Author’s response to reviews

Title: Using a Theory-Driven Creative Process to Design a Peri-Urban On-Site Sanitation Quality Improvement Intervention

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Author’s response to reviews:

Please see attached "Reviewer Responses" Document for better-formatted, easier to read responses. Note that yellow highlights are additions/green are relocations.

Editor Comments:

In addition to the referee comments, please address the following editorial points:

1. Please ensure the abstracts in the submission system and main manuscript are identical.
Done.

2. Ensure all section headings are as outlined in the submission guidelines.
   “Introduction” amended to “Background”

3. In the author contributions section, please ensure each individual author, and their role in the study/manuscript preparation, is mentioned.
   Have added explicit reference to each author’s name.
Reviewer reports:

Hans-Joachim Mosler (Reviewer 1): My definitive opinion is that this article possesses both strengths and weaknesses. On the one hand, I see the value of a stringently derived procedure to a behavior change campaign. On the other hand, I find it difficult to identify the scientific contribution of this article. Applying the BCD approach to a concrete case is certainly interesting; however, the question is what the scientific value of this may be. What empirical findings does this article offer? From my point of view, most scientific work rests on some kind of comparison: before-after, intervention-control, etc., but in this article I do not find any comparison. The authors could compare their approach to other behavior change approaches and explain why their approach works better. They could present an evaluation demonstrating that it is better. Or they could elaborate the difference from a 'business as usual' approach that NGOs normally use.

I leave it to the editor to judge whether this article is worth for publication in BMC Public Health or not.

We are grateful for this comment and agree that one of the main weaknesses is the comparison of the results with those from other processes. We have made many specific amendments, most described in response to particular concerns below, with the exception of the following:

1. “Assess and Build Steps” relocated from Background to Results

2. Comparison of process and results to processes for development of two similar interventions for peri-urban sanitation (lines 465-488):

It is not possible to ascertain whether this creative process produces a maximally effective intervention because creative processes can’t be compared based on program outcomes without incorporating multiple interventions, each produced using a different creative process, and delivered in the same way to the same population at the same time. Nevertheless, there are obvious strengths of the BCD process: it is based on that used by creative professionals (i.e., a design process); typically involves creative professionals (e.g., commercial creative firms) who are likely to be better at producing effective interventions than public health researchers or NGO members; is explicitly tied to a theory of change at all times (anchoring design processes to behavioural theory); and that theory allows for the broadest possible range of creative techniques and methods (including modification of environmental determinants -- e.g., product design, or physical ‘nudges’ such as our improved cleaning rota system).

For example, it is instructive to compare similar trials for their processes of designing peri-urban sanitation behavior change interventions. Two recent trials focussed on the cleanliness of shared on-site sanitation: One in Uganda, based on the RANAS model [26], where landlords and tenants
participated in group discussions about toilet maintenance [9], and one in Bangladesh, based on IBM-WASH [24] and the Health Belief Model [23], where behavior change communications were used along with provision of cleaning materials to encourage cleaning behavior [8]. As noted, we are unable to make direct comparisons of empirical results, since any such comparisons would inevitably offer only limited information for reflecting on the relative merits of the approaches themselves, especially due to the drastically different contexts and outcome measures used. Instead, we reflect on two strengths of BCD compared to weakness observed in these other approaches. First, since BCD is a theory-driven approach, any failure to produce behavior change in our program requires that there were flaws with either the list of determinants, the process of identifying relevant determinants, or the process of moving from these to the intervention. A similar failure in the program in Bangladesh, using the theory-based IBM-WASH and Health Belief Model, could have little to do with the validity of the underlying theories, but instead could be a result of any number of failures to apply these theories appropriately (due to their lack of a program development process) or due to the lack of a theory of change (rather than simply a list of behavioral determinants) provided by either approach. Second, while the RANAS model used to develop the intervention in Uganda includes a wide range of behavioral determinants and a systematic process, it is designed to produce behavior change communication with messages tailored to the identified determinants, rather than taking advantage of BCD’s explicitly broad creative approach. Exploring a wider range of intervention options is likely over the long run to produce more appropriate and hence more effective interventions.

