Turning reporting guidelines into a behaviour change intervention: Behavioural analysis and development process

Commit ID: b2b401e

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## Introduction

The output of my focus groups was a long list of ideas. This list included ideas from all stakeholders, including myself, and fed into step 7 of Michie et al.’s guide to applying the Behaviour Change Wheel [1]. In chapter (see 8) I explained why I expanded on this step. In this chapter I describe my process in more detail by explaining how I used behavioural analysis to identify behaviour change techniques. I then describe how I turned ideas into intervention components and developed these components into an intervention prototype. By intervention component, I mean a designed element that uses one or more behaviour change technique, which is theorized to work through one or more intervention functions to target one or more behavioural drivers. An intervention *change* is the addition or removal of an element. Defining intervention content in this way is useful because it helps intervention developers to understand why the component has been added (or removed), how it is theorised to be working and, therefore, how its effectiveness may be tested.

## Behavioural Analysis

#### Methods

For every idea generated from the workshops and focus groups, I labelled which barriers it was addressing, which behavioural drivers it was targeting, and which intervention functions it was employing to do so. This list was data driven, in that it was based upon the ideas and barriers generated from previous research (see chapters 3, 4, 5, 6, 8 and 9). To give structure and context to this list, I grouped ideas according to the sub-behaviours they targeted: 1) engaging with guidance and 2) applying it (see section on identifying the target behaviour in chapter 8).

Once all ideas were coded, I selected ideas to implement by considering a) whether they could be incorporated into a web-based intervention, b) the priority of the intervention function (determined in objective 2), and c) whether I could feasibly deliver the idea within the time constraints of my DPhil.

#### Results

See table [Table 1](#tbl-int-plan) for all 28 ideas, labelled with the barriers they address, the drivers they target, the intervention functions they use, and whether I could implement them.

### Building the intervention

#### Purpose

The result of my behavioural analysis was a list of components that were abstract. “Reassuring language” or “design that communicates simplicity” could be realised in many different ways. To build a working prototype that could be piloted I had to make these real.

#### Methods and Results

##### Designing the intervention

I began by describing how each intervention component could be realised and how this compared to the existing system (see #tab-int-plan). In doing these comparisons, I looked at how the EQUATOR website is currently, and I made generalisation about how popular reporting guidelines are disseminated, and the content of their Example and Elaboration documents and checklists.

Designing was iterative and collaborative. I included the same members of EQUATOR UK that had participated in the workshops. We met 3 times between November 2022 and January 2023 to discuss intervention design. In our first meeting, we decided which webpages required redesigning, and how webpages should be navigated. On the existing website, authors starting on the home page must visit up to 5 webpages to reach the full reporting guidance. Many authors leave at each step and so few reach the guidance. We redesigned this workflow to reduce this journey to 2 webpages - the EQUATOR home page, and a reporting guideline page containing the full guidance. These different website layouts are visualised in [Figure 1](#fig-sankey-b4) and [Figure 2](#fig-sankey-after).

Workshop participants then sketched ideas for how the home page and guidance pages could be laid out and where intervention components could be placed. Once participants had agreed on a layout, I created an alpha version of the new website and invited members to comment on it. These were webpages that could be viewed in a browser, but used dummy text and images. After another round of feedback I refined the alpha version, populated it with real text and images, and participants gave feedback again. The new pages can be viewed in [Figure 9](#fig-home), [Figure 10](#fig-rg-intro), and [Figure 12](#fig-discussion), and can be compared with the old pages in [Figure 3](#fig-home-b4) and [Figure 4](#fig-db-b4).

My intention was to create guideline pages for a sample of the most frequently accessed guidelines so that the website felt real for pilot participants. However, many intervention components involved changing the wording and layout of the guidance itself. Editing multiple guidelines was neither feasible not necessary, as we only needed one edited guideline to pilot the new website.

I selected SRQR as my test guideline to edit because I was familiar with it, having used it when writing up my own research, and because I felt it would make a good guideline to test with (see next chapter for why). I got written permission from Bridget O’Brien, the lead developer or SRQR, and from the publisher. I kept Bridget up to date with my work and invited her feedback.

I began editing SRQR by pasting the text into Microsoft Word and rearranging content into categories: what to write, how/where to write it, what to write if the item wasn’t/couldn’t be done, why the item is important and to whom, examples. I edited sentences to speak directly to authors. E.g. “Describe X” instead of “Authors should describe X”, and to use active voice. This shortened the text and made it clearer that the primary audience is authors.

For composite items I split the sub-items into bulleted lists. E.g.

For each X, describe:

* X
* Y
* Z

I rearranged conditional sub-items so that they read “If X, then describe Y”, rather than “Describe Y if X”. I moved definitions into the glossary and contextual information into notes. I edited the resulting text to join it back together. I edited the tone of voice to add reassuring language. An example of the redesigned guidance can be viewed in #sec-box-item.

After development, I double checked the intervention against the initial list of intervention components to ensure I had covered all of them. I consulted with EQUATOR members to verify that the components were realised as expected and invited another round of feedback.

##### System architecture

When considering architecture options I prioritized technology that could feasibly be maintained by EQUATOR staff or a future PhD student. I looked for tools that would be familiar to early career researchers. I considered DIY website builders (like Wix or Squarespace) but these services can be expensive. Most offer a ‘drag and drop’ building experience which, although easy to use, is a laborious way of uploading and formatting large amounts of content. Should EQUATOR want to change how an item is presented, they would have to manually edit each item for each reporting guideline. Additionally, our intended intervention changes required custom functionality that wasn’t offered by these services (e.g. integration with a DOI minting service, glossary definitions, discussion boards).

