Author's response to reviews

Title: Development and feasibility testing of a smartphone based attentive eating intervention

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Author's response to reviews: see over
We would like to thank the editor and both reviewers for their comments and suggestions. We have now revised the manuscript accordingly. Below we have provided a point by point explanation of how we have responded to each comment. Where appropriate, we have also provided extracts (these are in italics) from the revised manuscript to show how we have accommodated each suggested revision. Reviewer/editor comments are emboldened. Substantial changes to sections of the manuscript are in red.

**Associate Editor Comments**

Overall, this is an interesting and timely piece of work that will make a good contribution to the literature. However, the following aspects should be addressed:

1. The literature review is very sparse. It cannot be assumed that readers will be familiar with the cited review article, so more detail needs to be provided in this paper. For example, please give some explanation of episodic memories of ingestive consequences?

We appreciate this point and have now provided more detail in the Introduction to explain what we mean by episodic memories of ingestive consequences of eating, as well as:

a) the types of studies that were included in the review and meta-analysis paper,
b) other examples of empirical studies that support the episodic memory account,
c) theory papers that have discussed how and why episodic memory influence ingestive behaviour.

We recently reviewed and meta-analysed experimental studies that examined the influence of awareness and memory on food intake [7]. These studies tested whether manipulating food memory, awareness of eating and distraction whilst eating affect food intake in controlled laboratory settings. The results of this analysis indicated that eating whilst distracted increases concurrent food intake (moderate effect) and to an even greater degree, later food intake (large effect). Moreover, reducing awareness of food consumed was found to increase concurrent food intake and enhancing memory for food consumed was found to decrease later food intake (moderate effect). These results were interpreted within a memory framework, whereby, consistent with earlier findings in the literature [8, 9], episodic memories of the ingestive consequences of eating (memory for earlier eating episodes) are suggested to inform decisions regarding future food consumption [7, 8]. For example, it has been shown that amnesic patients over-eat (9, 10) and that impairing memory of eating results in later over-eating (11). Thus, awareness of food eaten throughout the day (stored as episodic memories) seems to be important in determining future decisions about how much food to eat. By this account, enhancing episodic memories of eating episodes could be a potential strategy to help people control their food intake [7, 8].

Based on the results of the meta-analysis and review we proposed that an intervention aimed at encouraging individuals to eat more ‘attentively’ could help to reduce calorie intake. More specifically, our conceptualization of an attentive eating approach involved encouraging eating devoid of distraction, increasing awareness of food being consumed and prompting of memory recall of food previously consumed prior to eating [7]. Based upon existing theories of the role of memory in the control of energy intake [8, 10], we reasoned that these attentive eating behaviors would enhance memory for food eaten and this in turn would reduce over-eating.
2. Given that for some time now there have been dietary recommendations relating to attentive eating, especially in relation to eating in front of the television, it would be best not to give the impression that this is a new idea introduced by this author team.

We agree that it has been suggested that people shouldn’t eat in front of the television for some time. However, our approach is also about enhancing memory and awareness of food intake in order to reduce over-eating. Moreover, there are not any interventions (we know of) that focus purely on human memory and attention systems to aid weight loss, so we feel this does constitute a new idea. Nevertheless, we appreciate the editor’s comments and went through the manuscript to tone down any claims about novelty. For example, we removed the reference to it being a ‘novel’ approach in the Conclusions section.

3. The leap from a lack of cues to ‘lack of psychological capability’ and from a choice to not record eating information to ‘lack of physical opportunity’ are probably too large. These cannot be equated.

We feel that to some extent, this is open to interpretation. We have discussed the points raised here by the editor. We agree that a lack of cues may not mean a lack of psychological capability, as with or without the cues one should still be capable of remembering. We have removed this point. We do think that suggesting that not having the physical tools to record information about eating reflects a lack of physical opportunity (it provides users with the tools to do this) is a reasonable line of argument, so wish to retain this.