Juliet Willetts (Reviewer 2): The paper "Using a theory-driven creative process to design a peri-urban sanitation intervention" presents a recent application of behaviour-centred design to urban sanitation. It makes a valuable contribution to the urban sanitation literature bringing a behaviour change perspective that is very much-needed.

In general the paper provides interesting and useful contributions, however as a scientific paper, it lacks a clear research methodology per se. That is, the purpose of the paper appears mainly to report on and share the experience of using a theory-driven approach, and this results in a tendency towards a descriptive rather than analytical paper. Equally, the discussion and conclusion point forward to the future when the design approach 'will' be evaluated (which seems inappropriate, rather than focusing on drawing directly on the material presented in this paper itself). One of the reasons that it may have been difficult to formulate a robust conclusion was potentially the lack of a clear methodology and analytical framework within which to examine the application of the chosen 'theory-driven' design approach.

That said, there is useful information provided on the design approach taken, and the approach is situated by the authors in the context of existing research and theory in various ways in the paper, and for these reasons I would suggest that the paper is publishable and can represent a
valuable contribution. However, significant revision and strengthening of the methodology, the
analysis and the conclusions is considered essential before publication, which may require some
re-structuring and re-framing of the paper. Other essential changes are to ensure appropriate
coverage of existing urban sanitation demand-related literature, reviewing and amending a
number of instances of unclear or potentially inappropriate referencing, and to ensure that all
terminology used in the paper is clearly explained to the reader. An important addition that
would add value to the paper would be to provide greater insight on the scale of the initiative (in
terms of numbers of

households/landlords/tenants, numbers of researchers etc.) and the costs of the intervention. A
final additional optional change would be a potentially strengthened focus reflecting on the
combining of different skill-sets to develop the intervention and the implications for upskilling
practitioners (not just researchers) to undertake this kind of approach.

We are grateful for the thorough and helpful feedback on the overall framing of the paper. We
appreciate that this differs from the standard Methods (intervention/data collection), Results
(data analysis), Discussion (Interpretation) format somewhat, but view BCD itself as the method
applied to a specific problem, which results in an intervention whose evaluation will do more
than just generate empirical evidence for a particular behavior in a particular setting, but rather
through the way that theory is applied, result in more translatable findings and also lead to
implications for behavioral science theories. We have replied to many of the other specified
changes from the summary statement above when they occur in the paper as identified below.

More detailed comments are provided below:

Abstract:

- The abstract (and later, the paper) assumes that the reader is familiar with BCD rather than
  explaining what BCD is in one sentence, which would be helpful

Added lines 27-29 in the abstract:

BCD is a generic behavior change framework with determinants drawn from ecological and
evolutionary psychology, is based on a reinforcement learning paradigm, and includes an explicit
intervention design process.

Further, BCD is first mentioned in the paper on line 133, with a detailed explanation
immediately following in lines 140-157, so we feel this gap does not apply in the main body of
the paper.
- The abstract concludes that "evaluation of this theory-driven intervention will advance behavioural science by determining how effective each of the behaviour techniques and the overall delivery mechanism were...", which seems an inappropriate conclusion given that such an evaluation is in the future, and this paper does not provide insight into the effectiveness of the approach. It is likely the product of dividing a single project (developing and designing and approach, and then evaluating it) into separate academic papers. Indeed this paper has sufficient content to warrant a single paper, however the framing must be around its unique contribution, not around a future evaluation of the approach. Or, an alternative would be to combine this paper with material from such an evaluation.

The restructuring and clarification of the paper imply that the main conclusion is that this intervention will be able to contribute to knowledge regardless of the overall impact of the intervention on behavior change. This and the outcome evaluation (and eventually process evaluation) papers do, we believe, represent distinct contributions to knowledge- one about how to develop interventions, one about the effectiveness of the intervention, and one about the mediators of that success and thus the contributions back to theory. We have clarified the conclusion of the abstract by making the following changes (highlighted):

The evaluation of this theory-driven intervention will advance applied behavioral science regardless of the overall success of the intervention by determining how effective each of the behavior change techniques and the overall delivery mechanism were in changing the target behaviors. This will allow reflection on how useful the design process itself was, and how these findings for sanitation can be applied to other behaviors and settings.