Although coding languages like html or javascript are used by many software developers to create websites, few early career researchers are familiar with them. I decided on markdown, an incredibly simple language that can be learnt in a few minutes. It uses asterisks, underscores, and carets to make text **\*\*bold\*\***, *\_italic\_*, or ^superscript^. Headings, URLS, and references are similarly easy, and can be simplified further by using one of many readily available editors that make writing markdown feel like writing a Microsoft Word document.

Many researchers write reproducible manuscripts in markdown using tools like RStudio or Quarto. Quarto can turn markdown into many different file formats including docx, pdf, and html (a website). Quarto documents can be further customised using programming languages commonly used in research, like Ruby or Python. Quarto requires no technical knowledge, is easy to learn, has great documentation, and is open source.

The website is served using Github Pages which is free, beginner friendly, configurable, and integrates (almost) seamlessly with Github’s version control system which will already be familiar to many researchers. I wanted EQUATOR to have ultimate control over the website. I also wanted guideline developers to have selective access to edit their own guideline content but not to other guidelines. I have built the website such that each reporting guideline is stored in its own repository on Github, accessible only to its developers. These guideline repositories are then “pulled in” to the main EQUATOR repository, so EQUATOR can double check changes that developers make before allowing them to go live on the site.

The website source code can be viewed at https://github.com/jamesrharwood/equator-guidelines-website and the website can be viewed at https://jamesrharwood.github.io/equator-guidelines-website/.

Table 1: Intervention Planning Table. Intervention ingredients labelled with the intervention function (INT. FN) they employ, examples of how they are (or are not) used before this redesign (Before) and, when included, within the redesigned intervention (Now). Components are grouped according to the key behaviours, barriers, and behavioural drivers that they are designed to target.