4. The references to the BWC are somewhat oblique. Exactly how was the intervention guided by the BWC?

This could have been clearer. We used the BCW to understand the likely existing barriers to achieving attentive eating behaviors (e.g. not having physical opportunity to record information about eating), so that we could design an intervention that addressed such barriers when encouraging attentive eating. We have now elaborated on this in the manuscript.

When considering how to design an attentive eating intervention we were guided by the Behaviour Change Wheel (BCW) framework [12]. The main tenet of this framework is the importance of understanding target behaviors in their context and individuals’ existing capability, motivation and opportunity to achieve target behaviors. We therefore considered these factors and how they related to the identified target behaviors, in order to decide what support/tools potential users would need to eat more attentively. A key target behavior of the attentive eating approach is memory recall of earlier food consumed prior to eating. We assumed that individuals would not normally recall earlier eating prior to eating and that in a natural environment there would be a lack of cues to promote recall. Eating whilst distracted may occur because individuals are doing so by habit and/or are not aware of its potentially detrimental effects (a lack of automatic and/or reflective motivation). Individuals may not have the necessary tools or information to increase awareness of food being consumed, as it is commonplace not to store or record eating information after consuming food (a lack of physical opportunity). We identified that a service provision intervention would be best suited, whereby we could design behavioral strategies to increase the
likelihood that individuals could complete attentive eating behaviors and learn how to use these strategies.

We also assumed that in order to raise awareness of eating and cue memory recall of food being consumed, the intervention tool would need to be able to store information about eating episodes and then prompt and relay relevant information back to users. We also identified that an intervention that would provide these resources and enable us to educate individuals about the principles and benefits of attentive eating, would help to overcome the earlier discussed existing motivational and physical barriers. Although a paper based tool could achieve some of these considerations, it would be unable to prompt or relay to users relevant stored eating information. Smartphone technology allows for such possibilities. We therefore opted to develop an attentive eating smartphone application. See Table 1 for examples of how a smartphone application was hypothesised to help users overcome barriers to attentive eating.

5. Lines 127-130 ? this is a little confusing. If they can navigate backwards and forwards through their photos, why would the prompt appear after viewing the most recent photo? Wouldn?t this disrupt their photo viewing process if they were intending to scroll through the photos in reverse chronological order. Similarly, in lines 132-135, does the app allow them to progress even if they haven?t completed the previous task?

We have made both of these points clearer now.

1) Most Recent: After finishing the meal/drink users access the Most Recent function and the photograph of the recently consumed food/drink is pictured, with information about the meal type and time consumed. With this image on the screen, users select drop down answers to questions about the consumption experience: ‘Did you finish it all?’ ‘How full are you now?’ If users attempt to enter another Snap whilst having outstanding consumption experience questions in the Most Recent section, they are prompted to visit the Most Recent section to complete the outstanding questions.

2) I’ve Been Eating: Prior to deciding what and how much to eat for a consumption episode, users access the I’ve Been Eating Function. This function opens up an interactive chronological slide show of the consumption episodes recorded during that day, starting with the earliest recorded entry (relaying the photograph and all information recorded from the Snap and Most Recent function for each entry on individual screens). A short text message instructs users to ‘remind themselves of what they have been eating’. Users can then navigate forwards and backwards through consumption episodes. If users attempt to move forwards past the most recently recorded consumption episode, they are reminded to eat attentively and to snap their next meal.

6. Line 171 ?we?, then afterwards ?the researcher?. There were multiple researchers so this terminology needs to be clearer.

We have made our terminology more consistent throughout. As the research team conducted the systematic review (that this intervention was based upon) and developed the intervention
(see Authors’ contributions), when referring to either of these, we now only use the term ‘we’. When describing the trial and the results, we use the third person, in order to avoid repetition and make it clear that the initial development and feasibility testing are distinct.

7. What was the average duration of the interviews? The interview protocol needs to be explained in more detail because it is initially presented as a qualitative interview but then there is reference to Likert scales. Please explicitly note that the interviews were recorded.

