
| **7.** | Describe the type(s) of location(s) where the intervention occurred, including any necessary infrastructure or relevant features. | \_\_\_\_\_\_\_\_\_\_\_\_\_ | \_\_\_\_\_\_\_\_\_\_\_\_\_ |
|  | **WHEN and HOW MUCH** |  |  |
| **8.** | Describe the number of times the intervention was delivered and over what period of time including the number of sessions, their schedule, and their duration, intensity or dose. | \_\_\_\_\_\_\_\_\_\_\_\_\_ | \_\_\_\_\_\_\_\_\_\_\_\_\_ |
|  | **TAILORING** |  |  |
| **9.** | If the intervention was planned to be personalised, titrated or adapted, then describe what, why, when, and how. | \_\_\_\_\_\_\_\_\_\_\_\_\_ | \_\_\_\_\_\_\_\_\_\_\_\_\_ |
|  | **MODIFICATIONS** |  |  |
| **10.ǂ** | If the intervention was modified during the course of the study, describe the changes (what, why, when, and how). | \_\_\_\_\_\_\_\_\_\_\_\_\_ | \_\_\_\_\_\_\_\_\_\_\_\_\_ |
|  | **HOW WELL** |  |  |
| **11.** | Planned: If intervention adherence or fidelity was assessed, describe how and by whom, and if any strategies were used to maintain or improve fidelity, describe them. | \_\_\_\_\_\_\_\_\_\_\_\_\_ | \_\_\_\_\_\_\_\_\_\_\_\_\_ |
| **12.ǂ** | Actual: If intervention adherence or fidelity was assessed, describe the extent to which the intervention was delivered as planned. | \_\_\_\_\_\_\_\_\_\_\_\_\_ | \_\_\_\_\_\_\_\_\_\_\_\_\_ |

\*\* **Authors** - use N/A if an item is not applicable for the intervention being described. **Reviewers** – use ‘?’ if information about the element is not reported/not sufficiently reported.

† If the information is not provided in the primary paper, give details of where this information is available. This may include locations such as a published protocol or other published papers (provide citation details) or a website (provide the URL).

ǂ If completing the TIDieR checklist for a protocol, these items are not relevant to the protocol and cannot be described until the study is complete.

\* We strongly recommend using this checklist in conjunction with the TIDieR guide (see *BMJ* 2014;348:g1687) which contains an explanation and elaboration for each item.

\* The focus of TIDieR is on reporting details of the intervention elements (and where relevant, comparison elements) of a study. Other elements and methodological features of studies are covered by other reporting statements and checklists and have not been duplicated as part of the TIDieR checklist. When a **randomised trial** is being reported, the TIDieR checklist should be used in conjunction with the CONSORT statement (see [www.consort-statement.org](http://www.consort-statement.org)) as an extension of **Item 5 of the CONSORT 2010 Statement.** When a **clinical trial** **protocol** is being reported, the TIDieR checklist should be used in conjunction with the SPIRIT statement as an extension of **Item 11 of the SPIRIT 2013 Statement** (see [www.spirit-statement.org](http://www.spirit-statement.org)). For alternate study designs, TIDieR can be used in conjunction with the appropriate checklist for that study design (see [www.equator-network.org](http://www.equator-network.org)).