| INTERVENTION INGREDIENT | INT. FN | BEFORE | NOW |
| --- | --- | --- | --- |
| **Key Behaviour: Engage with (read) appropriate reporting guidance as early as possible** |  |  |  |
| **Targeted barrier: Researchers may not know what RGs are**  **Behavioural driver: Capability** |  |  |  |
| Describe what RGs are where they are first encountered | Education | No prominent description of what reporting guidelines are on EQUATOR home page or in RGs resources.  Example: See [Figure 3](#fig-home-b4), [Figure 5](#fig-rg-intro-b4), [Figure 7](#fig-checklist-b4), [Figure 8](#fig-journal-instructions) | Prominent definition on home page and guideline page.  Example: See [Figure 9](#fig-home), [Figure 10](#fig-rg-intro) |
| Differentiate resources and advice aimed at different tasks (writing vs designing vs appraising) | Education | No clear instruction on what tasks RGs can and cannot be used for.  Example: See [Figure 3](#fig-home-b4), [Figure 4](#fig-db-b4), [Figure 5](#fig-rg-intro-b4) | Clear instruction and differentiation of resources  Example: See [Figure 9](#fig-home), [Figure 10](#fig-rg-intro) |
| **Targeted barrier: Researchers may not know what RGs exist**  **Behavioural driver: Capability** |  |  |  |
| Instruct authors to cite reporting guidelines | Education | No consistent instruction to cite reporting guidelines | Consistent instruction to cite reporting guidelines |
| Encourage journals, ethics committees, funders, and other stakeholders to endorse reporting guidelines | Education | Many journals endorsed reporting guidelines | No change |
| Encourage all stakeholders to promote reporting guidelines | Education | Few stakeholders run promotional campaigns to promote RGs (other than endorsing/enforcing them) | No change |
| Install reporting champions; individuals that promote reporting guidelines within their organisation or peer group | Education | Champions may exist informally | No change |
| Decision tools for discovering resources | Enablement | We previously made a “reporting guideline wizard” but it was difficult to find.  Example: see [Figure 3](#fig-home-b4) | Not included yet |
| Collections of related reporting guidelines | Environmental Restructuring | Collections exist on EQUATOR site but are difficult to find  Example: See [Figure 3](#fig-home-b4) | Home page includes a small table of collections  Example: See [Figure 9](#fig-home) |
| Links between related guidelines | Environmental Restructuring | E&E articles may reference guidelines published previously, but these references can be buried in text, and E&Es are not updated to reference guidelines published subsequently. EQUATOR website guideline pages feature links to extensions, but these are hard to find. Checklists do not link to related resources.  Example: See [Figure 4](#fig-db-b4), [Figure 5](#fig-rg-intro-b4) | Guidelines prominently link to other relevant guidelines and explain when they should be used.  Example: See [Figure 10](#fig-rg-intro) |
| embed reporting guidelines that “fit together” | Enablement | Checklists and their extensions are published separately. The best example of modular guidance is perhaps the JARS guidelines, but even these are published as separate documents. | No change |
| **Targeted barrier: Guidance may be difficult to find**  **Behavioural driver: Opportunity** |  |  |  |
| Centralised hosting | Enablement | EQUATOR maintained a database of reporting guideline meta-data, but the guidance and checklists were published and hosted in different locations and in different ways. | A core set of frequently accessed guidelines are now presented on a single website in a consistent structure and format, alongside all of their checklists, templates, and other tools. |
| Search function on website | Enablement | EQUATOR’s search function was difficult to find. | Search function is easier to find. A recognizable icon appears in the navigation bar of every page, and the home page includes additional ways to access search functionality. |
| Search Engine Optimization | Enablement | EQUATOR’s website did not make use of some commonly used search optimization heuristics. It ranked well for guideline acronyms (like STROBE) but not for general terms that naive authors may use, like “observational epidemiology”. | Site has meta data required by search engines |
| Permanent links (DOIs) | Enablement | Although guideline publications have DOIs, tools (commonly hosted on guideline developer’s websites) do not. EQUATOR’s website does not use document object identifiers. If resources move (e.g. a website is reorganised or depreciated) then links can “die”. | No change |
| **Targeted barrier: RGs may be difficult to access**  **Behavioural driver: Opportunity** |  |  |  |
| Ensure guidelines and tools are open access | Enablement | Some guidelines are published behind paywalls | No change |
| **Targeted barrier: Researchers may not know whether a RG applies to them**  **Behavioural driver: Capability** |  |  |  |
| Describe the scope of a reporting guideline at the top of every resource | Education | Some reporting guidelines may describe their scope within their E&E. Others might not, or may only describe their scope broadly without fully explaining the design assumptions within the guidance. Guidelines would not explain circumstances where the guidance should not be used. Checklists rarely define intended scope beyond the title of the guideline. | The intended scope of a guideline is clearly & prominently described. This definition includes contexts in which the guidance should not be used. |
| **Targeted barrier: Researchers may not know what RG is their best fit**  **Behavioural driver: Capability** |  |  |  |
| Use if-then rules to direct authors to more appropriate guidance when available | Education | Reporting guidelines do not consistently point authors towards related resources that might be better fits. If a reporting guideline E&E *does* do this, this advice becomes out of date as and when new guidelines are published. | Reporting guidelines clearly and consistently point authors to more appropriate guidance when appropriate, using if-then rules. |
| Explicitly state when no better guidance exists for a particular use case | Education | Guideline E&Es do not consistently explain what to do when no better guidance exists for their use case  Example: See [Figure 5](#fig-rg-intro-b4) | Guidelines warn authors when no better guidance exists for a use case, and how the current guidance can be adapted instead  Example: See [Figure 10](#fig-rg-intro) |
| Decision tools (see above) | See above | See above | See above |
| **Targeted barrier: Researchers may not understand the language**  **Behavioural driver: Opportunity** |  |  |  |
| provide translations of resources | Enablement | Translations were listed on EQUATOR database pages, but not on the guidance or checklists  Example: See [Figure 4](#fig-db-b4) | Translations are prominently listed above the guidance  Example: See [Figure 10](#fig-rg-intro) |
| **Targeted barrier: Researchers may expect the costs to outweigh benefits**  **Behavioural driver: Motivation** |  |  |  |
| Make guidance appear shorter by removing superfluous parts, hiding optional content, splitting long guidelines, using concise language, and separating design advice | Environmental restructuring | RG publications may include lengthy explanation of development, verbose language, and can be bloated by design advice  Example: See [Figure 6](#fig-item-b4) | The only information presented immediately is what to describe. Additional information is hidden at first and can be expanded. Text is shortened through editing and by using active voice. Overall, this reduces the text length by 60%.  Example: See [Figure 11](#fig-item) |
| Cater to different kinds of user (readers vs dippers) by structuring guidance with headings, itemisation, hyperlinking to particular sections, and with dynamic content | Environmental restructuring | Besides being split into items, reporting guidance is largely unstructured, and different items can be structured in different ways. Checklist items do not link to items within the E&E.  Example: See [Figure 6](#fig-item-b4) | SRQR items are structured consistently, making information easier to find.  Example: See [Figure 11](#fig-item) |
| Include testimonials from researchers who were nervous about being punished for reporting transparently | Persuasion | No such testimonials exist | No change |
| Decrease fear of judgement by making reporting guidelines design agnostic | Coercion (Removal of) | Reporting guidelines may conflate reporting advice with design advice or design assumptions. The justification for why an item is important to describe is frequently presented in terms of good and bad design. | SRQR explicitly states that it makes no assumptions about design. Where design advice was given, this has been moved to a separate page. |
