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

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| Might this chapter be better split into two chapters? One for the behavioural analysis, and another for the development description?  Known todos:   * Discussion section * I have thoughts on the intervention component table, but will wait off editing it further until I’ve had some feedback |

## Introduction

In chapter 8 I described how I used the Behaviour Change Wheel guide to run workshops with staff members from the UK EQUATOR Centre. By the end of these workshops we had defined our target behaviour, identified what needed to change for this behaviour to occur, prioritized intervention functions and policy categories that we wanted to pursue, identified possible behaviour change techniques that we might use, and decided that we could deliver this new intervention by improving and extending the EQUATOR website.

Prioritizing abstract intervention options was useful but I still had to decide how our chosen options could be actualized. To facilitate ideation (and to seek input from a broader range of stakeholders) I ran focus groups, as described in the previous chapter. These focus groups produced ideas relevant to a range of stakeholders. Not all ideas aligned with the priorities EQUATOR and I had set during the workshops and some ideas conflated intervention function with policy categories.

What remained was to select which ideas I wanted to act on, and to turn them into intervention components. By intervention component, I mean:

1. a designed element that uses one or more behaviour change technique,
2. which is theorized to work through one or more intervention functions
3. to target one or more behavioural drivers.

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.

In this chapter I describe how I turned *ideas* into *components* by coding them against the behaviour change techniques and intervention functions they are employing, and the barriers they address. I then describe how I designed and built these components into a prototype that could be piloted amongst authors.

## Behavioural Analysis

### Methods

The output of my focus groups with stakeholders (chapter 9) was a list of 128 ideas which I then grouped inductively into 28 broader ideas to make them easier to describe and digest. However, my starting point for the behavioural analysis was the *unaggregated* list (128 ideas). Whilst analysing and writing-up my focus group chapter, more ideas occurred to me, so this list became very slightly longer (136 ideas).

I then took each of these ideas in turn and considered a) whether it could be implemented by modifying the EQUATOR website, b) whether it aligned with the intervention options EQUATOR and c) whether it was feasible for me to create within the constraints of my DPhil. I had prioritised during our workshops (chapter 8). For each selected idea, I turned it into an intervention component by labelling which barriers it was addressing, which behavioural drivers it was targeting, and which intervention functions it was employing to do so. Hence, the resulting list of intervention components was data driven, in that it was based upon the ideas and barriers generated from my previous research (see chapters 3, 4, 5, 6, 8 and 9).

To give structure and context to this list of intervention components, I grouped them 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).

### Results

My analysis resulted in 63 intervention components that could be included by improving and extending the EQUATOR website. Together, these components utilised 18 behaviour change techniques and 6 intervention functions to target 32 barriers. See table [Table 1](#tbl-int-plan) for all intervention components, labelled with the barriers they address, the intervention functions they work through, and the behaviour change technique they employ.

Table 1: Intervention Planning Table. Intervention components labelled with the behaviour change techniques and intervention functions they employ, and grouped according to the key behaviours, barriers, and behavioural drivers that they aim to target. Where possible, examples demonstrate how components were (or were not) used originally (Before) and, how they are included within the redesigned intervention (Now).