- 'variety of processes' is vague

Clarified to explain that what was meant was that the design processes are more vs. less explicit:
design processes of varying specificity

- Assumes reader knows what 'Bauleni secret' is- suggest to either omit the specific name of the intervention, or explain it

Specific name removed.
- The results appear descriptive in nature rather than analytical - a point arising from the absence of a clear methodology/framework to analyse the experience.

The results are descriptive of the results of a process in an analogous manner to how the results of a mathematical procedure may produce a test statistic, which must then be interpreted. We have described how each aspect of the underlying theory corresponded to an intervention element, the evaluation of which can contribute to empirical and theoretical knowledge.

Introduction:
- Provide a reference for statement made in line 75-76, and re-word the subsequent sentence in 76-78 which is not clear in expression.

Citation to 2015 JMP report added.

Lines 72-75 amended to clarify:

While the discussion of whether high-quality shared sanitation can be considered adequate is ongoing, it is clear that the quality of much shared sanitation so poor that it is unlikely to meet any quality standard established.

- Reference #6 is from 2015- are there any more recent references that support this point (given it is claiming lack of rigorous evidence it should ideally be a very recent reference)

The project was begun in 2016, at which point this was a very recent reference. Additional studies were identified in the literature review (described in the paper), but there has been no more recent review focused on peri-urban sanitation- likely because there are several major trials underway whose results will be crucial in addition to ours (MapSan in Mozambique, for example). We have amended the line to the following to clarify the “when the project began, though identified in the process and since” nature of the statement:

and there was little rigorous evidence generated about what works to increase demand for the improvement of sanitation in peri-urban settings before the project began [7], though a few cleaning-focused trials have been conducted recently [8, 9].

- Line 84- should this be 'by' improving available supply (not 'while' improving available supply)?
Sanitation marketing approaches generally attempt to do both at the same time, so amended to the following:

...while simultaneously improving...

- Line 84-86 suggests that RCTs are the only way that impact can be assessed, which is not the case, since other methodologies can also be employed (and have been)

The argument made is the cited article is that non-randomized designs in peri-urban areas suffer from many different kinds of challenges, including measurement error, seasonality, confounding due to differences in neighborhoods, or secular trends. We have added the following to clarify that, while RCTs are not the only source of evidence, other approaches face many limitations in peri-urban sanitation evaluations:

so that little is known of their impact, or the impact of demand and supply components separately that is not subject to many competing explanations including measurement challenges or seasonal or secular trends.

- This para (80-84) seems to assume that sanitation marketing is the only 'demand creation' approach that has been used in peri-urban settings, whereas in general, sanitation marketing has mostly been employed in rural settings, and in urban settings, a variety of approaches have been attempted. Some possible references to review include (noting that some are grey literature):

  o Peal, A., Evans, B., Voorden, C. 2010 "Hygiene and sanitation software: and overview of approaches"
  
  
  o 2016 McGranahan, G., Miltin, D. Learning from Sustained Success: How Community-Driven Initiatives to Improve Urban Sanitation Can Meet the Challenges
  
  
  o WSP 2014 Improving On-site Sanitation and Connections to Sewers in Southeast Asia - Insight from Indonesia and Vietnam Indonesia Country Report
  
Overall, we find evidence surrounding the success of urban demand creation approaches particularly weak, noting as this reviewer does, that many are grey literature or “guidelines” developed without a strong evidence base or are descriptive of the kinds of approaches that might work. We do note that we did not adequately clarify that our trial is focused on “on-site” sanitation, that is, toilets on plots, and thus do not focus on a few successful programs with a wider focus (the McGranahan article refers to the Orangi Pilot Project (focusing on low-capacity sewerage) and the Alliance of Mahila Milan, SPARC, and the Indian National Federation of Slum Dwellers in Pune and Mumbai (focusing on community-shared latrines)). The Peal review above does note a range of approaches, but almost all involve interventions that focus on the supply side (developing new enterprises or products), and the review itself notes a bias towards rural application (and certainly evaluation!). The Okurut article actually furthers our argument in our view, as the review identifies many observational studies and commentaries describing aspects of demand that must be considered (role of the private sector, stakeholders, etc.) and when discussing effective initiatives, notes that supply-led approaches are common and lists effectiveness studies only in rural settings. De Buck et al. is a slightly modified version of RANAS. We have amended the paragraph to note our understanding of the literature, but feel that the general claim of a lack of evidence of the role for demand-side interventions in shared, on-site peri-urban sanitation stands:

Though a variety of programs have seen success in rural settings that could apply in urban or peri-urban settings, few have been tested in there, and the task of behavior change in these settings may be more difficult [11, 12].