We see how this was confusing. We have now clarified what happened. There was an interview (we now provide the requested detail), then participants completed a feedback questionnaire. We have also included information about timing.

*In the final session, the researcher first conducted and recorded a semi-structured interview with the participant. Open ended questions were based around participants’ impressions and experiences of using the application. This interview was recorded and lasted approximately 15 minutes. Once the interview had been completed, participants next completed a self-report questionnaire, consisting of five-point Likert scaled questions.*

8. The section titled ‘Behavioral Change Techniques’ appears to be out of place and fails to provide the reader with enough information to make it a worthwhile inclusion.

We have removed this.

9. Lines 217-220 ? please re-work these so they are proper sentences.

Correction made.

10. Why would there be more than 2 hours on average between the ?snap? and ?most recent? photos? This seems overly long and requires some attempt at explanation.

Yes, we agree. A couple of participants occasionally left very long time gaps between the two functions, so this resulted in the average being 2 hours. However, for the majority of participants the gap was one hour or less (which is what we would expect). This is now discussed in the paper.

*The mean time between entering a photograph in the Snap function and completing the Most Recent function was 126 minutes (S.D = 164). This long time gap appeared to be caused by a few participants leaving large time gaps between entering the Snap and Most Recent function. Thus, some participants did not use the mobile phone application as was intended. However, for the majority of the participants, the time gap was approximately one hour or less.*
11. Lines 225-229 ? please explain this more clearly.

These data refer to the use of reminders. The data show that users did set up reminders on their phone for usual meal times and that around 10% of the time it was these reminders resulted in users to accessing the application. We have elaborated on this in this section and also made our description of the reminder function clearer in the ‘Development’ section.

_During the trial, participants personalised usual meal times (mean number of meals personalised = 2.4, S.D = 1.9). Thus, users tended to alter the default settings of the application so that they would receive a reminder about using the application shortly before some of their usual meal times. The application was accessed M = 12.8% (S.D = 8.5) of the time via a reminder message. This indicates a modest benefit of including the reminder settings, as in these cases users were directly accessing the application through clicking on a reminder notification._

12. Line 230 ? does just over half the time constitute accessed regularly?

Users accessed the app every day and on multiple occasions, so we think so. The editor’s observation is interesting, but as we don’t actually know whether our participants actually ate breakfast, lunch and dinner every day, it is difficult to make definitive statements about what proportion of meals were recorded.

13. Themes 4 and 5 do not seem to be mutually exclusive. Extracts 10 and 15 in Table 2 exemplify this problem.

We see the point about Extract 15, so we have removed it (it can be seen as being very similar to Theme 4, as it shows how using the app can directly influence food eaten). However, we believe Theme 5 is distinct to Theme 4, as it focuses on other indirect effects on behaviour that are not linked directly to the main functions of the application. e.g. how simply knowing one has to snap a food might make them think twice about what they choose. See below:

14. Line 272 ? a negative loss (i.e., a double negative) would seem to indicate an average gain in weight. Presumably you mean a loss of 1.5kg? Or a change of -1.5kg?

Yes, correction made.
15. Given that the sample was comprised of university staff, their understanding and appreciation of research is likely to be higher than the average person, and hence their adherence rate could be expected to be also higher. This needs to be kept in mind when anticipating the extent to which the results are likely to apply to the broader population.

We now consider this point in the Discussion.

As participants were University staff, it could also be argued that their appreciation of research could be higher than the average person, which may have increased adherence.

16. The paper needs a thorough proof read to address the typos and incorrect use of grammar and punctuation. In particular, some of the extracts in Table 2 would benefit from the use of punctuation.

We have proof read the paper and altered the extracts in Table 2 accordingly.
Editorial Office Comments

1. Please change the title 'Introduction' to 'Background'.

Change made.

2. Competing interests: Manuscripts should include a 'Competing interests' section. This should be placed after the Conclusions/Abbreviations.

Section added.