| Intervention Ingredient | Behaviour Change Technique | Intervention Function | Before | Now |
| --- | --- | --- | --- | --- |
| **Key Behaviour: Engage with (read) appropriate reporting guidance as early as possible** |  |  |  |  |
| **Targeted barrier: Researchers may not know what reporting guidelines are**  **Behavioural driver: Capability** |  |  |  |  |
| Describe what reporting guidelines are where they are first encountered | Instruction on how to perform the behavior | Education | No prominent description of what reporting guidelines are on EQUATOR home page or in reporting guidelines 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) |
| Clarify what tasks (e.g., writing, designing, or appraising research) guidelines and resources are designed for | Instruction on how to perform the behavior | Education | No clear instruction on what tasks reporting guidelines or their resources 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 reporting guidelines exist**  **Behavioural driver: Capability** |  |  |  |  |
| Instruct authors to cite reporting guidelines so readers may learn about them | Instruction on how to perform the behavior | Education | No consistent instruction to cite reporting guidelines | Consistent instruction to cite reporting guidelines |
| Decision tools for discovering appropriate resources\* | Instruction on how to perform the behaviour | 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\* | Instruction on how to perform the behavior | Environmental Restructuring | Collections exist on EQUATOR site but are difficult to find. | Not included yet |
| Links between related guidelines | Restructuring the physical environment | Environmental Restructuring | Guideline publications may cite guidelines published previously, but these can be buried in text and are not updated. EQUATOR website guideline pages feature links to extensions, but these may be 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”\* | Instruction on how to perform the behavior | 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 | Restructuring the physical environment | Enablement | EQUATOR maintains 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. |
| Search function on website | Restructuring the physical environment | Enablement | EQUATOR’s search function was difficult to find.  Example: See [Figure 3](#fig-home-b4) | Search function is easier to find as a recognizable icon in the navigation bar of every page. The home page includes additional ways to access search functionality.  Example: See [Figure 9](#fig-home) |
| Search Engine Optimization | Adding objects to the environment | 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” or “how to write-up research”. The site wasn’t optimized for viewing on mobile devices, which will also harm google search rankings.  Example: (Not visible) | The site has additional meta-data. Each reporting guideline page has its own meta-data. The site is optimized for mobiles.  Example: (Not visible) |
| Permanent document object identifiers (DOIs)\* | Restructuring the physical environment | 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: reporting guidelines may be difficult to access**  **Behavioural driver: Opportunity** |  |  |  |  |
| Ensure guidelines and tools are open access\* | Restructuring the physical environment | Enablement | Some guidelines are published behind paywalls | No change |
| **Targeted barrier: Researchers may not know whether a reporting guideline applies to them**  **Behavioural driver: Capability** |  |  |  |  |
| Describe the scope of a reporting guideline at the top of every resource | Instruction on how to perform the behavior | Education | Some reporting guidelines may describe their scope within a publication. Others might not, or may only describe their scope broadly without fully explaining the design assumptions within the guidance. Guideline publications rarely 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.  Example: See [Figure 10](#fig-rg-intro) |
| **Targeted barrier: Researchers may not know what reporting guideline is their best fit**  **Behavioural driver: Capability** |  |  |  |  |
| Use if-then rules to direct authors to more appropriate and up-to-date guidance when available | Instruction on how to perform the behavior | Education | Reporting guidelines do not consistently point authors towards related resources that might be better fits. Guidelines are not updated as-and-when other guidelines become available. | Reporting guidelines clearly and consistently point authors to more appropriate guidance when appropriate, using if-then rules. These links can be updated any time.  Example: See [Figure 10](#fig-rg-intro) |
| Explicitly state when no better guidance exists for a particular use case | Instruction on how to perform the behavior | Education | Reporting guidelines rarely explain what to do when no better guidance exists for a particular use case. | Reporting 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) |
| **Targeted barrier: Researchers may not understand the language**  **Behavioural driver: Opportunity** |  |  |  |  |
| Provide translations | Instruction on how to perform the behavior | Enablement | Some guidelines have been translated, but many haven’t. Links to translations are present on reporting guideline database pages but these links may not be easy to find. The EQUATOR website has an automatic translation tool which will translate content on web pages, but this doesn’t cover the guidance itself.  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 information, hiding optional content, splitting long guidelines, using concise language, and separating design advice | Restructuring the physical environment | Environmental restructuring | reporting guideline publications may include lengthy explanation of development, verbose language, and can be bloated by design advice  Example: See [Figure 6](#fig-item-b4) | SRQR has been edited. The only text presented immediately is instruction on what the author needs to describe. Additional information is hidden at first and can be expanded. Text is shortened through editing and by using active voice. In the case of SRQR, this reduced 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 optional content | Restructuring the physical environment | Environmental restructuring | Besides being split into items, reporting guidance is largely unstructured and different items can be organised in different ways. Checklist items do not link to items within an elaboration document.  Example: See [Figure 6](#fig-item-b4) | SRQR items are structured consistently, making information easier to find. Itemisation is used consistently, content is hyperlinked when useful.  Example: See [Figure 11](#fig-item) |
| Include testimonials from researchers who were nervous about being punished for reporting transparently | Social support (practical & emotional) | Persuasion | No such testimonials exist | Quotes included alongside guideline  Example: see [Figure 11](#fig-item) |
| Decrease fear of judgement by making reporting guidelines design agnostic | Remove aversive stimulus | 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. Inadvertent design assumptions were edited. |