| Remove branding and messaging that may invoke feelings of judgement, complexity, or administrative red-tape | Coercion (Removal of) | EQUATOR’s website looked cluttered and visually unappealing. Guidance published in articles can look unappealing, depending on the publisher. Reporting guidance made frequent reference to waste, (lack of) transparency, bias, and poor design.  Example: See [Figure 3](#fig-home-b4) | A clean, simple interface for the home page and guidance pages. Text makes less use of to judgemental phrases.  Example: See [Figure 9](#fig-home) |
| Reassure that all research has limitations and encourage explanation over perfection | Persuasion | Few guidelines would include this kind of reassurance  Example: See [Figure 5](#fig-rg-intro-b4) | This reassurance appears on the home page and all guidance pages  Example: See [Figure 10](#fig-rg-intro) |
| **Targeted barrier: Researchers may feel that checking reporting is someone else’s job.**  **Behavioural driver: Motivation** |  |  |  |
| Address communications to authors | Persuasion | It wasn’t immediately clear whether the EQUATOR guideline website was aimed at authors, editors, reviewers, or all. Guidance was written in third person and would generally be worded as “authors should describe how…”, but it wouldn’t always be clear who was expected to use a checklist. | All resources and website copy are directed predominantly at authors. |
| Communicate why reporting is the responsibility of the author and not an editor or reviewer | See above | Because it wasn’t clear how reporting guidelines and checklists should be used, they (especially checklists) could appear as administrative tasks that should be the responsibility of the editor or reviewer. | Clearer description of how guidelines and tools should be used and who should use them.  Example: See [Figure 10](#fig-rg-intro) |
| **Targeted barrier: Researchers may not consider writing as reporting**  **Behavioural driver: Motivation** |  |  |  |
| Educate about writing as a process | Education | EQUATOR provided education about how to write | Guidelines link to this education  Example: See [Figure 11](#fig-item) |
| Provide training and education about writing as a process | Training | EQUATOR provided training about how to write | Guidelines link to this training  Example: See [Figure 11](#fig-item) |
| **Key Behaviour: Apply reporting guidance to writing** |  |  |  |
| **Targeted barrier: Researchers may not know what resources exist for a RG**  **Behavioural driver: Capability** |  |  |  |
| link all resources to each other | Environmental restructuring | Development articles, E&E articles, and checklist files may not link to each other.  Example: See [Figure 7](#fig-checklist-b4) | Guidance links to all tools and development article  Example: See [Figure 10](#fig-rg-intro) |
| **Targeted barrier: Researchers may not know what benefits to expect**  **Behavioural driver: Capability** |  |  |  |
| Describe personal benefits and benefits to others where reporting guidelines are introduced (home page, on resources, in communications) | Education | Benefits are not prominently described on EQUATOR’s home page, nor within the guideline publications. Benefits that are described may by hard to find, and often focus on hypothetical benefits to the research community, but not personal benefits to the author.  Example: See [Figure 3](#fig-home-b4) | Benefits are prominently and consistently displayed across the home page and guidance pages. Descriptions prioritize personal benefits to the authors above hypothetical benefits to others.  Example: See [Figure 10](#fig-rg-intro) |
| **Targeted barrier: Researchers may not believe stated benefits**  **Behavioural driver: Motivation** |  |  |  |
| Gather and communicate evidence for benefits | Persuasion | Benefits often presented without evidence (if at all) | A dummy quote provides evidence for experienced benefits. |
| Display citation metrics | Persuasion | Citation metrics are available for guideline publications, but are not displayed on the EQUATOR website or within the guidance or checklists themselves.  Example: See [Figure 4](#fig-db-b4) | Citation metrics are presented at the top of each reporting guideline.  Example: See [Figure 10](#fig-rg-intro) |
| Create spaces for authors to see other authors using reporting guidelines | Persuasion | There were no official on or offline spaces for authors to witness other users discussing guidelines. | Each reporting item has a discussion board.  Example: See [Figure 12](#fig-discussion) |
| Use language to communicate personal benefits; confidence and simplicity | Persuasion | Guidance text made little use of a reassuring tone or words. The EQUATOR website and guideline articles looked dense and complex.  Example: See [Figure 3](#fig-home-b4) and [Figure 5](#fig-rg-intro-b4) | A clean, simple interface for the home page and guidance pages. Text uses phrases like “confidence”, “quick”, “maximum impact”.  Example: See [Figure 9](#fig-home) and [Figure 10](#fig-rg-intro) |
| **Targeted barrier: Researchers may not care about the benefits of using a RG**  **Behavioural driver: Motivation** |  |  |  |
| Create new benefits that are more meaningful e.g., by offering recognition of good reporting through a certification service | Incentivization | Benefits to the scientific community were often described. Personal benefits were rarely described, suggesting they aren’t always considered by developers. | No new benefits created |
| Include testimonials from research users who benefit from complete reporting | Persuasion | Testimonials not included in reporting guidelines. | SRQR includes dummy testimonials and quotes from research users |
| Create training that helps students experience, first hand, the benefits of RGs and consequence of poor reporting | Training | Although many students are tasked with undertaking a systematic review, the primary focus of this is generally not to consider (in)complete reporting. | No changes made |
| **Targeted barrier: Researchers may misunderstand**  **Behavioural driver: Capability** |  |  |  |
| use plain language | Enablement | Although developers aspire to write clearly, authors may misinterpret guidance or fail to understand it completely. | SRQR is edited to use plainer language. |
| define key terms | Education | Few guidelines came with a glossary. Some key terms may be defined within the guideline text. Including definitions this way makes them hard to find and elongates the guidance. | SRQR now has a glossary, and text is marked-up with definitions that appear upon click.  Example: See [Figure 11](#fig-item) |
| use consistent terms | Enablement | Guidelines may use different terms to refer to the same thing. A single guideline may do this too. | SRQR uses consistent terms across items. |
| provide translations | Enablement | Some guidelines have been translated, but many haven’t. The EQUATOR website uses an automatic translation tool, but this doesn’t cover the guidance itself. Translations aren’t always easy to find.  Example: SRQR was available in French but the translation wasn’t advertised on the main guidance. | Translations are linked at the top of the guidance.  Example: See [Figure 10](#fig-rg-intro) |
| provide channels for feedback and support (see above) | None | See above | See above |
| **Targeted barrier: Researchers may not know why items are important**  **Behavioural driver: Capability** |  |  |  |
| For each item, explain why the *information* is important and to whom (regardless of whether a particular design choice is important) | Education | Sometimes there was no explanation as to why an item should be reported. Other times the justification would be about why a particular design choice was important.  Example: See [Figure 6](#fig-item-b4) | Informaiton added  Example: See [Figure 11](#fig-item) |
| For each item, indicate any conditions which modify importance | Education | It might not always be made clear when an item is only applicable in certain circumstances | No changes made |
| Explain importance of complete reporting to the scientific community | Education | EQUATOR and most RGs do this already | Continue to do this |
| **Targeted barrier: Researchers may not know how to do an item**  **Behavioural driver: Capability** |  |  |  |
| Provide links to other resources that explain how an item can be done | See above | Some RG E&Es include instruction in text but many don’t. SRQR did not. | Links included when relevant.  Example: See [Figure 11](#fig-item) |
| **Targeted barrier: Researchers may not know how to report an item in practice**  **Behavioural driver: Capability** |  |  |  |
| For each item, provide clear instruction of what needs to be described | Education | Writing instructions are often mixed in with other explanation and context. | Writing instruction occurs first for each item.  Example: See [Figure 11](#fig-item) |
| For each item, provide examples of reporting in different contexts | modelling | Not all RGs provide examples. Examples may not cover different contexts. | Additional examples  Example: See [Figure 11](#fig-item) |