**Supplement 3. PRISMA Checklist**

| **Topic** | **No.** | **Item** | **Location where item is reported** |
| --- | --- | --- | --- |
| **TITLE** |  |  |  |
| **Title** | 1 | Identify the report as a systematic review. | Page 1 |
| **ABSTRACT** |  |  |  |
| **Abstract** | 2 | See the PRISMA 2020 for Abstracts checklist | Page 2 |
| **INTRODUCTION** |  |  |  |
| **Rationale** | 3 | Describe the rationale for the review in the context of existing knowledge. | Page 4 |
| **Objectives** | 4 | Provide an explicit statement of the objective(s) or question(s) the review addresses. | Pages 4 |
| **METHODS** |  |  |  |
| **Eligibility criteria** | 5 | Specify the inclusion and exclusion criteria for the review and how studies were grouped for the syntheses. | Page 5 |
| **Information sources** | 6 | Specify all databases, registers, websites, organisations, reference lists and other sources searched or consulted to identify studies. Specify the date when each source was last searched or consulted. | Page 5 |
| **Search strategy** | 7 | Present the full search strategies for all databases, registers and websites, including any filters and limits used. | Page 5 |
| **Selection process** | 8 | Specify the methods used to decide whether a study met the inclusion criteria of the review, including how many reviewers screened each record and each report retrieved, whether they worked independently, and if applicable, details of automation tools used in the process. | Page 6 |
| **Data collection process** | 9 | Specify the methods used to collect data from reports, including how many reviewers collected data from each report, whether they worked independently, any processes for obtaining or confirming data from study investigators, and if applicable, details of automation tools used in the process. | Page 6 |
| **Data items** | 10a | List and define all outcomes for which data were sought. Specify whether all results that were compatible with each outcome domain in each study were sought (e.g. for all measures, time points, analyses), and if not, the methods used to decide which results to collect. | Page 6-7 |
|  | 10b | List and define all other variables for which data were sought (e.g. participant and intervention characteristics, funding sources). Describe any assumptions made about any missing or unclear information. | Page 6-7 |
| **Study risk of bias assessment** | 11 | Specify the methods used to assess risk of bias in the included studies, including details of the tool(s) used, how many reviewers assessed each study and whether they worked independently, and if applicable, details of automation tools used in the process. | Page 7 |
| **Effect measures** | 12 | Specify for each outcome the effect measure(s) (e.g. risk ratio, mean difference) used in the synthesis or presentation of results. | N/A |
| **Synthesis methods** | 13a | Describe the processes used to decide which studies were eligible for each synthesis (e.g. tabulating the study intervention characteristics and comparing against the planned groups for each synthesis (item 5)). | Page 7 |
|  | 13b | Describe any methods required to prepare the data for presentation or synthesis, such as handling of missing summary statistics, or data conversions. | Page 7 |
| 13c | Describe any methods used to tabulate or visually display results of individual studies and syntheses. | Page 7 |
| 13d | Describe any methods used to synthesize results and provide a rationale for the choice(s). If meta-analysis was performed, describe the model(s), method(s) to identify the presence and extent of statistical heterogeneity, and software package(s) used. | Page 7 |
| 13e | Describe any methods used to explore possible causes of heterogeneity among study results (e.g. subgroup analysis, meta-regression). | N/A (it is a narrative synthesis) |
| 13f | Describe any sensitivity analyses conducted to assess robustness of the synthesized results. | N/A (it is a narrative synthesis) |
| **Reporting bias assessment** | 14 | Describe any methods used to assess risk of bias due to missing results in a synthesis (arising from reporting biases). | Risk of bias was reported for two RCT studies (Page 7) |
| **Certainty assessment** | 15 | Describe any methods used to assess certainty (or confidence) in the body of evidence for an outcome. | N/A (it is a narrative synthesis) |
| **RESULTS** |  |  |  |
| **Study selection** | 16a | Describe the results of the search and selection process, from the number of records identified in the search to the number of studies included in the review, ideally using a flow diagram. | Page 7-8 |
|  | 16b | Cite studies that might appear to meet the inclusion criteria, but which were excluded, and explain why they were excluded. | This was stated in Figure 1 |
| **Study characteristics** | 17 | Cite each included study and present its characteristics. | Page 9 -10 |
| **Risk of bias in studies** | 18 | Present assessments of risk of bias for each included study. | Pages 12-14 |
| **Results of individual studies** | 19 | For all outcomes, present, for each study: (a) summary statistics for each group (where appropriate) and (b) an effect estimate and its precision (e.g. confidence/credible interval), ideally using structured tables or plots. | Pages 10-12 |
| **Results of syntheses** | 20a | For each synthesis, briefly summarise the characteristics and risk of bias among contributing studies. | Pages 13-20 |
|  | 20b | Present results of all statistical syntheses conducted. If meta-analysis was done, present for each the summary estimate and its precision (e.g. confidence/credible interval) and measures of statistical heterogeneity. If comparing groups, describe the direction of the effect. | N/A (narrative synthesis) |
| 20c | Present results of all investigations of possible causes of heterogeneity among study results. | N/A (narrative synthesis) |
| 20d | Present results of all sensitivity analyses conducted to assess the robustness of the synthesized results. | N/A (narrative synthesis) |
| **Reporting biases** | 21 | Present assessments of risk of bias due to missing results (arising from reporting biases) for each synthesis assessed. | N/A (narrative synthesis) |
| **Certainty of evidence** | 22 | Present assessments of certainty (or confidence) in the body of evidence for each outcome assessed. | N/A (narrative synthesis) |
| **DISCUSSION** |  |  |  |
| **Discussion** | 23a | Provide a general interpretation of the results in the context of other evidence. | Page 21-25 |
|  | 23b | Discuss any limitations of the evidence included in the review. | Pages 25-28 |
| 23c | Discuss any limitations of the review processes used. | Page 28-29 |
| 23d | Discuss implications of the results for practice, policy, and future research. | Pages 29 |
| **OTHER INFORMATION** |  |  |  |
| **Registration and protocol** | 24a | Provide registration information for the review, including register name and registration number, or state that the review was not registered. | Page 30 |
|  | 24b | Indicate where the review protocol can be accessed, or state that a protocol was not prepared. | Page 30 |
| 24c | Describe and explain any amendments to information provided at registration or in the protocol. | N/A (no amendments) |
| **Support** | 25 | Describe sources of financial or non-financial support for the review, and the role of the funders or sponsors in the review. | Page 30 |
| **Competing interests** | 26 | Declare any competing interests of review authors. | Pages 30 |
| **Availability of data, code and other materials** | 27 | Report which of the following are publicly available and where they can be found: template data collection forms; data extracted from included studies; data used for all analyses; analytic code; any other materials used in the review. | N/A (there are no data publicly available for this paper) |