- Line 89- clarifies that the intervention is 'to be evaluated' in the future, and as such, that this paper does not include that evaluation.

Done.

Use of a theoretically-driven intervention design process

- Important to take care with referencing- Reference 10 is used at the end of a long sentence which starts with a focus on peri-urban sanitation, however that reference is a general one
focused on theories of behaviour, and at the moment the inference is that that source discusses urban sanitation

Amended to specify that the problem is more general:

…to address public health problems such as poor on-site peri-urban sanitation quality…

- Paragraph ending at line 108 feels like it needs a concluding 'so what' statement to round it out

Added concluding sentence:

Thus, for ABS to advance as a discipline, an approach that is based on the most useful theories from across disciplines integrated into a system that can be applied in practice is needed.

- Line 125-126- very little information is provided on 'theory-driven' approaches, particularly since it is the main subject of this paper and the chosen approach. More is needed to clarify what is meant and how it is differentiated from 'theory-based'.

Have added to clarify lines 126-7:

These may come from a particular discipline (e.g., social psychology for the Health Belief Model [23]) or may be consolidated from a range of disciplines into a theory for a particular type of behavior (e.g., water, sanitation, and hygiene in the IBM-WASH model [24]), but there is no prescribed process leading from these determinants to an intervention package.

And lines 133-6:

These may use processes that are more prescribed [26] or open-ended (such as Behavioral Design [27]), and may have different determinants, but the common thread is that every aspect of the program development is guided by appeal to its theory of change.

- Line 128 refers to 'theory-based'- is this a typo and it is meant to be 'theory-driven'? Seems anomalous particularly since later parts of the paragraph refer to 'theory-driven'.

Yes, a typo. Fixed.

Behaviour-Centered Design Overview
- The opening description of BCD feels like it should be referenced to a source (lines 143-147)
Sources on reinforcement learning added.

- Lines 155-158- do the sources provide the examples that are provided in brackets here about sanitation? Again, the referencing isn't quite clear, and if they don't may be appropriate to list the examples separately rather than infer that these source address sanitation
Re-wrote the sentence to make referencing clear as follows:
behavior can be motivated even by an expected reward based on observing others' personal rewards [34] (e.g., in the study setting, perhaps seeing others who are pleased with sanitation improvements they have made), or the anticipated approval of others [35] (perhaps making a new sanitation improvement because one perceives that others will approve of it.

Assess and Build Steps
- A review of literature is referred to in Line 169, however little detail is provided on the nature of this review- what methods were used, what keywords etc. Overall, where is the 'methodology' section of this overall paper?
We have included additional detail on this systematized review in the methods section, lines 182-6:

We searched Medline, Embase, Scopus, Web of Science, and PubMed Central for the terms: (sanitation, toilet, or latrine) and (demand, motivation, driver, or determinant) and (slum, urban, or peri-urban). We limited the results to papers published prior to April 2016, and also consulted local and international experts for grey literature pertinent to the topic. Lessons were drawn for an intervention designed to improve sanitation quality strictly through creating demand – that is, without relying on subsidy or provision of sanitation-related infrastructure.

And also in the results section, lines 240-2:
Our literature review of peer-reviewed studies identified 6,088 unique titles that were scanned, 317 of these whose abstracts were reviewed, and a final set of 60 full-texts were read and analyzed.

This systematized literature review is not published in a separate paper, and its inclusion here is only to describe the knowledge of the existing literature that was fed into the intervention development process, and so a reporting of the process that is descriptive, rather than analyzed as if the review itself is being published as comprehensive, seems appropriate to us.
Further, to describe the methods of the formative research, we have added lines 187-191:

For the Build step, we conducted formative research consisting of semi-structured interviews with landlords and tenants in the Bauleni neighborhood in Lusaka, Zambia. Respondents were asked about characteristics of their homes and shared areas on the plot with other residents, toilet construction histories, and the process by which investment and improvement of structures on the plot took place.