| Discussion spaces (see above) | Enablement | No formal discussion spaces existed. Authors may use platforms like Twitter. | Each item is linked to its own discussion board.  Example: See [Figure 12](#fig-discussion) |
| **Targeted barrier: Researchers may not know what to write when they cannot report an item**  **Behavioural driver: Capability** |  |  |  |
| Provide clear instruction of what needs to be described when an item was not done, could not be done, or does not apply | Education | Rarely instructed  Example: See [Figure 6](#fig-item-b4) | Instructed where relevant  Example: See [Figure 11](#fig-item) |
| Provide examples of reporting “imperfect” items | Modelling | Examples not provided | No changes made |
| **Targeted barrier: Researchers have limited time**  **Behavioural driver: Opportunity** |  |  |  |
| Ensure resources (checklists and templates) are in ready-to-use formats | Enablement | Some checklists not in immediately usable formats e.g., PDFs | No changes made |
| Structure guidance to make it quicker to digest (see above) | Enablement | E&E documents not structured below the item level  Example: See [box 6](#fig-item-b4) | Items have consistent structure  Example: See [box 11](#fig-item) |
| Indicate priority of items for authors that are short on time | Enablement | ARRIVE indicates priority, other RGs including SRQR do not. | No changes made |
| Tell authors how long the guidance will take to read | Education | Estimated reading time not given | Estimated reading time given  Example: See [Figure 10](#fig-rg-intro) |
| Tell authors how long guidance will take to apply | Education | No advice given | No changes made  Example: No changes made |
| **Targeted barrier: Researchers may not know when RGs should be used**  **Behavioural driver: Capability** |  |  |  |
| Tell authors when to use RGs, or that RGs are best used as early as possible | Education | Rarely stated prominently | Stated prominently  Example: See [Figure 10](#fig-rg-intro) |
| Differentiate resources by task on website | Enablement | Resources not explicitly linked to tasks | Resources presented alongside the tasks they are intended for  Example: See [Figure 10](#fig-rg-intro) |
| **Targeted barrier: Researchers may not encounter RGs early enough to act on them**  **Behavioural driver: Opportunity** |  |  |  |
| Optimize websites for search terms aimed at early use like “how to write”, or “funding application”. | Enablement | Not done | No changes made |
| Promote RGs in writing clubs or writing training | Education | Done in some training courses | No changes made |
| Create prompts / communication campaigns authors early in their research | Enablement | EQUATOR has no way to do this | No changes made |
| Create tools to be used for early writing tasks | Enablement | Most RGs come with a checklist and some kind of E&E. Few guidelines cater to protocols. | No changes made |
| **Targeted barrier: Researchers may struggle to keep writing concise**  **Behavioural driver: Opportunity** |  |  |  |
| Provide instruction as to how information can be reported without breaching word count limits or making articles bloated. | Education | Few RGs or RG items include this information | Instruction at top of RG and in some items where most useful  Example: See [Figure 10](#fig-rg-intro) |
| Provide examples of concise reporting | Modelling | No examples specifically to display concise reporting | No changes made |
| **Targeted barrier: Researchers may not have tools for the job at hand**  **Behavioural driver: Opportunity** |  |  |  |
| Create planning-points; discussion points for planning research in the order decisions are made (see above) | See above | See above | See above |
| Create to-do lists in the order research is conducted, to help authors collect information they will need to report (see above) | See above | (see above) | (see above) |
| Create templates for drafting (see above) | See above | See above | See above |
| Create tools to facilitate checklist completion | Enablement | Updating page numbers in a checklist is time consuming. It takes editors time to double check page numbers and content. Checklists may not include instructions of how to complete them.  Example: See [Figure 7](#fig-checklist-b4) | No changes made |
| Create tools to facilitate particular reporting items | Enablement | Some tools exist (e.g., PRISMA flow chart diagram maker, COBWEB) | No changes made |
| Create tools to help collaborators check each other’s work | Enablement | Checklists exist but aren’t specifically designed for collaborators | No changes made |
| Create tools to help peer reviewers check reporting and request missing information | Enablement | Checklists are RGs are not specifically aimed at peer reviewers | No changes made |
| **Targeted barrier: RGs can become outdated**  **Behavioural driver: Opportunity** |  |  |  |
| Provide feedback channels to help developers keep guidance updated (see Discussion spaces above) | None | See above | See above |
| Create a system so that guideline developers can make small edits without publishing new articles | Enablement | Developers would have to publish a new article | Developers can make small updates any time |
| **Targeted barrier: Researchers may struggle to reconcile multiple sets of guidance**  **Behavioural driver: Opportunity** |  |  |  |
| Explain when RGs do not intended to prescribe structure | Education | Not always stated. Not always prominent  Example: see [Figure 5](#fig-rg-intro-b4) | Explained at top of guidance  Example: see [Figure 10](#fig-rg-intro) |
| Provide options for where items can be reported (see above) | None | See above | See above |
| Create a system whereby guidelines can be embedded into each other (see above) | None | See above | See above |
| **Targeted barrier: Researchers may be asked to remove RG content**  **Behavioural driver: Opportunity** |  |  |  |
| Provide advice regarding how to respond if asked to remove reporting guideline content by a colleague, editor, or reviewer | Education | No advice given | Advice given in FAQ beneath each RG  Example: See [Figure 10](#fig-rg-intro) |
| **Targeted barrier: RG resources may not be in usable formats**  **Behavioural driver: Opportunity** |  |  |  |
| Ensure resources (checklists and templates) are in ready-to-use formats (see above) | None | See above | See above |
| **Targeted barrier: Researchers may feel afraid to report transparently**  **Behavioural driver: Motivation** |  |  |  |
| Present design advice separately to reporting advice | Coercion (removal of) | Some RG E&Es include design advice | No changes made |
| Make reporting guidelines agnostic to design choices | Coercion (removal of) | Some RGs make implicit assumptions about design choices | No changes made to SRQR |
| Encourage explanation even when choices are unusual or not optimal | Education | Not always present  Example: See [Figure 6](#fig-item-b4) | Added to items  Example: See [Figure 11](#fig-item) |
| Reassure authors that all research has limitations | Persuasion | Not always present  Example: See [Figure 3](#fig-home-b4), [Figure 5](#fig-rg-intro-b4) | Present on home page and RG page  Example: See [Figure 9](#fig-home), [Figure 10](#fig-rg-intro) |
| Include testimonials from authors who were nervous about reporting transparently | Persuasion | Not present | No changes made |
| **Targeted barrier: Researchers may feel restricted if RGs prescribe design**  **Behavioural driver: Motivation** |  |  |  |
| Present design advice separately and remain design agnostic (see above) | None | See above | See above |
| Reassure when guidelines are *just* guidelines | Persuasion | Not always present or prominent  Example: See [Figure 5](#fig-rg-intro-b4) | Prominently displayed at top of RG  Example: See [Figure 10](#fig-rg-intro) |
| **Targeted barrier: Researchers may feel patronized**  **Behavioural driver: Motivation** |  |  |  |
| Create discussion spaces for authors to voice disagreements and contribute to revisions (see above) | Persuasion | See above | See above |
| Avoid patronizing language | Persuasion | Although authors may feel patronized when asked to adhere to a RG, RGs themselves rarely use patronizing language | Continue to avoid using patronizing language |
| Explain how the guidance was developed and why it can be trusted | Education | Most RGs explain this in a published article. Checklists do not  Example: See [Figure 5](#fig-rg-intro-b4) | Brief description included on home page and at top of RG, links to full to development information  Example: See [Figure 10](#fig-rg-intro) |
| **Key Behaviour: Repeat engagement with reporting guidelines for subsequent studies** |  |  |  |
| **Targeted barrier: Researchers may forget to use RGs at earlier research stages**  **Behavioural driver: Opportunity** |  |  |  |
| Create prompts / communication campaigns (see above) | None | See above | See above |