**PRIMSA Abstract Checklist**

| **Topic** | **No.** | **Item** | **Reported?** |
| --- | --- | --- | --- |
| **TITLE** |  |  |  |
| **Title** | 1 | Identify the report as a systematic review. | Yes |
| **BACKGROUND** |  |  |  |
| **Objectives** | 2 | Provide an explicit statement of the main objective(s) or question(s) the review addresses. | Yes |
| **METHODS** |  |  |  |
| **Eligibility criteria** | 3 | Specify the inclusion and exclusion criteria for the review. | Yes |
| **Information sources** | 4 | Specify the information sources (e.g. databases, registers) used to identify studies and the date when each was last searched. | Yes |
| **Risk of bias** | 5 | Specify the methods used to assess risk of bias in the included studies. | Yes |
| **Synthesis of results** | 6 | Specify the methods used to present and synthesize results. | Yes |
| **RESULTS** |  |  |  |
| **Included studies** | 7 | Give the total number of included studies and participants and summarise relevant characteristics of studies. | Yes |
| **Synthesis of results** | 8 | Present results for main outcomes, preferably indicating the number of included studies and participants for each. If meta-analysis was done, report the summary estimate and confidence/credible interval. If comparing groups, indicate the direction of the effect (i.e. which group is favoured). | Yes |
| **DISCUSSION** |  |  |  |
| **Limitations of evidence** | 9 | Provide a brief summary of the limitations of the evidence included in the review (e.g. study risk of bias, inconsistency and imprecision). | Yes |
| **Interpretation** | 10 | Provide a general interpretation of the results and important implications. | Yes |
| **OTHER** |  |  |  |
| **Funding** | 11 | Specify the primary source of funding for the review. | Yes |
| **Registration** | 12 | Provide the register name and registration number. | Yes |

*From:* Page MJ, McKenzie JE, Bossuyt PM, Boutron I, Hoffmann TC, Mulrow CD, et al. The PRISMA 2020 statement: an updated guideline for reporting systematic reviews. MetaArXiv. 2020, September 14. DOI: 10.31222/osf.io/v7gm2. For more information, visit: [www.prisma-statement.org](file:///C:\Users\laure\Downloads\www.prisma-statement.org)