- References 35, 36 and 37 are all referring to rural, not urban, sanitation. Above have already provided some further sources that focus on urban/peri-urban sanitation, and suggest that a more thorough literature review may be warranted.

Indeed, more than just these three are referring to rural sanitation, as is noted in the previous lines (“included evidence from other settings as suggestive to supplement the limited research in peri-urban settings”). As described in response to the previous comment, the literature review focused on how to improve on-site, peri-urban sanitation, and so additional sources above (almost all of which were identified in either the systematized review of peer-reviewed literature or expert-led grey literature searches, other than the Winters reference, which we did not locate in the grey literature) were examined and excluded. This should be more clear as we have now also included additional methodological detail about the literature review after moving the Assess and Build steps to the results section.

- Line 182-202- presents a significant amount of material (findings of formative research) that is referenced to another publication which is 'in preparation'- just checking that this is appropriate, or is this 'novel' material that is being presented in this paper itself, and therefore should be part of 'Results' in this paper.

All results come directly from the other paper. This other paper has just been accepted. Publication of this current paper can be delayed until this other paper is publicly available should the editor wish.

Methods

- The methods referred to are a description of the process that was undertaken to do the design, rather than the research methods applied to develop and write this paper. The paper structure needs some potential re-thinking in terms of what the main contribution is, and how to best present that within a robust framework.
We have re-organized as described elsewhere to make clear that the scope of the methods section is to describe the process by which BCD was applied to peri-urban on-site sanitation improvement. As such, we describe the literature review (in brief, because the method is quite standard) and formative research (in brief, because the results are the subject of other papers) steps followed by the generic BCD method for creating the intervention, and have relocated the details of the “Create” process to the results. We appreciate any additional suggestions on how to make this paper, which describes a long, multi-step process using many different methods, fit the somewhat restrictive IMRaD format. We originally considered the A&B steps background, Create as the method, and the intervention as the results, but are restructuring so that the ABC steps, described generically, are the method, and the outputs of all three (though the first two in summary form) are given in the results. We feel this is the clearest format we have tried to date so that the scope of the process can be captured in one place to help others designing interventions.

- In addition, the description of what occurred lacks methodological detail that would normal be expected (eg line 205- how many local government leaders, how many 'experts'). There is no information about the number of landlords/tenants, the scale of the intervention

For the framing workshop, we have added a few details about attendees, with a link to a report providing much more detail. We worry that additional detail in the text will make the vast amount of ground covered even more unwieldy and draws away from the key results.

Amended text:

The Create step began with the study team hosting a creative workshop to present findings from the Assess and Build steps to representatives of 12 key stakeholders working in sanitation in Lusaka (see additional logistical details here: [38]).

The intervention is designed to be delivered with a sample size allowing certain levels of change in the primary outcomes to be observed with adjustment for primary outcomes. However, we feel that the intervention to be delivered, and not the exact trial design, is a better focus for the paper. Painstaking detail is provided in the forthcoming RCT evaluation paper.

- Line 236-237- notes that certain communication methods were excluded as they couldn't be evaluated using a randomised design. Whilst this can be justified from certain perspectives in terms of ensuring an intervention can be evaluated, it should also be justified from the perspective that such methods were not deemed to be valuable, as otherwise we are suggesting that a particular research design is more important than discovering which types of interventions work
This is similar to other comments previously addressed. In general, it seems that we are more skeptical of non-randomized designs than this reviewer and more focused on testing the potential of one avenue of sanitation improvement to scale up afterwards across settings, rather than identifying the overall best possible intervention in a given setting, and thus have slightly more theoretical concerns than the reviewer. We have added line:

There may be effective approaches excluded by this constraint, but the priority was to carefully evaluate a pilot that may later be scaled in other settings and that could be most reliably evaluated to understand the effects of this kind of intervention in isolation.