## Figures

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| Figure 1: The layout of the existing EQUATOR Network website, as of the 5th of April, 2023. Users must navigate through up to 5 different web pages to reach reporting guidance. The proportion of users navigating between each step is shown in the width of the links. Links in grey are estimated proportions. |

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| Figure 2: The layout of the new web-intervention. Users must now only need to navigate to 2 pages to access reporting guidance. The proportion of users navigating between each step is shown in the width of the links. All links in are estimated proportions, based on a realistic aim to reduce the exit rate from the home page and database page by 50%. |

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| Figure 3: The existing EQUATOR home page, as captured on 5th of April, 2023. Limitations include: 1) No prominent description of what RGs are 2) No clear instruction on what tasks RGs can and cannot be used for 3) Search function hard to find (area A) 4) Decision tool for identifying which RG to use was hard to find (area B) 5) The page looked cluttered and unappealing 6) The tone of voice was functional. It was not particularly judgemental but not reassuring either. 7) There was little description of benefits of using a reporting guideline besides the mention of ‘quality’ and ‘transparency’ in the definition of EQUATOR, reference to ‘high-impact research’, ‘improve your writing’, and ‘enhance your peer review’ in the header. 8) No reassurance that most research has limitations 9) Frequently accessed guidelines are fairly easy to find (area C). |

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| Figure 4: The existing EQUATOR page for SRQR, as captured on 5th April, 2023. Limitations include: 1) The actual guidance is hard to find. Area A includes 3 links. The first two send users to an article describing how SRQR was developed. The actual guidance appears in a supplement of that article, which is the third link in area A. The label “relevant URLs” is vague. 2) Little instruction regarding what the RG is or can be used for other than “Qualitative research” 3) Links to related guidelines that are hard to find or, for SRQR, absent 4) No metrics around how many authors use this RG (e.g. citation counts) 5) The French translation of the guidance is well labelled and fairly easy to find (area B), but to the right of it is a box prominently labelled “Translations”, and the link in here would actually take the user further away from the translated guidance. |