COMPETING INTERESTS

All authors declare no competing interests.

3. Please check the instructions for authors on the journal website for the correct format to use for Authors' Contributions.

Changes made to meet correct format.

All authors were responsible for the design and development of the intervention. ER, PA and SH conceived the feasibility study, participated in its design and co-ordination. ER conducted the research and analysed the data. ER, PA and SH were responsible for the first drafting of the manuscript and all authors approved the final manuscript.

4. Figure cropping: It is important for the final layout of the manuscript that the figures are cropped as closely as possible to minimise white space around the image. For more information, see the instructions for authors: http://www.biomedcentral.com/info/ifora/figures.

Figure now cropped.
Reviewer 1 Comments

Abstract requires some detail on sampling, method of data collection and analysis.

We have now provided more detail in the abstract.

**Methods:** The development and feasibility testing of a smartphone based attentive eating intervention is reported. Informed by models of behavioral change, a smartphone application was developed. Feasibility was tested in twelve overweight and obese volunteers, sampled from university staff. Participants used the application during a four week trial and semi-structured interviews were conducted to assess acceptability and to identify barriers to usage. We also recorded adherence by downloading application usage data from participants’ phones at the end of the trial.

**Results:** Adherence data indicated that participants used the application regularly. Participants also felt the application was easy to use and lost weight during the trial. Thematic analysis indicated that participants felt that the application raised their awareness of what they were eating. Analysis also indicated barriers to using a smartphone application to change dietary behavior.

**Introduction - aims need developed**

We have now added a section outlining the main aims of the research at the end of the Introduction.

*Our main aims were to test whether overweight and obese participants find an attentive eating smartphone application acceptable to use and use it on a regular basis.*

**Method - more detail required on treatment of quantitative data statistical analyses required. In some case only descriptive analyses are presented, yet, for example, self-reported acceptance could be analysed using Chi 2 tests.**

We did not use quantitative statistical analyses, as this is an observational feasibility study and we do not have a control group to make formal comparisons against, nor did we plan or power this study for such analyses. Our main aims were to see if participants would use the app regularly and to assess acceptance.

**Results - The result was a small decrease in weight in the treatment group (there was no control group). Was the mean loss of -1.5kg statistically and/or clinically significant?**

The present research was to test initial feasibility, so it is difficult to draw conclusions on clinical significance. We have now discussed this and the need to now conduct a control trial over a longer period of time.
The clinical significance of the amount of weight lost requires further investigation. For example, if this level of weight loss was achieved at a constant rate in subsequent months, this intervention would be clinically significant. However, as the main aims of the present research were to assess initial feasibility, we are unable to draw conclusions about clinical significance. Moreover, as the sample size in the feasibility study was small, the conclusions made are tentative. Nevertheless, a randomized controlled trial testing proof of principle for an attentive eating intervention on weight loss is warranted, so that it will be possible to examine any potential benefits to weight loss over a longer period of time.

Discussion - limitations of very small sample and descriptive analyses of quantitative data not fully addressed.

We have now discussed the limitation of our sample size.

Moreover, as the sample size in the feasibility study was small, the conclusions made are tentative.

Suggestion - focus on intervention development process and qualitative evaluation and data analyses?

In response to the editor’s earlier comments we have further explained the intervention development. The information about weight loss is only a small part of the results section. The sections describing the qualitative data (including the table) and adherence data are the largest parts of the Results section, so we feel this point has been addressed.
Reviewer 2 Comments

Minor Essential Revisions
2. Line 80: "Tenet" instead of "tenant"?

Correction made.

3. Line 315: "Study's" rather than "studies"?

Wording altered.

Discretionary Revisions
4. Line 83/84: It would be helpful if there was a reference to justify this assumption.

We agree that supporting evidence is always good to include. However, we are not aware of any scientific data to support this. Nonetheless, we think it is reasonable to assume that a fair proportion of people don’t always actively recall what they have been eating during the day, prior to deciding what to eat.