Results

Behaviour-specific and intervention delivery mechanism theories of change

- The results section, following the same style as the introduction and methods, is descriptive in nature, with only a few links to relevant literature to situate particular points. The absence of a clear methodology to structure the paper weakens this section. It does provide interesting description, and these comments should not be taken to mean that some of the content is not valuable, it is just that it is not presented through a relevant analytical framework.

As discussed previously, these descriptive points are the results of applying the methods to the problem. Additional comparative has been added to the discussion (mentioned in that section).

- Some parts of what was done remain unclear- who are 'monitors' and similarly who are 'facilitators'? And were either of these roles paid or incentivised? (Lines 287 and 289) And lines 300-303 are unclear- what is 'improved cleaning rota'?

Altered line 310 to clarify monitors:

Paid monitors, distinct from the facilitators…

Facilitators are described in the previous paragraph (lines 286-294), but we have added “paid” to clarify their role within the program.

The sentence about the cleaning system has been re-written for clarity (lines 323-326):

In particular, the card related to regular cleaning of the toilet (available at the project website [64]) required a signature verifying that a meeting had taken place between the landlord and his or her tenants for the explicit purpose of discussing a system for toilet cleaning.
- Line 299 mentions "hopefully' led to an increasing number of discussions- which seems speculative.

Rephrased “hopefully led” to “designed to lead”

- Line 313- it is unclear as to what an 'emo-demo' or an 'exo-demo' are - terminology needs to be explained to the reader.

These are defined when introduced. We are not sure where the lack of clarity comes in.

- Lines 318- English expression is unclear- consider how to re-word this sentence - 'costs a landlord…’ is tricky to follow

Amended line as follows:

The overall theme of the revaluation sections was that a poor quality toilet leads to a landlord losing good tenants and giving up a steadier, higher monthly rental income.

- Line 320-321- there seems to be a reliance on supporting landlord interests in greater rental income- it would be good to critique this strategy carefully from an ethical perspective, in terms of whether development actors should be supporting landlords to increase their rent. No easy answers but worth considering and noting such dilemmas.

We very much agree with the thinking behind this comment. It has been of explored in-depth in a recent paper by Barrington, et. al. on the adverse impacts of sanitation marketing programs on well-being and assaults on dignity. We have elsewhere assessed willingness to pay of tenants, and this effect was in fact the main concern we expressed in our ethics application, so we are very sensitive to looking at any potential inequities. While we are injecting new information into the system (a willingness to pay for sanitation), we think it unlikely that this would long-term result in inflated prices, as the market mechanism would resolve this issue. Rather, we think it more likely that while there are currently only options (grossly simplifying) such as “poor house-poor toilet” and “nice house-nice toilet,” encouraging landlords to build better toilets will give tenants choices to select a home with a nicer toilet for a given price, while increasing supply would generally drive prices down for a given level of sanitation. This is all speculative, and worthy of much discussion, and we feel hesitant to engage with it in just a limited way in the paper, but are open to further suggestions.
- Line 327- not sure what 'use of a visible, durable symbol of the cleaning system' is referring to?

We have noticed that the cleaning rota was not explicitly described, and so have added a paragraph in lines 286-9 as follows:

The promoted locks, water sealed pans, and covers were already common in the local market. Regular cleaning was encouraged by replacing a daily, verbal cleaning rotation with each household cleaning for a week, with a plastic decal hung above the door of the responsible household to bring accountability.

- Line 329- handyman - was this someone in the community who already had such a role, or was he paid through this project?

Added “already working in the community” to clarify.

- Line 331-334- are the merry-go-rounds applicable to the landlords or the tenants or both?

Landlords for the one-time investment of toilet improvement. Added “landlords” to clarify.

Design process

- Line 339- what does 'reverts' mean? Line 345-346- again, emo and exo-demos language not explained

Rephrased “reverts” as “proposed versions.” Emo-/Exo-demos previously described.

- Material presented on the learning from the experience (such as final paras- line 363-373) is very useful. In general, greater critical reflection on the design process of this nature would increase the value of the overall paper and reduce the 'descriptive' nature of the paper.

Material added as described above on comparison to other processes.