| Remove branding and messaging that may invoke feelings of judgement, complexity, or administrative red-tape | Remove aversive stimulus | Coercion (Removal of) | EQUATOR’s website looked cluttered and visually unappealing. Guidance published in articles can look unappealing and dense. When justifying why authors should use reporting guidelines, guideline developers frequently referenced research 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 and fewer references to the negative consequences of poor reporting.  Example: See [Figure 9](#fig-home) |
| Reassure that all research has limitations to encourage explanation over perfect design | Social support (unspecified) | 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 | Instruction on how to perform a behaviour | Persuasion | It wasn’t immediately clear whether the EQUATOR guideline website was aimed at authors, editors, reviewers, or all. | All resources and website copy are directed predominantly at authors. |
| Communicate why reporting is primarily the responsibility of the author | Instruction on how to perform a behaviour | Education | 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 can be used by authors.  Example: See [Figure 10](#fig-rg-intro) |
| **Targeted barrier: Researchers may not consider writing as reporting**  **Behavioural driver: Motivation** |  |  |  |  |
| Educate authors about writing as a process | Instruction on how to perform a behaviour | Education | Many researchers don’t get trained on writing as a process, they just do it. EQUATOR provided education about how to write but this wasn’t advertised on guidelines. | Some SRQR items now link to relevant EQUATOR materials and courses.  Example: See [Figure 11](#fig-item) |
| **Key Behaviour: Apply reporting guidance to writing** |  |  |  |  |
| **Targeted barrier: Researchers may not know what resources exist for a reporting guideline**  **Behavioural driver: Capability** |  |  |  |  |
| link all resources to each other | Restructuring the physical environment | Environmental restructuring | Reporting guideline development articles, example and elaboration 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) | Information about emotional consequences, Information about others’ approval, Information about social and environmental consequences | 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 | Information about emotional consequences, Information about others’ approval, Information about social and environmental consequences | Persuasion | Benefits often presented without evidence (if at all) | Dummy quotes provides evidence for experienced benefits.  Example: See [Figure 11](#fig-item) |
| Display citation metrics as social proof | Social comparison, Information about emotional consequences, Information about others’ approval, Information about social and environmental consequences | Persuasion | Citation metrics are available for guideline publications, but are not displayed on the EQUATOR website or within the guidance publications or checklists themselves.  Example: See [Figure 4](#fig-db-b4) | Citation metrics are presented at the top the reporting guidance.  Example: See [Figure 10](#fig-rg-intro) |
| Create spaces for authors to discuss reporting guidelines with others | Social comparison, Information about emotional consequences, Information about others’ approval, Information about social and environmental consequences | Persuasion | There were no official on- or offline spaces for authors to discuss guidelines. | Each reporting item has its own discussion board.  Example: See [Figure 12](#fig-discussion) |
| Use language and design to communicate personal benefits; confidence and simplicity | Remove aversive stimulus, Information about others’ approval | 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 reporting guideline**  **Behavioural driver: Motivation** |  |  |  |  |
| Include testimonials from research users who benefit from complete reporting | Salience of consequence | Persuasion | Testimonials not included in reporting guidelines. | SRQR includes dummy testimonials and quotes from research users  Example: See [Figure 11](#fig-item) |
| **Targeted barrier: Researchers may misunderstand**  **Behavioural driver: Capability** |  |  |  |  |
| Use plain language | Instruction on how to perform the behavior | 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 | Instruction on how to perform the behavior | 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 | Instruction on how to perform the behavior | Enablement | Guidelines may use different terms to refer to the same thing (or the converse - use the same term to refer to different things). A single guideline may do this too. | SRQR uses consistent terms across items. |
| Provide translations | See above | None | See above |  |
| Create spaces for authors to discuss reporting guidelines with others (see above) | See above | None |  |  |
| **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 (not just what constitutes “good” design) | Information about social and environmental consequences | 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) | Information added when necessary  Example: See [Figure 11](#fig-item) |
| Explain importance of complete reporting to the scientific community | Information about social and environmental consequences | Education | EQUATOR and most reporting guidelines 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 | Instruction on how to perform the behavior | Education | Some reporting guideline publications (or elaboration articles) 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 | Instruction on how to perform the behavior | Education | Writing instructions are often mixed in with other explanation and context.  Example: See [Figure 6](#fig-item-b4) | Writing instruction occurs first for each item.  Example: See [Figure 11](#fig-item) |
| For each item, provide examples of reporting in different contexts | Demonstration of the behavior | Modelling | Not all reporting guidelines provide examples. Examples may not cover different contexts.  Example: See @ fig-item-b4 | SRQR already had some examples. No more examples added  Example: See [Figure 11](#fig-item) |
| Create spaces for authors to discuss reporting guidelines with others (see above) | See above | None |  |  |
| **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 | Instruction on how to perform the behavior | 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\* | Demonstration of the behavior | Modelling | Examples not provided | No changes made |
| **Targeted barrier: Researchers have limited time**  **Behavioural driver: Opportunity** |  |  |  |  |
| Ensure all resources and tools (e.g., checklists and templates) are in ready-to-use formats\* | Adding objects to the environment | Enablement | Some checklists not in immediately usable formats e.g., PDFs | No changes made |
| Structure guidance to make it quicker to digest (see above) | Restructuring the physical environment | Enablement | E&E documents not structured below the item level  Example: See [Figure 6](#fig-item-b4) | Items have consistent structure  Example: See [Figure 11](#fig-item) |