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| Figure 5: The SRQR publication, captured on the 5th April, 2023. Limitations of reporting guideline publications may include: 1) RG publications often focus on how the guidance was developed. The actual guidance (see area C) or checklist (area B) may be relegated to a box, table, or a linked supplement. 2) Not all RGs describe what RGs are or what they can be used for, and these descriptions can be hard to find (areas A). 3) RG publications may not reassure authors that most research has limitations, and that transparency is OK 4) Publications may not be written with a reassuring tone of voice. Instead, guideline developers may justify their work by emphasising the negative impact of research waste. This may be how developers justify their work to themselves, editors, reviewers, or readers. As a result, to a naive author considering using the guidance, the tone of voice may come across as judgemental. 5) Benefits to the user may be hard to find or (as with this RG) not described at all. Benefits to *others* are more likely to be described, including a focus on how transparent, complete reporting benefits the research community or, conversely, how poor reporting is wasteful. 6) Instruction on when RGs do/do not intend to prescribe structure, or instruction may be hard to find (see area D) or missing. 7) Instructions on whether a RG intends to be a strict standard vs. ‘just’ a guideline may be hard to find (see area D) or missing. 8) Links to related resources only include those that were created before the RG was published. Some guidelines don’t include any links. 9) No clear instruction on whether to use the guideline in a situation that it wasn’t designed for, but when no better guidance exists. |

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| Figure 6: An example item from the SRQR guideline. Limitations may include: 1) Text is unstructured, so it is difficult to immediately identify what needs to be written. 2) Text uses verbose, passive language 3) The text appears long and difficult to digest 4) Terms aren’t always defined 5) Not all reporting items are justified 6) Not all items include instruction of what to write if the item could not/was not done. |

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| Figure 7: The SRQR checklist. Limitations of RG checklists may include: 1) Checklists may not define what RGs are, what they can be used for, or their benefits. 2) Checklists may not be in a usable format (e.g. a PDF that cannot be filled in, or a table that cannot be copied) 3) Checklists may not include instruction of how to complete them. 4) Checklists may not link to the underlying guidance, or other related resources. 5) Content may lack nuance of full guidance and may appear dictatorial and administrative |

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| Figure 8: Author instructions for BMJ Open, a typical journal, captured on 5th April, 2023. Limitations of Journal instruction to authors may include: 1) Instructions advise authors to use RGs, but don’t define what RGs are, what they can be used for, or the benefits or using them. 2) Advice regarding reporting guidelines may be hard to find amongst lengthy instruction pages (see area A) |

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| Figure 9: Intervention home page. Intervention changes made to the homepage include the following: 1) RGs are now clearly defined (areas A) 2) The site looks simple and has plenty of white space 3) Personal benefits are described explicitly and communicated through reassuring language and quotes (see areas B) 4) Search and browse buttons are easy to find (area C) 5) Frequently accessed guidelines are still easy to find (area D) 6) The site describes what tasks RGs can be used for, and differentiates tools by task (area E) |

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| Figure 10: Intervention reporting guideline page. Intervention changes made to RG introductions include: 1) Clear description of what the RG is, what it can and cannot be used for, the benefits to the author and to society, and how and when it can be used. (area A) 2) Description of whether the RG is intended to be a standard or ‘just’ a guideline (area A) 3) Tools are clearly differentiated by task (area B) 4) Related guidelines and other resources are linked. These links can be updated as and when newer guidelines are published (area C) 5) Clear instruction on whether a RG can be used in a situation that it wasn’t designed for, but where no better guidance exists (area D) 6) Links to translations (area E) 7) Reassuring language throughout, and reassuring quotes from editors, readers, and authors (e.g., area F) 8) Citation metrics (area G) 9) An estimation of how long guidance will take to read (area H) 10) Advice on how or where to report items so as not to breach word count limits and when RGs do or do not intend to prescribe structure (area I) 11) Full guidance (area J, see [Figure 11](#fig-item)) 12) Citation information (area K) 13) Information on how the guidance was developed and why it can be trusted (area L) |

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| Figure 11: A re-designed item from the SRQR reporting guideline. Intervention changes include: 1) Content is separated into what to write (area A), why information is important (area B), examples (area C), and any additional background information (not shown). 2) Areas B and C are presented as expandable content, so the only instruction immediately visible is what to write (area A). This means that the guidance is easier to digest and less intimidating. 3) Definitions are presented as pop-ups for technical terms (area D) 4) Quotes provide reassurance and persuasion 5) Language is direct and edited for clarity and brevity 6) Each item has its own discussion page (linked to from the top right of area A) |

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| Figure 12: Intervention discussion page. Every reporting item now has its own discussion page where authors can ask and answer questions, and provide feedback to guideline developers. |

## Discussion

I have demonstrated how I have used a data-driven approach, guided by behaviour theory, to re-design how reporting guidance is disseminated. I have proposed TODO intervention components, addressing TODO barriers and employing TODO intervention functions. By linking components with barriers and functions, I have justified my suggestions using evidence and described how they are theorized to work. I have then created a prototype website to demonstrate how these components could be realised.

Together, these changes amount to a complete redesign of two key parts of the existing system through which reporting guidelines are currently disseminated; the guidelines themselves, and the EQUATOR Network website which is visited by almost 1 million authors each year.

### When comparing current intervention

This reassessment required participants to take a step back and look at the current set-up with fresh eyes. We did this informally. Some participants shared long-standing frustrations with the website or guidelines. One participant shared designs she had created years ago for a redesigned EQUATOR website. Other times, after discussing a barrier or idea, we would go to the guidelines to see how things are done currently.