- It is helpful to know the timeframe for the intervention (375-381) however many other details which would be very useful to understand that have been omitted- size of the research team and overall project in terms of inputs, costs of the interventions and the overall research project. If such approaches are to be used and replicated then these are important details to share.
Rather than getting into specifics of costs, we have added some detail on the exact inputs required (as they will have varying costs in other settings):

Delivery to 20 groups of up to 25 landlords, with four meetings occurring over two months, was done by four pairs of presenters (one community health worker and one actor each), with tablets to show videos and some reusable printed materials. Four research assistants also worked as monitors. Materials provided to participants were only small printed cards and a durable plastic rota symbol, and rooms in local venues (churches and schools) were rented for delivery.

Discussion

- The initial reflections (lines 383-405) are helpful, however perhaps they could be more strongly contextualised into other relevant literature, given that this is the discussion section.

- A large portion of the discussion is simply focused on describing the future evaluation that will be undertaken, which is perhaps not the most appropriate content for a discussion for this paper, which ideally needs to be reflecting on the experience of the design process itself and what can be learnt from this for the future. Returning to my earlier point, a clear analytical framework to analyse the design process would likely help illuminate aspects that are worth discussing and analysing as part of the discussion.

In response to both of these concerns (and as described previously to some degree), the evaluation details have been reduced somewhat (see summary of two paragraphs, originally lines 407-425, now as lines 442-47), while comparison to other design processes has been increased as indicated above.

- The paragraph on reflections on working together across researchers and a creative agency are helpful insights (Line 427-434). So at least one dimension of analysis of the design process could be a focus on how different groups with different expertise and background interacted and worked together to develop a shared approach.

We are grateful for suggestions about how to make this paper more useful for its intended audience. We have expanded this section somewhat as follows:

Reflection on the intervention development process has produced learning about the BCD design process itself—specifically, on how best to utilize creative agencies. At the beginning of the collaboration, the creative agency tended to move forward in ways that deviated from the formative research findings (such as health messages creeping into video dialogue), inserted typical campaign components not found in the brief (such as standard financial literacy training), drifted towards the flashy rather than the practical (such as an app rather than videos), or ignored
research-specific requirements (such as only using plot-level components). When closely supervised and given specific guidance (such as developing a rota symbol with explicit design criteria), the agency excelled, and they were also amenable to feedback. The efficiency of the design process could be improved by increasing the degree of collaboration – e.g., by involving a creative agency team member in all aspects of formative research, requiring quicker reverts on smaller sections of the intervention, encouraging informal feedback from the research team after creative agency brainstorming sessions, and including a research team member in all material production meetings or video production activities. In this case, the whole process was facilitated by the research team having already had extensive experience with a variety of creative agencies.

Conclusion

- As per earlier comment on the abstract, the conclusion feels like it needs work. It starts to make jumps ahead in evaluating effectiveness (using new material, which isn't appropriate in an conclusion- eg line 448-449) and makes assertions such as 'the intervention was developed in an efficient manner' (line 452) (efficient compared to what?)

Lines in the conclusion about specific behaviors (448-450 originally) have been removed, with prior lines (445-448) reframed to describe intervention components, not results, as follows:

The intervention will consist of videos to reveal surprising information to landlords, repeated group meetings to create opportunities for social learning and revaluation of the target behaviors, and accountability mechanisms and a new cleaning system to facilitate behavioral performance.

Line in the conclusion about efficiency amended to:

This intervention was developed for a behavior with little prior study by adapting findings from similar kinds of behaviors using the BCD list of behavioral determinants and collecting additional data via tools tailored to likely determinants.

- It would be interesting for the paper to provide comment on what skills are needed to employ theory-driven design approaches- clearly the project described in this paper was run by researchers- do we imagine in the future that practitioners rather than researchers would be developing such approaches, and if so, what does that mean in terms of development of the relevant skills to do so. This is just an idea for authors to consider, since it's beyond the current scope of the paper.

We thank the reviewer for this suggestion. BCD is being integrated into the program development process of a few INGOs at present, and some resources have been produced to
assist non-researchers in conducting BCD program development processes which are available on the web. We have added reference to these resources in the paper (lines 448-449):

Additional details about how to implement the process are available on the BCD website [67].