| Tell authors how long the guidance will take to read | Instruction on how to perform the behavior | 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\* | Instruction on how to perform the behavior | Education | No advice given | No changes made  Example: No changes made |
| **Targeted barrier: Researchers may not know when reporting guidelines should be used**  **Behavioural driver: Capability** |  |  |  |  |
| Tell authors when to use reporting guidelines, or that reporting guidelines are best used as early as possible | Instruction on how to perform the behavior | Education | Rarely stated prominently | Stated prominently  Example: See [Figure 10](#fig-rg-intro) |
| Clarify what tasks (e.g., writing, designing, or appraising research) guidelines and resources are designed for (see above) | See above | None |  |  |
| **Targeted barrier: Researchers may not encounter reporting guidelines 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”. (See *Search Engine Optimization* above) | See above | None |  |  |
| Create prompts / communication campaigns to target authors early in their research\* | Prompts/cues | Enablement | EQUATOR had no way to do this | No changes made |
| Create tools to be used for early writing tasks | Adding objects to the environment | Enablement | Most reporting guidelines come with a checklist but none come with a template, or tools/guidance specific to protocols or funding applications. | No changes made |
| **Targeted barrier: Researchers may struggle to keep writing concise**  **Behavioural driver: Opportunity** |  |  |  |  |
| Provide instruction as to how and where information can be reported without breaching word count limits or making articles bloated. | Instruction on how to perform the behavior | Education | Few reporting guidelines include this information | Added instruction at top of reporting guideline and in some items where most useful  Example: See [Figure 10](#fig-rg-intro) |
| Provide examples of concise reporting\* | Demonstration of the behavior | 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 guidance for planning research, or for writing protocols/funding applications (see *Create tools to be used for early writing tasks*)\* | 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 *Create tools to be used for early writing tasks*)\* | See above | See above |  |  |
| Create templates for drafting (see *Create tools to be used for early writing tasks*)\* | See above | See above |  |  |
| Create tools to facilitate checklist completion\* | Adding objects to the environment | 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\* | Adding objects to the environment | 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\* | Adding objects to the environment | 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\* | Adding objects to the environment | Enablement | Checklists are reporting guidelines are not specifically aimed at peer reviewers | No changes made |
| **Targeted barrier: reporting guidelines can become outdated**  **Behavioural driver: Opportunity** |  |  |  |  |
| Provide feedback channels to help developers keep guidance updated (see *Create spaces for authors to discuss reporting guidelines with others*) | See above | None |  |  |
| Make it possible for guideline developers to make small edits without having to publish new articles | Restructuring the physical environment | 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 reporting guidelines do not intended to prescribe structure | Instruction on how to perform the behavior | 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 instruction as to how and where information can be reported without breaching word count limits or making articles bloated (see above) | See above | None |  |  |
| Embed reporting guidelines that “fit together” (see above)\* | See above | None |  |  |
| **Targeted barrier: Researchers may be asked to remove reporting guideline content**  **Behavioural driver: Opportunity** |  |  |  |  |
| Provide advice regarding how to respond if asked to remove reporting guideline content by a colleague, editor, or reviewer | Problem solving | Education | No advice given | Advice given in FAQ  Example: See [Figure 10](#fig-rg-intro) |
| **Targeted barrier: reporting guideline resources may not be in usable formats**  **Behavioural driver: Opportunity** |  |  |  |  |
| Ensure all resources and tools (e.g., checklists and templates) are in ready-to-use formats (see above)\* | See above | None |  |  |
| **Targeted barrier: Researchers may feel afraid to report transparently**  **Behavioural driver: Motivation** |  |  |  |  |
| Present design advice separately to reporting advice\* | Restructuring the physical environment | Coercion (removal of) | Some reporting guideline E&Es include design advice | No changes made |
| Make reporting guidelines agnostic to design choices (see *Decrease fear of judgement by making reporting guidelines design agnostic*) | See above | None |  |  |
| Encourage explanation even when choices are unusual or not optimal | Instruction on how to perform the behavior | 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 (see *Reassure that all research has limitations to encourage explanation over perfect design*) | See above | None |  |  |
| Include testimonials from researchers who were nervous about being punished for reporting transparently (see above) | See above | None |  |  |
| **Targeted barrier: Researchers may feel restricted if reporting guidelines prescribe design**  **Behavioural driver: Motivation** |  |  |  |  |
| Present design advice separately and remain design agnostic (see *Present design advice separately to reporting advice* and *Decrease fear of judgement by making reporting guidelines design agnostic*) | See above | None |  |  |
| Reassure when guidelines are *just* guidelines | Social support | Persuasion | Not always present or prominent  Example: See [Figure 5](#fig-rg-intro-b4) | Prominently displayed at top of reporting guideline  Example: See [Figure 10](#fig-rg-intro) |
| **Targeted barrier: Researchers may feel patronized**  **Behavioural driver: Motivation** |  |  |  |  |
| Create spaces for authors to discuss reporting guidelines with others (see above) | See above | Persuasion |  |  |
| Avoid patronizing language | Remove aversive stimulus | Persuasion | Although authors may feel patronized when asked to adhere to a reporting guideline, reporting guidelines themselves rarely use patronizing language | Continue to avoid using patronizing language |
| Explain how the guidance was developed and why it can be trusted | Credible source | Education | Most reporting guidelines 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 reporting guideline, 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 reporting guidelines at earlier research stages**  **Behavioural driver: Opportunity** |  |  |  |  |
| Create prompts / communication campaigns to target authors early in their research (see above)\* | See above | None |  |  |