So this comparison was ad-hoc, and I have included pieces of it in this chapter purely to provide context to the proposed changes. I sought out examples of a behaviour change technique being implemented, not being implemented, or being implemented poorly. I made generalisations about RGs using words like “some” or “few” to give an impression of how frequently RGs currently use a given BCT. These frequency descriptions are based on my own observation, and not on a formal audit.

I considered systematically auditing the content of EQUATOR Network website and popular guidelines to see which behaviour change techniques they employ and which of our ideas were already present. I decided against this for two reasons. Firstly, with so many ideas and so many guidelines, this would have taken time and I decided instead to prioritize building and testing a prototype. Secondly, this audit wouldn’t have dramatically influenced the intervention components we designed, but would merely quantify how different my proposed intervention is to the current set-up. Who would be interested in quantifying this difference? Perhaps my thesis examiners, and perhaps the guideline development community. But quantifying differences wouldn’t bring me any further towards helping authors or impacting reporting quality, like building a prototype would. Should the guideline development community need that evidence then this audit could be done in the future once the redesigned intervention has been refined (see next chapter) and finalised.

### Limitations & reflections on process

Using a framework and a systematic method helped participants (and I) to check our biases. Instead of relying on personal preference, we tried to ensure choices reflected the function we were trying to employ. For example, when choosing a background image, instead of asking “do you like this one?”, the questions became “what feelings do you think this image conveys? Does it communicate simplicity?”. Working as a group helped mitigate individual preferences and peculiarities.

However, there is no avoiding the fact that many decisions required a degree of subjectivity and, as lead researcher, designer, and developer, often these decisions landed on my shoulders. I tried to mitigate this by involving EQUATOR members in the workshops and development process, prioritizing their ideas over my own, and providing many opportunities for feedback. But the result definitely has my “stamp”. If someone else had built it using the same table of intervention components then some things might be the same (like simplifying the user journey from 5 steps to 2, or the conventional layout of the home page) but other things would look very different (like the choice of wording and images).

Using a framework also helped participants to consider options that may not have otherwise come to mind. However, our imagination may have been constrained by what already exists. Although I encouraged blue-sky thinking, participants often focussed on tweaking what already exists instead of starting from a blank slate. If reporting guidelines didn’t exist, how else might we have tackled poor reporting? If EQUATOR didn’t exist, would we have a similar organisation to fill its place? How might that organisation be structured, governed, and what kind of legal entity might it be? If the publishing industry didn’t exist, might we have imagined different ways of describing research that were more formulaic than free-form articles?

These imagination constraints may be a weakness, but they are also al practical. EQUATOR is in a privileged position that in that it is known and trusted by publishers, guideline developers, and many authors. Thousands of journals and authors already use reporting checklists. So whilst the changes proposed in this chapter (and the ideas proposed in the chapter before) may be criticised for not being radical enough, for an organisation (and a PhD student) with limited time and resources, it makes sense to improve a system that already has significant buy-in from the academic community, over and above destroying that system or trying to create a new one from scratch.

Our horizons may have also been limited by group-think. If I were to repeat the work, I would have included a small, diverse group of authors to take part in the design process. I would have invited representatives from the publishing industry, funding community, and people more familiar with designing digital behavioural interventions. Including these diverse, informed voices in the design process could have lead to more radical design choices.

I did, however, include guideline developers in the design process. When editing SRQR I made sure to include Bridget O’Reilly, SRQR’s lead author, in every step. I explained my process and invited her feedback during and after editing. The experience was very positive. Bridget was supportive of what I was doing and liked the end result. But I acknowledge that other guideline developers may feel protective over their writing, and that many may not have the time nor funding to revise their guidance. I discuss these limitations further in my discussion chapter.

Editing SRQR revealed another limitation: gaps in item description. There was often no guidance of what to write if an item wasn’t or couldn’t be done. For instance, the target sample size item had no instruction of what to write if you didn’t ever have a target in mind. Some items were missing any kind of justification of why the item was important and to whom. Bridget and I both felt that filling these blanks would require time and input from SRQR’s development team, and so I left these gaps unfilled for now.

### Future work

I anticipate similar gaps for other reporting guidelines, and would seek to work alongside guideline developers to fill them and I upload other popular reporting guidelines and edit items into a consistent structure using the same process as for SRQR. Further development work will be required before the new website can be made live. Some of this work are technical tasks that, although necessary, do not have behavioural impact. For example, I will need to integrate the new website as a subdomain of EQUATOR’s existing one, and I will create automated tests that run before each deployment. However, other tasks *do* appear on the list of intervention ideas, and will affect behaviour. For example, I intend to optimise each guideline page so that it ranks highly in search engines.

Beyond the intervention components presented here, the prioritization exercise identified other ideas that EQUATOR would like to implement, but that I chose not to act upon. For example, participants favoured developing training resources specific to individual reporting items, and creation of network of “reporting champions”, akin to the UKRN model. EQUATOR participants liked the idea of lobbying funders to require reporting guidelines be used for applications. The work in this chapter could be used to support funding applications to support these endeavours.

I mentioned earlier that one limitation of this study was that authors weren’t included in the design process. In the next chapter, I explain how I have addressed this by piloting the website amongst authors.

1. Michie S, Atkins L, West R (2014) The Behaviour Change Wheel: A Guide to Designing Interventions. Silverback Publishing, London