## Building the intervention

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

#### Designing

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 generalisations about how popular reporting guidelines are written and disseminated.

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 (the home page, guideline database page, PubMed, a publication, and then sometimes a supplement). Many authors leave at each step (see [Figure 1](#fig-sankey-b4)). We redesigned this workflow to reduce this journey to 2 webpages (the EQUATOR home page, and a reporting guideline page containing the full guidance) and we hope that this will increase the proportion of authors that reach the full guidance (see [Figure 2](#fig-sankey-after)).

In our second meeting, workshop participants 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 (some of which we co-created in our third meeting) 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 had originally been 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 my intervention component table to ensure I had included 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 [1] or Squarespace [2]) 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 reporting items are 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. 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. In contrast, many researchers write reproducible manuscripts in markdown using tools like RStudio [3] or Quarto [4], and use languages like Python for data analysis.

I decided to use Quarto, which 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. Markdown is 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.

The website is served using Github Pages [5] 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.

### Results

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/.

## 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 intervention components, addressing 32 barriers and employing 6 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. Your website, your business, your future｜Wix.com. wix.com

2. Website Builder Create a Website in Minutes. Squarespace

3. Posit The RStudio Integrated Development Environment (IDE) is the preferred tools for data scientists who develop in R & Python. Posit

4. Quarto: An open source technical publishing system for creating beautiful articles, websites, blogs, books, slides, and more. Supports Python, R, Julia, and JavaScript. Quarto

5. GitHub Pages. GitHub Pages